YASKAWA

Energy in Motion™

General-Purpose Inverter

Varispeed E7

Instruction Manual and Parameter Description

Model: CIMR-E7C

CE

YEG -TOE-S616-56.1

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Warnings

⚠ CAUTION

Cables must not be connected or disconnected, nor signal tests carried out, while the power is switched on.

The VARISPEED E7's DC bus capacitor remains charged even after the power has been switched off. To avoid an electric shock hazard, disconnect the frequency inverter from the mains before carrying out maintenance. Then wait for at least 5 minutes after all LEDs have gone out.
Do not perform a withstand voltage test on any part of the VARISPEED E7. The frequency inverter contains semiconductors, which are not designed for such high voltages.

Do not remove the digital operator while the mains supply is switched on. The printed circuit board must also not be touched while the inverter is connected to the power.

Never connect general LC/RC interference suppression filters, capacitors or overvoltage protection devices to the inverter input or output.

To avoid unnecessary overcurrent faults, etc, being displayed, the signaling contacts of any contactor or switch fitted between inverter and motor must be integrated into the inverter control logic (eg baseblock).

This is absolutely imperative!

This manual must be read thoroughly before connecting and operating the inverter. All safety precautions and instructions for use must be followed.

The inverter may must be operated with the appropriate line filters, following the installation instructions in this manual and with all covers closed and terminals covered.
Only then will adequate protection be provided. Please do not connect or operate any equipment with visible damage or missing parts. The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

Safety Precautions and Instructions for Use!

■ 1. General

Please read these safety precautions and instructions for use thoroughly before installing and operating this inverter. Also read all of the warning signs on the inverter and ensure they are never damaged or removed.

Live and hot inverter components may be accessible during operation. Removal of housing components, the digital operator or terminal covers runs the risk of serious injuries or damage in the event of incorrect installation or operation. The fact that frequency inverters control rotating mechanical machine components can give rise to other dangers.

The instructions in this manual must be followed. Installation, operation and maintenance may only be carried out by qualified personnel. For the purposes of the safety precautions, qualified personnel are defined as individuals who are familiar with the installation, starting, operation and maintenance of frequency inverters and have the proper qualifications for this work. Safe operation of these units is only possible if they are used properly for their intended purpose.

The DC bus capacitors can remain live from about 5 minutes after the inverter is disconnected from the power. It is therefore necessary to wait for this time before opening its covers. All of the main circuit terminals may still carry dangerous voltages.

Children and other unauthorized persons must not be allowed access to these inverters.

Keep these Safety Precautions and Instructions for Use readily accessible and supply them to all persons with any form of access to the inverters.

■ 2. Intended Use

Frequency inverters are intended for installation in electrical systems or machinery.

Their installation in machinery and systems must conform to the following product standards of the Low Voltage Directive:

EN 50178, 1997-10,	Electronic equipment for use in power installations
EN 60204-1, 1997-12	Safety of machinery – Electrical equiment of machines – Part 1: General requirements Attention: plus corrigendum September 1998
EN 61010-1, A2 1995	Safety Requirements for electrical equiment for measurement, control and laboratory use. Part 1: General requirements (IEC 950, 1991 + A1, 1992 + A2, 1993 + A3, 1995 + A4, 1996, modified)

CE marking is carried out to EN 50178, using the line filters specified in this manual and following the appropriate installation instructions.

■ 3. Transportation and storage

The instructions for transportation, storage and proper handling must be followed in accordance with the technical data.

■ 4. Installation

Install and cool the inverters as specified in the documentation. The cooling air must flow in the specified direction. The inverter may therefore only be operated in the specified position (eg upright). Maintain the specified clearances. Protect the inverters against impermissible loads. Components must not be bent nor insulation clearances changed. To avoid damage being caused by static electricity, do not touch any electronic components or contacts.

■ 5. Electrical Connection

Carry out any work on live equipment in compliance with the national safety and accident prevention regulations (eg VBG 4). Carry out electrical installation in compliance with the relevant regulations. For further information please refer to the User's Manual. In particular, follow the installation instructions ensuring electromagnetic compatibility (EMC), eg shielding, grounding, filter arrangement and laying of cables. This also applies to equipment with the CE mark. It is the responsibility of the manufacturer of the system or machine to ensure conformity with EMC limits.

Your supplier or Yaskawa representative must be contacted when using leakage current circuit braker in conjunction with frequency inverters.

In certain systems it may be necessary to use additional monitoring and safety devices in compliance with the relevant safety and accident prevention regulations. The frequency inverter hardware must not be modified.

■ 6. Notes

The VARISPEED E7 frequency inverters are certified to UL, and c-UL.

EMC Compatibility

■ 1. Introduction

This manual was compiled to help system manufacturers using YASKAWA frequency inverters design and install electrical switchgear. It also describes the measures necessary to comply with the EMC Directive. The manual's installation and wiring instructions must therefore be followed.

Our products are tested by authorized bodies using the standards listed below.

Product standard: **EN 61800-3:1996**
EN 61000-3-2; A1, A2, A14:2000

■ 2. Measures to Ensure Conformity of YASKAWA Frequency inverters to the EMC Directive

YASKAWA frequency inverters do not necessarily have to be installed in a switch cabinet.

It is not possible to give detailed instructions for all of the possible types of installation. This manual therefore has to be limited to general guidelines.

All electrical equipment produces radio and line-borne interference at various frequencies. The cables pass this on to the environment like an aerial.

Connecting an item of electrical equipment (eg drive) to a supply without a line filter can therefore allow HF or LF interference to get into the mains.

The basic countermeasures are isolation of the wiring of control and power components, proper grounding and shielding of cables.

A large contact area is necessary for low-impedance grounding of HF interference. The use of grounding straps instead of cables is therefore definitely advisable.

Moreover, cable shields must be connected with purpose-made ground clips.

■ 3. Laying Cables

Measures Against Line-Borne Interference:

Line filter and frequency inverter must be mounted on the same metal plate. Mount the two components as close to each other as possible, with cables kept as short as possible.

Use a power cable with well-grounded shield. Use a shielded motor cable not exceeding 20 meters in length. Arrange all grounds so as to maximize the area of the end of the lead in contact with the ground

terminal (eg metal plate).

Shielded Cable:

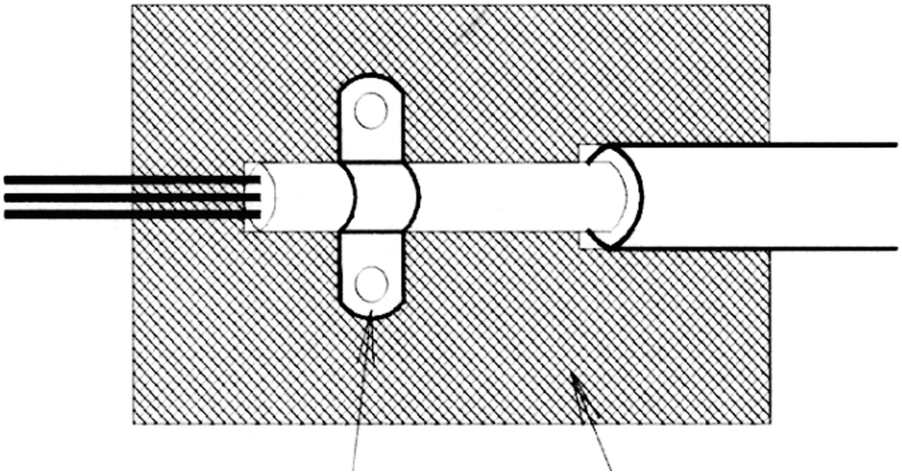
- Use a cable with braided shield.
- Ground the maximum possible area of the shield. It is advisable to ground the shield by connecting the cable to the ground plate with metal clips (see following figure).

Electromagnetic Compatibility (EMC)

■ Recommended EMC Filters

Inverter	Schaffner Filter			
	Type	Current	Weight	Dimensions
CIMR-E7C40P4	FS5972-10-07	10 A	1,1 kg	141 x 330 x 46
CIMR-E7C40P7				
CIMR-E7C41P5	FS5972-18-07	18 A	1,3 kg	141 x 330 x 46
CIMR-E7C42P2				
CIMR-E7C43P7				
CIMR-E7C44PO				
CIMR-E7C45P5				
CIMR-E7C47P5	FS5972-35-07	35 A	2,1 kg	206 x 355 x 50
CIMR-E7C4011				
CIMR-E7C4015	FS5972-60-07	60 A	4 kg	236 x 408 x 65
CIMR-E7C4018				
CIMR-E7C4022	FS5972-70-52	70 A	3,4 kg	80 x 329 x 185
CIMR-E7C4030				
CIMR-E7C4037	FS5972-130-35	130 A	4,7 kg	90 x 366 x 180
CIMR-E7C4045				
CIMR-E7C4055				
CIMR-E7C4075	FS5972-170-40	170 A	6 kg	120 x 451 x 170
CIMR-E7C4090	FS5972-250-37	250 A	11 kg	130 x 610 x 240
CIMR-E7C4110				

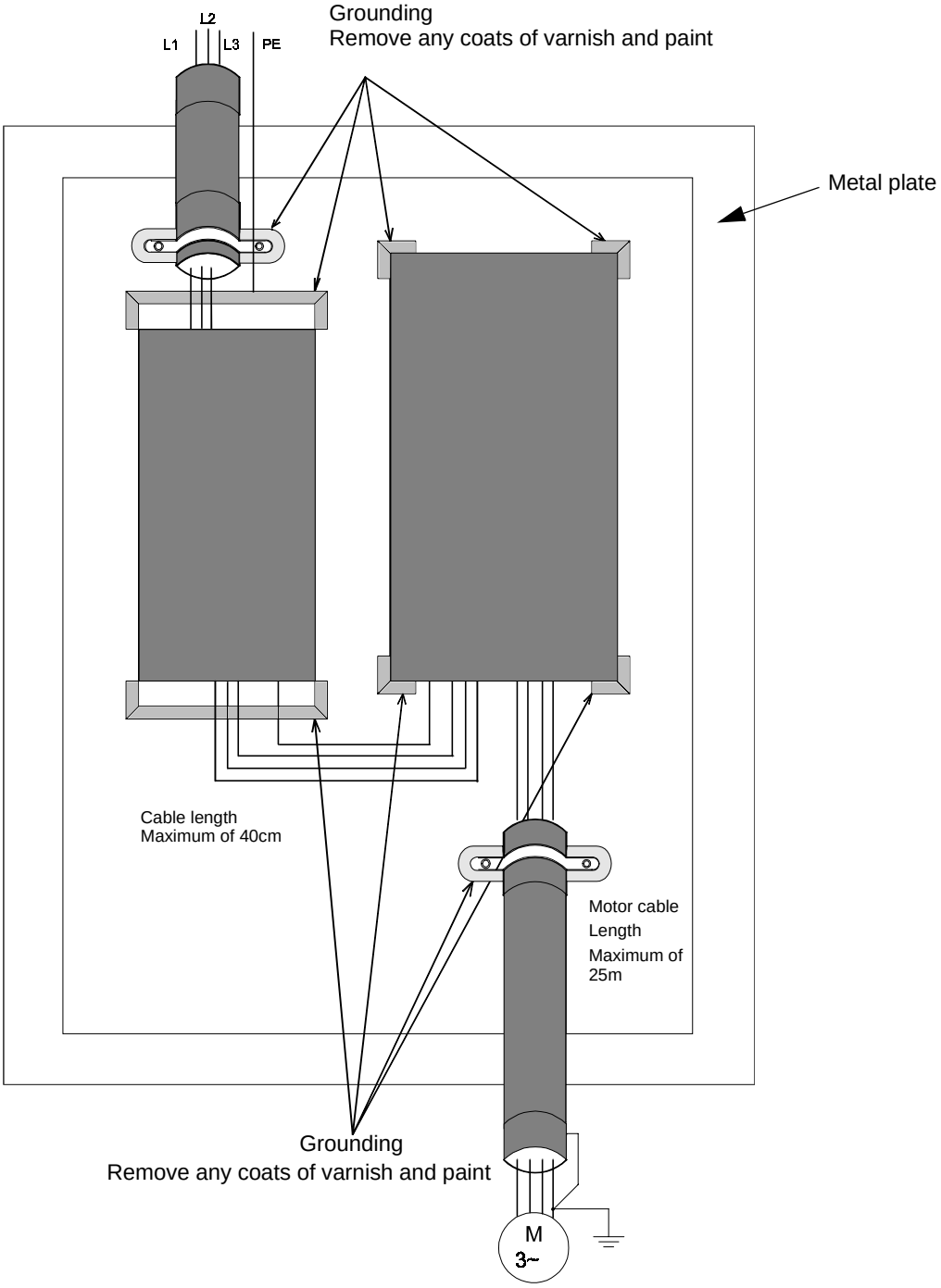
Inverter	Schaffner Filter			
	Type	Current	Weight	Dimensions
CIMR-E7C20P4	FS5972-10-07	10 A	1,1 kg	141 x 330 x 46
CIMR-E7C20P7				
CIMR-E7C21P5				
CIMR-E7C22P2	FS5972-18-07	18 A	1,3 kg	141 x 330 x 46
CIMR-E7C23P7	FS5973-35-07	35 A	1,4 kg	141 x 330 x 46
CIMR-E7C25P5				
CIMR-E7C27P5	FS5973-60-07	60 A	3 kg	206 x 355 x 60
CIMR-E7C2011	FS5973-100-07	100 A	4,9 kg	236 x 408 x 80
CIMR-E7C2015				
CIMR-E7C2018				
CIMR-E7C2022	FS5973-130-35	130 A	4,3 kg	90 x 366 x 180
CIMR-E7C2030				
CIMR-E7C2037	FS5973-160-40	160 A	6 kg	120 x 451 x 170
CIMR-E7C2045	FS5973-240-37	240 A	11 kg	130 x 610 x 240
CIMR-E7C2055				



The grounding surfaces must be highly conductive bare metal. Remove any coats of varnish and paint.

- Ground the cable shields at both ends.
- Ground the motor of the machine.

■ Installation of Boot Type Filters E7C 4022 to 4300



Registered Trademarks

The following registered trademarks are used in this manual.

- DeviceNet is a registered trademark of the ODVA (Open DeviceNet Vendors Association, Inc.).
- InterBus is a registered trademark of Phoenix Contact Co.
- ControlNet is a registered trademark of ControlNet International, Ltd.
- LONworks is a registered trademark of the Echolon.

1

Handling Inverters

This chapter describes the checks required upon receiving or installing an Inverter.

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Varispeed E7 Introduction

◆ Varispeed E7 Applications

The Varispeed E7 is ideal for the following applications.

- Fan, blower, and pump applications

Settings must be adjusted to the application for optimum operation. Refer to *Chapter 4 Trial Operation.*

◆ Varispeed E7 Models

The Varispeed E7 Series of Inverters included two Inverters in two voltage classes: 200 V and 400 V. Maximum motor capacities vary from 0.4 to 300 kW (42 models).

Table 1.1 Varispeed E7 Models

Voltage Class	Maximum Motor Capacity kW	Varispeed E7		Specifications (Always specify through the protective structure when ordering.)	
		Output Capacity kVA	Basic Model Number	Open Chassis (IEC IP00) CIMR-E7C□□□□□□	Enclosed Wall-mounted (IEC IP20, NEMA 1) CIMR-E7C□□□□□□
200 V class	0.4	1.2	CIMR-E7C20P4	Remove the top and bottom covers from the Enclosed Wall-mounted model.	20P41□
	0.75	1.6	CIMR-E7C20P7		20P71□
	1.5	2.7	CIMR-E7C21P5		21P51□
	2.2	3.7	CIMR-E7C22P2		22P21□
	3.7	5.7	CIMR-E7C23P7		23P71□
	5.5	8.8	CIMR-E7C25P5		25P51□
	7.5	12	CIMR-E7C27P5		27P51□
	11	17	CIMR-E7C2011		20111□
	15	22	CIMR-E7C2015		20151□
	18.5	27	CIMR-E7C2018	20220□	20181□
	22	32	CIMR-E7C2022		20221□
	30	44	CIMR-E7C2030	20300□	20301□
	37	55	CIMR-E7C2037	20370□	20371□
	45	69	CIMR-E7C2045	20450□	20451□
	55	82	CIMR-E7C2055	20550□	20551□
	75	110	CIMR-E7C2075	20750□	20751□
	90	130	CIMR-E7C2090	20900□	–
	110	160	CIMR-E7C2110	21100□	–

Voltage Class	Maximum Motor Capacity kW	Varispeed E7		Specifications (Always specify through the protective structure when ordering.)	
		Output Capacity kVA	Basic Model Number	Open Chassis (IEC IP00) CIMR-E7C□□□□□□	Enclosed Wall-mounted (IEC IP20, NEMA 1) CIMR-E7C□□□□□□
400 V class	0.4	1.4	CIMR-E7C40P4	Remove the top and bottom covers from the Enclosed Wall-mount model.	40P41□
	0.75	1.6	CIMR-E7C40P7		40P71□
	1.5	2.8	CIMR-E7C41P5		41P51□
	2.2	4.0	CIMR-E7C42P2		42P21□
	3.7	5.8	CIMR-E7C43P7		43P71□
	4.0	6.6	CIMR-E7C44P0		44P01
	5.5	9.5	CIMR-E7C45P5		45P51□
	7.5	13	CIMR-E7C47P5		47P51□
	11	18	CIMR-E7C4011		40111□
	15	24	CIMR-E7C4015		40151□
	18.5	30	CIMR-E7C4018	40220□	40181□
	22	34	CIMR-E7C4022		40221□
	30	46	CIMR-E7C4030	40300□	40301□
	37	57	CIMR-E7C4037	40370□	40371□
	45	69	CIMR-E7C4045	40450□	40451□
	55	85	CIMR-E7C4055	40550□	40551□
	75	110	CIMR-E7C4075	40750□	40751□
	90	140	CIMR-E7C4090	40900□	40901□
	110	160	CIMR-E7C4110	41100□	41101□
	132	200	CIMR-E7C4132	41320□	41321□
	160	230	CIMR-E7C4160	41600□	41601□
	185	280	CIMR-E7C4185	41850□	–
	220	390	CIMR-E7C4220	42200□	–
	300	510	CIMR-E7C4300	43000□	–

Confirmations upon Delivery

◆ Checks

Check the following items as soon as the Inverter is delivered.

Table 1.2 Checks

Item	Method
Has the correct model of Inverter been delivered?	Check the model number on the nameplate on the side of the Inverter.
Is the Inverter damaged in any way?	Inspect the entire exterior of the Inverter to see if there are any scratches or other damage resulting from shipping.
Are any screws or other components loose?	Use a screwdriver or other tools to check for tightness.

If you find any irregularities in the above items, contact the agency from which you purchased the Inverter or your Yaskawa representative immediately.

◆ Nameplate Information

There is a nameplate attached to the side of each Inverter. The nameplate shows the model number, specifications, lot number, serial number, and other information on the Inverter.

■ Example Nameplate

The following nameplate is an example for a standard domestic European Inverter: 3-phase, 200 VAC, 0.4 kW, IEC IP20 and NEMA 1 standards

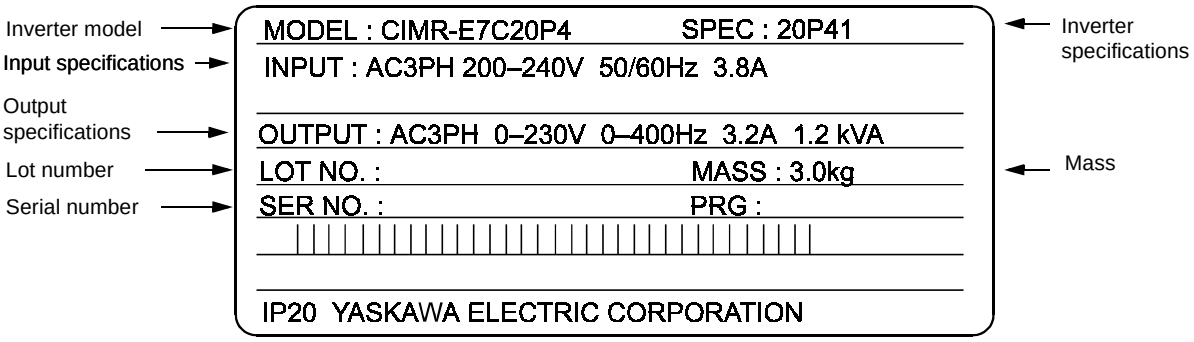


Fig 1.1 Nameplate

■Inverter Model Numbers

The model number of the Inverter on the nameplate indicates the specification, voltage class, and maximum motor capacity of the Inverter in alphanumeric codes.

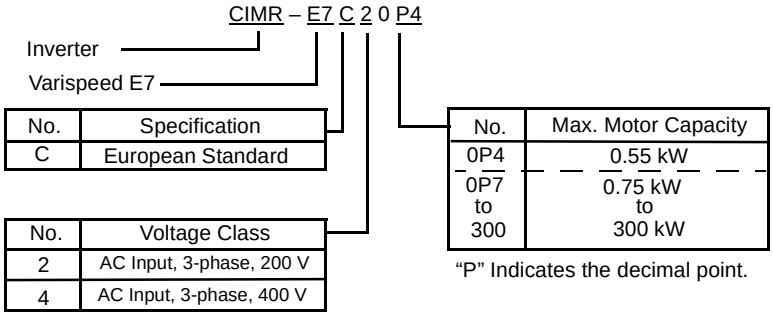


Fig 1.2 Inverter Model Numbers

■Inverter Specifications

The Inverter specifications ("SPEC") on the nameplate indicate the voltage class, maximum motor capacity, the protective structure, and the revision of the Inverter in alphanumeric codes.

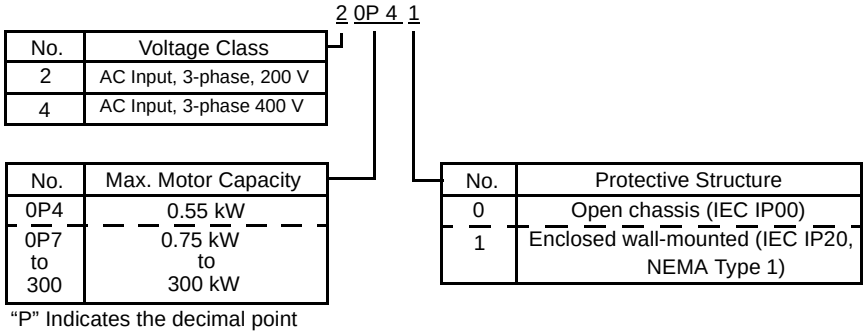


Fig 1.3 Inverter Specifications

TERMS

Open Chassis Type (IEC IP00)

Protected so that parts of the human body cannot reach electrically charged parts from the front when the Inverter is mounted in a control panel.

Enclosed Wall-mounted Type (IEC IP20, NEMA Type 1)

The Inverter is structured so that the Inverter is shielded from the exterior, and can thus be mounted to the interior wall of a standard building (not necessarily enclosed in a control panel). The protective structure conforms to the standards of NEMA 1 in the USA.
Top protective cover (Fig. 1.4) has to be installed to conform with IEG IP20 and NEMA Type 1 requirements.

◆ Component Names

■ Inverters of 18.5 kW or Less

The external appearance and component names of the Inverter are shown in *Fig 1.4*. The Inverter with the terminal cover removed is shown in *Fig 1.5*.

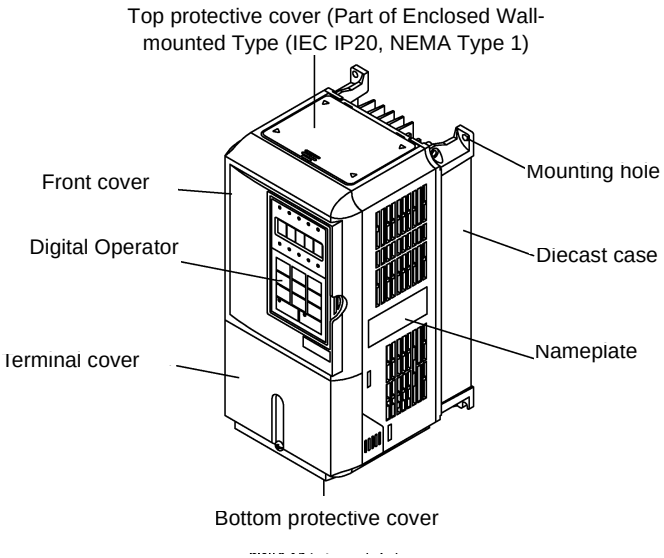


Fig 1.4 Inverter Appearance (18.5 kW or Less)

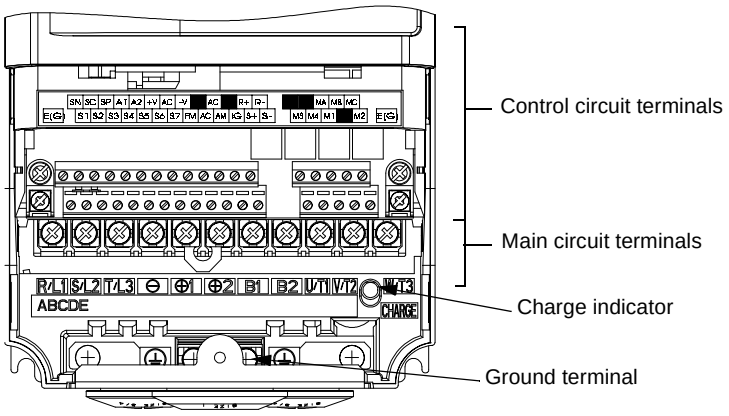


Fig 1.5 Terminal Arrangement (18.5 kW or Less)

■ Inverters of 22 kW or More

The external appearance and component names of the Inverter are shown in *Fig 1.6*. The Inverter with the terminal cover removed is shown in *Fig 1.7*.

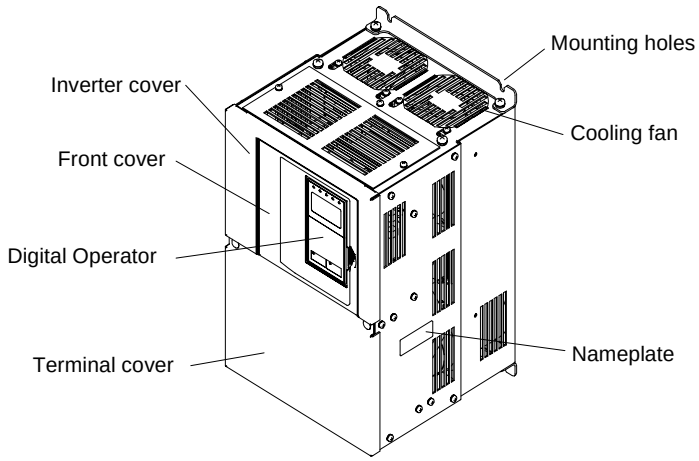


Fig 1.6 Inverter Appearance (22 kW or More)

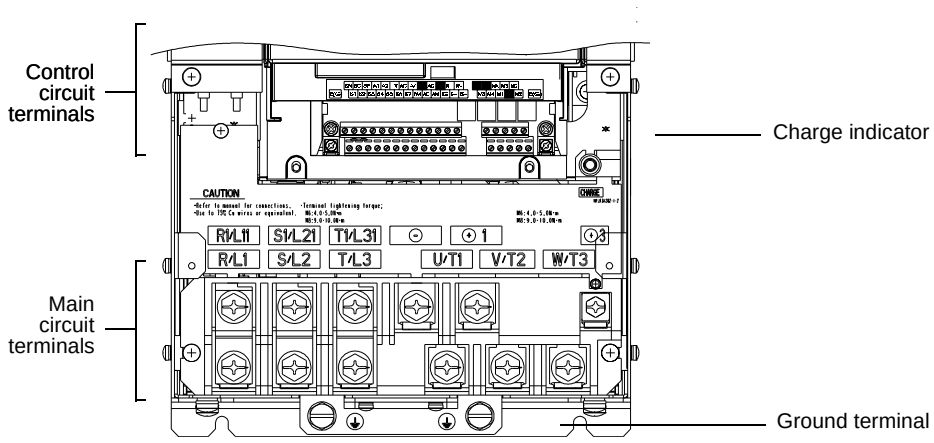
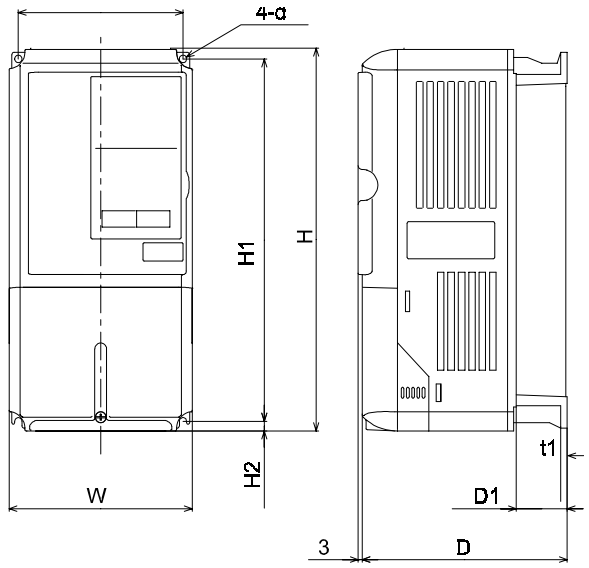


Fig 1.7 Terminal Arrangement (22 kW or More)

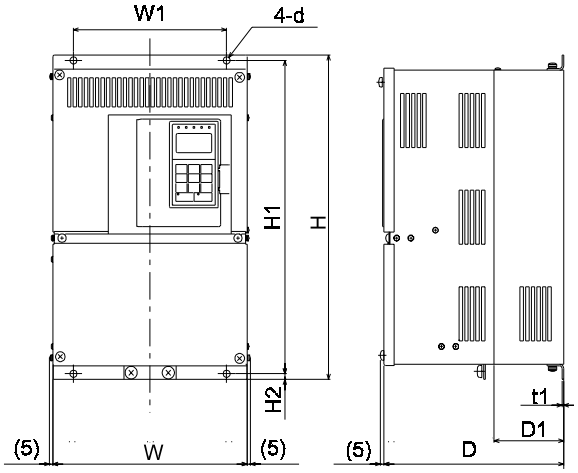
Exterior and Mounting Dimensions

◆ Open Chassis Inverters (IP00)

Exterior diagrams of the Open Chassis Inverters are shown below.



200 V/400 V Class Inverters of 0.4 to 18.5 kW

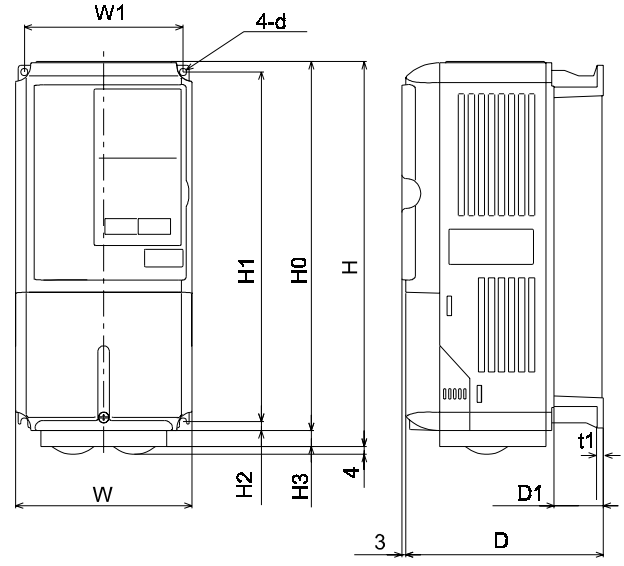


200 V Class Inverters of 22 or 30 kW
400 V Class Inverters of 22 to 55 kW

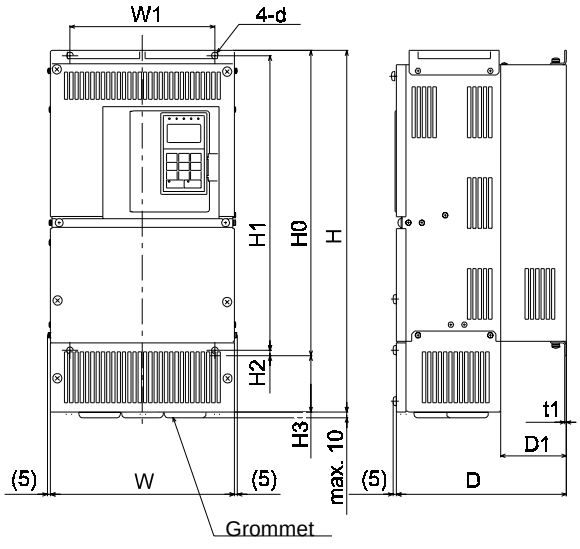
Fig 1.8 Exterior Diagrams of Open Chassis Inverters

◆ Enclosed Wall-mounted Inverters (NEMA1)

Exterior diagrams of the Enclosed Wall-mounted Inverters (NEMA1) are shown below.



200 V/400 V Class Inverters of 0.4 to 18.5 kW



200 V Class Inverters of 22 or 30 kW
400 V Class Inverters of 22 to 55 kW

Fig 1.9 Exterior Diagrams of Enclosed Wall-mounted Inverters

Table 1.3 Inverter Dimensions (mm) and Masses (kg)

Voltage Class	Max. Applicable Motor Output [kW]	Dimensions (mm)																					Caloric Value(W)			Cooling Method
		Open Chassis (IP00)									Enclosed Wall-mounted (NEMA1)												External	Internal	Total Heat Generation	
		W	H	D	W1	H1	H2	D1	t1	Approx. Mass	W	H	D	W1	H0	H1	H2	H3	D1	t1	Approx. Mass	Mounting Holes d*				
200 V (3-phase)	0.4	140	280	157	126	266	7	39	5	3	140	280	157	126	280	266	7	0	39	5	3	M5	20	39	59	Natural
	0.75																						27	42	69	
	1.5																						50	50	100	
	2.2																						70	59	129	
	3.7			177				59		4			177						59		4		112	74	186	Fan
	5.5																						164	84	248	
	7.5	200	300	197	186	285	7.5	65.5	2.3	6	200	300	197	186	300	285	7.5	0	65.5	2.3	6	M6	219	113	332	
	11									7		310						10			7		374	170	544	
	15	240	350	207	216	335		78		11	240	350	207	216	350	335		0	78		11		429	183	612	
	18.5											380						30					501	211	712	
	22	250	400	258	195	385		100		21	250	535	258	195	400	385		135	100		24		586	274	860	
	30	275	450		220	435				24	275	615		220	450	435		165			27		865	352	1217	
	37	375	600	300	250	575	13	100	3.2	57	380	890	300	250	600	575	13	210	100	3.2	62	M10	1015	411	1426	
	45			330				130		63			330								68		1266	505	1771	
	55	450	725	350	325	700				86	455	1100	350	325	725	700		305	130		94		1588	619	2207	
	75									87											95		2019	838	997	
	90	500	850	360	370	820	15		4.5	108	---											M12	2437	997	3434	
	110	575	885	380	445	855		140		150													2733	1242	3975	
400 V (3-phase)	0.4	140	280	157	126	266	7	39	5	3	140	280	157	126	280	266	7	0	39	5	3	M5	14	39	53	Natural
	0.75																						17	41	58	
	1.5																						36	48	84	
	2.2			177				59		4			177						59		4		59	56	115	Fan
	3.7																						80	68	148	
	4.0																						70	91	161	
	5.5																						127	82	209	
	7.5	200	300	197	186	285	7.5	65.5	2.3	6	200	300	197	186	300	285	7.5	0	65.5	2.3	6	M6	193	114	307	
	11																						252	158	410	
	15	240	350	207	216	335		78		10	240	350	207	216	350	335			78		10		326	172	498	
	18.5																						426	208	634	
	22	275	450	258	220	435		100		21	275	535	258	220	450	435		85	100		24		466	259	725	
	30																						678	317	995	
	37	325	550	283	260	535		105		36	325	635	283	260	550	535		165	105		40		784	360	1144	
	45											715											901	415	1316	
	55																						1203	495	1698	
	75	450	725	350	325	700	13	130	3.2	88	455	1100	350	325	725	700	13	305	130	3.2	96	M10	1399	575	1974	
	90									89											97		1614	671	2285	
	110	500	850	360	370	820	15		4.5	102	505	1245	360	370	850	820	15	395		4.5	122	M12	2097	853	2950	
	132									120											130		2388	1002	3390	
	160	575	925	380	445	895		140		160	580	1325	380	445	925	895		400	140		170		2791	1147	3938	
	185	Under development																								
	220																									
	300																									

* Same for Open Chassis and Enclosed Wall-mounted Inverters.

Checking and Controlling the Installation Site

Install the Inverter in the installation site described below and maintain optimum conditions.

◆ Installation Site

Install the Inverter under the following conditions in a pollution degree 2 environment.

Table 1.4 Installation Site

Type	Ambient Operating Temperature	Humidity
Enclosed wall-mounted	-10 to + 40 °C	95% RH or less (no condensation)
Open chassis	-10 to + 45 °C	95% RH or less (no condensation)

Protection covers are attached to the top and bottom of the Inverter. Be sure to remove the protection covers before installing a 200 or 400 V Class Inverter with an output of 18.5 kW or less in a panel.

Observe the following precautions when mounting the Inverter.

- Install the Inverter in a clean location which is free from oil mist and dust. It can be installed in a totally enclosed panel that is completely shielded from floating dust.
- When installing or operating the Inverter, always take special care so that metal powder, oil, water, or other foreign matter does not get into the Inverter.
- Do not install the Inverter on combustible material, such as wood.
- Install the Inverter in a location free from radioactive materials and combustible materials.
- Install the Inverter in a location free from harmful gasses and liquids.
- Install the Inverter in a location without excessive oscillation.
- Install the Inverter in a location free from chlorides.
- Install the Inverter in a location not in direct sunlight.

◆ Controlling the Ambient Temperature

To enhance the reliability of operation, the Inverter should be installed in an environment free from extreme temperature increases. If the Inverter is installed in an enclosed environment, such as a box, use a cooling fan or air conditioner to maintain the internal air temperature below 45°C.

◆ Protecting the Inverter from Foreign Matter

Place a cover over the Inverter during installation to shield it from metal power produced by drilling.

Always remove the cover from the Inverter after completing installation. Otherwise, ventilation will be reduced, causing the Inverter to overheat.

Installation Orientation and Space

Install the Inverter vertically so as not to reduce the cooling effect. When installing the Inverter, always provide the following installation space to allow normal heat dissipation.

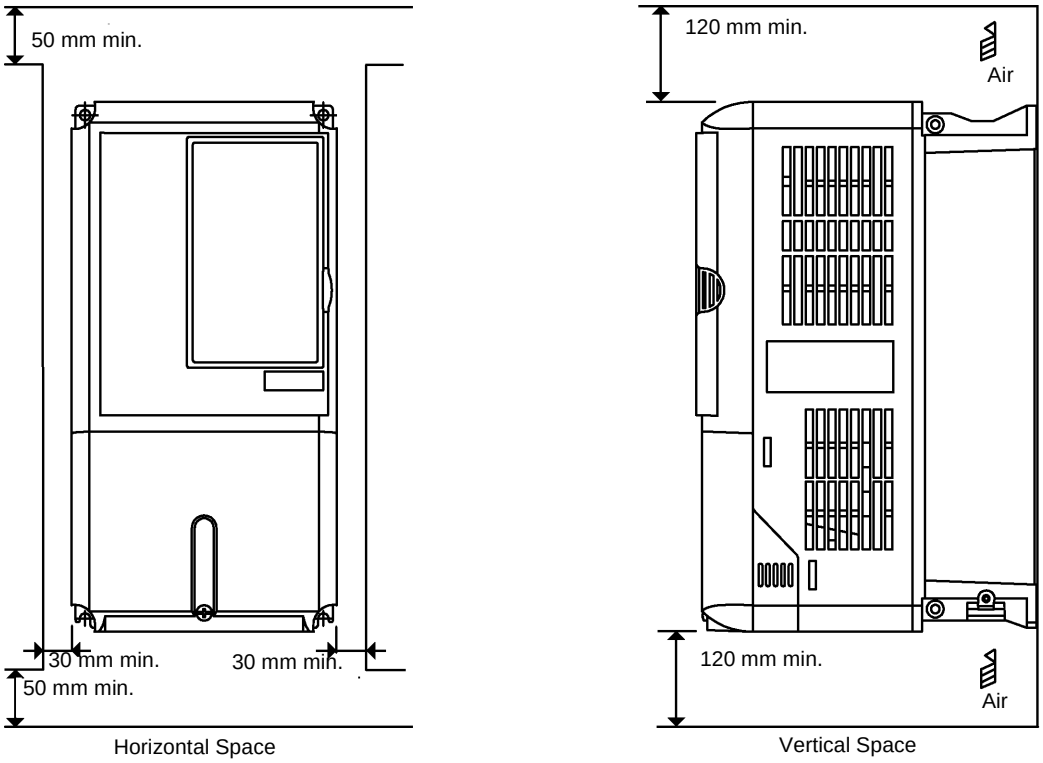


Fig 1.10 Inverter Installation Orientation and Space

IMPORTANT

1. The same space is required horizontally and vertically for both Open Chassis (IP00) and Enclosed Wall-mounted (IP20, NEMA 1) Inverters.
2. Always remove the protection covers before installing a 200 or 400 V Class Inverter with an output of 18.5 kW or less in a panel.
   Always provide enough space for suspension eye bolts and the main circuit lines when installing a 200 or 400 V Class Inverter with an output of 22 kW or more in a panel.

Removing and Attaching the Terminal Cover

Remove the terminal cover to wire cables to the control circuit and main circuit terminals.

◆ Removing the Terminal Cover

■ Inverters of 18.5 kW or Less

Loosen the screw at the bottom of the terminal cover, press in on the sides of the terminal cover in the directions of arrows 1, and then lift up on the terminal in the direction of arrow 2.

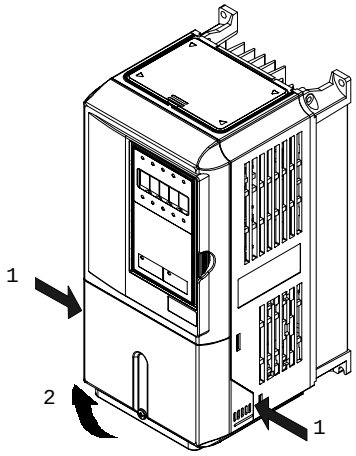


Fig 1.11 Removing the Terminal Cover (Model CIMR-E7C25P5 Shown Above)

■ Inverters of 22 kW or More

Loosen the screws on the left and right at the top of the terminal cover, pull out the terminal cover in the direction of arrow 1 and then lift up on the terminal in the direction of arrow 2.

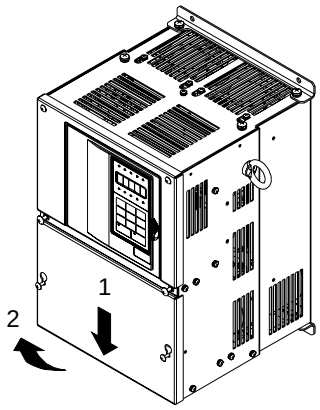


Fig 1.12 Removing the Terminal Cover (Model CIMR-E7C2022 Shown Above)

◆ Attaching the Terminal Cover

When wiring the terminal block has been completed, attach the terminal cover by reversing the removal procedure.

For Inverters with an output of 18.5 kW or less, insert the tab on the top of the terminal cover into the groove on the Inverter and press in on the bottom of the terminal cover until it clicks into place.

Removing/Attaching the Digital Operator and Front Cover

◆ Inverters of 18.5 kW or Less

To attach optional cards or change the terminal card connector, remove the Digital Operator and front cover in addition to the terminal cover. Always remove the Digital Operator from the front cover before removing the terminal cover.

The removal and attachment procedures are given below.

■Removing the Digital Operator

Press the lever on the side of the Digital Operator in the direction of arrow 1 to unlock the Digital Operator and lift the Digital Operator in the direction of arrow 2 to remove the Digital Operator as shown in the following illustration.

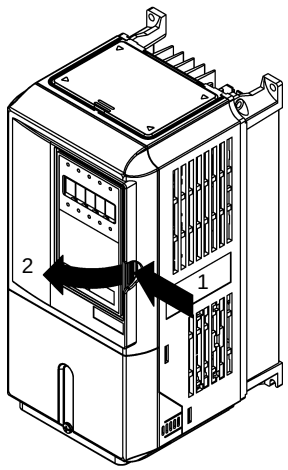


Fig 1.13 Removing the Digital Operator (Model CIMR-E7C45P5 Shown Above)

■Removing the Front Cover

Press the left and right sides of the front cover in the directions of arrows 1 and lift the bottom of the cover in the direction of arrow 2 to remove the front cover as shown in the following illustration.

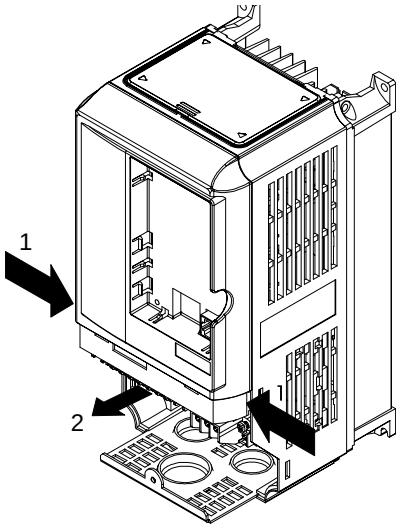


Fig 1.14 Removing the Front Cover (Model CIMR-E7C45P5 Shown Above)

■Mounting the Front Cover

After wiring the terminals, mount the front cover to the Inverter by performing the steps to remove the front cover in reverse order.

1. Do not mount the front cover with the Digital Operator attached to the front cover; otherwise, Digital Operator may malfunction due to imperfect contact.
2. Insert the tab of the upper part of the front cover into the groove of the Inverter and press the lower part of the front cover onto the Inverter until the front cover snaps shut.

■Mounting the Digital Operator

After attaching the terminal cover, mount the Digital Operator onto the Inverter using the following procedure.

1. Hook the Digital Operator at A (two locations) on the front cover in the direction of arrow 1 as shown in the following illustration.
2. Press the Digital Operator in the direction of arrow 2 until it snaps in place at B (two locations).

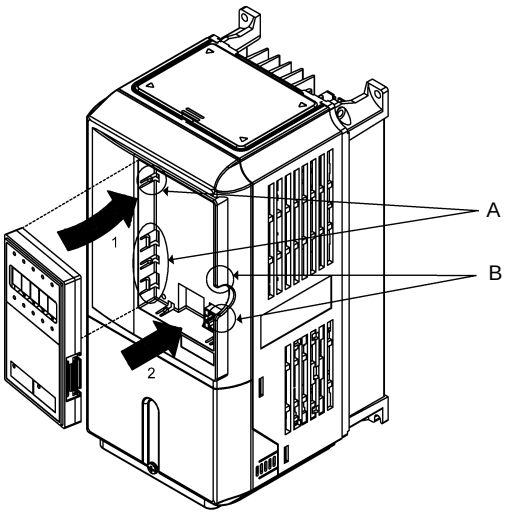


Fig 1.15 Mounting the Digital Operator

IMPORTANT

1. Do not remove or attach the Digital Operator or mount or remove the front cover using methods other than those described above, otherwise the Inverter may break or malfunction due to imperfect contact.
2. Never attach the front cover to the Inverter with the Digital Operator attached to the front cover. Imperfect contact can result.
   Always attach the front cover to the Inverter by itself first, and then attach the Digital Operator to the front cover.

◆ Inverters of 22 kW or More

For Inverter with an output of 22 kW or more, remove the terminal cover and then use the following procedures to remove the Digital Operator and main cover.

■Removing the Digital Operator

Use the same procedure as for Inverters with an output of 18.5 kW or less.

■Removing the Front Cover

Lift up at the location label 1 at the top of the control circuit terminal card in the direction of arrow 2.

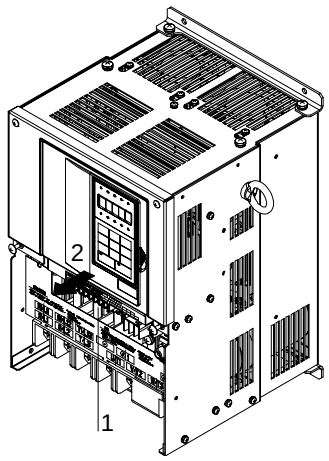


Fig 1.16 Removing the Front Cover (Model CIMR-E7C2022 Shown Above)

■ Attaching the Front Cover

After completing required work, such as mounting an optional card or setting the terminal card, attach the front cover by reversing the procedure to remove it.

1. Confirm that the Digital Operator is not mounted on the front cover. Contact faults can occur if the cover is attached while the Digital Operator is mounted to it.
2. Insert the tab on the top of the front cover into the slot on the Inverter and press in on the cover until it clicks into place on the Inverter.

■Attaching the Digital Operator

Use the same procedure as for Inverters with an output of 18.5 kW or less.

2 Wiring

This chapter describes wiring terminals, main circuit terminal connections, main circuit terminal wiring specifications, control circuit terminals, and control circuit wiring specifications.

Connections to Peripheral Devices 2-2
Connection Diagram 2-3
Terminal Block Configuration 2-5
Wiring Main Circuit Terminals 2-6
Wiring Control Circuit Terminals 2-20
Wiring Check 2-27
Installing and Wiring Option Cards 2-28

Connections to Peripheral Devices

Examples of connections between the Inverter and typical peripheral devices are shown in *Fig 2.1*.

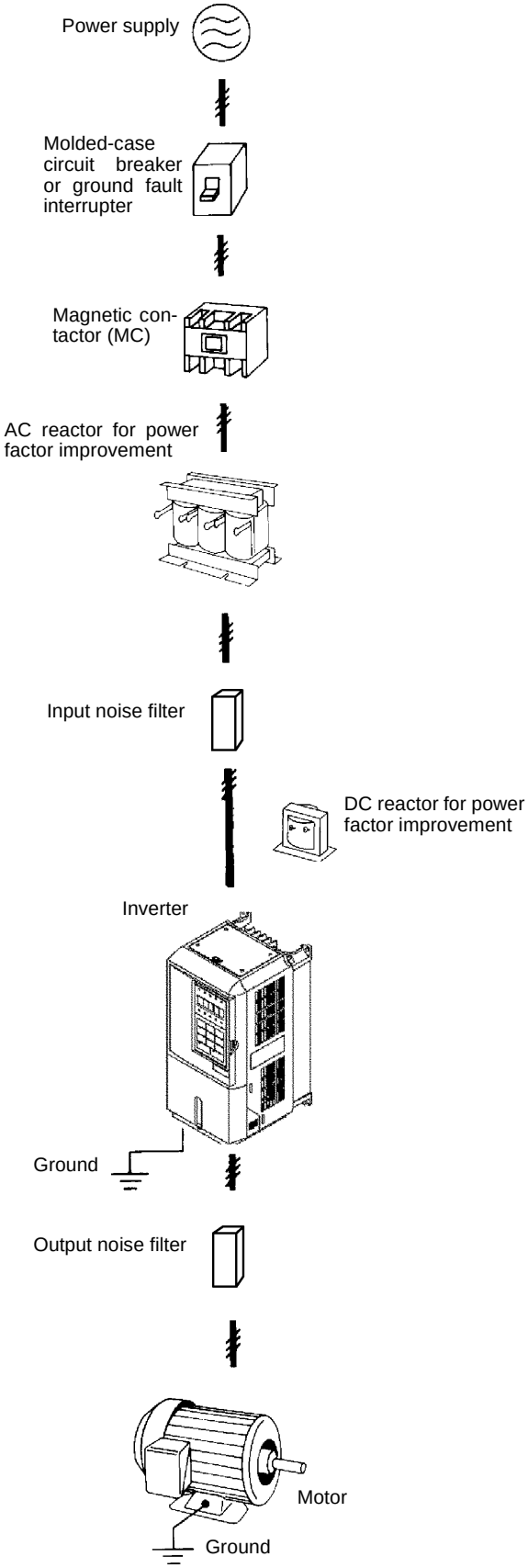


Fig 2.1 Example Connections to Peripheral Devices

Connection Diagram

The connection diagram of the Inverter is shown in *Fig 2.2*.

When using the Digital Operator, the motor can be operated by wiring only the main circuits.

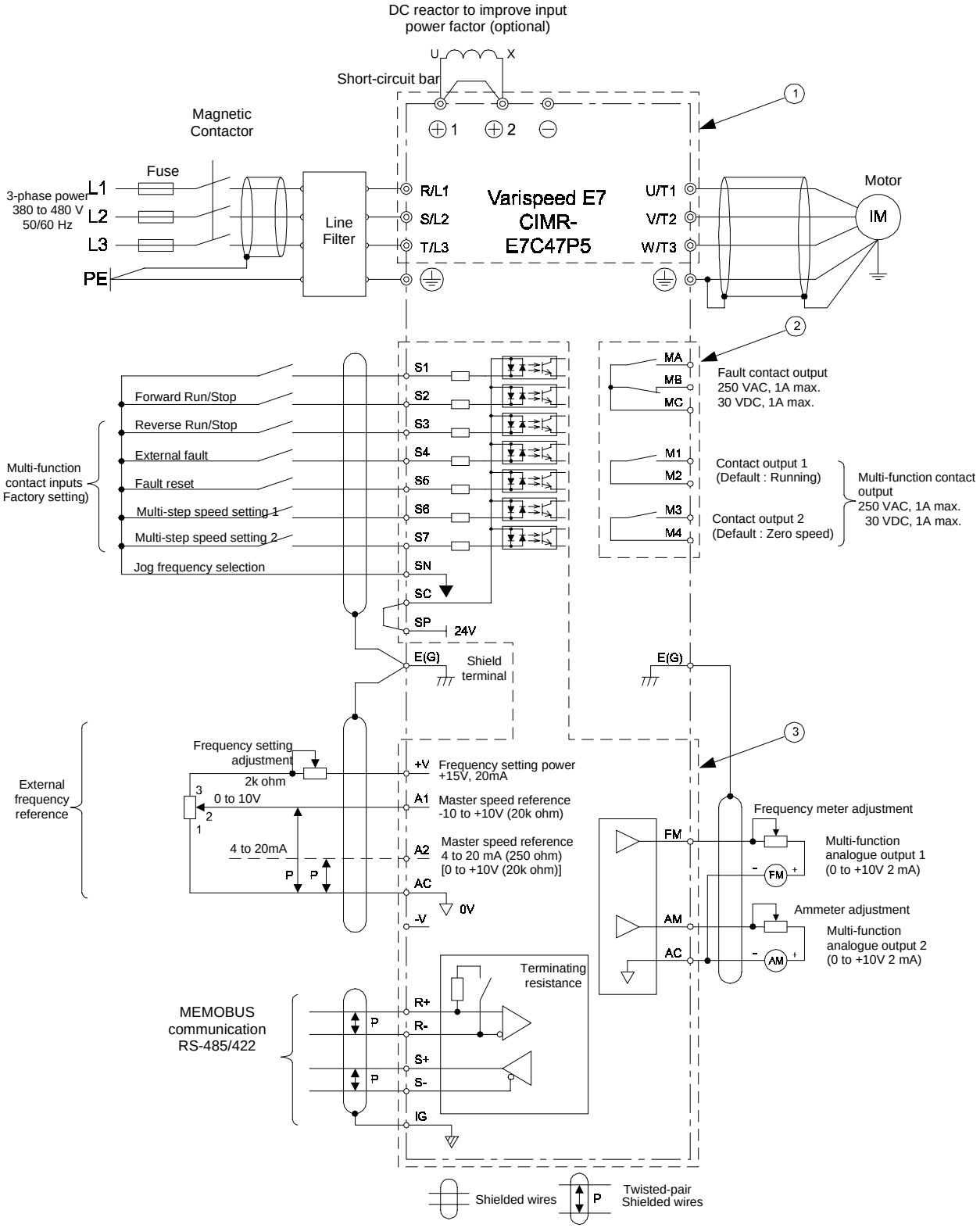


Fig 2.2 Connection Diagram (Model CIMR-E7C47P5 Shown Above)

◆ Circuit Descriptions

Refer to the numbers indicated in the diagram on the previous page.

① These circuits are hazardous and are separated from accessible surfaces by protective separation.

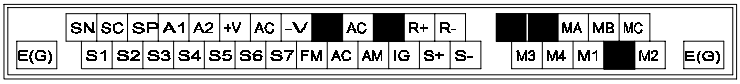
② These circuits are separated from all other circuits by protective separation consisting of double and reinforced insulation. These circuits may be interconnected with SELV (or equivalent) or non-SELV circuits, but not both.

③ **Inverter supplied by four-wire-system source (neutral grounded)**
These circuits are SELV circuits and are separated from all other circuits by protective separation consisting of double and reinforced insulation. These circuits may only be interconnected with other SELV (or equivalent) circuits. These circuits can be accessible or interconnected with other accessible SELV circuits.

Inverter supplied by three-wire-system source (ungrounded or corner grounded)
These circuits are not separated from hazardous circuits by protective separation, but only with basic insulation. These circuits cannot be accessed and must not be interconnected with any circuits which are accessible, unless they are isolated from accessible circuits by supplemental insulation.

IMPORTANT

1. Control circuit terminals are arranged as shown below.



2. The output current capacity of the +V terminal is 20 mA.
3. Disable the stall prevention during deceleration (set constant L3-04 to 0) when using a Braking Resistor Unit. If this user constant is not changed to disable stall prevention, the system may not stop within deceleration time.
4. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.
5. Sequence input signals S1 to S7 are labeled for sequence connections (0 V common and sinking mode) for no-voltage contacts or NPN transistors. These are the default settings.
   For PNP transistor sequence connections (+24V common and sourcing mode) or to provide a 24-V external power supply, refer to*Table 2.12*.
6. The master speed frequency reference can set to input either a voltage (terminal A1) or current (terminal A2) by changing the setting of parameter H3-13. The default setting is for a voltage reference input.
7. The multi-function analog output is a dedicated meter output for an analog frequency meter, ammeter, voltmeter, wattmeter, etc. Do not use this output for feedback control or for any other control purpose.
8. DC reactors to improve the input power factor built into 200 V Class Inverters for 22 to 110 kW and 400 V Class Inverters for 22 to 300 kW. The DC reactor is an option for Inverters for 18.5 kW or less.
   Remove the short bar when connecting a DC reactor to Inverters for 18.5 kW or less.
   Set parameter L8-01 to 1 when using an optional braking resistor unit and braking unit. When using this, a shutoff sequence for the power supply must be made using a thermal relay trip.

Terminal Block Configuration

The terminal arrangement for 200 V Class Inverters are shown in *Fig 2.3* and *Fig 2.4*.

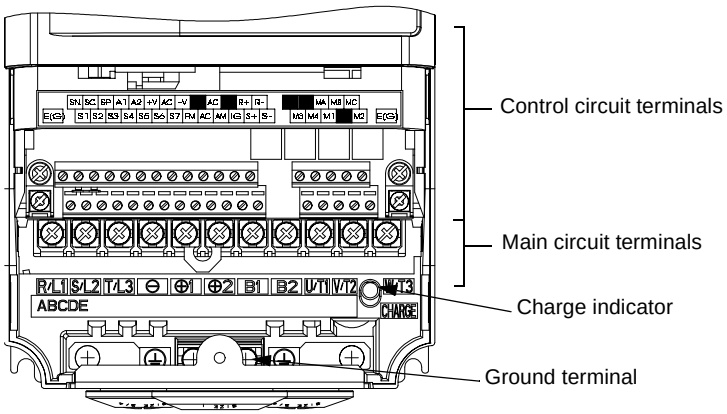


Fig 2.3 Terminal Arrangement (200 V Class Inverter for 0.4 kW Shown Above)

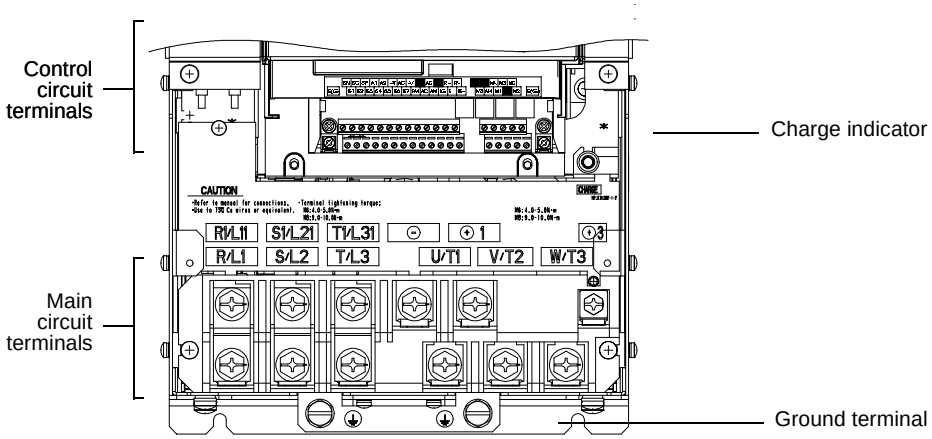


Fig 2.4 Terminal Arrangement (200 V/400 V Class Inverter for 22 kW or more)

Wiring Main Circuit Terminals

◆ Applicable Wire Sizes and Closed-loop Connectors

Select the appropriate wires and crimp terminals from *Table 2.1* to *Table 2.3*. Refer to instruction manual TOE-C726-2 for wire sizes for Braking Resistor Units and Braking Units.

Table 2.1 200 V Class Wire Sizes

Inverter Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2 (AWG)	Wire Type
E7C20P4	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	Power cables, e.g., 600 V vinyl power cables
	⏚					
E7C20P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
E7C21P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
E7C22P2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
E7C23P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
	⏚					
E7C25P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	5.5 (10)	5.5 (10)	
	⏚					
E7C27P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
	⏚					
E7C2011	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	14 to 22 (6 to 4)	14 (6)	
	⏚					
E7C2015	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	4.0 to 5.0	30 to 38 (4 to 2)	30 (4)	
	⏚	M6	4.0 to 5.0	22 (4)	22 (4)	
E7C2018	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M8	9.0 to 10.0	30 to 38 (3 to 2)	30 (3)	
	⏚	M6	4.0 to 5.0	22 (4)	22 (4)	
E7C2022	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	30 to 60 (3 to 1)	30 (3)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
E7C2030	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

Inverter Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2 (AWG)	Wire Type
E7C2037	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	60 to 100 (2/0 to 4/0)	60 (2/0)	Power cables, e.g., 600 V vinyl power cables
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	–	
	⏚	M10	17.6 to 22.5	30 to 60 (2 to 2/0)	30 (2)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C2045	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 (3/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	–	
	⏚	M10	17.6 to 22.5	38 to 60 (1 to 2/0)	38 (1)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C2055	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	100 (4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M10	17.6 to 22.5	30 to 60 (3 to 4/0)	50 (1/0)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C2075	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 125 (3/0 to 250)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M10	17.6 to 22.5	100 to 200 (3/0 to 400)	100 (3/0)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C2090	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	150 to 200 (250 to 400)	150 × 2P (250 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 × 2P (4/0 × 2P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	60 × 2P (2/0 × 2P)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C2110	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	200 to 325 (350 to 600)	200 × 2P, or 50 × 4P (350 × 2P, or 1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	31.4 to 39.2	150 to 325 (300 to 600)	150 × 2P, or 50 × 4P (300 × 2P, or 1/0 × 4P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M12	31.4 to 39.2	150 (300)	150 × 2P (300 × 2P)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

* The wire thickness is set for copper wires at 75°C

Table 2.2 400 V Class Wire Sizes

Inverter Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2 (AWG)	Recommended Wire Size mm^2 (AWG)	Wire Type
E7C40P4	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	Power cables, e.g., 600 V vinyl power cables
	⏚					
E7C40P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
E7C41P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
E7C42P2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
E7C43P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)	
	⏚				2 (14)	
E7C44P0	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)	
	⏚				2 (14)	
E7C45P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
	⏚			2 to 5.5 (14 to 10)	2 (14)	
E7C47P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	5.5(10)	5.5 (10)	
	⏚			3.5 to 5.5 (12 to 10)	3.5 (12)	
E7C4011	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	5.5 to 14 (10 to 6)	8 (8)	
	⏚				5.5 (10)	
E7C4015	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
	⏚	M5 (M6)	2.5 (4.0 to 5.0)	5.5 to 14 (10 to 6)	5.5 (10)	
E7C4018	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	4.0 to 5.0	8 to 38 (8 to 2)	8 (8)	
	⏚	M6	4.0 to 5.0	8 to 22 (8 to 4)	8 (8)	
E7C4022	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	4.0 to 5.0	14 to 22 (6 to 4)	14 (6)	
	⏚	M8	9.0 to 10.0	14 to 38 (6 to 2)	14 (6)	
E7C4030	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	4.0 to 5.0	22 (4)	22 (4)	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
E7C4037	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	22 to 60 (4 to 1/0)	38 (2)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

Inverter Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm² (AWG)	Recommended Wire Size mm² (AWG)	Wire Type
E7C4045	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	38 to 60 (2 to 1/0)	38 (2)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
E7C4055	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	Power cables, e.g., 600 V vinyl power cables
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
E7C4075	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 (2/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	50 to 100 (1/0 to 4/0)	50 (1/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	-	
	⏚	M12	31.4 to 39.2	38 to 60 (2 to 2/0)	38 (2)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4090	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 100 (3/0 to 4/0)	100 (4/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	8 to 22 (8 to 4)	-	
	⏚	M12	31.4 to 39.2	50 to 100 (1 to 4/0)	50 (1)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4110	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	600 (2/0)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4132	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 × 2P (2/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 (4/0)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4160	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	100 to 200 (4/0 to 400)	100 × 2P (4/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	80 to 200 (3/0 to 400)	80 × 2P (3/0 × 2P)	
	⊕3	M8	8.8 to 10.8	80 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	50 to 150 (1/0 to 300)	50 × 2P (1/0 × 2P)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4185 E7C4220 E7C4300	Under development					

* The wire thickness is set for copper wires at 75°C.

Table 2.3 Closed-loop Connector Sizes (JIS C2805) (200 V Class and 400 V Class)

Wire Thickness (mm^2)	Terminal Screws	Size
0.5	M3.5	1.25 to 3.5
	M4	1.25 to 4
0.75	M3.5	1.25 to 3.5
	M4	1.25 to 4
1.25	M3.5	1.25 to 3.5
	M4	1.25 to 4
2	M3.5	2 to 3.5
	M4	2 to 4
	M5	2 to 5
	M6	2 to 6
	M8	2 to 8
3.5/5.5	M4	5.5 to 4
	M5	5.5 to 5
	M6	5.5 to 6
	M8	5.5 to 8
8	M5	8 to 5
	M6	8 to 6
	M8	8 to 8
14	M6	14 to 6
	M8	14 to 8
22	M6	22 to 6
	M8	22 to 8
30/38	M8	38 to 8
50/60	M8	60 to 8
	M10	60 to 10
80	M10	80 to 10
100		100 to 10
100	M12	100 to 12
150		150 to 12
200		200 to 12
325	M12 x 2	325 to 12
	M16	325 to 16

IMPORTANT

Determine the wire size for the main circuit so that line voltage drop is within 2% of the rated voltage. Line voltage drop is calculated as follows:

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

◆ Main Circuit Terminal Functions

Main circuit terminal functions are summarized according to terminal symbols in *Table 2.4*. Wire the terminals correctly for the desired purposes.

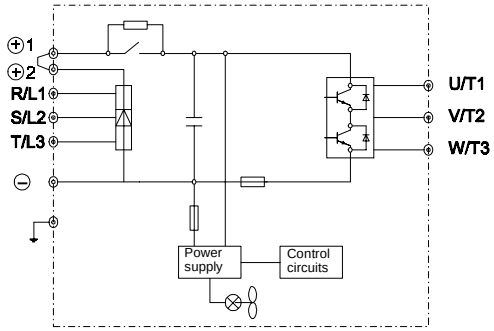
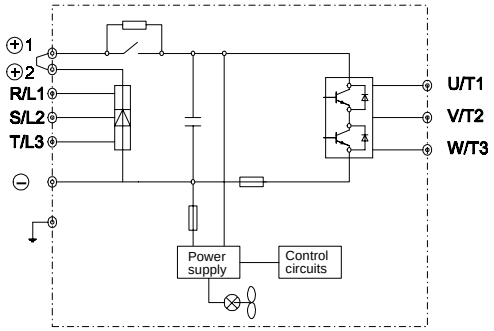
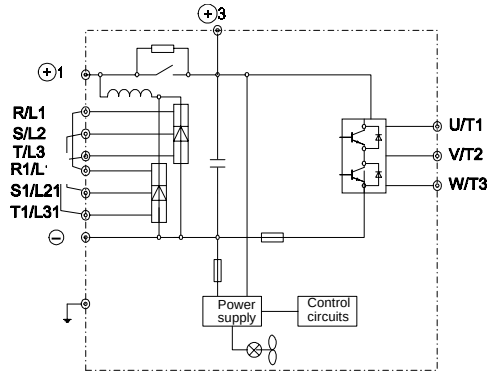
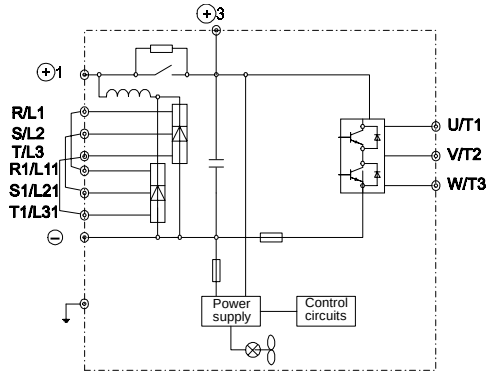
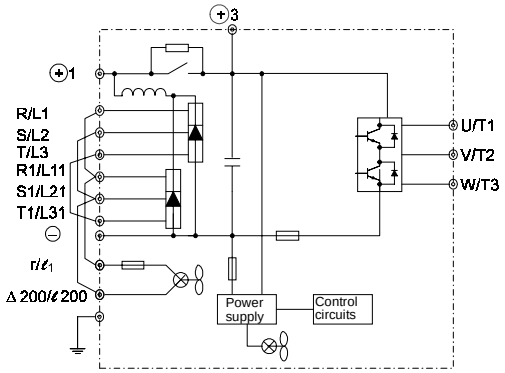
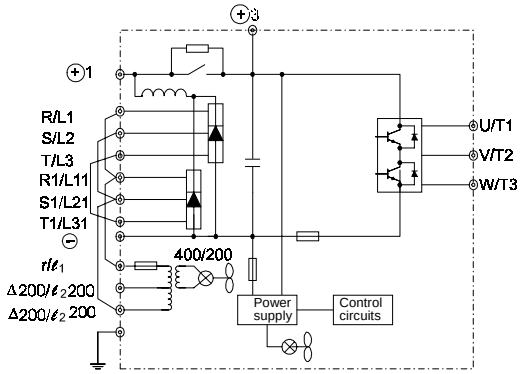
Table 2.4 Main Circuit Terminal Functions (200 V Class and 400 V Class)

Purpose	Terminal Symbol	Model: CIMR-E7C□□□□	
		200 V Class	400 V Class
Main circuit power input	R/L1, S/L2, T/L3	20P4 to 2110	40P4 to 4160
	R1/L11, S1/L21, T1/L31	2022 to 2110	4022 to 4160
Inverter outputs	U/T1, V/T2, W/T3	20P4 to 2110	40P4 to 4160
DC power input	⊕1, ⊖	20P4 to 2110	40P4 to 4160
DC reactor connection	⊕1, ⊕2	20P4 to 2018	40P4 to 4018
Braking Unit connection	⊕3, ⊖	2022 to 2110	4022 to 4160
Ground	⏚	20P4 to 2110	40P4 to 4160

◆ Main Circuit Configurations

The main circuit configurations of the Inverter are shown in *Fig 2.5*.

Table 2.5 Inverter Main Circuit Configurations

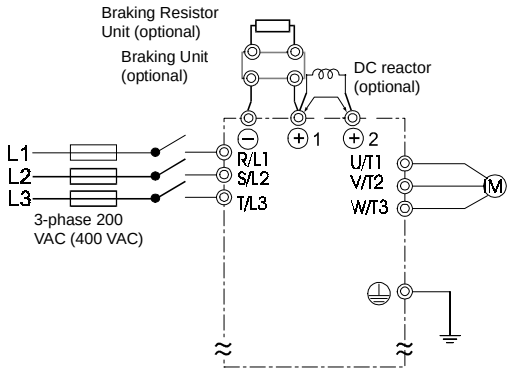
200 V Class	400 V Class
CIMR-E7C20P4 to 4018	CIMR-E7C40P4 to 4018
	
CIMR-E7C2022, 2030	CIMR-E7C4022 to 4055
	
CIMR-E7C2037 to 2110	CIMR-E7C4075 to 4160
	

Note 1. The CIMR-E7C4185 to 4300 Inverters are currently under development.
2. Consult your Yaskawa representative before using 12-phase rectification.

◆ Standard Connection Diagrams

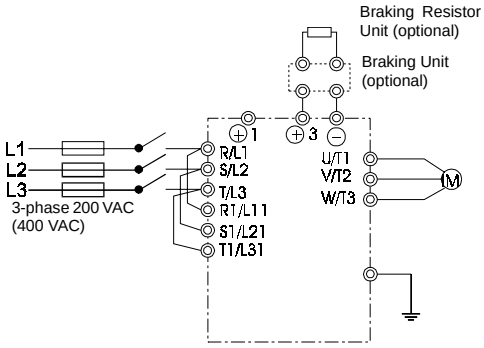
Standard Inverter connection diagrams are shown in *Fig 2.5.* These are the same for both 200 V Class and 400 V Class Inverters. The connections depend on the Inverter capacity.

■CIMR-E7C20P4 to 2018 and 40P4 to 4018



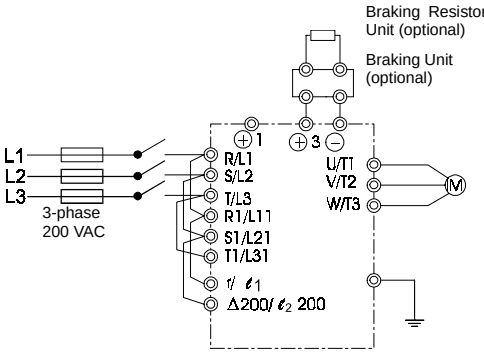
Be sure to remove the short-circuit bar before connecting the DC reactor.

■CIMR-E7C2022, 2030, and 4022 to 4055

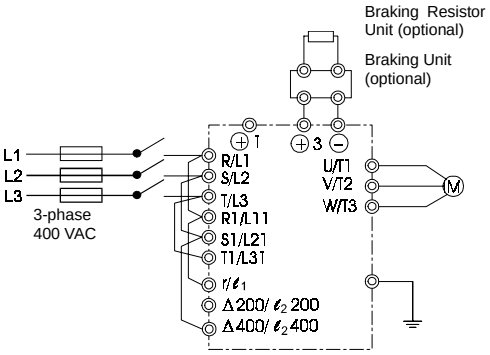


The DC reactor is built in.

■CIMR-E7C2037 to 2110



■CIMR-E7C4075 to 4160



Control power is supplied internally from the main circuit DC power supply for all Inverter models.

Fig 2.5 Main Circuit Terminal Connections

◆ Wiring the Main Circuits

This section describes wiring connections for the main circuit inputs and outputs.

■Wiring Main Circuit Inputs

Observe the following precautions for the main circuit power supply input.

Installing Fuses

To protect the inverter, it is recommended to use semiconductor fuses like they are shown in the table below.

Table 2.6 Input Fuses

Inverter Type	FUSE		
	Voltage (V)	Current (A)	I^2t (A^2s)
20P4	240	10	12~25
20P7	240	10	12~25
21P5	240	15	23~55
22P2	240	20	34~98
23P7	240	30	82~220
25P5	240	40	220~610
27P5	240	60	290~1300
2011	240	80	450~5000
2015	240	100	1200~7200
2018	240	130	1800~7200
2022	240	150	870~16200
2030	240	180	1500~23000
2037	240	240	2100~19000
2045	240	300	2700~55000
2055	240	350	4000~55000
2075	240	450	7100~64000
2090	240	550	11000~64000
2110	240	600	13000~83000
40P4	480	5	6~55
40P7	480	5	6~55
41P5	480	10	10~55
42P2	480	10	18~55
43P7	480	15	34~72
44P0	480	20	50~570
45P5	480	25	100~570
47P5	480	30	100~640
4011	480	50	150~1300
4015	480	60	400~1800
4018	480	70	700~4100
4022	480	80	240~5800
4030	480	100	500~5800
4037	480	125	750~5800
4045	480	150	920~13000
4055	480	150	1500~13000
4075	480	250	3000~55000
4090	480	300	3800~55000
4110	480	350	5400~23000
4132	480	400	7900~64000
4160	480	450	14000~250000
4185	480	600	20000~250000
4220	480	700	34000~400000
4300	480	900	52000~920000

Installing a Molded-case Circuit Breaker

When connecting the power input terminals (R/L2, S/L2, and T/L3) and power supply via a molded-case circuit breaker (MCCB) observe that the circuit breaker is suitable for the Inverter.

- Choose an MCCB with a capacity of 1.5 to 2 times the Inverter's rated current.
- For the MCCB's time characteristics, be sure to consider the Inverter's overload protection (one minute at 120% of the rated output current).

Installing a Ground Fault Interrupter

Inverter outputs use high-speed switching, so high-frequency leakage current is generated. Therefore, at the Inverter primary side, use a ground fault interrupter to detect only the leakage current in the frequency range that is hazardous to humans and exclude high-frequency leakage current.

- For the special-purpose ground fault interrupter for Inverters, choose a ground fault interrupter with a sensitivity amperage of at least 30 mA per Inverter.
- When using a general ground fault interrupter, choose a ground fault interrupter with a sensitivity amperage of 200 mA or more per Inverter and with an operating time of 0.1 s or more.

Installing a Magnetic Contactor

If the power supply for the main circuit is to be shut off during a sequence, a magnetic contactor can be used.

When a magnetic contactor is installed on the primary side of the main circuit to forcibly stop the Inverter, however, the regenerative braking does not work and the Inverter will coast to stop.

- The Inverter can be started and stopped by opening and closing the magnetic contactor on the primary side. Frequently opening and closing the magnetic contactor, however, may cause the Inverter to break down. Start and stop the Inverter at most once every 30 minutes.
- When the Inverter is operated with the Digital Operator, automatic operation cannot be performed after recovery from a power interruption.
- If a Braking Unit and a Braking Resistor Unit are used, program the sequence so that the magnetic contactor is turned OFF by the contact of the Braking Resistor Unit's thermal overload relay.

Connecting Input Power Supply to the Terminal Block

Input power supply can be connected to any terminal R, S or T on the terminal block; the phase sequence of input power supply is irrelevant to the phase sequence.

Installing an AC Reactor

If the Inverter is connected to a large-capacity power transformer (600 kW or more) or the phase advancing capacitor is switched, an excessive peak current may flow through the input power circuit, causing the converter unit to break down.

To prevent this, install an optional AC Reactor on the input side of the Inverter or a DC reactor to the DC reactor connection terminals (for units from 22 kW the DC reactor is standard).

This also improves the power factor on the power supply side.

Installing a Surge Absorber

Always use a surge absorber or diode for inductive loads near the Inverter. These inductive loads include magnetic contactors, electromagnetic relays, solenoid valves, solenoids, and magnetic brakes.

■Wiring the Output Side of Main Circuit

Observe the following precautions when wiring the main output circuits.

Connecting the Inverter and Motor

Connect output terminals U/T1, V/T2, and W/T3 to motor lead wires U, V, and W.

Check that the motor rotates forward with the forward run command. Switch over any two of the output terminals to each other and reconnect if the motor rotates in reverse with the forward run command.

Never Connect a Power Supply to Output Terminals

Never connect a power supply to output terminals U/T1, V/T2, and W/T3. If voltage is applied to the output terminals, the internal circuits of the Inverter will be damaged.

Never Short or Ground Output Terminals

If the output terminals are touched with bare hands or the output wires come into contact with the Inverter casing, an electric shock or grounding will occur. This is extremely hazardous. Do not short the output wires.

Do Not Use a Phase Advancing Capacitor or Noise Filter

Never connect a phase advancing capacitor or LC/RC noise filter to an output circuit. The high-frequency components of the Inverter output may result in overheating or damage to these part or may result in damage to the Inverter or cause other parts to burn.

Do Not Use an Electromagnetic Switch

Never connect an electromangetic switch (MC) between the Inverter and motor and turn it ON or OFF during operation. If the MC is turned ON while the Inverter is operating, a large inrush current will be caused and the overcurrent protection in the Inverter will operate.

When using an MC to switch to a commercial power supply, stop the Inverter and motor before operating the MC. Use the speed search function if the MC is operated during operation. If measures for momentary power interrupts are required, use a delayed release MC.

Installing a Thermal Overload Relay

This Inverter has an electronic thermal protection function to protect the motor from overheating. If, however, more than one motor is operated with one Inverter or a multi-polar motor is used, always install a thermal relay (THR) between the Inverter and the motor and set L1-01 to 0 (no motor protection). The sequence should be designed so that the contacts of the thermal overload relay turn OFF the magnetic contactor on the main circuit inputs.

Cable Length between Inverter and Motor

If the cable between the Inverter and the motor is long, the high-frequency leakage current will increase, causing the Inverter output current to increase as well. This may affect peripheral devices. To prevent this, adjust the carrier frequency (set in C6-02) as shown in *Table 2.7*. (For details, refer to *Chapter 5 User Constants.)*

Table 2.7 Cable Length between Inverter and Motor

Cable length	50 m max.	100 m max.	More than 100 m
Carrier frequency	15 kHz max.	10 kHz max.	5 kHz max.

■Ground Wiring

Observe the following precautions when wiring the ground line.

- Always use the ground terminal of the 200 V Inverter with a ground resistance of less than 100 Ω and that of the 400 V Inverter with a ground resistance of less than 10 Ω.
- Do not share the ground wire with other devices, such as welding machines or power tools.
- Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire.
  Leakage current flows through the Inverter. Therefore, if the distance between the ground electrode and the ground terminal is too long, potential on the ground terminal of the Inverter will become unstable.
- When using more than one Inverter, be careful not to loop the ground wire.

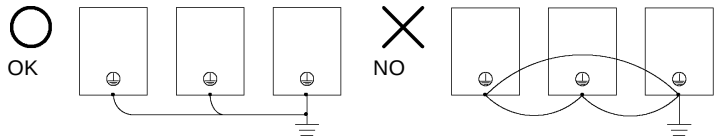


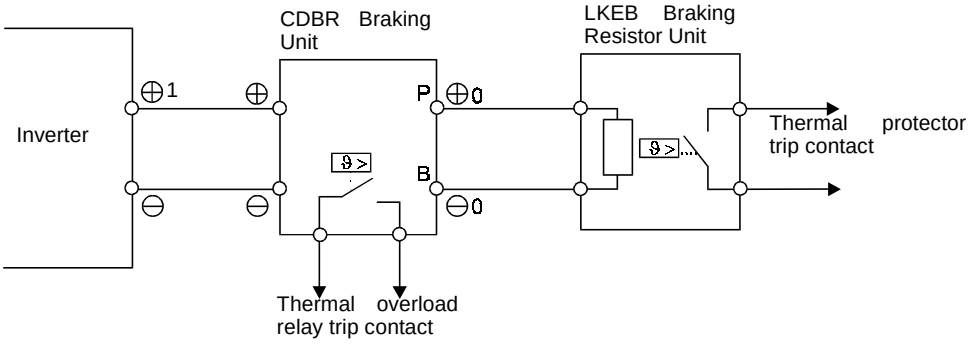
Fig 2.6 Ground Wiring

■Connecting an optional Braking Resistor Unit (LKEB) and Braking Unit (CDBR)

Connect the Braking Resistor Unit and Braking Unit to the Inverter as shown in the *Fig 2.7*.

To prevent the Unit from overheating, design the sequence to turn OFF the power supply for the thermal overload relay trip contacts of the Unit as shown in *Fig 2.7*.

200 V and 400 V Class Inverters with 0.4 to 18.5 kW Output



200 V and 400 V Class Inverters with 22 kW or higher Output

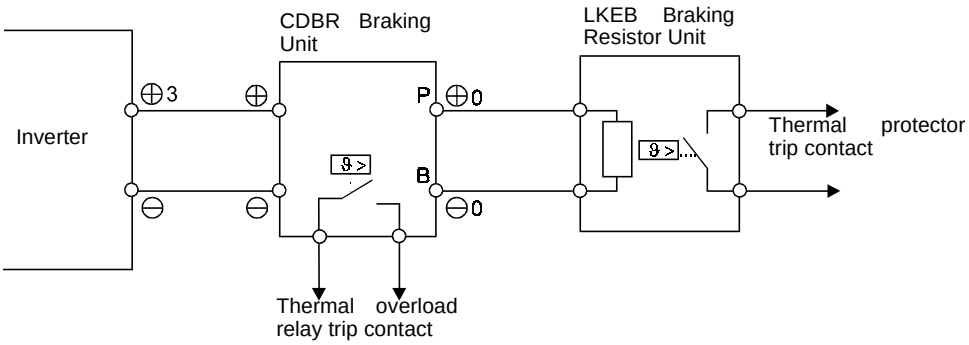


Fig 2.7 Connecting the Braking Resistor Unit and Braking Unit

IMPORTANT

When using an optional Braking Unit and Braking Resistor Unit, the parameter L3-04 (Stall prevention selection during deceleration) has to be set to 0. Otherwise stall prevention is enabled and the Braking Unit will not work.

Connecting Braking Units in Parallel

When connecting two or more Braking Units in parallel, use the wiring and connectors shown in *Fig 2.8*. There are connectors for selecting whether each Braking Unit is to be a Master or Slave. Select “Master” for the first Braking Unit only, and select “Slave” for all other Braking Units (i.e., from the second Unit onwards).

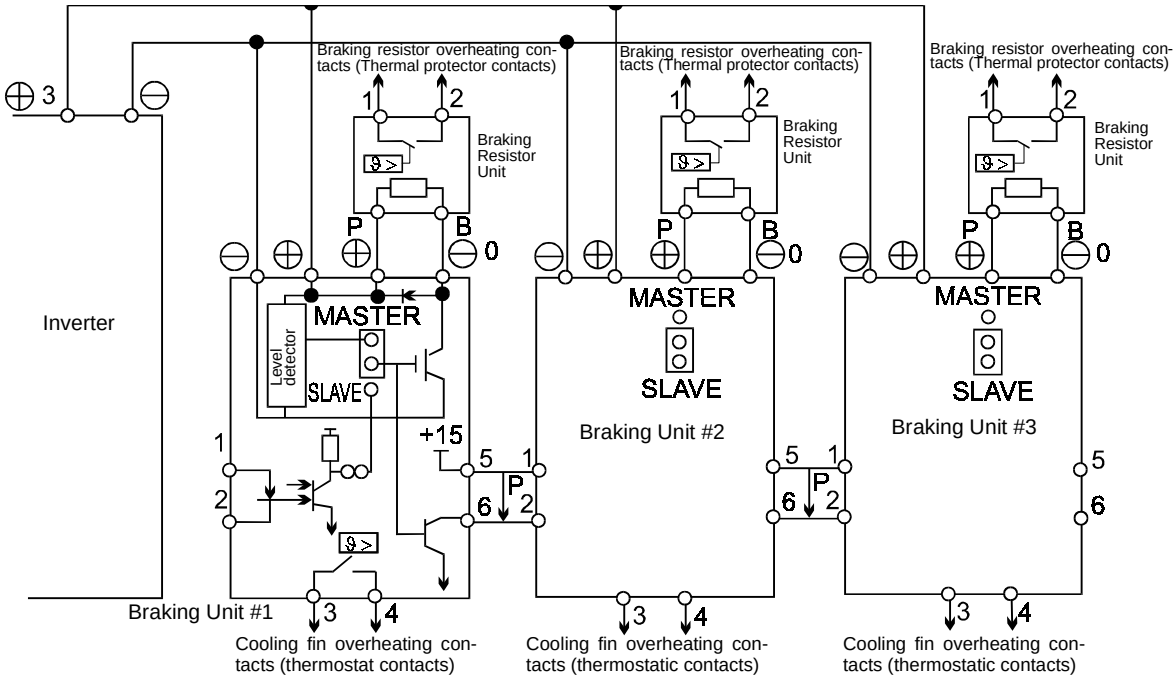


Fig 2.8 Connecting Braking Units in Parallel

Breaking Unit Application Precautions

When using a Braking Resistor Unit, create a sequence to detect overheating of the braking resistor.

Wiring Control Circuit Terminals

◆ Wire Sizes

For remote operation using analog signals, keep the control line length between the Analog Operator or operation signals and the Inverter to 50 m or less, and separate the lines from high-power lines (main circuits or relay sequence circuits) to reduce induction from peripheral devices.

When setting frequencies from an external frequency setter (and not from a Digital Operator), used shielded twisted-pair wires and ground the shield to terminal E (G), as shown in the following diagram.

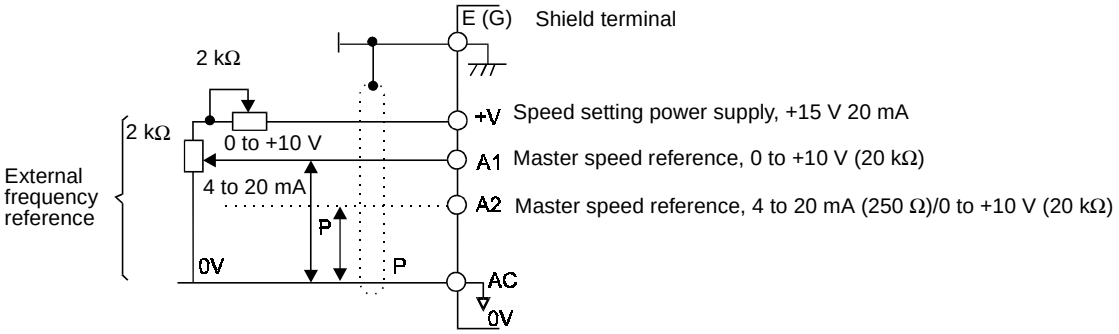


Fig 2.9

Terminal numbers and wire sizes are shown in *Table 2.8*.

Table 2.8 Terminal Numbers and Wire Sizes (Same for all Models)

Terminals	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2(AWG)	Wire Type
FM, AC, AM, SC, A1, A2, +V, –V, S1, S2, S3, S4, S5, S6, S7 MA, MB, MC, M1, M2, M3, M4 R+, R-, S+, S-, IG	Phoenix type	0.5 to 0.6	Single wire*3: 0.14 to 2.5 Stranded wire: 0.14 to 1.5 (26 to 14)	0.75 (18)	• Shielded, twisted-pair wire*1 • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electrical Wire or equivalent)
E (G)	M3.5	0.8 to 1.0	0.5 to 2*2 (20 to 14)	1.25 (12)	

* 1. Use shielded twisted-pair cables to input an external frequency reference.

* 2. Refer to *Table 2.3 Close-loop Connector Sizes* for suitable closed-loop crimp terminal sizes for the wires.

* 3. We recommend using straight solderless terminal on signal lines to simplify wiring and improve reliability.

■ Straight Solderless Terminals for Signal Lines

Models and sizes of straight solderless terminal are shown in the following table.

Table 2.9 Straight Solderless Terminal Sizes

Wire Size mm^2 (AWG)	Model	d1	d2	L	Manufacturer
0.25 (24)	AI 0.25 - 8YE	0.8	2	12.5	Phoenix Contact
0.5 (20)	AI 0.5 - 8WH	1.1	2.5	14	
0.75 (18)	AI 0.75 - 8GY	1.3	2.8	14	
1.25 (16)	AI 1.5 - 8BK	1.8	3.4	14	
2 (14)	AI 2.5 - 8BU	2.3	4.2	14	

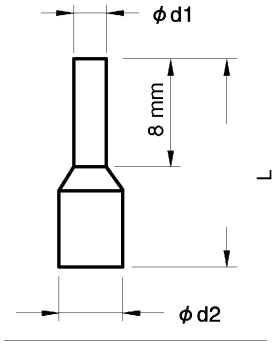


Fig 2.10 Straight Solderless Terminal Sizes

■Wiring Method

Use the following procedure to connect wires to the terminal block.

1. Loosen the terminal screws with a thin-slot screwdriver.
2. Insert the wires from underneath the terminal block.
3. Tighten the terminal screws firmly.

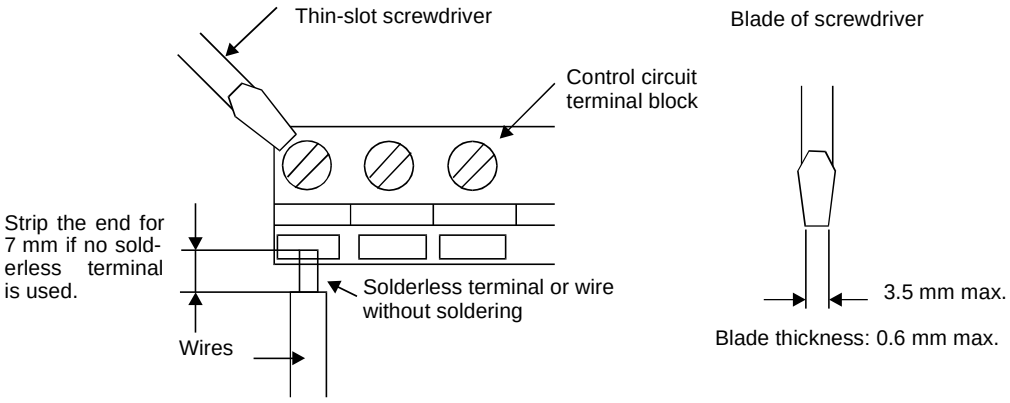


Fig 2.11 Connecting Wires to Terminal Block

◆ Control Circuit Terminal Functions

The functions of the control circuit terminals are shown in *Table 2.10*. Use the appropriate terminals for the correct purposes.

Table 2.10 Control Circuit Terminals

Type	No.	Signal Name	Function		Signal Level
Sequence input signals	S1	Forward run/stop command	Forward run when ON; stopped when OFF.		24 VDC, 8 mA Photocoupler isolation
	S2	Reverse run/stop command	Reverse run when ON; stopped when OFF.		
	S3	External fault input*1	Fault when ON.	Functions are selected by setting H1-01 to H1-05.	
	S4	Fault reset*	Reset when ON		
	S5	Multi-step speed reference 1*1 (Master/auxiliary switch)	Auxiliary frequency reference when ON.		
	S6	Multi-step speed reference 2*1	Multi-step setting 2 when ON.		
	S7	Jog frequency reference*1	Jog frequency when ON.		
	SC	Sequence input common	–		–
Analog input signals	+V	15 V power output	15 V power supply for analog references		15 V (Max. current: 20 mA)
	–V	–15 V power output	not used		–15 V (Max. current: 20 mA)
	A1	Frequency reference	0 to +10 V/100%		0 to +10 V(20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100% 0 to +10 V/100%	Function is selected by setting H3-09.	4 to 20 mA(250Ω) 0 to +10 V(20kΩ)
	AC	Analog reference common	–		–
	E(G)	Shield wire, optional ground line connection point	–		–
Sequence output signals	M1	Running signal (1NO contact)	Operating when ON.	Multi-function contact outputs	Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	M2				
	M3	Zero speed	Zero level (b2-01) or below when ON		
	M4				
	MA	Fault output signal (SPDT)	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC		Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	MB				
	MC				
Analog output signals	FM	Multi-function analog output (frequency output)	0 to +10 V/100% frequency	Multi-function analog monitor 1	0 to +10 V max. ±5% 2 mA max.
	AC	Analog common (copy)	–		
	AM	Multi-function analog output (current monitor)	5 V/Inverter's rated current	Multi-function analog monitor 2	
RS-485/422	R+	MEMOBUS communications input	For 2-wire RS-485, short R+ and S+ as well as R- and S-.		Differential input, PHC isolation
	R-				
	S+	MEMOBUS communications output			Differential input, PHC isolation
	S-				
	IG	Signal common	-		-

* 1. The default settings are given for terminals S3 to S7. For a 3-wire sequence, the default settings are a 3-wire sequence for S5, multi-step speed setting 1 for S6 and multi-step speed setting 2 for S7.

* 2. When driving a reactive load, such as a relay coil with DC power supply, always insert a flywheel diode as shown in *Fig 2.12*.

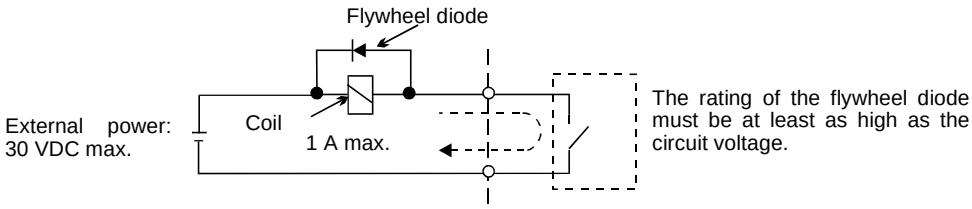
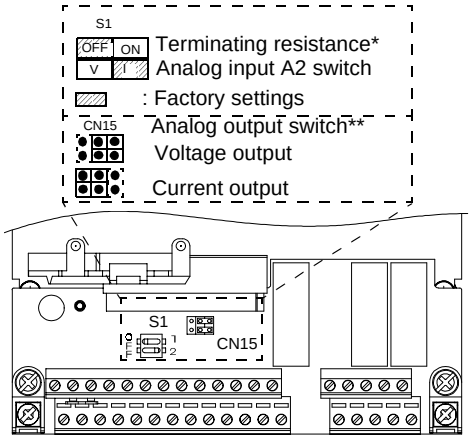


Fig 2.12 Flywheel Diode Connection

■DIP Switch S1 and Shunt Connector CN15

The DIP switch S1 and shunt connector CN 15 are described in this section.



* Note: Refer to *Table 2.11* for S1 functions .
**Note: CN15 is not available at the standard terminal board.
An optional terminal board with CN15 Shunt Connector is available.
The standard setting is voltage output.

Fig 2.13 DIP Switch S1 and Shunt Connector CN15

The functions of DIP switch S1 are shown in the following table.

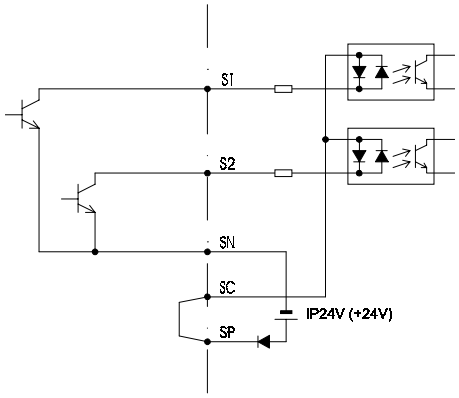
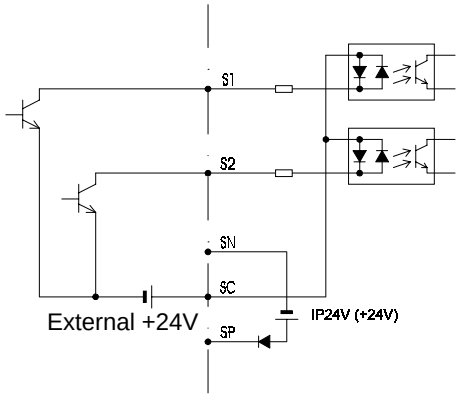
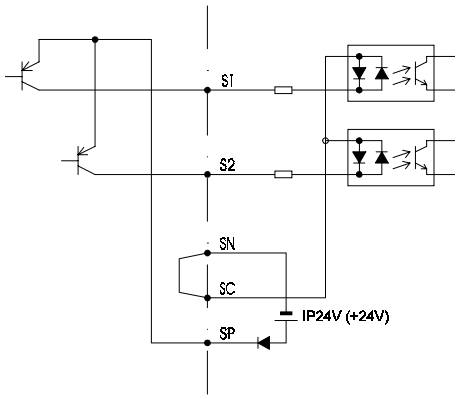
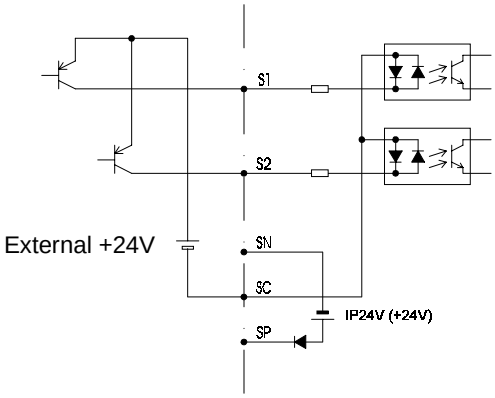
Table 2.11 DIP Switch S1

Name	Function	Setting
S1-1	RS-485 and RS-422 terminating resistance	OFF: No terminating resistance ON: Terminating resistance of 110 Ω
S1-2	Input method for analog input A2	OFF: 0 to 10 V (internal resistance: 20 kΩ) ON: 4 to 20 mA (internal resistance: 250 Ω)

■ Sinking/Sourcing Mode

The input terminal logic can be switched between sinking mode (0-V common) and sourcing mode (+24V common) by using the terminals SN, SC, and SP. An external power supply is also supported, providing more freedom in signal input methods.

Table 2.12 Sinking/Sourcing Mode and Input Signals

Internal Power Supply – Sinking Mode 	External Power Supply – Sinking Mode 
Internal Power Supply – Sourcing Mode 	External Power Supply – Sourcing Mode 

◆ Control Circuit Terminal Connections

Connections to Inverter control circuit terminals are shown in *Fig 2.14*.

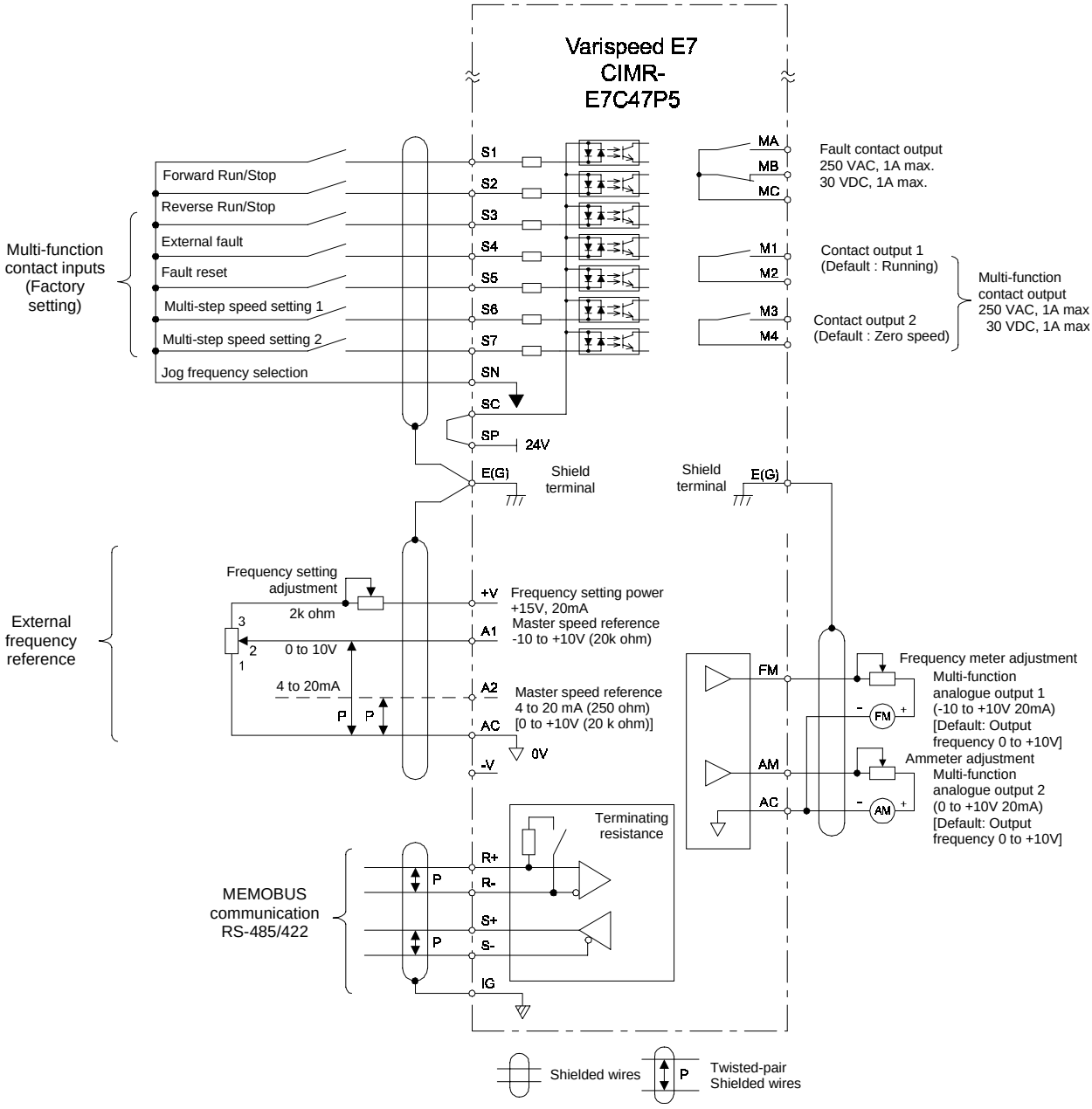


Fig 2.14 Control Circuit Terminal Connections

◆ Control Circuit Wiring Precautions

Observe the following precautions when wiring control circuits.

- Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⊖, ⊕1, ⊕2, and ⊕3) and other high-power lines.
- Separate wiring for control circuit terminals MA, MB, MC, M1, M2, M3 and M4 (contact outputs) from wiring to other control circuit terminals.
- If using an optional external power supply, it shall be a UL Listed Class 2 power supply source.
- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Process cable ends as shown in *Fig 2.15*.
- Connect the shield wire to terminal E (G).
- Insulate the shield with tape to prevent contact with other signal lines and equipment.

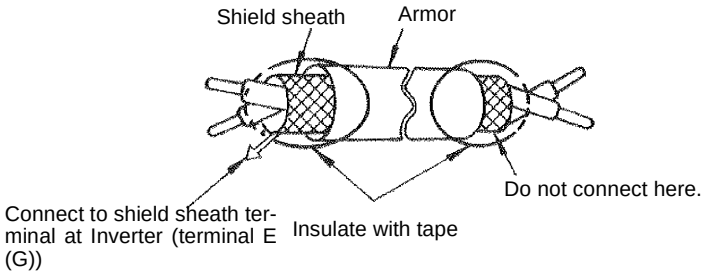


Fig 2.15 Processing the Ends of Twisted-pair Cables

Wiring Check

◆ Checks

Check all wiring after wiring has been completed. Do not perform a buzzer check on control circuits. Perform the following checks on the wiring.

- Is all wiring correct?
- Have any wire clippings, screws, or other foreign material been left?
- Are all screws tight?
- Are any wire ends contacting other terminals?

Installing and Wiring Option Cards

◆ Option Card Models and Specifications

One Option Card can be mounted in the Inverter as shown in *Fig 2.16.*

Table 2.13 lists the type of Option Cards and their specifications.

Table 2.13 Option Card and their Specifications

Card	Model	Specifications	Mounting Location
DeviceNet Communications Card	SI-N	DeviceNet communications support	C
Profibus-DP Communications Card	SI-P	Profibus-DP communications support	C
InterBus-S Communications Card	SI-R	InterBus-S communications support	C

◆ Installation

Before mounting an Option Card, remove the terminal cover and be sure that the charge indicator inside the Inverter is not lit. After confirming that the charge indicator is not lit, remove the Digital Operator and front cover and then mount the Option Card.

Refer to documentation provided with the Option Card for actual mounting instructions for option slot C.

■ Preventing C Option Card Connectors from Rising

After installing an Option Card into slot C, insert an Option Clip to prevent the side with the connector from rising. The Option Clip can be easily removed by holding onto the protruding portion of the Clip and pulling it out.

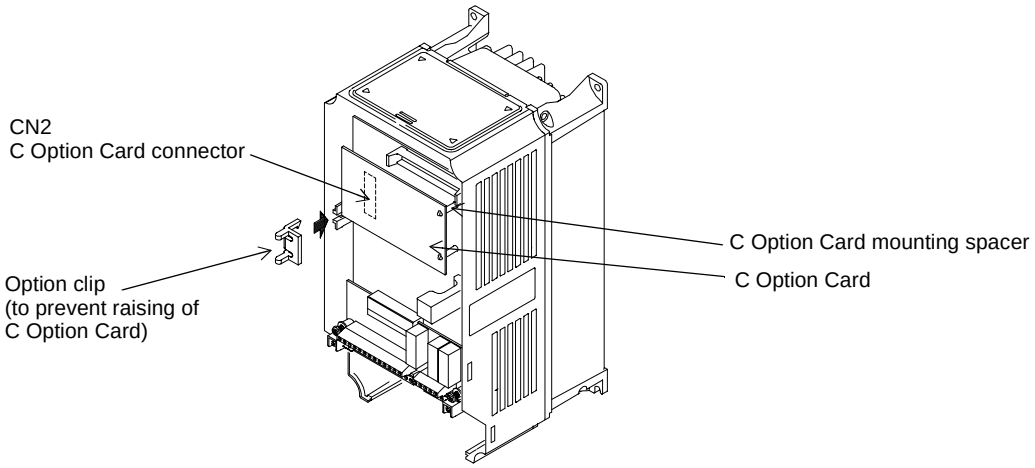


Fig 2.16 Mounting Option Cards

3

Digital Operator and Modes

This chapter describes Digital Operator displays and functions, and provides an overview of operating modes and switching between modes.

Digital Operator 3-2
Modes 3-4

Digital Operator

This section describes the displays and functions of the Digital Operator.

◆ Digital Operator Display

The key names and functions of the Digital Operator are described below.

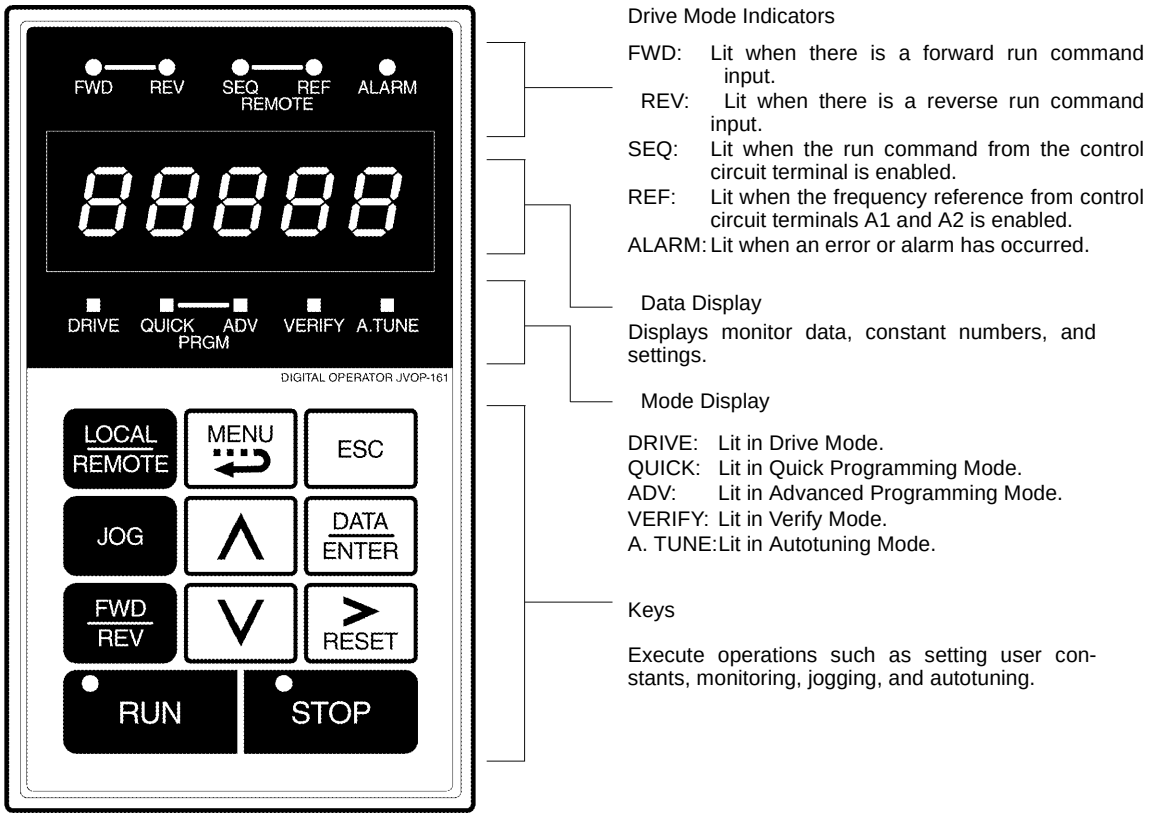


Fig 3.1 Digital Operator Component Names and Functions

◆ Digital Operator Keys

The names and functions of the Digital Operator Keys are described in *Table 3.1*.

Table 3.1 Key Functions

Key	Name	Function
LOCAL/REMOTE	LOCAL/REMOTE Key	Switches between operation via the Digital Operator (LOCAL) and control circuit terminal operation (REMOTE). This Key can be enabled or disabled by setting user constant o2-01.
MENU	MENU Key	Selects menu items (modes).
ESC	ESC Key	Returns to the status before the DATA/ENTER Key was pressed.

Table 3.1 Key Functions (Continued)

Key	Name	Function
JOG	JOG Key	Enables jog operation when the Inverter is being operated from the Digital Operator.
FWD/REV	FWD/REV Key	Selects the rotation direction of the motor when the Inverter is being operated from the Digital Operator.
RESET	Shift/RESET Key	Sets the number of digits for user constant settings. Also acts as the Reset key when a fault has occurred.
∧	Increment Key	Selects menu items, sets user constant numbers, and increments set values. Used to move to the next item or data.
∨	Decrement Key	Selects menu items, sets user constant numbers, and decrements set values. Used to move to the previous item or data.
DATA/ENTER	DATA/ENTER Key	Pressed to enter menu items, user constants, and set values. Also used to switch from one screen to another.
RUN	RUN Key	Starts the Inverter operation when the Inverter is being controlled by the Digital Operator.
STOP	STOP Key	Stops Inverter operation. This Key can be enabled or disabled when operating from the control circuit terminal by setting user constant o2-02.

Note Except in diagrams, Keys are referred to using the Key names listed in the above table.

There are indicators on the upper left of the RUN and STOP Keys on the Digital Operator. These indicators will light and flash to indicate operating status.

The RUN Key indicator will flash and the STOP Key indicator will light during initial excitation of the dynamic brake. The relationship between the indicators on the RUN and STOP Keys and the Inverter status is shown in the *Fig 3.2*.

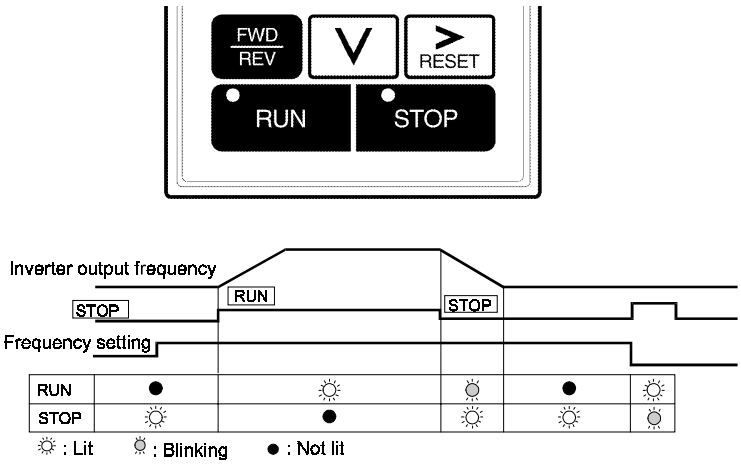


Fig 3.2 RUN and STOP Indicators

Modes

This section describes the Inverter's modes and switching between modes.

◆ Inverter Modes

The Inverter's user constants and monitoring functions are organized in groups called modes that make it easier to read and set user constants.The Inverter is equipped with 5 modes.

The 5 modes and their primary functions are shown in the *Table 3.2*.

Table 3.2 Modes

Mode	Primary function(s)
Drive mode	The Inverter can be run in this mode. Use this mode when monitoring values such as frequency references or output current, displaying fault information, or displaying the fault history.
Quick programming mode	Use this mode to reference and set the minimum user constants to operate the Inverter (e.g., the operating environment of the Inverter and Digital Operator).
Advanced programming mode	Use this mode to reference and set all user constants.
Verify mode	Use this mode to read/set user constants that have been changed from their factory-set values.
Autotuning mode	Use this mode when running a motor with unknown motor constants. While autoruning the line-to-line resistance is measured and set automatically.

◆ Switching Modes

The mode selection display will appear when the MENU key is pressed from a monitor or setting display. Press the MENU key from the mode selection display to switch between the modes.

Press the DATA/ENTER key from the mode selection key to monitor data and from a monitor display to access the setting display.

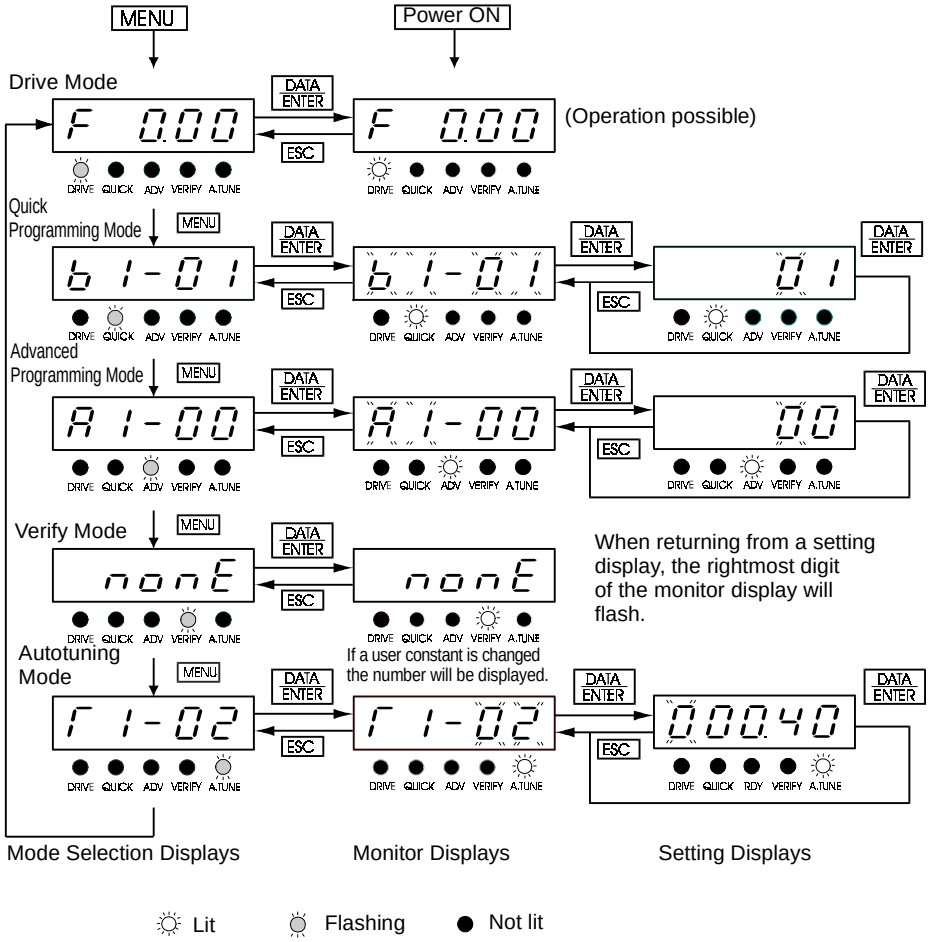


Fig 3.3 Mode Transitions

◆ Drive Mode

Drive mode is the mode in which the Inverter can be operated. The following monitor displays are possible in drive mode: The frequency reference, output frequency, output current, and output voltage, as well as fault information and the fault history.

When b1-01 (Reference selection) is set to 0, the frequency can be changed from the frequency setting display. Use the Increment, Decrement, and Shift/RESET keys to change the frequency. The user constant will be written and the monitor display will be returned to when the DATA/ENTER key is pressed after changing the setting.

■Example Operations

Key operations in drive mode are shown in the following figure.

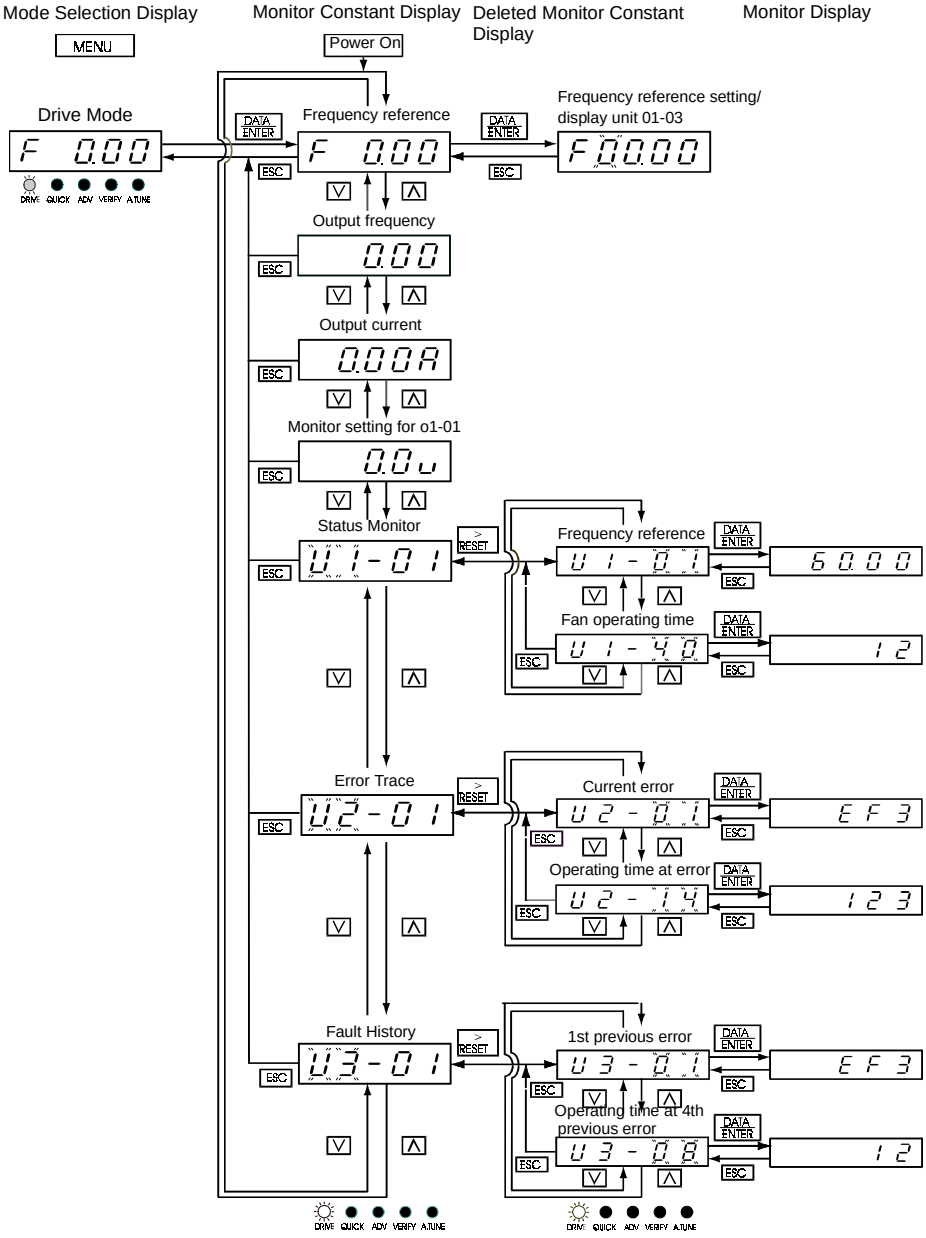


Fig 3.4 Operations in Drive Mode

IMPORTANT

The display for the first monitor constant (frequency reference) will be displayed when power is turned ON. The monitor item displayed at startup can be set in o1-02 (Monitor Selection after Power Up).

Operation cannot be started from the mode selection display.

◆ Quick Programming Mode

In quick programming mode, the constants required for Inverter trial operation can be monitored and set.

Constants can be changed from the setting displays. Use the Increment, Decrement, and Shift/RESET keys to change the frequency. The user constant will be written and the monitor display will be returned to when the DATA/ENTER key is pressed after changing the setting.

Refer to *Chapter 5 User Constants* for details on the constants displayed in quick programming mode.

■Example Operations

Key operations in quick programming mode are shown in the following figure.

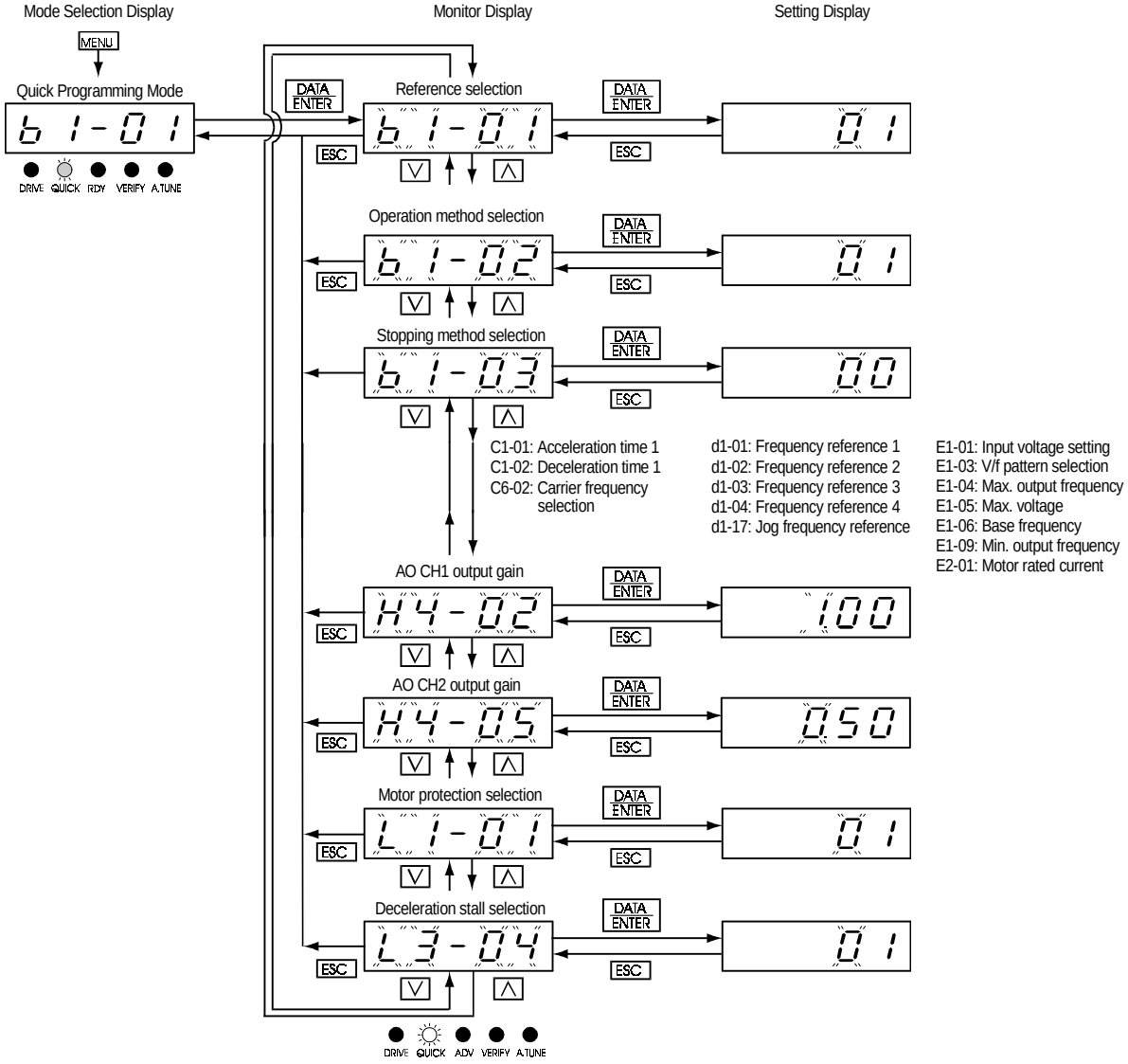


Fig 3.5 Operations in Quick Programming Mode

◆ Advanced Programming Mode

In advanced programming mode, all Inverter constants can be monitored and set.

Constants can be changed from the setting displays. Use the Increment, Decrement, and Shift/RESET keys to change the frequency. The user constant will be written and the display will return to monitor display when the DATA/ENTER key is pressed after changing the setting.

Refer to *Chapter 5 User Constants* for details on the constants.

■Example Operations

Key operations in advanced programming mode are shown in the following figure.

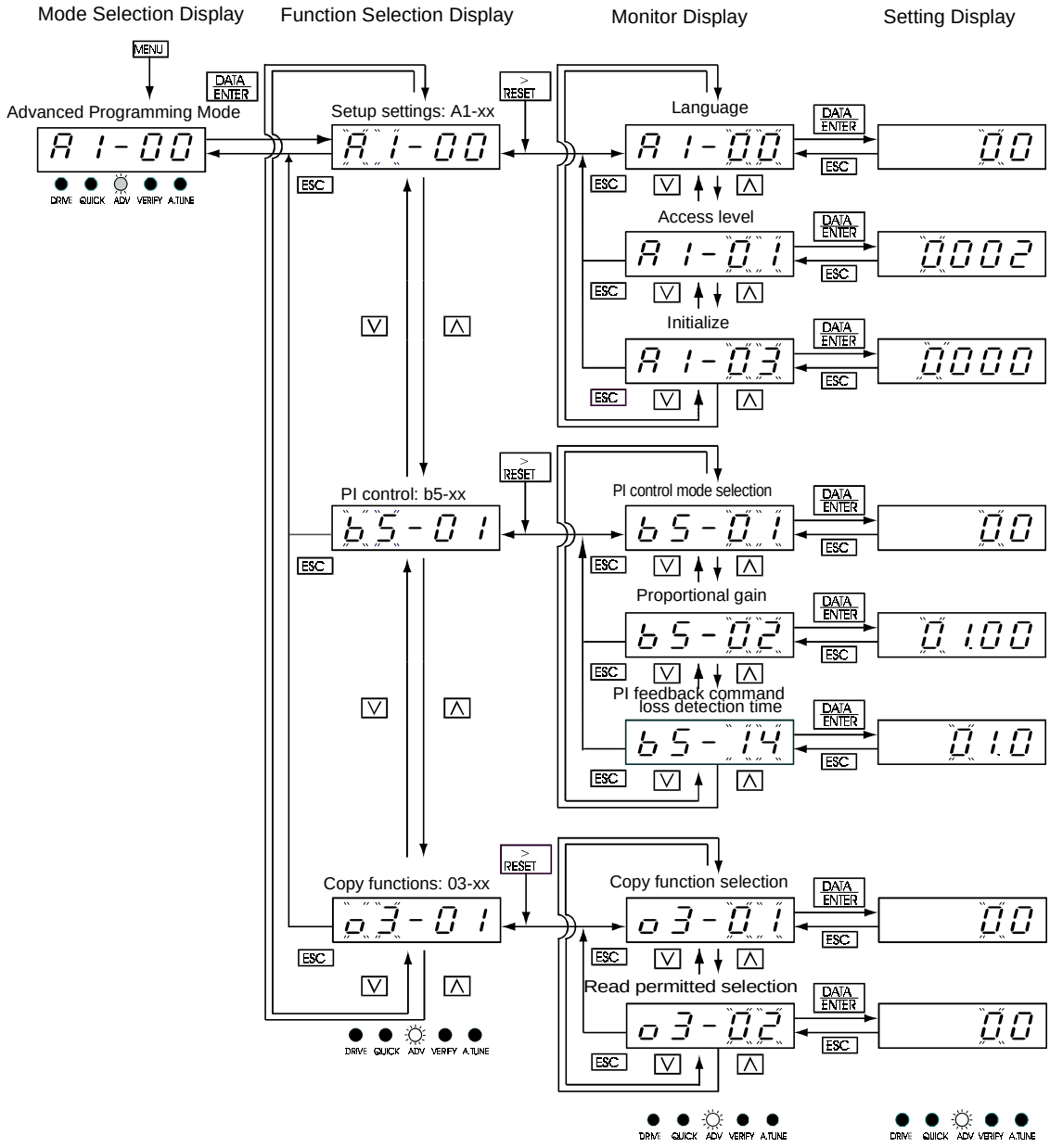
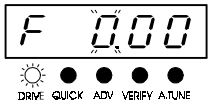
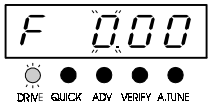
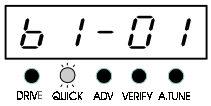
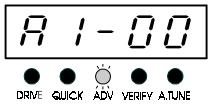
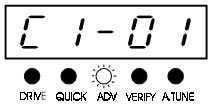
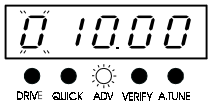
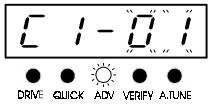


Fig 3.6 Operations in Advanced Programming Mode

■Setting User Constants

Here, the procedure is shown to change C1-01 (Acceleration Time 1) from 10 s to 20 s.

Table 3.3 Setting User Constants in Advanced Programming Mode

Step No.	Digital Operator Display	Description
1		Power supply turned ON.
2		MENU Key pressed to enter drive mode.
3		MENU Key pressed to enter quick programming mode.
4		MENU Key pressed to enter advanced programming mode.
5		DATA/ENTER pressed to access monitor display.
6		Increment or Decrement Key pressed to display C1-01 (Acceleration Time 1).
7		DATA/ENTER Key pressed to access setting display. The setting of C1-01 (10.00) is displayed.
8		Shift/RESET Key pressed to move the flashing digit to the right.
9		Increment Key pressed to change set value to 20.00 s.
10		DATA/ENTER Key pressed to enter the set data. “END” is displayed for 10 s and then the entered value is displayed for 0.5 s.
11		The monitor display for C1-01 returns.

◆ Verify Mode

Verify mode is used to display any constants that have been changed from their default settings in a programming mode or by autotuning. “None” will be displayed if no settings have been changed.

Even in verify mode, the same procedures can be used to change settings as they are used in the programming modes. Use the Increment, Decrement, and Shift/RESET keys to change the frequency. The user constant will be written and the monitor display will be returned to when the DATA/ENTER key is pressed after changing the setting.

■Example Operations

An example of key operations is given below for when the following settings have been changed from their default settings: b1-01 (Reference Selection), C1-01 (Acceleration Time 1), E1-01 (Input Voltage Setting), and E2-01 (Motor Rated Current).

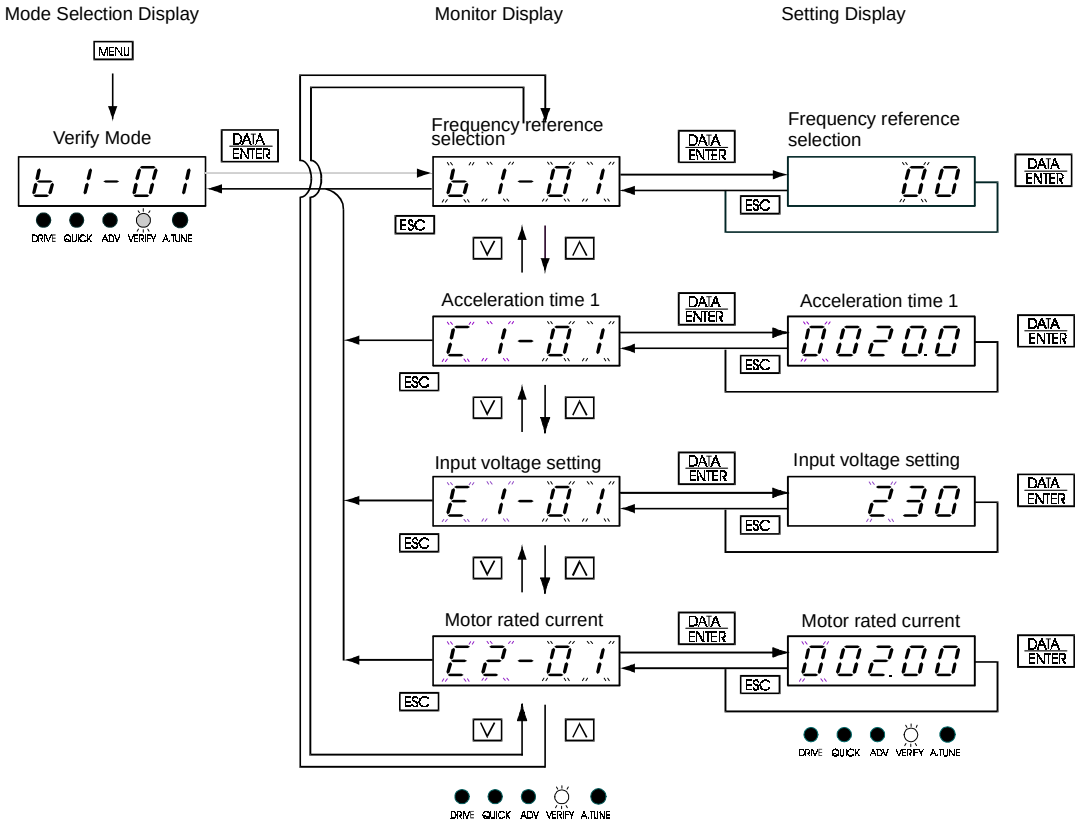


Fig 3.7 Operations in Verify Mode

◆ Autotuning Mode

Autotuning automatically tunes and sets the line-to-line resistance of the motor to achieve the best performance.

■Example of Operation

Set the motor output power (in kW) and rated current specified on the nameplate on the motor and then press the RUN key. The motor is automatically run and the motor line-to-line resistance measured based on these settings will be set.

Always set the above items. Autotuning cannot be started otherwise.

Constants can be changed from the setting displays. Use the Increment, Decrement, and Shift/RESET keys to change. The user constant will be written and the display will be returned to monitor display when the DATA/ENTER key is pressed after changing the setting.

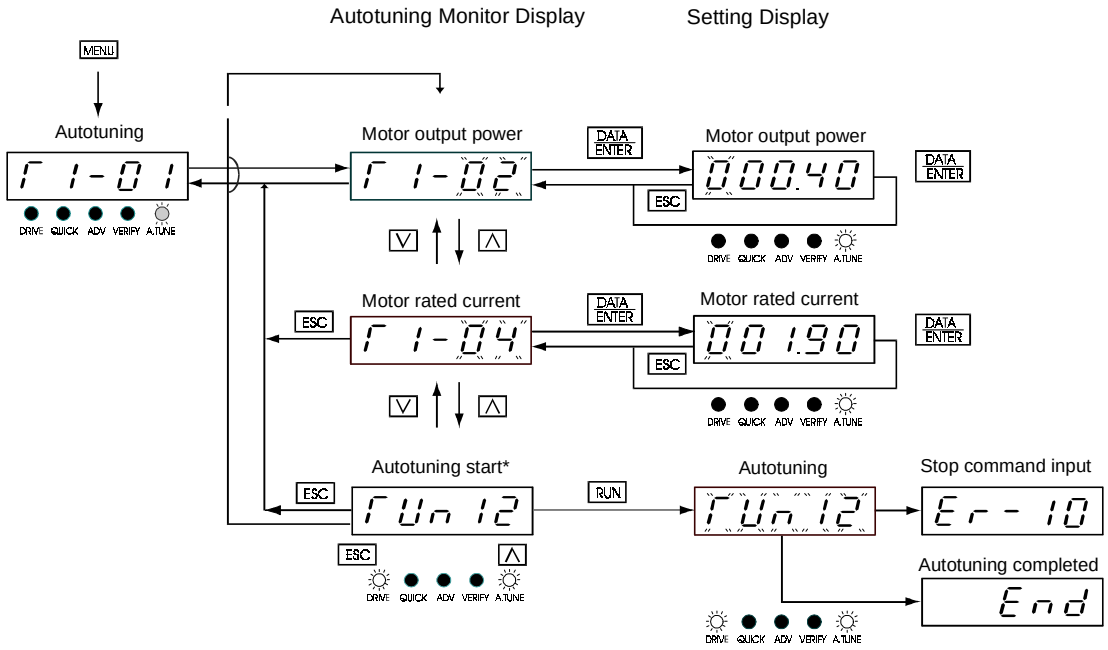


Fig 3.8 Operation in Autotuning Mode

IMPORTANT

If a fault occurs during autotuning, refer to *Chapter 7 Troubleshooting.*

4

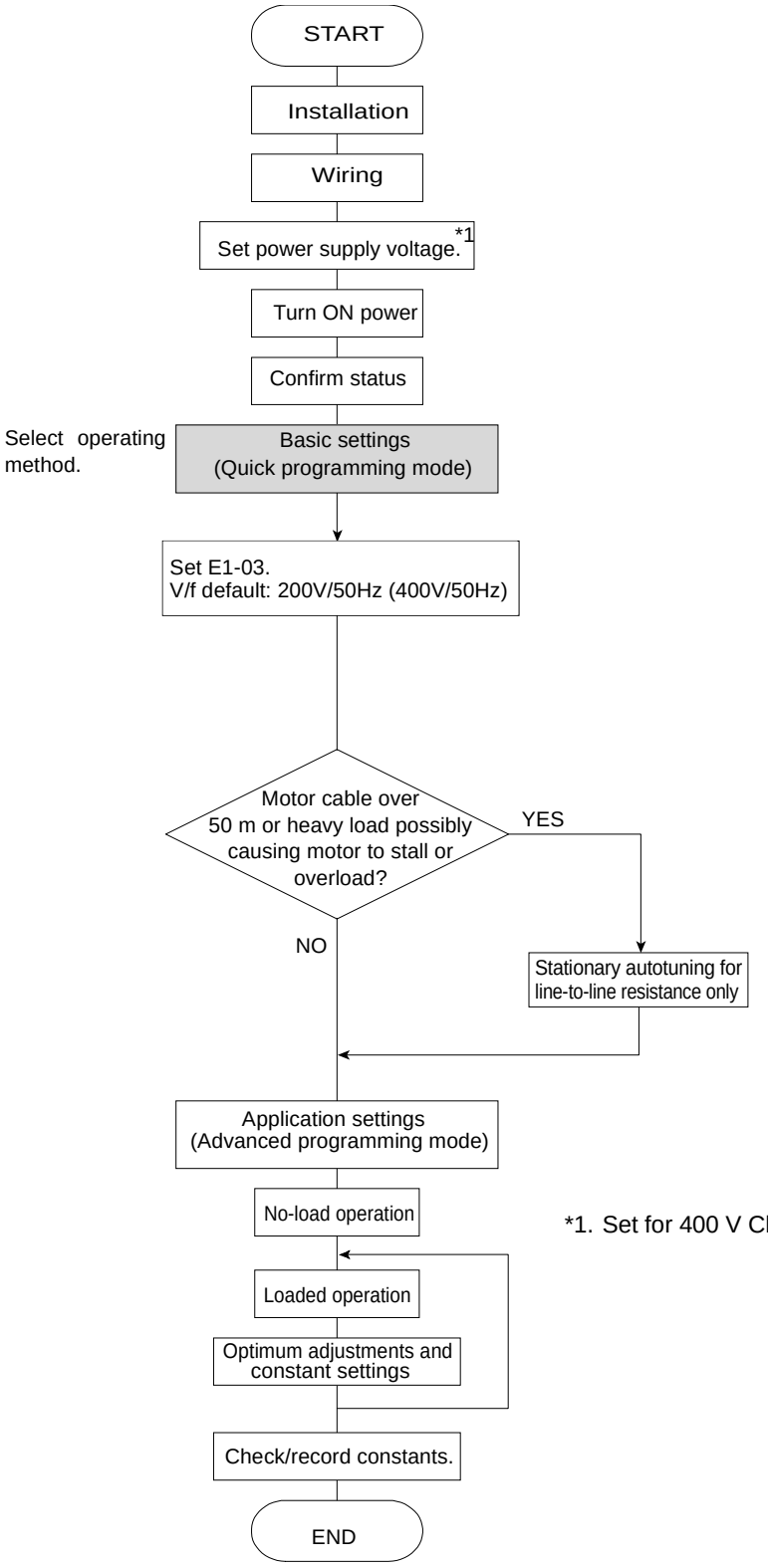
Trial Operation

This chapter describes the procedures for trial operation of the Inverter and provides an example of trial operation.

Trial Operation Procedure 4-2
Trial Operation Procedures 4-3
Adjustment Suggestions 4-11

Trial Operation Procedure

Perform trial operation according to the following flowchart.



*1. Set for 400 V Class Inverter for 75 kW or more.

Fig 4.1 Trial Operation Flowchart

Trial Operation Procedures

The procedure for the trial operate is described in order in this section.

◆ Application Confirmation

First, confirm the application before using the Inverter. The unit is designed for using with:

- Fan, blower, pump applications

◆ Setting the Power Supply Voltage Jumper (400 V Class Inverters of 75 kW or Higher)

Set the power supply voltage jumper after setting E1-01 (Input Voltage Setting) for 400 V Class Inverters of 75 kW or higher. Insert the jumper into the voltage connector nearest to the actual power supply voltage.

The jumper is factory-set to 440 V when shipped. If the power supply voltage is not 440 V, use the following procedure to change the setting.

1. Turn OFF the power supply and wait for at least 5 minutes.
2. Confirm that the CHARGE indicator has gone out.
3. Remove the terminal cover.
4. Insert the jumper at the position for the voltage supplied to the Inverter (see *Fig 4.2*).
5. Return the terminal cover to its original position.

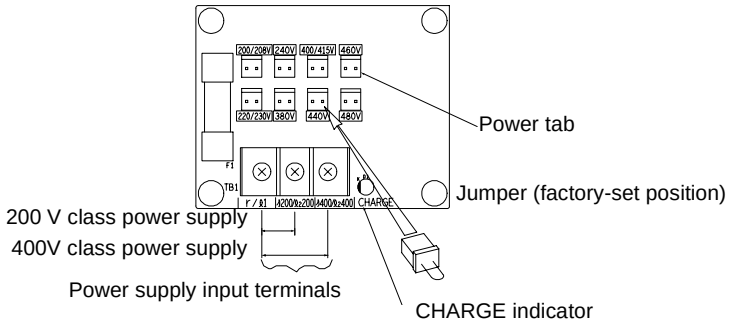


Fig 4.2 Large-capacity Inverter Connections

◆ Power ON

Confirm all of the following items and then turn ON the power supply.

- Check that the power supply is of the correct voltage.
  200 V class: 3-phase 200 to 240 VDC, 50/60 Hz
  400 V class: 3-phase 380 to 480 VDC, 50/60 Hz
- Make sure that the motor output terminals (U, V, W) and the motor are connected correctly.
- Make sure that the Inverter control circuit terminal and the control device are wired correctly.
- Set all Inverter control circuit terminals to OFF.
- Make sure that the motor is not connected to the mechanical system (no-load status)

◆ Checking the Display Status

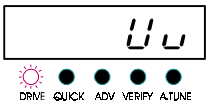
If the Digital Operator's display at the time the power is connected is normal, it will read as follows:

Display for normal operation

The frequency reference monitor is displayed in the data display section.

When an fault has occurred, the details of the fault will be displayed instead of the above display. In that case, refer to *Chapter 7 Troubleshooting*. The following display is an example of a display for faulty operation.

Display for fault operation



The display will differ depending on the type of fault.
A low voltage alarm is shown at left.

◆ Basic Settings

Switch to the quick programming mode (the QUICK indicator on the Digital Operation should be lit) and then set the following user constants.

Refer to *Chapter 3 Digital Operator and Modes* for Digital Operator operating procedures and to *Chapter 5 User Constants* and *Chapter 6 Constant Settings by Function* for details on the user constants.

Table 4.1 Basic Constant Settings

● : Must be set. O : Set as required.

Class	Constant Number	Name	Description	Setting Range	Factory Setting	Page
●	b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	5-9 6-4 6-43 6-52
●	b1-02	Operation method selection	Set the run command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	5-9 6-8 6-43 6-52
O	b1-03	Stopping method selection	Select stopping method when stop command is sent. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop 3: Coast to stop with timer	0 to 3	0	5-9 6-10
●	C1-01	Acceleration time 1	Set the acceleration time in seconds for the output frequency to climb from 0% to 100%.	0.0 to 6000.0	10.0 s	5-14 6-15
●	C1-02	Deceleration time 1	Set the deceleration time in seconds for the output frequency to fall from 100% to 0%.	0.0 to 6000.0	10.0 s	5-14 6-15
O	C6-02	Carrier frequency selection	The carrier frequency is set low if the motor cable is 50 m or longer or to reduce radio noise or leakage current.	0 to D, F	F	5-16
O	d1-01 to d1-04 and d1-17	Frequency references 1 to 4 and jog frequency reference	Set the required speed references for multi-step speed operation or jogging.	0 to 120.00 Hz	d1-01 to d1-04: 0.00 Hz d1-17: 6.00 Hz	5-17 6-6
●	E1-01	Input voltage setting	Set the Inverter's nominal input voltage in volts.	155 to 255 V (200 V class) 310 to 510 V (400 V class)	200 V (200 V class) 400 V (400 V class)	5-19 6-72

Table 4.1 Basic Constant Settings (Continued)

● : Must be set. O : Set as required.

Class	Constant Number	Name	Description	Setting Range	Factory Setting	Page
●	E2-01	Motor rated current	Set the motor rated current.	10% to 200% of Inverter's rated current	Setting for general-purpose motor of same capacity as Inverter	5-20 6-30 6-71
O	H4-02 and H4-05	FM and AM terminal output gain	Adjust when an instrument is connected to the FM or AM terminal.	0.00 to 2.50	H4-02: 1.00 H4-05: 0.50	5-24
●	L1-01	Motor protection selection	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General motor protection	0 or 1	1	5-26 6-30
O	L3-04	Stall prevention selection during deceleration	If using the dynamic brake option (Braking Resistor Units and Braking Units), be sure to set constant L3-04 to 0 (disabled).	0 to 2	1	5-28 6-19

◆ Selecting the V/f pattern

- Set either one of the fixed patterns (0 to D) in E1-03 (V/f Pattern Selection) or set F in E1-03 to specify a user-set pattern as required for the motor and load characteristics in E1-04 to E1-13 in advanced programming mode.

  Simple operaton of a general-pupose motor at 50 Hz: E1-03 = F (default) or 0
  If E1-03 = F, the default setting in the user setting from E1-04 to E1-13 are for 50 Hz

- Perform autotuning for the line-to-line resistance only if the motor cable is 50 m or longer for the actual installation or when the load causes stalling.

◆ Autotuning for Line-to-Line Resistance

Autotuning can be used to prevent control errors when the motor cable is long or the cable length has changed or when the motor and Inverter have different capacities.

To perform autotuning set parameters T1-02 and T1-04 and then press the RUN Key on the Digital Operator. The Inverter will supply power to the motor for approximately 20 seconds and the Motor Line-to-Line Resistance (E2-05) and cable resistance will be automatically measured

IMPORTANT

Power will be supplied to the motor when autotuning is performed even though the motor will not turn. Do not touch the motor until autotuning has been completed.

■ Constant Settings for Autotuning

The following constants must be set before autotuning.

Table 4.2 Constant Settings before Autotuning

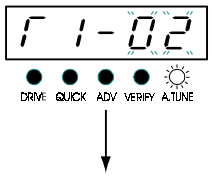
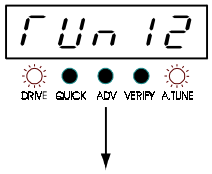
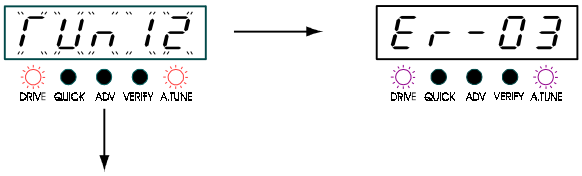
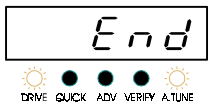
Constant Number	Name	Display	Setting Range	Factory Setting
T1-02	Motor output power	Set the output power of the motor in Kilowatts.*1	10% to 200% of Inverter rated output	Same as Inverter rated output
T1-04	Motor rated current	Set the rated current of the motor in Amps.*1	10% to 200% of Inverter rated current	Same as general-purpose motor with same capacity as Inverter

* 1. For a constant-output motor, set the value at the base speed.

■Digital Operator Displays during Autotuning

The following displays will appear on the Digital Operator during autotuning.

Table 4.3 Digital Operator Displays during Autotuning

Digital Operator Display	Description
Motor rated : T1-02 	The autotuning start display will appear when all settings through T1-04 have been completed. The A.TUNE and DRIVE indicators will be lit.
Autotuning started: TUn12 	Autotuning will start when the RUN Key is pressed from the autotuning start display.
Autotuning Stop command input 	If the STOP Key is pressed or a measurement error occurs during autotuning, and error message will be display and autotuning will be stopped. Refer to *Errors during Autotuning* on page 7-10.
Autotuning completed 	END will be displayed after approximately 1 to 2 minutes, indicating that autotuning has been completed.

◆ Application Settings

User constants are set as required in advanced programming mode (i.e., with the ADV indicator lit on the Digital Operator). All the constants that can be set in quick programming mode can also be displayed and set in advanced programming mode.

■Setting Examples

The following are examples of settings for applications.

- To prevent the machine from being operated in reverse, set b1-04 to 1 to disable reverse operation.
- To increase the speed of a 50 Hz motor by 10%, set E1-04 to 55.0 Hz.
- To use a 0 to 10-V analog signal for a 50 Hz motor for variable-speed operation between 0 and 45 Hz (0% to 90% speed deduction), set H3-02 to 90.0%.
- To control speed between 20% and 80% to ensure smooth gear operation and limit the maximum speed of the machine, set d2-01 to 80.0% and set d2-02 to 20.0%.

◆ No-load Operation

This section describes trial operation in which the motor is in no-load state, that means the machine is not connected to the motor. To avoid failures caused due to the wiring of the control circuit it's recommended to use the LOCAL mode. Press the LOCAL/REMOTE Key on the Digital Operator to change to LOCAL mode (the SEQ and REF indicators on the Digital Operator should be OFF).

Always confirm safety around the motor and machine before starting Inverter operation from the Digital Operator. Confirm that the motor works normally and that no errors are displayed at the Inverter. For applications, at which the machine only can be driven in one direction, check the motor rotation direction.

Jog Frequency Reference (d1-17, default: 6.00 Hz) can be started and stopped by pressing and releasing the JOG Key on the Digital Operator. If the external sequence prevent operation from the Digital Operator, confirm that emergency stop circuits and machine safety mechanisms are functioning, and then start operation in REMOTE mode (i.e., with a signal from the control signal terminals). The safety precautions must always be taken before starting the Inverter with the motor connected to the machine.

INFO

Both a RUN command (forward or reverse) and a frequency reference (or multi-step speed command) must be provided to start Inverter operation.
Input these commands and reference regardless of the operation method (i.e., LOCAL of REMOTE).

◆ Loaded Operation

■Connecting the Load

- After confirming that the motor has stopped completely, connect the mechanical system.
- Be sure to tighten all the screws when securing the motor shaft to the mechanical system.

■Operation using the Digital Operator

- Use the Digital Operator to start operation in LOCAL mode in the same way as in no-load operation.
- If fault occurs during operation, make sure the STOP Key on the Digital Operator is easily accessible.
- At first, set the frequency reference to a low speed of one tenth the normal operating speed.

■ Checking Operating Status

- Having checked that the operating direction is correct and that the machine is operating smoothly at slow speed, increase the frequency reference.
- After changing the frequency reference or the rotation direction, check that there is no oscillation or abnormal sound from the motor. Check the monitor display to ensure that U1-03 (Output Current) is not to high.
- Refer to *Adjustment Suggestions* on page 4-11 if hunting, vibration, or other problems originating in the control system occur.

◆ Check and Recording User Constants

Use verify mode (i.e., when the VERIFY indicator on the Digital Operator is lit) to check user constants that have been changed for trial operation and record them in a user constant table.

Any user constants that have been changed by autotuning will also be displayed in verify mode.

If required, the copy function in constants o3-01 and o3-02 displayed in advanced programming mode can be used to copy the changed settings from the Inverter to a recording area in the Digital Operator. If changed settings are saved in the Digital Operator, they can be easily copied back to the Inverter to speed up system recovery if for any reason the Inverter has to be replaced.

The following functions can also be used to manage user constants.

- Recording user constants
- Setting access levels for user constants
- Setting a password

■ Recording User Constants (o2-03)

If o2-03 is set to 1 after completing trial operation, the settings of user constants will be saved in a separate memory area in the Inverter. When the Inverter settings have been changed for any reason, the user constants can be initialized to the settings saved in the separate memory area by setting A1-03 (Initialize) to 1110.

■User Constant Access Levels (A1-01)

A1-01 can be set to 0 (monitoring-only) to prevent user constants from being changed. If A1-01 is set to 2 (factory setting) all parameters can be read or written.

■Password (A1-04 and A1-05)

When the access level is set to monitoring-only (A1-01 = 0), a password can be set so that user constants will be displayed only when the correct password is input.

Adjustment Suggestions

If hunting, vibration, or other problems originating in the control system occur during trial operation, adjust the constants listed in the following table according to the control method. This table lists only the most commonly used user constants.

Table 4.4 Adjusted User Constants

Name (Constant Number)	Performance	Factory Setting	Recommended Setting	Adjustment Method
Hunting-prevention gain (N1-02)	Controlling hunting and vibration in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Reduce the setting if torque is insufficient for heavy loads. • Increase the setting if hunting or vibration occurs for light loads.
Carrier frequency selection (C6-02)	• Reducing motor magnetic noise • Controlling hunting and vibration at low speeds	Depends on capacity	0 to default	• Increase the setting if motor magnetic noise is high. • Reduce the setting if hunting or vibration occurs at low to middle-range speeds.
Torque compensation primary delay time constant (C4-02)	• Increasing torque and speed response • Controlling hunting and vibration	Depends on capacity	200 to 1000 ms	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or vibration occurs.
Torque compensation gain (C4-01)	• Improving torque at low speeds (10 Hz or lower) • Controlling hunting and vibration	1.00	0.50 to 1.50	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if hunting or vibration occurs for light loads.
Middle output frequency voltage (E1-08) Minimum output frequency voltage (E1-10)	• Improving torque at low speeds • Controlling shock at startup	Depends on capacity and voltage	Default to Default + 3 to 5 V*	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if shock at startup is large.

* The setting is given for 200 V Class Inverters. Double the voltage for 400 V Class Inverters.

The following user constants will also affect the control system indirectly.

Table 4.5 Constants Affecting Control and Applications Indirectly

Name (Constant Number)	Application
Acceleration/deceleration times (C1-01 to C1-11)	Adjust torque during acceleration and deceleration.
S-curve characteristics (C2-01 and C2-02)	Used to prevent shock when completing acceleration.
Jump frequencies (d3-01 to d3-04)	Used to avoid resonance points during acceleration or deceleration.
Stall prevention (L3-01 to L3-06)	Used to prevent OV (overvoltage errors) and motor stalling for heavy loads or rapid acceleration/deceleration. Stall prevention is enabled by default and the setting normally has not to be changed. When using a braking resistor, however, disable stall prevention during deceleration by setting L3-04 to 0.

5

User Constants

This chapter describes all user constants that can be set in the Inverter.

User Constant Descriptions 5-2
Digital Operation Display Functions and Levels 5-3
User Constant Tables 5-7

User Constant Descriptions

This section describes the contents of the user constant tables.

◆ Description of User Constant Tables

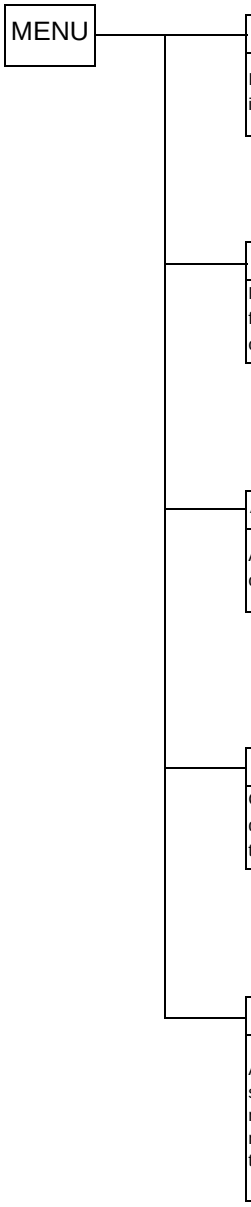
User constant tables are structured as shown below. Here, b1-01 (Frequency Reference Selection) is used as an example.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q	180H	-

- Constant Number: The number of the user constant.
- Name: The name of the user constant.
- Description: Details on the function or settings of the user constant.
- Setting Range: The setting range for the user constant.
- Factory Setting: The factory setting.
- Change during Operation: Indicates whether or not the constant can be changed while the Inverter is in operation.
  - Yes: Changes possible during operation.
  - No: Changes not possible during operation.
- Access Level: Indicates the access level in which the user constant can be monitored or set.
  - Q: Items which can be monitored and set in either quick programming mode or advanced programming mode.
  - A: Items which can be monitored and set only in advanced programming mode.
- MEMOBUS Register: The register number used for MEMOBUS communications.
- Page: Reference page for more detailed information about the constant.

Digital Operation Display Functions and Levels

The following figure shows the Digital Operator display hierarchy for the Inverter.



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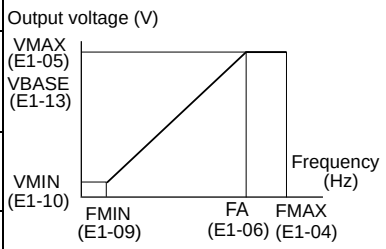
◆ User Constants Setable in Quick Programming Mode

The minimum user constants required for Inverter operation can be monitored and set in quick programming mode. The user constants displayed in quick programming mode are listed in the following table. These, and all other user constants, are also displayed in advanced programming mode.

Refer to the overview of modes on page 3-4 for an overview of quick programming mode.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q	180H
b1-02	Operation method selection	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q	181H
b1-03	Stopping method selection	Select stopping method when stop command is input. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop (Stops faster than coast to stop, without regenerative operation.) 3: Coast to stop with timer (Run commands are disregarded during deceleration time.)	0 to 3	0	No	Q	182H
C1-01	Acceleration time 1	Set the acceleration time in seconds for the output frequency to climb from 0% to 100%.	0.0 to 6000.0	10.0 s	Yes	Q	200H
C1-02	Deceleration time 1	Set the deceleration time in seconds for the output frequency to fall from 100% to 0%.			Yes	Q	201H
C6-02	Carrier frequency selection	Select carrier wave fixed pattern. Select F to enable detailed settings using constants C6-03 to C6-07.	1 to F	6 *1	No	Q	224H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
d1-01	Frequency reference 1	Set the frequency reference in the unit specified in o1-03 (frequency units for reference setting and monitor, default: Hz)	0 to 120.00	0.00 Hz	Yes	Q	280H
d1-02	Frequency reference 2	Frequency reference when multi-step speed command 1 is ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	281H
d1-03	Frequency reference 3	Frequency reference when multi-step speed command 2 is ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	282H
d1-04	Frequency reference 4	Frequency reference when multi-step speed command 1 and 2 are ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	283H
d1-17	Jog frequency reference	Frequency reference when multi-function inputs „Jog Frequency Command“, „FJOG command“, or „RJOG command“ is ON (unit: Set in o1-03).		6.00 Hz	Yes	Q	292H
E1-01	Input voltage setting	Set the Inverter input voltage in units of 1 volt. This set value will be the basis for the protection functions.	155 to 255 *2	200 V *2	No	Q	300H
E1-03	V/f pattern selection	0 to E: Select from 15 preset patterns. F: Custom user-set patterns (Applicable for setting E1-04 to E1-10).	0 to D, F	F	No	Q	302H
E1-04	Max. output frequency (FMAX)		40.0 to 120.0	50.0 Hz	No	Q	303H
E1-05	Max. voltage (VMAX)		0.0 to 255.0 *2	200.0 V *2	No	Q	304H
E1-06	Base frequency (FA)		0.0 to 120.0	50.0 Hz	No	Q	305H
E1-09	Min. output frequency (FMIN)		0.0 to 120.0	1.5 Hz	No	Q	308H
E1-13	Base voltage (VBASE)	Change this setting only when making advanced adjustments for V/f in the fixed outputs area. Normally, there is no need to make these settings.	0.0 to 255.0 *2	0.0 V *3	No	A	30CH
E2-01	Motor rated current	Set the motor rated current in Amps. This set value becomes the base value for motor protection, torque limit, and torque control. It is an input data for autotuning.	0.32 to 6.40 *5	1.90 A *4	No	Q	30EH
H4-02	Gain (terminal FM)	Set the voltage level gain for multi-function analog output 1. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. Voltage output from the terminals, however, have a 10 V max. meter calibration function.	0.00 to 2.50	1.00	Yes	Q	41EH

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
H4-05	Gain (terminal AM)	Set the voltage level gain for multi-function analog output 2.	0.00 to 2.50	0.50	Yes	Q	421H
L1-01	Motor protection selection	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General-purpose motor protection In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this constant is set to 1, protection may not be effective. When several motors are connected to one Inverter, set to 0 and ensure that each motor is equipped with a protection device.	0 or 1	1	No	Q	480H
L3-04	Stall prevention selection during deceleration	0: Disabled (Deceleration as set. If deceleration time is too short, a main circuit overvoltage may result.) 1: Enabled (Deceleration is stopped when the main circuit voltage exceeds the overvoltage level. Deceleration restarts when voltage is returned.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. Set deceleration time is disregarded.) When a braking option (Braking Resistor Unit and Braking Unit) is used, always set to 0.	0 to 2	1	No	Q	492H

* 1. The factory setting depends on the Inverter capacity.
* 2. These are values for a 200 V class Inverter. Values for a 400 V class Inverter are double.
* 3. After autotuning, E1-13 will contain the same value as E1-05.
* 4. The factory setting depends on the Inverter capacity. (The value for a 200 V Class Inverter for 0.4 kW is given.)
* 5. The setting range is from 10% to 200% of the Inverter rated output current. (The value for a 200 V Class Inverter for 0.4 kW is given.)

User Constant Tables

◆ A: Setup Settings

■ Initialize Mode: A1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
A1-00	Language selection for Digital Operator display	Used to select the language displayed on the Digital LCD Operator (JVOP-160). 0: English 1: Japanese This constant is not initialized by the initialize operation.	0 or 1	1	Yes	A	100H	–
A1-01	Constant access level	Used to set the constant access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 2: Advanced (Constants can be read and set in both, quick programming mode (Q) and advanced programming (A) mode.)	0 or 2	2	Yes	A	101H	6-84 6-112
A1-03	Initialize	Used to initialize the constants using the specified method. 0: No initializing 1110: Initializes using the User constants 2220: Initializes using a two-wire sequence. (Initializes to the factory setting.) 3330: Initializes using a three-wire sequence.	0 to 3330	0	No	A	103H	–
A1-04	Password	Password input when a password has been set in A1-05. This function write-protects some constants of the initialize mode. If the password is changed, A1-01 to A1-03 constants can no longer be changed. (Programming mode constants can be changed.)	0 to 9999	0	No	A	104H	6-84

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
A1-05	Password setting	Used to set a four digit number as the password. This constant usually is not displayed. When the Password (A1-04) is displayed, hold down the RESET Key and press the Menu Key and A1-05 will be displayed.	0 to 9999	0	No	A	105H	6-84

◆ Application Constants: b

■Operation Mode Selections: b1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q	180H	4-5 6-4 6-43 6-52
b1-02	Operation method selection	Set the run command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q	181H	4-5 6-8 6-43 6-52
b1-03	Stopping method selection	Used to set the stopping method used when a stop command is input. 0: Deceleration to stop 1: Coast to stop 2: DC injection braking stop (Stops faster than coast to stop, no regenerative operation.) 3: Coast to stop with timer (Run commands are disregarded during deceleration.)	0 to 3	0	No	Q	182H	4-5 6-10
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled	0 to 1	0	No	A	183H	6-33
b1-07	Operation selection after switching to remote mode	Used to set the operation mode by switching to the Remote mode using the Local/Remote Key. 0: Run signals that are input during mode switching are disregarded. (Input Run signals after switching the mode.) 1: Run signals become effective immediately after switching to the Remote mode.	0 or 1	0	No	A	186H	-

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b1-08	Run command selection in programming modes	Used to set an operation interlock in programming modes. 0: Cannot operate. 1: Can operate (Disabled when Digital Operator is set to select run command (when b1-02 = 0)).	0 or 1	0	No	A	187H	-

■DC Injection Braking: b2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b2-01	Zero speed level (DC injection braking starting frequency)	Used to set the frequency at which DC injection braking starts in units of Hz when deceleration to stop is selected. When b2-01 is less than E1-09, E1-09 becomes the DC injection braking starting frequency.	0.0 to 10.0	0.5 Hz	No	A	189H	6-10
b2-02	DC injection braking current	Sets the DC injection braking current as a percentage of the Inverter rated current.	0 to 100	50%	No	A	18AH	6-10 6-13
b2-03	DC injection braking time at start	Used to set the time to perform DC injection braking at start in units of 1 second. Used to stop coasting motor and restart it. When the set value is 0, DC injection braking at start is not performed.	0.00 to 10.00	0.00 s	No	A	18BH	6-13
b2-04	DC injection braking time at stop	Used to set the time to perform DC injection braking at stop in units of 1 second. Used to prevent coasting after the stop command is input. When the set value is 0.00, DC injection braking at stop is not performed.	0.00 to 10.00	0.50 s	No	A	18CH	6-10

■Speed Search: b3

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access level	MEMOBUS Register	Page
b3-01	Speed search selection (current detection or speed calculation)	Enables/disables the speed search function for the RUN command and sets the speed search method. 0:Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation: When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection: The speed search is started from the frequency when power was momentarily lost and the maximum frequency, and the speed is detected at the search current level.	0 to 3	2	No	A	191H	6-35
b3-02	Speed search operating current (current detection)	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Not usually necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%	No	A	192H	6-35
b3-03	Speed search deceleration time (current detection)	Sets the output frequency deceleration time during speed search in 1-second units. Set the time for deceleration from the maximum output frequency to the minimum output frequency.	0.1 to 10.0	2.0 s	No	A	193H	6-35
b3-05	Speed search wait time (current detection or speed calculation)	Sets the contactor operating delay time when there is a contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	0.2 s	No	A	195H	6-35

■PI Control: b5

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b5-01	PI control mode selection	0: Disabled 1: Enabled	0 to 1	0	No	A	1A5H	6-64
b5-02	Proportional gain (P)	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	1A6H	6-64
b5-03	Integral (I) time	Sets I-control integral time in 1-second units. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A	1A7H	6-64
b5-04	Integral (I) limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	1A8H	6-64
b5-06	PI limit	Sets the limit after PI-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	1AAH	6-64
b5-07	PI offset adjustment	Sets the offset after PI-control as a percentage of the maximum output frequency.	-100.0 to +100.0	0.0%	Yes	A	1ABH	6-64
b5-08	PI primary delay time constant	Sets the time constant for low pass filter for PI-control outputs in 1-second units. Usually not necessary to set.	0.00 to 10.00	0.00 s	Yes	A	1ACH	6-64
b5-12	Selection of PI feedback command loss detection	0: No detection of loss of PI feedback. 1: Detection of loss of PI feedback. Operation continues during detection, with the malfunctioning contact not operating. 2: Detection of loss of PI feedback. Coasts to stop during detection, and fault contact operates.	0 to 2	0	No	A	1B0H	6-64
b5-13	PI feedback command loss detection level	Sets the PI feedback loss detection level as a percent units, with the maximum output frequency at 100%.	0 to 100	0%	No	A	1B1H	6-64
b5-14	PI feedback command loss detection time	Sets the PI feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A	1B2H	6-64
b5-15	PI sleep function operation level	Set the PI sleep function start level as a frequency.	0.0 to 120.0	0.0 Hz	No	A	1B3H	6-64

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b5-16	PI sleep operation delay time	Set the delay time until the PI sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	A	1B4H	6-64
b5-17	Accel/decel time for PI reference	Set the accel/decel time for PI reference in seconds.	0.0 to 25.5	0.0 s	No	A	1B5H	6-64

■Energy Saving: b8

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b8-01	Energy-saving mode selection	Select whether to enable or disable energy-saving control. 0: Disable 1: Enable	0 or 1	0	No	A	1CCH	–
b8-04	Energy-saving coefficient	Set the motor rated capacity in E2-11, and adjust the value by 5% at a time until output power reaches a minimum value.	0.0 to 655.00 *1	*2	No	A	1CFH	–
b8-05	Power detection filter time constant	Set the time constant for output power detection.	0 to 2000	20 ms	No	A	1D0H	–
b8-06	Search operation voltage limiter	Set the limit value of the voltage control range during search operation. Set to 0 to disable the search operation. 100% is the motor base voltage.	0 to 100	0%	No	A	1D1H	–

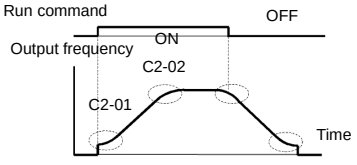
* 1. The same capacity as the Inverter will be set by initializing the constants.
* 2. The factory settings depend on the Inverter capacity.

◆ Autotuning Constants: C

■Acceleration/Deceleration: C1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
C1-01	Acceleration time 1	Sets the acceleration time to accelerate from 0 to the maximum output frequency.	0.0 to 6000.0	10.0 s	Yes	Q	200H	4-5 6-15
C1-02	Deceleration time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0.			Yes	Q	201H	4-5 6-15
C1-03	Acceleration time 2	The acceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	202H	6-15
C1-04	Deceleration time 2	The deceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	203H	6-15
C1-09	Emergency stop time	The deceleration time when the multi-function input “Emergency (fast) stop” is set to ON.			No	A	208H	6-14
C1-11	Accel/decel time switching frequency	Sets the frequency for automatic acceleration/deceleration switching. Below set frequency: Accel/decel time 2 Above set frequency: Accel/decel time 1 The multi-function input “accel/decel time 1” or “accel/decel time 2” has priority.	0.0 to 120.0	0.0 Hz	No	A	20AH	-

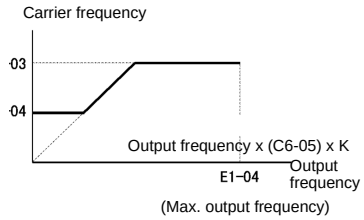
■S-curve Acceleration/Deceleration: C2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
C2-01	S-curve characteristic time at acceleration start	When the S-curve characteristic time is set, the accel/decel times will increase by only half of the S-curve characteristic times at start and end.  The S-curve characteristic time at start and end of deceleration is fixed to 0.2 sec and can not be changed.	0.00 to 2.50	0.20 s	No	A	20BH	-
C2-02	S-curve characteristic time at acceleration end		0.00 to 2.50	0.20 s	No	A	20CH	-

■Torque Compensation: C4

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
C4-01	Torque compensation gain	Sets torque compensation gain as a ratio. Usually setting is not necessary. Adjust in the following circumstances: • When the cable is long; increase the set value. • When the motor capacity is smaller than the Inverter capacity (Max. applicable motor capacity), increase the set values. • When the motor is oscillating, decrease the set values. Adjust the output current range at minimum speed rotation so that it does not exceed the Inverter rated output current.	0.00 to 2.50	1.00	Yes	A	215H	4-11 6-25
C4-02	Torque compensation primary delay time constant	The torque compensation delay time is set in ms units. Usually setting is not necessary. Adjust in the following circumstances: • When the motor is oscillating, increase the set values. • When the responsiveness of the motor is low, decrease the set values.	0 to 10000	200 ms	No	A	216H	4-11 6-25

■Carrier Frequency: C6

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
C6-02	Carrier frequency selection	Select carrier wave fixed pattern. Select F to enable detailed settings using constants C6-03 to C6-05. 1: Carrier 2.0 kHz 2: Carrier 5.0 kHz 3: Carrier 8.0 kHz 4: Carrier 10.0 kHz 5. Carrier 12.5 kHz 6: Carrier 15.0 kHz F: User set *1	1 to F	6 *1	No	Q	224H	4-5 4-11 6-2
C6-03	Carrier frequency upper limit	Set the carrier frequency upper limit and lower limit in kHz units. The carrier frequency gain is set as follows:  K is a coefficient that depends on the setting of 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	2.0 to 15.0 *2 *3	15.0 kHz *1	No	A	225H	-
C6-04	Carrier frequency lower limit		0.4 to 15.0 *2 *3	15.0 kHz *1	No	A	226H	-
C6-05	Carrier frequency proportional gain		00 to 99 *3	00	No	A	227H	-

* 1. The factory setting depends on the capacity of the Inverter.
* 2. The setting range depends on the capacity of the Inverter.
* 3. This constant can be monitored or set only when F is set for C6-02.

◆ Reference Constants: d

■Preset Reference: d1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
d1-01	Frequency reference 1	Sets the frequency reference in the units used in o1-03.	0 to 120.00	0.00 Hz	Yes	Q	280H	4-6 6-6
d1-02	Frequency reference 2	The frequency reference when multi-step speed command 1 is ON for a multi-function input.		0.00 Hz	Yes	Q	281H	4-6 6-6
d1-03	Frequency reference 3	The frequency reference when multi-step speed command 2 is ON for a multi-function input.		0.00 Hz	Yes	Q	282H	4-6 6-6
d1-04	Frequency reference 4	The frequency reference when multi-step speed commands 1 and 2 are ON for multi-function inputs.		0.00 Hz	Yes	Q	283H	4-6 6-6
d1-17	Jog frequency reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.		6.00 Hz	Yes	Q	292H	4-5 6-46

Note The unit is set in o1-03 (frequency units of reference setting and monitor, default: 0.01 Hz).

■Reference Limits: d2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
d2-01	Frequency reference upper limit	Set the output frequency upper limit as a percentage of the max. output frequency.	0.0 to 110.0	100.0%	No	A	289H	6-24 6-63
d2-02	Frequency reference lower limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	28AH	6-24 6-63
d2-03	Master speed reference lower limit	Set the master speed reference lower limit as a percentage of the max. output frequency.	0.0 to 110.0	0.0%	No	A	293H	6-24 6-63

■Jump Frequencies: d3

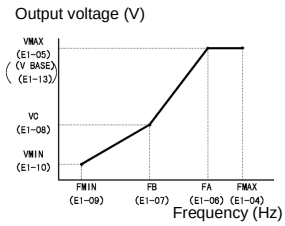
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
d3-01	Jump frequency 1	Set the center values of the jump frequencies in Hz. This function is disabled by setting the jump frequency to 0 Hz. Always ensure that the following applies: d3-01 ≥ d3-02 ≥ d3-03 Operation in the jump frequency range is prohibited but during acceleration and deceleration, the speed changes smoothly without jumping	0.0 to 120.0	0.0 Hz	No	A	294H	6-22
d3-02	Jump frequency 2			0.0 Hz	No	A	295H	6-22
d3-03	Jump frequency 3			0.0 Hz	No	A	296H	6-22
d3-04	Jump frequency width	Sets the jump frequency bandwidth in Hz. The jump frequency range will be the jump frequency ± d3-04.	0.0 to 20.0	1.0 Hz	No	A	297H	6-22

■Field Weakening: d6

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
d6-01	Field weakening level	Set the Inverter output voltage when the field weakening command is input. It is enabled when the field weakening command is set for a multi-function input. Set the level as a percentage taking the voltage set in the V/f pattern as 100%.	0 to 100	80%	No	A	2A0H	-
d6-02	Field frequency	Set the lower limit in Hertz of the frequency range where field control is valid. The field weakening command is valid only at frequencies above this setting and only when the speed is in agreement with the current speed reference.	0.0 to 120.0	0.0 Hz	No	A	2A1H	-

◆ Motor Constant Constants: E

■V/f Pattern: E1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
E1-01	Input voltage setting	Sets the Inverter input voltage. This setting is used as a reference value in protection functions.	155 to 255 *1	200 V *1	No	Q	300H	4-5 6-72
E1-03	V/f pattern selection	0 to D: Select from the 14 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10.)	0 to D, F	F	No	Q	302H	6-72
E1-04	Max. output frequency	 To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 120.0	50.0 Hz	No	Q	303H	6-72
E1-05	Max. voltage		0.0 to 255.0 *1	200.0 V *1	No	Q	304H	6-72
E1-06	Base frequency		0.0 to 120.0	50.0 Hz	No	Q	305H	6-72
E1-07	Mid. output frequency		0.0 to 120.0	3.0 Hz	No	A	306H	6-72
E1-08	Mid. output frequency voltage		0.0 to 255 *1	15.0 V *1	No	A	307H	4-15 6-72
E1-09	Min. output frequency		0.0 to 120.0	1.3 Hz	No	Q	308H	6-72
E1-10	Min. output frequency voltage		0.0 to 255.0 *1	9.0 V *1	No	A	309H	4-11 4-15 6-72
E1-11	Mid. output frequency 2	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 120.0	0.0 Hz *2	No	A	30AH	6-72
E1-12	Mid. output frequency voltage 2		0.0 to 255.0 *1	0.0 V *2	No	A	30BH	6-72
E1-13	Base voltage		0.0 to 255.0 *1	0.0 V *3	No	A	30CH	6-72

* 1. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.
* 2. E1-11 and E1-12 are disregarded when set to 0.0.
* 3. E1-13 is set to the same value as E1-05 by autotuning.

■Motor Setup: E2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
E2-01	Motor rated current	Sets the motor rated current. These set values will become the reference values for motor protection, torque limits and torque control. This constant is an input data for autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	30EH	6-30 6-71
E2-05	Motor line-to-line resistance	Sets the motor phase-to-phase resistance in Ω units. This constant is automatically set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	312H	6-71

* 1. The factory setting depends upon the Inverter capacity. The value for a 200 V class Inverter of 0.4 kW is given.
* 2. The setting range is 10% to 200% of the Inverter's rated output current. The value for a 200 V class Inverter of 0.4 kW is given.

◆ Option Constants: F

■Communications Option Cards: F6

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
F6-01	Operation selection after communications error	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	1	No	A	3A2H	-
F6-02	Input level of external error from Communications Option Card	0: Always detect 1: Detect during operation	0 or 1	0	No	A	3A3H	-
F6-03	Stopping method for external error from Communications Option Card	0: Deceleration stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	1	No	A	3A4H	-
F6-05	Current monitor unit selection	Sets the unit of current monitor 0: Ampere 1: 100%/8192	0 or 1	1	No	A	3A6H	-

◆ Terminal Function Constants: H

■Multi-function Contact Inputs: H1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H1-01	Terminal S3 function selection	Multi-function contact input 1	0 to 77	24	No	A	400H	-
H1-02	Terminal S4 function selection	Multi-function contact input 2	0 to 77	14	No	A	401H	-
H1-03	Terminal S5 function selection	Multi-function contact input 3	0 to 77	3 (0)*	No	A	402H	-
H1-04	Terminal S6 function selection	Multi-function contact input 4	0 to 77	4 (3)*	No	A	403H	-
H1-05	Terminal S7 function selection	Multi-function contact input 5	0 to 77	6 (4)*	No	A	404H	-

* The values in parentheses indicate initial values when initialized in 3-wire sequence.

Multi-function Contact Input Functions

Setting Value	Function	Page
0	3-wire sequence (Forward/Reverse Run command)	6-9
1	Local/Remote selection (ON: Operator, OFF: Constant setting)	6-43
2	Option/Inverter selection (ON: Option Card)	6-46
3	Multi-step speed reference 1 When H3-05 is set to 0, this function is combined with the master/auxiliary speed switch.	6-6
4	Multi-step speed reference 2	6-6
6	Jog frequency command (higher priority than multi-step speed reference)	6-6
7	Accel/decel time 1	6-19
8	External baseblock NO (NO contact: Baseblock at ON)	6-44
9	External baseblock NC (NC contact: Baseblock at OFF)	6-44
F	Not used (Set when a terminal is not used)	-
12	FJOG command (ON: Forward run at jog frequency d1-17)	6-46
14	Fault reset (Reset when turned ON)	7-2
19	PI control disable (ON: PI control disabled)	6-65
1B	Constants write enable (ON: All constants can be written-in. OFF: All constants other than frequency monitor are write protected.)	6-84
1E	Analog frequency reference sample/hold	6-45
20 to 2F	External fault (Desired settings possible) Input mode: NO contact/NC contact, Detection mode: Normal/during operation	6-47
34	PI soft starter	6-65

Set-ting Value	Function	Page
61	External search command 1 (ON: Speed search from maximum output frequency)	6-36
62	External search command 2 (ON: Speed search from set frequency)	6-36
64	External speed search command 3	-
67	Communications test mode	6-62
68	High-slip braking (HSB)	-
69	Jog Frequency 2	–
6A	Drive enable	–

■ Multi-function Contact Outputs: H2

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	MEMO-BUS Register	Page
H2-01	Terminal M1-M2 function selection	Multi-function contact output 1	0 to 37	0	No	A	40BH	-
H2-02	Terminal M3-M4 function selection	Multi-function contact output 2	0 to 37	1	No	A	40CH	-

Multi-function Contact Output Functions

Set-ting Value	Function	Page
0	During run (ON: run command is ON or voltage is being output)	-
1	Zero-speed	-
2	Frequency agree 1 (L4-02 used.)	-
3	Desired frequency agree 1 (ON: Output frequency = ±L4-01, L4-02 used and during frequency agree)	-
4	Frequency (FOUT) detection 1 (ON: +L4-01 ≥ output frequency ≥ -L4-01, L4-02 used)	-
5	Frequency (FOUT) detection 2 (ON: Output frequency ≥ +L4-01 or output frequency ≤ -L4-01, L4-02 used)	-
6	Inverter operation ready READY: After initialization, no faults	-
7	During DC bus undervoltage (UV) detection	-
8	During baseblock (ON: during baseblock)	-
9	Frequency reference selection (ON: Frequency reference from Operator)	-
A	Run command selection status (ON: Run command from Operator)	-
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/undertorque detection at ON)	6-28
C	Loss of frequency reference (Effective when 1 is set for L4-05)	6-40
E	Fault (ON: Digital Operator communications error or fault other than CPF00 and CPF01 has occurred.)	-
F	Not used. (Set when the terminals are not used.)	-

Setting Value	Function	Page
10	Minor fault (ON: Alarm displayed)	-
11	Fault reset command active	-
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at OFF)	6-28
1E	Restart enabled (ON: Restart enabled)	6-41
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	6-30
38	Drive enabled	–

■Analog Inputs: H3

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H3-02	Gain (terminal A1)	Sets the frequency when 10 V is input, as a percentage of the maximum output frequency.	0.0 to 1000.0	100.0%	Yes	A	411H	6-20
H3-03	Bias (terminal A1)	Sets the frequency when 0 V is input, as a percentage of the maximum frequency.	-100.0 to +100.0	0.0%	Yes	A	412H	6-20
H3-08	Multi-function analog input terminal A2 signal level selection	0: Limit negative frequency settings for gain and bias settings to 0. 2: 4 to 20 mA (9-bit input). Switch current and voltage input using the switch S1 on the control panel.	0 or 2	2	No	A	417H	6-20
H3-09	Multi-function analog input terminal A2 function selection	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	418H	6-20
H3-10	Gain (terminal A2)	Sets the input gain (level) when terminal 14 is 10 V (20 mA). Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	419H	6-20
H3-11	Bias (terminal A2)	Sets the input gain (level) when terminal 14 is 0 V (4 mA). Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	41AH	6-20
H3-13	Terminal A1/A2 switching	0: Use terminal A1 analog input as main speed frequency reference. 1: Use terminal A2 analog input as main speed frequency reference. Effective when H3-09 is set to 2.	0 or 1	0	No	A	41CH	-

H3-09 Settings

Set-ting Value	Function	Contents (100%)	Page
0	Frequency bias (Add to terminal A1)	Maximum output frequency	6-26
2	Auxiliary frequency reference (2nd step analog)	Maximum output frequency	6-21
B	PI feedback	Maximum output frequency	6-65
E	Motor temperature input	10 V = 100%	6-33
1F	Analog input not used.	-	

■Multi-function Analog Outputs: H4

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	MEMO-BUS Register	Page
H4-01	Monitor selection (terminal FM)	Sets the number of the monitor item to be output (U1-□□) from terminal FM. 10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	2	No	A	41DH	6-48
H4-02	Gain (termi-nal FM)	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibra-tion function is available.	0 to 1000.0 %	100%	Yes	Q	41EH	4-6 6-48
H4-03	Bias (termi-nal FM)	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a per-centage of 10 V. The maximum output from the terminal is 10 V. A meter calibra-tion function is available.	-110 to +110%	0.0%	Yes	A	41FH	4-6
H4-04	Monitor selection (terminal AM)	Sets the number of the monitor item to be output (U1-□□) from terminal AM. 10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	3	No	A	420H	4-6 6-48
H4-05	Gain (termi-nal AM)	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maxi-mum output from the terminal is 10 V. A meter calibration func-tion is available.	0 to 1000.0 %	50.0%	Yes	Q	421H	4-6 6-48

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H4-06	Bias (terminal AM)	Sets the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110.0 to +110.0 %	0.0%	Yes	A	422H	-
H4-07	Analog output 1 signal level selection	Sets the signal output level for multi-function output 1 (terminal FM) 0: 0 to +10 V output 2: 4 – 20 mA*	0 or 2	0	No	A	423H	-
H4-08	Analog output 2 signal level selection	Sets the signal output level for multi-function output 2 (terminal AM) 0: 0 to +10 V output 2: 4 – 20 mA*	0 or 2	0	No	A	424H	-

* An analog output of 4 - 20 mA can not be used with the standard terminal board. Therefore an optional terminal board (with shunt connector CN15) is needed.

■MEMOBUS Communications: H5

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H5-01	Station address	Set the Inverter's node address.	0 to 20 *	1F	No	A	425H	6-52
H5-02	Communication speed selection	Set the baud rate for 6CN MEMOBUS communications. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	426H	6-52
H5-03	Communication parity selection	Set the parity for 6CN MEMOBUS communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	427H	6-52
H5-04	Stopping method after communication error	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	3	No	A	428H	6-52
H5-05	Communication error detection selection	Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect. 1: Detect	0 or 1*	1	No	A	429H	6-52

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H5-06	Send wait time	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	42AH	6-52
H5-07	RTS control ON/OFF	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	42BH	6-52

* Set H5-01 to 0 to disable Inverter responses to MEMOBUS communications.

◆ Protection Function Constants: L

■Motor Overload: L1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L1-01	Motor protection selection	Sets whether the motor overload function is enabled or disabled at electric thermal overload relay. 0: Disabled 1: General-purpose motor protection In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this constant is set to 1, protection may not be effective.	0 or 1	1	No	Q	480H	4-6 6-30
L1-02	Motor protection time constant	Sets the electric thermal detection time in seconds units. Usually changing this setting is not necessary. The factory setting is 150% overload for one minute. When the motor's overload resistance is known, also set the overload resistance protection time for when the motor is hot started.	0.1 to 5.0	1.0 min	No	A	481H	6-30
L1-03	Alarm operation selection during motor overheating	Set H3-09 to E and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level (1.17 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09. 3: Continue operation (OH3 on the Operator flashes).	0 to 3	3	No	A	482H	6-32

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L1-04	Motor overheating operation selection	Set H3-09 to E and select the operation when the motor temperature (thermistor) input exceeds the operation detection level (2.34 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09.	0 to 2	1	No	A	483H	6-32
L1-05	Motor temperature input filter time constant	Set H3-09 to E and set the primary delay time constant for motor temperature (thermistor) inputs in seconds.	0.00 to 10.00	0.20 s	No	A	484H	6-32

■Power Loss Ridethrough: L2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L2-01	Momentary power loss detection	0: Disabled (main circuit undervoltage (UV) detection) 1: Enabled (Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit undervoltage detection.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect main circuit undervoltage.)	0 to 2	0	No	A	485H	6-34
L2-02	Momentary power loss ridethru time	Ridethrough time, when Momentary Power Loss Selection (L2-01) is set to 1, in units of seconds.	0 to 2.0	0.1 s *	No	A	486H	6-34
L2-03	Min. baseblock time	Sets the Inverter's minimum baseblock time, when the Inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times the motor secondary circuit time constant. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s *1	No	A	487H	6-34 6-35
L2-04	Voltage recovery time	Sets the time required to return the Inverter output voltage to normal voltage at the completion of a speed search. Sets the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s *1	No	A	488H	6-34 6-35

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L2-05	Undervoltage detection level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage). Usually changing this setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	A	489H	6-34

* 1. The factory setting depends upon the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

* 2. These are values for a 200 V class Inverter. Value for a 400 V class Inverter is double.

■Stall Prevention: L3

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L3-01	Stall prevention selection during accel	0: Disabled (Acceleration as set. With a heavy load, the motor may stall.) 1: Enabled (Acceleration stopped when L3-02 level is exceeded. Acceleration starts again when the current is returned.) 2: Intelligent acceleration mode (Using the L3-02 level as a basis, acceleration is automatically adjusted. Set acceleration time is disregarded.)	0 to 2	1	No	A	48FH	6-17
L3-02	Stall prevention level during accel	Effective when L3-01 is set to 1 or 2. Set as a percentage of Inverter rated current. Usually changing this setting is not necessary. The factory setting reduces the set values when the motor stalls.	0 to 200	120%	No	A	490H	6-17
L3-04	Stall prevention selection during decel	0: Disabled (Deceleration as set. If deceleration time is too short, a DC-Bus overvoltage may result.) 1: Enabled (Deceleration is stopped when the DC-Bus voltage exceeds the overvoltage level. Deceleration restarts when voltage is returned.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. Set deceleration time is disregarded.) When a braking option (Braking Resistor Unit and Braking Unit) is used, always set to 0.	0 to 2	1	No	Q	492H	4-6 6-19

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L3-05	Stall prevention selection during running	0: Disabled (Runs as set. With a heavy load, the motor may stall.) 1: Deceleration time 1 (the deceleration time for the stall prevention function is C1-02.) 2: Deceleration time 2 (the deceleration time for the stall prevention function is C1-04.)	0 to 2	1	No	A	493H	6-27
L3-06	Stall prevention level during running	Effective when L3-05 is 1 or 2. Set as a percentage of the Inverter rated current. Usually changing this setting is not necessary. The factory setting reduces the set values when the motor stalls.	30 to 200	120%	No	A	494H	6-27

■Reference Detection: L4

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L4-01	Speed agreement detection level	Effective when "Desired frequency (ref/setting) agree 1," "Frequency detection 1," or "Frequency detection 2" is set for a multi-function output.	0.0 to 120.0	0.0 Hz	No	A	499H	-
L4-02	Speed agreement detection width	Effective when "Frequency (speed) agree 1," "Desired frequency (speed) agree 1," or "Frequency (FOUT) detection 1," is set for a multi-function output.	0.0 to 20.0	2.0 Hz	No	A	49AH	-
L4-05	Operation when frequency reference is missing	0: Stop (Operation follows the frequency reference.) 1: Operation continues at the frequency, set in parameter L4-06*. Frequency reference loss means that the frequency reference value drops over 90% in 400 ms.	0 or 1	0	No	A	49DH	6-40
L4-06	Frequency reference value at frequency reference loss	Sets the frequency reference value when the frequency reference is missing	0.0 to 100.0%	80%	No	A	4C2H	-

■Fault Restart: L5

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L5-01	Number of auto restart attempts	Sets the number of auto restart attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A	49EH	6-41
L5-02	Auto restart operation selection	Sets whether a fault contact output is activated during fault restart. 0: No output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A	49FH	6-41

■Torque Detection: L6

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L6-01	Torque detection selection 1	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A	4A1H	6-28

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L6-02	Torque detection level 1	Inverter rated current is set as 100%.	0 to 300	150%	No	A	4A2H	6-28
L6-03	Torque detection time 1	Sets the overtorque/undertorque detection time.	0.0 to 10.0	0.1 s	No	A	4A3H	6-28

■Hardware Protection: L8

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L8-02	Overheat pre-alarm level	Sets the detection temperature for the Inverter overheat detection pre-alarm in °C. The pre-alarm detects when the cooling fin temperature reaches the set value.	50 to 130	95 °C*	No	A	4AEH	6-42
L8-03	Operation selection after overheat pre-alarm	Sets the operation for when the Inverter overheat pre-alarm occurs. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	4AFH	6-42
L8-09	Ground protection selection	0:Disabled 1:Enabled	0 or 1	1	No	A	4B5H	-
L8-11	Cooling fan control delay time	Set the time in seconds to delay turning OFF the cooling fan after the cooling fan OFF command is received.	0 to 300	60 s	No	A	4B7H	-
L8-12	Ambient temperature	Set the ambient temperature.	45 to 60	45 °C*	No	A	4B8H	-
L8-15	OL2 characteristics selection at low speeds	0: OL2 characteristics at low speeds disabled. 1: OL2 characteristics at low speeds enabled.	0 or 1	1	No	A	4BBH	-
L8-18	Soft CLA selection	0: Disabled (gain = 0) 1: Enabled	0 or 1	1	No	A	4BFH	-

* The factory setting depends upon the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

◆ N: Special Adjustments

■Hunting Prevention Function: N1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
N1-01	Hunting-prevention function selection	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. If high response has to have the priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A	580H	6-26
N1-02	Hunting-prevention gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to change this setting. Make the adjustments as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is to large, the voltage will be to suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A	581H	4-11 6-26

■High-slip Braking: N3

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
N3-01	High-slip braking deceleration frequency width	Sets the frequency width for deceleration during high-slip braking in percent, taking the Maximum Frequency (E1-04) as 100%.	1 to 20	5%	No	A	588H	-
N3-02	High-slip braking current limit	Sets the current limit for deceleration during high-slip braking in percent, taking the motor rated current as 100%. The resulting limit must be 150% of the Inverter rated current or less.	100 to 200	150%	No	A	589H	-
N3-03	High-slip braking stop dwell time	Sets the dwell time for the output frequency for FMIN (1.5 Hz) during V/f control. Effective only during deceleration for high-slip braking.	0.1 to 10.0	1.0 s	No	A	58AH	-

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
N3-04	High-slip braking OL time	Set the OL time when the output frequency does not change for some reason during deceleration for high-slip braking.	30 to 1200	40 s	No	A	58BH	-

◆ Digital Operator Constants: o

■Monitor Select: o1

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
o1-01	Monitor selection	Set the number of the 3rd. monitor item to be displayed in the Drive Mode. (U1-□□) (Only LED operator.)	4 to 33	6	Yes	A	500H	-
o1-02	Monitor selection after power up	Sets the monitor item to be displayed when the power is turned on. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	501H	6-78
o1-03	Frequency units of reference setting and monitor	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: r/min units (Sets the motor poles.) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency. □□□□□ Set digit number excluding the decimal point. Set the number of digits below the decimal point to display. Example: When the max. output frequency value is 200.0, set 12000	0 to 39999	0	No	A	502H	6-78
o1-05	LCD-Focus	1: light 2: 3: normal 4: 5: dark	0 to 5	3	Yes	A	509H	

■Multi-function Selections: o2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
o2-01	LOCAL/ REMOTE key enable/ disable	Sets the Digital Operator Local/ Remote Key 0: Disabled 1: Enabled (Switches between the Digital Operator and the constant settings.)	0 or 1	1	No	A	505H	6-78
o2-02	STOP key during control circuit terminal operation	Sets the Stop Key in the run mode. 0: Disabled (When the run command is issued from and external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	506H	6-78
o2-03	User constant initial value	Clears or stores user initial values. 0: Stores/not set 1: Begins storing (Records the set constants as user initial values.) 2: All clear (Clears all recorded user initial values) When the set constants are recorded as user initial values, 1110 will be set in A1-03.	0 to 2	0	No	A	507H	6-78
o2-04	kVA selection	Do not set unless using a control board from an Inverter with a different capacity.	0 to FF	0*	No	A	508H	-
o2-05	Frequency reference setting method selection	When the frequency reference is set on the Digital Operator frequency reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the frequency reference without Enter Key operation.	0 or 1	0	No	A	509H	6-78
o2-06	Operation selection when digital operator is disconnected	Sets the operation when the Digital Operator is disconnected. 0: Disabled (Operation continues even if the Digital Operator is disconnected.) 1: Enabled (OPR is detected at Digital Operator disconnection. Inverter output is cut off, and fault contact is operated.)	0 or 1	0	No	A	50AH	-
o2-07	Cumulative operation time setting	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0 hr	No	A	50BH	6-78

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
o2-08	Cumulative operation time selection	0: Cumulative time when the Inverter power is on. (All time while the Inverter power is on is accumulated.) 1: Cumulative Inverter run time. (Only Inverter output time is accumulated.)	0 or 1	0	No	A	50CH	-
o2-09	Initialize Mode	1: US 2: Europe	1 or 2	2	No	A	50DH	–
o2-10	Fan operation time setting	Set the initial value of the fan operation time. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	50EH	6-78
o2-12	Fault trace initialize	0: Disable 1: Initialize (= zero clear) after setting ”1“ o2-12 will be returned to ”0“	0 or 1	0	No	A	511H	-

* This setting depends on the inverter capacity.

■ Copy Function: o3

User constants for the copy function are shown in the following table.

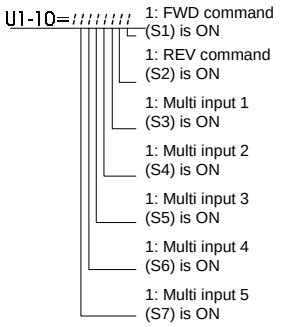
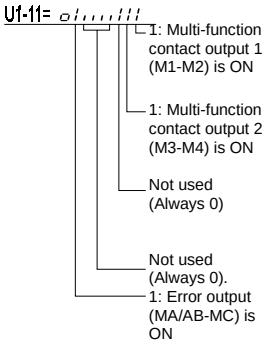
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
o3-01	Copy function selection	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A	515H	6-80
o3-02	Read permission selection	0: Read prohibited 1: Read permitted	0 or 1	0	No	A	516H	6-80

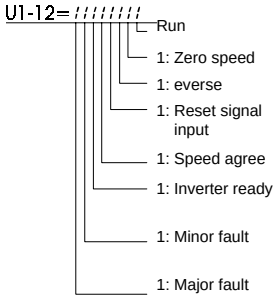
◆ T: Motor Autotuning

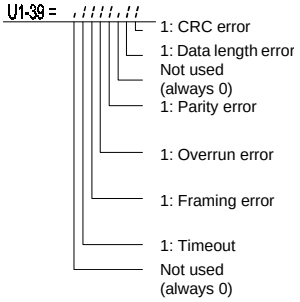
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
T1-02	Motor output power	Set the output power of the motor in kilowatts.	0.00 to 650.00	0.40 kW	No	A	702H	4-10
T1-04	Motor rated current	Set the rated current of the motor in Amps.	0.32 to 6.40	1.90 A	No	A	704H	4-10

◆ U: Monitor Constants

■ Status Monitor Constants: U1

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	MEMOBUS Register
U1-01	Frequency reference	Monitors/sets the frequency reference value.*	10 V: Max. frequency (0 to + 10 V possible)	0.01 Hz	A	40H
U1-02	Output frequency	Monitors the output frequency.*	10 V: Max. frequency (0 to + 10 V possible)	0.01 Hz	A	41H
U1-03	Output current	Monitors the output current.	10 V: Inverter rated output current (0 to +10 V, absolute value output)	0.1 A	A	42H
U1-06	Output voltage	Monitors the output voltage reference value in the Inverter.	10 V: 200 VAC (400 VAC) (0 to +10 V output)	0.1 V	A	45H
U1-07	DC bus voltage	Monitors the main DC voltage in the Inverter.	10 V: 400 VDC (800 VDC)	1 V	A	46H
U1-08	Output power	Monitors the output power (internal detected value)	10V: Inverter maximum capacity (max. applicable motor capacity) (0 to +10 V possible)			
U1-10	Input terminal status	Shows input ON/OFF status. 	(Cannot be output.)	-	A	49H
U1-11	Output terminal status	Shows output ON/OFF status. 	(Cannot be output.)	-	A	4AH

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	MEMOBUS Register
U1-12	Operation status	Inverter operating status. 	(Cannot be output.)	-	A	4BH
U1-13	Cumulative operation time	Monitors the total operating time of the Inverter. The initial value and the operating time/power ON time selection can be set in o2-07 and o2-08.	(Cannot be output.)	1 hr	A	4CH
U1-14	Software No. (flash memory)	(Manufacturer's ID number)	(Cannot be output.)	-	A	4DH
U1-15	Terminal A1 input voltage	Monitors the input voltage of the voltage frequency reference. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to + 10 V possible)	0.1%	A	4EH
U1-16	Terminal A2 input voltage	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to +10 V possible)	0.1%	A	4FH
U1-18	Motor secondary current (Iq)	Monitors the calculated value of the motor secondary current. The motor rated secondary current corresponds to 100%.	10 V:Motor rated secondary current) (0 to +10 V output)	0.1%	A	51H
U1-20	Output frequency after soft-starter (SFS output)	Monitors the output frequency after the soft starter. The frequency given does not include compensations. The unit is set in o1-03.	10 V: Max. frequency (0 to + 10 V possible)	0.01 Hz	A	53H
U1-24	PI feedback value	Monitors the feedback value when PI control is used. The input for the max. frequency corresponds to 100%.	10 V: Max. frequency (0 to + 10 V possible)	0.01 %	A	57H
U1-28	Software No. (CPU)	(Manufacturer's CPU software No.)	(Cannot be output.)	-	A	5BH
U1-31	LED Test	For testing LED's on operator. If this monitor is selected, all LED's on operator lit (only on LED operator).	(Cannot be output.)	-	A	-
U1-34	OPE fault constant	Shows the first constant number where an OPE fault was detected.	(Cannot be output.)	-	A	61H
U1-36	PI input volume	PI feedback volume Given as maximum frequency/ 100%	10 V: Max. frequency (0 to + 10 V possible)	0.01 %	A	63H

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	MEMOBUS Register
U1-37	PI output volume	PI control output Given as maximum frequency/ 100%	10 V: Max. frequency (0 to + 10 V possible)	0.01 %	A	64H
U1-38	PI command	PI command + PI command bias Given as maximum frequency/ 100%	10 V: Max. frequency	0.01 %	A	65H
U1-39	MEMOBUS communications error code	Shows MEMOBUS errors. 	(Cannot be output.)	-	A	66H
U1-40	Cooling fan operating time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	(Cannot be output.)	1 hr	A	68H

* The unit is set in o1-03 (frequency units of reference setting and monitor).

■ Fault Trace: U2

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	MEMOBUS Register
U2-01	Current fault	The content of the current fault.	(Cannot be output.)	-	A	80H
U2-02	Previous fault	The content of the error that occurred just prior to the current fault.		-	A	81H
U2-03	Reference frequency at fault	The reference frequency when the previous fault occurred.		0.01 Hz	A	82H
U2-04	Output frequency at fault	The output frequency when the previous fault occurred.		0.01 Hz	A	83H
U2-05	Output current at fault	The output current when the previous fault occurred.		0.1 A	A	84H
U2-07	Output voltage reference at fault	The output reference voltage when the previous fault occurred.		0.1 V	A	86H
U2-08	DC bus voltage at fault	The main current DC voltage when the previous fault occurred.		1 V	A	87H
U2-09	Output power at fault	The output power when the previous fault occurred.		0.1 kW	A	88H
U2-11	Input terminal status at fault	The input terminal status when the previous fault occurred. The format is the same as for U1-10.		-	A	8AH
U2-12	Output terminal status at fault	The output terminal status when the previous fault occurred. The format is the same as for U1-11.	(Cannot be output.)	-	A	8BH
U2-13	Operation status at fault	The operating status when the previous fault occurred. The format is the same as for U1-12.		-	A	8CH
U2-14	Cumulative operation time at fault	The operating time when the previous fault occurred.		1 hr	A	8DH

Note The following errors are not included in the error trace: CPF00, 01, 02, 03, UV1, and UV2.

■Fault History: U3

Con-stant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	MEMO-BUS Register
U3-01	Last fault	The error content of 1st last fault.	(Cannot be output.)	-	A	90H
U3-02	Second last fault	The error content of 2nd last fault.		-	A	91H
U3-03	Third last fault	The error content of 3rd last fault.		-	A	92H
U3-04	Fourth last fault	The error content of 4th last fault.		-	A	93H
U3-05	Cumulative operation time at fault	The total operating time when the 1st previous fault occurred.		1 hr	A	94H
U3-06	Accumu-lated time of second fault	The total operating time when the 2nd previous fault occurred.		1 hr	A	95H
U3-07	Accumu-lated time of third fault	The total operating time when the 3rd previous fault occurred.		1 hr	A	96H
U3-08	Accumu-lated time of fourth/old-est fault	The total operating time when the 4th previous fault occurred.		1 hr	A	97H
U3-09 – U3-14	Fifth last to tenth last fault	The error content of the 5th to 10th last fault		–	A	804 805H 806H 807H 808H 809H
U3-15 – U3-20	Accumu-lated time of fifth to tenth fault	Total generating time when 5th ... 10th pevious fault occured		1hr	A	806H 80FH 810H 811H 812H 813H

Note The following errors are not recorded in the error log: CPF00, 01, 02, 03, UV1, and UV2.

■200 V and 400 V Class Inverters of 0.4 to 1.5 kW

Constant Number	Unit	Factory Setting														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10 *	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0

* The settings shown are for 200 V class Inverters. The values will double for 400 V class Inverters.

■200 V and 400 V Class Inverters of 2.2 to 45 kW

Constant Number	Unit	Factory Setting														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10 *	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0

* The settings shown are for 200 V class Inverters. The values will double for 400 V class Inverters.

■200 V Class Inverters of 55 to 110 kW and 400 V Class Inverters of 55 to 300 kW

Constant Number	Unit	Factory Setting														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10 *	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0

* The settings shown are for 200 V class Inverters. The values will double for 400 V class Inverters.

◆ Factory Settings that Change with the Inverter Capacity (o2-04)

■200 V Class Inverters

Constant Number	Name	Unit	Factory Setting								
-	Inverter Capacity	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
o2-04	kVA selection	-	0	1	2	3	4	5	6	7	8
b8-04	Energy-saving coefficient	-	288.20	223.70	169.40	156.80	122.90	94.75	72.69	70.44	63.13
C6-02	Carrier frequency selection	-	6	6	6	6	6	6	6	6	6
E2-01 (E4-01)	Motor rated current	A	1.90	3.30	6.20	8.50	14.00	19.60	26.60	39.7	53.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	9.842	5.156	1.997	1.601	0.771	0.399	0.288	0.230	0.138
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	1.0	1.0	1.0	2.0
L2-03	Min. baseblock (BB) time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
L2-04	Voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	95	95	95	95

Constant Number	Name	Unit	Factory Setting								
-	Inverter Capacity	kW	18.5	22	30	37	45	55	75	90	110
o2-04	kVA selection	-	9	A	B	C	D	E	F	10	11
b8-04	Energy-saving coefficient	-	57.87	51.79	46.27	38.16	35.78	31.35	23.10	23.10	23.10
C6-02	Carrier frequency selection*	-	6	6	4	3	3	3	3	3	1
E2-01 (E4-01)	Motor rated current	A	65.8	77.2	105.0	131.0	160.0	190.0	260.0	260.0	260.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	0.101	0.079	0.064	0.039	0.030	0.022	0.023	0.023	0.023
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.7
L2-04	Voltage recovery time	s	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	95	95	95	95

Note Attach a Momentary Power Interruption Compensation Unit if compensation for power interruptions of up to 2.0 seconds is required for 200 V class Inverters with outputs of 0.4 to 11 kW.

* If C6-02 is set to 0, 1, or F and the initial value of C6-03 and C6-04 is 2.0 kHz, the initial settings for C6-02 are as follows: 2: 5.0 kHz, 3: 8.0 kHz, 4: 10 kHz, 5: 12.5 kHz, and 6: 15 kHz. If the carrier frequency is set higher than the factory setting for Inverters with outputs of 7.5 kW or more, the Inverter rated current will need to be reduced.

■400 V Class Inverters

Constant Number	Name	Unit	Factory Setting									
-	Inverter Capacity	kW	0.4	0.75	1.5	2.2	3.7	4.0	5.5	7.5	11	15
o2-04	kVA selection	-	20	21	22	23	24	25	26	27	28	29
b8-04	Energy-saving coefficient	-	576.40	447.40	338.80	313.60	245.80	236.44	189.50	145.38	140.88	126.26
C6-02	Carrier frequency selection *	-	6	6	6	6	6	6	6	6	6	6
E2-01 (E4-01)	Motor rated current	A	1.00	1.60	3.10	4.20	7.00	7.00	9.80	13.30	19.9	26.5
E2-05 (E4-05)	Motor line-to-line resistance	Ω	38.198	22.459	10.100	6.495	3.333	3.333	1.595	1.152	0.922	0.550
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	0.5	0.8	0.8	1.0	2.0
L2-03	Min. baseblock (BB) time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9
L2-04	Voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	95	95	95	95	95

Constant Number	Name	Unit	Factory Setting									
-	Inverter Capacity	kW	18.5	22	30	37	45	55	75	90	110	132
o2-04	kVA selection	-	2A	2B	2C	2D	2E	2F	30	31	32	33
b8-04	Energy-saving coefficient	-	115.74	103.58	92.54	76.32	71.56	67.20	46.20	41.22	36.23	33.18
C6-02	Carrier frequency selection *	-	6	6	4	4	4	4	3	3	3	2
E2-01 (E4-01)	Motor rated current	A	32.9	38.6	52.3	65.6	79.7	95.0	130.0	156.0	190.0	223.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	0.403	0.316	0.269	0.155	0.122	0.088	0.092	0.056	0.046	0.035
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.7	1.7
L2-04	Voltage recovery time	s	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	100	95	110	110	110

Constant Number	Name	Unit	Factory Setting				
-	Inverter Capacity	kW	160	185	200	220	300
o2-04	kVA selection	-	34	35	3E	36	37
b8-04	Energy-saving coefficient	-	30.13	30.57	27.13	27.13	21.76
C6-02	Carrier frequency selection *	-	2	4	1	1	1
E2-01 (E4-01)	Motor rated current	A	270.0	310.0	370.0	370.0	500.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	0.029	0.025	0.020	0.020	0.014
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.8	1.9	2.0	2.0	2.1
L2-04	Voltage recovery time	s	1.0	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	100	95	95	95	95

Note Attach a Momentary Power Interruption Compensation Unit if compensation for power interruptions of up to 2.0 seconds is required for 200 V class Inverters with outputs of 0.4 to 11 kW.

* If C6-02 is set to 0, 1, or F and the initial value of C6-03 and C6-04 is 2.0 kHz, the initial settings for C6-02 are as follows: 2: 5.0 kHz, 3: 8.0 kHz, 4: 10 kHz, 5: 12.5 kHz, and 6: 15 kHz. If the carrier frequency is set higher than the factory setting for Inverters with outputs of 7.5 kW or more, the Inverter rated current will need to be reduced.

6

Constant Settings by Function

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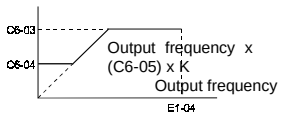
Carrier Frequency Selection

◆ Select the Carrier Frequency suit to the Application

Depending on the application, the carrier frequency can be changed. Pay attention to the following explanations when changing the settings.

■Related Constants

No. Constant No.	Name	Details	Setting Range	Factory Setting	Changes During Operation?	Access Level
C6-02	Carrier frequency selection	Select carrier wave fixed pattern. Select F to enable detailed settings using constants C6-03 to C6-05. 1: Catrrier 2 kHz 2: Carrier 5 kHz 3: Carrier 8,0 kHz 4: Carrier 10.0 kHz 5: Carrier 12.5 kHz 6: Carrier 15 kHz F: User set*1	1 to F	6*1	No	Q
C6-03	Carrier frequency upper limit	Set upper and lower carrier frequency limits in kHz. Set the carrier wave gain as shown below. In vector control method, the carrier frequency is fixed according to C6-03 (Carrier Frequency Upper Limit). Carrier frequency  (Maximum output frequency)	2.0 to 15.0 *2 *3	15.0 kHz *1	No	A
C6-04	Carrier frequency lower limit		0.4 to 15.0 *2 *3	15.0 kHz *1	No	A
C6-05	Carrier frequency proportional gain	K is the coefficient determined by the set value in 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 = 2	00 to 99 *3	00	No	A

* 1. The factory settings depend on the Inverter capacity.
* 2. The setting ranges depend on the Inverter capacity.
* 3. Can be set and referenced only when C6-02 is set to F.

Carrier Frequency

When selecting the carrier frequency, observe the following precautions:

- Adjust the carrier frequency according to the cases shown below.
  If the wiring distance between Inverter and motor is long: Set the carrier frequency low. (Use the following values as guidelines.

Wiring Length	50 m or less	100 m or less	Over 100 m
C6-02 (carrier frequency) setting	1 to 6 (15 kHz)	1 to 4 (10 kHz)	1 to 2 (5 kHz)

  If speed and torque are inconsistent at low speeds: Set the carrier frequency low.
  If Inverter noise is affecting peripheral devices: Set the carrier frequency low.
  If leakage current from the Inverter is large: Set the carrier frequency low.
  If metallic noise from the motor is large: Set the carrier frequency high.

- The carrier frequency can be varied to match the output frequency, as shown in the following diagram, by setting C6-03 (Carrier Frequency Upper Limit), C6-04 (Carrier Frequency Lower Limit), and C6-05 (Carrier Frequency Proportional Gain).

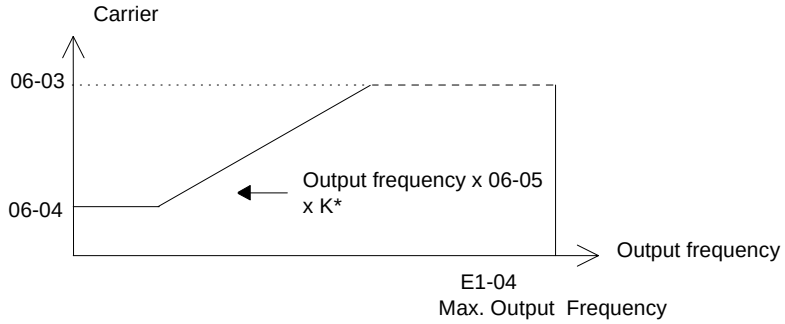


Fig 6.1

*K is the coefficient determined by the set value in 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

- To fix the carrier frequency, set C6-03 and C6-04 to the same value, or set C6-05 to 0.
- If Carrier Frequency Proportional Gain (C6-05) < 6 and C6-03 < C6-04, OPE11 (Data setting error) will occur.

■Carrier Frequency and Inverter Overload Current Level

When using a 200 V Class Inverter 30 to 90 kW or a 400 V Class Inverter for 30 to 185 kW with a carrier frequency higher than 10 kHz, the Inverter overload level will be reduced. Even when the overload current is below 120%, in this case an OL2 (Inverter overload) will be detected. The Inverter overload current reduction level is shown below.

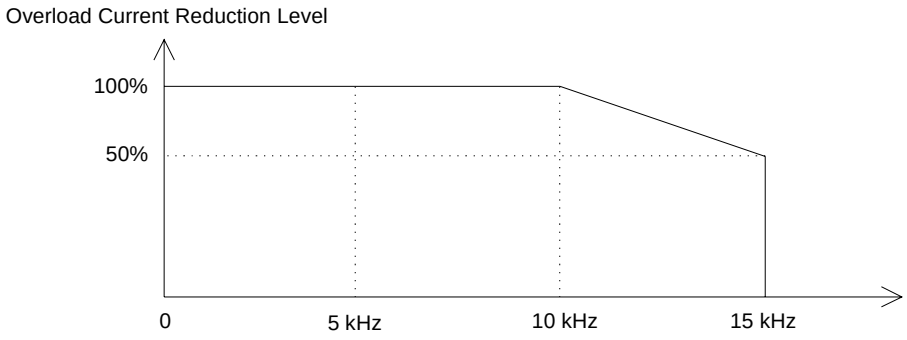


Fig 6.2 Overload Current Reduction Level

Frequency Reference

This section explains how to input the frequency reference.

◆ Selecting the Frequency Reference Source

Set constant b1-01 to select the frequency reference source.

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
b1-01	Reference selection	Set the frequency reference source 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q

■Input the Reference Frequency from the Digital Operator

When b1-01 is set to 0, you can input the reference frequency from the Digital Operator.

For details on setting the reference frequency, refer to *Chapter 3 Digital Operator and Modes*.

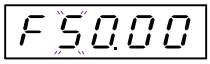


Fig 6.3 Frequency Setting Display

■Inputting the Frequency Reference Using Voltage (Analog Setting)

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A1 (voltage input), or control circuit terminal A2 (voltage or current input).

Inputting Master Speed Frequency Reference Only

If inputting the master speed frequency reference only, input the voltage reference to control circuit terminal A1.

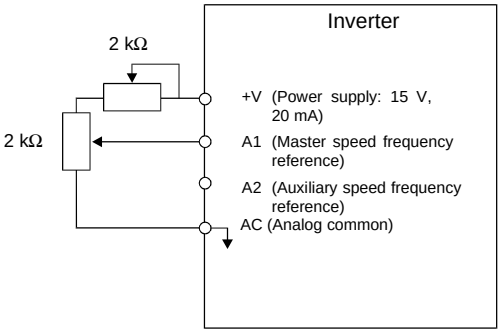


Fig 6.4 Master Speed Frequency Reference Input

2-Step Switching: Master/Auxiliary

If performing 2-step switching between master and auxiliary speed frequencies, input the master speed frequency reference to control circuit terminal A1, and input the auxiliary speed frequency reference to A2.

When terminal S3 (multi-step speed command 1) is OFF, terminal A1 (master speed frequency reference) will be the Inverter frequency reference, and when terminal S3 is ON, terminal A2 (auxiliary speed frequency reference) will be the Inverter frequency reference.

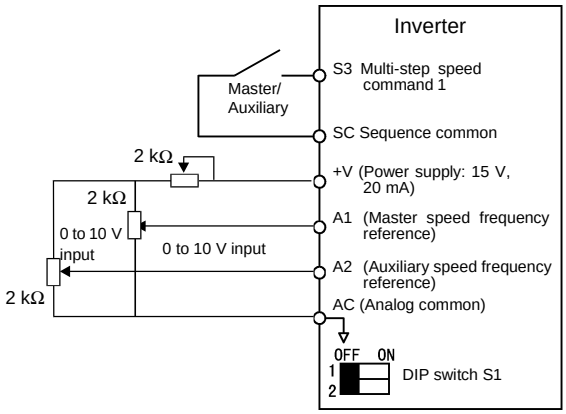


Fig 6.5 Master/Auxiliary Frequency Reference Input

Setting Precautions

When inputting a voltage signal to terminal A2, observe the following precautions.

- Turn OFF pin 2 on DIP switch S1 for switching between voltage and current (factory setting is ON).
- The parameter H3-08 has to be set to 0.

■Inputting Frequency Reference Using Current

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A2. Input the current (4 to 20 mA) in control circuit terminal A2.

When H3-09 (Multi-Function Analog Input Terminal A2 Signal Level Selection) is set to 0 (factory setting) the input on A2 is added to A1.

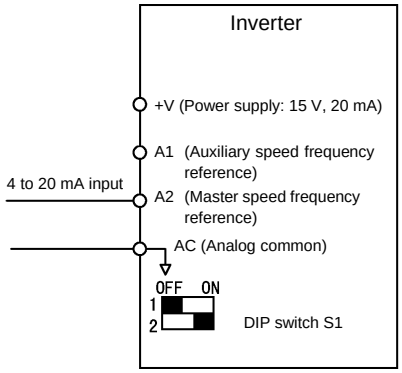


Fig 6.6 Frequency Reference Using Current

Setting Precautions

- When inputting a current signal to terminal A2, turn ON pin 2 on DIP switch S1 (factory setting: ON).
- The parameter H3-08 has to be set to 2 (4 - 20 mA input).
- If using terminal A2 to input the master speed reference and terminal A1 to input the auxiliary frequency reference, set H3-13 (Terminal A1/A2 Switching) to 1.

◆ Using Multi-Step Speed Operation

With Varispeed-F7 series Inverters, you can change the speed to a maximum of 5 steps, using 4 frequency references, and one jog frequency reference.

The following example of a multi-function input terminal function shows a 9-step operation using multi-step references 1 to 3 and jog frequency selection functions.

■Related Constants

To switch frequency references, set multi-step references 1 to 3 and the jog reference selection in the multi-function contact inputs.

Multi-function Contact Inputs (H1-01 to H1-05)

Terminal	Constant Number	Set Value	Details
S5	H1-03	4	Multi-step speed command 1 (Also used for master speed/auxiliary speed switching when multi-function analog input H3-09 is set to 2 (auxiliary frequency reference).)
S6	H1-04	5	Multi-step speed command 2
S7	H1-05	6	Jog frequency selection (given priority over multi-step speed command)

Combining Multi-Function References and Multi-Function Contact Inputs

You can change the selected frequency reference by combining the ON/OFF status of S4 to S7 (multi-function contact input terminals) to set multi-step speed commands 1 to 3 and the jog frequency selection. The following table shows the possible combinations.

Speed	TerminalS5	TerminalS6	TerminalS7	Selected Frequency
	Multi-step Speed Command 2	Multi-step Speed Command 3	Jog Frequency Selection	
1	OFF	OFF	OFF	Frequency reference 1 d1-01, master speed frequency
2	ON	OFF	OFF	Frequency reference 2 d1-02, auxiliary frequency
3	OFF	ON	OFF	Frequency reference 3 d1-03
4	ON	ON	OFF	Frequency reference 4 d1-04
5	-	-	ON*	Jog frequency d1-17

* Terminal S7's jog frequency selection is given priority over multi-step speed commands.

Setting Precautions

When setting analog inputs to step 1 and step 2, observe the following precautions.

- When setting terminal A1's analog input to step 1, set b1-01 to 1, and when setting d1-01 (Frequency Reference 1) to step 1, set b1-01 to 0.
- When setting terminal A2's analog input to step 2, set H3-09 to 2 (auxiliary frequency reference). When setting d1-02 (Frequency Reference 2) to step 2, set H3-09 to 1F (do not use analog inputs).

■Connection Example and Time Chart

The following diagram shows a time chart and control circuit terminal connection example during a 9-step operation.

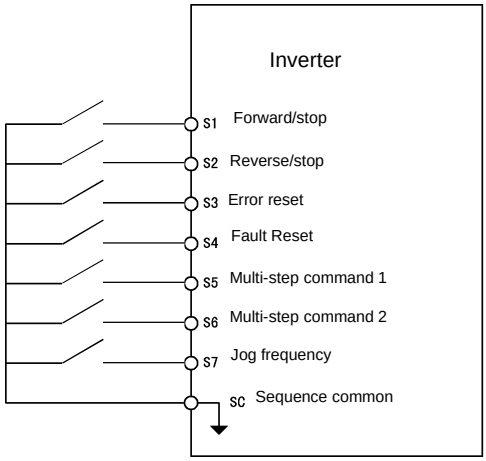


Fig 6.7 Control Circuit Terminal During 9-step Operation

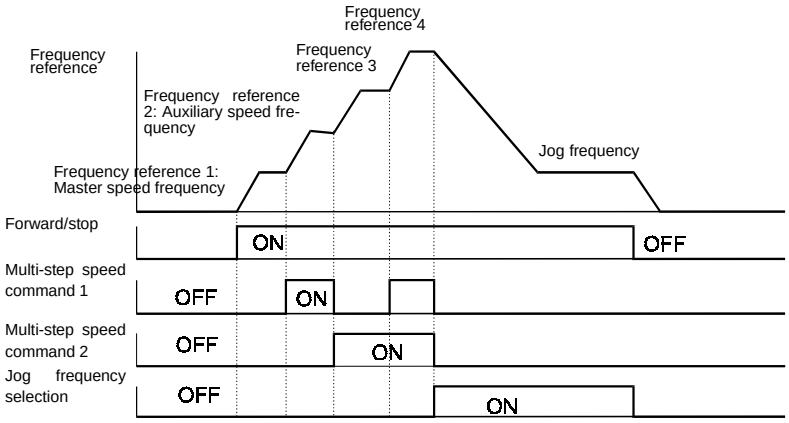


Fig 6.8 Multi-step speed command/Jog Frequency Selection Time Chart

Run Command

This section explains input methods for the run command.

◆ Selecting the Run Command Source

Set constant b1-02 to select the source for the run command.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-02	Operation method selection	Set the run command source. 0: Digital operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q

■Performing Operations Using a Digital Operator

When b1-02 is set to 0, you can perform Inverter operations using the Digital Operator keys (RUN, STOP, JOG, and FWD/REV). For details on the Digital Operator, refer to *Chapter 3 Digital Operator and Modes*.

■Performing Operations Using Control Circuit Terminals

When b1-02 is set to 1, you can perform Inverter operations using the control circuit terminals.

Performing Operations Using a 2-wire Sequence

The factory setting is set to a 2-wire sequence. When control circuit terminal S1 is set to ON, forward operation will be performed, and when S1 is turned OFF, the Inverter will stop. In the same way, when control circuit terminal S2 is set to ON, reverse operation will be performed, and when S2 is turned OFF, the Inverter will stop.

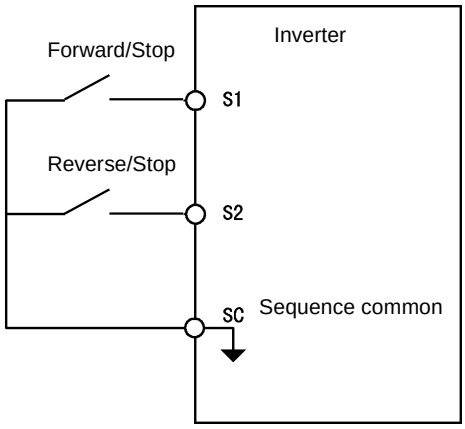


Fig 6.9 2-wire Sequence Wiring Example

Performing Operations Using a 3-wire Sequence

When any constant from H1-01 to H1-05 (multi-function contact input terminals S3 to S7) is set to 0, terminals S1 and S2 are used for a 3-wire sequence, and the multi-function input terminal that has been set functions as a forward/reverse run command terminal.

When the Inverter is initialized for 3-wire sequence control with A1-03, multi-function input 3 becomes the input terminal for the forward/reverse run command.

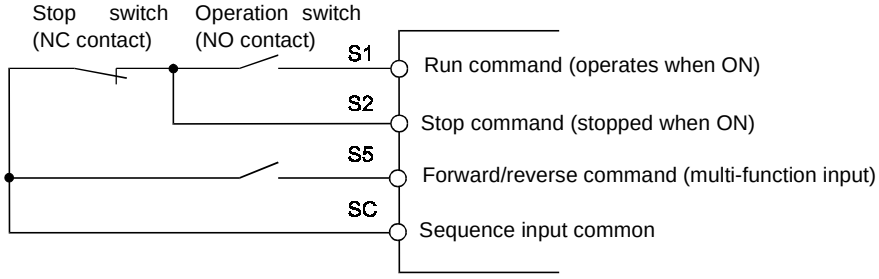


Fig 6.10 3-wire Sequence Wiring Example

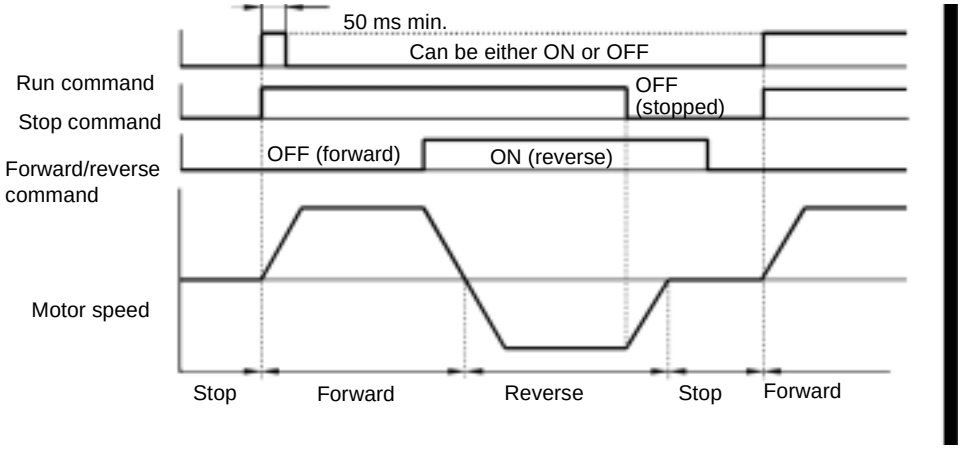


Fig 6.11 Three-wire Sequence Time Chart

INFO

Use a sequence that turns ON terminal S1 for 50 ms or longer for the run command. This will make the run command self-holding in the Inverter.

Stopping Methods

◆ Selecting the Stopping Method when a Stop Command is Input

There are four methods of stopping the Inverter when a stop command is input:

- Deceleration to stop
- Coast to stop
- DC braking stop
- Coast to stop with timer

Set constant b1-03 to select the Inverter stopping method.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-03	Stopping method selection	Select stopping method when stop command is sent. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop (Stops faster than coast to stop, without regenerative operation.) 3: Coast to stop with timer (Run commands are ignored during deceleration time.)	0 to 3	0	No	Q
b2-01	Zero speed level (DC injection braking starting frequency)	Set the frequency to start the DC injection braking in units of Hz when deceleration to stop is selected. DC injection braking starts from E1-09 when b2-01 < E1-09.	0.0 to 10.0	0.5 Hz	No	A
b2-02	DC injection braking current	Set the DC injection braking current as a percentage, taking the Inverter rated current as 100%.	0 to 100	50%	No	A
b2-04	DC injection braking time at stop	Set the DC injection braking time at stop. Use when stopping if rotations continue due to momentum. Set to 0.00 to disable DC injection braking time at stop.	0.00 to 10.00	0.50 s	No	A

■Deceleration to Stop

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 0, the motor decelerates to a stop according to the deceleration time that has been set. (Factory setting: C1-02 (Deceleration Time 1))

If the output frequency when decelerating to a stop falls below b2-01, the DC injection brake will be applied using the DC current set in b2-02 only for the time set in b2-04.

For deceleration time settings, refer to *page 6-16 Setting Acceleration and Deceleration Times*.

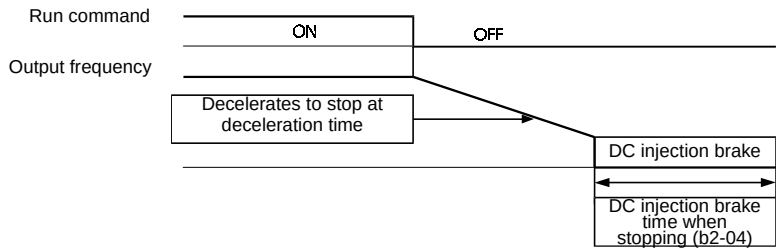


Fig 6.12 Deceleration to Stop

■Coast to Stop

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 1, the Inverter output voltage is interrupted. The motor coasts to a stop.

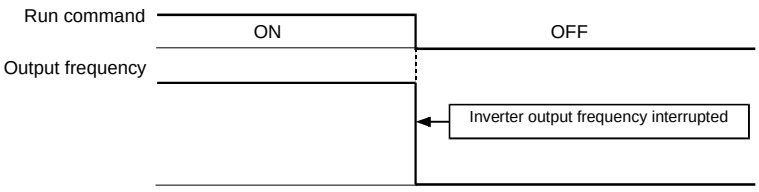


Fig 6.13 Coast to Stop

INFO

After the stop command is input, run commands are ignored until the Minimum Baseblock Time (L2-03) has elapsed.

■DC Braking Stop

After the stop command is input and the minimum baseblock time (L2-03) is elapsed, DC injection will be applied to the motor. The applied DC injection current is programmed in parameter b2-02. The DC injection brake time is determined by the set value in b2-04 and the output frequency when the stop command is input.

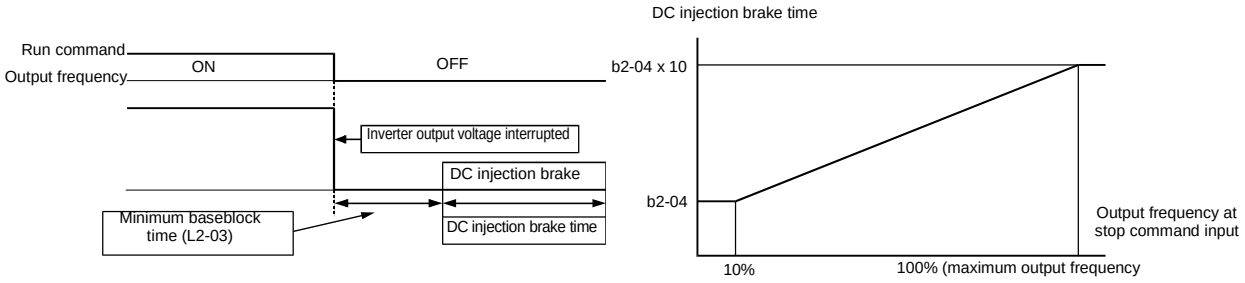


Fig 6.14 DC Injection Braking (DB) Stop

INFO

Lengthen the Minimum Baseblock Time (L2-03) when an overcurrent (OC) occurs during stopping.

■Coast to Stop with Timer

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 3, the Inverter output is interrupted to coast the motor to a stop. After the stop command is input, run commands are ignored until the time T has elapsed. The time T depends upon the output frequency when the stop command is input and the deceleration time.

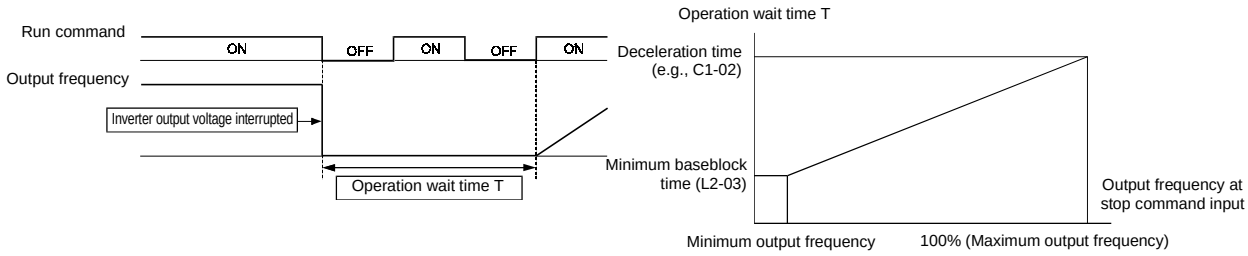


Fig 6.15 Coast to Stop with Timer

◆ Using the DC Injection Brake

Set constant b2-03 to apply DC injection to the motor, before it starts to accelerate. Applying DC injection at start will stop the motor before starting, if it was coasting through inertia or wind mill effect.

Set b2-03 to 0 to disable the DC injection brake at start.

Set the DC injection brake current using b2-02.

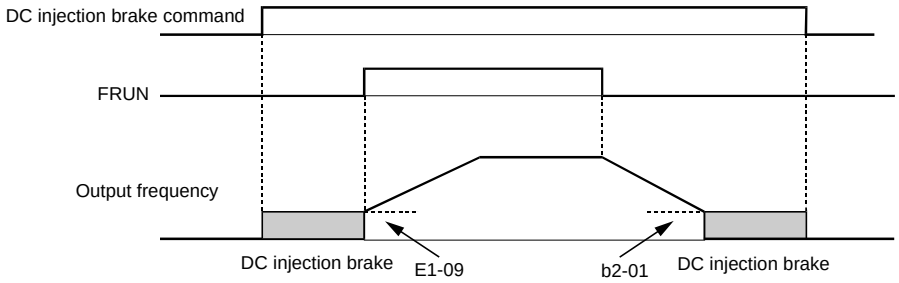
■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b2-02	DC injection braking current	Set the DC Injection Braking Current as a percentage of the Inverter rated current.	0 to 100	50%	No	A
b2-03	DC injection braking time at start	Used to set the time to perform DC injection braking at start. Used to stop coasting motor and restart it. When the set value is 0, DC injection braking at start is not performed.	0.00 to 10.00	0.00 s	No	A

■Inputting the DC Injection Brake Command from Control Circuit Terminals

If you set a multi-function contact input terminal (H1-□□) to 60 (DC injection brake command), you can apply the DC injection brake to the motor by turning ON the terminal for which the DC injection brake command has been set, when the Inverter is being stopped.

The time chart for the DC injection brake is shown below.



If you input the DC injection brake command from an external terminal, or if the run command and jog command are input, the DC injection brake will be disabled, and operation will resume.

Fig 6.16 DC Injection Brake Time Chart

◆ Using an Emergency Stop

Set a multi-function input terminal (H1-□□) to 28 to 2B (emergency stop) to decelerate to a stop at the deceleration time set in C1-09. If inputting the emergency stop with an NO contact, set the multi-function input terminal (H1-□□) to 28 or 2A, and if inputting the emergency stop with an NC contact, set the multi-function input terminal (H1-□□) to 29 or 2B.

After the emergency stop command has been input, operation cannot be restarted until the Inverter has stopped. To cancel the emergency stop, turn OFF the run command and emergency stop command.

■Related parameters

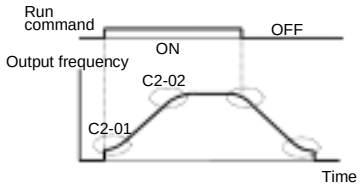
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
C1-09	Emergency stop time	The deceleration time when the multi-function input "Emergency (fast) stop" is ON. This time will be used when a fault is detected, for which emergency stop was programmed.	0.0 to 6000.0	10.0 s	No	A

Acceleration and Deceleration Characteristics

◆ Setting Acceleration and Deceleration Times

Acceleration time indicates the time to increase the output frequency from 0% to 100% of the maximum output frequency (E1-04). Deceleration time indicates the time to decrease the output frequency from 100% to 0% of (E1-04). The factory setting of the acceleration time is C1-01, and the factory setting of the deceleration time is C1-02.

■Related Parameters

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
C1-01	Acceleration time 1	Set the acceleration time to accelerate from 0 to the maximum output frequency, in 1-second units.	0.0 to 6000.0	10.0 s	Yes	Q
C1-02	Deceleration time 1	Set the deceleration time in seconds for the output frequency to fall from 100% to 0%.			Yes	Q
C1-03	Acceleration time 2	Acceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A
C1-04	Deceleration time 2	Deceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A
C1-11	Acceleration/deceleration time switching frequency	Set the frequency at which acceleration/deceleration time switches automatically. Less than set frequency: Acceleration/deceleration time 2 Set frequency or above: Acceleration/deceleration time 1 Multi-function inputs "Acceleration/deceleration time selection 1" and "Acceleration/deceleration time selection 2" are given priority.	0.0 to 120.0	0.0 Hz	No	A
C2-01	S-curve characteristic time at acceleration start	Set the S-curve characteristic time for each part in seconds. When you set the S-curve characteristic time, the start time and end time S-curve characteristic time's acceleration time is lengthened by 1/2 only.  The S-curve characteristic time at start and end of deceleration is fixed to 0.2 sec. and can not be changed.	0.00 to 2.50	0.20 s	No	A
C2-02	S-curve characteristic time at acceleration end		0.00 to 2.50	0.20 s	No	A

■Switching Acceleration and Deceleration Time Using Multi-Function Input Terminal Commands

Using VARISPEED E7, you can set two acceleration times and two deceleration times. When the multi-function input terminals (H1-□□) are set to 7 (acceleration/deceleration time selection 1), you can switch the acceleration/deceleration time even during operation.

The following table shows the acceleration/deceleration time switching combinations.

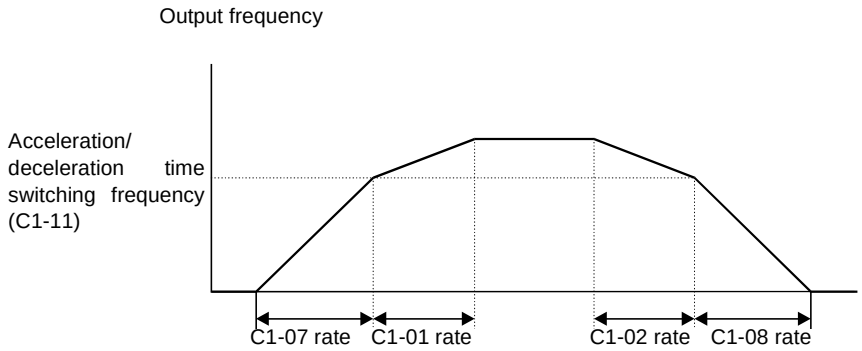
Acceleration/Deceleration Time Selection 1 Terminal	Acceleration Time	Deceleration Time
OFF	C1-01	C1-02
ON	C1-03	C1-04

■Switching Acceleration and Deceleration Time Automatically

Use this setting when you want to switch acceleration/deceleration time automatically using the output frequency.

When the output frequency reaches the set value in C1-11, the Inverter switches the acceleration/deceleration time automatically as shown in the following diagram.

Set C1-11 to a value other than 0.0 Hz. If C1-11 is set to 0.0 Hz, the function will be disabled.



When output frequency ≥ C1-11, acceleration and deceleration are performed using Acceleration/deceleration Time 1 (C1-01, C1-02).

When output frequency < C1-11, acceleration and deceleration are performed using Acceleration/deceleration Time 2 (C1-03, C1-04).

Fig 6.17 Acceleration/deceleration Time Switching Frequency

■Entering S-curve Characteristics in the Acceleration and Deceleration Time

By performing acceleration using an S-curve pattern, you can reduce shock when starting the machine.

By using the VARISPEED E7 inverter, you can set an S-curve characteristic time for each of the following: At acceleration start, and at acceleration end.

For deceleration start and deceleration end the S-curve characteristic times are fixed to 0.2 sec. They can not be switched off or changed.

INFO

When S-curve is set, calculate acceleration/deceleration time as follows:

Acceleration time = Selected acceleration time + (Acceleration start time S-curve characteristic time + Acceleration end time S-curve characteristic time) / 2

Setting Example

The S-curve characteristic when switching operation (forward/reverse) is shown in the following diagram.

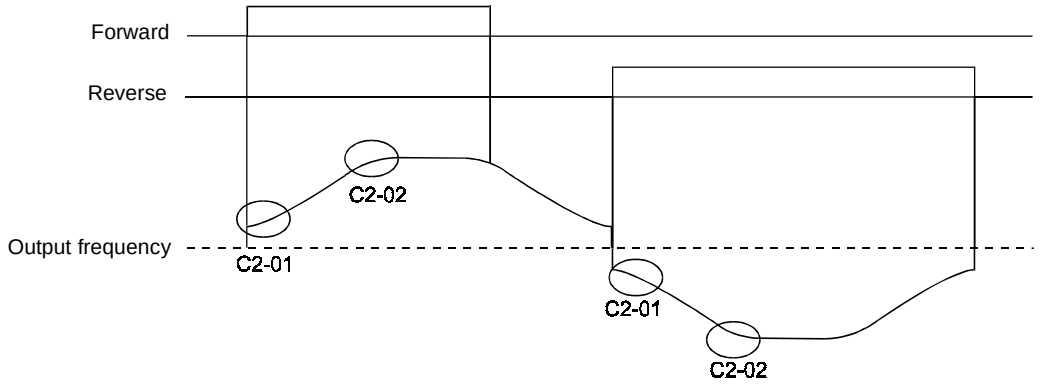


Fig 6.18 S-curve Characteristic during Operation Switching

◆ Preventing the Motor from Stalling During Acceleration (Stall Prevention During Acceleration Function)

The Stall Prevention During Acceleration function prevents the motor from stalling if a heavy load is applied to the motor, or sudden rapid acceleration is performed.

If you set L3-01 to 1 (enabled) and the Inverter output current exceeds the -15% level of the set value in L3-02, the acceleration rate will begin to slow down. When L3-02 is exceeded, acceleration will stop.

If you set L3-01 to 2 (optimum adjustment), the motor current accelerates to the value set in L3-02. With this setting, the acceleration time setting is ignored.

■Related Parameters

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L3-01	Stall prevention selection during acceleration	0: Disabled (Accelerates according to the setting. Motor may stall if the load is too high.) 1: Enabled (Acceleration stops when the level set in L3-02 is exceeded. Acceleration continues when current value is reduced.) 2: Optimum adjustment (Adjusts acceleration using the level set in L3-02 as the standard. The acceleration time setting is ignored.)	0 to 2	1	No	A
L3-02	Stall prevention level during acceleration	Set as a percentage taking the Inverter rated current to be 100%. Normally, it is not necessary to change this setting. Lower the set value if the motor stalls using the factory setting.	0 to 200	120%	No	A

■Time Chart

The following figure shows the frequency characteristics when L3-01 is set to 1.

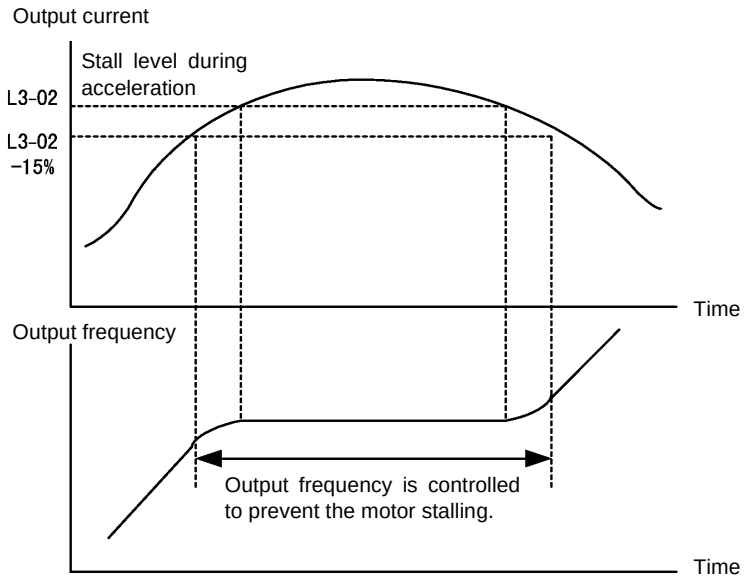


Fig 6.19 Time Chart for Stall Prevention During Acceleration

■Setting Precautions

- If the motor capacity is small compared to the Inverter capacity, or if the motor is operated using the factory settings, resulting in the motor stalling, lower the set value of L3-02.
- If using the motor in the constant output range, L3-02 will be automatically lowered to prevent stalling.
- Set the constants as a percentage taking the inverter rated current to be 100%.

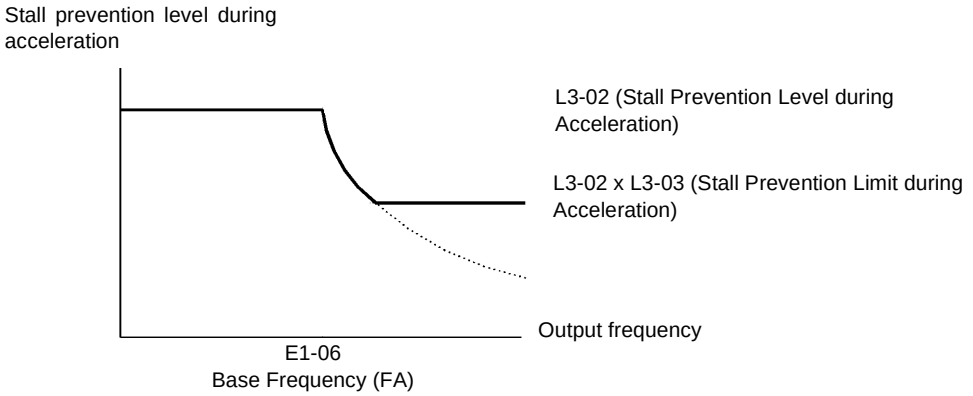


Fig 6.20 Stall Prevention Level and Limit During Acceleration

◆ Preventing Overvoltage During Deceleration (Stall Prevention During Deceleration Function)

This function automatically lengthens the deceleration time with respect to the DC-bus voltage to avoid overvoltage tripping.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Acess Level
L3-04	Stall prevention selection during deceleration function selection	0: Disabled (Motor decelerates according to setting. When the deceleration time is short, there is a risk of DC bus overvoltage (0V) occurring.) 1: Enabled (Prevents deceleration when DC bus voltage reaches the overvoltage level. Deceleration restarts after voltage has been restored.) 2: Optimum adjustment (Minimizes deceleration judging from DC bus voltage. The deceleration time setting is ignored.) If using the dynamic brake option (Braking Resistor Units and Braking Units), be sure to set constant L3-04 to 0.	0 to 2	1	No	A

■Setting Example

An example of stall prevention during deceleration when L3-04 is set to 1 as shown below.

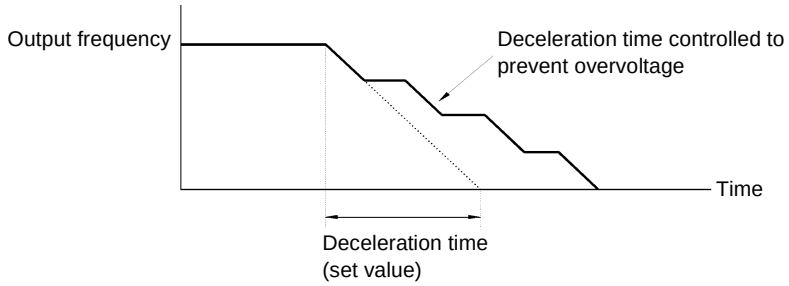


Fig 6.21 Stall Prevention During Deceleration Operation

■Setting Precautions

- The stall prevention level during deceleration differs depending on the inverter rated voltage and the input voltage. Refer to the following table for details.

Inverter Rated/Input Voltage		Stall Prevention Level during Deceleration (V)
200 V class		380
400 V class	E1-01 ≥ 400 V	760
	E1-01 < 400 V	660

- When using the braking option (Braking Resistor Units and Braking Units), be sure to set constant L3-04 to 0.

Adjusting Frequency References

◆ Adjusting Analog Frequency References

Gain and bias are among the constants used to adjust analog inputs.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
H3-02	Frequency reference (voltage) terminal A1 input gain	Set the frequency during 10 V input as a percentage, taking max. output frequency to be 100%.	0.0 to 1000.0	100.0%	Yes	A
H3-03	Frequency reference (voltage) terminal A1 input bias	Set the frequency during 0 V input as a percentage, taking max. output frequency to be 100%.	-100.0 to +100.0	0.0%	Yes	A
H3-08	Multi-function analog input terminal A2 signal level selection	0: 0 to +10V input. 2: 4 to 20 mA (9-bit input). Switch current and voltage input using the switch S1 on the control panel.	0 or 2	2	No	A
H3-09	Multi-function analog input terminal A2 function selection	Select multi-function analog input function for terminal A2.	0 to 1F	0	No	A
H3-10	Multi-function analog input (current) terminal A2 input gain	Set the reference capacity for each function during 10 V (20 mA) input as a percentage. Set the 100% content function selected using H3-09 to 100%.	0.0 to 1000.0	100.0%	Yes	A
H3-11	Multi-function analog input (current) terminal A2 input bias	Set the reference capacity for each function during 0 V (4 mA) input as a percentage. Set the 100% content function selected using H3-09 to 100%.	-100.0 to +100.0	0.0%	Yes	A

■Adjusting Analog Frequency Reference Using Constants

The frequency reference is input from the control circuit terminals using analog voltage and current.

If using frequency reference terminal A1 as an input terminal, perform adjustments using constants H3-02 and H3-03. If using multi-function analog input terminal A2 as a frequency reference terminal, perform adjustments using H3-10 and H3-11.

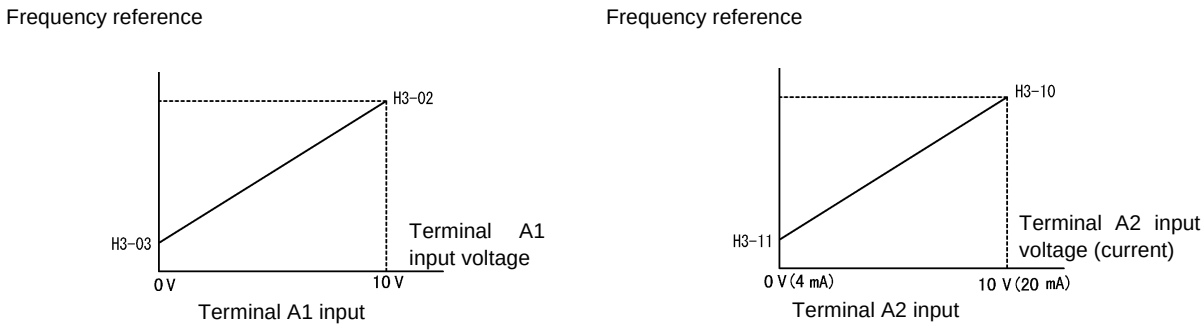


Fig 6.22 Terminals A1 and A2 Inputs

■Adjusting Frequency Gain Using an Analog Input

When H3-09 is set to 1 (frequency gain), you can adjust the frequency gain using an analog input.

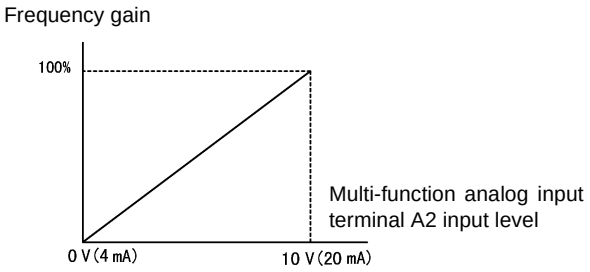
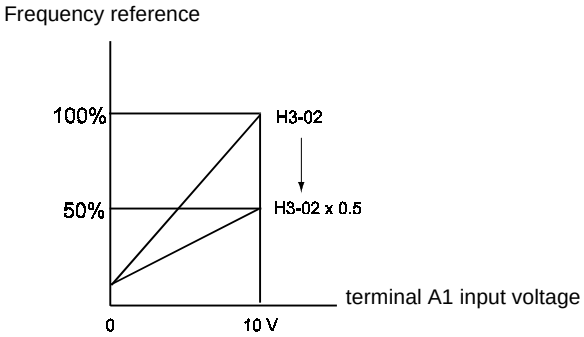


Fig 6.23 Frequency Gain Adjustment (Terminal A2 Input)

The frequency gain for terminal A1 is the sum of H3-02 and terminal A2 gain. For example, when H3-02 is set to 100% and terminal A2 is set to 5 V, the terminal A1 frequency reference will be 50%.



■Adjusting Frequency Bias Using an Analog Input

When constant H3-09 is set to 0 (add to terminal A1), the frequency equivalent to the terminal A2 input voltage is added to A1 as a bias.

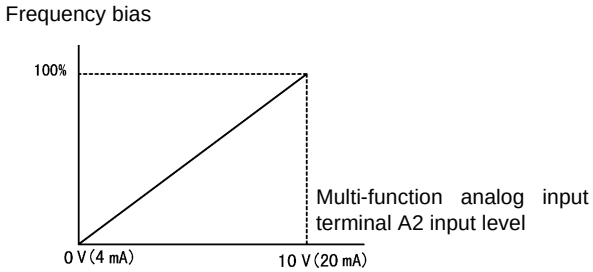
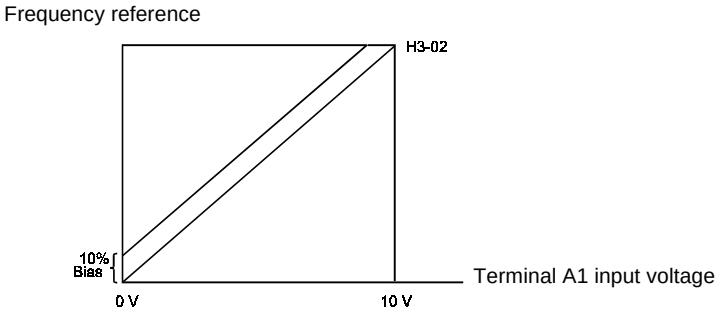


Fig 6.24 Frequency Bias Adjustment (Terminal A2 Input)

For example, if H3-02 is 100%, H3-03 is 0%, and terminal A2 is set to 1 V, the frequency reference from terminal A1 when 0 V is input to A1 will be 10%.



◆ Operation Avoiding Resonance (Jump Frequency Function)

- This function allows the prohibition or „jumping“ of certain frequencies within the Inverter’s output frequency range so that the motor can operate without resonant oscillations caused by some machine systems.
- It is also used for deadband control.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d3-01	Jump frequency 1	Set the frequency center value at which to prohibit settings. Set to 0.0 to disable the jump frequency. Make sure the settings are as follows: d3-01 ≥ d3-02 ≥ d3-03. Operation within the jump frequency range is prohibited. Changes during acceleration and deceleration are made gradually without performing jumps.	0.0 to 120.0	0.0 Hz	No	A
d3-02	Jump frequency 2			0.0 Hz	No	A
d3-03	Jump frequency 3			0.0 Hz	No	A
d3-04	Jump frequency width	Set the jump frequency width in hertz. The jump frequency range is as follows: (Jump frequency ±d3-04).	0.0 to 20.0	1.0 Hz	No	A

The relationship between the output frequency and the jump frequency reference is as follows:

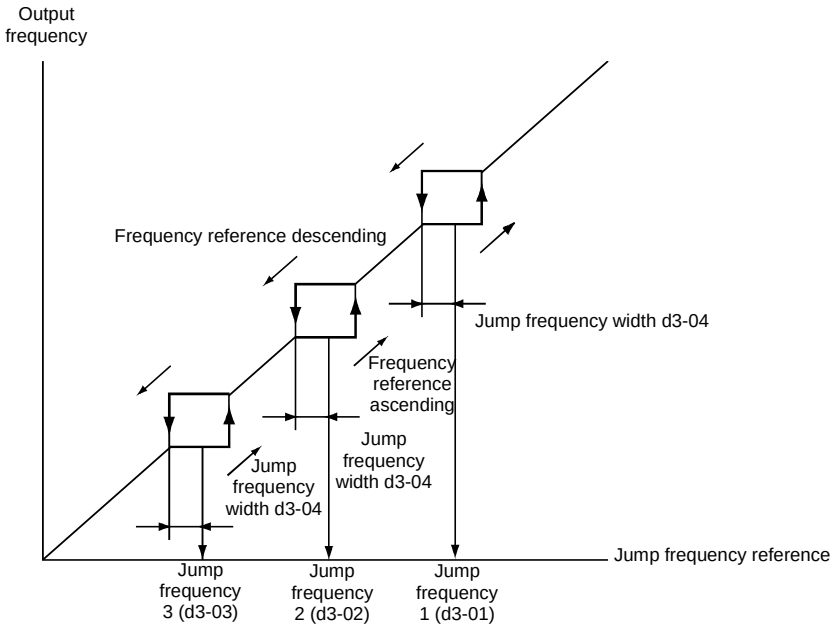


Fig 6.25 Jump Frequency

■Setting Precautions

- Set the jump frequency according to the following formula: d3-01 ≥ d3-02 ≥ d3-03 > Analog input.
- When constants d3-01 to d3-03 are set to 0 Hz, the jump frequency function is disabled.

Speed Limit (Frequency Reference Limit Function)

◆ Limiting Maximum Output Frequency

If you do not want the motor to rotate above a given frequency, use constant d2-01.

Set the upper limit value of the Inverter output frequency as a percentage, taking E1-04 (Maximum Output Frequency) to be 100%.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d2-01	Frequency reference upper limit	Set the output frequency upper limit, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0%	No	A

◆ Limiting Minimum Frequency

If you do not want the motor to rotate at below a given frequency, use constants d2-02 or d2-03.

There are two methods of limiting the minimum frequency, as follows:

- Adjust the minimum level for all frequencies.
- Adjust the minimum level for the master speed frequency (i.e., the lower levels of the jog frequency, multi-step speed frequency, and auxiliary frequency will not be adjusted).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d2-02	Frequency reference lower limit	Set the output frequency lower limit, taking the base reference to be 100%.	0.0 to 110.0	0.0%	No	A
d2-03	Master speed reference lower limit	Set the master speed reference lower limit, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A

Improved Operating Efficiency

This section explains functions for improving motor operating efficiency.

◆ Compensating for Insufficient Torque at Start and Low-speed Operation (Torque Compensation)

The torque compensation function detects that the motor load has increased, and increases the output torque.

The Torque Compensation function calculates and adjusts the motor primary loss voltage according to the output voltage (V), and compensates for insufficient torque at startup and during low-speed operation. Calculate the compensation voltage as follows: Motor primary voltage loss × constant C4-01.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
C4-01	Torque compensation gain	Set the torque compensation gain using the multiplication factor. Normally, there is no need to set this constant. Adjust the torque compensation gain in the following circumstances. • If the cable is very long, increase the set value. • If the (maximum applicable) motor capacity is smaller than the Inverter capacity, increase the set value. • If the motor is vibrating, reduce the set value. Adjust this constant so that the output current during low-speed rotation does not exceed the Inverter rated output current range.	0.00 to 2.50	1.00	Yes	A
C4-02	Torque compensation primary delay time constant	Set the primary delay for the torque compensation function in ms. Normally, there is no need to make this setting. Adjust this constant in the following circumstances. • If the motor is vibrating, increase the set value. • If the motor response is low, decrease the set value.	0 to 10000	200 ms	No	A

■Adjusting Torque Compensation Gain

Normally, there is no need to make this adjustment.

Adjust the torque compensation gain under the following circumstances.

- If the cable is very long, increase the set value.
- If the (maximum applicable) motor capacity is smaller than the Inverter capacity, increase the set value.
- If the motor is vibrating, reduce the set value.

Adjust this constant so that the output current during low-speed rotation does not exceed the Inverter rated output current range.

■Adjusting the Torque Compensation Primary Delay Time Constant

Set the torque compensation function primary delay in ms.

Normally, there is no need to make this setting. Adjust the constant as shown below.

- If the motor is vibrating, increase the set value.
- If the motor response is low, decrease the set value.

◆ Hunting-prevention Function

The hunting-prevention function suppresses hunting when the motor is operating with a light load.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
N1-01	Hunting-prevention function selection	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. If high response is to be given priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A
N1-02	Hunting-prevention gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to make this setting. Make the adjustments as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A

Machine Protection

◆ Preventing Motor Stalling During Operation

Stall prevention during operation prevents the motor from stalling by automatically lowering the Inverter's output frequency when a transient overload occurs while the motor is operating at a constant speed.

If the Inverter output current continues to exceed the setting in constant L3-06 for 100 ms or longer, the motor speed is reduced. Set whether to enable or disable deceleration time using constant L3-05. Set the deceleration time using C1-02 (Deceleration time 1) or C1-04 (Deceleration Time 2).

If the Inverter output current reaches the set value in L3-06 – 2%, the motor will accelerate again to the set frequency.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L3-05	Stall prevention selection during running function selection	0: Disabled (Operates according to the setting. Motor may stall when the load is large.) 1: Enabled--Deceleration time 1 (Stall prevention function during operation deceleration time is set in C1-02.) 2: Enabled--Deceleration time 2 (Stall prevention function during operation deceleration time is set in C1-04.)	0 to 2	1	No	A
L3-06	Stall prevention level during running	Enabled when L3-05 is set to 1 or 2. Set as a percentage, taking Inverter rated current to be 100%. Normally, there is no need to make this setting. Lower the set value if the motor stalls at the factory setting.	30 to 200	120%	No	A

◆ Detecting Motor Torque

If an excessive load is placed on the machinery (overtorque) or the load is suddenly lightened (undertorque), you can output an alarm signal to multi-function output terminal M1-M2 or M3-M4.

To use the overtorque/undertorque detection function, set B, 17 (overtorque/undertorque detection NO/NC) in one of the following constants: H2-01 and H2-02 (multi-function output terminals M1-M2 and M3-M4 function selection).

The overtorque/undertorque detection level is the current level (Inverter rated output current 100%).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L6-01	Torque detection selection 1	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A
L6-02	Torque detection level 1	V/f control: Inverter rated current is set as 100%.	0 to 300	150%	No	A
L6-03	Torque detection time 1	Set the overtorque/undertorque detection time.	0.0 to 10.0	0.1 s	No	A

Multi-function Output (H2-01 and H2-02)

Set Value	Function
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque detection and undertorque detection enabled when contact is ON)
17	Overtorque/undertorque detection 1 NC (NC contact: Overtorque detection and undertorque detection enabled when contact is OFF)

■L6-01 Set Values and LED Indicators

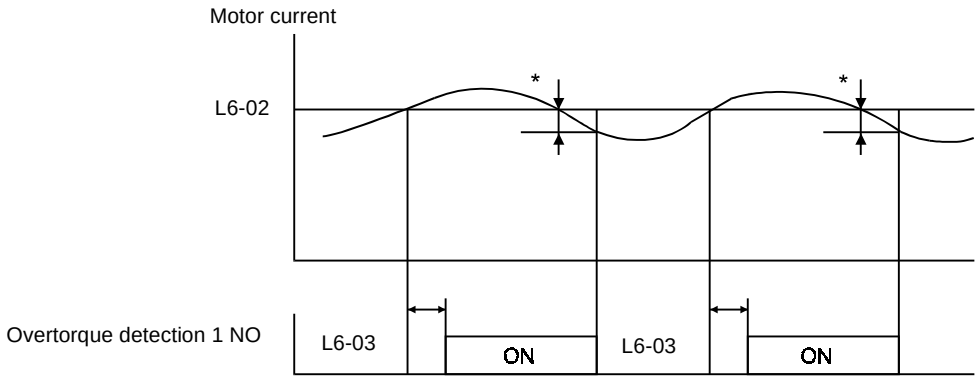
The relationship between alarms displayed by the Digital Operator when overtorque or undertorque is detected, and the set values in L6-01, is shown in the following table.

Set Value	Function	LED Indicator
		Overtorque/Undertorque Detection 1
0	Overtorque/undertorque detection disabled.	-
1	Overtorque detection only with speed matching; operation continues after overtorque (warning).	OL3 flashes
2	Overtorque detected continuously during operation; operation continues after overtorque (warning).	OL3 flashes
3	Overtorque detection only with speed matching; output stopped upon detection (protected operation).	OL3 lit
4	Overtorque detected continuously during operation; output stopped upon detection (protected operation).	OL3 lit
5	Undertorque detection only with speed matching; operation continues after overtorque (warning).	UL3 flashes
6	Undertorque detected continuously during operation; operation continues after overtorque (warning).	UL3 flashes
7	Undertorque detection only with speed matching; output stopped upon detection (protected operation).	UL3 lit
8	Undertorque detected continuously during operation; output stopped upon detection (protected operation).	UL3 lit

■Setting Example

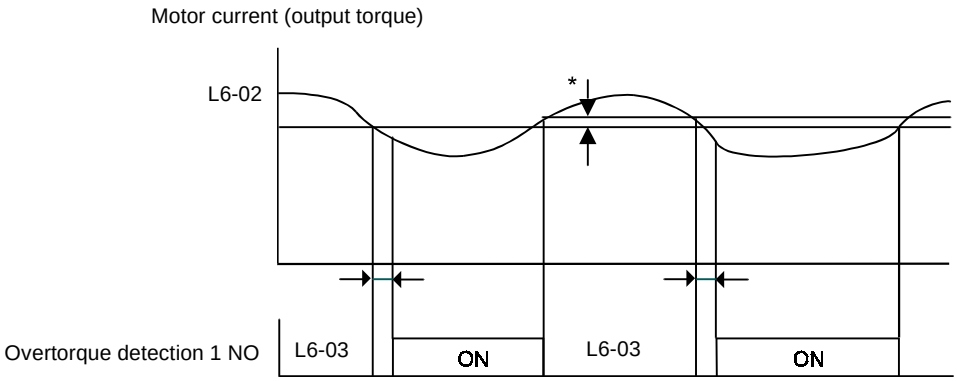
The following diagram shows the time chart for overtorque and undertorque detection.

- Overtorque Detection



*Overtorque detection disabled band is approximately 10% of the Inverter rated output current.

- Undertorque Detection



*Overtorque detection disabled band is approximately 10% of the Inverter rated output current.

◆ Motor Overload Protection

You can protect the motor from overload using the Inverter's built-in electronic thermal overload relay.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods
E2-01	Motor rated current	Set the motor rated current. This set value becomes the base value for motor protection and torque limit. It is an input data for autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q
L1-01	Motor protection selection	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General motor protection With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this constant has been set to 1, as the thermal value will be reset. If multiple motors are connected to one Inverter, set this constant to 0, and install a thermal relay in each motor.	0 or 1	1	No	Q
L1-02	Motor protection time constant	Set the electronic thermal detection time in minutes. Normally, there is no need to make this setting. The factory setting is resistance at 150% for 1 min. If the motor overload resistance is clear, set the overload resistance protection time during hot start to suit the motor.	0.1 to 5.0	1.0 min	No	A

* 1. Factory settings depend on Inverter capacity. (The shown values are for a 200 V Class Inverter for 0.4 kW.)

* 2. The settings range is 10% to 200% of the Inverter rated output current. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

Multi-Function Outputs (H2-01 and H2-02)

Set Value	Function
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)

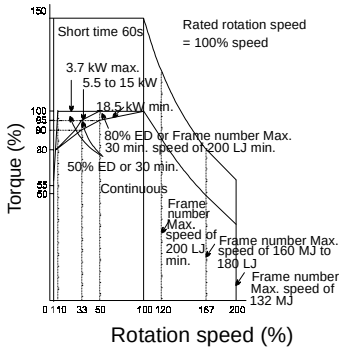
■Setting Motor Rated Current

Set the rated current value on the motor nameplate in constants E2-01 (for motor 1).

■Motor Overload Protection Characteristics

Enable or disable the overload protection function for a general purpose motor.

The following table shows the motor type and tolerance load characteristics.

L1-01 Set Value	Motor Type	Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
1	General-purpose motor (standard motor)		Use this motor for operations using a commercial power supply. This motor construction yields best cooling effect when operating at 50/60 Hz.	When operating continuously at 50/60 Hz or less, motor overload detection (OL1) is detected. The Inverter outputs the error contact, and the motor coasts to a stop.

■Setting Motor Protection Operation Time

Set the motor protection operation time in L1-02.

If, after operating the motor continuously at the rated current, a 150% overload is experienced, set the (hot start) electronic thermal protection operation time. The factory setting is resistance to 150% for 60 seconds.

The following diagram shows an example of the characteristics of the electronic thermal protection operation time (L1-02 = 1.0 min., operation at 60 Hz, general-purpose motor characteristics, when L1-01 is set to 1)

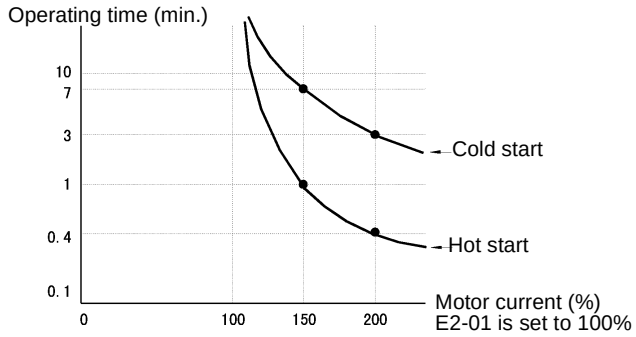


Fig 6.26 Motor Protection Operation Time

■Setting Precautions

- If multiple motors are connected to one Inverter, set constant L1-01 to 0 (disabled). To protect the motor, install a thermal relay in the motor power cable, and perform overload protection on each motor.
- With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this constant has been set to 1 (enabled), because the thermal value will be reset.
- For save overload tripping, set the set value in constant L1-02 to a low setting.
- When using a general-purpose motor (standard motor), the cooling ability will be lowered by $f^{1/4}$ (frequency). Consequently, the frequency may cause motor overload protection (OL1) to occur, even below the rated current. If operating using the rated current at a low frequency, use a special motor.

■Setting the Motor Overload Pre-Alarm

If the motor overload protection function is enabled (i.e., L1-01 is set to 1) and you set H2-01 or H2-02 (multi-function output terminals M1-M2 and M3-M4 function selection) to 1F (motor overload OL1 pre-alarm), the motor overload pre-alarm will be enabled. If the electronic thermal value reaches minimum 90% of the overload detection level, the output terminal that has been set will be turned ON.

◆ Motor Overheating Protection Using PTC Thermistor Inputs

Perform motor overheating protection using the thermistor temperature resistance characteristics of the PTC (Positive Temperature Coefficient) built into the windings of each motor phase.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L1-03	Alarm operation selection during motor overheating	Set H3-09 to E, and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level (1.17 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09. 3: Continue operation (OH3 on the Digital Operator flashes).	0 to 3	3	No	A
L1-04	Motor overheating operation selection	Set H3-09 to E, and select the operation when the motor temperature (thermistor) input exceeds the operation detection level (2.34 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09.	0 to 2	1	No	A
L1-05	Motor temperature input filter time constant	Set H3-09 to E, and set the primary delay time constant for motor temperature (thermistor) inputs in seconds.	0.00 to 10.00	0.20 s	No	A

■PTC Thermistor Characteristics

The following diagram shows the characteristics of the PTC thermistor temperature to the resistance value.

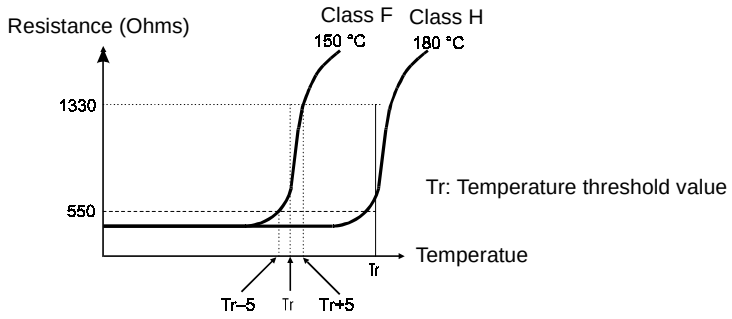


Fig 6.27 PTC Thermistor Temperature-Resistance Value Characteristics

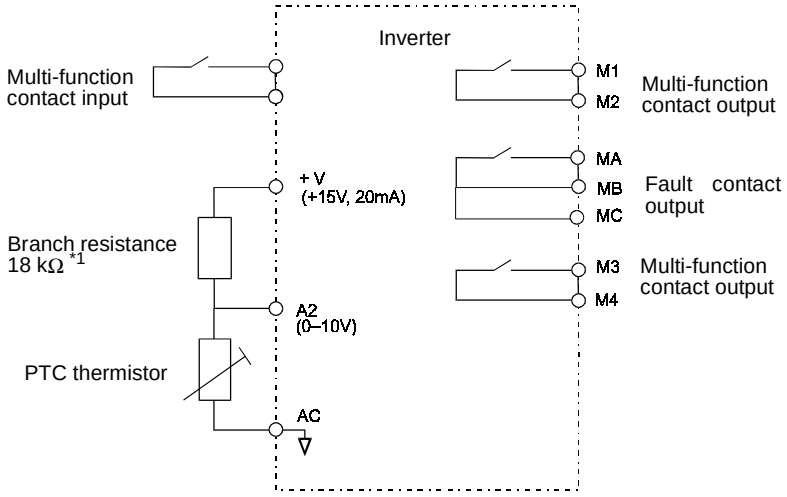
■Operation during Motor Overheating

Set the operation if the motor overheats in constants L1-03 and L1-04. Set the motor temperature input filter time constant in L1-05. If the motor overheats, the OH3 and OH4 error codes will be displayed on the Digital Operator.

Error Codes If the Motor Overheats

Error Code	Details
OH3	Inverter stops or continues to operate, according to the setting in L1-03.
OH4	Inverter stops according to the setting in L1-04.

By setting H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to E (Motor temperature input), you can detect alarm OH3 or OH4 using the PTC temperature-resistance characteristics, and protect the motor. The terminal connections are shown in the following diagram.



*1 The resistance value of 18 kΩ is only valid for using a 3-phase PTC with the characteristic shown on the previous page.

Fig 6.28 Mutual Connections for Motor Overheating Protection

Setting Precautions

- When inputting a voltage signal to terminal A2, pin 2 of the DIP-switch S1 on the control terminal board has to be turned to OFF (A2 voltage input). The factory setting is ON (A2 current input).
- The parameter H3-08 (analog input terminal A2 signal level) has to be set to 0 (0-10V input).

◆ Limiting Motor Rotation Direction

If you set motor reverse rotation prohibited, a reverse run command will not be accepted even if it is input. Use this setting for applications in which reverse motor rotation can cause problems (e.g., fans, pumps, etc.)

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled	0 or 1	0	No	A

Continuing Operation

This section explains functions for continuing or automatically restarting Inverter operation after a momentary power loss.

◆ Restarting Automatically After Power Is Restored

After a momentary power loss, the Inverter can be restarted automatically to continue motor operation.

To restart the Inverter after power is recovered, set L2-01 to 1 or 2.

If L2-01 is set to 1, when power is recovered within the time set in L2-02, the Inverter will restart. If the power loss time exceeds the time set in L2-02, an alarm UV1 (main circuit undervoltage) will be detected.

If L2-01 is set to 2, when the main power supply is recovered while the control power supply (i.e., power supply to the control circuit) is backed up, the Inverter will restart. Consequently, alarm UV1 (main circuit undervoltage) will not be detected.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L2-01	Momentary power loss detection	0: Disabled (main circuit undervoltage (UV) detection) 1: Enabled (Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit undervoltage detection.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect main circuit undervoltage.)	0 to 2	0	No	A
L2-02	Momentary power loss ridethru time	Ridethrough time, when momentary power loss selection (L2-01) is set to 1.	0 to 2.0	0.1 s *1	No	A
L2-03	Min. baseblock (BB) time	Set the Inverter's minimum baseblock time; when the Inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times of the motor secondary circuit time constant. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s	No	A
L2-04	Voltage recovery time	Set the time required to return the Inverter output voltage to normal voltage at the completion of a speed search. Set the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s *1	No	A
L2-05	Undervoltage (UV) detection level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage). Usually changing this setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	A

* 1. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

* 2. These values are for a 200 V Class Inverter. For a 400 V Class Inverter, double the values.

■Setting Precautions

- Error output signals are not output during momentary power loss recovery.
- To continue Inverter operation after power has been restored, make settings so that run commands from the control main circuit terminal are stored even while power is suspended.
- If the momentary power loss operation selection is set to 0 (Disabled), when the momentary power loss exceeds 15 ms during operation, alarm UV1 (main circuit undervoltage) will be detected.

◆ Speed Search

The speed search function finds the actual speed of a motor that is coasting without control, and then starts smoothly from that speed. It is also activated after momentary power loss detection when L2-01 is set to enabled.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b3-01	Speed search selection (current detection or speed calculation)	Enables/disables the speed search function for the RUN command and sets the speed search method. 0: Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection The speed search is started from the frequency when power was momentarily lost or the maximum frequency, and the speed is detected when the set search current level is reached.	0 to 4	2	No	A
b3-02	Speed search operating current (current detection)	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Not usually necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%	No	A
b3-03	Speed search deceleration time (current detection)	Sets the output frequency deceleration time during speed search. Set the time for deceleration from the maximum output frequency to the minimum output frequency.	0.1 to 10.0	2.0 s	No	A
b3-05	Speed search wait time (current detection or speed calculation)	Sets the contactor operating delay time when there is a contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	0.2 s	No	A
L2-03	Min. baseblock time	Sets the Inverter's minimum baseblock time, when the inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times the motor secondary circuit time constant. If an overcurrent or undercurrent occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s	No	A
L2-04	Voltage recovery time	Sets the time required to return the Inverter output voltage to normal voltage at the completion of a speed search. Sets the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s*1	No	A

* 1. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

Multi-function Contact Inputs

Set Value	Function	Access Level
61	External search command 1 OFF: Speed search disabled (Start from lowest output frequency) ON: Speed estimation (Estimate the motor speed, and start search from estimated speed) Current detection (Start speed search from maximum output frequency)	Yes
62	External search command 2 OFF: Speed search disabled (Start from lowest output frequency) ON: Speed estimation (Estimate the motor speed, and start search from estimated speed) (Same operation as external search command 1) Current detection: Start speed search from set frequency (reference frequency when search command was input).	Yes

■Setting Precautions

- When both external search commands 1 and 2 are set for the multi-function contact terminals, an OPE03 (invalid multi-function input selection) operation error will occur. Set either external search command 1 or external search command 2.
- If performing speed search using external search commands, add an external sequence so that the run command and external search command are both ON. This two commands must be kept on, at least for the time set in parameter L2-03.
- If the Inverter output is equipped with a contact, set the contact operation delay time in the Speed Search Wait Time (b3-05). The factory setting is 0.2 s. When not using the contact, you can reduce the search time by setting 0.0 s. After waiting for the speed search wait time, the Inverter starts the speed search.
- Constant b3-02 is a current detection speed search (current detection level for search completion). When the current falls below the detection level, the speed search is viewed as completed, and the motor accelerates or decelerates to the set frequency.
- If an overcurrent (OC) is detected when using speed search after power recovery, lengthen the Minimum Baseblock Time (L2-03).

■Application Precautions for Speed Searches Using Estimated Speed

- Always perform stationary autotuning for line-to-line resistance before using speed searches based on estimated speeds.
- If the cable length between the motor and Inverter is changed after autotuning has been performed, perform autotuning again.

■Speed Search Selection

Set whether to enable or disable speed search at start , and set the type of speed search (estimated speed or current detection) using setting b3-01. To perform speed search when inputting the run command, set b3-01 to 1 or 3.

Table 6.1 Search Methods

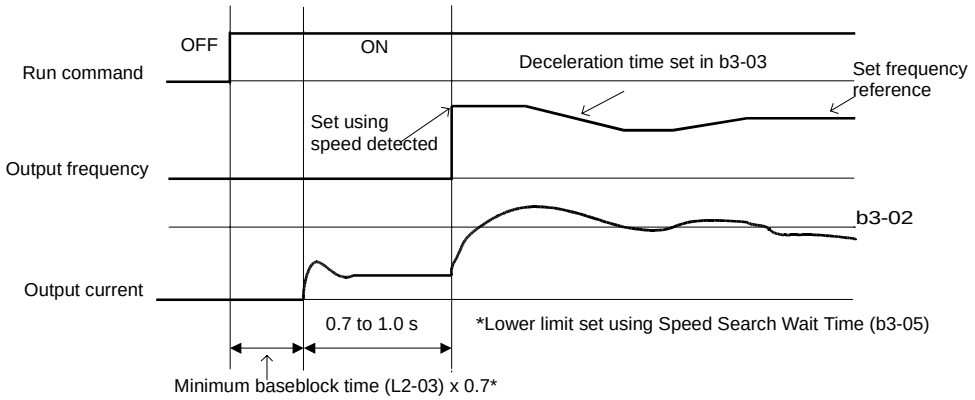
Search Name	Estimated Speed	Current Detection
Search Method	Estimates the motor speed when the search starts, and accelerates and decelerates from the estimated speed to the set frequency. You can also search including direction of motor rotation.	Starts speed search from the frequency when the temporary power loss was detected, or from the highest frequency, and performs speed detection by watching the current level during the search.
External Speed Search Command	External search command 1 and external search command 2 become the same operation, estimating the motor speed and starting the search from the estimated speed.	External speed search command 1: Starts speed search from the maximum output frequency. External speed search command 2: Starts speed search from the frequency reference set before the search command.
Application Precautions	Cannot be used multi-motor drives, motors two or more frames smaller than the Inverter capacity.	The motor may accelerate suddenly with light loads.

■Estimated Speed Search

The time chart for estimated speed searches is shown below.

Search at Startup

The time chart for when speed search at startup and speed search to multi-function input terminals is shown below.



Note: If the stopping method is set to coast to stop, and the run command turns ON in a short time, the operation may be the same as the search in case 2.

Fig 6.29 Speed Search at Startup (Estimated Speed)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time shorter than the Minimum Baseblock Time (L2-03)

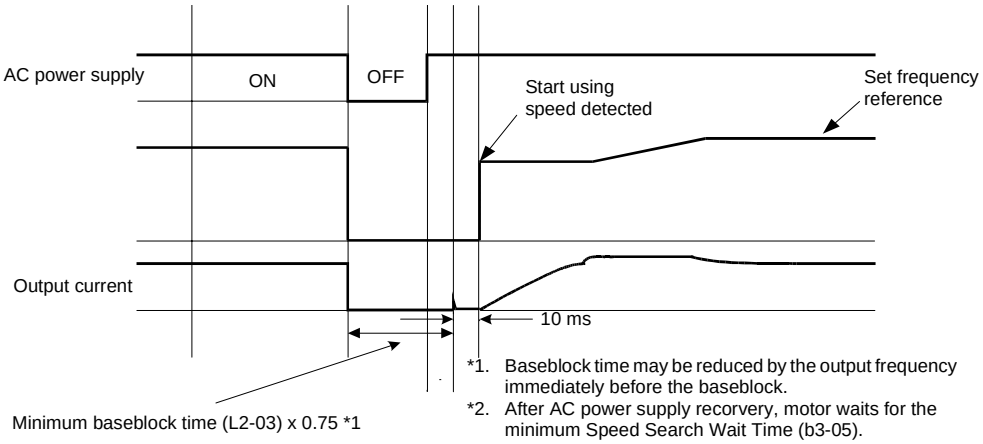
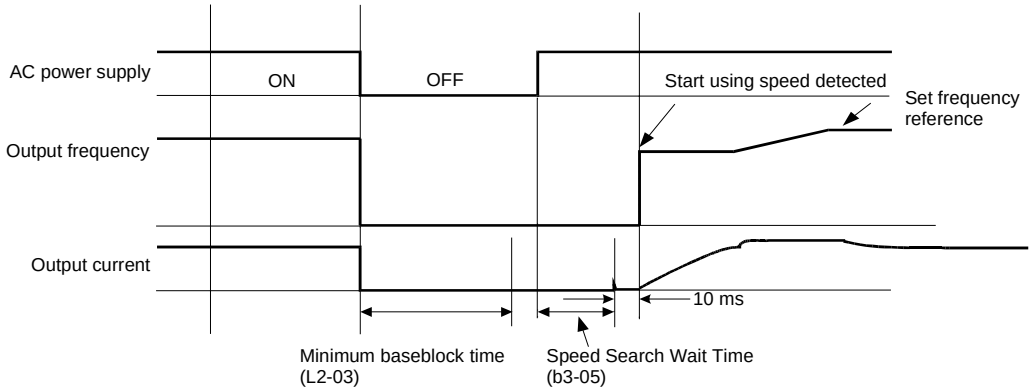


Fig 6.30 Speed Search after Baseblock (When Estimated Speed: Loss Time Is Set in L2-03)

- Loss Time longer than the Minimum Baseblock Time (L2-03)



Note: If the frequency immediately before the baseblock is low or the power supply break time is long, operation may be the same as the search in case 1.

Fig 6.31 Speed Search after Baseblock (Estimated Speed: Loss Time > L2-03)

■Current Detection Speed Search

Speed Search at Startup

The time chart when speed search at startup or external speed search command is selected is shown below.

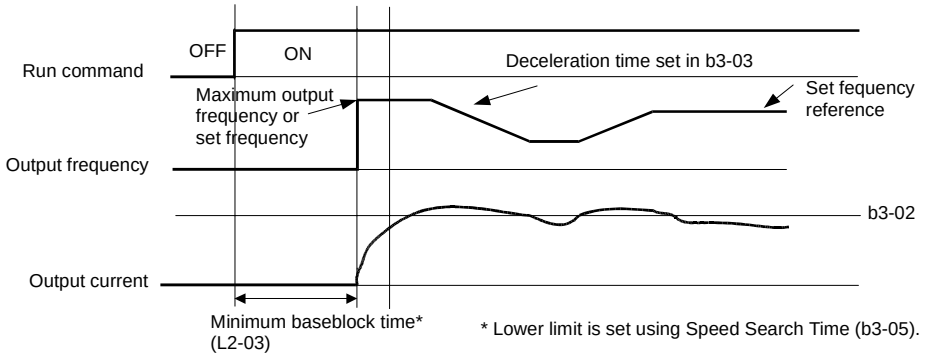


Fig 6.32 Speed Search at Startup (Using Current Detection)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time Shorter Than Minimum Baseblock Time

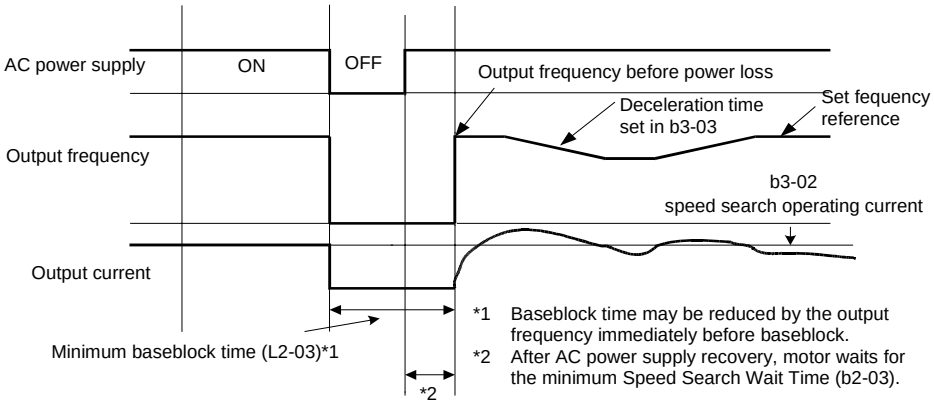


Fig 6.33 Speed Search After Baseblock (Current Detection: Loss Time < L2-03)

- Loss Time Longer Than Minimum Baseblock Time

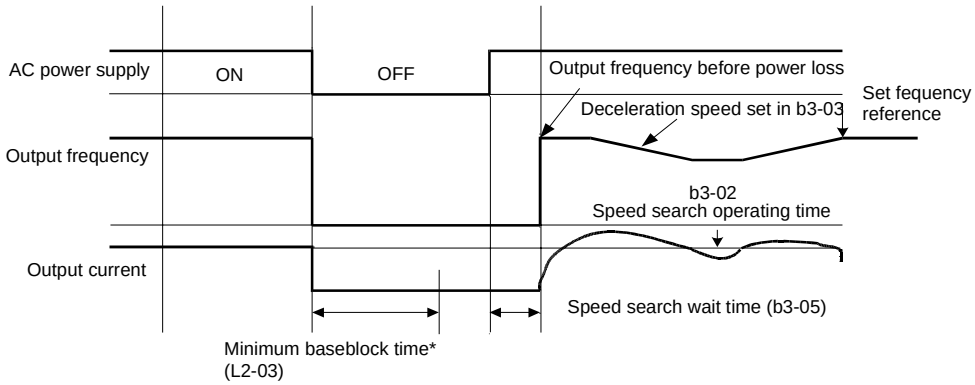


Fig 6.34 Speed Search After Baseblock (Current Detection: Loss Time > L2-03)

◆ Continuing Operation at Constant Speed When Frequency Reference Is Lost

The frequency reference loss detection function continues operation at reduced speed using the set value in parameter L4-06 as frequency reference value. When using an analog input as frequency reference, a frequency reference loss is detected, when the reference value drops over 90 % in 400 ms or less.

When the error signal during frequency reference loss is output externally, set H2-01 or H2-02 (multi-function contact output terminal M1-M2 and M3-M4 function selection) to C (frequency reference lost).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L4-05	Operation when frequency reference is missing	0: Stop 1: Operation (L4-06*fref@loss) inverter runs with reduced speed. Frequency reference is lost: Frequency reference dropped over 90% in 400 ms.	0 or 1	0	No	A
L4-06	Output frequency adjustment after freq. reference loss	If L4-05 is set to 1 and the reference is lost, inverter will run at: fout = L4-06*fref before lossing.	0 – 100%	80%	No	A

◆ Restarting Operation After Transient Error (Auto Restart Function)

If an Inverter error occurs during operation, the Inverter will perform self-diagnosis. If no error is detected, the Inverter will automatically restart. This is called the auto restart function.

Set the number of auto restarts in constant L5-01.

The auto restart function can be applied to the following errors. If an error not listed below occurs, the protection function will operate and the auto restart function will not work.

- OC (Overcurrent)
- GF (Ground fault)
- PUF (Fuse blown)
- OV (Main circuit overvoltage)
- UV1 (Main Circuit Undervoltage, Main Circuit MC Operation Failure)*
- PF (Main circuit voltage fault)
- LF (Output phase failure)
- OL1 (Motor overload)
- OL2 (Inverter overload)
- OH1 (Motor overheat)
- OL3 (Overtorque)

* When L2-01 is set to 1 or 2 (continue operation during momentary power loss)

■Auto Restart External Outputs

To output auto restart signals externally, set H2-01 or H2-02 (multi-function contact output terminals M1-M2 and M3-M4 function selection) to 1E (auto restart).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L5-01	Number of auto restart attempts	Set the number of auto restarts attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A
L5-02	Auto restart operation selection	Sets whether a fault contact output is activated during fault restart. 0: Not output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A

■ Application Precautions

- The number of auto restarts counter is reset under the following conditions:

  After auto restart, normal operation has continued for 10 minutes.

  After the protection operation has been performed, and the error has been verified, and an error reset has been input.

  After the power supply is turned OFF, and then ON again.

Inverter Protection

◆ Reducing Inverter Overheat Pre-Alarm Warning Levels

The Inverter detects the temperature of the cooling fin using the thermistor, and protects the Inverter from overheating.

The following overheating pre-alarm warnings are available: Stopping the Inverter as error protection, and continuing operation, with the alarm OH (Radiation fin overheating) on the Digital Operator flashing.

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
L8-02	Overheat pre-alarm level	Sets the detection temperature for the Inverter overheat detection pre-alarm in °C. The pre-alarm is detected when the cooling fin tempera-ture reaches the set value.	50 to 130	95°C	No	A
L8-03	Inverter overheat (OH) pre-alarm operation selection	Sets the operation for when the Inverter overheat pre-alarm goes ON. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A

Input Terminal Functions

◆ Temporarily Switching Operation between Digital Operator and Control Circuit Terminals

You can switch the Inverter run command inputs and frequency reference inputs between local (i.e., Digital Operator) and remote (input method using b1-01 and b1-02).

You can switch between local and remote by turning ON and OFF the terminals if an input from H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) has been set to 1 (local/remote selection).

To set the control circuit terminals to remote, set b1-01 and b1-02 to 1 (Control circuit terminals).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q
b1-02	Operation method selection	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q

INFO

You can also perform local/remote switching using the LOCAL/REMOTE Key on the Digital Operator. When the local/remote function has been set in the external terminals, the LOCAL/REMOTE Key function on the Digital Operator will be disabled.

◆ Blocking Inverter Outputs (Baseblock Commands)

Set 8 or 9 (Baseblock command NO/NC) in one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to perform baseblock commands using the terminal's ON/OFF operation, and prohibit Inverter output using the baseblock commands.

Clear the baseblock command to restart the operating using speed search from the frequency reference value before the baseblock command was input.

Multi-function Contact Inputs (H1-01 to H1-05)

Set Value	Function
8	External baseblock NO (Normally Open contact: Baseblock when ON)
9	External baseblock NC (Normally Closed contact: Baseblock when OFF)

■Time Chart

The time chart when using baseblock commands is shown below.

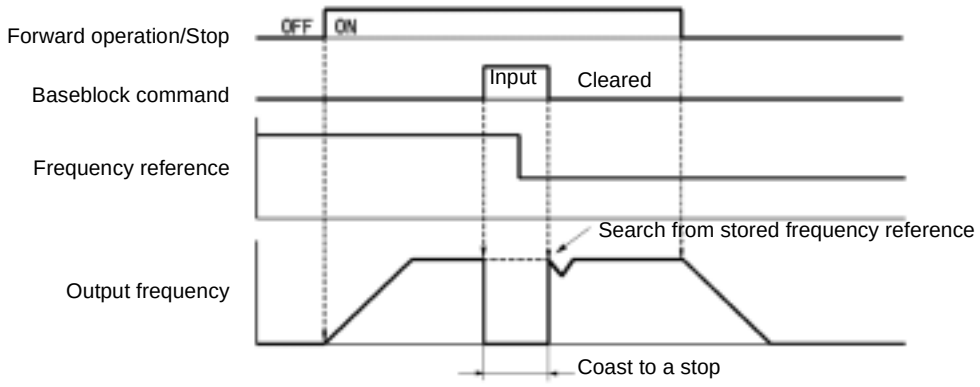


Fig 6.35 Baseblock Commands

IMPORTANT

If using baseblock commands with a variable load, do not frequently input baseblock commands during operation, as this may cause the motor to suddenly start coasting, and may result in the motor falling or slipping.

- Always use base block command when a contactor between inverter and motor is installed.

◆ Hold Analog Frequency Using User-set Timing

When one of H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) is set to 1E (sample/hold analog frequency command), the analog frequency reference will be held from 100 ms after the terminal is turned ON, and operation will continue thereafter at that frequency.

The analog value 100 ms after the command is turned ON is used as the frequency reference.

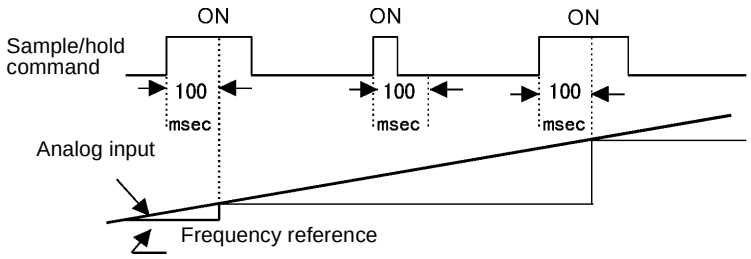


Fig 6.36 Sample/Hold Analog Frequency

■Application Precautions

When setting and executing sample and hold for analog frequency references, observe the following precautions.

- When performing sample/hold of analog frequency reference, be sure to store reference for 100 ms minimum. If the sample/hold time is less than 100 ms, the frequency reference will not be held.
- The analog frequency reference that is held will be deleted when the power supply is turned OFF.

◆ Switching Operations between a Communications Option Card and Control Circuit Terminals

You can switch frequency reference input between the Communications Option Card and the control circuit terminals. Set one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 2 (Option/Inverter selection) to enable switching reference input using the terminal ON/OFF status when the Inverter is stopped.

■Setting Precautions

To switch command inputs between the Communications Option Card and the control circuit terminals, set the following constants.

- Set b1-01 (Reference Selection) to 1 (Control circuit terminal [analog input])
- Set b1-02 (Operation Method Selection to 1 (Control circuit terminal [sequence inputs])
- Set one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 2 (Option/Inverter selection).

Terminal Status	Frequency Reference and Run Command Selection
OFF	Inverter (Can be operated from frequency reference or control circuit terminal from analog input terminal.)
ON	Communications Option Card (Frequency reference and run command are enabled from communications Option Card.)

◆ Jog Frequency Operation without Forward and Reverse Commands (FJOG/RJOG)

The FJOG/RJOG command functions operate the Inverter using jog frequencies by using the terminal ON/OFF operation. When using the FJOG/RJOG commands, there is no need to input the run command.

To use this function, set one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 12 (FJOG command) or 13 (RJOG command).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d1-17	Jog frequency reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.	0 to 120.00	6.00 Hz	Yes	Q

Multi-Function Contact Inputs (H1-01 to H1-05)

Set Value	Function
12	FJOG command (ON: Forward run at jog frequency d1-17)
13	RJOG command (ON: Reverse run at jog frequency d1-17)

■Application Precautions

- Jog frequencies using FJOG and RJOG commands are given priority over other frequency references.
- When both FJOG command and RJOG commands are ON for 500 ms or longer at the same time, the Inverter stops according to the setting in b1-03 (stopping method selection).

◆ Stopping the Inverter by Notifying Programming Device Errors to the Inverter (External Error Function)

The external error function performs the error contact output, and stops the Inverter operation if the Inverter peripheral devices break down or an error occurs. The digital operator will display EFx (External error [input terminal Sx]). The x in EFx shows the terminal number of the terminal that input the external error signal. For example, if an external error signal is input to terminal S3, EF3 will be displayed.

To use the external error function, set one of the values 20 to 2F in one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection).

Select the value to be set in H1-01 to H1-05 from a combination of any of the following three conditions.

- Signal input level from peripheral devices
- External error detection method
- Operation during external error detection

The following table shows the relationship between the combinations of conditions and the set value in H1-□□.

Set Value	Input Level (See Note 1.)		Error Detection Method (See Note 2.)		Operation During Error Detection			
	NO Contact	NC Contact	Constant Detection	Detection During Operation	Decelerate to Stop (Error)	Coast to Stop (Error)	Emergency Stop (Error)	Continue Operation (Warning)
20	Yes		Yes		Yes			
21		Yes	Yes		Yes			
22	Yes			Yes	Yes			
23		Yes		Yes	Yes			
24	Yes		Yes			Yes		
25		Yes	Yes			Yes		
26	Yes			Yes		Yes		
27		Yes		Yes		Yes		
28	Yes		Yes				Yes	
29		Yes	Yes				Yes	
2A	Yes			Yes			Yes	
2B		Yes		Yes			Yes	
2C	Yes		Yes					Yes
2D		Yes	Yes					Yes
2E	Yes			Yes				Yes
2F		Yes		Yes				Yes

Note1.Set the input level to detect errors using either signal ON or signal OFF. (NO contact: External error when ON; NC contact: External error when OFF).

2. Set the detection method to detect errors using either constant detection or detection during operation.
Constant detection: Detects while power is supplied to the Inverter.
Detection during operation: Detects only during Inverter operation.

Monitor Constants

◆ Using the Analog Monitor Constants

This section explains the analog monitor constants.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
H4-01	Monitor selection (terminal FM)	Sets the number of the monitor item to be output (U1-□□) at terminal FM. 10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	2	No	A
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 (FM) voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	0 ~ 1000.0%	100%	Yes	Q
H4-03	Bias (terminal FM)	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110.0 ~ +110.0%	0.0%	Yes	A
H4-04	Monitor selection (terminal AM)	Sets the number of the monitor item to be output (U1-□□) from terminal AM. 10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	3	No	A
H4-05	Gain (terminal AM)	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maimum output from the terminal is 10 V. A meter calibration function is available.	0 ~ 1000.0%	50%	Yes	Q
H4-06	Bias (terminal AM)	Set the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110.0 ~ +110.0%	0.0%	Yes	A
H4-07	Analog output 1 signal level selection (FM)	Sets the signal output level for multi-function output 1 (terminal FM) 0: 0 to 10 V output 2: 4 to 20 mA	0 or 1 0, 1, 2	0	No	A
H4-08	Analog output signal 2 level selection (AM)	Sets the signal output level for multi-function output 2 (terminal FM) 0: 0 to 10 V output 2: 4 to 20 mA	0 or 1 0, 1, 2	0	No	A

■Selecting Analog Monitor Items

The digital operator monitor items (U1-□□ [status monitor]) are output from multi-function analog output terminals FM-AC and AM-AC. Refer to *Chapter 5 User Constants*, and set the values for the □□ part of U1-□□ (status monitor).

■Adjusting the Analog Monitor Items

Adjust the output voltage for multi-function analog output terminals FM-AC and AM-AC using the gain and bias in H4-02, H4-03, H4-05, and H4-06.

Adjusting the Meter

The influence of the settings of gain and bias on the analog output channel is shown in Fig. 6.51.

10 V/100% monitor output × output gain + output bias

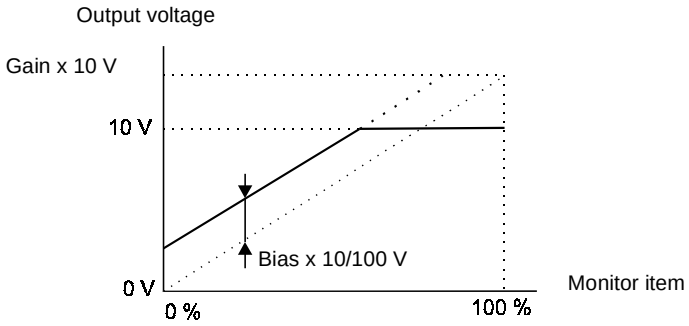


Fig 6.37 Monitor Output Adjustment

Individual Functions

◆ Using MEMOBUS Communications

You can perform serial communications with Programmable Controllers (PLCs) or similar devices using the MEMOBUS protocol.

■MEMOBUS Communications Configuration

MEMOBUS communications are configured using 1 master (PLC) and a maximum of 31 slaves. Serial communications between master and slave are normally started by the master and the slaves respond.

The master performs serial communications with one slave at a time. Consequently, you must set the address of each slave before, so that the master can perform serial communications using that address. Slaves receiving commands from the master perform the specified function, and send a response to the master.

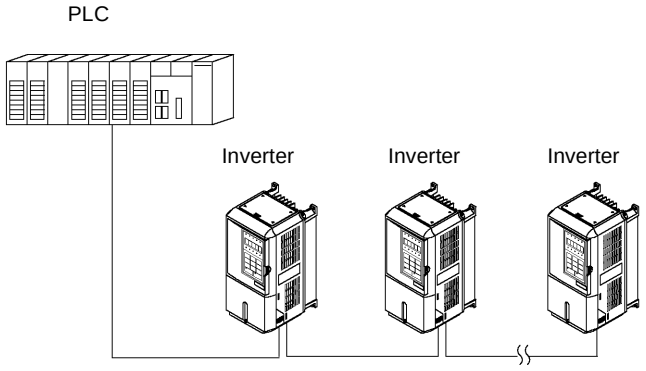


Fig 6.38 Example of Connections between PLC and Inverter

■Communications Specifications

The MEMOBUS communications specifications are shown in the following table.

Item	Specifications
Interface	RS-422, RS-485
Communications Cycle	Asynchronous (Start-stop synchronization)
Communications Parameters	Baud rate: Select from 1,200, 2,400, 4,800, 9,600, and 19,200 bps. Data length: 8 bits fixed Parity: Select from even, odd, or none. Stop bits: 1 bit selected
Communications Protocol	MEMOBUS
Number of Connectable Units	31 units max.

■Communications Connection Terminal

MEMOBUS communications use the following terminals: S+, S-, R+, and R-. Set the terminating resistance by turning ON pin 1 of switch S1 for the last Inverter only, as seen from the PLC.

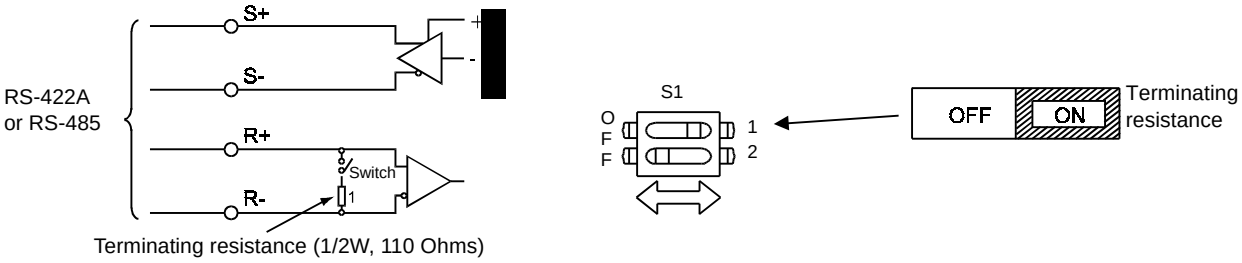
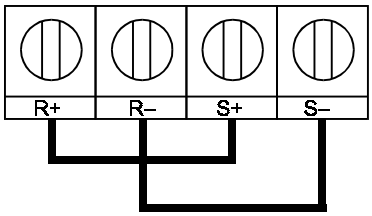


Fig 6.39 Communications Connection Terminal

IMPORTANT

1. Separate the communications cables from the main circuit cables and other wiring and power cables.
2. Use shielded cables for the communications cables, and use proper shield clamps
3. When using RS-485 communications, connect S+ to R+, and S- to R-, on the Inverter exterior. See picture.



■Procedure for Communicating with the PLC

Use the following procedure to perform communications with the PLC.

1. Turn OFF the power supply and connect the communications cable between the PLC and the Inverter.
2. Turn ON the power supply.
3. Set the required communications constants (H5-01 to H5-07) using the Digital Operator.
4. Turn OFF the power supply, and check that the Digital Operator display has completely disappeared.
5. Turn ON the power supply once again.
6. Perform communications with the PLC.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-01	Reference selection	Set the frequency reference input method 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q
b1-02	Operation method selection	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q
H5-01	Station address	Set the Inverter station address [hex].	0 to 20 *	1F	No	A
H5-02	Baud rate selection	Set the baud rate for 6CN MEMOBUS communications. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A
H5-03	Communications parity selection	Set the parity for 6CN MEMOBUS communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A
H5-04	Communication error detection selection	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to a stop 2: Emergency stop using deceleration time in C1-02 3: Continue operation	0 to 3	3	No	A
H5-05	Communications error detection selection	Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect 1: Detect	0 or 1	1	No	A
H5-06	Send wait time	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65 ms	5 ms	No	A
H5-07	RTS control ON/OFF	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A

* Set H5-01 to 0 to disable Inverter responses to MEMOBUS communications.

MEMOBUS communications can perform the following operations regardless of the settings in b1-01 and b1-02.

- Monitoring operation status of the inverter
- Setting and reading constants
- Resetting errors
- Inputting multi-function commands

IMPORTANT

An OR operation is performed between the multi-function commands input from the PLC and commands input from multi-function contact input terminals S3 to S7.

■Message Format

In MEMOBUS communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets is changed by the command (function) contents.

Slave address
Function code
Data
Error check

The space between messages must support the following:

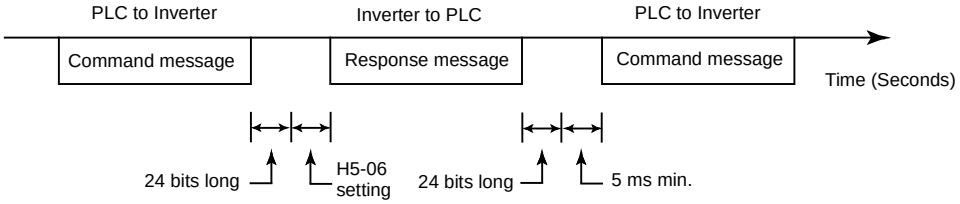


Fig 6.40 Message Spacing

Slave Address

Set the Inverter address from 0 to 32. If you set 0, commands from the master will be broadcast (i.e., the Inverter will not return responses).

Function Code

The function code specifies commands. There are three function codes, as shown below.

Function Code (Hexadecimal)	Function	Command Message		Response Message	
		Min. (Bytes)	Max. (Bytes)	Min. (Bytes)	Max. (Bytes)
03H	Read storage register contents	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write multiple storage registers	11	41	8	8

Data

Configure consecutive data by combining the storage register address (test code for a loopback address) and the data the register contains. The data length changes depending on the command details.

Error Check

Errors are detected during communications using CRC-16. Perform calculations using the following method:

1. The factory setting for CRC-16 communications is usually 0, but when using the MEMOBUS system, set the factory setting to 1 (i.e., set all 16 bits to 1).
2. Calculate CRC-16 using MSB as slave address LSB, and LSB as the MSB of the final data.
3. Also calculate CRC-16 for response messages from the slaves, and compare them to the CRC-16 in the response messages.

■MEMOBUS Message Example

An example of MEMOBUS command/response messages is given below.

Reading Storage Register Contents

Read the contents of the storage register only for specified quantities. The addresses must be consecutive, starting from a specified address. The data content of the storage register are separated into higher 8 bits and lower 8 bits.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 Inverter.

Command Message

Slave Address		02H
Function Code		03H
Start Address	Higher	00H
	Lower	20H
Quantity	Higher	00H
	Lower	04H
CRC-16	Higher	45H
	Lower	F0H

Response Message (During Normal Operation)

Slave Address		02H
Function Code		03H
Data quantity		08H
1st storage register	Higher	00H
	Lower	65H
Next storage register	Higher	00H
	Lower	00H
Next storage register	Higher	00H
	Lower	00H
Next storage register	Higher	01H
	Lower	F4H
CRC-16	Higher	AFH
	Lower	82H

Response Message (During Error)

Slave Address		02H
Function Code		83H
Error code		03H
CRC-16	Higher	F1H
	Lower	31H

Loopback Test

The loopback test returns command messages directly as response messages without changing the contents to check the communications between the master and slave. You can set user-defined test code and data values.

The following table shows a message example when performing a loopback test with the slave 1 Inverter.

Command Message

Slave address		01H
Function code		08H
Test Code	Higher	00H
	Lower	00H
Data	Higher	A5H
	Lower	37H
CRC-16	Higher	DAH
	Lower	8DH

Response Message (During Normal Operation)

Slave address		01H
Function code		08H
Test Code	Higher	00H
	Lower	00H
Data	Higher	A5H
	Lower	37H
CRC-16	Higher	DAH
	Lower	8DH

Response Message (During Error)

Slave address		01H
Function code		89H
Error Code		01H
CRC-16	Higher	86H
	Lower	50H

Writing to Multiple Storage Registers

Write the specified data to the registers from the specified addresses. The written data must be consecutive, starting from the specified address in the command message: Higher 8 bits, then lower 8 bits, in storage register address order.

The following table shows an example of a message when forward operation has been set at a frequency reference of 60.0 Hz in the slave 1 Inverter by the PLC.

Command Message

Slave Address		01H
Function Code		10H
Start Address	Higher	00H
	Lower	01H
Quantity	Higher	00H
	Lower	02H
No. of data		04H
Lead data	Higher	00H
	Lower	01H
Next data	Higher	02H
	Lower	58H
CRC-16	Higher	63H
	Lower	39H

Response Message (During Normal Operation)

Slave Address		01H
Function Code		10H
Start Address	Higher	00H
	Lower	01H
Quantity	Higher	00H
	Lower	02H
CRC-16	Higher	10H
	Lower	08H

Response Message (During Error)

Slave Address		01H
Function Code		90H
Error code		02H
CRC-16	Higher	CDH
	Lower	C1H

* No. of data = 2 x (quantity)

IMPORTANT

Set the number of data specified using command messages as quantity of specified messages x 2. Handle response messages in the same way.

■Data Tables

The data tables are shown below. The types of data are as follows: Reference data, monitor data, and broadcast data.

Reference Data

The reference data table is shown below. You can both read and write reference data.

Register No.	Contents	
0000H	Reserved	
0001H	Frequency reference	
	Bit 0	Run/stop command 1: Run 0: Stop
	Bit 1	Forward/reverse operation 1: Reverse 0: Forward
	Bit 2	External error 1: Error (EFO)
	Bit 3	Error reset 1: Reset command
	Bit 4	ComNet
	Bit 5	ComCtrl
	Bit 6	Multi-function input command 3
	Bit 7	Multi-function input command 4
	Bit 8	Multi-function input command 5
	Bit 9	Multi-function input command 6
	Bit A	Multi-function input command 7
	Bits B to F	Not used
0002H	Frequency reference (Set units using constant o1-03)	
0003H to 0005H	Not used	
0006H	Not used	
0007H	Analog output 1 setting (0 V/0 to 11 V/726) → 10V = 660	
0008H	Analog output 2 setting (0 V/0 to 11 V/726) → 10V = 660	
0009H	Multi-function contact output setting	
	Bit 0	Contact output 1 (Terminal M1-M2) 1: ON 0: OFF
	Bit 1	Contact output 2 (Terminal M3-M4) 1: ON 0: OFF
	Bit 2	Not used
	Bits 3 to 5	Not used
	Bit 6	Set error contact (terminal MA-MC) output using bit 7. 1: ON 0: OFF
	Bit 7	Error contact (terminal MA-MC) 1: ON 0: OFF
	Bits 8 to F	Not used
000AH to 000EH	Not used	

Register No.	Contents	
000FH	Reference selection settings	
	Bit 0	Not used
	Bit 1	Not used
	Bits 3 to B	Not used
	C	Broadcast data terminal S5 input 1: Enabled 0: Disabled
	D	Broadcast data terminal S6 input 1: Enabled 0: Disabled
	E	Broadcast data terminal S7 input 1: Enabled 0: Disabled
	F	Not used

Note Write 0 to all unused bits. Also, do not write data to reserved registers.

Monitor Data

The following table shows the monitor data. Monitor data can only be read.

Register No.	Contents	
0020H	Inverter status	
	Bit 0	Operation 1: Operating 0: Stopped
	Bit 1	Reverse operation 1: Reverse operation 0: Forward operation
	Bit 2	Inverter startup complete 1: Completed 2: Not completed
	Bit 3	Error 1: Error
	Bit 4	Data setting error 1: Error
	Bit 5	Multi-function contact output 1 (terminal M1 - M2) 1: ON 0: OFF
	Bit 6	Multi-function contact output 2 (terminal M3 - M4) 1: ON 0: OFF
	Bit 7	Not used
	Bits 8 to F	Not used
0021H	Error details	
	Bit 0	Overcurrent (OC) Ground fault (GF)
	Bit 1	Main circuit overvoltage (OV)
	Bit 2	Inverter overload (OL2)
	Bit 3	Inverter overheat (OH1, OH2)
	Bit 4	Not used
	Bit 5	Fuse blown (PUF)
	Bit 6	PI feedback reference lost (FbL)
	Bit 7	External error (EF, EFO)
	Bit 8	Hardware error (CPF)
	Bit 9	Motor overload (OL1) or overtorque 1 (OL3) detected
	Bit A	Not used
	Bit B	Main circuit undervoltage (UV) detected
	Bit C	Main circuit undervoltage (UV1), control power supply error (UV2), inrush prevention circuit error (UV3), power loss
	Bit D	Missing output phase (LF)
	Bit E	MEMOBUS communications error (CE)
	Bit F	Operator disconnected (OPR)

Register No.	Contents	
0022H	Data link status	
	Bit 0	Writing data
	Bit 1	Not used
	Bit 2	Not used
	Bit 3	Upper and lower limit errors
	Bit 4	Data integrity error
	Bits 5 to F	Not used
0023H	Frequency reference	Monitors U1-01
0024H	Output frequency	Monitors U1-02
0025H	Output voltage reference (U1-06)	
0026H	Output current	U1-03
0027H	Output power	U1-08
0028H	Not used	
0029H	Not used	
002AH	Not used	
002BH	Sequence input status	
	Bit 0	Multi-function contact input terminal S1 1: ON 0: OFF
	Bit 1	Multi-function contact input terminal S2 1: ON 0: OFF
	Bit 2	Multi-function contact input terminal S3 1: ON 0: OFF
	Bit 3	Multi-function contact input terminal S4 1: ON 0: OFF
	Bit 4	Multi-function contact input terminal S5 1: ON 0: OFF
	Bit 5	Multi-function contact input terminal S6 1: ON 0: OFF
	Bit 6	Multi-function contact input terminal S7 1: ON 0: OFF
	Bits 7 to F	Not used

Register No.	Contents		
002CH	Inverter status		
	Bit 0	Operation	1: Operating
	Bit 1	Zero speed	1: Zero speed
	Bit 2	Frequency matching	1: Matched
	Bit 3	User-defined speed matching	1: Matched
	Bit 4	Frequency detection 1	1: Output frequency ≤ L4-01
	Bit 5	Frequency detection 2	Output frequency ≥ L4-01
	Bit 6	Inverter startup completed	1: Startup completed
	Bit 7	Low voltage detection 1: Detected	
	Bit 8	Baseblock	1: Inverter output baseblock
	Bit 9	Frequency reference mode	1: Not communication 0: Communication
	Bit A	Run command mode	1: Not communication 0: Communication
	Bit B	Overtorque detection	1: Detected
	Bit C	Frequency reference lost	1: Lost
	Bit D	Retrying error	1: Retrying
	Bit E	Error (including MEMOBUS communications time-out) 1:Error occurred	
	Bit F	MEMOBUS communications time-out 1: Timed out	
002DH	Multi-function contact output status		
	Bit 0	Multi-function contact output 1 (terminal M1-M2) 1: ON 0: OFF	
	Bit 1	Multi-function contact output 2 (terminal M3-M4): 1: ON 0: OFF	
	Bit 2	Not used	
	Bits 3 to F	Not used	
002EH - 0030H	Not used		
0031H	Main circuit DC voltage		
0032H - 0037H	Not used		
0038H	PI feedback quantity (Input equivalent to 100%/Max. output frequency; 10/1%; without sign)		
0039H	PI input quantity (±100%/±Max. output frequency; 10/1%; with sign)		
003AH	PI output quantity (±100%/±Max. output frequency; 10/1%; with sign)		
003BH	CPU software number		
003CH	Flash software number		
003DH	Communications error details		
	Bit 0	CRC error	
	Bit 1	Invalid data length	
	Bit 2	Not used	
	Bit 3	Parity error	
	Bit 4	Overrun error	
	Bit 5	Framing error	
	Bit 6	Time-out	
	Bits 7 to F	Not used	
003EH	KVA setting		
003FH	Not used		

Note Communications error details are stored until an error reset is input (you can also reset while the Unit is operating).

Broadcast Data

The following table shows the broadcast data. You can also write this data.

Register Address	Contents	
0001H	Operation signal	
	Bit 0	Run command 1: Operating 0: Stopped
	Bit 1	Reverse operation command 1: Reverse 0: Forward
	Bits 2 and 3	Not used
	Bit 4	External error 1: Error (set using H1-01)
	Bit 5	Error reset 1: Reset command (set using H1-02)
	Bits 6 to B	Not used
	Bit C	Multi-function contact input terminal S5 input
	Bit D	Multi-function contact input terminal S6 input
	Bit E	Multi-function contact input terminal S7 input
	Bit F	Not used.
0002H	Frequency reference	30000/100%

Note Bit signals not defined in the broadcast operation signals use local node data signals continuously.

■ENTER Command

When writing constants to the Inverter from the PLC using MEMOBUS communications, the constants are temporarily stored in the constant data area in the Inverter. To enable these constants in the constant data area, use the ENTER command.

There are two types of ENTER commands: ENTER commands that enable constant data in RAM, and ENTER commands that write data to EEPROM (non-volatile memory) in the Inverter at the same time as enabling data in RAM.

The following table shows the ENTER command data. ENTER command data can only be written.

The ENTER command is enabled by writing 0 to register number 0900H or 0901H.

Register No.	Contents
0900H	Write constant data to EEPROM
0910H	Constant data is not written to EEPROM, but refreshed in RAM only.

INFO

The maximum number of times you can write to EEPROM using the Inverter is 100,000. Do not frequently execute ENTER commands (0900H) written to EEPROM.
The ENTER command registers are write-only. Consequently, if reading these registers, the register address will become invalid (Error code: 02H).

■Error Codes

The following table shows MEMOBUS communications error codes.

Error Code	Contents
01H	Function code error A function code other than 03H, 08H, or 10H has been set by the PLC.
02H	Invalid register number error • The register address you are attempting to access is not recorded anywhere. • With broadcast sending, a start address other than 0000H, 0001H, or 0002H has been set.
03H	Invalid quantity error • The number of data packets being read or written is outside the range 1 to 16. • In write mode, the number of data packets in the message is not No. of packets x 2.
21H	Data setting error • A simple upper limit or lower limit error has occurred in the control data or when writing constants. • When writing constants, the constant setting is invalid.
22H	Write mode error • Attempting to write constants to the inverter during operation. • Attempting to write via ENTER commands during operation. • Attempting to write constants other than A1-00 to A1-05, E1-03, or 02-04 when warning alarm CPF03 (defective EEPROM) has occurred. • Attempting to write read-only data.
23H	Writing during main circuit undervoltage (UV) error • Writing constants to the inverter during UV (main circuit undervoltage) alarm. • Writing via ENTER commands during UV (main circuit undervoltage) alarm.
24H	Writing error during constants processing Attempting to write constants while processing constants in the Inverter.

■Slave Not Responding

In the following cases, the slave will ignore the write function.

- When a communications error (overrun, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the Inverter do not agree.
- When the data that configures the message and the data time length exceeds 24 bits.
- When the command message data length is invalid.

Application Precautions

INFO

If the slave address specified in the command message is 0, all slaves execute the write function, but do not return response messages to the master.

■Self-Diagnosis

The Inverter has a built-in function for self-diagnosing the operations of serial communications interface circuits. This function is called the self-diagnosis function. The self-diagnosis function connects the communications parts of the send and receive terminals, receives the data sent by the Inverter, and checks if communications are being performed normally.

Perform the self-diagnosis function using the following procedure.

1. Turn ON the power supply to the Inverter, and set 67 (communications test mode) in constant H1-05 (Terminal S7 Function Selection).
2. Turn OFF the power supply to the Inverter.
3. Perform wiring according to the following diagram while the power supply is turned OFF.
4. Turn ON the terminating resistance. (Turn ON pin 1 on DIP switch 1.)
5. Turn ON the power supply to the Inverter again.

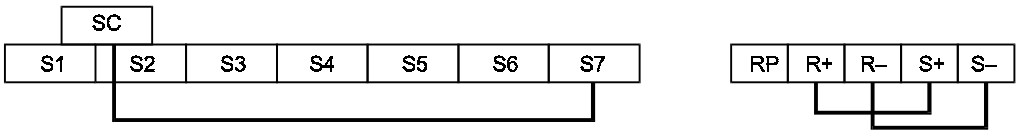


Fig 6.41 Details of Communications Terminals

During normal operation, the Digital Operator displays the frequency reference value.

If an error occurs, a CE (MEMOBUS communications error) alarm will be displayed on the Digital Operator, the error contact output will be turned ON, and the Inverter operation ready signal will be turned OFF.

◆ Using PI Control

PI control is a method of making the feedback value (detection value) match the set target value. By combining proportional control (P) and integral control (I), you can even control targets (machinery) with play time.

The characteristics of the PI control operations are given below.

P control Outputs the amount of operation proportional to the deviation. You cannot, however, set the deviation to zero using P control alone.

I control Outputs the amount of operation that integrates the deviation. Used for matching feedback value to the target value.

■PI Control Operation

To understand the differences between the PI control operations P and I, the variation in the amount of operation (output frequency) is as shown in the following diagram when the deviation (i.e., the difference between the target value and feedback value) is fixed.

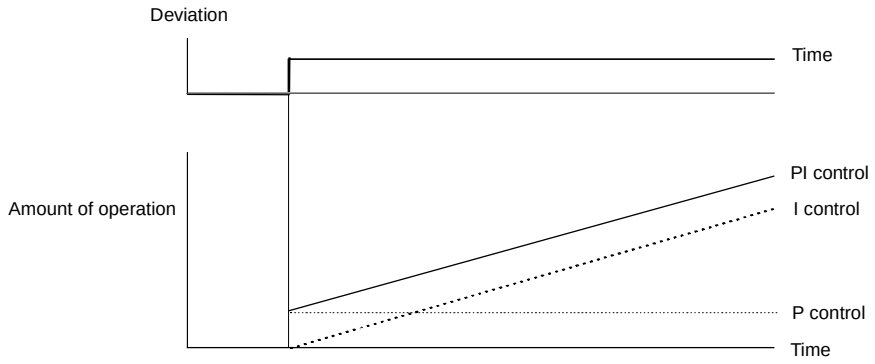


Fig 6.42 PI Control Operation

■PI Control Applications

The following table shows examples of PI control applications using the Inverter.

Application	Control Details	Example of Sensor Used
Speed Control	• Feeds back machinery speed information, and matches speed to the target value. • Inputs speed information from other machinery as the target value, and performs synchronous control using the actual speed feedback.	Tachometer generator
Pressure Control	Feeds back pressure information, and performs constant pressure control.	Pressure sensor
Flow Rate Control	Feeds back flow rate information, and controls the flow rate highly accurately.	Flow rate sensor
Temperature Control	Feeds back temperature information, and performs temperature adjustment control by rotating the fan.	• Thermocouple • Thermistor

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b5-01	PI control mode selection	0: Disabled 1: Enabled	0 or 1	0	No	A
b5-02	Proportional gain (P)	Sets P-control proportional. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A
b5-03	Integral (I) time	Sets I-control integral time. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A
b5-04	Integral (I) limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A
b5-06	PI limit	Sets the limit after PI-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A
b5-07	PI offset adjustment	Sets the offset after PI-control as a percentage of the maximum outut frequency.	-100.0 to +100.0	0.0%	Yes	A
b5-08	PI primary delay time constant	Sets the time constant for low pass filter for PI-control outputs. Not usually necessary to set.	0.00 to 10.00	0.00 s	Yes	A
b5-12	Selection of PI feedback command loss detection	0: No detection of loss of PI feedback 1: Detection of loss of PI feedback. Operation continues during detection, with the malfunctioning contact not operating. 2: Detection of loss of PI feedback. Coasts to stop during detection, and fault contact oprates.	0 to 2	0	No	A
b5-13	PI feedback command loss detection level	Set the PI feedback loss detection level as a percent, with the maximum output frequency at 100%.	0 to 100	0%	No	A
b5-14	PI feedback command loss detection time	Sets the PI feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A
b5-15	PI sleep function operation level	Set the PI sleep function start level as a frequency.	0.0 to 120.0	0.0 Hz	No	A
b5-16	PI sleep operation delay time	Set the delay time until the PI sleep function starts.	0.0 to 25.5	0.0 s	No	A
b5-17	Accel/decel time for PI reference	Set the accel/decel time for PI reference.	0.0 to 25.5	0.0 s	No	A
H6-01	Pulse train input function selection	0: Frequency reference 1: PI feedback value 2: PI target value	0 to 2	0	No	A

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level
U1-24	PI feedback value	Monitors the feedback value when PI control is used. The input for the max. frequency corresponds to 100%.	10 V: Max. frequency (0 to + 10 V possible)	0.01	A
U1-36	PI input volume	PI feedback volume Given as maximum frequency/100%	10 V: Max. frequency (0 to + 10 V possible)	0.01%	A
U1-37	PI output volume	PI control output Given as maximum frequency/100%	10 V: Max. frequency (0 to + 10 V possible)	0.01%	A
U1-38	PI command	PI command + PI command bias Given as maximum frequency/100%	10 V: Max. frequency	0.01%	A

Multi-Function Contact Inputs (H1-01 to H1-05)

Set Value	Function
19	PI control disable (ON: PI control disabled)

Multi-Function Analog Input (H3-09)

Set Value	Function	
B	PI feedback	Max. output frequency

■PI Control Methods

The PI control method can be enabled or disabled by setting constant b5-01.

Set Value	Control Method
0	PI disabled
1	PI output becomes the Inverter output frequency.

PI Feedback Input Methods

The multifunction analog input A2 can be used for PI control feedback input.

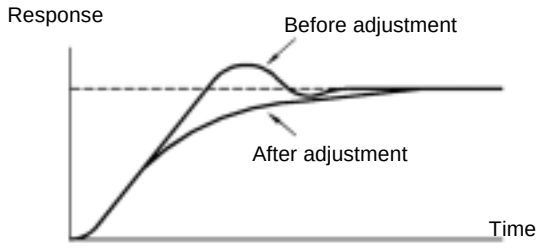
Therefore the parameter H3-09 (Multi-Function Analog Input Terminal A2 Selection) has to be set to B (PI-feedback).

The PI feedback value can be adjusted by using the analog input terminal gain and bias.

■PI Adjustment Examples

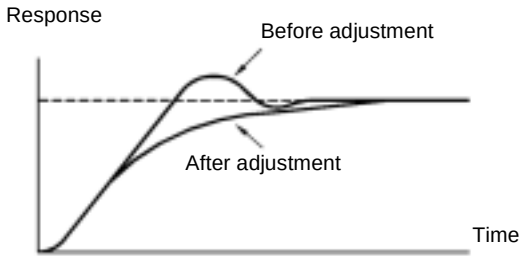
Suppressing Overshoot

If overshoot occurs, reduce Proportional gain (P), and increase integral time (I).



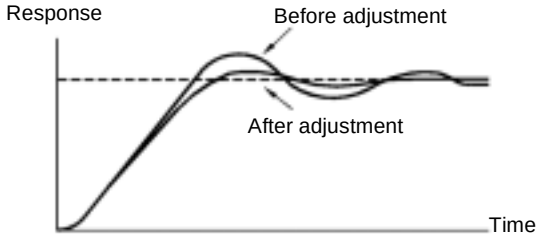
Set a Rapidly Stabilizing Control Condition

To rapidly stabilize the control even if overshoot occurs, reduce integral time (I).



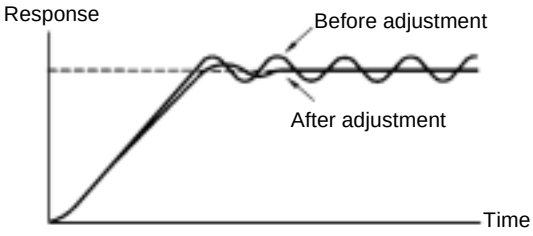
Suppressing Long-cycle Vibration

If vibration occurs with a longer cycle than the integral time (I) set value, lengthen the integral time (I) to suppress the vibration.



Suppressing Short Cycle Vibration

If vibration occures, reduce the proportional gain (P), or increase the PI primary delay time constant.



■Setting Precautions

- In PI control, the b5-04 constant is used to prevent the calculated integral control value from exceeding a specified amount. When the load varies rapidly, Inverter response is delayed, and the machine may be damaged or the motor may stall. In this case, reduce the set value to speed up Inverter response.
- The b5-06 constant is used to prevent the arithmetic operation following the PI control calculation from exceeding a specified amount. Set taking the maximum output frequency to be 100%.
- The b5-07 constant is used to adjust PI control offset. Set in increments of 0.1%, taking the maximum output frequency to be 100%.

- Set the low pass filter time constant for the PI control output in b5-08. Enable this constant to prevent machinery resonance when machinery adhesive abrasion is great, or rigidity is poor. In this case, set the constant to be greater than the resonance frequency cycle. Increase this time constant to reduce Inverter responsiveness.
- With the Inverter, by setting an independent acceleration/deceleration time in constant b5-17, you can increase or decrease the PI target value using the acceleration/deceleration time. The acceleration/deceleration function (constant C1) that is normally used, however, is allocated after PI control, so depending on the settings, resonance with PI control and hunting in the machinery may occur. If this happens, reduce constant C1 until hunting does not occur, and maintain the acceleration/deceleration time using b5-17. Also, you can disable the set value in b5-17 from the external terminals during operation using multi-function input set value 34 (PI soft starter).

■PI Control Block

The following diagram shows the PI control block in the Inverter.

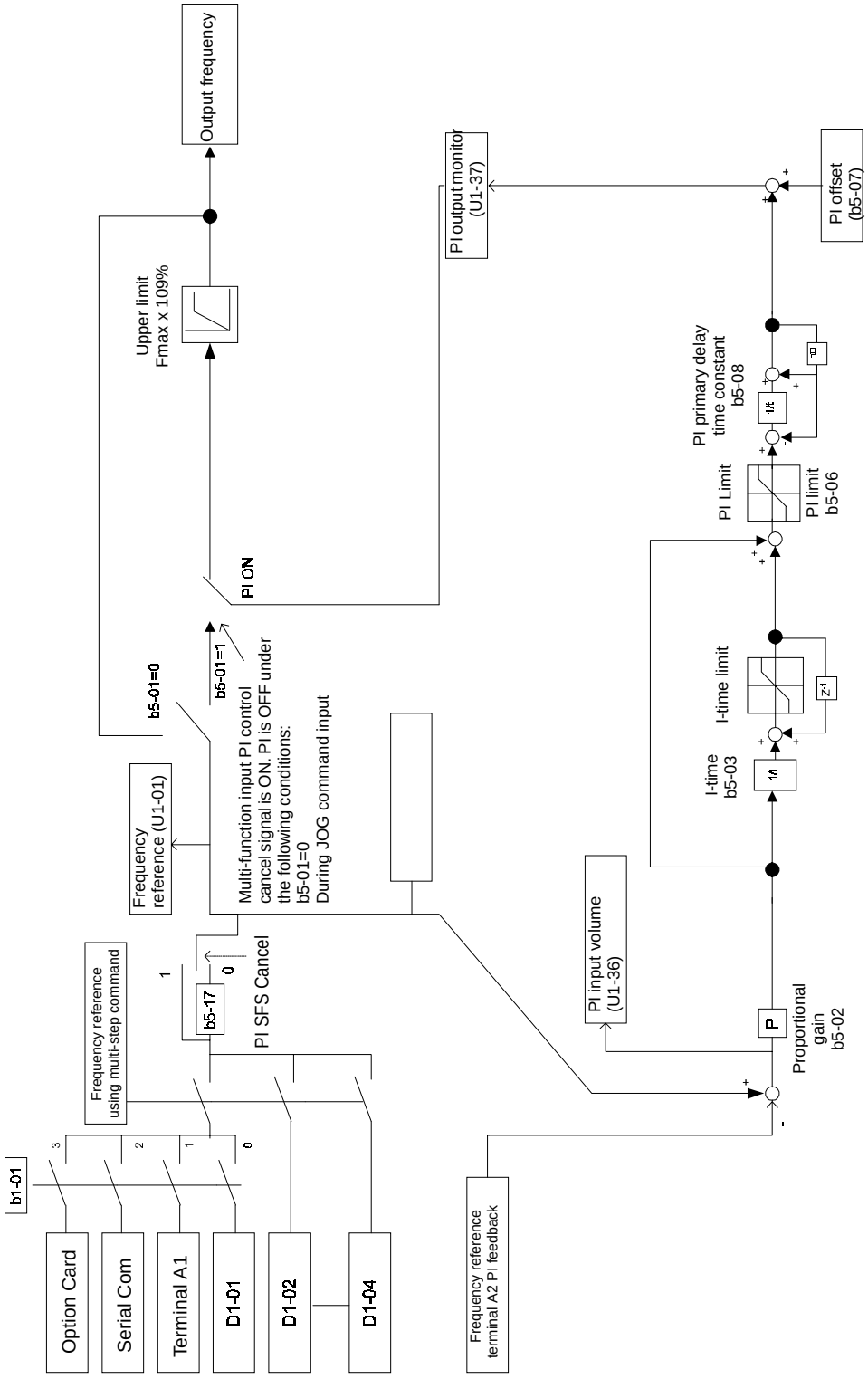


Fig 6.43 PI Control Block

■PI Feedback Loss Detection

When performing PI control, be sure to use the PI feedback loss detection function. If PI feedback is lost, the Inverter output frequency may accelerate to the maximum output frequency.

When setting b5-12 to 1 and the status of the PI feedback value detection level in b5-13 is insufficient and continues for the time set in b5-14, an FbL (PI feedback reference lost) alarm will be displayed on the Digital Operator and Inverter operation will continue.

When b5-12 is set to 2, an FbL (PI feedback reference lost) error alarm will be displayed on the Digital Operator, the error contact will operate, and Inverter operation will be stopped.

The time chart for PI feedback loss detection (set b5-12 to 2) is shown below.

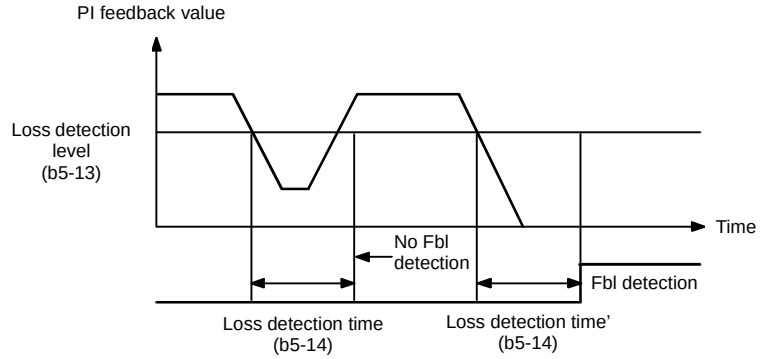


Fig 6.44 PI Feedback Loss Detection Time Chart

■PI Sleep

The PI sleep function stops the Inverter when the PI target value falls below the sleep operation level (b5-15) for the sleep operation time set in parameter b5-16 or longer. The inverter operation will resume, if the PI target value exceeds the sleep operation level for the time set in parameter b5-16 or longer.

When PI control is disabled, the PI sleep function is also disabled. When using the PI sleep function, select decelerate to stop or coast to stop as the stopping method.

The PI sleep time chart is shown below.

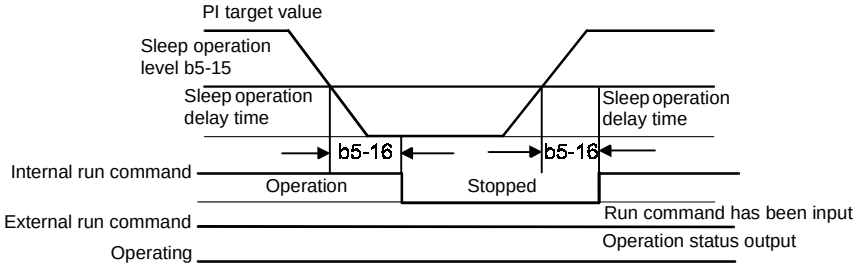


Fig 6.45 PI Sleep Time Chart

◆ Energy-saving

To perform energy saving, set b8-01 (Energy Saving Mode Selection) to 1.

■Related Constants

Constant Number	Name	Details	Setting Range	Factory Setting	Change During Operation	Access Level
b8-01	Energy-saving mode selection	Select whether to enable or disable energy-saving control. 0: Disable 1: Enable	0 or 1	0	No	A
b8-04	Energy-saving coefficient	Set the maximum motor efficiency value. Set the motor rated capacity in E2-11, and adjust the value by 5% at a time until output power reaches a minimum value.	0.0 to 655.00*1	*2	No	A
b8-05	Power detection filter time constant	Set the time constant for output power detection.	0 to 2000	20 ms	No	A
b8-06	Search operation voltage limiter	Set the limit value of the voltage control range during search operation. Perform search operation to optimize operations using minute variations in voltage using energy-saving control. Set to 0 to disable the search operation. 100% is the motor base voltage.	0 to 100	0%	No	A

* 1. The same capacity as the Inverter will be set by initializing the constants.

* 2. The factory settings depend on the Inverter capacity.

■Adjusting Energy-saving Control

By the Energy Saving function the voltage for optimum motor efficiency is calculated and becomes the output voltage reference.

- b8-04 (Energy-saving Coefficient) is set at the factory for motor use applied to the Inverter. If the motor capacity differs from the motor applied to the Inverter, set the motor capacity in E2-11 (Motor Rated Output). Also, adjust b8-04 in steps of 5 until reaches it's minimum. The larger the energy-saving coefficient, the greater the output voltage.
- To improve response when the load fluctuates, reduce the power detection filter time constant b8-05. If b8-05 is set too small, however, motor rotations when the load is light may become unstable.
- Motor efficiency varies due to temperature fluctuations and differences in motor characteristics. Consequently the motor efficiency has to be controlled. To have optimized efficiency, the search operation is used by varieting voltage. Constant b8-06 (Search Operation Voltage Limiter) controls the range that control the voltage using the search operation. For 200 V Class Inverters, set the range to 100%/200 V, and for 400 V Class Inverters, set the range to 100%/400 V. Set to 0 to disable the search operation.

◆ Setting Motor Constants

Normally the motor constants are set automatically using autotuning. If autotuning does not complete normally, set them manually.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
E2-01	Motor rated current	Sets the motor rated current. These set values will become the reference values for motor protection, torque limits and torque control. This constant is an input data for autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q
E2-05	Motor line-to-line resistance	Sets the motor phase-to-phase resistance.	0.000 to 65.000	9.842 Ω *1	No	A

Note The factory-set constants are for a Yaskawa standard 4-pole motor.

* 1. The factory settings depend on Inverter capacity (the values shown are for a 200 V Class Inverter for 0.4 kW).

* 2. The setting range is 10% to 200% of the Inverter rated output current (the values shown are for a 200 V Class Inverter for 0.4 kW).

■Manual Motor Constant Setting Methods

The motor constants settings methods are given below. To enter settings refer to the motor test report.

Motor Rated Voltage Setting

Set E2-01 to the rated current on the motor nameplate.

Motor Line-to-Line Resistance Setting

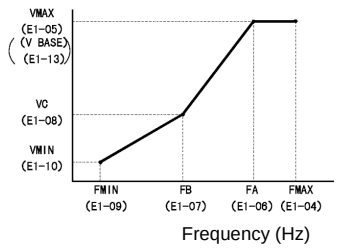
E2-05 is set automatically when performing motor line-to-line resistance autotuning. When you cannot perform tuning, consult the motor manufacturer for the line-to-line resistance value. Calculate the resistance from the line-to-line resistance value in the motor test report using the following formula, and then make the setting accordingly.

- E-type insulation: [Line-to line resistance (Ω) at 75°C of test report] × 0.92 (Ω)
- B-type insulation: [Line-to line resistance (Ω) at 75°C of test repor]t × 0.92 (Ω)
- F-type insulation: [Line-to line resistance (Ω) at 115°C of test report] × 0.87 (Ω)

◆ Setting the V/f Pattern

Inverter input voltage and the V/f pattern can be set as the need arises.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
E1-01	Input voltage setting	Set the Inverter input voltage. This setting is used as a reference value in protection functions.	155 to 255 *1	200 V *1	No	Q
E1-03	V/f pattern selection	0 to E: Select from the 15 preset V/f patterns. F: Custom user-set patterns (Application for settings E1-04 to E1-10.)	0 to F	F	No	Q
E1-04	Max. output frequency (FMAX)	Output voltage (V)  Frequency (Hz) To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) >E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 120.0	50.0 Hz	No	Q
E1-05	Max. voltage (VMAX)		0.0 to 255.0 *1	200.0 V *1	No	Q
E1-06	Base frequency (FA)		0.0 to 120.0	50.0 Hz	No	Q
E1-07	Mid. output frequency		0.0 to 255.0 *1	3.0 Hz	No	A
E1-08	Mid. output frequency voltage		0.0 to 120.0	15.0 V *1	No	A
E1-09	Min. output frequency (FMIN)		0.0 to 120.0	1.3 Hz	No	Q
E1-10	Min. output frequency voltage		0.0 to 255.0 *1	9.0 V *1	No	A
E1-11	Mid. output frequency 2	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 120.0	0.0 Hz *2	No	A
E1-12	Mid. output frequency voltage 2		0.0 to 255.0 *1	0.0 V *2	No	A
E1-13	Base voltage		0.0 to 255.0 *1	0.0 V *2	No	A

* 1. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.

* 2. The contents of constants E1-11 and E1-12 are ignored when set to 0.00.

* 3. E1-13 is set to the same value as E1-05 by autotuning.

■Setting Inverter Input Voltage

Set the Inverter input voltage correctly in E1-01 to match the power supply voltage. This set value will be the standard value for the protection function and similar functions (overvoltage level, stall trip).

■Setting V/f Pattern

Set the V/f pattern in E1-03. There are two methods of setting the V/f pattern: Select one of the 14 pattern types (set value: 0 to D) that have been set beforehand, or set a user-defined V/f pattern (set value: F).

The factory setting for E1-03 is F. The contents of E1-03 when factory-set to F are the same as when E1-03 is set to 0.

To select one of the existing patterns, refer to the following table.

Characteristic	Application	Set Value	Specifications
Constant Torque Characteristic	This pattern is used in general applications. Used when the load torque is fixed, regardless of rotation speed, for linear transport systems.	0 (F)	50 Hz specifications
		1	60 Hz specifications
		2	60 Hz specifications, voltage saturation at 50 Hz
		3	72 Hz specifications, voltage saturation at 60 Hz
Variable torque characteristic	This pattern is used for loads with torque proportional to two or three times the rotation speed, such as fans and pumps.	4	50 Hz specifications,× 3 decrement
		5	50 Hz specifications, × 2 decrement
		6	60 Hz specifications, × 3 decrement
		7	60 Hz specifications, × 2 decrement
High Startup Torque (See Note)*	Select the high startup torque V/f pattern only in the following cases. • The wiring distance between Inverter and motor is large (approx. 150 m min.) • A large torque is required at startup (elevator loads, etc.) • An AC reactor is inserted in the Inverter input or output. • You are operating a motor that is less than optimum.	8	50 Hz specifications, medium startup torque
		9	50 Hz specifications, large startup torque
		A	60 Hz specifications, medium startup torque
		B	60 Hz specifications, large startup torque
Fixed Output Operation	This pattern is used for frequencies of 60 Hz or higher. A fixed voltage is applied.	C	90 Hz specifications, voltage saturation at 60 Hz
		D	120 Hz specifications, voltage saturation at 60 Hz

* The torque is protected by the fully automatic torque boost function, so normally there is no need to use this pattern.

When you select these patterns, the values of constants E1-04 to E1-10 are changed automatically. There are three types of values for E1-04 to E1-10, depending on the Inverter capacity.

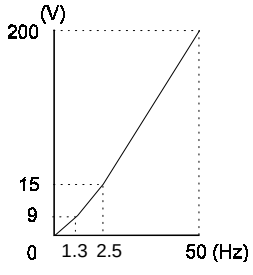
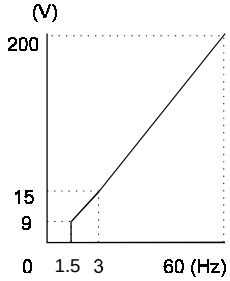
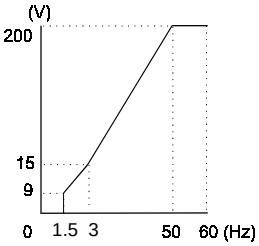
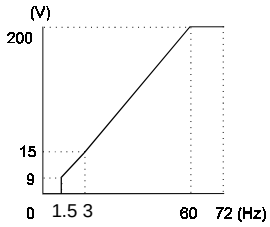
- 0.4 to 1.5 kW V/f pattern
- 2.2 to 45 kW V/f pattern
- 55 to 300 kW V/f pattern

The characteristics diagrams for each are shown in the following pages.

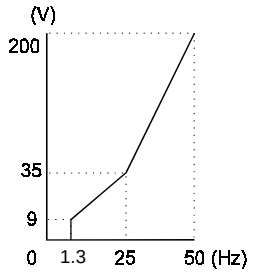
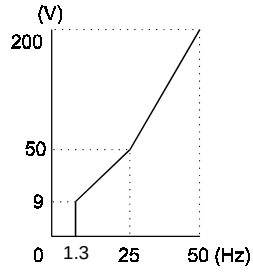
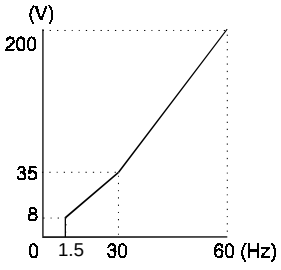
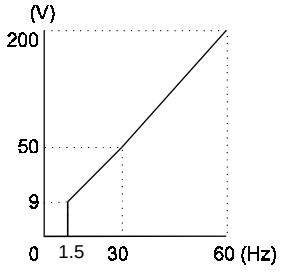
0.4 to 1.5 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

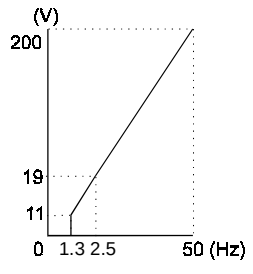
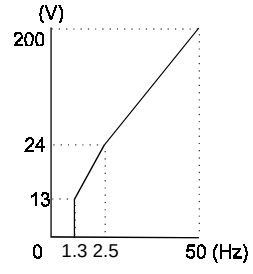
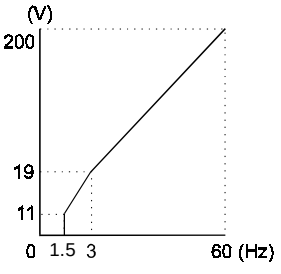
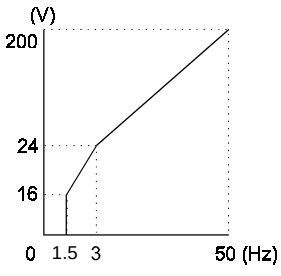
- Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0	50 Hz	Set Value 1	60 Hz	Set Value 2	60 Hz	Set Value 3	72 Hz
							

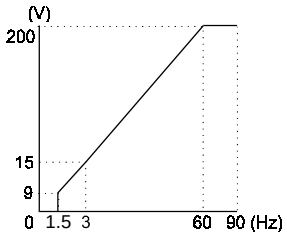
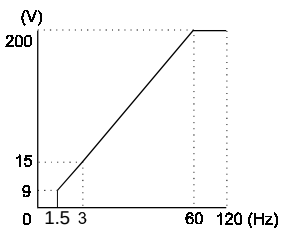
- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz
							

- High startup torque (Set value 8: to b)

Set Value 8	50 Hz	Set Value 9	50 Hz	Set Value A	60 Hz	Set Value B	60 Hz
							

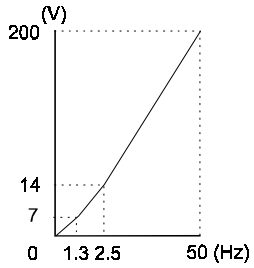
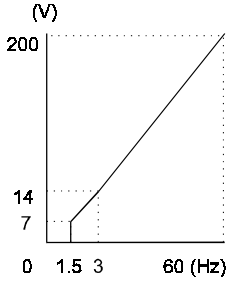
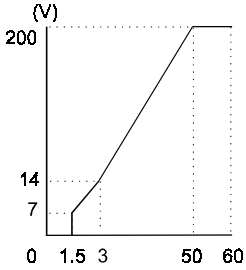
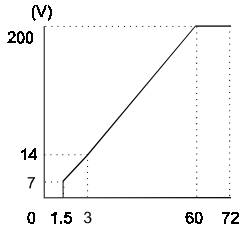
- Fixed Output Operation (Set Value: C to E)

Set Value C	90 Hz	Set Value D	120 Hz
			

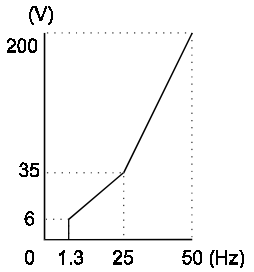
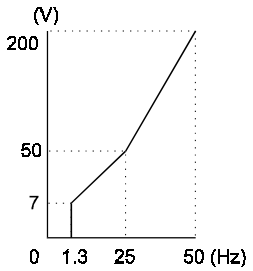
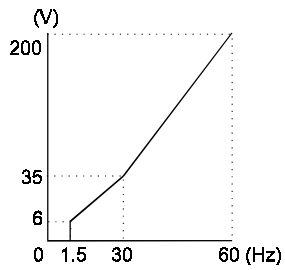
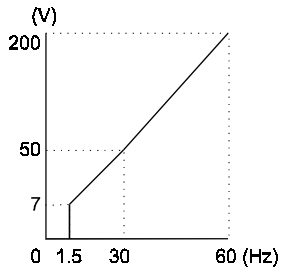
2.2 to 45 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

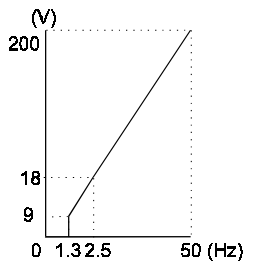
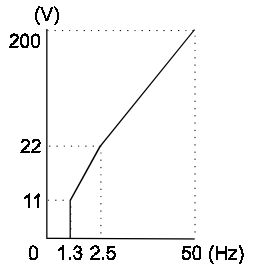
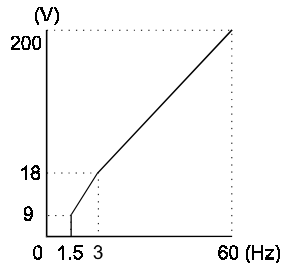
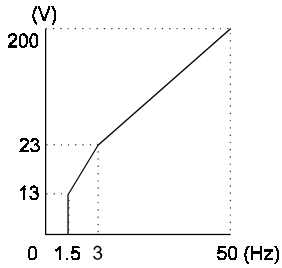
- Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0	50 Hz	Set Value 1	60 Hz	Set Value 2	60 Hz	Set Value 3	72 Hz
							

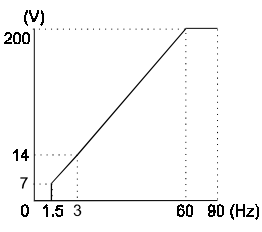
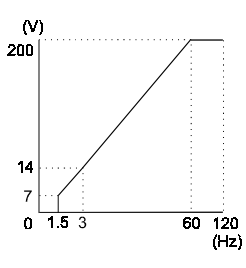
- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz
							

- High Startup Torque (Set Value: 8 to b)

Set Value 8	50 Hz	Set Value 9	50 Hz	Set Value A	60 Hz	Set Value B	60 Hz
							

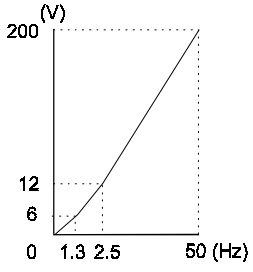
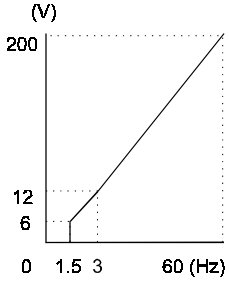
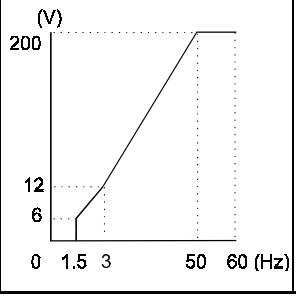
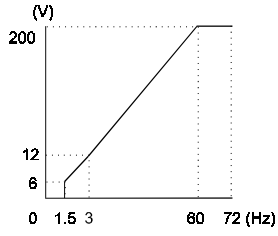
- Fixed Output Operation (Set Value: C to E)

Set Value C	90 Hz	Set Value D	120 Hz
			

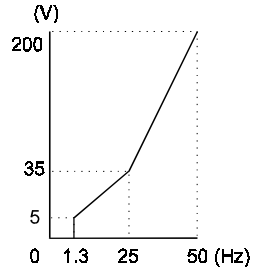
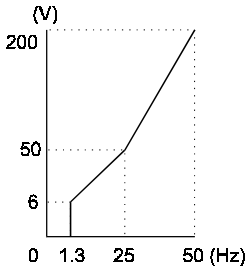
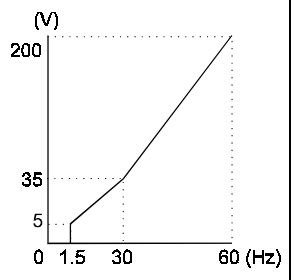
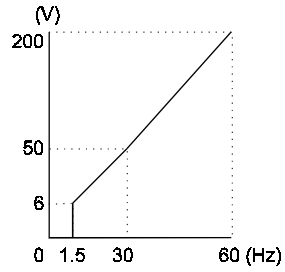
55 to 300 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

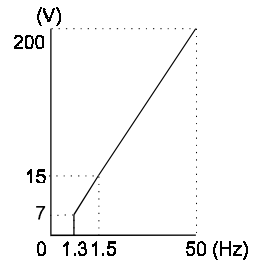
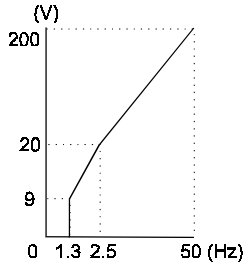
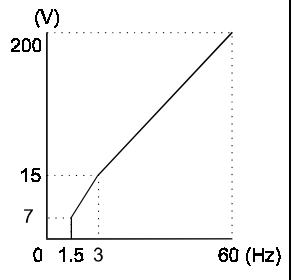
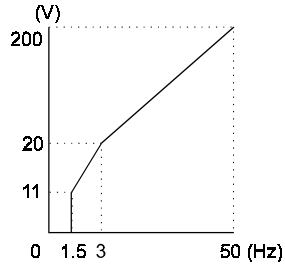
- Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0	50 Hz	Set Value 1	60 Hz	Set Value 2	60 Hz	Set Value 3	72 Hz
							

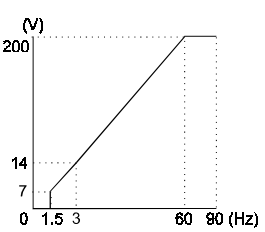
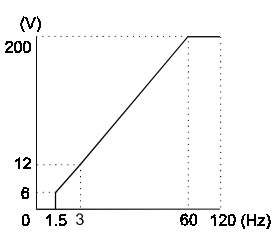
- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz
							

- High Startup Torque (Set Value: 8 to b)

Set Value 8	50 Hz	Set Value 9	50 Hz	Set Value A	60 Hz	Set Value B	60 Hz
							

- Fixed Output Operation (Set Value: C to E)

Set Value C	90 Hz	Set Value D	120 Hz
			

INFO

When E1-03 is set to F (User-defined V/f pattern), you can set constants E1-04 to E1-10. If E1-03 is set to anything other than F, you can only refer to constants E1-04 to E1-10. If the V/f characteristics are linear, set E1-07 and E1-09 to the same value. In this case, E1-08 will be ignored.

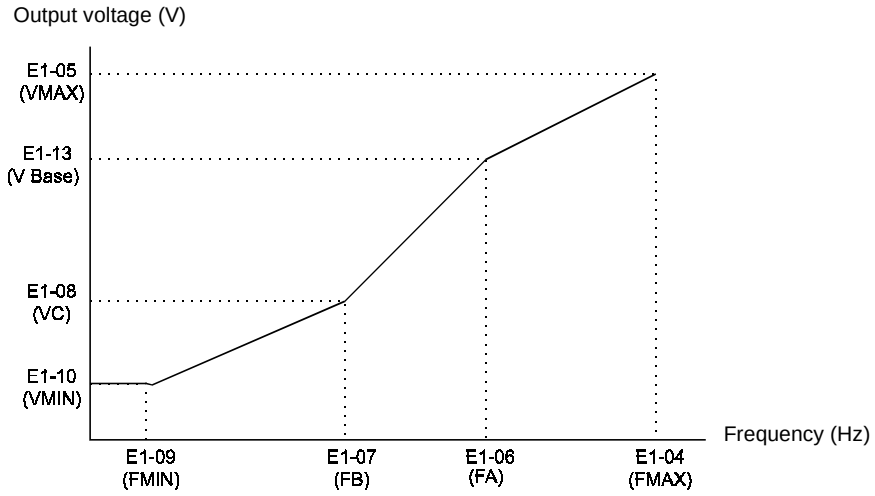


Fig 6.46 User-Set V/f Pattern

■Setting Precautions

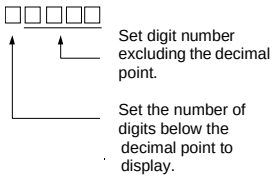
When the setting is to user-defined V/f pattern, beware of the following points.

- When changing control method, constants E1-07 to E1-10 will change to the factory settings for that control method.
- Be sure to set the four frequencies as follows:
  E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)

Digital Operator Functions

◆ Setting Digital Operator Functions

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
o1-02	Monitor selection after power up	Set the monitor item to be displayed when the power supply is turned ON. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A
o1-03	Frequency units of reference setting and monitor	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% (Maximum output frequency is 100%) 2 to 39: rotation per minute (rpm) (Sets the motor poles) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency.  Example: When the max. output frequency value is 200.0, set 12000.	0 to 39999	0	No	A
o2-01	LOCAL/REMOTE key enable/disable	Set the run method selection key (LOCAL/REMOTE Key) function. 0: Disabled 1: Enabled (Switches between the Digital Operator and the constant settings.)	0 or 1	1	No	A
o2-02	STOP Key during control circuit terminal operation	Set the STOP Key in the run mode. 0: Disabled (When the run command is issued from an external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A
o2-03	User constant initial value	Clears or stores user initial values. 0: Stores/not set 1: Begins storing (Records the set constants as user initial values.) 2: All clear (Clears all recorded user initial values) When the set constants are recorded as user initial values, 1110 will be set in A1-03.	0 to 2	0	No	A
o2-05	Frequency reference setting method selection	When the frequency reference is set on the Digital Operator frequency reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the frequency reference without Enter Key operation.	0 or 1	0	No	A
o2-07	Cumulative operation time setting	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0	No	A
o2-10	Fan operation time setting	Set the initial value of the fan operation time using hour units. The operation time accumulates from the set value.	0 to 65535	0	No	A

■Changing Frequency Reference and Display Units

Set the Digital Operator frequency reference and display units using constant o1-03. You can change the units for the following constants using o1-03.

- U1-01 (Frequency Reference)
- U1-02 (Output Frequency)
- U1-05 (Motor Speed)
- U1-20 (Output Frequency after Soft Start)
- d1-01 to d1-04 and d1-17 (Frequency references)

■Switching Monitors when the Power Supply Is ON

Using constant o1-02 selects the monitor item (U1-□□ [status monitor]) that is to be displayed on the Digital Operator when the power supply is turned ON. For monitors that can be displayed, refer to U1-□□ in *Chapter 5 User Constants*.

Setting Precautions

INFO

If selecting monitor constants other than U1-01 (Frequency Reference), U1-02 (Output Frequency), and U1-03 (Output Current), first select the monitor items to be displayed in o1-01 (monitor selection), and then set o1-02 to 4.

■Disabling the STOP Key

If b1-02 (Operation Method Selection) is set to 1, 2, or 3, the stop command from the STOP Key on the Digital Operator is an emergency stop command.

Set o2-02 to 0 to disable emergency stop commands from the STOP Key on the Digital Operator.

■Disabling the LOCAL/REMOTE Key

Set o2-01 to 0 to disable the LOCAL/REMOTE Key on the Digital Operator. If the key is disabled, you cannot use it to switch over the frequency reference source or the RUN-command source.

■Initializing Changed Constant Values

You can save to the Inverter constant set values that you have changed as constant initial values. Change the set values from the Inverter factory settings, and then set o2-03 to 1.

Set A1-03 (Initialize) to 1110 to initialize the Inverter constants using the user-set initial values in memory. To clear the user-set initial values in memory, set o2-03 to 2.

■Setting the Frequency Reference using the UP and DOWN Keys without Using the Enter Key

Use this function when inputting frequency references from the Digital Operator. When o2-05 is set to 1, you can increment and decrement the frequency reference using the UP and DOWN keys without using the Enter key.

For example, enter the Run command using a 0 Hz reference, and then continuously press the UP key to increment the frequency reference by 0.01 Hz only for the first 0.5 s, and then by 0.01 Hz every 80 ms for 3 s thereafter. Press and hold down the UP key for 3 s minimum to reach the maximum output frequency 10 s after that. The frequency reference that has been set will be stored in memory 5 s after the UP or DOWN keys are released.

■Clearing Cumulative Operation Time

Set the cumulative operation time initial value in time units in constant o2-07. Set o2-07 to 0 to clear U1-13 (inverter Operating Time).

■Clearing Inverter Cooling Fan Operation Time

Set the fan operation time initial value in time units in constant o2-10. Set o2-10 to 0 to clear U1-40 (Cooling Fan Operating Time).

◆ Copying Constants

The Digital Operator can perform the following three functions using the built-in EEPROM (non-volatile memory).

- Store Inverter constant set values in the Digital Operator (READ)
- Write constant set values stored in the Digital Operator to the Inverter (COPY)
- Compare constant set values stored in the Digital Operator with Inverter constants (VERIFY)

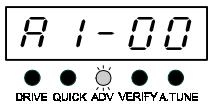
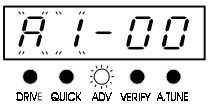
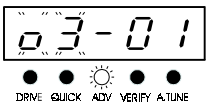
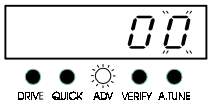
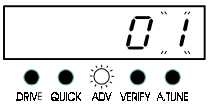
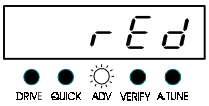
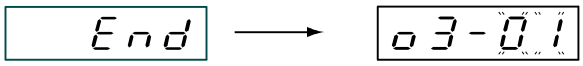
■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
o3-01	Copy function selection	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A
o3-02	Read permitted selection	0: Read prohibited 1: Read permitted	0 or 1	0	No	A

■Storing Inverter set values in the Digital Operator (READ)

To store Inverter set values in the Digital Operator, make the settings using the following method.

Table 6.2 READ Function Procedure

Step No.	Digital Operator Display	Explanation
1		Press the MENU key, and select advanced programming mode.
2		Press the DATA/ENTER key, and select the constants monitor display.
3		Display o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4		Press the DATA/ENTER key, and select the constants setting display.
5		Change the set value to 1 using the Increment key.
6		Set the changed data using the DATA/ENTER key. The READ function will start.
7		If the READ function ends normally, End is displayed on the Digital Operator. Constant o3-01 is automatically reset to 0, and then the display returns to o3-01.

If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.)*

Error Display	Meaning
PrE	You are attempting to set o3-01 to 1 while o3-02 is set to 0.
iFE	Read data length mismatch or read data error.
rdE	Tried to write constants to EEPROM on the Digital Operator, but unable to perform write operation.

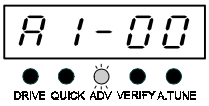
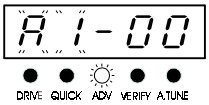
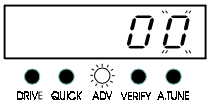
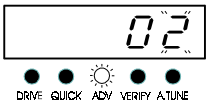
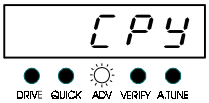
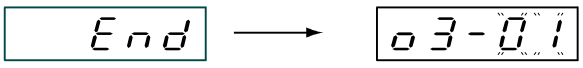
Select READ Permitted

Prevent overwriting the data stored in EEPROM in the Digital Operator by mistake. With o3-02 set to 0, if you set o3-01 to 1, and perform the write operation, PrE will be displayed on the Digital Operator, and the write operation will be stopped.

■Writing Constant Set Values Stored in the Digital Operator to the Inverter (COPY)

To write constant set values stored in the Digital Operator to the Inverter, make the settings using the following method.

Table 6.3 COPY Function Procedure

Step No.	Digital Operator Display	Explanation
1		Press the MENU key, and select advanced programming mode.
2		Press the DATA/ENTER key, and select the constants monitor display.
3		Display o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4		Press the DATA/ENTER key, and select the constants setting display.
5		Change the set value to 2 using the Increment Key.
6		Set the changed data using the DATA/ENTER key. The COPY function will start.
7		If the COPY function ends normally, End is displayed on the Digital Operator. Constant o3-01 is automatically reset to 0, and then the display returns to o3-01.

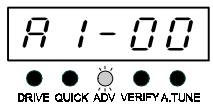
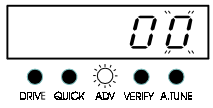
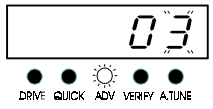
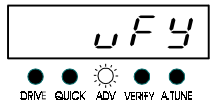
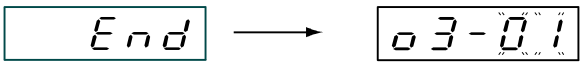
If an error is displayed, set the constants again. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.)*

Error Display	Meaning
CPE	Inverter product code and Inverter software number are different.
vAE	Inverter capacity with which you are trying to copy, and the Inverter capacity stored in the Digital Operator are different.
Cre	The Inverter control method in which you are trying to copy, and the Inverter control method stored in the Digital Operator are different.
CYE	Comparison between the constant written to the Inverter and the constant in the Digital Operator are different.
CSE	After copying has ended, comparison between the sum value of the Inverter constant area and the sum value of the Digital Operator constant area are different.

■Comparing Inverter Constants and Digital Operator Constant Set Values (VERIFY)

To compare Inverter constants and Digital Operator constant set values, make the settings using the following method.

Table 6.4 VERIFY Function Procedure

Step No.	Digital Operator Display	Explanation
1		Press the MENU key. and select advanced programming mode.
2		Press the DATA/ENTER key, and select the constants monitor display.
3		Display o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4		Press the DATA/ENTER key, and select the function setting display.
5		Change the set value to 3 using the Increment key.
6		Set the changed data using the DATA/ENTER key. The VERIFY function will start.
7		If the VERIFY function ends normally, End is displayed on the Digital Operator. Constant o3-01 is automatically reset to 0, and then the display returns to o3-01.

If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.)*

Error Display	Meaning
	Verify error (Settings in the Digital Operator and the Inverter do not match).

■Application Precautions

INFO

When using the copy function, check that the following settings are the same between the Inverter and the Digital Operator.

- Inverter product and type
- Software number
- Inverter capacity and voltage
- Control method

◆ Prohibiting Writing Constants from the Digital Operator

If you set A1-01 to 0, you can refer to and set the A1 and A2 constant groups, and refer to drive mode, using the Digital Operator.

If you set one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 1B (write constants permitted), you can write parameters from the digital operator when the terminal that has been set is ON. When the set terminal is OFF, writing constants other than the frequency reference is prohibited. You can, however, reference constants.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
A1-01	Constant access level	Used to set the constant access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 2: ADVANCED (Constants can be read and set in both quick programming mode and advanced programming (A) mode.)	0 or 2	2	Yes	A

◆ Setting a Password

When a password is set in A1-05, if the set values in A1-04 and A1-05 do not match, you cannot refer to or change the settings of constants A1-01 to A1-03.

You can prohibit the setting and referencing of all constants except A1-00 by using the password function in combination with setting A1-01 to 0 (Monitor only).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
A1-01	Constant access level	Used to set the constant access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 2: ADVANCED (Constants can be read and set in both quick programming mode and advanced programming (A) mode.)	0 or 2	2	Yes	A
A1-04	Password	Password input when a password has been set in A1-05. This function write-protects some constants of the initialize mode. If the password is changed, A1-01 to A1-03 constants can no longer be changed. (Programming mode constants can be changed.)	0 to 9999	0	No	A
A1-05	Password setting	Used to set a four digit number as the password. This constant is not usually displayed. When the password (A1-04) is displayed, hold down the RESET Key and press the Menu Key and the password will be displayed.	0 to 9999	0	No	A

■Setting Precautions

INFO

Constant A1-05 cannot be displayed using normal key operations. To display A1-05, hold down the RESET Key and press the MENU Key while A1-04 is displayed.

7

Troubleshooting

This chapter describes the fault displays and countermeasure for the Inverter and motor problems and countermeasures.

Protective and Diagnostic Functions 7-2
Troubleshooting 7-12

Protective and Diagnostic Functions

This section describes the alarm functions of the Inverter. The alarm functions include fault detection, alarm detection, operation error detection, and autotuning error detection.

◆ Fault Detection

When the Inverter detects a fault, the fault contact output operates, and the Inverter output is shut OFF causing the motor to coast to a stop. (The stopping method can be selected for some faults, and the selected stopping method will be used with these faults.) A fault code is displayed on the Digital Operator.

When a fault has occurred, refer to the following table to identify and correct the cause of the fault.

Use one of the following methods to reset the fault after restarting the Inverter:

- Set a multi-function contact input (H1-01 to H1-05) to 14 (Fault Reset) and turn ON the error reset signal.
- Press the RESET key on the Digital Operator.
- Turn the main circuit power supply OFF and then ON again.

Table 7.1 Fault Displays and Processing

Display	Meaning	Probable Causes	Corrective Actions
oC	Overcurrent The Inverter output current exceeded the overcurrent detection level.	• A short-circuit or ground fault occurred at the Inverter output. (A short or ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.) • The load is too large or the acceleration/deceleration time is too short. • A special-purpose motor or motor with a capacity too large for the Inverter is being used. • A magnetic switch was switched at the Inverter output.	Reset the fault after correcting its cause.
GF	Ground Fault The ground fault current at the Inverter output exceeded approximately 50% of the Inverter rated output current.	A ground fault occurred at the Inverter output. (A ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.)	Reset the fault after correcting its cause.
PUF	Fuse Blown The fuse in the main circuit is blown.	The output transistor has failed because of a short-circuit or ground fault at the Inverter output. Check whether there is a short-circuit between the following terminals. A short-circuit will damage the output transistor: U, V, W ⊖, ← →U, V, W	Replace the Inverter after correcting the cause.
ov	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 410 V 400 V class: Approx. 820 V	The deceleration time is too short and the regenerative energy from the motor is too large.	Increase the deceleration time or connect a Braking Resistor Unit and Braking Unit.
		The power supply voltage is too high.	Decrease the voltage so it's within specifications.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
Uv1	Main Circuit Undervoltage The main circuit DC voltage is below the Undervoltage Detection Level (L2-05). 200 V class: Approx. 190 V 400 V class: Approx. 380 V Main Circuit MC Operation Failure The MC stopped responding during Inverter operation. Applicable Inverter Capacities 200 V class: 37 to 110 kW 400 V class: 75 to 300 kW	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • A fault occurred in the surge prevention circuit.	Reset the fault after correcting its cause.
Uv2	Control Power Fault The control power supply voltage dropped.	---	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
Uv3	Inrush Prevention Circuit Fault Overheating occurred in the inrush resistor. The MC did not respond for 10 s even though the MC ON signal has been output. Applicable Inverter Capacities 200 V class: 37 to 110 kW 400 V class: 75 to 300 kW	• The MC in the main circuit failed. • The MC excitation coil is burned out.	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
PF	Main Circuit Voltage Fault The main circuit DC voltage oscillates unusually (not when regenerating).	• An open-phase occurred in the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • The voltage balance between phases is bad.	Reset the fault after correcting its cause.
LF	Output Open-phase An open-phase occurred at the Inverter output.	• There is a broken wire in the output cable. • There is a broken wire in the motor-winding. • The output terminals are loose.	Reset the fault after correcting its cause.
		The motor being used has a capacity less than 5% of the Inverter's maximum motor capacity.	Check the motor and Inverter capacity.
oH (oH1)	Cooling Fin Overheating The temperature of the Inverter's cooling fin exceeded the setting in L8-02 or 105°C. OH: The temperature exceeded the setting in L8-02 (Stopping method can be changed by L8-03.). OH1: The temperature exceeded 100°C (Stopping method: Coast to stop).	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
	Inverter's Cooling Fan Stopped	The Inverter's cooling fan has stopped.	

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
oH3	Motor Overheating Alarm The Inverter will stop or will continue to operate according to the setting of L1-03.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
oH4	Motor Overheating Fault The Inverter will stop according to the setting of L1-04.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
oL1	Motor Overload The motor overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time, and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high or too low.	Check the V/f characteristics.
		The Motor Rated Current (E2-01) is incorrect.	Check the Motor Rated Current (E2-01).
oL2	Inverter Overload The Inverter overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high or too low.	Check the V/f characteristics.
		The Inverter capacity is too low.	Replace the Inverter with one that has a larger capacity.
oL3	Overtorque Detected 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
oL7	High-slip Braking OL The output frequency did not change for longer than the time set in N3-04.	The inertia returned to the load is too large.	• Make sure the load is an inertial load. • Set the system so that the deceleration time that does not produce 0 V is 120 s or less.
UL3	Undertorque Detected 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
CF	Control Fault The torque limit was reached continuously for 3 seconds or longer during a deceleration stop during open-loop vector control.	-	Check the motor constants.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
FbL	PI Feedback Reference Lost A PI feedback reference loss was detected (b5-12 = 2) and the PI feedback input was less than b5-13 (PI feedback loss detection level) for longer than the time set in b5-14 (PI feedback loss detection time).	-	-
EF0	External fault input from Communications Option Card	-	Check the Communications Option Card and communications signals.
EF3	External fault (Input terminal 3)	An "external fault" was input from a multi-function input terminal (S3 to S7).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4	External fault (Input terminal 4)		
EF5	External fault (Input terminal 5)		
EF6	External fault (Input terminal 6)		
EF7	External fault (Input terminal 7)		
oPr	Digital Operator Connection Fault The connection to the Digital Operator was broken during operation for a RUN command from the Digital Operator.	-	Check the connection to the Digital Operator.
CE	MEMOBUS Communications Error A normal reception was not possible for 2 s or longer after control data was received once.	-	Check the communications devices and communications signals.
bUS	Option Communications Error A communications error was detected during a run command or while setting a frequency reference from a Communications Option Card.	-	Check the communications devices and communications signals.
LPF00	Digital Operator Communications Error 1 Communications with the Digital Operator were not established within 5 seconds after the power was turned on.	The Digital Operator's connector isn't connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter's control circuits are faulty.	Replace the Inverter.
	CPU External RAM Fault	-	Try turning the power supply off and on again.
		The control circuits were destroyed.	Replace the Inverter.
LPF01	Digital Operator Communications Error 2 After communications were established, there was a communications error with the Digital Operator for more than 2 seconds.	The Digital Operator isn't connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter's control circuits are faulty.	Replace the Inverter.
LPF02	Baseblock circuit error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
LPF03	EEPROM error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
LPF04	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
LPF05	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
LPF06	Option Card connection error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Inverter or Option Card is faulty.	Replace the Option Card or the Inverter.
LPF07	ASIC internal RAM fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
LPF08	Watchdog timer fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
LPF09	CPU-ASIC mutual diagnosis fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
LPF 10	ASIC version fault	The Inverter control circuit is faulty	Replace the Inverter.
LPF20	Communications Option Card A/D converter error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Option Card's A/D converter is faulty.	Replace the Communications Option Card.
LPF21	Communications Option Card self diagnostic error	Communications Option Card fault.	Replace the Option Card.
LPF22	Communications Option Card model code error		
LPF23	Communications Option Card DPRAM error		

◆ Alarm Detection

Alarms are detected as a type of Inverter protection function that do not operate the fault contact output. The system will automatically returned to its original status once the cause of the alarm has been removed.

The Digital Operator display flashes and the alarm is output at the multi-function outputs (H2-01 to H2-03).

When an alarm occurs, take appropriate countermeasures according to the table below.

Table 7.2 Alarm Displays and Processing

Display	Meaning	Probable causes	Corrective Actions
EF (blinking)	Forward/Reverse Run Commands Input Together Both the forward and reverse run commands have been ON for more than 0.5 s.	-	Check the sequence of the forward and reverse run commands. Since the rotational direction is unknown, the motor will be decelerated to a stop when this minor fault occurs.
Uv (blinking)	Main Circuit Undervoltage The following conditions occurred when there was no Run signal. • The main circuit DC voltage was below the Undervoltage Detection Level Setting (L2-05). • The surge current limiting contactor opened. • The control power supply voltage when below the CUV level.	See causes for UV1, UV2, and UV3 faults in the previous table.	See corrective actions for UV1, UV2, and UV3 faults in the previous table.
ov (blinking)	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 400 V 400 V class: Approx. 800 V	The power supply voltage is too high.	Decrease the voltage so it's within specifications.
oH (blinking)	Cooling Fin Overheating The temperature of the Inverter's cooling fin exceeded the setting in L8-02.	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source
		The Inverter cooling fan has stopped.	Replace the cooling fan. (Contact your Yaskawa representative.)
oH2 (blinking)	Inverter Overheating Pre-alarm An OH2 alarm signal (Inverter overheating alarm signal) was input from a multi-function input terminal (S3 to S7).	-	Clear the multi-function input terminal's overheating alarm input.
oH3 (blinking)	Motor overheating E was set for H3-09 and the motor temperature thermistor input exceeded the alarm detection level.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
oL3 (blinking)	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
EF0	External error detected for Communications Card other than SI-K2 Continuing operation was specified for EF0 (F6-03 = 3)and an external fault was input from the Option Card.	-	Remove the cause of the external fault.
EF3 (blinking)	External fault (Input terminal S3)	An external fault was input from a multi-function input terminal (S3 to S7).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 (blinking)	External fault (Input terminal S4)		
EF5 (blinking)	External fault (Input terminal S5)		
EF6 (blinking)	External fault (Input terminal S6)		
EF7 (blinking)	External fault (Input terminal S7)		
FbL (blinking)	PI Feedback Reference Lost A PI feedback reference loss was detected (b5-12 = 2) and the PI feedback input was less than b5-13 (PI feedback loss detection level) for longer than the time set in b5-14 (PI feedback loss detection time).	-	-
CF (blinking)	MEMOBUS Communications Error Normal reception was not possible for 2 s or longer after received control data.	-	Check the communications devices and signals.
bUS (blinking)	Option Card Communications Error A communications error occurred in a mode where the run command or a frequency reference is set from an Communications Option Card.	-	Check the communications devices and signals.
CALL (blinking)	Communications on Standby Control data was not normally received when power was turned ON.	-	Check the communications devices and signals.

◆ Operation Errors

An operation error will occur if there is an invalid setting or a contradiction between two constant settings. It won't be possible to start the Inverter until the constants have been set correctly. (The alarm output and fault contact outputs will not operate either.)

When an operation error has occurred, refer to the following table to identify and correct the cause of the errors.

Table 7.3 Operation Error Displays and Incorrect Settings

Display	Meaning	Incorrect settings
oPE01	Incorrect Inverter capacity setting	The Inverter capacity setting doesn't match the Unit. (Contact your Yaskawa representative.)
oPE02	Constant setting range error	The constant setting is outside of the valid setting range.
oPE03	Multi-function input selection error	One of the following errors has been made in the multi-function input (H1-01 to H1-06) settings: • The same setting has been selected for two or more multi-function inputs. • Speed Search 1 (61, maximum output frequency) and Speed Search 2 (62. set frequency) were selected at the same time. • External Baseblock NO (8) and External Baseblock NC (9) were selected at the same time. • The Multi-function Analog Input Terminal (A2) Function Selection (H3-09) was set to a value other than 1F and the Terminal 13/14 Switch (1F) was selected, but the Terminal A1/A2 Switching (H3-13) was set to use the main speed frequency for A2 (H3-13 = 1). • The emergency stop command NO and NC have been set at the same time.
oPE05	Option Card selection error	The Option Card was selected as the frequency reference source by setting b1-01 to 3, but an Option Card isn't connected (C option).
oPE07	Multi-function analog input selection error	• H3-09 = B and H6-01 = 1
oPE08	Constant selection error	A setting has been made that is not required in the current control method. Example: A function used only with open loop vector control was selected for V/f control.
oPE09	PI control selection error	The following settings have been made at the same time. • b5-01 (PI Control Mode Selection) has been set to a value other than 0. • b5-15 (PI Sleep Function Operation Level) has been set to a value other than 0. • b1-03 (Stopping Method Selection) has been set to 2 or 3.
oPE09	V/f data setting error	Constants E1-04, E1-06, E1-07, and E1-09 do not satisfy the following conditions: • E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN) • E3-02 (FMAX) ≥ E3-04 (FA) > E3-05 (FB) ≥ E3-07 (FMIN)
oPE11	Constant setting error	One of the following constant setting errors exists. • C6-05 (Carrier Rrequency Gain) > 6, the Carrier Frequency Lower Limit (C6-04) > the Carrier Frequency Gain(C6-05) • Upper/lower limit error in C6-03 to 05.
Err	EEPROM write error	A verification error occurred when writing EEPROM. • Try turning the power supply off and on again. • Try setting the constants again.

◆ Errors During Autotuning

The errors that can occur during autotuning are given in the following table. If an error is detected, an error code will be displayed on the Digital Operator. The error contact output and alarm output will not function.

Table 7.4 Errors During Autotuning

Display	Meaning	Probable causes	Corrective Actions
Er-01	Motor data error	There is an error in the data input for autotuning. There is an error in the relationship between the motor output and the motor rated current.	• Check the input data. • Check the capacity of the Inverter and motor.
Er-02	Alarm	A minor fault occurred during autotuning (xxx).	• Check the input data. • Check wiring and the machine. • Check the load.
Er-03	STOP key input	The STOP Key was pressed to cancel autotuning.	
Er-04	Line-to-line resistance error	Autotuning was not completed in the specified time. The results of autotuning has exceeded the setting range for a user constant.	• Check the input data. • Check motor wiring. • If the motor is connected to the machine, disconnect it.
Er-09	Acceleration error (detected only for rotational autotuning)	The motor did not accelerate in the specified time.	• Increase C1-01 (Acceleration Time 1). • If the motor is connected to the machine, disconnect it.
Er-12	Current detection error	The current flow exceeded the motor rated current.	Check the current detection circuit, motor wiring, current detector, and installation methods.
		The detected current sign was the opposite of what it should be.	
		There is a phase fault for U, V, or W.	
End1	V/f settings excessive*	The torque reference exceeded 100% and the no-load torque exceeded 70% during autotuning.	• Check and correct the settings. • Disconnect the load from the motor.
End3	Rated current setting alarm*	The rated current is set high.	Check the input data (particularly the motor output current and motor rated current).

* Displayed after autotuning has been completed.

◆ Errors when Using the Digital Operator Copy Function

The errors that can occur when using the copy function from the Digital Operator are given in the following table. An error code will be displayed on the Digital Operator. If a Digital Operator key is pressed when an error code is being displayed, the display will be cleared and 03-01 will be displayed. The error contact output and alarm output will not function.

Table 7.5 Errors during Copy Function

Function	Display	Meaning	Probable causes	Corrective Actions
Read	PrE	Digital Operator write-protected	o3-01 was set to 1 to write a constant when the Digital Operator was write-protected (o3-02 = 0).	Set o3-02 to 1 to enable writing constants with the Digital Operator.
	iFE	Illegal read data	The read data length does not agree.	Repeat the read. Check the Digital Operator cable. Replace the Digital Operator.
			The write data is incorrect.	
	rdE	Illegal write status	An attempted write of a constant to EEPROM on the Digital Writer failed.	A low Inverter voltage has been detected. Repeat the read. Replace the Digital Operator.
Copy	CPE	ID not matched	The Inverter product code or software number is different.	Use the copy function for the same product code and software number.
	vAE	Inverter capacity matched	The capacity of the Inverter being copied and the capacity in the Digital Operator are different.	Use the copy function for the same Inverter capacity.
	Cre	Control method matched	The control method of the Inverter being copied and the control method in the Digital Operator are different.	Use the copy function for the same control method.
	CyE	Verify error	The constant written to the Inverter was compared with the constant in the Digital Operator and they were different.	Retry the copy.
	CSE	Checksum error	The checksum in the Inverter constant area was compared with the checksum in the Digital Operator constant area and they were different.	Retry the copy.

Troubleshooting

Due to constant setting errors, faulty wiring, and so on, the Inverter and motor may not operate as expected when the system is started up. If that occurs, use this section as a reference and apply the appropriate measures.

If the contents of the fault are displayed, refer to *Protective and Diagnostic Functions.*

◆ If Constant Constants Cannot Be Set

Use the following information if an Inverter constant cannot be set.

■The display does not change when the Increment and Decrement Keys are pressed.

The following causes are possible.

The Inverter is operating (drive mode).

There are some constants that cannot be set during operation. Turn the Inverter off and then make the settings.

Constant write enable is input.

This occurs when "constant write enable" (set value: 1B) is set for a multi-function input terminal (H1-01 to H1-05). If the constant write enable input is OFF, the constants cannot be changed. Turn it ON and then set the constants.

Passwords do not match. (Only when a password is set.)

If the constant A1-04 (Password) and A1-05 (Password Setting) numbers are different, the constants for the initialize mode cannot be changed. Reset the password.

If you cannot remember the password, display A1-05 (Password Setting) by pressing the Reset/Select Key and the Menu Key simultaneously while in the A1-04 display. Then reset the password. (Input the reset password in constant A1-04.)

■OPE01 through OPE11 is displayed.

The set value for the constant is wrong. Refer to *Operation Errors* in this chapter and correct the setting.

■CPF00 or CPF01 is displayed.

This is a Digital Operator communications error. The connection between the Digital Operator and the Inverter may be faulty. Remove the Digital Operator and then re-install it.

◆ If the Motor Does Not Operate

■The motor does not operate when the RUN key on the Digital Operator is pressed.

The following causes are possible.

IMPORTANT

If the Inverter is not in drive mode, it will remain in ready status and will not start. Press the Menu Key to make the DRIVE indicator flash, and enter the drive mode by pressing the DATA/ENTER key. The DRIVE indicator will light when drive mode is entered.

The operation method setting is wrong.

If constant b1-02 (Operation Method Selection) is set to 1 (control circuit terminal), the motor will not operate when the Run key is pressed. Either press the LOCAL/REMOTE key* to switch to Digital Operator operation or set b1-02 to 0 (Digital Operator).

INFO

The LOCAL/REMOTE key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the drive mode is entered.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the Inverter will not operate.

Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog input H3-09 is set to 1 (frequency gain), and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor does not operate when an external operation signal is input.

The following causes are possible.

The Inverter is not in drive mode.

If the Inverter is not in drive mode, it will remain in ready status and will not start. Press the MENU key make the DRIVE indicator flash, and enter the drive mode by pressing the DATA/ENTER key. The DRIVE indicator will light when drive mode is entered.

The operation method selection is wrong.

If constant b1-02 (reference selection) is set to 0 (Digital Operator), the motor will not operate when an external operation signal is input. Set b1-02 to 1 (control circuit terminal) and try again.

Similarly, the motor will also not operate if the LOCAL/REMOTE key has been pressed to switch to Digital Operator operation. In that case press the LOCAL/REMOTE key* again to return to the original setting.

INFO

The LOCAL/REMOTE key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the drive mode is entered.

A 3-wire sequence is in effect.

The input method for a 3-wire sequence is different than when operating by forward/stop and reverse/stop (2-wire sequence). When 3-wire sequence is set, the motor will not operate even when an input terminal suitable for forward run/stop and reverse run/stop is turned ON.

When using a 3-wire sequence, refer to the timing chart and input the proper signals.

When using a 2-wire sequence, set the multi-function input terminal (H1-01 through H1-05, terminals S3 to S7) to a value other than 0.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the Inverter will not operate. Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog inputs H3-05 and H3-09 are set to 1 (frequency gain), and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor stops during acceleration or when a load is connected.

The load may be too heavy. The Inverter has a stall prevention function and an automatic torque boost function, but the motor responsiveness limit may be exceeded if acceleration is too rapid or if the load is too heavy. Lengthen the acceleration time or reduce the load. Also consider increasing the motor capacity.

■The motor only rotates in one direction.

"Reverse run prohibited" is selected. If b1-04 (Prohibition of Reverse Operation) is set to 1 (reverse run prohibited), the Inverter will not receive reverse run commands. To use both forward and reverse operation, set b1-04 to 0.

◆ If the Direction of the Motor Rotation is Reversed

If the motor operates in the wrong direction, the motor output wiring is faulty. When the Inverter T1(U), T2(V), and T3(W) are properly connected to the motor T1(U), T2(V), and T3(W), the motor operates in a forward direction when a forward run command is executed. The forward direction depends on the manufacturer and the motor type, so be sure to check the specifications.

The direction of rotation can be reversed by switching two wires among U, V, and W.

◆ If the Motor Does Not Put Out Torque or If Acceleration is Slow

■The stall prevention level during acceleration is too low.

If the value set for L3-02 (Stall Prevention Level during Acceleration) is too low, the acceleration time will be too long. Check to be sure that the set value is suitable.

■The stall prevention level during running is too low.

If the value set for L3-06 (Stall Prevention Level during Running) is too low, the speed will drop before outputting torque. Check to be sure that the set value is suitable.

◆ If the Motor Operates Higher Than the Reference

Use the following information if the motor operates higher than the reference.

■The analog frequency reference bias setting is wrong (the gain setting is wrong).

The frequency reference bias set in constant H3-03 is added to the frequency reference. Check to be sure that the set value is suitable.

■A signal is being input to the frequency reference (current) terminal A1.

When 1F (frequency reference) is set for constant H3-09 (Multi-function Analog Input Terminal A2 Function Selection), a frequency corresponding to the terminal A2 input voltage (current) is added to the frequency reference. Check to be sure that the set value and analog input value are suitable.

◆ If Motor Deceleration is Slow

Use the following information when the motor deceleration is slow.

■The deceleration time is long even when braking resistor unit and braking unit is connected.

The following causes are possible.

"Stall prevention during deceleration enabled" is set.

When Braking Resistor Unit and Braking Unit is connected, set constant L3-04 (Stall Prevention Selection during Deceleration) to 0 (disabled). When this constant is set to 1 (enabled, the factory setting), braking resistor unit and the braking unit do not fully function.

The deceleration time setting is too long.

Check the deceleration time setting (constants C1-02 and C1-04).

Motor torque is insufficient.

If the constants are correct and there is no overvoltage fault, then the motor's power is limited. Consider increasing the motor capacity.

■If the Vertical-axis Load Drops When Brake is Applied

The sequence is incorrect. The Inverter goes into DC injection braking status for 0.5 seconds after deceleration is completed. (This is the factory-set default.)

To ensure that the brake holds, set frequency detection 2 (H2-01 = 5) for the multi-function contact output terminals (M1 and M2) so that the contacts will turn OFF when the output frequency is greater than L4-01 (3.0 to 5.0 Hz). (The contacts will turn ON below L4-01.)

There is hysteresis in frequency detection 2 (i.e., a frequency detection width, L4-02 = 2.0 Hz) . Change the setting to approximately 0.5 Hz if there are drops during stop. Do not use the multi-function contact output run signal (H2-01 = 0) for the brake ON/OFF signal.

◆ If the Motor Overheats

■The load is too big.

If the motor load is too heavy and the motor is used with the effective torque exceeding the motor's rated torque, the motor will overheat. Reduce the load amount by either lightening the load or lengthening the acceleration/deceleration time. Also consider increasing the motor capacity.

■The ambient temperature is too high.

The motor rating is determined within a particular ambient operating temperature range. The motor will burn out if it is run continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded. Lower the motor's ambient temperature to within the acceptable ambient operating temperature range.

■The withstand voltage between the motor phases is insufficient.

When the motor is connected to the Inverter output, a surge is generated between the Inverter switching and the motor coil. Normally the maximum surge voltage is three times the Inverter's input power supply voltage (i.e., 1,200 V for 400 V class). Be sure to use a motor with a withstand voltage between the motor phases that is greater than the maximum surge voltage. In particular, when using a 400 V class Inverter, use a special motor for Inverters.

◆ If peripheral devices like PLC’s or other are influenced by the starting or running inverter

If noise is generated by Inverter switching, implement the following countermeasures:

- Change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. This will help to some extent by reducing the amount of internal switching.
- Install an Input Noise Filter at the Inverter's power supply input area.
- Install an Output Noise Filter at the Inverter's power supply output area.
- Use metal tubing. Electric waves can be shielded by metal, so encase the Inverter with metal (steel).
- Ground the Inverter and motor.
- Separate main circuit wiring from control wiring.

◆ If the Ground Fault Interrupter Operates When the Inverter is Run

The Inverter performs internal switching, so there is a certain amount of leakage current. This may cause the ground fault interrupter to operate and cut off the power supply. Change to a ground fault interrupter with a high leakage detection level (i.e., a sensitivity current of 200 mA or greater per Unit, with an operating time of 0.1 s or more), or one that incorporates high frequency countermeasures (i.e., one designed for use with Inverters). It will also help to some extent to change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. In addition, remember that the leakage current increases as the cable is lengthened.

◆ If There is Mechanical Oscillation

■The machinery is making unusual sounds.

The following causes are possible.

There may be resonance between the mechanical system's characteristic frequency and the carrier frequency.

If the motor is running with no problems and the machinery is oscillating with a high-pitched whine, it may indicate that this is occurring. To prevent this type of resonance, adjust the carrier frequency with constants C6-02 to C6-05.

There may be resonance between a machine's characteristic frequency and the output frequency of the Inverter.

To prevent this from occurring, either use the jump frequency functions in constants d3-01 to d3-04 or install rubber padding on the motor base to reduce oscillation.

■Oscillation and hunting are occurring.

The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting constants C4-02 (Torque Compensation Primary Delay Time Constant) and N1-02 (Hunting Prevention Gain) in order. Lower the gain setting and raise the primary delay time setting.

■Oscillation and hunting are occurring with PI control.

If there is oscillation or hunting during PI control, check the oscillation cycle and individually adjust P and I constants. (Refer to page 6-65.)

◆ If the Motor Rotates Even When Inverter Output is Stopped

If the motor rotates even when the Inverter output is stopped, the DC injection braking is insufficient. If the motor continues operating at low speed, without completely stopping, and after a deceleration stop has been executed, it means that the DC injection braking is not decelerating enough. Adjust the DC injection braking as follows:

- Increase the constant b2-02 (DC Injection Braking Current) setting.
- Increase the constant b2-04 (DC Injection Braking (initial excitation) Time at Stop) setting.

◆ If OV is Detected When a Fan is Started, or Fan Stalls

Generation of OV (Over Voltage) and stalling can occur if a fan is turning when it is started. The DC injection braking is insufficient when starting.

This can be prevented by slowing fan rotation by DC injection braking before starting the fan. Increase the constant b2-03 (DC injection braking time (initial excitation) at start) setting.

◆ If Output Frequency Does Not Rise to Frequency Reference

■The frequency reference is within the jump frequency range.

When the jump frequency function is used, the output frequency does not change within the jump frequency range. Check to be sure that the Jump Frequency (constants d3-01 to d3-03) and Jump Frequency Width (constant d3-04) settings are suitable.

■The frequency reference upper limit has been reached.

The output frequency upper limit is determined by the following formula:
Maximum Output Frequency (E1-04) × Frequency Reference Upper Limit (d2-01) / 100
Check to be sure that the constant E1-04 and d2-01 settings are suitable.

8

Maintenance and Inspection

This chapter describes basic maintenance and inspection for the Inverter

Maintenance and Inspection 8-2

Maintenance and Inspection

◆ Outline of Maintenance

The maintenance period of the Inverter is as follows:

Maintenance Period: Within 18 months of shipping from the factory or within 12 months of being delivered to the final user, whichever comes first.

◆ Daily Inspection

Check the following items with the system in operation.

- The motor should not be vibrating or making unusual noises.
- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The output current value shown on the monitor displays should not be higher than normal.
- The cooling fan on the bottom of the Inverter should be operating normally.

◆ Periodic Inspection

Check the following items during periodic maintenance.

Always turn OFF the power supply before beginning inspection. Confirm that the LED indicators on the front cover have all turned OFF, and then wait until at least five minutes has elapsed before beginning the inspection. Be sure not to touch terminals right after the power has been turned off. Doing so can result in electric shock.

Fig 8.1 Periodic Inspections

Item	Inspection	Corrective Procedure
External terminals, mounting bolts, connectors, etc.	Are all screws and bolts tight?	Tighten loose screws and bolts firmly.
	Are connectors tight?	Reconnect the loose connectors.
Cooling fins	Are the fins dirty or dusty?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2). Replace the boards if they cannot be made clean.
Cooling fan	Is there any abnormal noise or vibration or has the total operating time exceeded 20,000 hours?	Replace the cooling fan.
Power elements	Is there any conductive dirt or oil mist on the elements?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
Smoothing capacitor	Are there any irregularities, such as discoloration or odor?	Replace the capacitor or Inverter.

◆ Periodic Maintenance of Parts

The Inverter is configured of many parts, and these parts must be operating properly in order to make full use of the Inverter functions.

Among the electronic components, there are some that require maintenance depending on their usage conditions. In order to keep the Inverter operating normally over a long period of time, it is necessary to perform period inspections and replace parts according to their service life.

Periodic inspection standards vary depending the Inverter's installation environment and usage conditions. The Inverter's maintenance periods are noted below. Keep them as reference.

Fig 8.2 Part Replacement Guidelines

Part	Standard Replacement Period	Replacement Method
Cooling fan	2 to 3 years	Replace with new part.
Smoothing capacitor	5 years	Replace with new part. (Determine need by inspection.)
Breaker relays	-	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

Note The standard replacement period is based on the following usage conditions:
Ambient temperature:Yearly average of 30°C
Load factor: 80% max.
Operating rate: 12 hours max. per day

◆ Cooling Fan Replacement Outline

■200 V and 400 V Class Inverters of 18.5 kW or Less

A cooling fan is attached to the bottom of the Inverter.

If the Inverter is installed using the mounting holes on the back of the Inverter, the cooling fan can be replaced without removing the Inverter from the installation panel.

Removing the Cooling Fan

1. Press in on the right and left sides of the fan cover in the direction of arrows 1 and when pull the fan out in the direction of arrow 2.
2. Pull out the cable connected to the fan from the fan cover and disconnect the relay connector.
3. Open the fan cover on the left and right sides and remove the fan cover from the fan.

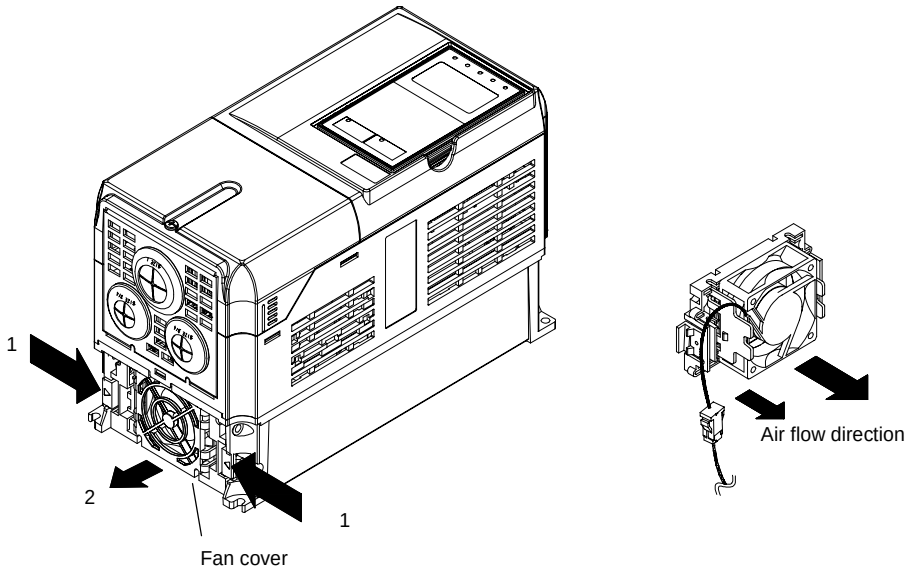


Fig 8.3 Cooling Fan Replacement (Inverters of 18.5 kW or Less)

Mounting the Cooling Fan

1. Attach the fan cover to the cooling fan. Be sure that the air flow direction indicated by the arrows above faces into the Inverter.
2. Connect the relay connector securely and place the relay connector and cable into the fan cover.
3. Mount the fan cover on the Inverter. Be sure that the tabs on the sides of the fan cover click into place on the Inverter.

■200 V and 400 V Class Inverters of 22 kW or More

A cooling fan is attached to the top panel inside the Inverter.

The cooling fan can be replaced without removing the Inverter from the installation panel.

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove the controller bracket to which the cards are mounted. Remove all cables connected to the controler.
3. Remove the cooling fan power cable connector (CN26 and CN27) from the gate driver positioned at the back of the controller.
4. Remove the fan cover screws and pull out the fan cover from the Inverter.
5. Remove the cooling fan from the fan cover.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.
When attaching the cooling fan to the mounting bracket, be sure that the air flow faces the top of the Inverter.

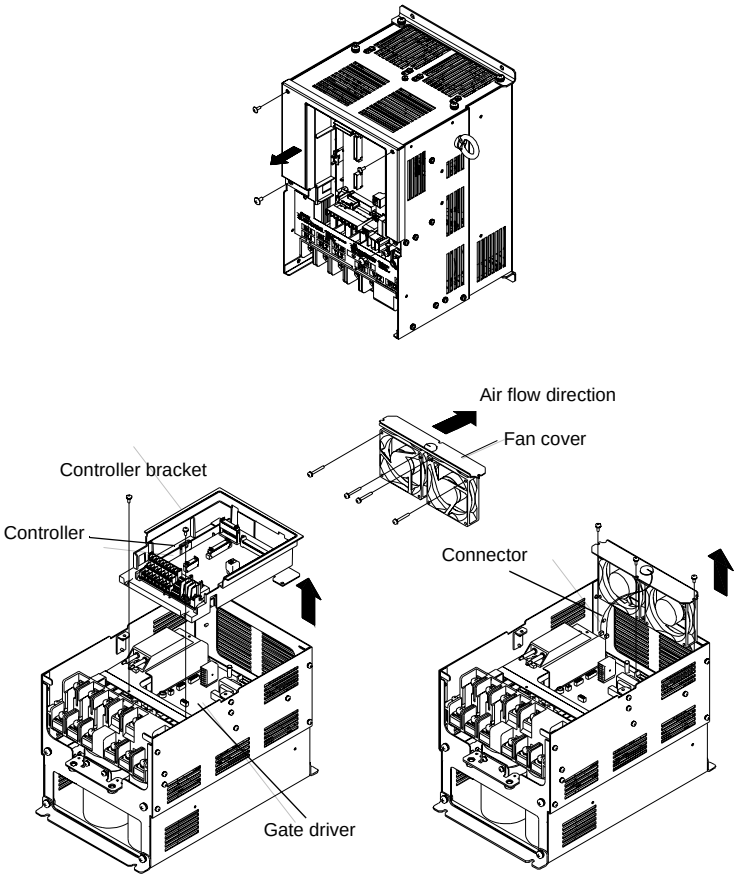


Fig 8.4 Cooling Fan Replacement (Inverters of 22 kW or More)

◆ Removing and Mounting the Control Circuit Terminal Card

The control circuit terminal card can be removed and mounted without disconnecting the cables.

IMPORTANT

Always confirm that the charge indicator is not lit before removing or mounting the control circuit terminal card.

■Removing the Control Circuit Terminal Card

1. Remove the Digital Operator and front cover.
2. Remove the connecting line connectors connected to FE and NC on the control circuit terminal card.
3. Loosen the mounting screws (1) on the left and right sides of the control terminals until they are free. (It is not necessary to remove these screws completely. They are self-rising.)
4. Pull the terminal card out sideways (in direction 2) with the screws sticking out from the card.

■Mounting the Control Circuit Terminal Card

Reverse the removal procedure to mount the terminal card.

Confirm that the terminal circuit card and the controller properly meet at connector CN5 before pressing in on the card.

The connector pins may be bent if the card is forced into place, possibly preventing correct Inverter operation.

Removing and Mounting the
Control Circuit Terminal Card

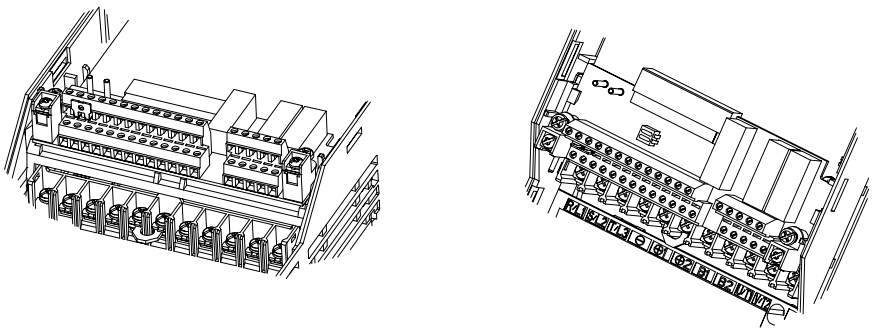


Fig 8.5 Removing the Control Circuit Terminal Card

9

Specifications

This chapter describes the basic specifications of the Inverter and specifications for options and peripheral devices.

Standard Inverter Specifications 9-2
Specifications of Options and Peripheral Devices 9-5

Standard Inverter Specifications

◆ Specifications by Model

Specifications are given by model in the following tables.

■200V Class

Table 9.1 200 V Class Inverters

Model Number CIMR-E7C □			20P4	20P7	21P5	22P2	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037	2045	2055	2075	2090	2110
Max. applicable motor output (kW)*1			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
Output ratings	Rated output capacity (kVA)		1.2	1.6	2.7	3.7	5.7	8.8	12	17	22	27	32	44	55	69	82	110	130	160
	Rated output current (A)		3.2	4.1	7.0	9.6	15	23	31	45	58	71	85	115	145	180	215	283	346	415
	Max. output voltage (V)		3-phase; 200, 208, 220, 230, or 240 VAC (Proportional to input voltage.)																	
	Max. output frequency (Hz)		120 Hz max.																	
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)		3-phase, 200/208/220/230/240 VAC, 50/60 Hz																	
	Allowable voltage fluctuation		+ 10%, - 15%																	
	Allowable frequency fluctuation		±5%																	
Control characteristics	Measures for power supply harmonics	DC reactor	Optional										Built in							
		12-phase rectification	Not possible										Possible*2							

* 1. The maximum applicable motor output is given for a standard 4-pole Yaskawa motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

* 2. A 3-wire transformer is required on the power supply for 12-phase rectification.

■400 V Class

Table 9.2 400 V Class Inverters

Model Number CIMR-E7C □			40P4	40P7	41P5	42P2	43P7	44P0	45P5	47P5	4011	4015	4018
Max. applicable motor output (kW) *1			0.4	0.75	1.5	2.2	3.7	4.0	5.5	7.5	11	15	18.5
Output ratings	Rated output capacity (kVA)		1.4	1.6	2.8	4.0	5.8	6.6	9.5	13	18	24	30
	Rated output current (A)		1.8	2.1	3.7	5.3	7.6	8.7	12.5	17	24	31	39
	Max. output voltage (V)		3-phase; 380, 400, 415, 440, 460, or 480 VAC (Proportional to input voltage.)										
	Max. output frequency (Hz)		120 Hz max.										
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)		3-phase, 380, 400, 415, 440, 460 or 480 VAC, 50/60 Hz										
	Allowable voltage fluctuation		+ 10%, - 15%										
	Allowable frequency fluctuation		±5%										
Control characteristics	Measures for power supply harmonics	DC reactor	Optional										
		12-phase rectification	Not possile										

Model Number CIMR-E7C □			4022	4030	4037	4045	4055	4075	4090	4110	4132	4160	4185	4220	4300
Max. applicable motor output (kW) *1			22	30	37	45	55	75	90	110	132	160	185	220	300
Output ratings	Rated output capacity (kVA)		34	46	57	69	85	110	140	160	200	230	280	390	510
	Rated output current (A)		45	60	75	91	112	150	180	216	260	304	370	506	675
	Max. output voltage (V)		3-phase, 380, 400, 415, 440, 460, or 480 VAC (Proportional to input voltage.)												
	Max. output frequency (Hz)		120 Hz max.												
Power supply characteristics	Max. voltage (V) Rated frequency (Hz)		3-phase, 380, 400, 415, 440, 460, or 480 VAC, 50/60 Hz												
	Allowable voltage fluctuation		+ 10%, - 15%												
	Allowable frequency fluctuation		±5%												
Control characteristics	Measures for power supply harmonics	DC reactor	Built in												
		12-phase rectification	Possible*2												

* 1. The maximum applicable motor output is given for a standard 4-pole Yaskawa motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

* 2. A 3-wire transformer is required on the power supply for 12-phase rectification.

◆ Common Specifications

The following specifications apply to both 200 V and 400 V Class Inverters.

Table 9.3 Common Specifications

Model Number CIMR-E7C □		Specification
Control characteristics	Control method	Sine wave PWM V/f control
	Speed control range	1:40
	Speed control accuracy	±2 to 3% (25°C ± 10°C)
	Frequency accuracy (temperature characteristics)	Digital references: ± 0.01% (-10°C to +40°C)
		Analog references: ±0.1% (25°C ±10°C)
	Frequency setting resolution	Digital references: 0.01 Hz
		Analog references: 0.025/50 Hz (10 bit with sign)
	Overload capacity and maximum current*2	120% of rated output current per minute
	Frequency setting signal	0 to 10 V, 4 to 20 mA
	Acceleration/Deceleration time	0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Main control functions	Restarting for momentary power loss, speed searches, overtorque detection, 4-speed control (maximum), acceleration/deceleration time changes, S-curve acceleration, 3-wire sequence, autotuning, cooling fan ON/OFF control, torque compensation, jump frequencies, upper and lower limits for frequency references, DC braking for starting and stopping, high-slip braking, PI control (with sleep function), energy-saving control, MEMOBUS communications (RS-485/422, 19.2 kbps maximum), fault reset, and function copying.
Protective functions	Motor protection	Protection by electronic thermal overload relay.
	Fuse blown protection	Stops for fuse blown.
	Overload protection	120% of rated output current for 1 minute
	Overvoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is above 410 V. 400 Class Inverter: Stops when main-circuit DC voltage is above 820 V.
	Undervoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is below 190 V. 400 Class Inverter: Stops when main-circuit DC voltage is below 380 V.
	Momentary power loss ridethru	Stops for 15 ms or more. By selecting the momentary power loss method, operation can be continued if power is restored within 2 s.
	Cooling fin overheating	Protection by thermistor.
	Stall prevention	Stall prevention during acceleration, deceleration, or running.
	Grounding protection	Protection by electronic circuits. (50% of inverter rated current)
	Charge indicator	Lit when the main circuit DC voltage is approx. 50 V or more.
Protective structure		Enclosed wall-mounted type (NEMA 1): 18.5 kW or less (same for 200 V and 400 V class Inverters) Open chassis type (IP00): 22 kW or more (same for 200 V and 400 V class Inverters)
Environment	Ambient operating temperature	-10°C to 40°C (Enclosed wall-mounted type) –10°C to 45°C (Open chassis type)
	Ambient operating humidity	95% max. (with no condensation)
	Storage temperature	- 20°C to + 60°C (short-term temperature during transportation)
	Application site	Indoor (no corrosive gas, dust, etc.)
	Altitude	1000 m max.
	Vibration	10 to 20 Hz, 9.8 m/s^2 max.; 20 to 50 Hz, 2 m/s^2 max

* 1. Not including the 200 V Class Inverter for 110 kW and the 400 V Class Inverters for 220 and 300 kW.

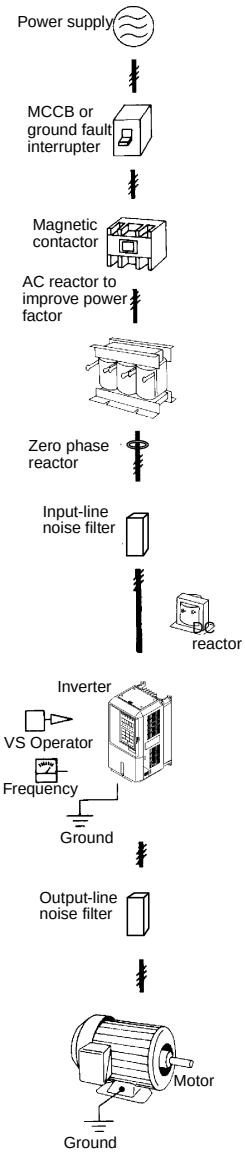
* 2. Increase the Inverter capacity if loads exceeding these current values are expected.

Specifications of Options and Peripheral Devices

The following options and peripheral devices can be used for the Inverter. Select them according to the application.

Table 9.4 Options and Peripheral Devices

Purpose	Name	Model (Code)	Descriptions
Protect Inverter wiring	MCCB or Ground Fault Interrupter*	NF□	Always connect a breaker to the power supply line to protect Inverter wiring. Use a ground fault interrupter suitable for high frequencies.
Prevents burning when a Braking Resistor is used.	Magnetic Contactor	HI-□J	Install to prevent the braking resistor from burning out when one is used. Always attach a surge absorber to the coil.
Contains switching surge	Surge Absorber	DCR2-□	Absorbs surge from the magnetic contactor and control relays. Connect surge absorbers to all magnetic contactors and relays near the Inverter.
Isolates I/O signals	Isolator	DGP□	Isolates the I/O signals of the Inverter and is effective against inductive noise.
Improve the input power factor of the Inverter	DC Reactor AC Reactor	UZDA-□ UZBA-□	Used to improve the input power factor of the Inverter. All Inverters of 22 kW or higher contain built-in DC reactors. These are optional for Inverters of 18.5 kW or less. Install DC and AC reactors for applications with a large power supply capacity (600 kVA or higher).
Reduce the affects of radio and control device noise	Input Noise Filter	(See EMC Part.)	Reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connect as close to the Inverter as possible.
	Finemet zero-phase reactor to reduce radio noise	F6045GB (FIL001098) F11080GB (FIL001097)	Reduces noise from the line that sneaks into the Inverter input power system. Insert as close to the Inverter as possible. Can be use on both the input side and output side.
	Output Noise Filter	LF-□	Reduces noise generated by the Inverter. Connect as close to the Inverter as possible.
Enable stopping the machine in a set time	Braking Resistor Unit	LKEB-□ (75600-K□□□0)	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED). (Braking Unit is needed.)
	Braking Unit	CDBR-□ (72600-R□□□0)	Used with a Braking Resistor Unit to reduce the deceleration time of the motor.
Operates the Inverter externally	VS Operator (small plastic Operator)	JVOP-95•□ (73041-0905X-□)	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 60/120 Hz, 90/180Hz
	VS Operator (Standard steel-plate Operator)	JVOP-96•□ (73041-0906X-□)	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 75 Hz, 150 Hz, 220 Hz
	Digital Operator Connection Cable	1 m cable: (72616-W5001) 3 m cable: (72616-W5003)	Extension cable to use a Digital Operator remotely. Cable length: 1 m or 3 m
Controls an Inverter system	VS System Module	JGSM-□	A system controller that can be match to the automatic control system to produce an optimum system configuration.
Provides Inverter momentary power loss recovery time	Momentary Power Loss Recovery Unit	P00□0 (73600-P00□0)	Handles momentary power losses for the control power supply for models 2.2 kW or less (maintains power for 2 s).
Set/monitor frequencies and voltages externally.	Frequency Meter	DCF-6A	Devices to set or monitor frequencies externally.
	Frequency Setter	RV30YN20S (2 kΩ)	
	Frequency Setter Knob	CM-3S	
	Output Voltmeter	SCF-12NH	Measures the output voltage externally and designed for use with a PWM Inverter.
Correct frequency reference input, frequency meter, ammeter scales	Variable Resistor Board for Frequency Reference	2 kΩ (ETX003270) 20 kΩ (ETX003120)	Connected to the control circuit terminals to input a frequency reference.
	Frequency Meter Scale Correction Resistor	(RH000850)	Calibrates the scale of frequency meters and ammeters.



* Use a ground fault interrupter with a current sensitivity of 200 mA minimum and an operating time of 0.1 s minimum to prevent operating errors. The interrupter must be suitable for high-frequency operation.
Example: NV series by Mitsubishi Electric Corporation (manufactured in or after 1988)
EG, SG series by Fuji Electric Co., Ltd. (manufactured in or after 1984)

■Available Option Cards

Table 9.5 Option Cards

Type		Name	Code Number	Function	Document Number
Built-in (connected to connector)	Communications Option Cards	DeviceNet Communications Interface Card SI-N	73600-C021X	Used to communicate with an Inverter from a host computer using DeviceNet communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		ProfiBus-DP Communications Interface Card SI-P	73600-C022X	Used to communicate with an Inverter from a host computer using ProfiBus-DP communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		InterBus-S Communications Interface Card SI-R	*	Used to communicate with an Inverter from a host computer using InterBus-S communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		CANopen Communications Interface Card SI-S	*	Used to communicate with an Inverter from a host computer using CANopen communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		ControlNet Communications Interface Card SI-U	*	Used to communicate with an Inverter from a host computer using ControlNet communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		CC-Link Communications Interface Card SI-C	73600-C032X	Used to communicate with an Inverter from a host computer using CC-Link communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-

* Under development.

10

Appendix

This chapter provides precautions for the Inverter, motor, and peripheral devices and also provides lists of constants.

Inverter Application Precautions 10-2
Motor Application Precautions 10-5
User Constants 10-7

Inverter Application Precautions

This section provides precautions for selecting, installing, setting, and handling Inverters.

◆ Selection

Observe the following precautions in selecting an Inverter.

■Installing Reactors

A large peak current will flow in the power input circuit when the Inverter is connected to a large-capacity power transformer (600 kVA or higher) or when switching a phase capacitor. Excessive peak current can destroy the convertor section. To prevent this, install a DC or AC reactor (optional) to improve the power supply power factor.

DC reactors are built into 200 V class Inverters of 22 to 110 kW and 400 V class Inverters of 22 to 300 kW.

If a thyristor convertor, such as a DC drive, is connected in the same power supply system, connect a DC or AC reactor regardless of the power supply conditions shown in the following diagram.

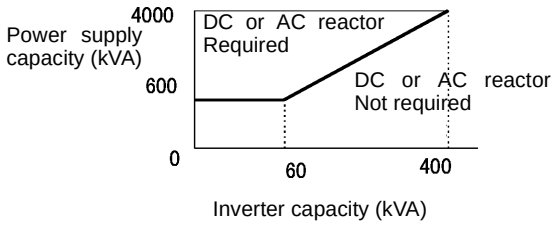


Fig 10.1

■Inverter Capacity

When connecting special motors or multiple motors in parallel to an Inverter, select the Inverter capacity so that the rated output current of the Inverter is minimum 1.1 times the sum of all the motor rated currents.

■Initial Torque

The startup and acceleration characteristics of the motor are restricted by the overload current ratings of the Inverter that is driving the motor. The torque characteristics are generally less than those required when starting using a normal commercial power supply. If a large initial torque is required, select an Inverter with a somewhat larger capacity or increase the capacity of both the motor and the inverter.

■Emergency Stop

Although the Inverter's protective functions will stop operation when a fault occurs, the motor will not stop immediately. Always provide mechanical stop and protection mechanisms on equipment requiring an emergency stop.

■Options

Terminals ⊖, ⊕1, ⊕2, ⊕3 are for connecting only the options specifically provided by Yaskawa. Never connect any other devices to these terminals.

◆ Installation

Observe the following precautions when installing an Inverter.

■Installation in Enclosures

Either install the Inverter in a clean location not subject to oil mist, air-bourne matter, dust, and other contaminants, or install the Inverter in a completely enclosed panel. Provide cooling measures and sufficient panel space so that the temperature surrounding the Inverter does not go beyond the allowable temperature. Do not install the Inverter on wood or other combustible materials.

■Installation Direction

Mount the Inverter vertically to a wall or other horizontal surface.

◆ Settings

Observe the following precautions when making settings for an Inverter.

■Upper Limits

The Digital Operator can be used to set high-speed operation up to a maximum of 120 Hz. Incorrect settings can be dangerous. Use the maximum frequency setting functions to set upper limits. (The maximum output frequency is factory-set to 50 Hz.)

■DC Injection Braking

The motor can overheat if the DC injection braking voltage or braking time is set to a large value.

■Acceleration/Deceleration Times

The motor's acceleration and deceleration times are determined by the torque generated by the motor, the load torque, and the load's inertial moment ($GD^2/4$). If the stall prevention functions are activated during acceleration or deceleration, increase the acceleration or deceleration time. The stall prevention functions will increase the acceleration or deceleration time by the amount of time the stall prevention function is active.

To reduce the acceleration or deceleration times, increase the capacity of the motor and Inverter.

◆ Handling

Observe the following precautions when wiring or performing maintenance for an Inverter.

■Wiring Check

The Inverter will be internally damaged if the power supply voltage is applied to output terminal U, V, or W. Check wiring for any mistakes before supplying power. Check all wiring and sequences carefully.

■Magnetic Contactor Installation

Do not start and stop operation frequently with a magnetic contactor installed on the power supply line. Doing so can cause the Inverter to malfunction. Do not turn the Inverter ON and OFF with a magnetic contactor more than one time every 30 minutes.

■Maintenance and Inspections

After turn OFF the main circuit power supply, always confirm that the CHARGE indicator does not lit anymore before performing maintenance or inspections. The voltage remaining in the capacitor may cause electric shock.

Motor Application Precautions

◆ Using the Inverter for an Existing Standard Motor

When a standard motor is operated with the Inverter, power loss is slightly higher than when operated with a commercial power supply. Observe the following precautions when using an Inverter for an existing standard motor.

■Low Speed Ranges

Cooling effects diminish in the low-speed range, resulting in an increase in the motor temperature. Therefore, the motor torque should be reduced in the low-speed range.

■Installation Withstand Voltage

If the input voltage is high (440 V or higher) or the wiring distance is long, the motor insulation voltage must be considered. Contact your Yaskawa representative for details.

■High-speed Operation

When using the motor at a high speed (50 Hz or more), problems may arise in dynamic balance and bearing durability. Contact your Yaskawa representative for details.

■Torque Characteristics

The motor may require more acceleration torque when the motor is operated with the Inverter than when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor to set a proper V/f pattern.

■Vibration

The Inverter uses a high carrier PWM to reduce motor vibration. (A constant can be set to select low carrier, PWM modulation control as well.) When the motor is operated with the Inverter, motor vibration is almost the same as when operated with a commercial power supply.
Motor vibration may, however, become greater in the following cases.

Resonance with the Natural Frequency of the Mechanical System

Take special care when a machine that has been operated at a constant speed is to be operated in variable speed mode. If resonance occurs, install vibration-proof rubber on the motor base or use the frequency jump function to skip any frequency resonating the machine.

Imbalanced Rotor

Take special care when the motor is operated at a higher speed (50 Hz or more).

■Noise

Noise varies with the carrier frequency. At high carrier frequencies, the noise is almost the same when the motor is operated with a commercial power supply. Motor noise, however, becomes louder when the motor is operated at a speed higher than the rated speed (50 Hz).

◆ Using the Inverter for Special Motors

Observe the following precautions when using a special motor.

■Pole-changing Motor

The rated input current of pole-changing motors differs from that of standard motors. Select, therefore, an appropriate Inverter according to the maximum input current of the motor to be used. Before changing the number of poles, always make sure that the motor has stopped. Otherwise, the overvoltage protective or over-current protective mechanism will be actuated, resulting in an error.

■Submersible Motor

The rated input current of submersible motors is higher than that of standard motors. Therefore, always select an Inverter by checking its rated output current. When the distance between the motor and Inverter is long, use a cable thick enough to connect the motor and Inverter to prevent motor torque reduction.

■Explosion-proof Motor

When an explosion-proof motor is to be used, it must be subject to an explosion-proof test in conjunction with the Inverter. This is also applicable when an existing explosion-proof motor is to be operated with the Inverter. Since the Inverter itself is, however, not explosion-proof, always install it in a safe place.

■Gearmotor

The speed range for continuous operation differs according to the lubrication method and motor manufacturer. In particular, continuous operation of an oil-lubricated motor in the low speed range may result in burning. If the motor is to be operated at a speed higher than 50 Hz, consult with the manufacturer.

■Synchronous Motor

A synchronous motor is not suitable for Inverter control. If a group of synchronous motors is individually turned ON and OFF, synchronism may be lost.

■Single-phase Motor

Do not use an Inverter for a single-phase motor. The motor should be replaced with a 3-phase motor.

◆ Power Transmission Mechanism (Speed Reducers, Belts, and Chains)

If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, oil lubrication will be affected when the motor operates only in the low speed range. The power transmission mechanism will make noise and experience problems with service life and durability if the motor is operated at a speed higher than 50 Hz.

User Constants

Factory settings are given in the following table. These setting are for a 200 V Class Inverter of 0.4 kW set to factory set control method (open loop vector control).

Table 10.1 User Constants

No.	Name	Factory Setting	Setting
A1-00	Language selection for digital LCD operator display	1*1	
A1-01	Constant access level	2	
A1-03	Initialize	0	
A1-04	Password	0	
A1-05	Password setting	0	
b1-01	Reference selection	1	
b1-02	Operation method selection	1	
b1-03	Stopping method selection	0	
b1-04	Prohibition of reverse operation	0	
b1-07	Operation selection after switching to remote mode	0	
b1-08	Run command selection in programming modes	0	
b2-01	Zero speed level (DC injection braking starting frequency)	0.5	
b2-02	DC injection braking current	50	
b2-03	DC injection braking time at start	0.00	
b2-04	DC injection braking time at stop	0.50	
b3-01	Speed search selection	2	
b3-02	Speed search operating current	100	
b3-03	Speed search deceleration time	2.0	
b3-05	Speed search wait time	0.2	
b5-01	PI control mode selection	0	
b5-02	Proportional gain (P)	1.00	
b5-03	Integral (I) time	1.0	
b5-04	Integral (I) limit	100.0	
b5-06	PI limit	100.0	
b5-07	PI offset adjustment	0.0	
b5-08	PI primary delay time constant	0.00	
b5-12	Selection of PI feedback command loss detection	0	
b5-13	PI feedback command loss detection level	0	
b5-14	PI feedback command loss detection time	1.0	
b5-15	PI sleep function operation level	0.0	
b5-16	PI sleep operation delay time	0.0	
b5-17	Acceleration/deceleration time for PI reference	0.0	
b8-01	Energy saving mode selection	0.0	
b8-04	Energy-saving coefficient	0	
b8-05	Power detection filter time constant	20	
b8-06	Search operation voltage limiter	0	
C1-01	Acceleration time 1	10.0	
C1-02	Deceleration time 1	10.0	
C1-03	Acceleration time 2	10.0	
C1-04	Deceleration time 2	10.0	
C1-09	Fast Stop Time	10.0	
C1-11	Accel/decel time switching frequency	0.0	
C2-01	S-curve characteristic time at acceleration start	0.20	
C2-02	S-curve characteristic time at acceleration end	0.20	
C4-01	Torque compensation gain	1.00	
C4-02	Torque compensation time constant	200	
C6-02	Carrier frequency selection	6*3	
C6-03	Carrier Frequency Upper Limit	15.0*3	
C6-04	Carrier Frequency Lower Limit	15.0*3	
C6-05	Carrier Freq. Proportional Gain	00	
d1-01	Frequency reference 1	0.00	
d1-02	Frequency reference 2	0.00	
d1-03	Frequency reference 3	0.00	
d1-04	Frequency reference 4	0.00	
d1-17	Jog frequency reference	6.00	
d2-01	Frequency reference upper limit	100.0	

Table 10.1 User Constants (Continued)

No.	Name	Factory Setting	Setting
d2-02	Frequency reference lower limit	0.0	
d2-03	Master speed reference lower limit	0.0	
d3-01	Jump frequency 1	0.0	
d3-02	Jump frequency 2	0.0	
d3-03	Jump frequency 3	0.0	
d3-04	Jump frequency width	1.0	
d6-01	Field weakening level	80	
d6-02	Field frequency	0.0	
E1-01	Input voltage setting	200*4	
E1-03	V/f pattern selection	F	
E1-04	Max. output frequency	50.0	
E1-05	Max. voltage	200.0*7	
E1-06	Base frequency	50.0	
E1-07	Mid. output frequency	3.0	
E1-08	Mid. output frequency voltage	15.0 *4	
E1-09	Min. output frequency	1.3	
E1-10	Min. output frequency voltage	9.0*4	
E1-11	Mid. output frequency 2	0.0*6	
E1-12	Mid. output frequency voltage 2	0.0*6	
E1-13	Base voltage	0.0*7	
E2-01	Motor rated current	1.90*3	
E2-05	Terminal Resistance	9.842	
F6-01	Operation selection after communications error	1	
F6-02	Input level of external error from Communications Option Card	0	
F6-03	Stopping method for external error from Communications Option Card	1	
F6-05	I monitor unit selection	0	
H1-01	Terminal S3 function selection	24	
H1-02	Terminal S4 function selection	14	
H1-03	Terminal S5 function selection	3 (0)*5	
H1-04	Terminal S6 function selection	4 (3)*5	
H1-05	Terminal S7 function selection	6 (4)*5	
H2-01	Terminal M1-M2 function selection (contact)	0	
H2-02	Terminal M3-M4 function selection (contact)	1	
H3-02	Gain (terminal A1)	0	
H3-03	Bias (terminal A1)	100.0	
H3-08	Multi-function analog input terminal A2 signal level selection	0	
H3-09	Multi-function analog input terminal A2 function selection	2	
H3-10	Gain (terminal A2)	100.0	
H3-11	Bias (terminal A2)	0.0	
H3-13	Terminal A1/A2 switching	0	
H4-01	Monitor selection (terminal FM)	2	
H4-02	Gain (terminal FM)	100%	
H4-03	Bias (terminal FM)	0.0	
H4-04	Monitor selection (terminal AM)	3	
H4-05	Gain (terminal AM)	50%	
H4-06	Bias (terminal AM)	0.0	
H4-07	Analog output 1 signal level selection	0	
H4-08	Analog output 2 signal level selection	0	
H5-01	Station address	1F	
H5-02	Communication speed selection	3	
H5-03	Communication parity selection	0	
H5-04	Stopping method after communication error	3	
H5-05	Communication error detection selection	1	
H5-06	Send wait time	5	
H5-07	RTS control ON/OFF	1	
L1-01	Motor protection selection	1	
L1-02	Motor protection time constant	1.0	
L1-03	Alarm operation selection during motor overheating	3	

Table 10.1 User Constants (Continued)

No.	Name	Factory Setting	Setting
L1-04	Motor overheating operation selection	1	
L1-05	Motor temperature input filter time constant	0.20	
L2-01	Momentary power loss detection	0	
L2-02	Momentary power loss ridethru time	0.1*3	
L2-03	Min. baseblock time	0.1	
L2-04	Voltage recovery time	0.3	
L2-05	Undervoltage detection level	190*4	
L3-01	Stall prevention selection during accel	1	
L3-02	Stall prevention level during accel	120	
L3-04	Stall prevention selection during decel	1	
L3-05	Stall prevention selection during running	1	
L3-06	Stall prevention level during running	120	
L4-01	Speed agreement detection level	0.0	
L4-02	Speed agreement detection width	2.0	
L4-05	Operation when frequency reference is missing	0	
L4-06	F_{Ref} @ F_{Ref} Loss	80%	
L5-01	Number of auto restart attempts	0	
L5-02	Auto restart operation selection	0	
L6-01	Torque detection selection 1	0	
L6-02	Torque detection level 1	150	
L6-03	Torque detection time 1	0.1	
L8-02	Overheat pre-alarm level	95	
L8-03	Operation selection after overheat pre-alarm	3	
L8-09	Ground protection selection	1	
L8-11	Cooling fan control delay time	60	
L8-12	Ambient temperature	45	
L8-15	OL2 characteristics selection at low speeds	1	
L8-18	Soft CLA selection	1	
N1-01	Hunting-prevention function selection	1	
N1-02	Hunting-prevention gain	1.00	
N3-01	High-slip braking deceleration frequency width	5	
N3-02	High-slip braking current limit	150	
N3-03	High-slip braking stop dwell time	1.0	
N3-04	High-slip braking OL time	40	
o1-01	Monitor selection	6	
o1-02	Monitor selection after powerup	1	
o1-03	Frequency units of reference setting and monitor	0	
o1-05	LCD Focus	3	
o2-01	LOCAL/REMOTE key enable/disable	1	
o2-02	STOP key during control circuit terminal operation	1	
o2-03	User constant initial value	0	
o2-04	kVA selection	0*3	
o2-05	Frequency reference setting method selection	0	
o2-06	Operation selection when digital operator is disconnected	0	
o2-07	Cumulative operation time setting	0	
o2-08	Cumulative operation time selection	0	
o2-09	Initialize mode	2	
o2-10	Fan operation time setting	0	
o2-12	Fault trace initialisation	0	
o3-01	Copy function selection	0	
o3-02	Read permitted selection	0	

* 1. Not initialized. (European standard specifications: A1-00 = 0)
* 2. For Inverters with a capacity of 55 kW or more: 2.00
* 3. Setting range and initial setting depend on Inverter capacity.
* 4. Setting for 200 V class Inverters. For 400 V class Inverters, double the value.
* 5. Factory setting in the parentheses is for 3-wire sequence.
* 6. The contents is ignored if the setting is 0.0.
* 7. E1-13 will have the same value as E1-05 after autotuning.

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