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YASKAWA
Mechatronics Solutions

HVAC Frequency Inverter

Varispeed E7

Instruction Manual and Parameter Description

Model: CIMR-E7C□□□□



CE

YEG-TOE-S616-56.1B

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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 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. 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.

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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 for 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,	Equipping of Power Systems with Electronic Devices
EN 60204-1, 1997-12	Machine Safety and Equipping with Electrical Devices Part 1: General Requirements (IEC 60204-1:1997)/ Please note: Includes Corrigendum of September 1998
EN 61010-1, A2, 1995	Safety Requirements for Information Technology Equipment (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 (e.g. 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.

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■ 5. Electrical Connection

Carry out any work on live equipment in compliance with the national safety and accident prevention regulations. Carry out electrical installation in compliance with the relevant regulations. 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 CE, UL, and c-UL.

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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 61800-3; A11:2000

■ 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:

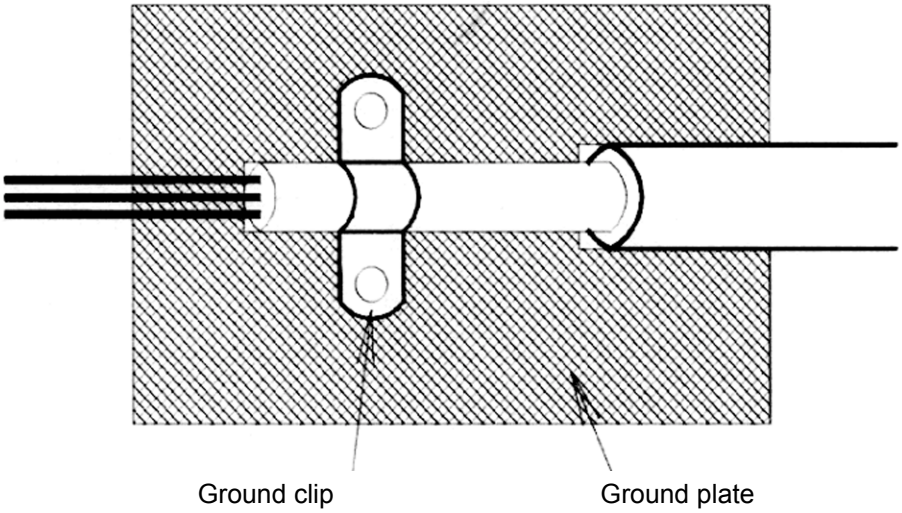
Line filter and frequency inverter must be mounted on the same metal plate. Mount the two components as close to each other as possible, with cables kept as short as possible.

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).

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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.

You can find further informations in the document EZZ006543 which can be ordered at Yaskawa.

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Electromagnetic Compatibility (EMC)

■ Recommended Line Filters for Varispeed E7 made by Schaffner EMV AG

Inverter Model	Line Filter (Schaffner)				
Varispeed E7	Model	EN 55011 Class*	Current (A)	Weight (kg)	Dimensions W x D x H
CIMR-E7C40P4	FS 5972-10-07	B, 50 m	10	1.1	141 x 46 x 330
CIMR-E7C40P7		B, 50 m			
CIMR-E7C41P5		B, 50 m			
CIMR-E7C42P2		B, 50 m			
CIMR-E7C43P7		B, 50 m			
CIMR-E7C44P0	FS 5972-18-07	B, 50 m	18	1.3	141 x 46 x 330
CIMR-E7C45P5		B, 50 m			
CIMR-E7C47P5	FS 5972-21-07	B, 50 m	21	1.8	206 x 50 x 355
CIMR-E7C4011	FS 5972-35-07	B, 50 m	35	2.1	206 x 50 x 355
CIMR-E7C4015	FS 5972-60-07	B, 50 m	60	4.0	236 x 65 x 408
CIMR-E7C4018		B, 50 m			
CIMR-E7C4022	FS 5972-70-52	B, 50 m	70	3.4	80 x 185 x 329
CIMR-E7C4030		B, 50 m			
CIMR-E7C4037	FS 5972-100-35	B, 50 m	100	4.5	90 x 150 x 326
CIMR-E7C4045		B, 50 m			
CIMR-E7C4055	FS 5972-130-35	B, 50 m	130	4.7	90 x 180 x 366
CIMR-E7C4075	FS 5972-170-40	B, 50 m	170	6.0	120 x 170 x 451
CIMR-E7C4090	FS 5972-250-37	A, 50 m	250	11.7	130 x 240 x 610
CIMR-E7C4110	or				
	FN 3359-250-28	A, 50 m		7.0	230 x 125 x 300
CIMR-E7C4132	FS 5972-410-99	A, 50 m	410	10.5	260 x 115 x 386
CIMR-E7C4160					
CIMR-E7C4185					
CIMR-E7C4220	FS 5972-600-99	A, 50 m	600	11	260 x 135 x 386
CIMR-E7C4300	FS 5972-800-99	A, 50 m	800	31	300 x 160 x 716

Maximum Voltage : AC 480V 3phase
Ambient Temperature : 45°C (max.)

* Permissible emission of power drive systems for commercial and light environment (EN61800-3, A11) (general availability, 1st environment)

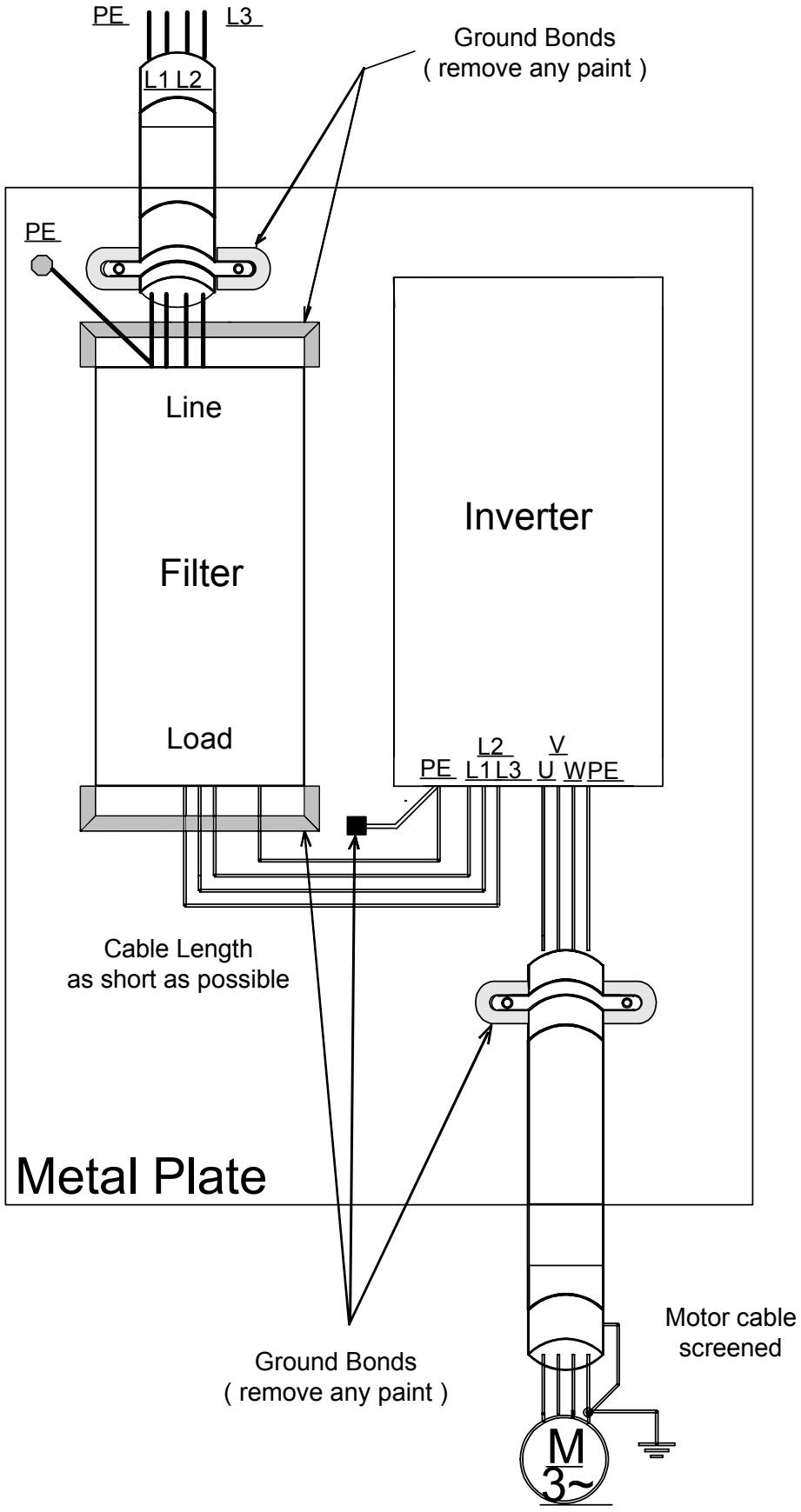
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Line Filters (Schaffner)					
Varispeed E7	**Type**	**EN 55011 Class**	**Current (A)**	**Weight (kg)**	**Dimensions W x D x H**
CIMR-E7C20P4	FS 5972-10-07	B*	7	1.1	141 x 45 x 330
CIMR-E7C20P7		B*			
CIMR-E7C21P5		B*			
CIMR-E7C22P2	FS 5972-18-07	B*	18	1.7	141 x 46 x 330
CIMR-E7C23P7	FS 5973-35-07	B*	35	1.4	141 x 46 x 330
CIMR-E7C25P5		B*			
CIMR-E7C27P5	FS 5973-60-07	B*	60	3	206 x 60 x 355
CIMR-E7C2011		B*			
CIMR-E7C2015	FS 5973-100-07	A	100	4.9	236 x 80 x 408
CIMR-E7C2018		A			
CIMR-E7C2022	FS 5973-130-35	A	130	4.3	90 x 180 x 366
CIMR-E7C2030		A			
CIMR-E7C2037	FS 5973-160-40	A	160	6	120 x 170 x 451
CIMR-E7C2045	FS 5973-240-37	A	240	11	130 x 240 x 610
CIMR-E7C2055		A			
CIMR-E7C2075	FS 5973-500-37	A	500	19.5	300 x 160 x 564
CIMR-E7C2090		A			
CIMR-E7C2110		A			

Max. motor cable length : 10 m Class B, 50 m Class A
Max. voltage : AC 240 V, 3 ph.
Ambient temperature : 45°C max.

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■ **Installation inverters and EMC filters**



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- 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.

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1

Handling Inverters

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

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Confirmations upon Delivery 1-4
Exterior and Mounting Dimensions 1-8
Checking and Controlling the Installation Site 1-11
Installation Orientation and Space 1-12
Removing and Attaching the Terminal Cover 1-13
Removing/Attaching the Digital Operator and Front Cover 1-13

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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 includes Inverters in two voltage classes: 200 V and 400 V. The maximum motor capacities vary from 0.55 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	0.55	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		20181□
	22	32	CIMR-E7C2022	20220□	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□	–

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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	0.55	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		40181□
	22	34	CIMR-E7C4022	40220□	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□	–

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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, 400 VAC, 0.55 kW, IEC IP20 and NEMA 1 standards

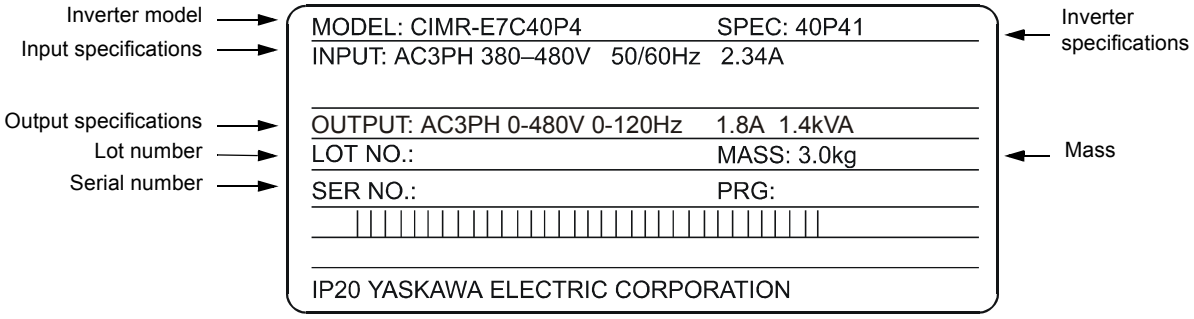


Fig 1.1 Nameplate

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■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.

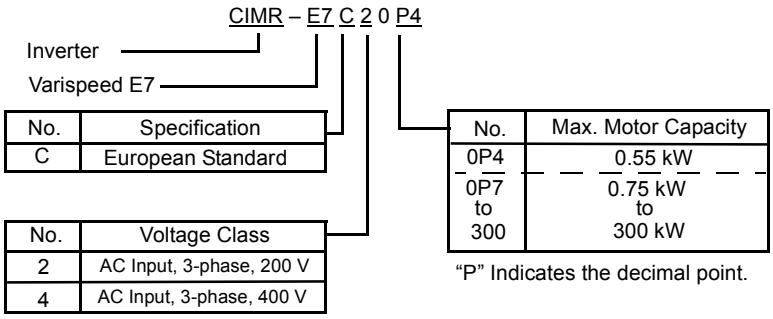


Fig 1.2 Inverter Model Numbers

■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.

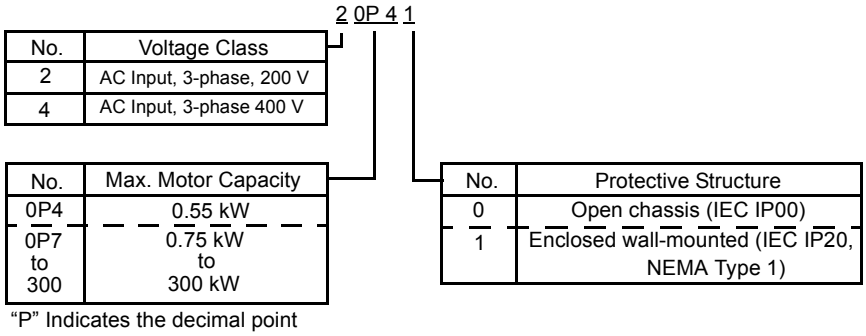


Fig 1.3 Inverter Specifications

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◆ 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*.

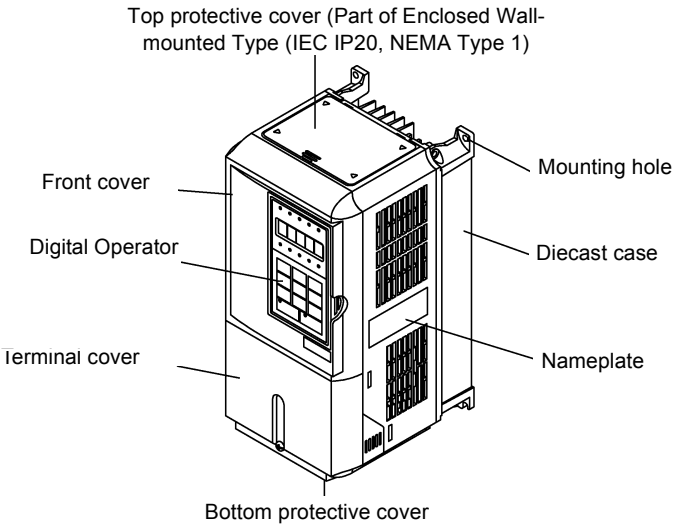


Fig 1.4 Inverter Appearance (18.5 kW or Less)

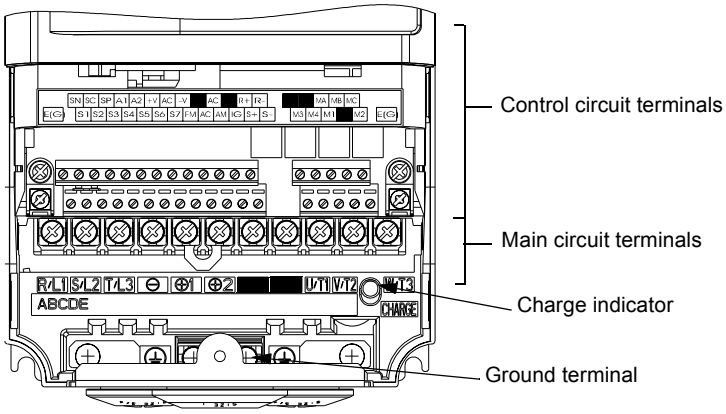


Fig 1.5 Terminal Arrangement (18.5 kW or Less)

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■ 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*.

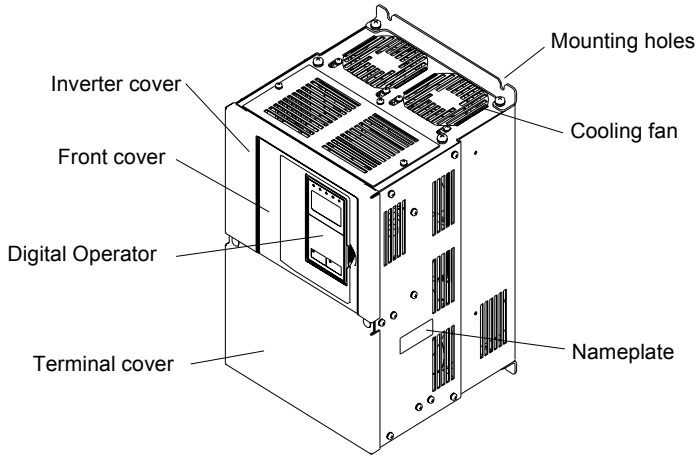


Fig 1.6 Inverter Appearance (22 kW or More)

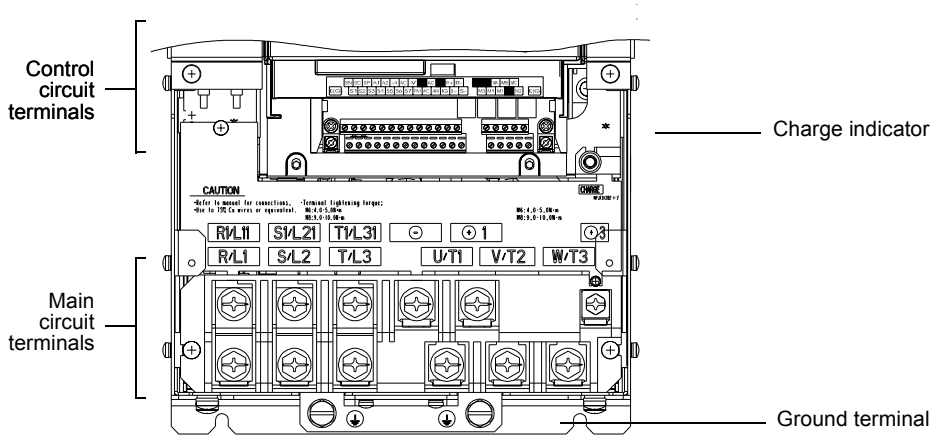


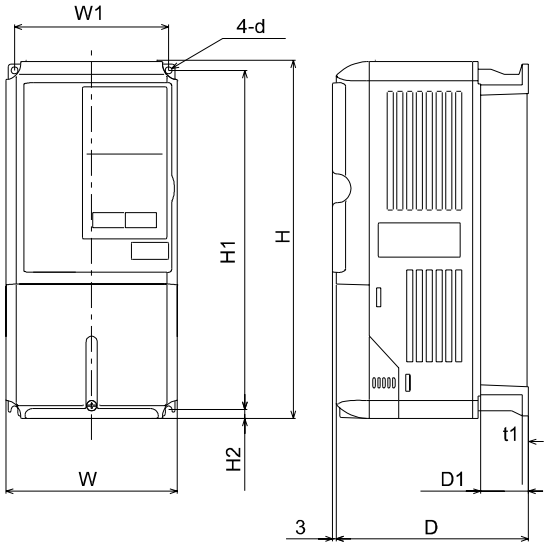
Fig 1.7 Terminal Arrangement (22 kW or More)

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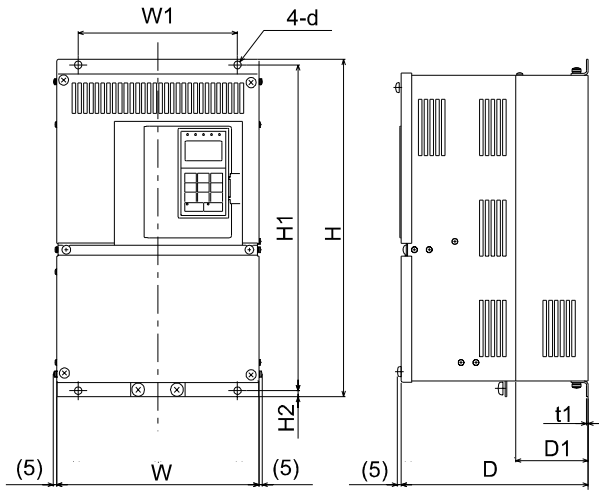
Exterior and Mounting Dimensions

◆ Open Chassis Inverters (IP00)

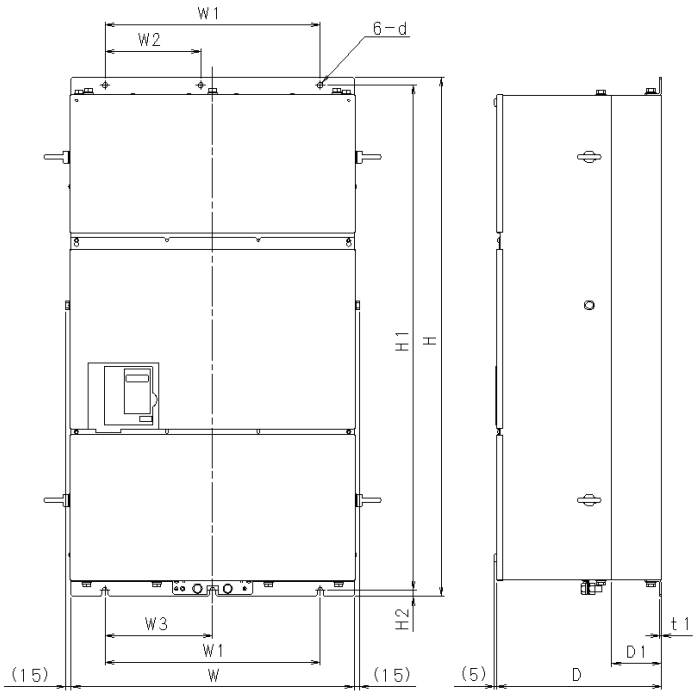
Exterior diagrams of the Open Chassis Inverters are shown below.



200 V/400 V Class Inverters of 0.55 to 18.5 kW



200 V Class Inverters of 22 or 110 kW
400 V Class Inverters of 22 to 160 kW



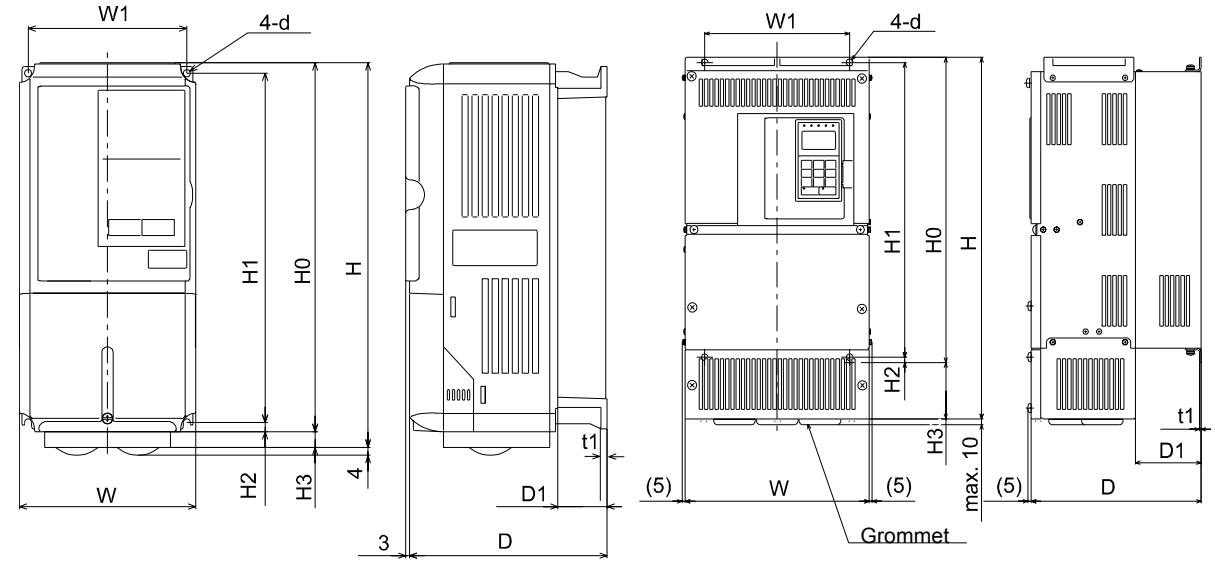
400 V Class Inverters of 185 to 300 kW

Fig 1.8 Exterior Diagrams of Open Chassis Inverters

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◆ Enclosed Wall-mounted Inverters (NEMA1)

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



200 V/400 V Class Inverters of 0.55 to 18.5 kW

200 V Class Inverters of 22 or 75 kW
400 V Class Inverters of 22 to 160 kW

Fig 1.9 Exterior Diagrams of Enclosed Wall-mounted Inverters

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Table 1.3 Inverter Dimensions (mm) and Masses (kg)
of 200V Class Inverters and 400V Class Inverters of 0.55 to 160 kW

Voltage Class	Max. Applicable Motor Output [kW]	Dimensions (mm)																					Caloric Value(W)			Cooling Method
		Open Chassis (IP00)									Enclosed Wall-mounted (NEMA1)															
		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*	External	Internal	Total Heat Generation	
200 V (3-phase)	0.55	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						130		68		1266	505	1771	
	55	450	725	350	325	700				86	455	1100	350	325	725	700		305			94		1588	619	2207	
	75									87											95		2019	838	2857	
	90	500	850	360	378	820	15	140	4.5	108	---											M12	2437	997	3434	
	110	575	885	380	445	855				150													2733	1242	3975	
400 V (3-phase)	0.55	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	85	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			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	14		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	916	378	445	855	46	140		160	579	1324	378	445	916	855	46	408	140		170		2791	1147	3938	

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

Table 1.4 Inverter Dimensions (mm) and Masses (kg) of 400V Class Inverters of 185 kW to 300 kW

Voltage Class	Max. Applicable Motor Output [kW]	Dimensions (mm)												Caloric Value (W)			Cooling Method
		Open Chassis (IP00)											Mounting Holes d	External	Internal	Total Heat Generation	
		W	H	D	W1	W2	W3	H1	H2	D1	t1	Approx. Mass					
400V (3-phase)	185	710	1305	413	540	240	270	1270	15	125.5	4.5	260	M12	3237	1372	4609	Fan
	220											280		3740	1537	5277	
	300	916	1475	413	730	365	365	1440	15	125.5	4.5	405		5838	2320	8158	

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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 1.5 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

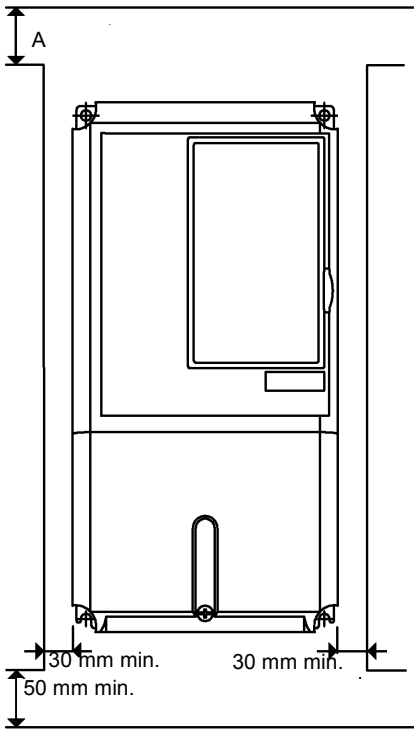
Place a cover over the Inverter during installation to shield it from metal power produced by drilling.

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

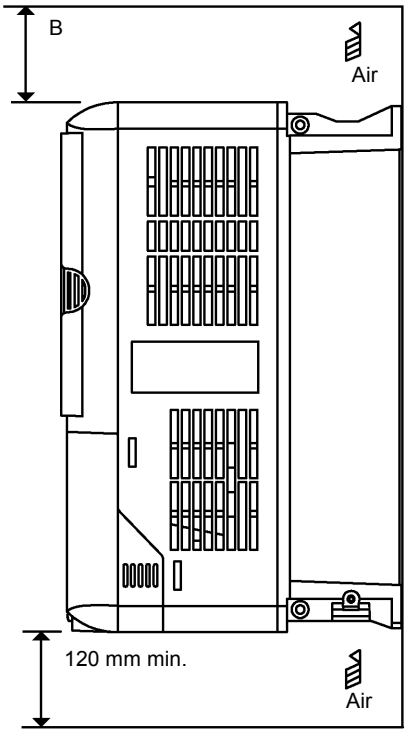
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Installation Orientation and Space

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.



Horizontal Space



Vertical Space

	A	B
200V class inverter, 0.55 to 90 kW 400V class inverter, 0.55 to 132 kW	50 mm	120 mm
200V class inverter, 110 kW 400V class inverter, 160 to 220 kW	120 mm	120 mm
400V class inverter, 300 kW	300 mm	300 mm

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.

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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.

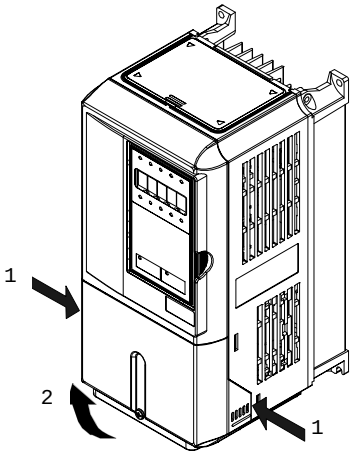


Fig 1.11 Removing the Terminal Cover (Model CIMR-E7C25P5 Shown Above)

■ 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.

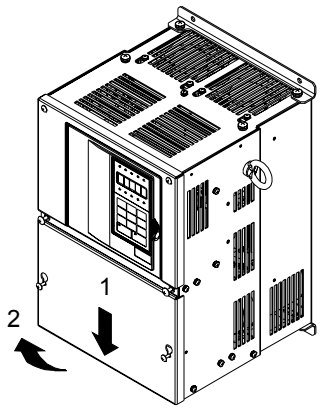


Fig 1.12 Removing the Terminal Cover (Model CIMR-E7C2022 Shown Above)

◆ 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.

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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 front cover.

The removal and attachment procedures are described 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.

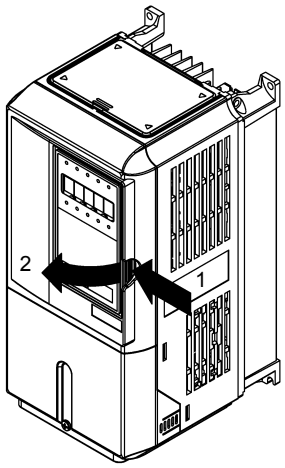


Fig 1.13 Removing the Digital Operator (Model CIMR-E7C45P5 Shown Above)

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■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.

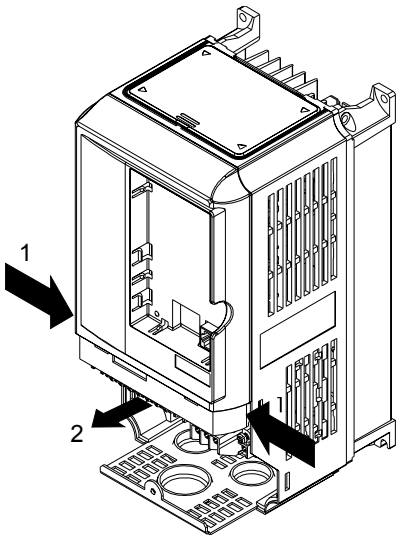


Fig 1.14 Removing the Front Cover (Model CIMR-E7C45P5 Shown Above)

■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).

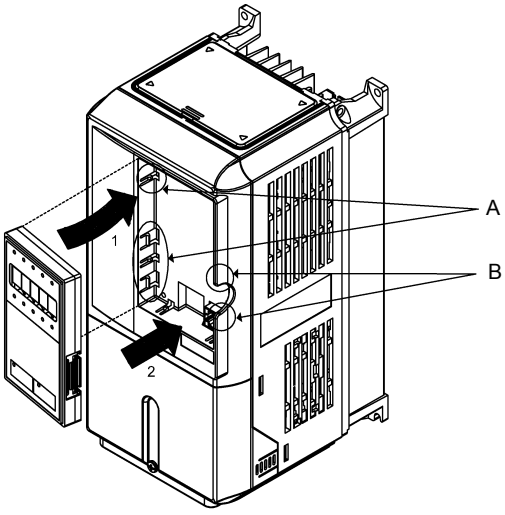


Fig 1.15 Mounting the Digital Operator

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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.

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◆ Inverters of 22 kW or More

For inverters 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.

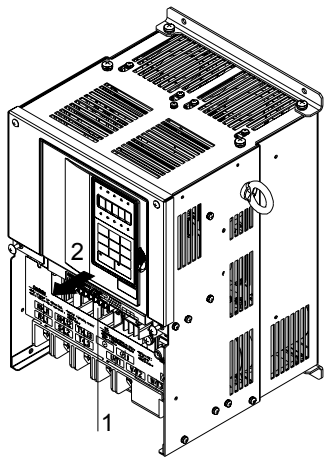


Fig 1.16 Removing the Front Cover (Model CIMR-E7C2022 Shown Above)

■ 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.

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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 2-19
Wiring Check 2-26

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Connections to Peripheral Devices

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

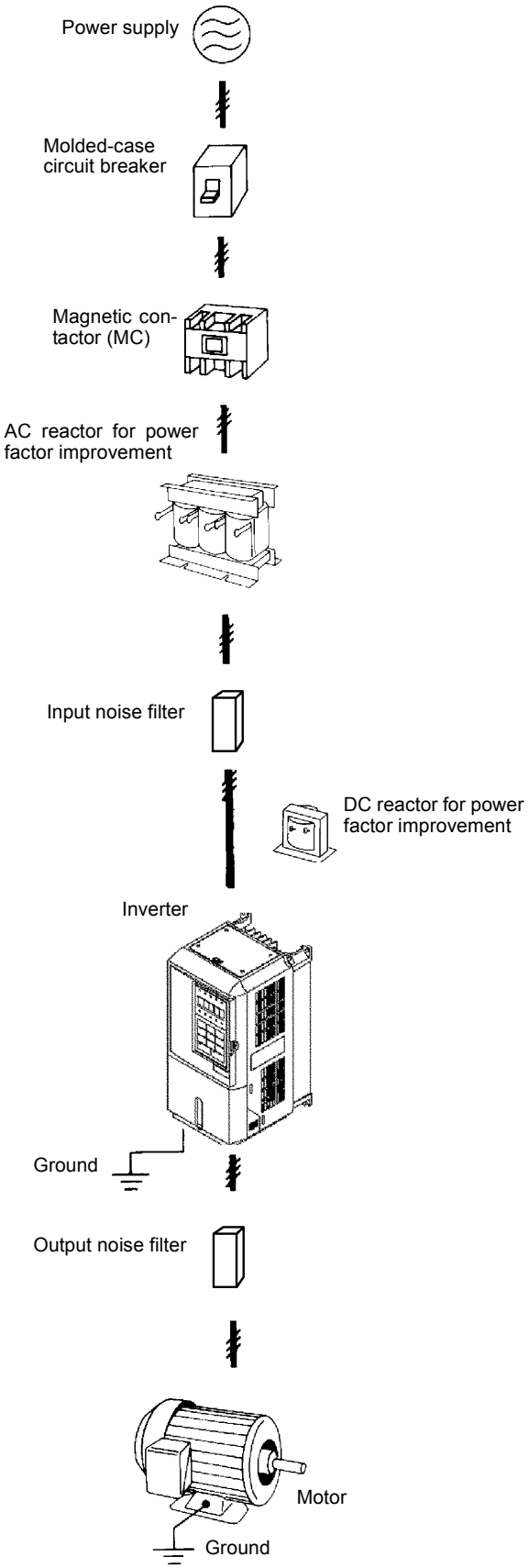


Fig 2.1 Example Connections to Peripheral Devices

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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.

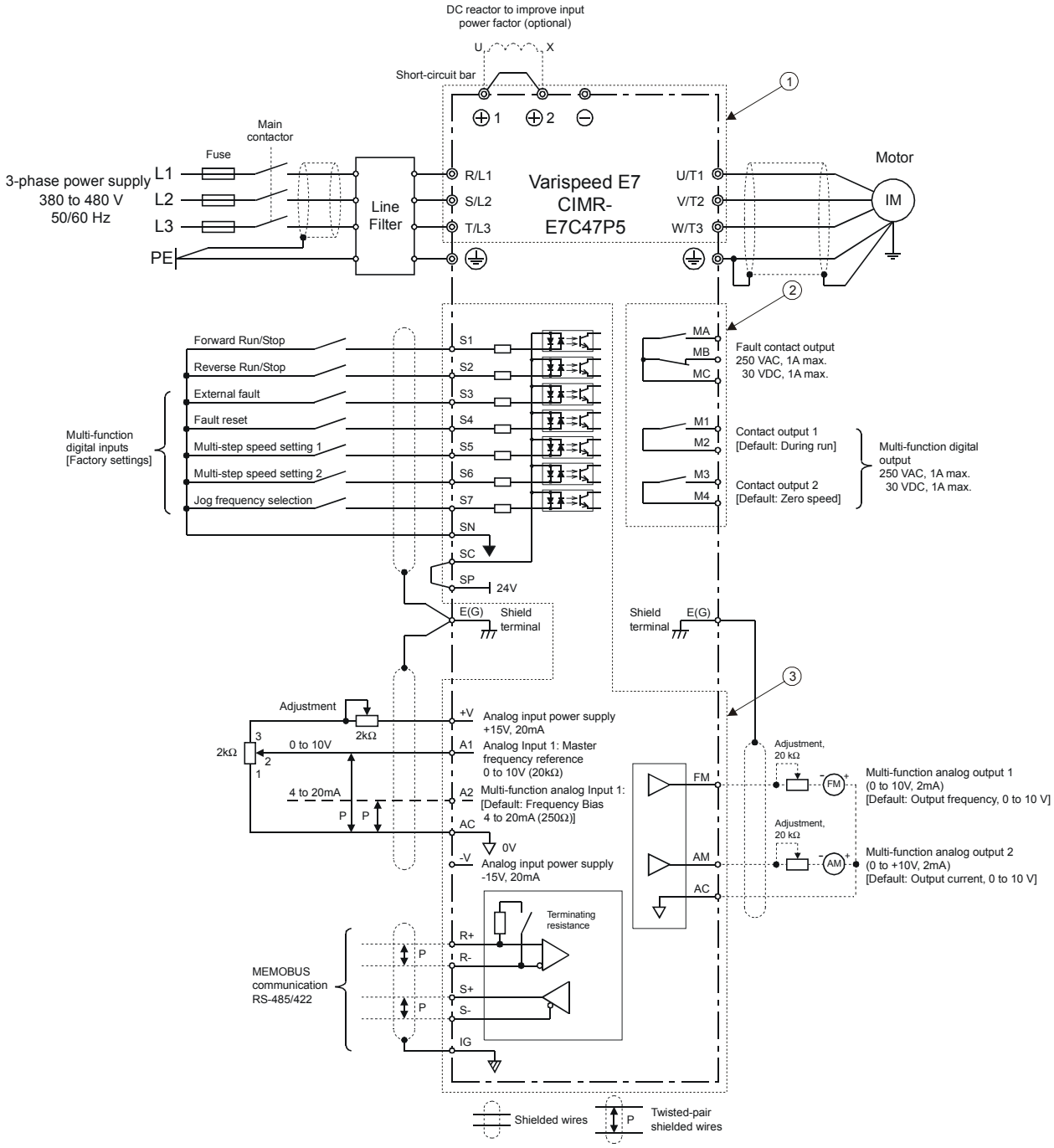


Fig 2.2 Connection Diagram (Model CIMR-E7C47P5 Shown Above)

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◆ Circuit Descriptions

Refer to the numbers indicated in *Fig 2.2*.

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

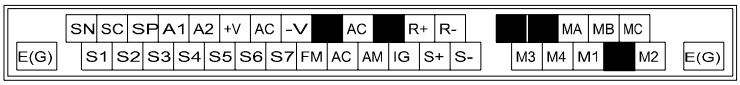
② These circuits are separated from all other circuits by protective separation consisting of double and reinforced insulation. These circuits may be interconnected with SELV (or equivalent) or non-SELV circuits, but not both.

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.

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 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 capability of the +V terminal is 20 mA.
   Disable the stall prevention during deceleration (L3-04 = 0) when using a Braking Option. If this user constant is not changed to disable stall prevention, the system may not stop within set deceleration time.
3. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.
4. The wiring of the digital inputs S1 to S7 is shown for the connection of contacts or NPN transistors (0V common and sinking mode). This is the default setting.
   For the connection of PNP transistors or for using a 24V external power supply, refer to *Table 2.13*.
5. The master speed frequency reference can be input either at terminal A1 or at terminal A2 by changing the setting of parameter H3-13. The default setting is terminal A2.
6. DC reactors to improve the input power factor are built into 200 V Class Inverters from 22 up to 110 kW and 400 V Class Inverters from 22 up to 300 kW. A DC reactor is an option only for Inverters of 18.5 kW or less. Remove the short circuit bar when connecting a DC reactor.

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Terminal Block Configuration

The terminal arrangements are shown in *Fig 2.3* and *Fig 2.4*.

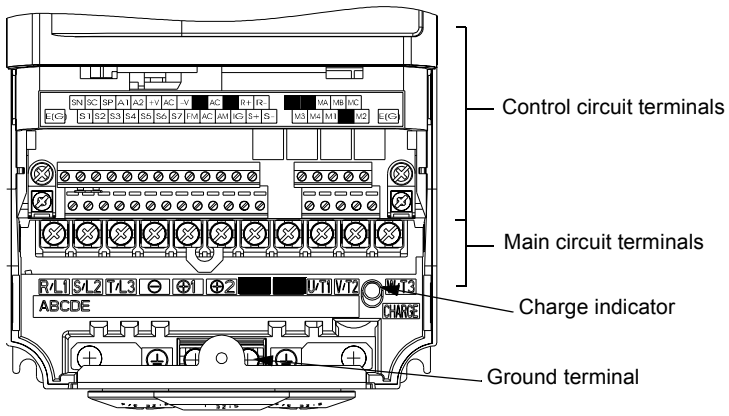


Fig 2.3 Terminal Arrangement (200 V/400 V Class Inverter of 0.4 kW)

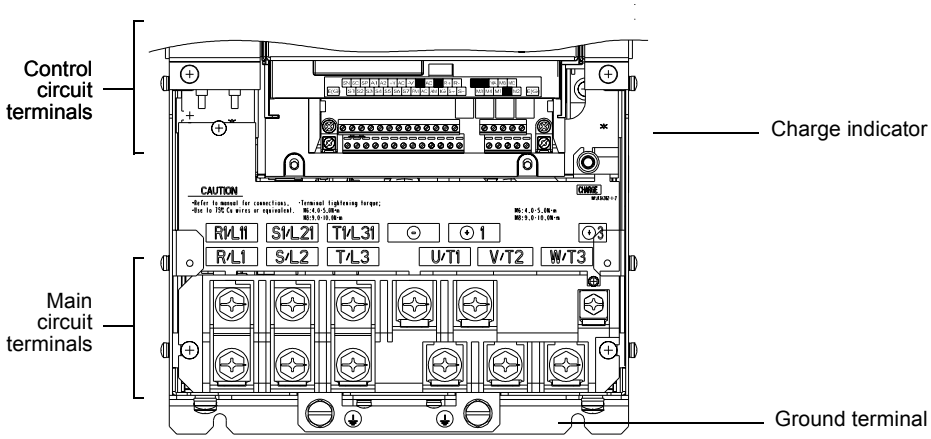


Fig 2.4 Terminal Arrangement (200 V/400 V Class Inverter of 22 kW or more)

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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 Units and Braking Resistor 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)	

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Inverter Model CIMR-☐	Terminal Symbol	Termi-nal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recom-mended 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

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Table 2.2 400 V Class Wire Sizes

Inverter Model CIMR-□	Terminal Symbol	Termi-nal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2 (AWG)	Recom-mended 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)	

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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)	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)	
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)	
	⊕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	M10	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)	-	
	⏚	M10	31.4 to 39.2	38 to 60 (2 to 2/0)	38 (2)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4090	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	31.4 to 39.2	80 to 100 (3/0 to 4/0)	100 (4/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	8 to 22 (8 to 4)	-	
	⏚	M10	31.4 to 39.2	50 to 100 (1 to 4/0)	50 (1)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4110	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M10	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	600 (2/0)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4132	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	31.4 to 39.2	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M10	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 × 2P (2/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 (4/0)	
	r/l1, Δ200/$_{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)	

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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
E7C4185	R/L1, S/L2, T/L3	M16	78.4 to 98	100 to 325 (4/0 to 600)	150 × 2P (300 × 2P)	Power cables, e.g., 600 V vinyl power cables
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P)	
	⊖, ⊕ 1	M16	78.4 to 98	100 to 325 (4/0 to 600)	325 × 2P (600 × 2P)	
	⊕ 3	M16	78.4 to 98	100 to 325 (4/0 to 600)	–	
	⏚	M16	78.4 to 98	100 to 325 (4/0 to 600)	100 × 2P (3/0 × 2P	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4220	R/L1, S/L2, T/L3	M16	78.4 to 98	100 to 325 (4/0 to 600)	250 × 2P (500 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M16	78.4 to 98	100 to 325 (4/0 to 600)	200 × 2P (400 × 2P)	
	⊖, ⊕ 1	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (250 × 4P)	
	⊕ 3	M16	78.4 to 98	100 to 325 (4/0 to 600)	–	
	⏚	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
E7C4300	R/L1, S/L2, T/L3	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (250 × 4P)	
	R1/L11, S1/L21, T1/L31	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (250 × 2P	
	U/T1, V/T2, W/T3	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (4/0 × 4P)	
	⊖, ⊕ 1	M16	78.4 to 98	100 to 325 (4/0 to 600)	200 × 4P (400 × 4P)	
	⊕ 3	M16	78.4 to 98	100 to 325 (4/0 to 600)	–	
	⏚	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

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

Table 2.3 Lug Sizes (JIS C2805) (200 V Class and 400 V Class)

Wire Thickness (mm^2)	Terminal Screws	Size
0.5	M3.5	1.25 / 3.5
	M4	1.25 / 4
0.75	M3.5	1.25 / 3.5
	M4	1.25 / 4
1.25	M3.5	1.25 / 3.5
	M4	1.25 / 4
2	M3.5	2 / 3.5
	M4	2 / 4
	M5	2 / 5
	M6	2 / 6
	M8	2 / 8
3.5/5.5	M4	5.5 / 4
	M5	5.5 / 5
	M6	5.5 / 6
	M8	5.5 / 8

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Wire Thickness (mm^2)	Terminal Screws	Size
8	M5	8 / 5
	M6	8 / 6
	M8	8 / 8
14	M6	14 / 6
	M8	14 / 8
22	M6	22 / 6
	M8	22 / 8
30/38	M8	38 / 8
50/60	M8	60 / 8
	M10	60 / 10
80	M10	80 / 10
100		100 / 10
100	M12	100 / 12
150		150 / 12
200		200 / 12
325	M12 x 2	325 / 12
	M16	325 / 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)

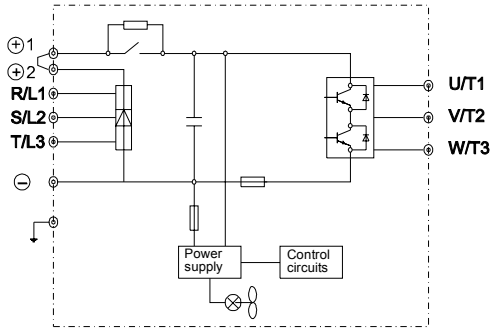
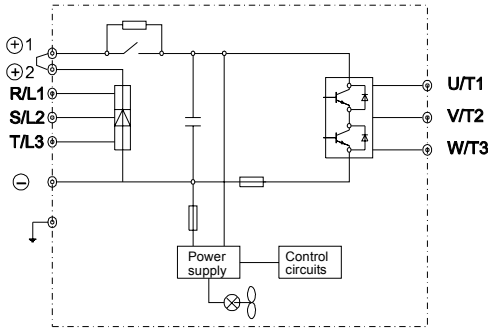
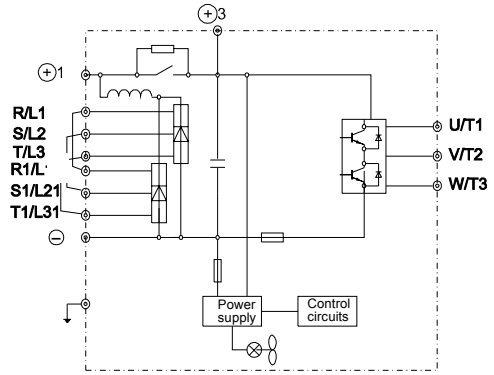
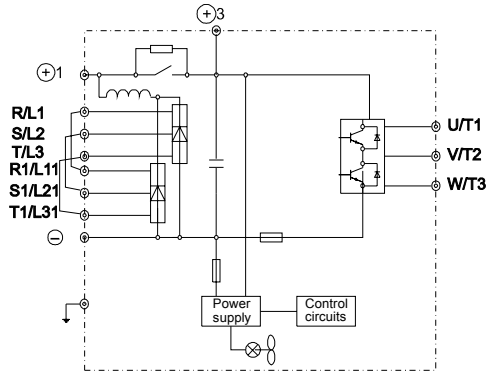
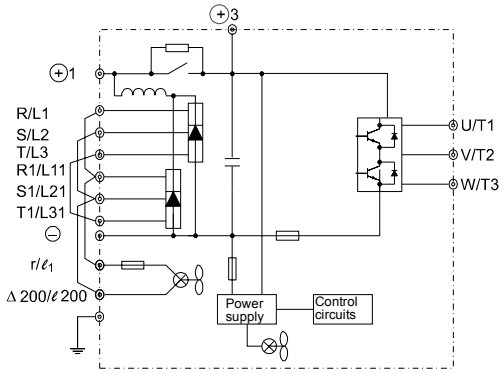
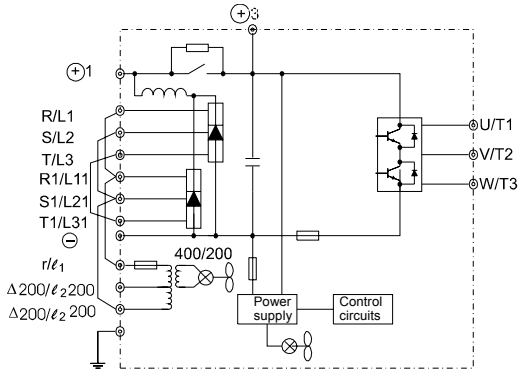
Purpose	Terminal Symbol	Model: CIMR-F7C□□□□	
		200 V Class	400 V Class
Main circuit power input	R/L1, S/L2, T/L3	20P4 to 2110	40P4 to 4300
	R1/L11, S1/L21, T1/L31	2022 to 2110	4022 to 4300
Inverter outputs	U/T1, V/T2, W/T3	20P4 to 2110	40P4 to 4300
DC bus terminals	⊕1, ⊖	20P4 to 2110	40P4 to 4300
DC reactor connection	⊕1, ⊕2	20P4 to 2018	40P4 to 4018
Braking Unit connection	⊕3, ⊖	2022 to 2110	4022 to 4300
Ground	⏚	20P4 to 2110	40P4 to 4300

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◆ Main Circuit Configurations

The main circuit configurations of the Inverter are shown in *Table 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 4300 

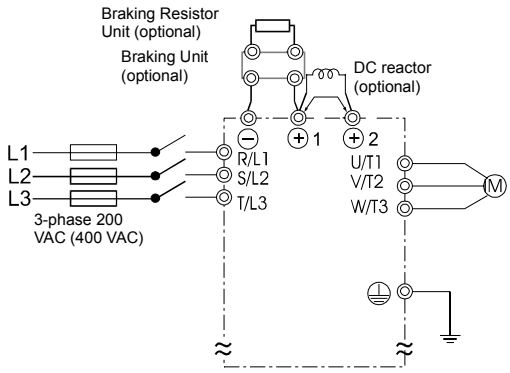
Note: Consult your Yaskawa representative before using 12-phase rectification.

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◆ Standard Connection Diagrams

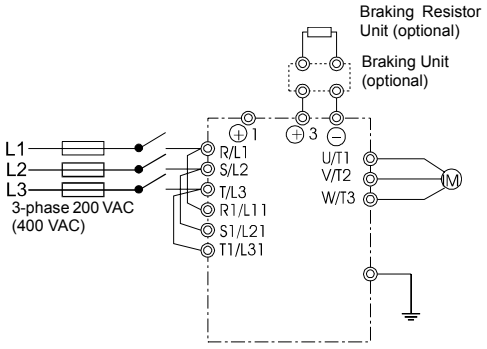
Standard Inverter connection diagrams are shown in *Fig 2.5*. These are the same for both 200 V Class and 400 V Class Inverters. The connections depend on the Inverter capacity.

■CIMR-E7C20P4 to 2018 and 40P4 to 4018



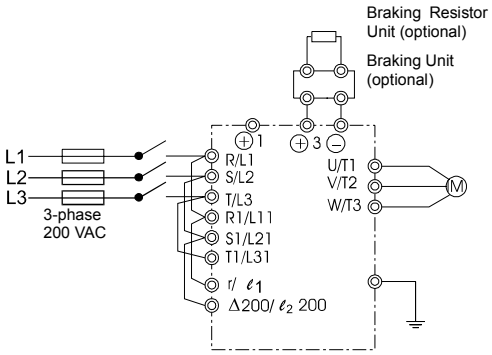
Be sure to remove the short-circuit bar before connecting the DC reactor.

■CIMR-E7C2022, 2030, and 4022 to 4055

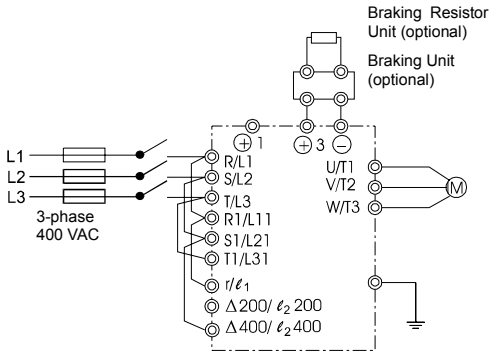


The DC reactor is built in.

■CIMR-E7C2037 to 2110



■CIMR-E7C4075 to 4300



Control power is supplied internally from the DC bus at all inverter models.

Fig 2.5 Main Circuit Terminal Connections

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◆ 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

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Installing a Moulded-case Circuit Breaker

When connecting the power input terminals (R/L2, S/L2, and T/L3) to the power supply using a moulded-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 of the inverter's rated current.
- For the MCCB's time characteristics, be sure to consider the inverter's overload protection (one minute at 150% of the rated output current).

Installing an Earth Leakage Breaker

Inverter outputs use high-speed switching, so high-frequency leakage current is generated. If an earth leakage breaker should be used, select a breaker that detects only the leakage current which is in the frequency range that is hazardous to humans but not high-frequency leakage currents.

- For a special-purpose earth leakage breaker for Inverters, choose a ground fault interrupter with a sensitivity amperage of at least 30 mA per Inverter.
- When using a general earth leakage breaker, choose one 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 by a control circuit, a magnetic contactor can be used.

The following things should be considered:

- 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.

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 output phase sequence.

Installing an AC Reactor

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

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 respective to the motor lead wires U, V, and W.

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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 may occur. This is extremely hazardous. Do not short the output wires.

Do Not Use a Phase Advancing Capacitor

Never connect a phase advancing capacitor to an output circuit. The high-frequency components of the Inverter output may overheat and be damaged and may cause other parts to burn.

Do Not Use an Electromagnetic Switch

Never connect an electromagnetic 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 created and the inverter's overcurrent protection will operate.

When using a MC to switch for instance between two motors, stop the Inverter output before operating the MC.

Installing a Thermal Overload Relay Contact for Motor Protection

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 control circuit should be designed so that the contacts of the thermal overload relay turn OFF the magnetic contactor on the main circuit inputs.

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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.

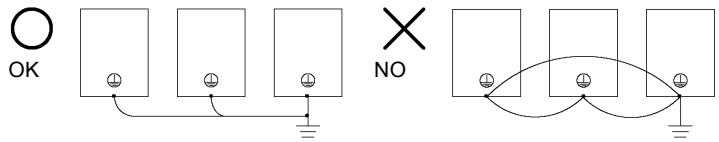


Fig 2.6 Ground Wiring

■Connecting a Braking Unit (CDBR) and a Braking Resistor Unit (LKEB)

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

Table 2.8

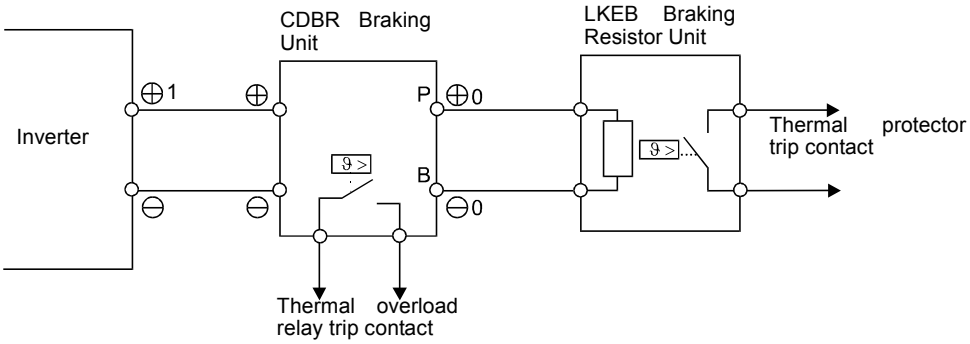
L3-04 (Stall prevention selection during deceleration) (Select either of them.)	0 (Disable stall prevention function)

The Braking Resistor Unit will not work if L3-04 is set to 1 (i.e., if stall prevention is enabled for deceleration). Hence the deceleration time may be longer than the set time (C1-02/04).

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To prevent the braking unit/braking resistor unit from overheating, design the control circuit to turn OFF the inverter output using the thermal overload relay 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 Capacity



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

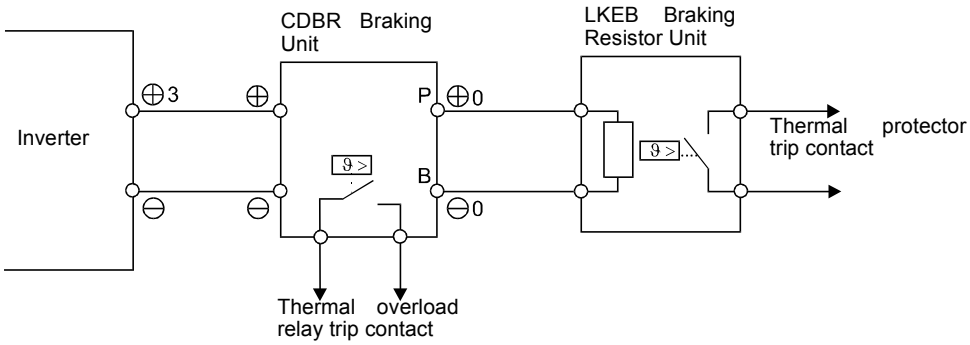


Fig 2.7 Connecting the Braking Resistor Unit and Braking Unit

Connecting Braking Units in Parallel

When connecting two or more Braking Units in parallel, use the wiring and jumper settings like shown in *Fig 2.8*. There is a jumper 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).

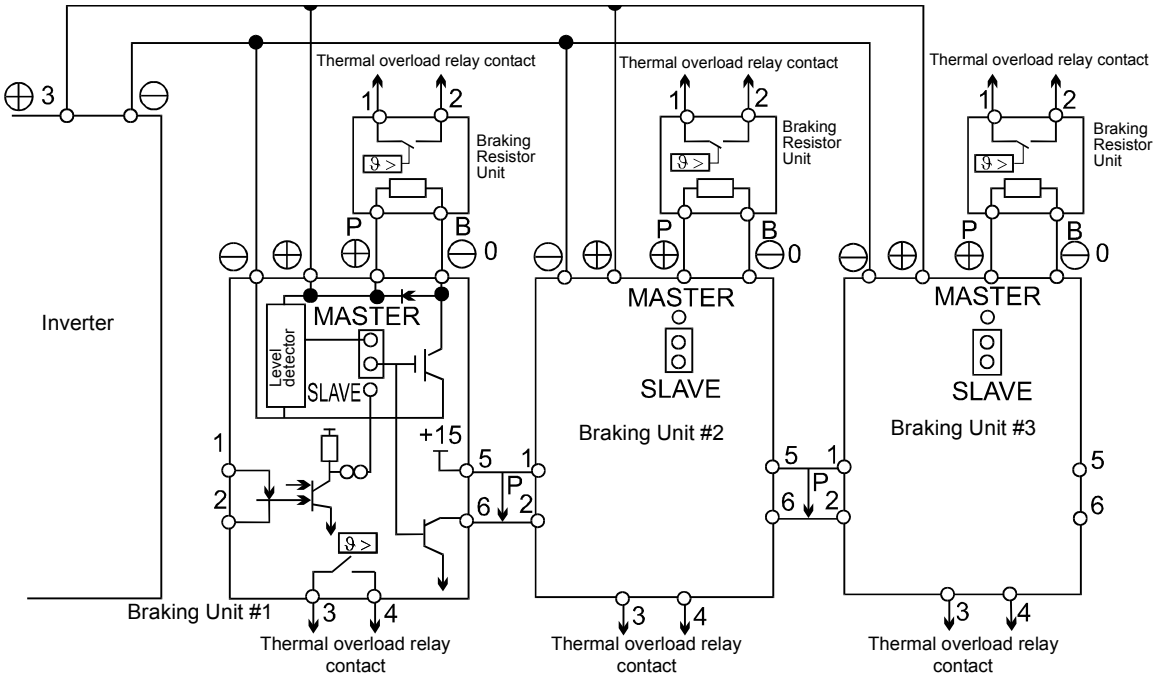


Fig 2.8 Connecting Braking Units in Parallel

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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 main power lines or other control circuits to reduce induction from peripheral devices.

When setting frequencies from an external frequency source (and not from a Digital Operator), used shielded twisted-pair wires and ground the shield for the largest area of contact between shield and ground. See the figure below for details on the wiring.

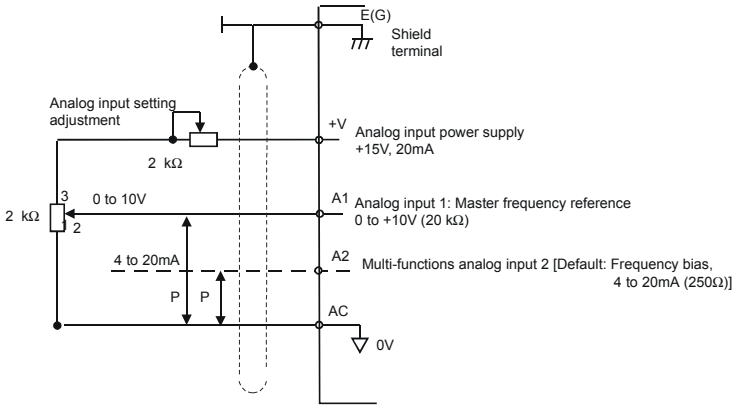


Fig 2.9

Terminal numbers and wire sizes are shown in *Table 2.9*.

Table 2.9 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, SP, SN, A1, A2, +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 Lug Sizes* for suitable lug sizes for the wires.
* 3. We recommend using straight solderless terminal on signal lines to simplify wiring and improve reliability.

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■ Straight Solderless Terminals for Signal Lines

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

Table 2.10 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	

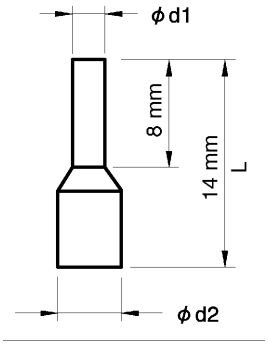


Fig 2.10 Straight Solderless Terminal Sizes

■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.

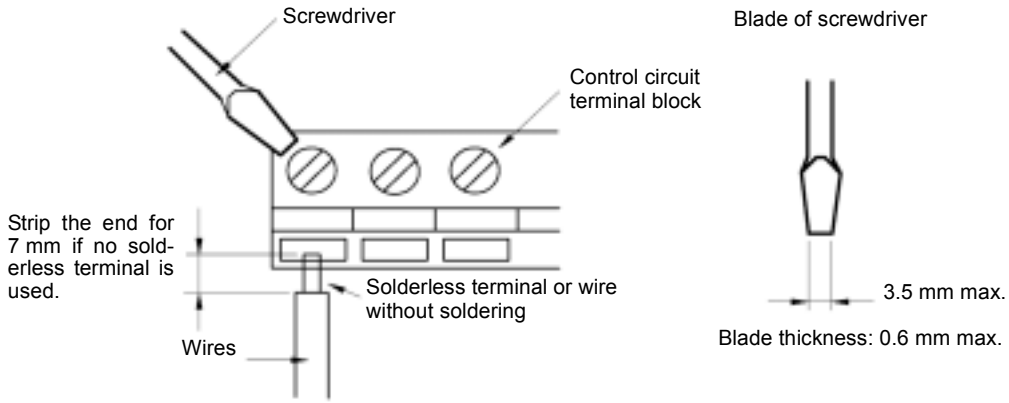


Fig 2.11 Connecting Wires to Terminal Block

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◆ Control Circuit Terminal Functions

The functions of the control circuit terminals are shown in *Table 2.11*. Use the appropriate terminals for the correct purposes.

Table 2.11 Control Circuit Terminals with default settings

Type	No.	Signal Name	Function		Signal Level
Digital 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	Digital input common	–		–
	SN	Digital Input Neutral	–		–
	SP	Digital Input Power Supply	+24VDC power supply for digital inputs		24 VDC, 250 mA max. *2
Analog input signals	+V	15 V power output	15 V power supply for analog references		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 V to +10 V/100% 0 to 20 mA/100%	Function is selected by setting H3-09.	4 to 20 mA(250Ω) 0 V to +10 V(20kΩ) 0 to 20 mA (250Ω)
	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*3
	M2				
	M3	Zero speed	Zero level (b2-01) or below when ON		
	M4				
	MA	Fault output signal	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC		–
	MB				
	MC				
Analog output signals	FM	Multi-function analog output (frequency output)	0 to +10 V/100% frequency	Multi-function analog output 1	0 to +10 V max. ±5% 2 mA max.
	AC	Analog common	–		
	AM	Multi-function analog output (current monitor)	5 V/Inverter's rated current	Multi-function analog output 2	

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Table 2.11 Control Circuit Terminals with default settings (Continued)

Type	No.	Signal Name	Function	Signal Level
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. Do not use this power supply for supplying any external equipment.

* 3. 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*.

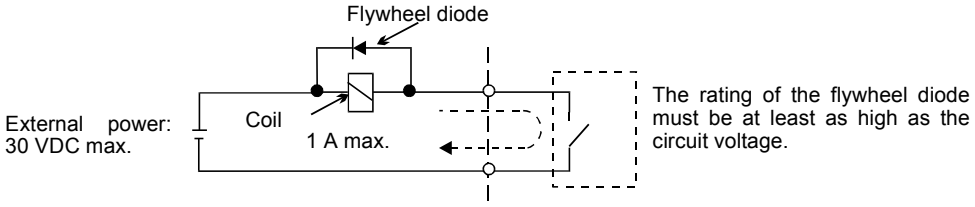
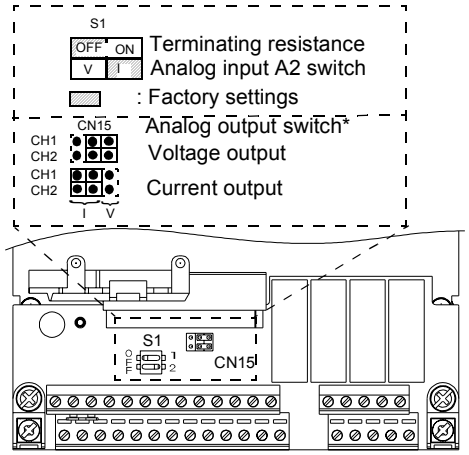


Fig 2.12 Flywheel Diode Connection

■Jumper CN15 and DIP Switch S1

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



Note: Refer to *Table 2.12* for S1 functions.

Fig 2.13 Jumper CN15 and DIP Switch S1

The functions of DIP switch S1 and jumper CN15 are shown in the following table.

Table 2.12 DIP Switch S1 and jumper CN15

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	V: 0 to 10 V (internal resistance: 20 kΩ) I: 0/4 to 20 mA (internal resistance: 250 Ω)
CN15-CH1*	Multifunction analog output FM voltage/current switch	I: Current output V: Voltage output
CN15-CH2*	Multifunction analog output AM voltage/current switch	I: Current output V: Voltage output

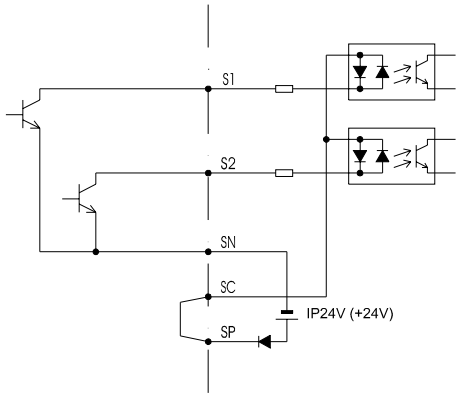
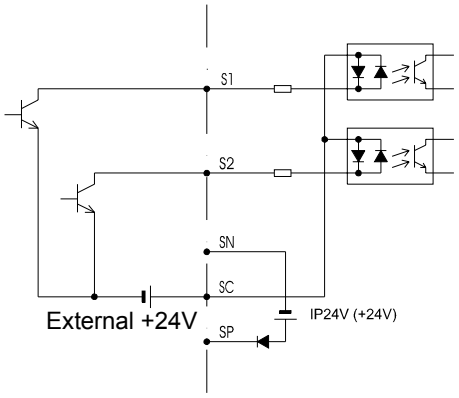
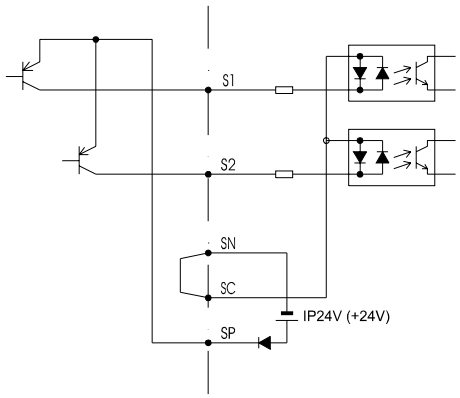
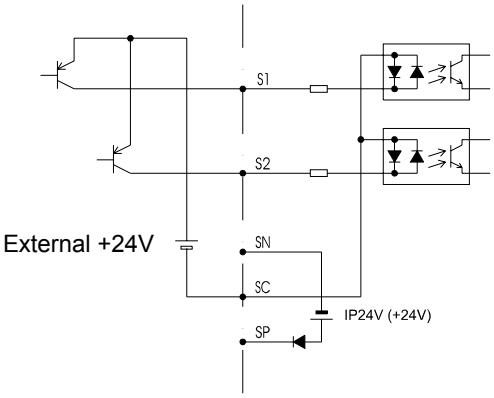
*CN15 is not available on the standard terminal board. An optional terminal board which has this jumper is available.

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■ 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 2.13 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
	

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◆ Control Circuit Terminal Connections

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

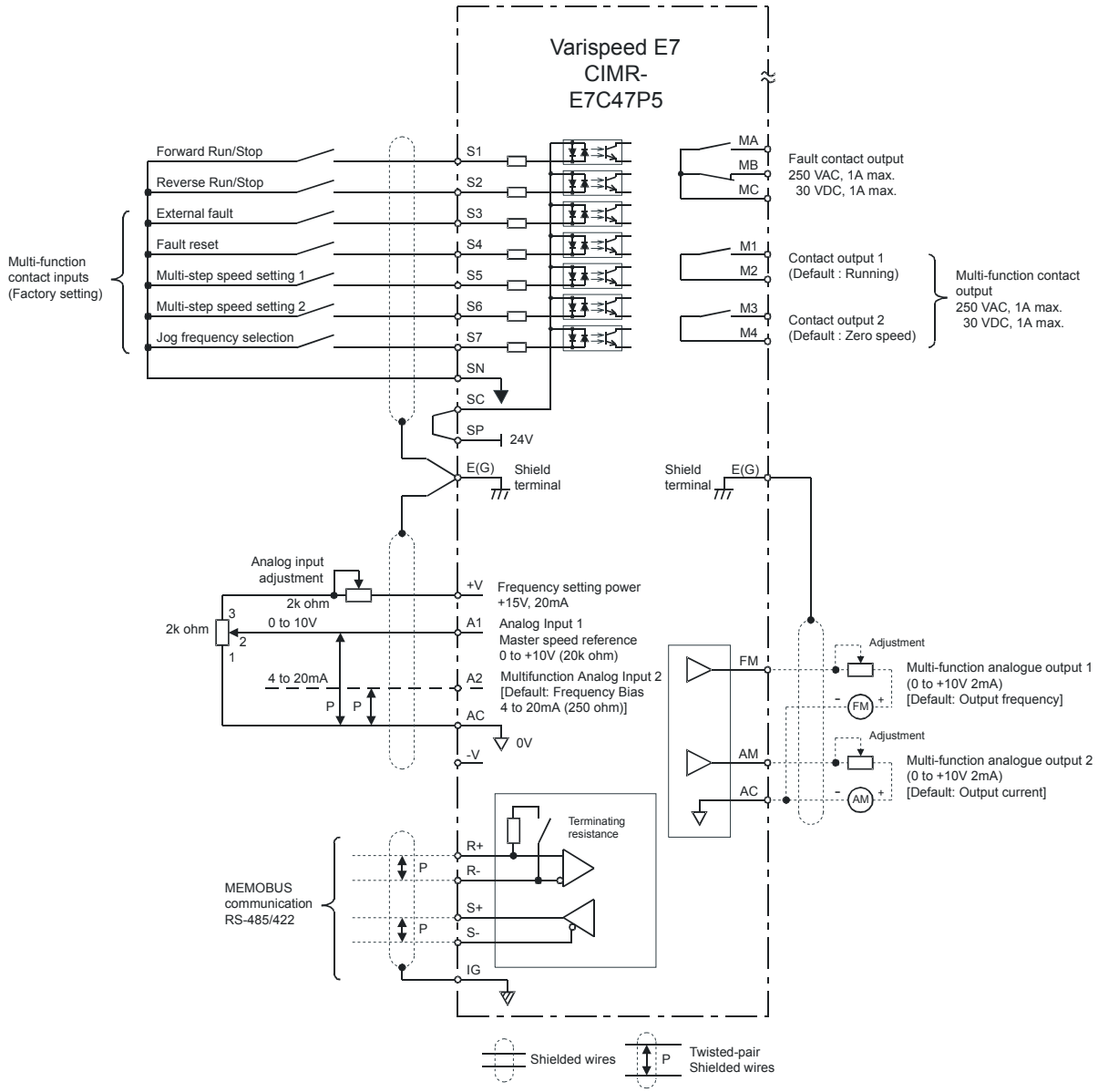


Fig 2.14 Control Circuit Terminal Connections

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◆ 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.
- Ground the cable shields so as to maximise the contact area of the shield and ground.
- Cable shields have to be grounded on both cable ends.

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Wiring Check

◆ Checks

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

- Is all wiring correct?
- Have no wire clippings, screws, or other foreign material been left?
- Are all screws tight?
- Are any wire ends contacting other terminals?

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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

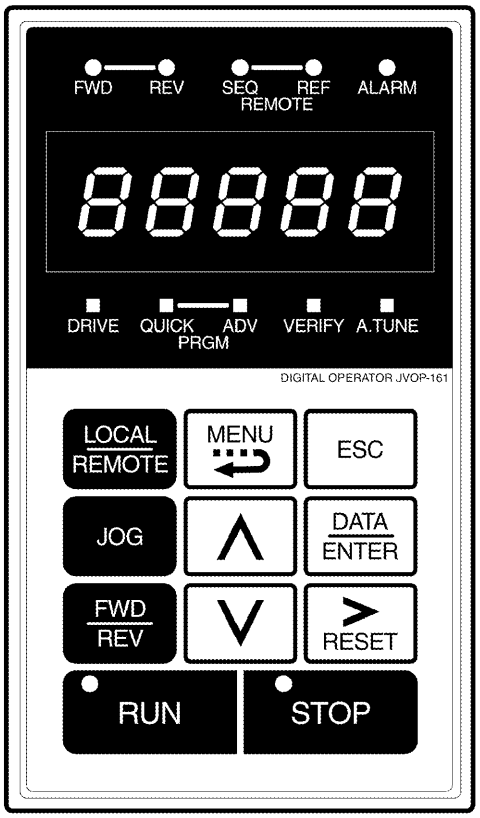
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Digital Operator

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.



Drive Mode Indicators

FWD: Lights up when a forward run command is input.
REV: Lights up when a reverse run command is input.
SEQ: Lights up when the run command from the control circuit terminal is enabled.
REF: Lights up when the frequency reference from control circuit terminals A1 and A2 is enabled.
ALARM: Lights up when an error or alarm has occurred.

Data Display

Displays monitor data, constant numbers, and settings.

Mode Display

DRIVE: Lights up in Drive Mode.
QUICK: Lights up in Quick Programming Mode.
ADV: Lights up in Advanced Programming Mode.
VERIFY: Lights up in Verify Mode.
A. TUNE: Lights up in Autotuning Mode.

Keys

Execute operations such as setting user constants, monitoring, jogging, and autotuning.

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 modes.
ESC	ESC Key	Returns to the status before the DATA/ENTER Key was pressed.

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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 active digit when programming user constants. 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 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 or DC brake. The relationship between the indicators on the RUN and STOP keys and the Inverter status is shown in *Fig 3.2*.

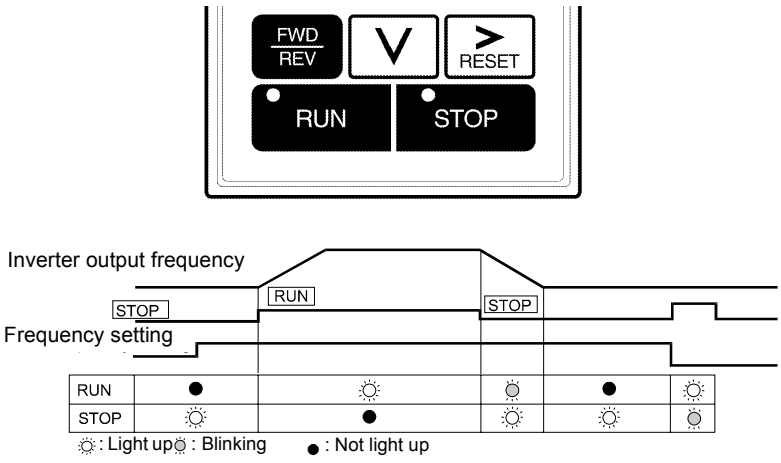


Fig 3.2 RUN and STOP Indicators

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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 read and set the basic user constants to operate the Inverter.
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. During Autotuning the line-to-line resistance is measured and set automatically.

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◆ 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 display to monitor data and from a monitor display to access the setting display.

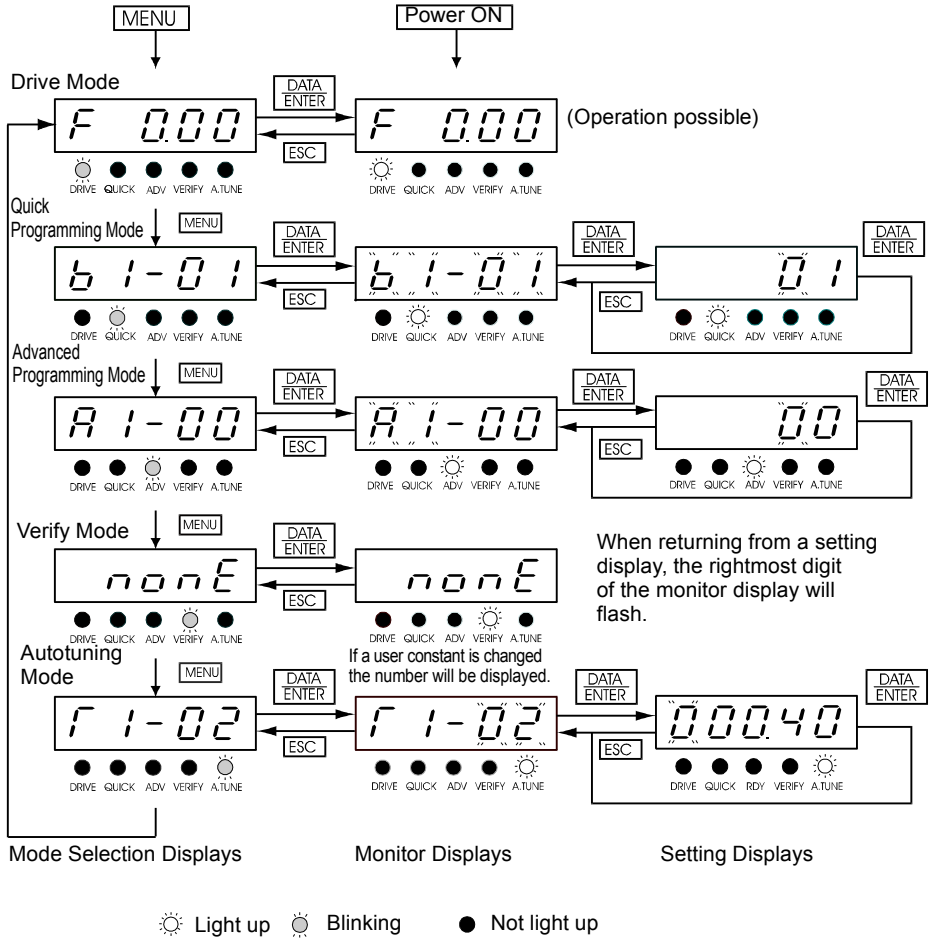


Fig 3.3 Mode Transitions

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◆ Drive Mode

The 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.

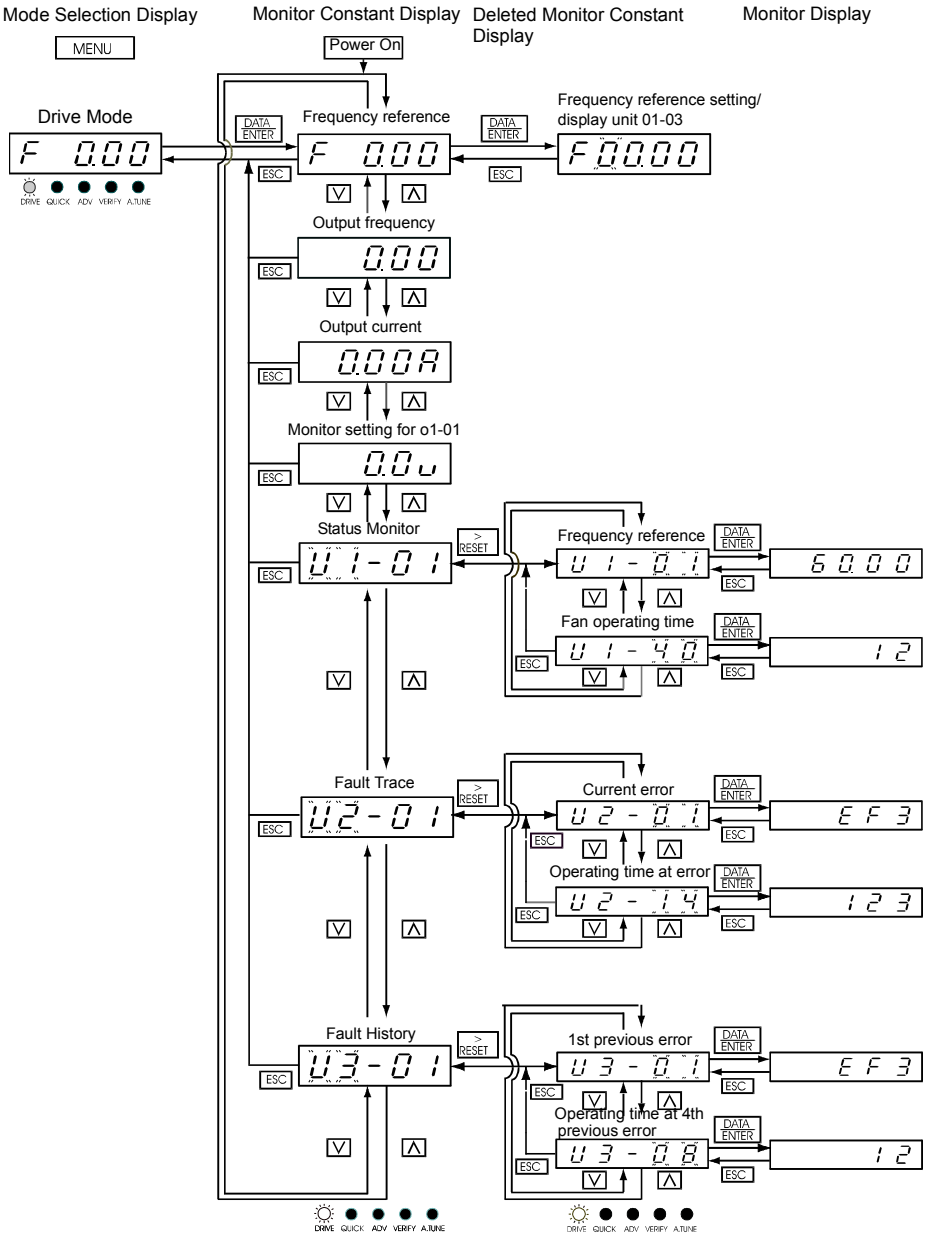


Fig 3.4 Operations in Drive Mode

IMPORTANT

The 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.

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◆ 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.

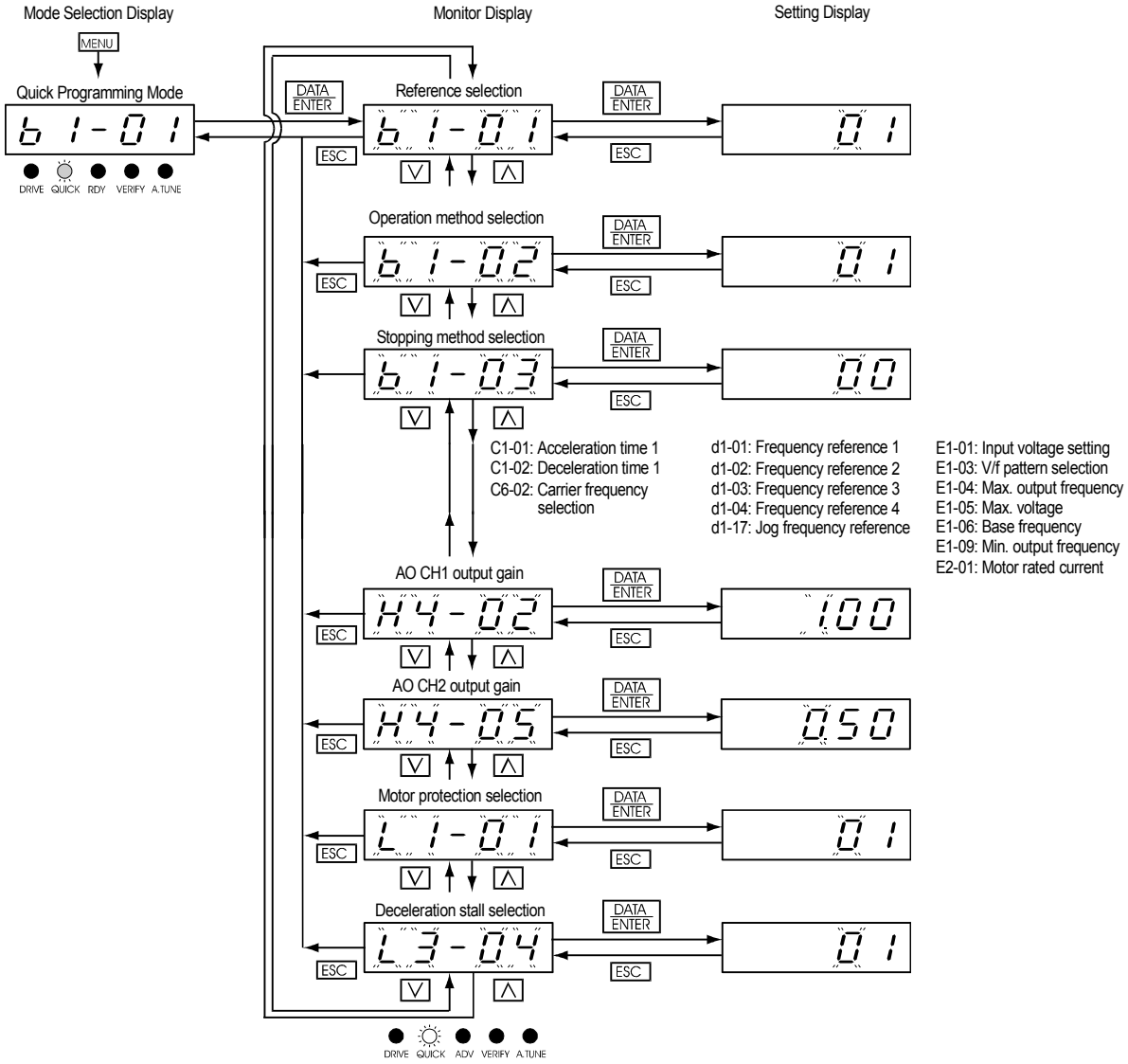


Fig 3.5 Operations in Quick Programming Mode

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◆ 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 constant. 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.

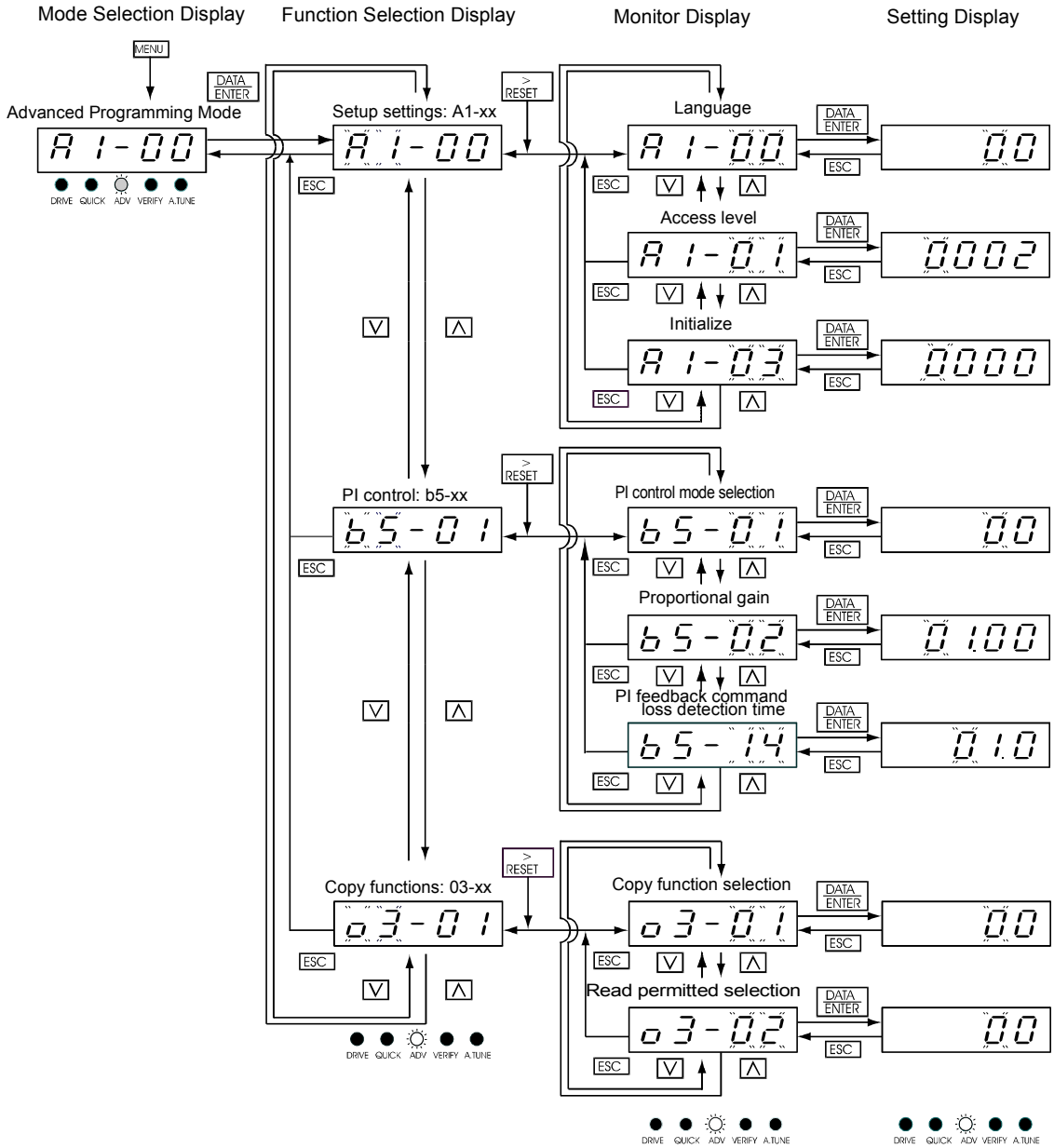


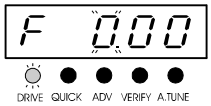
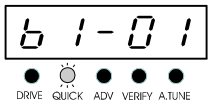
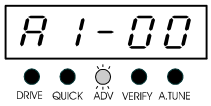
Fig 3.6 Operations in Advanced Programming Mode

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■Setting User Constants

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

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.

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◆ 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 settings. The user constant will be written and the monitor display will be returned to when the DATA/ENTER key is pressed.

■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).

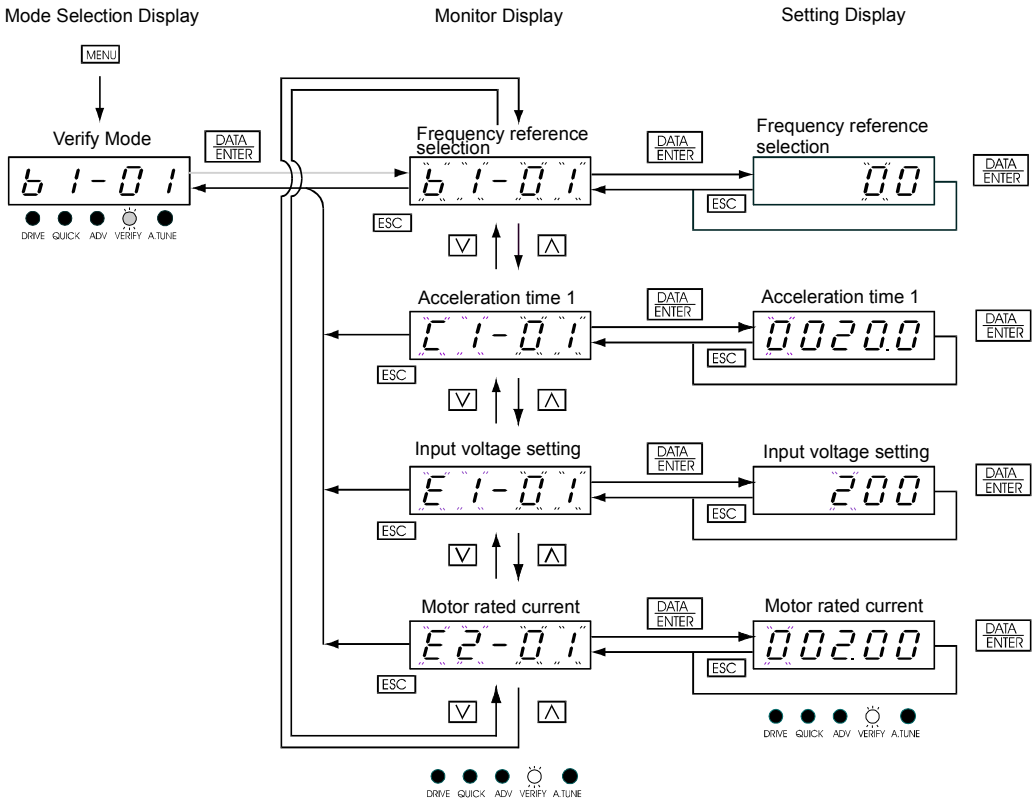


Fig 3.7 Operations in Verify Mode

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◆ Autotuning Mode

Autotuning automatically measures and sets the motor line-to-line resistance of the motor and motor cable to compensate the voltage drop and thereby to achieve the best performance.

■Example of Operation

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

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

The following example shows the autotuning procedure.

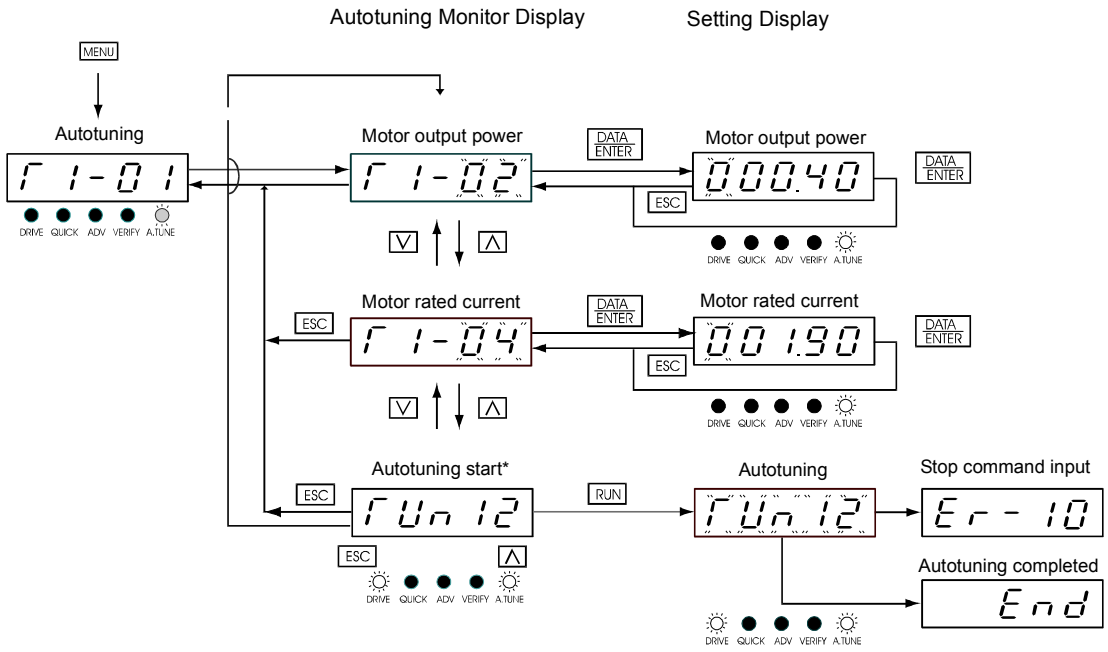


Fig 3.8 Operation in Autotuning Mode

IMPORTANT

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

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4

Trial Operation

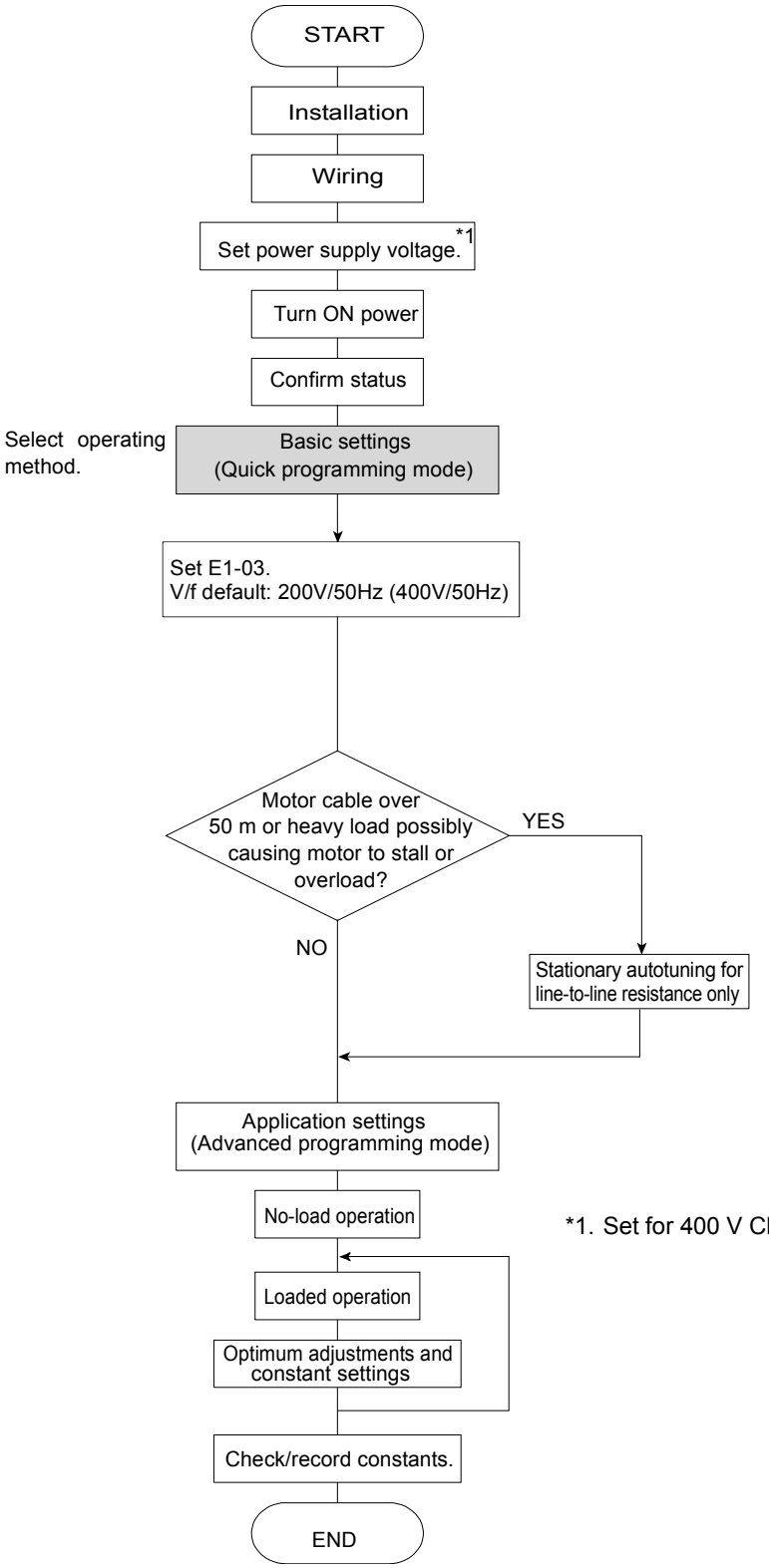
This chapter describes the procedures for trial operation of the Inverter and provides an example of trial operation.

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

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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

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Trial Operation

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

◆ Application Confirmation

First, confirm the application before using the Inverter. It is designed for:

- Fan, blower, pump

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

The power supply voltage jumper must be set 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.

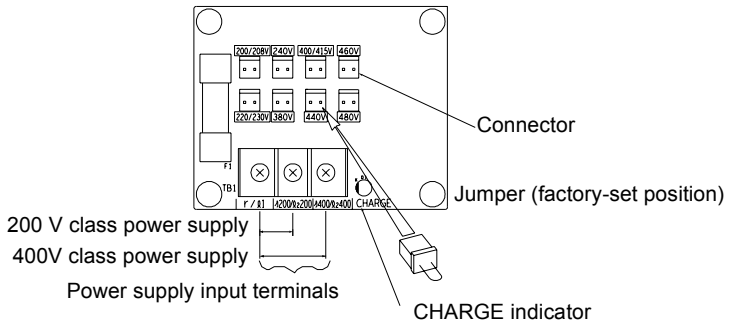


Fig 4.2 Power Supply Voltage Setting

◆ 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) if possible.

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◆ Checking the Display Status

After normal power up without any faults the operator display will show the following:

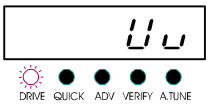
Display for normal operation



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

When a 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.

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◆ Basic Settings

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

Refer to *Chapter 3 Digital Operator and Modes* for Digital Operator operating procedures. Find a list of the Quick Programming Parameters on *Page 5-4* and details of the parameters in *Chapter 6 Constant Settings by Function*.

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◆ 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-purpose motor at 50 Hz: E1-03 = 0 or F (default)

  If E1-03 = F, the default setting in the user setting from E1-04 to E1-13 are for 50 Hz

- It is recommended to perform non-rotating autotuning for the line-to-line resistance if the motor cable is 50 m or longer for the actual installation or the load is heavy enough to produce stalling.

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◆ Autotuning

■Autotuning for Line-to-Line Resistance

Autotuning can be used to improve the performance when very long motor cables are used or when motor and inverter have different power ratings.

To perform autotuning set T1-02 (Motor rated power) and T1-04 (Motor rated current) and then press the RUN key on the Digital Operator. The Inverter will supply power to the non-rotating motor for approximately 20 seconds and the line-to-line resistance and motor + cable resistance will be automatically measured



IMPORTANT

Power will be supplied to the motor during autotuning but 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 4.1 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

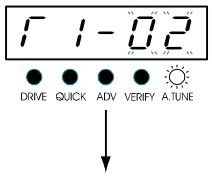
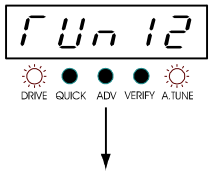
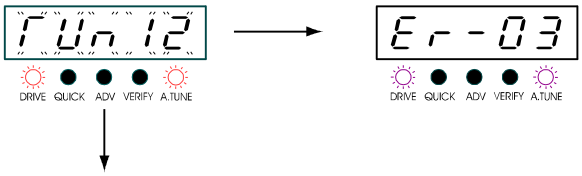
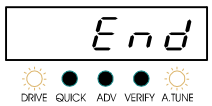
* 1. For a constant-output motor, set the value at the base speed.

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■Digital Operator Displays during Autotuning

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

Table 4.2 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: TUn10 	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.

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◆ Application Settings

User constants can be set as required in advanced programming mode (i.e. the ADV indicator lights 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 or to 3 for output phase rotation and reverse disabled.*
- 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 limit the speed range between 20% and 80% 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 can be driven in one direction only, check the motor rotation direction.

Operation with 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 control circuit prevents 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 terminal).



Both, a RUN command (forward or reverse) and a frequency reference (or multi-step speed command) must be provided to start Inverter operation.

◆ 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 connecting the motor shaft to the mechanical system.

* Setting 3 for b1-04 will be available in future software versions. For details please contact your Yaskawa representative.

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■Operation using the Digital Operator

- Use the Digital Operator to start operation in LOCAL mode in the same way as in no-load operation.
- For the case that a fault occurs during operation, make sure that the STOP key on the Digital Operator is easily accessible.
- At first, set the frequency reference to a low speed, e.g. to one tenth of 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 too high.
- Refer to *Adjustment Suggestions* on page *4-11* if hunting, vibration, or other problems originated by the control system occur.

◆ Check and Recording User Constants

Use verify mode (i.e., when the VERIFY indicator on the Digital Operator lights up) 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. A1-01 can also be set to 1 (User-specified Constants) to display only constants required by the machine or application in a programming mode. These constants can be determined by setting the A2-XX constants.

■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 has been input.

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Adjustment Suggestions

If hunting, vibration, or other problems originated by 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 only.

Table 4.3 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 4.4 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.
Analog input filter time constant (H3-12)*	Used to prevent fluctuations in analog input signals caused by noise.
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 an optional braking resistor unit and braking unit, however, disable stall prevention during deceleration by setting L3-04 to 0.

* Will be available in future software versions. For details please contact your Yaskawa representative.

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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 5-10

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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.

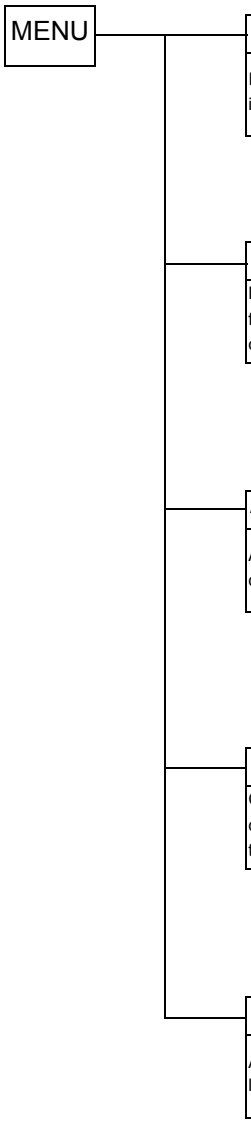
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b1-01	Reference selection	Sets the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	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 default setting of the user constant.
- Change during Operation: Indicates whether or not the constant can be changed while the Inverter is in operation.
  - Yes: Changes are possible during operation.
  - No: Changes are not possible during operation.
- Access Level: Indicates the constant access level in which the constant can be changed or monitored.
  - Q: Quick programming mode and advanced programming mode.
  - A: Advanced programming mode only.
- MEMOBUS Register: The register number used for MEMOBUS communications.
- Page: Reference page for more detailed information about the constant.

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Digital Operation Display Functions and Levels

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



No.	Function	Page
U1	Status Monitor Constants	5-42
U2	Fault Trace	5-45
U3	Fault History	5-46
A1	Initialize Mode	5-10
A2	User-specified Setting Mode	5-11
b1	Operation Mode Selections	5-12
b2	DC Injection Braking	5-13
b3	Speed Search	5-14
b4	Timer Function	5-15
b5	PI Control	5-15
b8	Energy Saving	5-17
C1	Acceleration/Deceleration	5-18
C2	S-curve Acceleration	5-18
C4	Torque Compensation	5-19
C6	Carrier Frequency	5-20
d1	Preset Reference	5-21
d2	Reference Limits	5-21
d3	Jump Frequencies	5-22
d4	Reference Frequency Hold	5-22
E1	V/f Pattern	5-23
E2	Motor Setup	5-24
F6	Communications Option Card	5-25
H1	Multi-function Digital Inputs	5-26
H2	Multi-function Digital Outputs	5-27
H3	Multi-function Analog Inputs	5-28
H4	Multi-function Analog Outputs	5-29
H5	MEMOBUS Communications	5-31
L1	Motor Overload	5-32
L2	Power Loss Ridethrough	5-33
L3	Stall Prevention	5-34
L4	Reference Detection	5-35
L5	Fault Restart	5-35
L6	Torque Detection	5-36
L8	Hardware Protection	5-37
N1	Hunting Prevention Function	5-38
N3	High-slip Braking	5-38
o1	Monitor Select	5-39
o2	Multi-function Selections	5-40
o3	Copy Function	5-41
T	Motor Autotuning	5-42

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◆ User Constants Setable in Quick Programming Mode

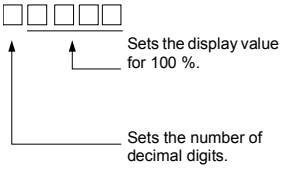
The minimum user constants required for Inverter operation can be monitored and set in quick programming mode. The user constants displayed in quick programming mode are listed in the following table. These, and all other user constants, are also displayed in advanced programming mode.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
A1-00	Language selection for Digital Operator display	Used to select the language displayed on the Digital Operator JVOP-160 only. 0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portuguese This constant is not changed by the initialize operation.	0 to 6	0	Yes	A	100H
b1-01	Reference source selection	Sets 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	RUN command source selection	Sets the run command input method 0: Digital Operator 1: Control circuit terminal (digital multi-function inputs) 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
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled 2: Output Phase Rotation (both rotational directions are enabled) 3: Output Phase Rotation with Reverse prohibited.	0 to 3	0	No	A	183H
b4-01	Timer function ON-delay time	Sets the timer function output ON-delay time (dead time) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-□□ and H2-□□.	0.0 to 3000.0	0.0 s	No	A	1A3H
b5-01	PI control mode selection	0: Disabled 1: Enabled 3: PI control enabled (frequency reference + PI output)	0, 1, 3	0	No	A	1A5H

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
b5-02	Proportional gain (P)	Sets P-control proportional gain. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	1A6H
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
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
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
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
b5-08	PI 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
b5-09	PI output characteristics selection	Selects forward/reverse direction for PI output. 0: PI output is forward. 1: PI output is reverse	0 or 1	0	No	A	1ADH
b5-10	PI output gain	Sets output gain.	0.0 to 25.0	1.0	No	A	1AEH
b5-11	PI reverse output selection	0: Limit to 0 when PI output is negative. 1: Reverses when PI output is negative. Limit to 0 is also active when reverse prohibit is selected by b1-04.	0 or 1	0	No	A	1AFH
b5-12	Selection of PI feedback signal loss detection	0: No detection of PI feedback loss. 1: Detection of PI feedback loss. Operation continues during detection, the fault contact is not operated. 2: Detection of PI feedback loss. The motor coasts to stop at detection, and the fault contact operates.	0 to 2	0	No	A	1B0H
b5-13	PI feedback loss detection level	Sets the PI feedback loss detection level as percentage using the maximum output frequency as 100%.	0 to 100	0%	No	A	1B1H
b5-14	PI feedback loss detection time	Sets the PI feedback loss detection time.	0.0 to 25.5	1.0 s	No	A	1B2H
b5-15	Sleep function operation level	Sets the sleep function start level as a frequency.	0.0 to 200.0	0.0 Hz	No	A	1B3H
b5-16	Sleep operation delay time	Sets the delay time until the sleep function starts.	0.0 to 25.5	0.0 s	No	A	1B4H
b5-17	Accel/decel time for PI reference	Sets the accel/decel time for the PI Soft-starter (SFS).	0.0 to 25.5	0.0 s	No	A	1B5H
b5-18	PI Setpoint Selection	0: Disabled 1: Enabled	0 to 1	0	No	A	1DCH
b5-19	PI Setpoint	PI-target value	0.00 to 100.00 %	0	Yes	A	1DDH

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
b5-20	PI Setpoint Scaling	Sets the unit for b5-19, U1-38 and U1-24 0: 0.01 Hz 1: 0.01% (the maximum output frequency E1-04 is taken as 100%. 2 – 39: rpm, set value is equal to motor poles 40 – 39999: User desired display  	0 to 39999	0	No	A	1E2H
b5-21	Sleep Function Selection	Sets the operation method of the PI sleep function 0: Output frequency before Softstarter (SFS) 1: Frequency reference/PI target 2: Snooze	0 to 2	0	No	A	1E3H
b5-22	Snooze Level	Sets the frequency level at which the snooze operation starts as percentage of the max. output frequency.	0 to 100%	0	Yes	A	1E4H
b5-23	Snooze Delay Time	Sets a delay timer for the snooze function	0 to 3600 s	0 s	No	A	1E5H
b5-24	Wake-Up Level	Sets the feedback level at which the inverter wakes up from snooze operation.	0 to 100 %	0	No	A	1E6H
b5-25	Setpoint Boost	Sets the PI setpoint boost when the snooze mode is activated. If it is reached once the output will be switched off. The value is set as percentage of the PI setpoint.	0 to 100%	0	No	A	1E7H
b5-26	Maximum Boost Time	Sets the maximum time the boost operation is performed.	0 to 3600 s	0 s	No	A	1E8H
b5-27	Snooze feedback	PI Snooze function will only be activated when the feedback value is above this parameter setting. The value is set as percentage of the PI setpoint.	0 to 100%	60%	No	A	1E9H
b5-28	PI Feedback Square Root Operation	Enables or disables the square root operation for the PI feedback value. 0: Disabled 1: Enabled	0 or 1	0	No	A	1EAH
b5-29	PI Feedback Square Root Gain	Sets the gain for the feedback when square root operation is enabled.	0 to 2.00	1.00	No	A	1EBH
b5-30	PI Output Monitor Square Root	Selects whether the PI output monitor is shown as square root value or not. 0: Disable 1: Enable	0 or 1	0	No	A	1ECH
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

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
C1-01	Acceleration time 1	Sets the acceleration time to accelerate from 0 Hz to the maximum output frequency.	0.0 to 6000.0	10.0 s	Yes	Q	200H
C1-02	Deceleration time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0 Hz.			Yes	Q	201H
d2-01	Frequency reference upper limit	Sets the frequency reference upper limit as a percentage of the max. output frequency.	0.0 to 110.0	100.0%	No	A	289H
d2-02	Frequency reference lower limit	Sets the frequency reference lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	28AH
E1-01	Input voltage setting	Sets the inverter input voltage. This set value will be the basis for the protection functions.	155 to 255 *2	200 V *2	No	Q	300H
E2-01	Motor rated current	Sets the motor rated current in Amps. 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 *5	1.90 A *4	No	Q	30EH
F6-01	Operation selection after communications error	Set the stopping method for communications errors. 0: Deceleration to stop using the deceleration time in C1-02 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09 3: Continue operation	0 to 3	1	No	A	3A2H
H3-02	Gain (terminal A1)	Sets the frequency as a percentage of the maximum output frequency, when 10 V is input.	0.0 to 1000.0	100.0%	Yes	A	411H
H3-03	Bias (terminal A1)	Sets the frequency as a percentage of the maximum frequency, when 0 V is inut.	-100.0 to +100.0	0.0%	Yes	A	412H
H3-10	Gain (terminal A2)	Sets the input level when terminal A2 input is 10 V (20 mA) according to the 100% value of the function set in constant H3-09.	0.0 to 1000.0	100.0%	Yes	A	419H
H3-11	Bias (terminal A2)	Sets the input level when terminal A2 is 0 V (4 mA/0 mA) according to the 100% value of the function set in constant H3-09.	-100.0 to +100.0	0.0%	Yes	A	41AH
L2-01	Momentary power loss detection	0: Disabled (DC bus undervoltage (UV1) detection) 1: Enabled (Restarted when the power returns within the time set in L2-02. When L2-02 is exceeded, DC bus undervoltage is detected.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect DC bus undervoltage.)	0 to 2	0	No	A	485H
L2-02	Momentary power loss ride-thru 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 *1	No	A	486H

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
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	1	No	A	49DH
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
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
L5-03	Fault Retry time	Sets the maximum time, the restart is tried.	0.5 to 180.0	10.0s	No	A	4A0H
L6-01	Torque detection selection	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues (warning is output). 2: Overtorque detected continuously during operation; operation continues (warning is output). 3: Overtorque detection only with speed agreement; output stopped upon detection. 4: Overtorque detected continuously during operation; output stopped upon detection. 5: Undertorque detection only with speed agreement; operation continues (warning is output). 6: Undertorque detected continuously during operation; operation continues (warning is output). 7: Undertorque detection only with speed agreement; output stopped upon detection. 8: Undertorque detected continuously during operation; output stopped upon detection.	0 to 8	6	No	A	4A1H
L6-02	Torque detection level	Inverter rated current is set as 100%.	0 to 300	15%	No	A	4A2H
L6-03	Torque detection time	Sets the overtorque/undertorque detection time.	0.0 to 10.0	10.0 s	No	A	4A3H
L8-11	Cooling fan control delay time	Set the time in seconds to delay turning OFF the cooling fan after the inverter STOP command is given.	0 to 300	300 s	No	A	4B7H
o1-01	Monitor selection	Set the number of the 3rd. monitor item to be displayed in the Drive Mode (U1-□□). (Not on LCD operator.)	6 to 53	6	Yes	A	500H

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register
o1-05	LCD-Focus	Sets the brightness on the optional LCD operator (JVOP-160). 0: light 1: 2: 3: normal 4: 5: dark	0 to 5	3	Yes	A	509H
o1-07	2nd Monitor Selection *6	Selects the monitor that is displayed and locked in the second line of the operator display	1 to 53	2	No	A	518H
o1-08	3rd Monitor Selection *6	Selects the monitor that is displayed and locked in the third line of the operator display	1 to 53	3	No	A	519H
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
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 or not. 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
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
o3-02	Read permission selection	0: READ prohibited 1: READ permitted	0 or 1	0	No	A	516H

* 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.)
* 6. Parameter is only effective if HOA operator with LCD (JVOP-162) is used.

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◆ 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 Operator JVOP-160 only. 0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portuguese This constant is not changed by the initialize operation.	0 to 6	0	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.) 1: Used to select user constant (Only constants set in A2-01 to A2-32 can be read and set.) 2: Advanced (Constants can be read and set in both, quick programming mode (Q) and advanced programming (A) mode.)	0 to 2	2	Yes	A	101H	6-109 6-110
A1-03	Initialize	Used to initialize the constants using the specified method. 0: No initializing 1110: Initializes using the user constants that have been stored before using o2-03 parameter 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 constants of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 constants can only be changed after inputting the right password.	0 to 9999	0	No	A	104H	6-109

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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. Usually this constant 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	6-109

■User-set Constants: A2

The constants set by the user are listed in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
A2-01 to A2-32	User specified constants	Used to select the function for each of the user specified constants. User constants are the only accessable constants if Constant Access Level is set to user constants (A1-01=1)	b1-01 to o2-08	–	No	A	106H to 125H	6-110

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◆ 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 source selection	Sets 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	6-5 6-51
b1-02	RUN command source selection	Sets the run command input method. 0: Digital Operator 1: Control circuit terminal (digital multifunktion inputs) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q	181H	6-9 6-51
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	6-11
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled 2: Output Phase Rotation (both rotational directions are enabled) 3: Output Phase Rotation with Reverse prohibited.	0 to 3	0	No	A	183H	6-37
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	–
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	–
b1-11	RUN delay	Sets the delay time for the internal RUN command.	0 to 600s	0 s	No	A	1DFH	–

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b1-12	HAND Fref Source	Sets the source of frequency reference for HAND operation. 0: Digital Operator 1: Control Circuit Terminal (analog input)	0 or 1	0	No	A	0IE0	–

■DC Injection Braking: b2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b2-01	DC injection braking starting frequency	Used to set the frequency at which DC injection braking starts in units of Hz when b1-03 is set to 0 (deceleration to stop). 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	6-11
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	6-11 6-14
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	6-14
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	6-11
b2-09	Motor pre-heat current	Sets the DC current level when the motor pre-heat function is enabled using a digital input.	0 to 100	0%	No	A	IE1H	6-14

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■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	6-39
b3-02	Speed search operating current (current detection)	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Usually not necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%	No	A	192H	6-39
b3-03	Speed search deceleration time (current detection)	Sets the output frequency deceleration time during speed search in 1-second units. Sets 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	6-39
b3-05	Speed search wait time (current detection or speed calculation)	When a speed search is performed after recovering from a momentary power loss, the search operation is delayed for the time set here. If e.g. a contactor is used at the output side of the inverter set this constant to the contactor delay time or more.	0.0 to 20.0	0.2 s	No	A	195H	6-39
b3-14	Bi-directional speed search selection	Can be used to turn off the bi-directional capabilities of the speed calculation form of speed search. Then speed search will only be performed in the last known direction. 0: Disabled 1: Enabled	0 or 1	1	No	A	19EH	6-39

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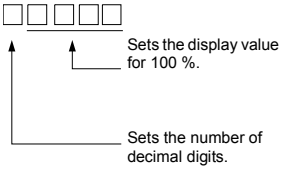
■Timer Function: b4

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b4-01	Timer function ON-delay time	Sets the timer function output ON-delay time (dead time) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-□□ and H2-□□.	0.0 to 3000.0	0.0 s	No	A	1A3H	6-82
b4-02	Timer function OFF-delay time	Sets the timer function output OFF-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-□□ and H2-□□	0.0 to 3000.0	0.0 s	No	A	1A4H	6-82

■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 3: PI control enabled (frequency reference + PI output)	0, 1, 3	0	No	A	1A5H	6-84
b5-02	Proportional gain (P)	Sets P-control proportional gain. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	1A6H	6-84
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	6-84
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	6-84
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	6-84
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	6-84
b5-08	PI 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	6-84
b5-09	PI output characteristics selection	Selects forward/reverse direction for PI output. 0: PI output is forward. 1: PI output is reverse	0 or 1	0	No	A	1ADH	6-84
b5-10	PI output gain	Sets output gain.	0.0 to 25.0	1.0	No	A	1AEH	6-84
b5-11	PI reverse output selection	0: Limit to 0 when PI output is negative. 1: Reverses when PI output is negative. Limit to 0 is also active when reverse prohibit is selected by b1-04.	0 or 1	0	No	A	1AFH	6-84

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Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	MEMO-BUS Register	Page
b5-12	Selection of PI feedback signal loss detection	0: No detection of PI feedback loss. 1: Detection of PI feedback loss. Operation continues during detection, the fault contact is not operated. 2: Detection of PI feedback loss. The motor coasts to stop at detection, and the fault contact operates.	0 to 2	0	No	A	1B0H	6-111
b5-13	PI feedback loss detection level	Sets the PI feedback loss detection level as percentage using the maxi-mum output frequency as 100%.	0 to 100	0%	No	A	1B1H	6-84
b5-14	PI feedback loss detection time	Sets the PI feedback loss detection time.	0.0 to 25.5	1.0 s	No	A	1B2H	6-84
b5-15	Sleep function operation level	Sets the sleep function start level as a frequency.	0.0 to 200.0	0.0 Hz	No	A	1B3H	6-84
b5-16	Sleep operation delay time	Sets the delay time until the sleep function starts.	0.0 to 25.5	0.0 s	No	A	1B4H	6-84
b5-17	Accel/decel time for PI reference	Sets the accel/decel time for the PI Softstarter (SFS).	0.0 to 25.5	0.0 s	No	A	1B5H	6-84
b5-18	PI Setpoint Selec-tion	0: Disabled 1: Enabled	0 to 1	0	No	A	1DCH	6-84
b5-19	PI Setpoint	PI-target value	0.00 to 100.00 %	0	Yes	A	1DDH	6-84
b5-20	PI Setpoint Scal-ing	Sets the unit for b5-19, U1-38 and U1-24 0: 0.01 Hz 1: 0.01% (the maximum output frequency E1-04 is taken as 100%. 2 – 39: rpm, set value is equal to motor poles 40 – 39999: User desired display  	0 to 39999	0	No	A	1E2H	6-84
b5-21	Sleep Function Selection	Sets the operation method of the PI sleep function 0: Output frequency before Soft-starter (SFS) 1: Frequency reference/PI target 2: Snooze	0 to 2	0	No	A	1E3H	6-85
b5-22	Snooze Level	Sets the frequency level at which the snooze operation starts as per-centage of the max. output fre-quency.	0 to 100%	0	Yes	A	1E4H	6-85
b5-23	Snooze Delay Time	Sets a delay timer for the snooze function	0 to 3600 s	0 s	No	A	1E5H	6-85
b5-24	Wake-Up Level	Sets the feedback level at which the inverter wakes up from snooze operation.	0 to 100 %	0	No	A	1E6H	6-85

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
b5-25	Setpoint Boost	Sets the PI setpoint boost when the snooze mode is activated. If it is reached once the output will be switched off. The value is set as percentage of the PI setpoint.	0 to 100%	0	No	A	1E7H	6-85
b5-26	Maximum Boost Time	Sets the maximum time the boost operation is performed.	0 to 3600 s	0 s	No	A	1E8H	6-85
b5-27	Snooze feedback	PI Snooze function will only be activated when the feedback value is above this parameter setting. The value is set as percentage of the PI setpoint.	0 to 100%	60%	No	A	1E9H	6-85
b5-28	PI Feedback Square Root Operation	Enables or disables the square root operation for the PI feedback value. 0: Disabled 1: Enabled	0 or 1	0	No	A	1EAH	6-85
b5-29	PI Feedback Square Root Gain	Sets the gain for the feedback when square root operation is enabled.	0 to 2.00	1.00	No	A	1EBH	6-85
b5-30	PI Output Monitor Square Root	Selects whether the PI output monitor is shown as square root value or not. 0: Disable 1: Enable	0 or 1	0	No	A	1ECH	6-85

■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	6-93
b8-04	Energy-saving coefficient	Sets the energy-saving coefficient. Adjust the value in 5% steps until the output power becomes minimal.	0.0 to 655.00	*1	No	A	1CFH	6-93
b8-05	Power detection filter time constant	Sets the time constant for output power detection.	0 to 2000	20 ms	No	A	1D0H	6-93
b8-06	Search operation voltage limiter	Sets the limit value of the voltage control range during search operation. Set to 0 to disable the search operation. 100% is the motor rated voltage.	0 to 100	0%	No	A	1D1H	6-93

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

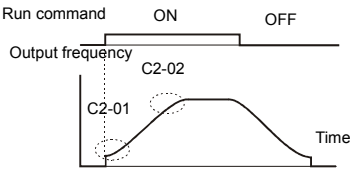
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◆ Tuning Constants: C

■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 Hz to the maximum output frequency.	0.0 to 6000.0	10.0 s	Yes	Q	200H	4-5 6-16
C1-02	Deceleration time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0 Hz.			Yes	Q	201H	4-5 6-16
C1-03	Acceleration time 2	Sets the acceleration time when the multi-function input "accel/decel time 1" is set to ON.			Yes	A	202H	6-16
C1-04	Deceleration time 2	Sets the deceleration time when the multi-function input "accel/decel time 1" is set to ON.			Yes	A	203H	6-16
C1-09	Emergency stop time	Sets the deceleration time when the multi-function input "Emergency (fast) stop" is set to ON.			No	A	208H	6-15
C1-11	Accel/decel time switching frequency	Sets the frequency for automatic acceleration/deceleration switching. If the output frequency is below the set frequency: Accel/decel time 2 If the output freuquency is above the set frequency: Accel/decel time 1 The multi-function input "accel/decel time 1" or "accel/decel time 2" has priority.	0.0 to 200.0	0.0 Hz	No	A	20AH	6-17

■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 time will increase by only half of the S-curve characteristic times at start and end.	0.00 to 2.50	0.20 s	No	A	20BH	6-17
C2-02	S-curve characteristic time at acceleration end	 $T_{accel} = \frac{C2\text{-}01}{2} + C1\text{-}01 + \frac{C2\text{-}02}{2}$ The S-Curve characteristic time at start and end of deceleration is fixed to 0.2 sec and can not be changed.		0.20 s	No	A	20CH	6-17

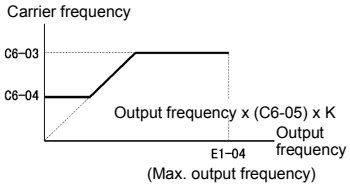
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■Torque Compensation: C4

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
C4-01	Torque compensation gain	Sets the torque compensation gain. Usually setting is not necessary. Adjust under 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 torque compensation gain so that at minimum speed the output current does not exceed the Inverter rated output current.	0.00 to 2.50	1.00	Yes	A	215H	4-11 6-28
C4-02	Torque compensation delay time constant	The torque compensation delay time is set in ms units. Usually setting is not necessary. Adjust under 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 6-28

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■Carrier Frequency: C6

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
C6-02	Carrier frequency selection	Selects the carrier frequency. Select F to enable detailed settings using constants C6-03 to C6-05.	0 to F	6 *1	No	Q	224H	4-5 4-11 6-2
C6-03	Carrier frequency upper limit	Sets 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	6-2
C6-04	Carrier frequency lower limit		0.4 to 15.0 *2 *3	15.0 kHz *1	No	A	226H	6-2
C6-05	Carrier frequency proportional gain		00 to 99 *3	00	No	A	227H	6-2

* 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 C6-02 is set to F.

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◆ 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.	0 to FMAX	0.00 Hz	Yes	Q	280H	6-7
d1-02	Frequency reference 2	Sets the frequency reference when multi-step speed command 1 is ON for a multi-function input.		0.00 Hz	Yes	Q	281H	6-7
d1-03	Frequency reference 3	Sets the frequency reference when multi-step speed command 2 is ON for a multi-function input.		0.00 Hz	Yes	Q	282H	6-7
d1-04	Frequency reference 4	Sets the frequency reference when multi-step speed commands 1 and 2 are ON for multi-function inputs.		0.00 Hz	Yes	Q	283H	6-7
d1-17	Jog frequency reference	Sets the frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.		6.00 Hz	Yes	Q	292H	6-7 6-61

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	Sets the frequency reference upper limit as a percentage of the max. output frequency.	0.0 to 110.0	100.0%	No	A	289H	6-25 6-55
d2-02	Frequency reference lower limit	Sets the frequency reference lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	28AH	6-25 6-55
d2-03	Master speed reference lower limit	Sets the master speed reference lower limit as a percentage of the max. output frequency.	0.0 to 110.0	0.0%	No	A	293H	6-25 6-55

Note: The PI Sleep Function is also available and can be used without enabled PI controller. It can be used to let the inverter switch off its output automatically when a minimum output frequency (set in b5-15) has been output for a time longer than b5-16. Refer also to page *6-90*.

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■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 when the jump frequency is set 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 200.0	0.0 Hz	No	A	294H	6-24
d3-02	Jump frequency 2			0.0 Hz	No	A	295H	6-24
d3-03	Jump frequency 3			0.0 Hz	No	A	296H	6-24
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	6-24

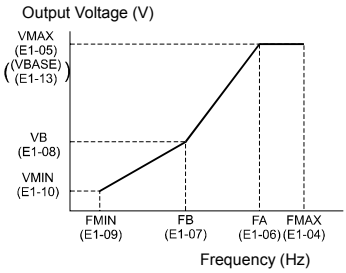
■Reference Frequency Hold: d4

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
d4-01	Frequency reference hold function selection	Sets whether or not frequency reference value on hold will be recorded. 0: Disabled (when operation is stopped or the power is turned on again the frequency reference is set to 0.) 1: Enabled (when operation is stopped or the power is turned on again the inverter starts at the previous hold frequency.) This function is available when the multi-function inputs “Accel/Decel Ramp Hold” or “Up/Down” commands are set.	0 or 1	0	No	A	298H	6-53
d4-02	+ – Speed limits	Sets the frequency to be added to or subtracted from the analog frequency reference as a percentage of the max. output frequency. Enabled when the increase (+) speed command or decrease (–) speed command is set for a multi-function input.	0 to 100	10%	No	A	299H	6-58

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◆ Motor 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 for protection functions.	155 to 255 *1	200 V *1	No	Q	300H	6-95
E1-03	V/f pattern selection	0 to D: Select from the 14 preset patterns. F: Custom user-set pattern (Applicable for setting of E1-04 to E1-10.)	0 to F	F	No	Q	302H	6-95
E1-04	Max. output frequency (FMAX)		0.0 to 200.0	50.0 Hz	No	Q	303H	6-95
E1-05	Max. output voltage (VMAX)		0.0 to 255.0 *1	200.0 V *1	No	Q	304H	6-95
E1-06	Base frequency (FA)		0.0 to 200.0	50.0 Hz	No	Q	305H	6-95
E1-07	Mid. output frequency (FB)		0.0 to 200.0	2.5 Hz	No	A	306H	6-95
E1-08	Mid. output frequency voltage (VB)	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 255 *1	15.0 V *1	No	A	307H	6-95
E1-09	Min. output frequency (FMIN)		0.0 to 200.0	1.2 Hz	No	Q	308H	6-95
E1-10	Min. output frequency voltage (VMIN)		0.0 to 255.0 *1	9.0 V *1	No	A	309H	4-11 6-95
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 200.0	0.0 Hz *2	No	A	30AH	6-95
E1-12	Mid. output frequency voltage 2		0.0 to 255.0 *1	0.0 V *2	No	A	30BH	6-95
E1-13	Base voltage (VBASE)	Sets the output voltage of the base frequency (E1-06).	0.0 to 255.0 *1	0.0 V *5	No	A	30CH	6-95

* 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.

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■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. This set value will become the reference value for motor protection and torque limits. This constant is an input data for autotuning.	0.32 to 6.40 *1	1.90 A *2	No	Q	30EH	6-33 6-94
E2-03	Motor no-load current	Sets the motor no-load current. This constant is automatically set during autotuning.	0.00 to 1.89*3	1, 2*2	No	A	310H	–
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 *2	No	A	312H	6-94

* 1. 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.
* 2. The factory setting depends upon the Inverter capacity. The value for a 200 V class inverter of 0.4 kW is given.
* 3. The setting range depends on the inverter capacity. The values for a 200 V class inverter of 0.4 kW are given.

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◆ 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 the deceleration time in C1-02 1: Coast to stop 2: Emergency stop using the 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 to stop using the deceleration time in C1-02 1: Coast to stop 2: Emergency stop using the 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	–

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◆ 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 6F	24	No	A	400H	–
H1-02	Terminal S4 function selection	Multi-function contact input 2	0 to 6F	14	No	A	401H	–
H1-03	Terminal S5 function selection	Multi-function contact input 3	0 to 6F	3 (0)*	No	A	402H	–
H1-04	Terminal S6 function selection	Multi-function contact input 4	0 to 6F	4 (3)*	No	A	403H	–
H1-05	Terminal S7 function selection	Multi-function contact input 5	0 to 6F	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)	6-10
1	Local/Remote selection (ON: Operator, OFF: Constant b1-01/b1-02 setting)	6-51
2	Operation Source Option Card/Inverter selection (ON: Option Card)	6-60
3	Multi-step speed reference 1 When H3-09 is set to 2, this function is combined with the master/auxiliary speed switch.	6-7
4	Multi-step speed reference 2	6-7
6	Jog frequency command (higher priority than multi-step speed reference)	6-7 6-51
7	Accel/decel time 1	6-16
8	External baseblock NO (NO contact: Baseblock at ON)	6-52 6-43
9	External baseblock NC (NC contact: Baseblock at OFF)	6-52 6-43
A	Acceleration/deceleration ramp hold (ON: Acceleration/deceleration stopped, frequency is hold)	6-53
C	Multi-function analog input A2 disable/enable (ON: Enable)	6-52
F	Not used (Set when a terminal is not used)	–
10	Up command (Always set with the Down command)	6-55
11	Down command (Always set with the Up command)	6-55
12	FJOG command (ON: Forward run at jog frequency d1-17)	6-61
13	RJOG command (ON: Reverse run at jog frequency d1-17)	6-61
14	Fault reset (Reset when turned ON)	7-2
15	Emergency stop. (NO: Deceleration to stop in deceleration time set in C1-09 when ON.)	6-15
17	Emergency stop (NC: Deceleration to stop in deceleration time set in C1-09 when OFF)	6-15
18	Timer function input (Functions are set in b4-01 and b4-02 and the timer function outputs are set in H2-□□.)	6-82

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Setting Value	Function	Page
19	PI control disable (ON: PI control disabled)	6-86
1B	Constants write enable (ON: All constants can be written-in. OFF: All constants are write protected.)	6-109
1C	Trim control increase (ON: d4-02 frequency is added to analog frequency reference.)	6-58
1D	Trim control decrease (ON: d4-02 frequency is subtracted from analog frequency reference.)	6-58
1E	Analog frequency reference sample/hold	6-59
20 to 2F	External fault Input mode: NO contact/NC contact, Detection mode: Normal/during operation	6-62
30	PI control integral reset (reset when reset command is input or when stopped during PI control)	6-86
31	PI control integral hold (ON: Hold)	6-86
34	PI soft starter disable (ON: disabled)	6-86
35	PI input characteristics switch	6-86
36	Operation Source Option/Inverter selection 2 (ON: inverter settings)	6-60
60	Motor preheat command (ON: Performs motor preheat)	6-14
61	External search command 1 (ON: Speed search from maximum output frequency)	6-40
62	External search command 2 (ON: Speed search from set frequency)	6-40
64	External speed search command 3	6-39
65	KEB (deceleration at momentary power loss) command (NC contact)	–
66	KEB (deceleration at momentary power loss) command (NO contact)	–
67	Communications test mode	6-81
68	High-slip braking (HSB)	6-101
69	Jog Frequency 2	6-8
6A	Drive enable (NC, ON: Drive enabled, OFF: Drive disabled	6-53
6B	Operation Source Communication/Inverter selection (ON: RS-422/485 port)	6-60
6C	Operation Source Communication/Inverter selection 2 (ON: inverter settings)	6-60
6D	AUTO mode selection (ON: AUTO mode active)	6-61
6E	HAND mode selection (ON: HAND mode active)	6-61
6F	Maintenance Mode	–
70	Bypass Drive Enable	6-53

■ Multi-function Contact Outputs: H2

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H2-01	Terminal M1-M2 function selection	Multi-function contact output 1	0 to 38	0	No	A	40BH	–
H2-02	Terminal M3-M4 function selection	Multi-function contact output 2	0 to 38	1	No	A	40CH	–

Multi-function Contact Output Functions

Setting Value	Function	Page
0	During run (ON: run command is ON or voltage is being output)	6-63
1	Zero-speed	6-64

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Setting Value	Function	Page
2	f_{ref}/f_{out} agree 1 (detection width L4-02 is used.)	6-27
3	f_{ref}/f_{set} agree 1 (ON: Output frequency = ±L4-01, with detection width L4-02 used and during frequency agree)	6-27
4	Frequency detection 1 (ON: +L4-01 ≥ output frequency ≥ -L4-01, with detection width L4-02 used)	6-27
5	Frequency detection 2 (ON: Output frequency ≥ +L4-01 or output frequency ≤ -L4-01, with detection width L4-02 used)	6-27
6	Inverter operation ready READY: After initialization or no faults	6-64
7	During DC bus undervoltage (UV) detection	6-64
8	During baseblock (NO contact, ON: during baseblock)	6-64
9	Frequency reference source selection (ON: Frequency reference from Operator)	6-64
A	Run command source selection status (ON: Run command from Operator)	6-64
B	Overtorque/undertorque detection 1 NO (NO contact, ON: Overtorque/undertorque detection)	6-31
C	Loss of frequency reference (Effective when 1 is set for L4-05)	6-44
E	Fault (ON: Digital Operator communications error or fault other than CPF00 and CPF01 has occurred.)	6-64
F	Not used. (Set when the terminal is not used.)	-
10	Minor fault (ON: Alarm displayed)	6-64
11	Fault reset command active	6-65
12	Timer function output	6-82
17	Overtorque/undertorque detection 1 NC (NC Contact, OFF: Torque detection)	6-31
1A	Reverse direction	6-65
1E	Restart enabled (ON: Restart enabled)	6-45
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	6-33
20	OH pre-alarm (temperature reached L8-02)	6-65
38	Drive enabled	6-65
39	Drive waiting (start delay time b1-11 is active)	6-65
3A	During OH and reduced Frequency	6-65
3B	RUN command from option card/communications	6-65

■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 as a percentage of themaximum output frequency, when 10 V is input.	0.0 to 1000.0	100.0%	Yes	A	411H	6-22
H3-03	Bias (terminal A1)	Sets the frequency as a percentage of the maximum frequency, when 0 V is inut.	-100.0 to +100.0	0.0%	Yes	A	412H	6-22
H3-08	Multi-function analog input terminal A2 signal level selection	0: 0 to +10V (11 bit). 2: 4 to 20 mA (9-bit input). 3: 0 to 20 mA (9-bit input) Switch current and voltage input using the switch S1 on the control terminal board.	0, 2, 3	2	No	A	417H	6-22

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H3-09	Multi-function analog input terminal A2 function selection	Selects the multi-function analog input function for terminal A2. Refer to the table on the next page.	0 to 16	0	No	A	418H	6-22
H3-10	Gain (terminal A2)	Sets the input level when terminal A2 input is 10 V (20 mA) according to the 100% value of the function set in constant H3-09.	0.0 to 1000.0	100.0%	Yes	A	419H	6-22
H3-11	Bias (terminal A2)	Sets the input level when terminal A2 is 0 V (4 mA/0 mA) according to the 100% value of the function set in constant H3-09.	-100.0 to +100.0	0.0%	Yes	A	41AH	6-22
H3-12	Analog input filter time constant	Sets primary delay filter time constant for the two analog input terminals (A1 and A2). Effective for noise supression etc.	0.00 to 2.00	0.00 s	No	A	41BH	6-22
H3-13	Terminal A1/A2 switching	0: Use terminal A1 analog input as main frequency reference. 1: Use terminal A2 analog input as main frequency reference. Effective when H3-09 is set to 2.	0 or 1	0	No	A	41CH	–

H3-09 Settings

Setting Value	Function	Contents (100%)	Page
0	Frequency bias	Maximum output frequency	6-22
2	Auxiliary frequency reference (is used as frequency reference 2)	Maximum output frequency	6-5
B	PI feedback	Maximum output frequency	–
D	Frequency Bias 2	Maximum output frequency	6-22
E	Motor temperature input	–	6-36
16	PI differential mode	Maximum output frequency	–
1F	Analog input not used.	–	–

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■Multi-function Analog Outputs: H4

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H4-01	Monitor selection (terminal FM)	Sets the number of the monitor item to be output (U1-□□) at terminal FM.	1 to 53	2	No	A	41DH	6-66
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 (terminal FM) gain. Sets the percentage of the monitor item that is equal to 10V output at terminal FM. Note that the maximum output voltage is 10V.	0 to 1000.0 %	100%	Yes	Q	41EH	6-66
H4-03	Bias (terminal FM)	Sets the multi-function analog output 1 (terminal FM) bias. Sets the percentage of the monitor item that is equal to 0V output at terminal FM. The maximum output from the terminal is 10 V.	-110 to +110%	0.0%	Yes	A	41FH	6-66
H4-04	Monitor selection (terminal AM)	Sets the number of the monitor item to be output (U1-□□) at terminal AM.	1 to 53	8	No	A	420H	6-66
H4-05	Gain (terminal AM)	Set the multi-function analog output 2 (terminal AM) gain. Sets the percentage of the monitor item that is equal to 10V output at terminal AM. Note that the maximum output voltage is 10V.	0 to 1000.0 %	50.0%	Yes	Q	421H	6-66
H4-06	Bias (terminal AM)	Sets the multi-function analog output 2 (terminal AM) bias. Sets the percentage of the monitor item that is equal to 0V output at terminal AM. The maximum output from the terminal is 10 V.	-110.0 to +110.0 %	0.0%	Yes	A	422H	6-66
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	6-66
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	6-66

* An analog output signal of 4 - 20 mA requiers an optional terminal board for current output.

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■MEMOBUS Communications: H5

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
H5-01	Station address	Sets the Inverter's node address.	0 to 20 *	1F	No	A	425H	6-70
H5-02	Communications speed selection	Sets the baud rate for MEMOBUS communications. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	426H	6-70
H5-03	Communications parity selection	Sets the parity for MEMOBUS communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	427H	6-70
H5-04	Stopping method after communications error	Sets the stopping method for communications errors. 0: Deceleration to stop using the deceleration time in C1-02 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09 3: Continue operation 4: Continue operation with the frequency reference set in d1-04	0 to 4	3	No	A	428H	6-70
H5-05	Communications error detection selection	Sets 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	6-70
H5-06	Send wait time	Sets the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	42AH	6-70
H5-07	RTS control ON/OFF	Enables or disables RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	42BH	6-70
H5-08	Communications Selection	Selects the Protocol for the Communication 0: Memobus 1: N2 protocol 2: PI protocol	0 to 2	0	No	A	434H	6-70
H5-09	CE detection time	Sets the time before CE error (Communication error) is detected when MEMOBUS communication is used.	0.0 to 10.0 sec	2.0 sec	No	A	435H	

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

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◆ 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 (fan cooled motor) When several motors are connected to one Inverter, set to 0 and ensure that each motor is installed with a protection device.	0 or 1	1	No	Q	480H	6-33
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 capability 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	6-33
L1-03	Alarm operation selection during motor overheating	Selects the operation when the input motor temperature (thermistor) input exceeds the alarm detection level (1.17 V) (H3-09 must be set to E). 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	6-35
L1-04	Motor overheating operation selection	Selects the operation when the motor temperature (thermistor) input exceeds the overheating detection level (2.34 V) (H3-09 must be set to E). 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	6-35
L1-05	Motor temperature input filter time constant	Sets H3-09 to E and sets the delay time constant for the motor temperature (thermistor) input in seconds.	0.00 to 10.00	0.20 s	No	A	484H	6-35

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■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 (DC bus undervoltage (UV1) detection) 1: Enabled (Restarted when the power returns within the time set in L2-02. When L2-02 is exceeded, DC bus undervoltage is detected.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect DC bus undervoltage.)	0 to 2	0	No	A	485H	6-38
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 *1	No	A	486H	6-38
L2-03	Min. baseblock time	Sets the Inverter's minimum baseblock time, when the Inverter is restarted after power loss ridethrough. Set the time to approximately 0.7 times the motor 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	6-38 6-39
L2-04	Voltage recovery time	Sets the time required to return the Inverter output voltage from 0V to normal voltage at the completion of a speed search.	0.0 to 5.0	0.3 s *1	No	A	488H	6-38 6-39
L2-05	Undervoltage detection level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage). Usually changing this setting is not necessary.	150 to 210 *2	190 V *2	No	A	489H	6-38

* 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.

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■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 has fallen below the stall prevention level). 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	6-18
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. Reduce the setting when the motor stalls.	0 to 200	120%	No	A	490H	6-18
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 stall prevention level. Deceleration restarts when the voltage falls below the stall prevention level again.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. The set deceleration time is disregarded.) When a braking option (Braking Resistor Unit, Braking Unit) is used, always set to 0.	0 to 2	1	No	Q	492H	6-20
L3-05	Stall prevention selection during running	0: Disabled (Runs as set. With a heavy load, the motor may stall.) 1: Deceleration using deceleration time 1 (C1-02.) 2: Deceleration using decelera-tiontime 2 (C1-04.)	0 to 2	1	No	A	493H	6-30
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. Reduce the setting when the motor stalls.	30 to 200	120%	No	A	494H	6-30

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■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 "f_{out}/f_{set} agree 1", "Frequency detection 1" or "Frequency detection 2" is set for a multi-function output.	0.0 to 200.0	0.0 Hz	No	A	499H	6-26
L4-02	Speed agreement detection width	Effective when "f_{ref}/f_{out} agree 1", "f_{out}/f_{set} agree 1" or "Frequency detection 1" or "Frequency detection 2" is set for a multi-function output.	0.0 to 20.0	2.0 Hz	No	A	49AH	6-26
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	1	No	A	49DH	6-44
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	6-44

■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	6-46
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	6-46
L5-03	Fault Retry time	Sets the maximum time, the restart is tried.	0.5 to 180.0	10.0s	No	A	4A0H	6-46

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■Torque Detection: L6

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
L6-01	Torque detection selection	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues (warning is output). 2: Overtorque detected continuously during operation; operation continues (warning is output). 3: Overtorque detection only with speed agreement; output stopped upon detection. 4: Overtorque detected continuously during operation; output stopped upon detection. 5: Undertorque detection only with speed agreement; operation continues (warning is output). 6: Undertorque detected continuously during operation; operation continues (warning is output). 7: Undertorque detection only with speed agreement; output stopped upon detection. 8: Undertorque detected continuously during operation; output stopped upon detection.	0 to 8	6	No	A	4A1H	6-31
L6-02	Torque detection level	Inverter rated current is set as 100%.	0 to 300	15%	No	A	4A2H	6-31
L6-03	Torque detection time	Sets the overtorque/undertorque detection time.	0.0 to 10.0	10.0 s	No	A	4A3H	6-31

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■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	6-47
L8-03	Operation selection after overheat pre-alarm	Sets the operation for when the Inverter overheat pre-alarm occurs. 0: Decelerate to stop using the deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) 4: OH-Alarm and output frequency reduction (L8-19) A fault will be given in setting 0 to 2 and a alarm will be given in setting 3 and 4.	0 to 4	4	No	A	4AFH	6-47
L8-06	Input Phase Loss Detection Level	Allowed DC bus ripple before Input Phase Loss is detected.	0.0 to 25.0 %	5 %	No	A	4B2H	6-47
L8-09	Ground fault protection selection	0: Disabled 1: Enabled It is not recommended to use another setting than factory setting.	0 or 1	1	No	A	4B5H	6-47
L8-10	Cooling Fan control selection	Sets the ON/OFF control for the cooling fan. 0: ON only when RUN command is on 1: ON whenever inverter is powered up	0 or 1	0	No	A	4B6H	6-48
L8-11	Cooling fan control delay time	Set the time in seconds to delay turning OFF the cooling fan after the inverter STOP command is given.	0 to 300	300 s	No	A	4B7H	6-48
L8-12	Ambient temperature	Set the ambient temperature.	45 to 60	45 °C	No	A	4B8H	6-49
L8-15	OL2 characteristics selection at low speeds	0: OL2 characteristics at low speeds disabled. 1: OL2 characteristics at low speeds enabled. It is not recommended to use another setting than factory setting.	0 or 1	1	No	A	4BBH	6-49
L8-18	Soft CLA selection	0: Disable (gain = 0) 1: Enable It is not recommended to use another setting than factory setting.	0 or 1	1	No	A	4BEH	6-50
L8-19	Frequency reference during OH pre-alarm	Sets the frequency reference when OH pre-alarm is detected in percent of maximum frequency (E1-04)	0.0 to 100.0	20.0 %	No	A	4BFH	6-48

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

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◆ 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	0 or 1	1	No	A	580H	6-29
N1-02	Hunting-prevention gain	Sets the hunting-prevention gain multiplication factor.	0.00 to 2.50	1.00	No	A	581H	4-11 6-29

■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	6-101
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 120% of the Inverter rated current or less.	100 to 200	150%	No	A	589H	6-101
N3-03	High-slip braking stop dwell time	Sets the dwell time for the output frequency for FMIN (1.5 Hz). Effective only during deceleration with high-slip braking.	0.0 to 10.0	1.0 s	No	A	58AH	6-101
N3-04	High-slip braking OL time	Set the OL time when the output frequency does not change for any reason during deceleration with high-slip braking.	30 to 1200	40 s	No	A	58BH	6-101

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◆ 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-□□). (Not on LCD operator.)	6 to 53	6	Yes	A	500H	6-102
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	6-102
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: rpm units (Set the motor poles.) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency. □□□□□ Sets the value that is to be displayed at 100% excluding the decimal point. Sets the number of decimal places. Example: When the max. output frequency value is 200.0, set 12000	0 to 39999	0	No	A	502H	6-102
o1-05	LCD-Focus	Sets the brightness on the optional LCD operator (JVOP-160). 0: light 1: 2: 3: normal 4: 5: dark	0 to 5	3	Yes	A	504H	–
o1-06	Monitor Mode Selection*1	0: Below the active monitor parameter the next 2 sequential monitors are diaplayed. 1: Below the active monitor the 2 monitors specified by o1-07 and o1-08 are locked	0 or 1	0	No	A	517H	–
o1-07	2nd Monitor Selection*1	Selects the monitor that is displayed and locked in the second line of the operator display.	1 to 53	2	No	A	518H	–

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
o1-08	3rd Monitor Selection*1	Selects the monitor that is displayed and locked in the third line of the operator display.	1 to 53	3	No	A	519H	–

* 1. Parameter is only effective if HOA operator with LCD (JVOP-162) is used.

■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 b1-01, b1-02.)	0 or 1	1	No	A	505H	6-102
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 an external terminal, the Stop key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	506H	6-102
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	6-102
o2-04	kVA selection	Do not set unless using a control board from an Inverter with a different capacity. (Refer to *page 5-48* for the setting values).	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 or not. 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	6-102
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 switched off, and fault contact is operated.)	0 or 1	0	No	A	50AH	6-102

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
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	6-102
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	6-102
o2-09	Initialize Mode	2: Europe 5: PV-E Spec.	2 or 5	2	No	A	50DH	6-102
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	6-102
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	6-102
o2-14	Energy monitor initialize	Resets the monitor parameters U1-24 and U1-30 back to zero. 0: No change 1: Reset to zero	0 or 1	0	No	A	512H	6-102
o2-15	HAND Key function selection	If set to 0 the HAND button on the digital operator is disabled and the drive will not enter the HAND mode and start to run when the HAND button is pressed. 0: HAND button disabled 1: HAND button enabled	0 or 1	1	No	A	513H	6-102

■ 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	6-105
o3-02	Read permission selection	0: READ prohibited 1: READ permitted	0 or 1	0	No	A	516H	6-105

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◆ T: Motor Autotuning

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level	MEMOBUS Register	Page
T1-02	Motor output power	Sets the output power of the motor in kilowatts.	0.00 to 650.00	0.40 kW *1	No	A	702H	4-7
T1-04	Motor rated current	Sets the rated current of the motor in Amps.	0.32 to 6.40 *2	1.90 A *1	No	A	704H	4-7

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

* 2. 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.)

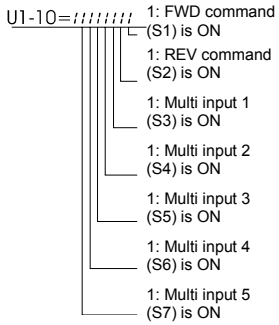
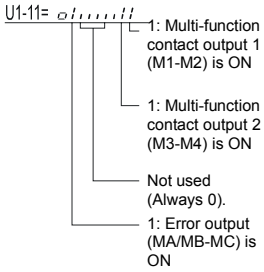
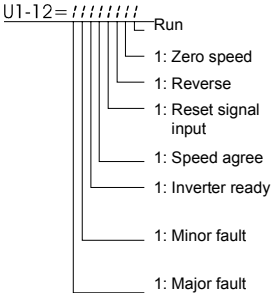
◆ U: Monitor Constants

■ Status Monitor Constants: U1

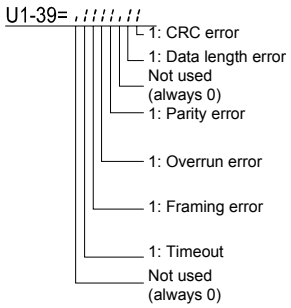
Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	MEMOBUS Register
U1-01	Frequency reference	Monitors/sets the frequency reference value.*	10 V: Max. frequency (0 to + 10 V possible)	0.01 Hz	40H
U1-02	Output frequency	Monitors the output frequency.*	10 V: Max. frequency (0 to + 10 V possible)	0.01 Hz	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	42H
U1-06	Output voltage	Monitors the output voltage reference value.	10 V: 200 VAC (400 VAC) (0 to +10 V output)	0.1 V	45H
U1-07	DC bus voltage	Monitors the main DC bus voltage.	10 V: 400 VDC (800 VDC) (0 to +10 V output)	1 V	46H
U1-08	Output power	Monitors the output power (internally detected value).	10 V: Inverter capacity (max. applicable motor capacity) (0 to + 10 V possible)	0.1 kW	47H

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

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Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	MEMOBUS Register
U1-10	Input terminal status	Shows input ON/OFF status. 	(Cannot be output.)	–	49H
U1-11	Output terminal status	Shows output ON/OFF status. 	(Cannot be output.)	–	4AH
U1-12	Operation status	Inverter operating status. 	(Cannot be output.)	–	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	4CH
U1-14	Software No. (flash memory)	(Manufacturer's ID number)	(Cannot be output.)	–	4DH
U1-15	Terminal A1 input level	Monitors the input level of analog input A1. A value of 100% corresponds to 10V input.	10 V: 100% (0 to + 10 V possible)	0.1%	4EH
U1-16	Terminal A2 input level	Monitors the input level of analog input A2. A value of 100% corresponds to 10V/20mA input.	10 V/20mA: 100% (0 to +10 V possible)	0.1%	4FH
U1-18	Motor secondary current (Iq)	Monitors the calculated value of the motor secondary current. The motor rated current corresponds to 100%.	10 V: Motor rated current) (0 to +10 V output)	0.1%	51H

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Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	MEMOBUS Register
U1-20	Output frequency after soft-starter (SFS output)	Monitors the frequency reference after the soft starter. This frequency value does not include compensations, such as slip compensation. The unit is set in o1-03.	10 V: Max. frequency (0 to + 10 V possible)	0.01 Hz	53H
U1-24	PI feedback value	Monitors the feedback value when PI control is used.	10 V: 100% feedback value (0 to + 10 V possible)	0.01 %	57H
U1-28	Software No. (CPU)	(CPU software No.)	(Cannot be output.)	–	5BH
U1-29	MWh display	Monitors the 5 higher digits MWh display.	(Cannot be output.)	1 MWh	5CH
U1-30	kWh display	Monitors the 4 lower digits, kWh display.	(Cananot be output.)	0.1 kWh	5DH
U1-31	LED Test	For testing LEDs on operator. If this monitor is selected, all LED's light up (only on LED operator).	(Cannot be output.)	–	3CH
U1-34	OPE fault constant	Shows the first constant number when an OPE fault is detected.	(Cannot be output.)	–	61H
U1-36	PI input volume	PI input volume	10 V: 100% PI input (0 to + 10 V possible)	0.01 %	63H
U1-37	PI output volume	PI control output	10 V: 100% PI output (0 to + 10 V possible)	0.01 %	64H
U1-38	PI setpoint	PI setpoint	10 V: 100% PI setpoint	0.01 %	65H
U1-39	MEMOBUS communications error code	Shows MEMOBUS errors. 	(Cannot be output.)	–	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	68H
U1-51	Frequency reference at AUTO operation	Monitors the value of the frequency reference when AUTO operation is active.	10 V: Max. frequency (0 to 10 V possible)	0.01 %	72H
U1-52	Frequency reference at HAND operation	Monitors the value of the frequency reference when HAND operation is active.	10 V: Max. frequency (0 to 10 V possible)	0.01 %	73H
U1-53	PI feedback 2	Monitors the feedback value of the PI fdbk2 input when Differential PI is selected (H3-□□=6B)	10V: 100% feedback value (0 to + 10V possible)	0.01 %	74H

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■ Fault Trace: U2

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

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

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■Fault History: U3

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

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

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◆ Factory Settings that Change with the Control Method (A1-02)

■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.

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◆ 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	Motor rated current	A	1.90	3.30	6.20	8.50	14.00	19.60	26.60	39.7	53.0
E2-03	Motor no-load current	A	1.20	1.80	2.80	3.00	4.50	5.10	8.00	11.2	15.2
E2-05	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

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 30 kW or more, the Inverter rated current will need to be reduced.

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	Motor rated current	A	65.8	77.2	105.0	131.0	160.0	190.0	260.0	260.0	260.0
E2-03	Motor no-load current	A	15.7	18.5	21.9	38.2	44.0	45.6	72.0	72.0	72.0
E2-05	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 30 kW or more, the Inverter rated current will need to be reduced.

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■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	Motor rated current	A	1.00	1.60	3.10	4.20	7.00	7.00	9.80	13.30	19.9	26.5
E2-03	Motor no-load current	A	0.60	0.80	1.40	1.50	2.30	2.30	2.60	4.00	5.6	7.6
E2-05	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	Motor rated current	A	32.9	38.6	52.3	65.6	79.7	95.0	130.0	156.0	190.0	223.0
E2-03	Motor no-load current	A	7.8	9.2	10.9	19.1	22.0	24.0	36.0	40.0	49.0	58.0
E2-05	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

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Constant Number	Name	Unit	Factory Setting			
–	Inverter Capacity	kW	160	185	220	300
o2-04	kVA selection	–	34	35	36	37
b8-04	Energy-saving coefficient	–	30.13	30.57	27.13	21.76
C6-02	Carrier frequency selection *	–	2	2	1	1
E2-01	Motor rated current	A	270.0	310.0	370.0	500.0
E2-03	Motor no-load current	A	70.0	81.0	96.0	130.0
E2-05	Motor line-to-line resistance	Ω	0.029	0.025	0.020	0.014
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.8	1.9	2.0	2.1
L2-04	Voltage recovery time	s	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	108	95	100	108

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 30 kW or more, the Inverter rated current will need to be reduced.

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6

Constant Settings by Function

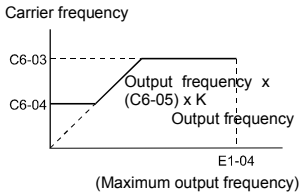
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◆ Setting the Carrier Frequency

Using the following constants the carrier frequency setting can be fitted to the applications requirements.

■Related Constants

No. Constant No.	Name	Details	Setting Range	Factory Setting	Changes During Operation?	Access Level
C6-02	Carrier frequency selection	Selects the carrier frequency. Select F to enable detailed settings using constants C6-03 to C6-05.	0 to F	6*1	No	Q
C6-03	Carrier frequency upper limit	Sets the upper and lower carrier frequency limits in kHz. Set the carrier wave gain as shown below.  	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 = 1	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.

When selecting the carrier frequency, observe the following precautions:

- 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	0 to 6 (15 kHz)	0 to 4 (10 kHz)	0 to 2 (5 kHz)

- If speed and torque vary 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 set to vary depending on 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).

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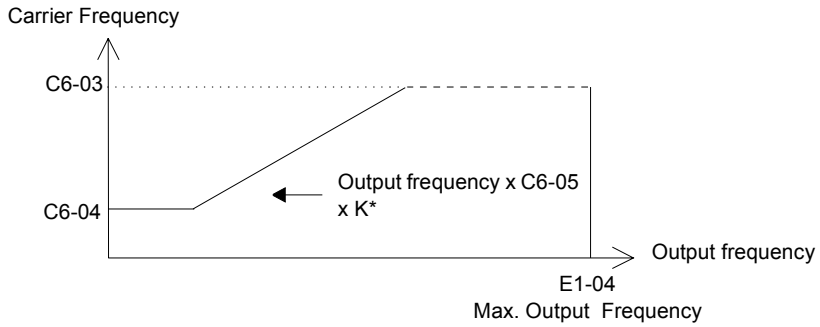


Fig 6.1

*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 an OPE11 fault (Data setting error) will occur.

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■Carrier Frequency and Inverter Overload Current Level

The inverter overload capability depends among other things on the carrier frequency setting. If the carrier frequency setting is higher than the factory setting, the overload current capability must be reduced as shown in the tables below.

Inverter Type	Initial carrier frequency setting	Maximum carrier frequency setting	Current derating %
20P4	6 (15 kHz)	6 (15 kHz)	–
20P7	6 (15 kHz)	6 (15 kHz)	–
21P5	6 (15 kHz)	6 (15 kHz)	–
22P2	6 (15 kHz)	6 (15 kHz)	–
23P7	6 (15 kHz)	6 (15 kHz)	–
25P5	6 (15 kHz)	6 (15 kHz)	–
27P5	6 (15 kHz)	6 (15 kHz)	–
2011	6 (15 kHz)	6 (15 kHz)	–
2015	6 (15 kHz)	6 (15 kHz)	–
2018	6 (15 kHz)	6 (15 kHz)	–
2022	6 (15 kHz)	6 (15 kHz)	–
2030	4 (10 kHz)	6 (15 kHz)	80 %
2037	3 (8 kHz)	4 (10 kHz)	80 %
2045	3 (8 kHz)	4 (10 kHz)	80 %
2055	3 (8 kHz)	4 (10 kHz)	80 %
2075	3 (5 kHz)	4 (10 kHz)	–
2090	3 (5 kHz)	4 (10 kHz)	–
2110	1 (2 kHz)	1 (2 kHz)	–

40P4	6 (15 kHz)	6 (15 kHz)	–
40P7	6 (15 kHz)	6 (15 kHz)	–
41P5	6 (15 kHz)	6 (15 kHz)	–
42P2	6 (15 kHz)	6 (15 kHz)	–
43P7	6 (15 kHz)	6 (15 kHz)	–
44P0	6 (15 kHz)	6 (15 kHz)	–
45P7	6 (15 kHz)	6 (15 kHz)	–
47P5	6 (15 kHz)	6 (15 kHz)	–
4011	6 (15 kHz)	6 (15 kHz)	–
4015	6 (15 kHz)	6 (15 kHz)	–
4018	6 (15 kHz)	6 (15 kHz)	–
4022	6 (15 kHz)	6 (15 kHz)	–
4030	4 (10 kHz)	6 (15 kHz)	80 %
4037	4 (10 kHz)	6 (15 kHz)	80 %
4045	4 (10 kHz)	6 (15 kHz)	80 %
4055	4 (10 kHz)	6 (15 kHz)	80 %
4075	3 (8 kHz)	4 (10 kHz)	80 %
4090	3 (8 kHz)	4 (10 kHz)	80 %
4110	3 (8 kHz)	4 (10 kHz)	80 %
4132	2 (5 kHz)	4 (10 kHz)	75 %
4160	2 (5 kHz)	4 (10 kHz)	80 %
4185	2 (5 kHz)	–	–
4220	1 (2.5 kHz)	–	–
4300	1 (2.5 kHz)	–	–

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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

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	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 Frequency Reference from the Digital Operator

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

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

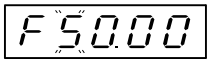


Fig 6.2 Frequency Setting Display

■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.

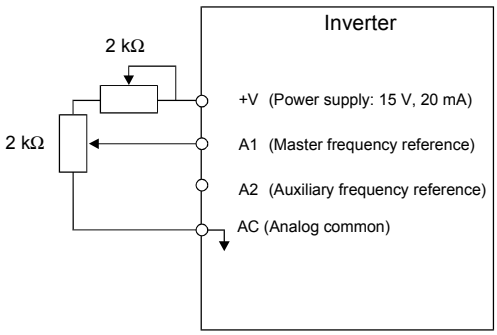


Fig 6.3 Master Speed Frequency Reference Input

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2-Step Switching: Master/Auxiliary

If 2-step switching between master and auxiliary speed frequencies is performed, 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 input (master speed frequency reference) will be the Inverter frequency reference, and when terminal S3 is ON, terminal A2 input (auxiliary speed frequency reference) will be the Inverter frequency reference.

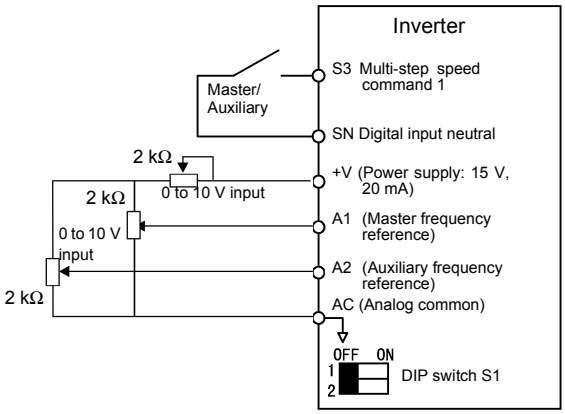


Fig 6.4 Master/Auxiliary Frequency Reference Input

Setting Precautions

When inputting a voltage signal to terminal A2, turn OFF pin 2 on DIP switch S1 to switch to voltage input (factory setting is ON).

■Inputting Frequency Reference Using Current

When b1-01 is set to 1, the frequency reference can be input 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 function selection) is set to 0 (factory setting) the input on A2 is added to A1.

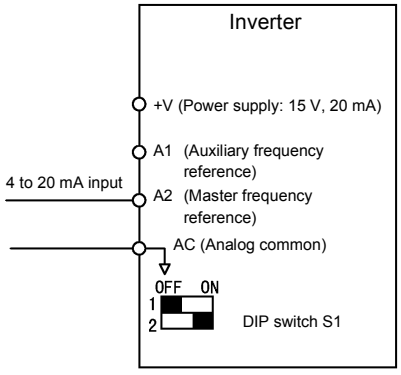


Fig 6.5 Frequency Reference Using Current

Setting Precautions

- When inputting a current signal to terminal A2, turn ON pin 2 on DIP switch S1 (factory setting: ON).
- 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.

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◆ Using Multi-Step Speed Operation

With Varispeed-E7 series Inverters, you can change the speed to a maximum of 5 steps, using 4 multi-step frequency references, and one jog frequency reference.

The following example of a multi-function input terminal function shows a 5-step operation using multi-step references 1 and 2 and jog frequency selection functions.

■Related Constants

To switch frequency references, set multi-step references 1 and 2 and the jog reference selection in the multi-function contact inputs.

Multi-function Contact Inputs (H1-01 to H1-04)

Terminal	Constant Number	Set Value	Details
S4	H1-02	3	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).)
S5	H1-03	4	Multi-step speed command 2
S6	H1-04	6	Jog frequency selection (given priority over multi-step speed command)

Combining Multi-Step Speed References and Multi-Function Contact Inputs

You can change the selected frequency reference by combining the ON/OFF status of S4 to S6 (multi-function contact input terminals) . The following table shows the possible combinations.

Speed	TerminalS4	TerminalS5	TerminalS6	Selected Frequency
	Multi-step Speed Command 1	Multi-step Speed Command 2	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 S6'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, 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).

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■Connection Example and Time Chart

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

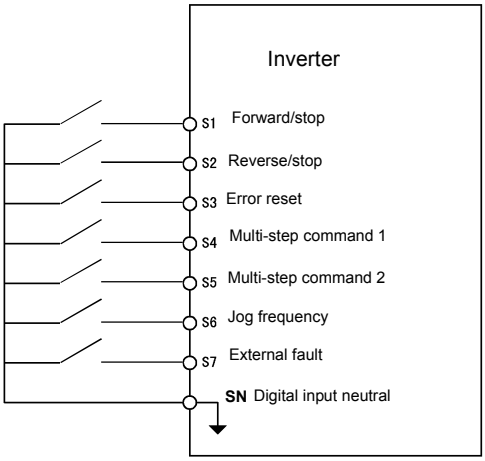


Fig 6.6 Control Circuit Terminal During 5-step Operation

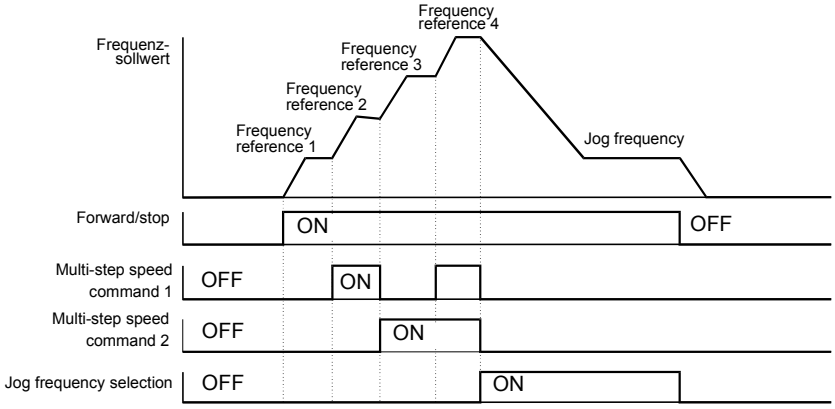


Fig 6.7 Multi-step speed command/Jog Frequency Selection Time Chart

Note:

- The multifunction input setting “Jog Frequency 2” (69) can be used for jog frequency selection when a 3-wire control is used for the control circuit. If it is selected while the inverter is initialized to 2-wire control an OPE03 error will be displayed.

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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 (digital multifunction inputs) 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, 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 Control

The factory setting is set to a 2-wire control. 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.

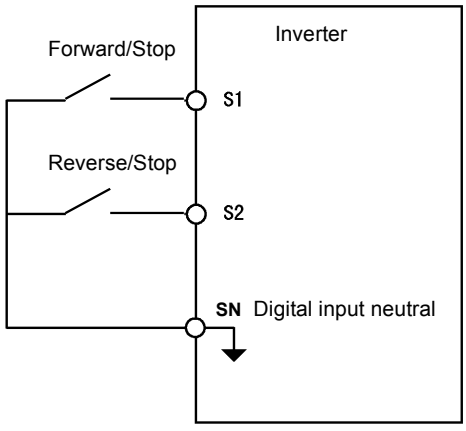


Fig 6.8 2-Wire Control Wiring Example with Positive Logic

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Performing Operations Using 3-Wire Control

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 control, and the multi-function input terminal that has been set to 0 works as a forward/reverse selection command terminal.

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

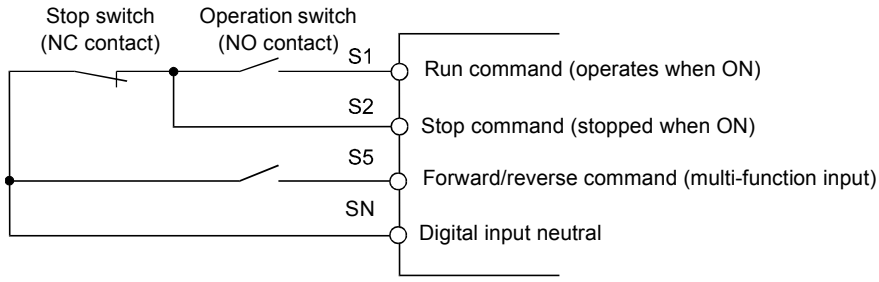


Fig 6.9 3-Wire Control Wiring Example

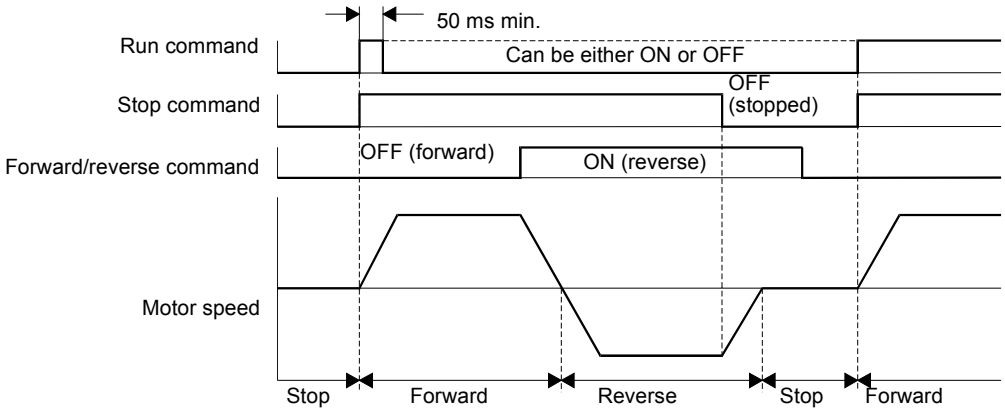


Fig 6.10 Three-wire Control Time Chart

INFO

Use a control circuit 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.

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Stopping Methods

This section explains methods of stopping the Inverter.

◆ 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 given. 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 at which the DC injection braking starts in units of Hz when b1-03 is set to 0 (deceleration to stop). 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 the machines inertia. Set to 0.00 to disable DC injection braking time at stop.	0.00 to 10.00	0.50 s	No	A

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■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 stop according to the deceleration time that has been set. (Factory setting: C1-02 (Deceleration Time 1))

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

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

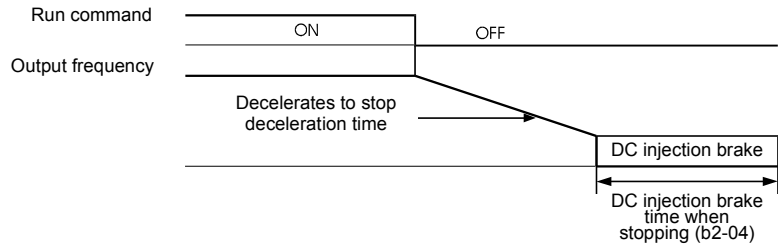


Fig 6.11 Deceleration to Stop

■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 switched off. The motor coasts to stop.

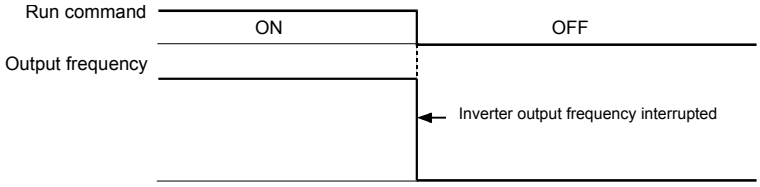


Fig 6.12 Coast to Stop

INFO

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

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■DC Braking Stop

After the stop command is input and the minimum baseblock time (L2-03) has 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 depends on the set value of b2-04 and on the output frequency at the moment the stop command is input.

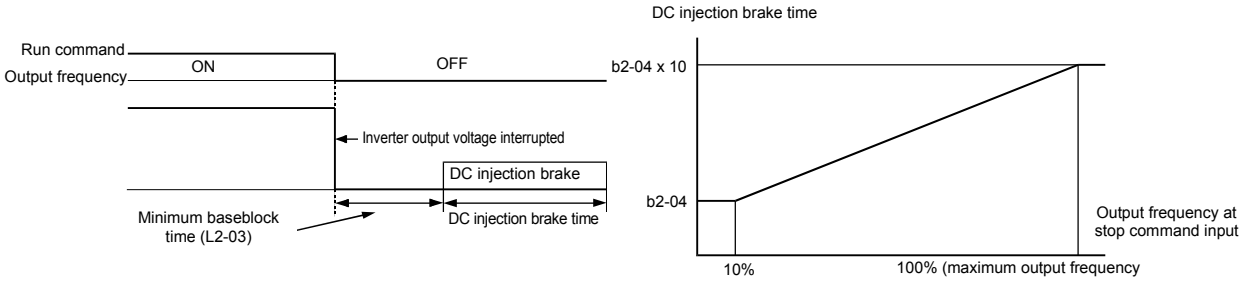


Fig 6.13 DC Injection Braking Stop

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 switched off so that the motor coasts to stop. After the stop command is input, run commands are ignored until the time T has elapsed. The time T depends on the output frequency when the stop command is input and on the deceleration time.

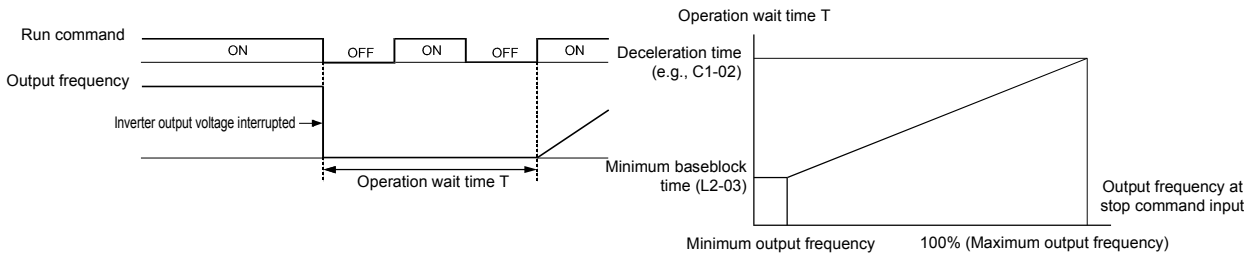


Fig 6.14 Coast to Stop with Timer

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◆ 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 constant b2-04 to apply a DC injection brake to the motor at stopping. It prevents the motor from coasting when it would not be stopped completely using the normal deceleration. This can occur if the inertia is very high. The DC injection brake can be disabled by setting b2-04 to 0.

Set the DC injection brake current using b2-02.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b2-01	DC injection braking starting frequency	Used to set the frequency at which DC injection braking starts in units of Hz when b1-03 is set to 0 (deceleration to stop). 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
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
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 10.0	0.50 s	No	A

◆ Motor Pre-heat Function

The motor pre-heat function can be used to prevent e.g. moisture inside the motor due to condensation. The pre-heat current can be set in b2-09. Using a digital input which is set for motor pre-heat (H1-□□=60) the function can be enabled or disabled.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b2-09	Motor pre-heat current	Sets the DC current level when the motor pre-heat function is enabled using a digital input.	0 to 100	0%	No	A

■Multi-function Digital Inputs (H1-01 to H1-05)

Set value	Function
60	Motor pre-heat command

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The time chart for motor pre-heat is shown below.

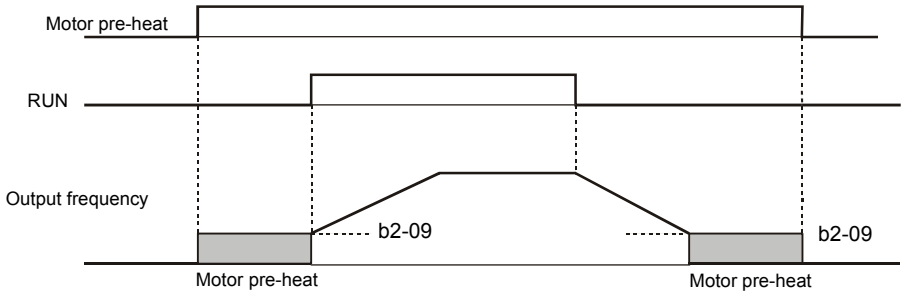


Fig 6.15 DC Injection Brake Time Chart

◆ Using an Emergency Stop

Set a multi-function input terminal (H1-□□) to 15 or 17 (emergency stop) to decelerate to stop using the deceleration time set in C1-09. If inputting the emergency stop with an NO contact, set the multi-function input terminal (H1-□□) to 15, and if inputting the emergency stop with an NC contact, set the multi-function input terminal (H1-□□) to 17.

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

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
C1-09	Emergency stop time	Sets 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 as stoping method.	0.0 to 6000.0	10.0 s	No	A

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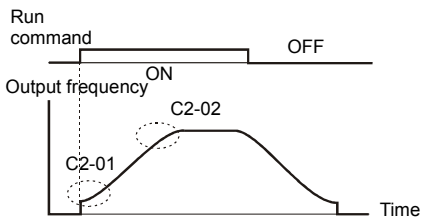
Acceleration and Deceleration Characteristics

This section explains the acceleration and deceleration characteristics of the Inverter.

◆ 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 accel./decel. times 1 are used with the factory setting, the accel./decel. times 2 can be selected using a multifunction input.

■Related Parameters

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
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
C1-02	Deceleration time 1	Sets the deceleration time in seconds for the output frequency to fall from 100% to 0%.			Yes	Q
C1-03	Acceleration time 2	Sets the acceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A
C1-04	Deceleration time 2	Sets the deceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A
C1-11	Acceleration/deceleration time switching frequency	Sets 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 input "Acceleration/deceleration time selection 1" is given priority.	0.0 to 200.0	0.0 Hz	No	A
C2-01	S-curve characteristic time at acceleration start	Sets 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.	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

Two different acceleration times and deceleration times can be set. When one multi-function input terminal (H1-□□) is set to 7 (acceleration/deceleration time selection 1), you can switch the acceleration/deceleration time even during operation by changing the ON/OFF status of this terminal.

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

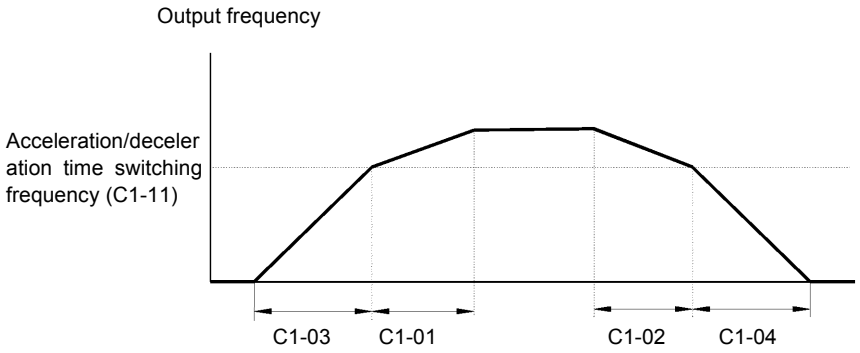
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■Switching Acceleration and Deceleration Time Automatically

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 6.16 Acceleration/deceleration Time Switching Frequency

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

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

Two S-curve characteristic times can be set: At acceleration start and at acceleration end. For deceleration start and end the S-curve times are fixed to 0.2 sec.

INFO

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

$$\text{Accel. time} = \frac{\text{C2-01} + \text{C2-02}}{2} + \text{C1-01/03}$$

$$\text{Decel. time} = 0.2\ \text{s} + \text{C1-02/04}$$

Setting Example

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

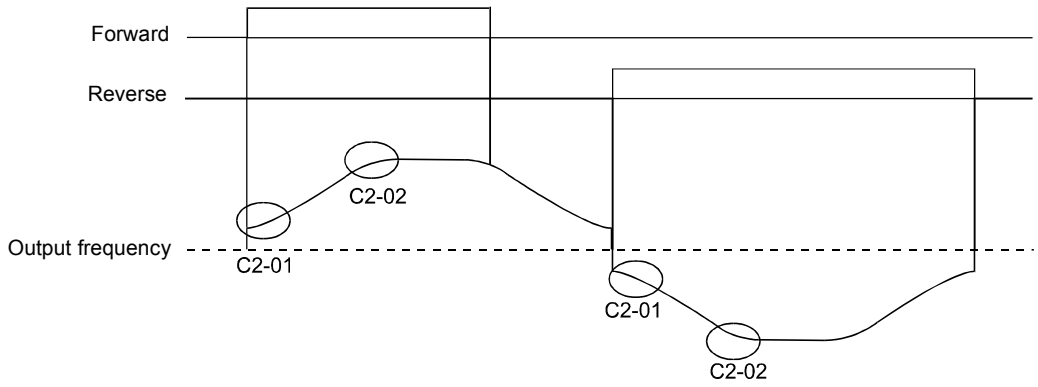


Fig 6.17 S-curve Characteristic during Operation Switching

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◆ 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 reaches 85 % of the set value in L3-02, the acceleration rate will begin to slow down. When L3-02 is exceeded, the acceleration will stop.

If you set L3-01 to 2 (optimum adjustment), the motor accelerates so that the current is held at a level of 50 % of the inverter rated current. With this setting, the acceleration time setting is ignored.

■Related Parameters

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	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 falls below the level set in L3-02.) 2: Optimum adjustment (Adjusts acceleration using the current level set in L3-02 as reference. 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.

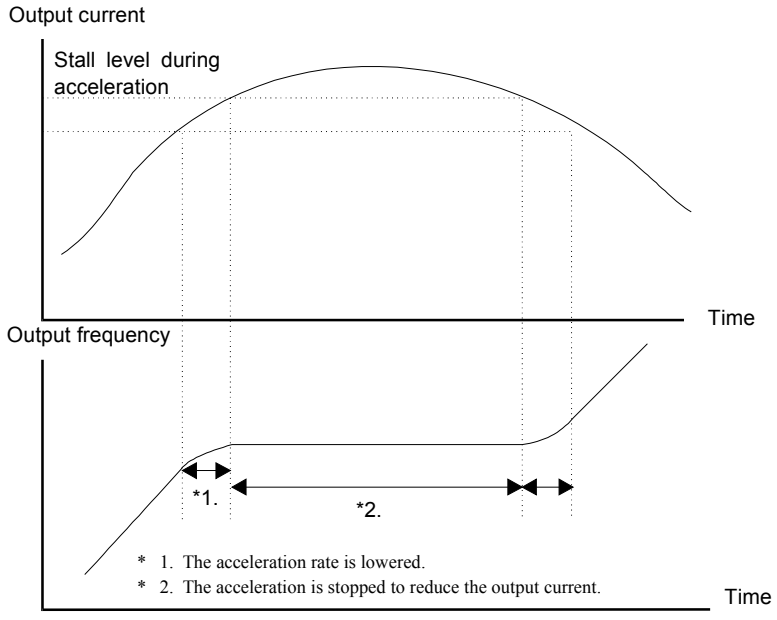


Fig 6.18 Time Chart for Stall Prevention During Acceleration

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■Setting Precautions

- If the motor capacity is small compared to the Inverter capacity or if the inverter is operated using the factory settings and the motor stalls, 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. It will be reduced to a fixed value of 50 % of the inverter rated current.
- Set the constants as a percentage taking the inverter rated current to be 100%.

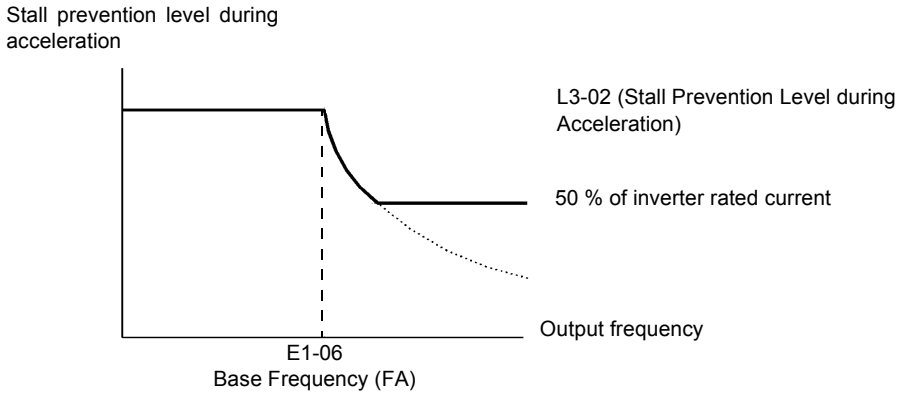


Fig 6.19 Stall Prevention Level and Limit During Acceleration

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◆ 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	Access Level
L3-04	Stall prevention selection during deceleration function selection	0: Disabled (Motor decelerates according to setting. When the deceleration time is too short, there is a risk of DC bus overvoltage (OV) occurring.) 1: Enabled 2: Optimum adjustment 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 the Stall Prevention Selection During Deceleration (L3-04)

There are four different settings selectable for L3-04.

L3-04=0: This setting disables the stall prevention function during deceleration. The motor will be decelerated using the time set in C1-02 (C1-04). If the load inertia is very high and an OV fault occurs during deceleration a Braking option has to be used or the time has to be lengthened.

L3-04=1: This setting enables the stall prevention during deceleration. The inverter tries to decelerate within the set deceleration time. It also observes the DC bus voltage. If the DC bus voltage reaches the stall prevention level the deceleration is stopped and the output frequency is held. When the DC bus voltage falls below the stall prevention level the deceleration will be continued.

L3-04=2: This setting enables the stall prevention during deceleration. The deceleration time set as C1-☐☐ is taken as reference. The function automatically tries to optimize the deceleration time by observing the DC bus voltage and shortening the deceleration time. The function does not lengthen the deceleration time, i.e. if C1-☐☐ is set too short OV may occure.

■Setting Example

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

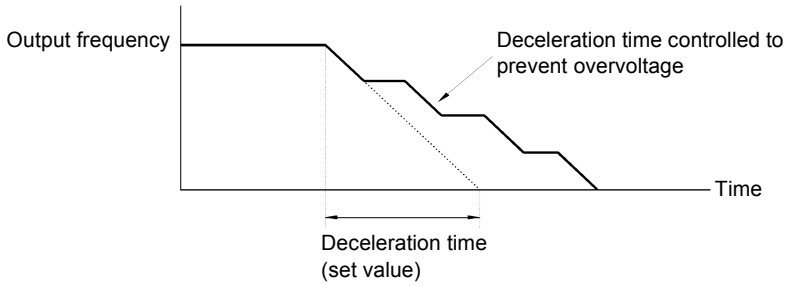


Fig 6.20 Stall Prevention During Deceleration Operation

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■Setting Precautions

- The stall prevention level during deceleration differs depending on the inverter rated voltage and 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, be sure to set constant L3-04 to 0.

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Adjusting Frequency References

This section explains methods of 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 terminal A1 input gain	Sets the frequency as a percentage of the maximum output frequency, when 10V is input.	0.0 to 1000.0	100.0%	Yes	A
H3-03	Frequency reference terminal A1 input bias	Sets the frequency as a percentage of the maximum output frequency, when 0V is input.	-100.0 to +100.0	0.0%	Yes	A
H3-08	Multi-function analog A2 signal level selection	0: 0 to +10V (11 bit) 2: 4 to 20 mA (9-bit input) 3: 0 to 20 mA (9-bit input) Switch current and voltage input using the switch S1 on the control terminal board.	0, 2, 3	2	No	A
H3-09	Multi-function analog A2 function selection	Selects the multi-function analog input function for terminal A2.	0 to 16	0	No	A
H3-10	Multi-function analog A2 input gain	Sets the input levelwhen terminal A2 input is 10V (20mA) according to the 100% value of the function set in constant H3-09.	0.0 to 1000.0	100.0%	Yes	A
H3-11	Multi-function analog A2 input bias	Sets the input level when terminal A2 input is 0V (4mA) according to the 100% value of the function set in constant H3-09.	-100.0 to +100.0	0.0%	Yes	A
H3-12	Analog input filter time constant	Sets primary delay filter time constant for the two analog input terminals (A1 and A2). Effective for noise control etc.	0.00 to 2.00	0.00 s	No	A
H3-13	Terminal A1/A2 switching	0: Use terminal A1 analog input as main frequency reference. 1: Use terminal A2 analog input as main frequency reference. Effective when H3-09 is set to 2.	0 or 1	0	No	A

■Adjusting Analog Frequency Reference Using Constants

The frequency reference can be input from the control circuit terminals using analog voltage and current signals.

If using terminal A1 as an input terminal for the frequency reference value, perform adjustments using constants H3-01 to H3-03. If using multi-function analog input terminal A2 as a frequency reference terminal, perform adjustments using H3-08 to H3-11. Set the analog input signal level using the constants H3-01 or H3-08. Refer the following figures for setting the input gain and bias.

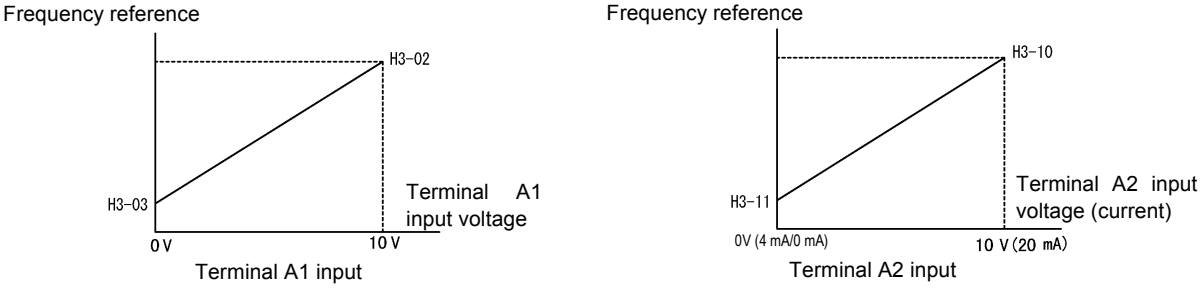


Fig 6.21 Terminals A1 and A2 Inputs

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■Adjusting Frequency Bias Using an Analog Input

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

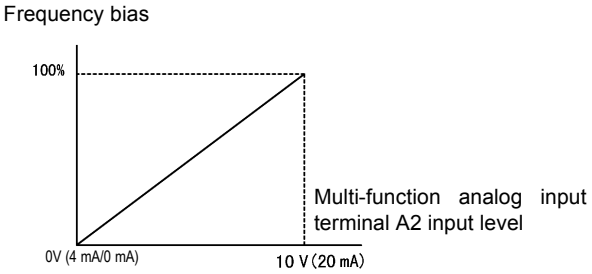
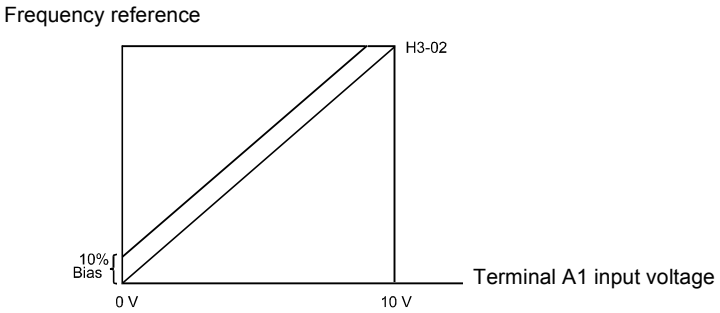


Fig 6.22 Frequency Bias Adjustment (Terminal A2 Input)

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%.



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◆ 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 can also be 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 of the jump frequency settings, in hertz. Set to 0.0 to disable the jump frequency function. Make sure that 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 200.0	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	Sets 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:

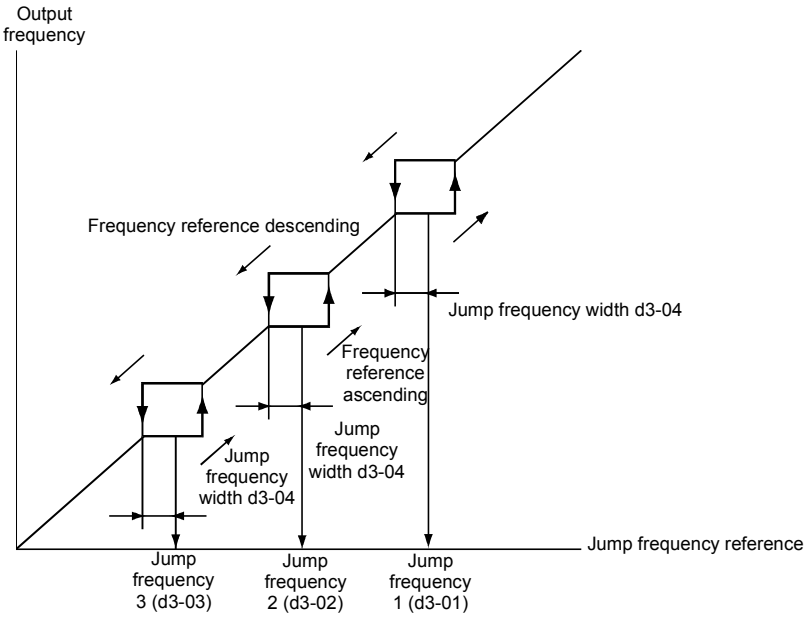


Fig 6.23 Jump Frequency

■Setting Precautions

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

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Speed Limit (Frequency Reference Limit Function)

This section explains how to limit the motor speed.

◆ 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 frequency reference 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 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

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Frequency Detection

◆ Speed Agreement Function

There are four different types of frequency detection methods available. The digital multifunction outputs M1 to M4 can be programmed for this function and can be used to indicate a frequency detection or agreement to any external equipment.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L4-01	Speed agreement detection level	Effective when "f_{out}/f_{set} agree 1", "Frequency detection 1" or "Frequency detection 2" is set for a multi-function output.	0.0 to 200.0	0.0 Hz	No	A
L4-02	Speed agreement detection width	Effective when "f_{ref}/f_{out} agree 1", "f_{out}/f_{set} agree 1", "Frequency detection 1" or "Frequency detection 2" is set for a multi-function output.	0.0 to 20.0	2.0 Hz	No	A

- With L4-01 an absolute speed agreement level is set, i.e. a speed agreement is detected in both directions (FWD and REV).

■Multifunction Output Settings: H2-01 to H2-02 (M1 – M4 function selection)

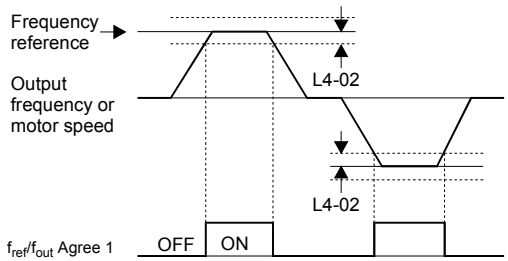
The table below shows the necessary H2-01 and H2-02 parameter setting for each of the speed agreement functions.

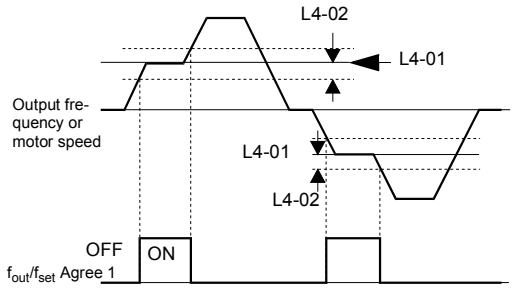
Function	Setting
f_{ref}/f_{out} Agree 1	2
f_{out}/f_{set} Agree 1	3
Frequency detection 1	4
Frequency detection 2	5

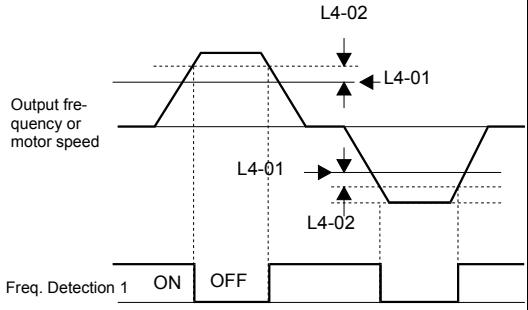
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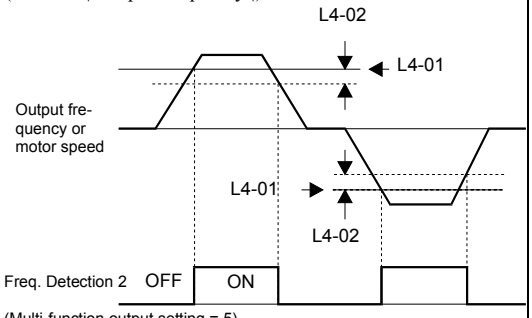
■Time Charts

The following table shows the time charts for each of the speed agreement functions.

<table>
<tr><th>Related constant</th><th>L4-01: Speed Agree Level
L4-02: Speed Agree Width</th></tr>
<tr><td>f_{ref}/f_{out} Agree</td><td>f_{ref}/f_{out} Agree 1


(Multi-function output setting = 2)</td></tr>
<tr><td>f_{out}/f_{set} Agree</td><td>f_{out}/f_{set} Agree 1
(ON at the following conditions during frequency agree)


(Multi-function output setting = 3)</td></tr>
<tr><td rowspan="2">Frequency Detection</td><td>Frequency (FOUT) Detection 1
(L4-01 > | Output frequency |)


(Multi-function output setting = 4)</td></tr>
<tr><td>Frequency (FOUT) Detection 2
(L4-01 < | Output frequency |)


(Multi-function output setting = 5)</td></tr>
</table>

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Improved Operating Efficiency

This section explains functions for improving motor operating efficiency.

◆ Torque Compensation for Sufficient Torque at Start and Low-speed Operation

The torque compensation function detects a rising motor load, and increases the output torque.

The inverter calculates the motor primary loss voltage and adjusts the output voltage (V) to compensate insufficient torque at startup and during low-speed operation. The compensation voltage is calculated 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	Sets the torque compensation gain using the multiplication factor.	0.00 to 2.50	1.00	Yes	A
C4-02	Torque compensation delay time constant	Set the delay for the torque compensation function in ms.	0 to 10000	200 ms	No	A

■Adjusting Torque Compensation Gain (C4-01)

Normally, there is no need to change this setting.

Adjust the torque compensation gain under the following circumstances.

- If the cable is very long, increase the set value.
- If the motor capacity is smaller than the Inverter capacity (max. applicable motor 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 (C4-02)

Set the torque compensation function primary delay in ms.

Normally, there is no need to change this setting. Adjust the constant under the following circumstances:

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

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◆ Hunting-Prevention Function

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

If high response has the priority to vibration suppression this function should be disabled (N1-01 = 0).

■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	0 or 1	1	No	A
N1-02	Hunting-prevention gain	Set the hunting-prevention gain multiplication factor.	0.00 to 2.50	1.00	No	A

■Adjusting the Hunting-Prevention Gain (N1-02)

Normally it is not necessary to change this setting. Adjust the value under the following circumstances:

- If vibrations occur under light load condition increase the setting.
- If the motor stalls reduce the setting.

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◆ 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 the stall prevention using constant L3-05. Set the according deceleration times 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 too large.) 1: Enabled--Deceleration time 1 (Deceleration time set in C1-02 is used.) 2: Enabled--Deceleration time 2 (Deceleration time set in C1-04 is used.)	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 change this setting. Lower the set value if the motor stalls at the factory setting.	30 to 200	120%	No	A

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◆ Detecting Motor Torque

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

To use the overtorque/undertorque detection function, set B or 17 (overtorque/undertorque detection NO/NC) in one of the constant 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 taking the inverter rated output current as 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 is output). 2: Overtorque detected continuously during operation; operation continues (warning is output). 3: Overtorque detection only with speed agreement; output is stopped upon detection. 4: Overtorque detected continuously during operation; output is stopped upon detection. 5: Undertorque detection only with speed agreement; operation continues (warning is output). 6: Undertorque detected continuously during operation; operation continues (warning is output). 7: Undertorque detection only with speed agreement; output is stopped upon detection. 8: Undertorque detected continuously during operation; output is stopped upon detection.	0 to 8	6	No	A
L6-02	Torque detection level 1	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	10.0 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 Value and Operator Display

The relationship between alarms displayed on the Digital Operator when overtorque or undertorque is detected and the setting in L6-01 is shown in the following table.

Set Value	Function	Operator
		Overtorque/ Undertorque Detection 1
0	Overtorque/undertorque detection disabled.	–
1	Overtorque detection only with speed agree; operation continues (warning is output).	OL3 flashes
2	Overtorque detected continuously during operation; operation continues (warning is output).	OL3 flashes
3	Overtorque detection only with speed agree; output is stopped upon detection.	OL3 lights up

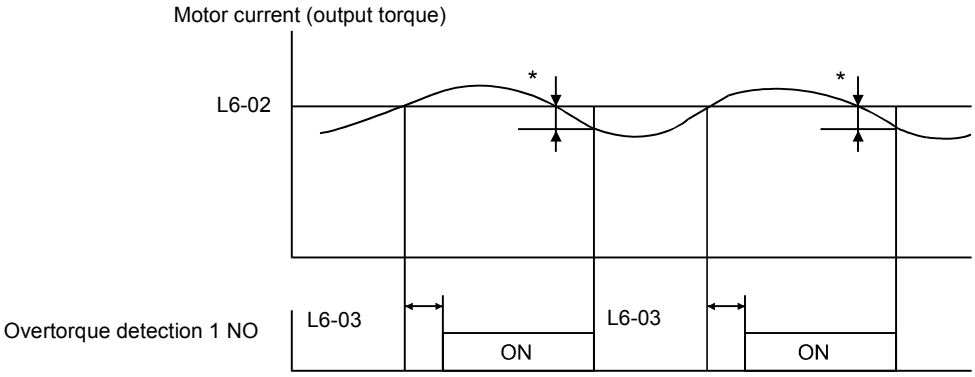
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Set Value	Function	Operator
		Overtorque/ Under-torque Detection 1
4	Overtorque detected continuously during operation; output is stopped upon detection.	OL3 lights up
5	Undertorque detection only with speed agree; operation continues (warning is output).	UL3 flashes
6	Undertorque detected continuously during operation; operation continues (warning is output).	UL3 flashes
7	Undertorque detection only with speed matching; output is stopped upon detection.	UL3 lights up
8	Undertorque detected continuously during operation; output is stopped upon detection.	UL3 lights up

■Setting Example

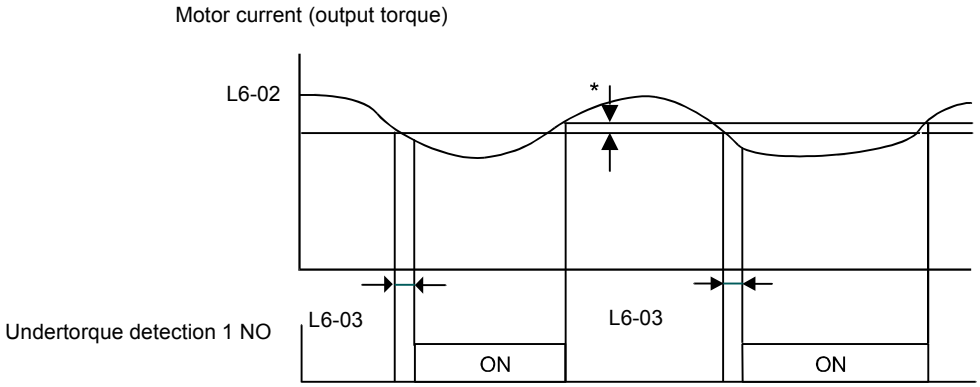
The following diagram shows the time chart for overtorque and undertorque detection.

- Overtorque Detection



*Overtorque detection switch off bandwidth is approximately 10% of the Inverter rated output current (or motor rated torque).

- Undertorque Detection



*Undertorque detection switch off bandwidth is approximately 10% of the Inverter rated output current (or motor rated torque).

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◆ Motor Overload Protection

The motor can be protected from overload using the Inverter's built-in electronic thermal overload relay function.

■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 of motor 1. 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 *1	1.90 A *2	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 (fan cooled motor) With applications where the power supply is often turned ON and OFF, there is a risk that the motor cannot be protected even if this constant has been set to 1, because 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 150% overload for 1 min. If the motor overload capability is known, set the overload resistance protection time during hot start to L1-02.	0.1 to 5.0	1.0 min	No	A

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

Multi-Function Outputs (H2-01 to H2-03)

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

■Setting Motor Rated Current (E2-01)

Set the rated current value on the motor nameplate in constants E2-01 (for motor 1). This set value is the base current for the internal thermal overload calculation.

■Setting Motor Overload Protection Characteristics (L1-01)

Set the overload protection function in L1-01 according to the application.

Set L1-01 to:
0: to disable the thermal motor protection function.
1: to enable the thermal motor protection for a fan cooled general purpose motor (self-cooled).

■Setting Motor Protection Operation Time (L1-02)

Set the motor protection operation time in L1-02.

The motor protection operation time is the time for that the motor can handle a 150% overload when it was running with the rated load before (i.e. operating temperature was reached before applying the 150% overload). Set the motor protection operation time in L1-02. The factory setting is 60 sec.

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The following diagram shows an example of the characteristics of the electronic thermal protection operation time (L1-02 = 1.0 min., operation at 50 Hz, general-purpose motor characteristics, when L1-01 is set to 1)

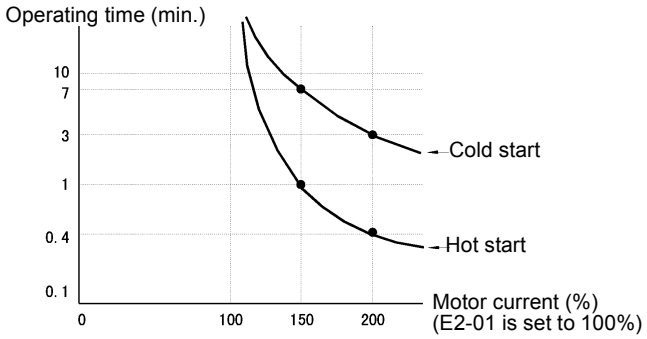


Fig 6.24 Motor Protection Operation Time

■Setting Precautions

- If multiple motors are connected to one inverter, set constant L1-01 to 0 (disabled). To protect each of the motors, use a control circuit that switches off the inverter output when one of the motors overheats.
- With applications where the power supply is often turned ON and OFF, there is a risk that the motor cannot be protected even if this constant has been set to 1 (enabled), because the thermal value will be reset after inverter power supply switch off.
- For safe overload tripping, set the value in constant L1-02 to a low setting.

■Setting the Motor Overload Pre-Alarm

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

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◆ Motor Overheating Protection Using PTC Thermistor Inputs

This function provides a motor overheating protection using a thermistor (PTC characteristic – Positive Temperature Coefficient) that is 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	Selects 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	Selects 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	Sets the delay time constant for the motor temperature (thermistor) input 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.

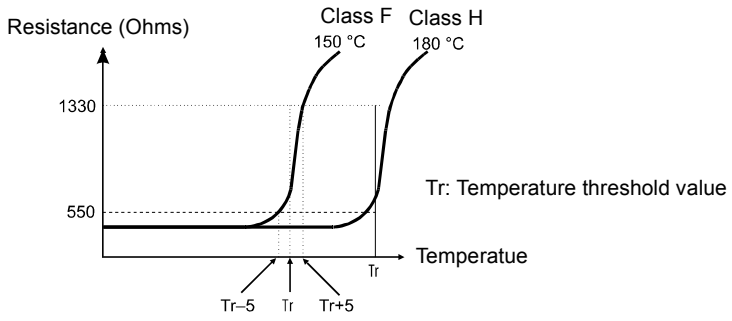


Fig 6.25 PTC Thermistor Temperature-Resistance Value Characteristics*

* The shown resistance value is for one motor phase. Normally the resistors are connected in series.

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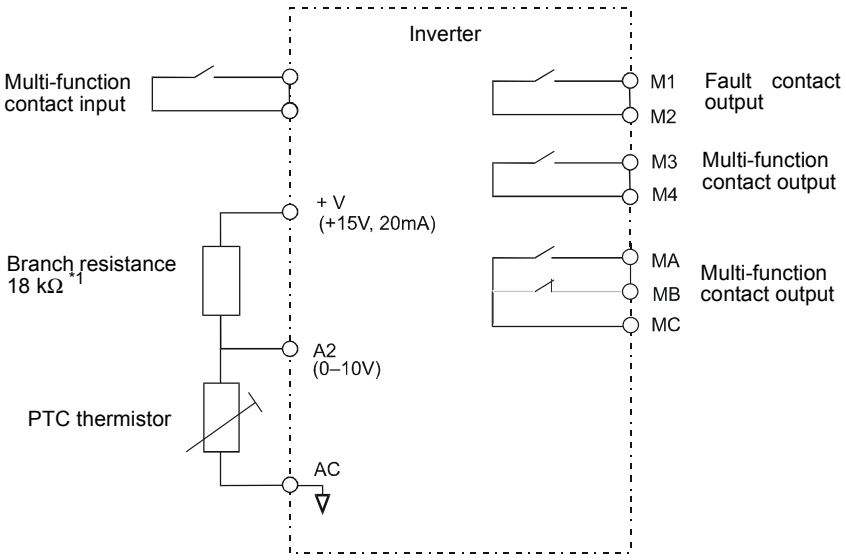
■Operation during Motor Overheating

The operation when the motor overheats can be selected using the 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. The fault contact is activated

By setting H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to E (Motor temperature input) the motor temperature can be detected and OH3 respectively OH4 can be output if the motor overheats. The terminal connections that are to be used are shown in *Fig 6.26*.



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

Fig 6.26 Terminal Connections for Motor Overheating Protection

Setting Precautions

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

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◆ Limiting Motor Rotation Direction and Output Phase Rotation

If the motor reverse rotation is 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.)

It is also possible to change the output phase order by changing b1-04 to 2 or 3. This much easier and faster than changing the wiring if the motor rotational direction is wrong.

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled 2: Output Phase Rotation 3: Output Phase Rotation, Reverse disabled	0 to 3	0	No	A

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Automatically Restart

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

◆ Restarting Automatically After Momentary Power Loss

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, the inverter will restart, when power is recovered within the time set in L2-02. If the power loss time exceeds the time set in L2-02, an UV1 alarm (DC bus undervoltage) will be detected.

If L2-01 is set to 2, the inverter will restart, when the main power supply is recovered as long as the control power supply (i.e., power supply to the control circuit) is maintained. Consequently, alarm UV1 (DC bus 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 (DC bus undervoltage (UV) detection) 1: Enabled (Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, DC bus undervoltage detection.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect DC bus 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	Sets 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 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	Sets the time required to return the Inverter output voltage from 0 V to normal voltage at the completion of a speed search.	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.	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), an alarm UV1 (main circuit undervoltage) will be detected when the momentary power loss exceeds 15 ms during operation.

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◆ 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 3	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%. Usually not 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. Sets 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)	When a speed search is performed after recovering from a momentary power loss, the search operation is delayed for the time set here. If e.g. a contactor is used at the output side of the inverter set this constant to the contactor delay time or more.	0.0 to 20.0	0.2 s	No	A
b3-14	Bi-directional speed search selection	Can be used to turn off the bidirectional capabilities of the speed calculation form of speed search. Then speed search will only be performed in the last known direction.	0 or 1	1	No	A
L2-03	Min. baseblock time	Sets the Inverter's minimum baseblock time, when the inverter is restarted after power loss ridethrough. Set the time to approximately 0.7 times the motor 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*	No	A

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

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Multi-function Contact Inputs

Set Value	Function
61	External search command 1 OFF: Speed search disabled (Start from lowest output frequency) ON: Speed calculation (Calculates the motor speed, and starts search from calculated speed) Current detection (Starts speed search from maximum output frequency)
62	External search command 2 OFF: Speed search disabled (Start from lowest output frequency) ON: Speed calculation (Calculates the motor speed, and starts search from calculated speed) (Same operation as external search command 1) Current detection: Starts speed search from set frequency (reference frequency when search command was input).
64	External seach command 3 OFF: Inverter is base blocked ON: Inverter starts operation using speed search (same operation as speed search 2)

■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, design the control circuit so that the run command and external search command are both ON. These two commands must be kept on, at least for the time set in parameter L2-03.
- If the Inverter output is equipped with a contactor, set the contactor operation delay time in the Speed Search Wait Time (b3-05). The factory setting is 0.2 s. When not using a contactor, you can reduce the search time to 0.0 s. After waiting for the speed search wait time, the Inverter starts the speed search.
- Constant b3-02 (current detection level for search completion) is effective only when current detection speed search is selected. When the current falls below the detection level, the speed search is supposed to be 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 non-rotating autotuning for line-to-line resistance before using speed searches based on calculated speeds.
- If the cable length between the motor and Inverter is changed after autotuning has been performed, perform stationary autotuning for line-to-line resistance again.

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■Speed Search Selection

The speed search method can be selected using b3-01. If b3-01 is set to 0 the search method is speed calculation. It has to be activated by a multi-function input (H1-☐☐ set to 61 or 62).

If b3-01 is set to 1, the search method is speed calculation too, but speed search is performed at every RUN command and has not to be activated by a multifunction input.

The same is valid for setting b3-01 to 2 or 3, only the search method is current detection and not speed calculation.

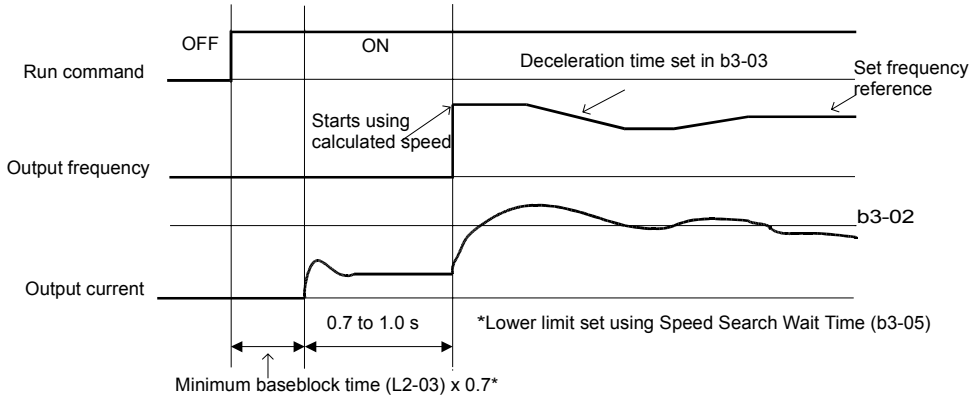
Table 6.1 Search Methods

Search Name	Speed Calculation	Current Detection
Search Method	Calculates the motor speed when the search starts, and accelerates or decelerates from the calculated speed to the set frequency. The direction of motor rotation is also detected.	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 calculation of the motor speed and starting the search from the calculated 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 with multi-motor drives or with motors two or more sizes smaller than the Inverter capacity.	The motor may accelerate suddenly with light loads.

■Speed Calculation

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 6.27 Speed Search at Startup (Calculated Speed)

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

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

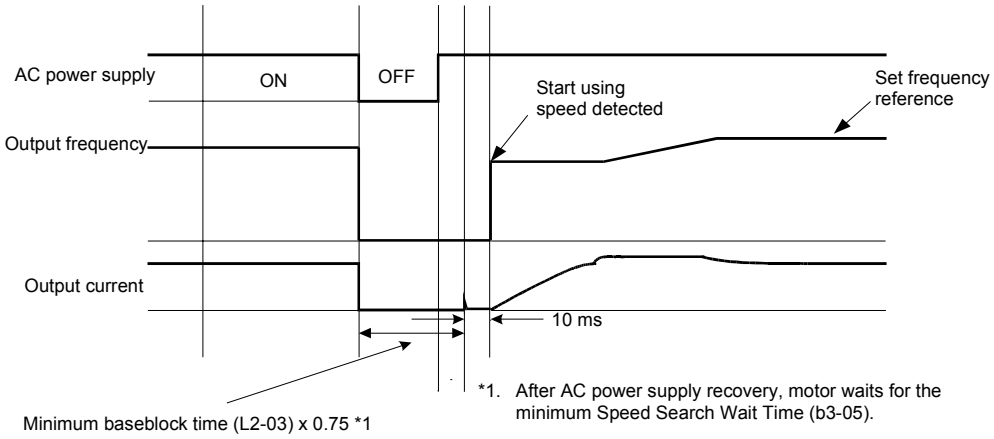
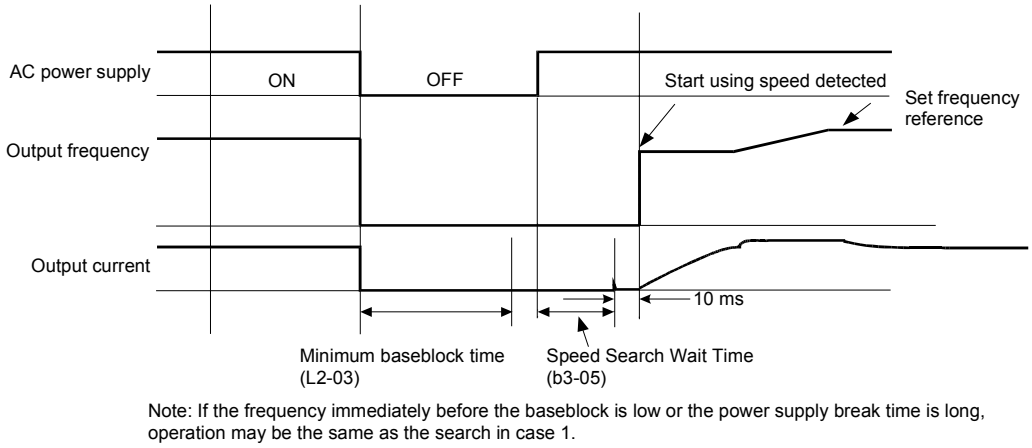


Fig 6.28 Speed Search after Baseblock (Calculated Speed: Loss Time Is Set in L2-03)

- 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 6.29 Speed Search after Baseblock (Calculated Speed: Loss Time > L2-03)

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■Current Detection

Speed Search at Startup

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

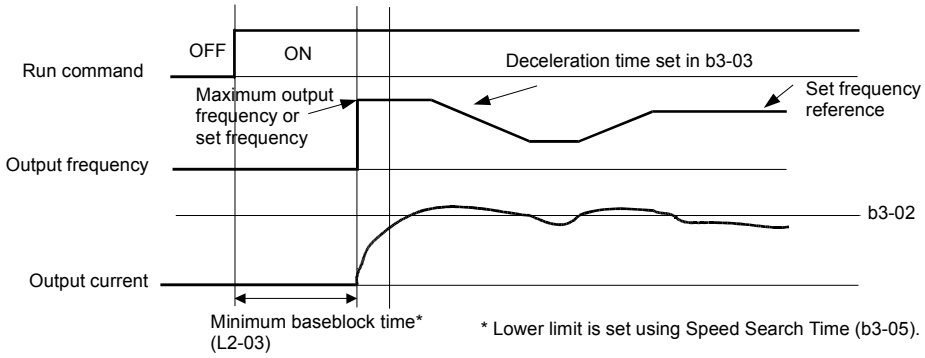


Fig 6.30 Speed Search at Startup (Current Detection)

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

- Loss time shorter than minimum baseblock time

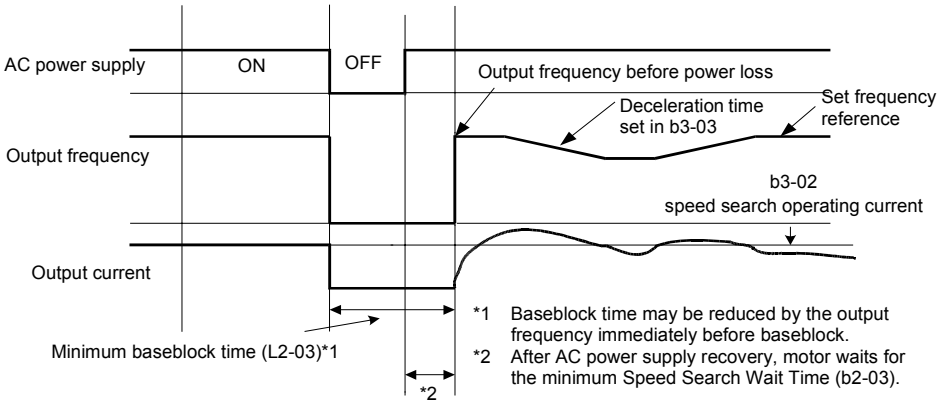


Fig 6.31 Speed Search After Baseblock (Current Detection: Loss Time < L2-03)

- Loss time longer than minimum baseblock time

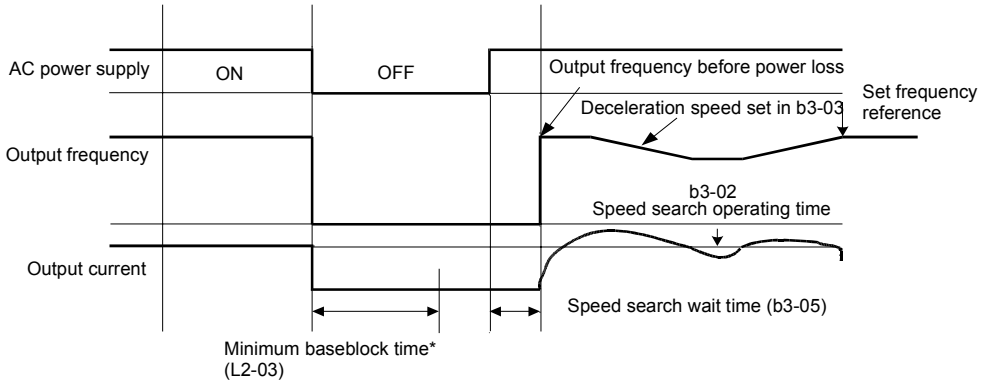


Fig 6.32 Speed Search After Baseblock (Current Detection: Loss Time > L2-03)

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◆ Continuing Operation at Constant Speed When Frequency Reference Is Lost

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

When an error signal during frequency reference loss shall be 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 loss means that the frequency reference drops over 90% in 400 ms.	0 or 1	1	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@loss	0 to 100%	80%	No	A

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◆ 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.

The auto restart function can be applied to the following errors.

- OC (Overcurrent)
- GF (Ground fault)
- PUF (DC bus fuse blown)
- OV (Main circuit overvoltage)
- UV1 (Main Circuit Undervoltage, Main Circuit MC Operation Failure)*
- PF (Main circuit voltage fault)
- 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)

If an error that is not listed above occurs, the protection function will operate and the auto restart function will not work.

The number of auto restarts is set in parameter L5-01. If a fault occurs the inverter performs the auto restart corresponding to *Fig 6.33*. The inverter tries to restart every 5 ms for the maximum time of L5-03. All retries performed during L5-03 are regarded as one restart attempt.

The internal counting of restart attempts is reset to 0 when the drive has run 10 minutes without fault.

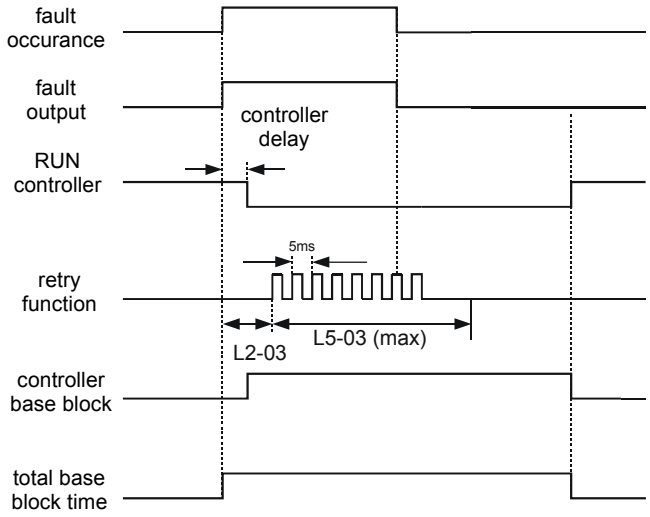


Fig 6.33 Timing Chart for Auto Restart Function

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■Auto Restart External Outputs

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

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
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
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
L5-03	Fault Retry Time	Sets the maximum time a restart is tried.	0.5 to 180.0	10.0 s	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 an error reset has been input.
- After the power supply is turned OFF, and then ON again.

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Inverter Protection

◆ Inverter Overheat Protection

The Inverter is protected against overheating using a thermistor that detects the heatsink temperature.

When the overheat temperature level is reached the inverter output is switched off.

To prevent a suddenly and unexpected stop of the inverter due to an overtemperature, an overheating pre-alarm can be output. The temperature level for that pre-alarm can be set in constant L8-02. Using constant L8-03 the inverter operation when an overtemperature occurs can be selected.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	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 temperature 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. 4: OH alarm and output frequency reduction (L8-19) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 4	4	No	A
L8-19	Frequency reference during OH pre-alarm	Sets the frequency reference when OH pre-alarm is detected in percent of the maximum frequency (E1-04).	0.0 to 20.0 %	20.0 %	No	A

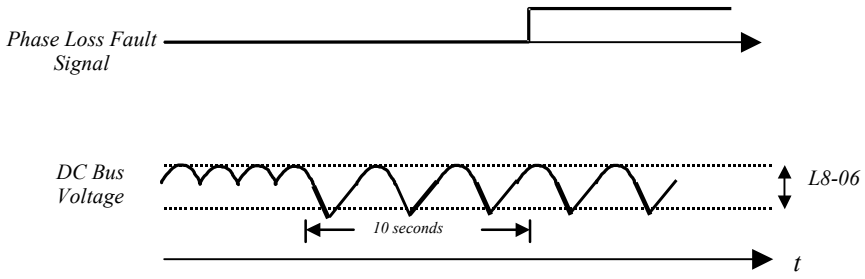
■Multifunction Output Settings: H2-01 and H2-02 (M1 – M4 Function Selection)

Inverter Overheat Pre-Alarm: “20”

If a multifunction output is programmed for this function the output is switched ON when the heatsink temperature exceeds the overheat pre-alarm level set in L8-02.

◆ Input Phase Loss Detection Level

For the Input Phase Loss Detection the drive monitors the DC bus ripple. The drive integrates this ΔV value over 10 scans (appr. 10 seconds). If the integrated ΔV value of any consecutive ten scan range is greater than the voltage determined by multiplying L8-06 times the drives rated OV Trip point (400Vdc/800Vdc), a PF fault will occur and the Drive will coast to stop.



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■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L8-06	Input Phase Loss Detection Level	Allowed DC bus ripple before input phase loss is detected in percent of the OV trip level. 200V class: 400 VDC 400V class: 800 VDC	0.0 to 25.0 %	5.0 %	No	A

◆ Ground Fault Protection

This function detects the earth leakage current by calculating the sum of the three output currents. Normally it should be 0. If the earth leakage current gets too high, the inverter output will be switched off and a GF fault is shown on the display. The fault contact is activated.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L8-09	Ground fault protection selection	0: Disabled 1: Enabled	0 or 1	1	No	A

It is not recommended to disable this function.

◆ Cooling Fan Control

This function controls the fan that is mounted to the inverters heatsink.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L8-10	Cooling fan control selection	Sets the ON/OFF control for the cooling fan. 0: ON only when inverter output is active. 1: ON whenever power is ON.	0 or 1	0	No	A
L8-11	Cooling fan control delay time	Sets the time in seconds to delay turning OFF the cooling fan after the inverter STOP command is given.	0 to 300	300 s	No	A

■Selecting the Cooling Fan Control

Using constant L8-10 two modes can be selected:

0: The fan is ON only when the inverter output is ON, i.e. a voltage is output. This is the factory setting.

1: The fan is ON whenever the inverter power supply is switched ON.

If L8-10 is set to 0, the turn OFF delay time for the fan can be set in constant L8-11. After a stop command the inverter waits for this time before switching OFF the cooling fan. The factory setting is 300 sec.

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◆ Setting the Ambient Temperature

The overload capability of the inverter depends on the ambient temperature. At ambient temperatures higher than 45°C (40°C for IP20/NEMA1 types) the output current capacity is reduced, i.e. the OL2 alarm level will be lowered.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L8-12	Ambient temperature	Sets the ambient temperature.	45 to 60	45 °C	No	A

The ambient temperature must be set in constant L8-12.

◆ OL2 Characteristics at Low Speed

At output frequencies below 6 Hz the overload capability of the inverter is lower than at higher speeds, i.e. an OL2 fault (inverter overload) may occur even if the current is below the normal OL2 current level (see *Fig. 6.34*).

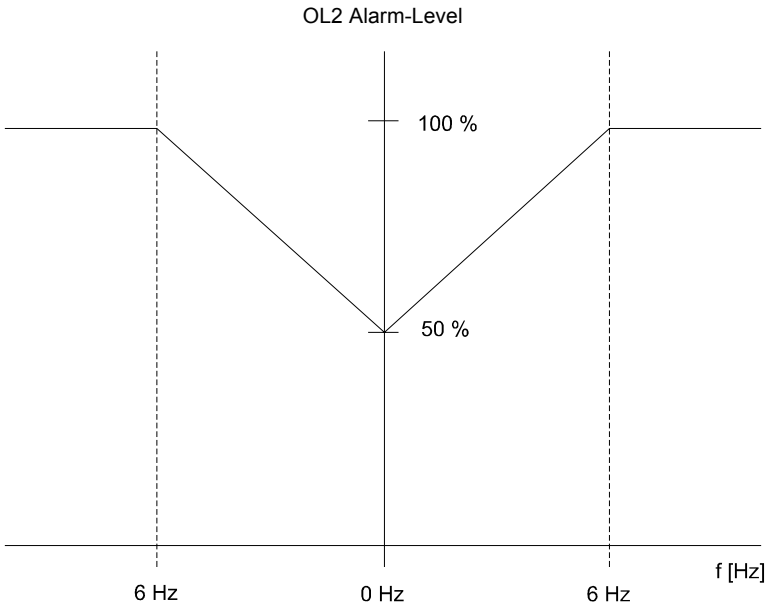


Fig. 6.34 OL2 Alarm Level at Low Frequencies

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
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

Generally it is not recommended to disable this function. Otherwise the inverter life time might be shortened.

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◆ Soft CLA Selection

Soft CLA is a current detection level for the output IGBT protection. Using constant L8-18 Soft CLA can be enabled or disabled.

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L8-18	Soft CLA selection	0: Disable 1: Enable	0 or 1	1	No	A

Generally it is absolutely not recommended to disable this function.

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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 set in b1-01 and b1-02).

If any 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), this input can be used to switch over between local and remote.

To set the frequency reference source and RUN command source to control circuit terminals, set b1-01 and b1-02 to 1.

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
b1-01	Reference selection	Sets 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	RUN command source selection	Sets the run command input method 0: Digital Operator 1: Control circuit terminal (digital multifunction inputs) 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 for one external terminal, the LOCAL/REMOTE key function on the Digital Operator will be disabled.

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◆ 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 thereby to block the inverter output.

Clear the baseblock command to restart the operation using the speed search method set in b3-01 (speed search selection).

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 a baseblock command is shown below.

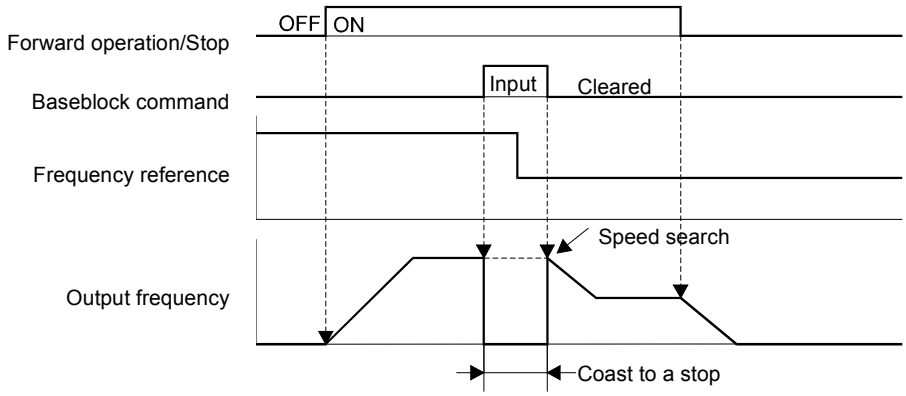


Fig 6.35 Baseblock Commands

IMPORTANT

When a contactor between inverter and motor is used, always perform a base block command before opening the contactor.

◆ Multifunction Analog Input A2 Disable/Enable

If a digital input is programmed for this function (H1-☐☐ = C) the analog input A2 can be enabled or disabled by switching the digital input ON/OFF (ON – Analog Input A2 enabled).

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◆ Drive Enable/Disable

If a digital input is programmed for this function (H1-□□ = 6A) the drive can be enabled or disabled by switching the digital input ON/OFF (ON – Drive enabled).

If the input is switched OFF while a RUN command is active the inverter will stop using the stopping method set in b1-03.

The rive Enable/Disable signal has to be ON before the RUN command is activated.

◆ Bypass Drive Enable

If Bypass Drive Enable (70) is programmed into one of the parameters H1-01 to H1-05 the drive will not execute a RUN command until this input is closed.

Unlike the setting 6A (Drive Enable/Disable) the RUN command does not to be cycled after closing the input. The drive will start whenever the digital input is closed a RUN command is active with the activated acceleration time.

If a RUN command is active and the Bypass Drive Enable input is OFF the digital operator shows the alarm message “dnE”.

◆ Stopping Acceleration and Deceleration (Acceleration/Deceleration Ramp Hold)

- When a multi-function digital input is set for Accel./Decel. Ramp Hold (H1-□□=A*), the input can be used to pause the acceleration or deceleration and maintain (holds) the output frequency.
- Acceleration/deceleration is restarted when the acceleration/deceleration ramp hold input is turned OFF.
- The motor will be stopped if a stop command is input while the acceleration/deceleration ramp hold input is ON.
- When constant d4-01 (the frequency reference hold function selecton) is set to 1, the held frequency will be stored in memory. This stored frequency will be retained as frequency reference even after a power loss and the motor will be restarted at this frequency when a run command is input again.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d4-01	Frequency reference hold function selection	Sets whether or not frequencies will be recorded on hold command. 0: Disabled (when operation is stopped or the power is turned ON again the frequency reference is set to 0.) 1: Enabled (when operation is stopped or the power is turned ON again the inverter starts at the previous hold frequency.) This function is available when the multi-function inputs “Accel/Decel Ramp Hold” or “Up/Down” commands are set.	0 or 1	0	No	A

Set Value	Function
A*	Accel./Decel. Ramp Hold

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■Time Chart

The time chart when using Acceleration/Deceleration Ramp Hold commands is given below.

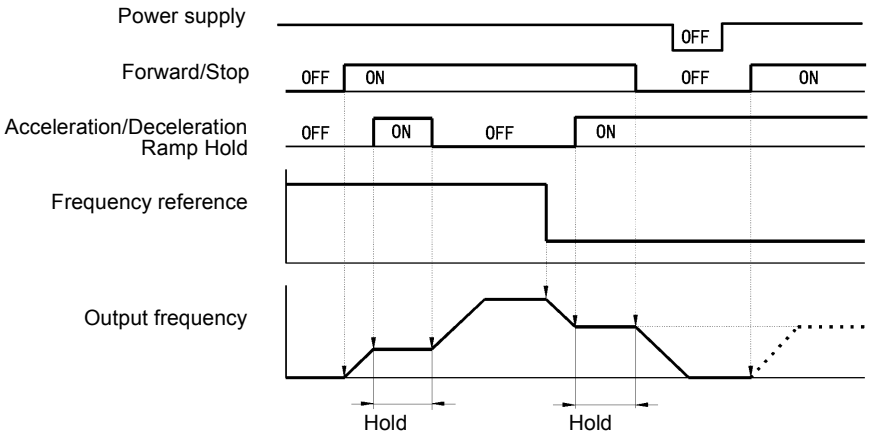


Fig 6.36 Acceleration/Deceleration Ramp Hold

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◆ Raising and Lowering Frequency References Using Contact Signals (UP/DOWN)

The UP and DOWN commands raise and lower Inverter frequency references by turning ON and OFF a multi-function contact input terminal S3 to S7.

To use this function, set two of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 10 (UP command) and 11 (DOWN command). Be sure to allocate two terminals so that the UP and DOWN commands are used as a pair. Otherwise an OPE03 alarm will be displayed.

The table below shows the possible combinations of the UP and DOWN command and the corresponding operation.

Operation	Acceleration	Deceleration	Hold	Hold
Up command	ON	OFF	ON	OFF
Down command	OFF	ON	ON	OFF

The change of the output frequency depends on the acceleration and deceleration times. Be sure to set b1-02 (Run command selection) to 1 (Control circuit terminal).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d2-01	Frequency reference upper limit	Sets the frequency reference upper limit as a percent, taking the maximum output frequency to be 100%.	0.0 to 110.0	100.0%	No	A
d2-02	Frequency reference lower limit	Sets the frequency reference lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A
d2-03	Master speed reference lower limit	Sets the master speed frequency reference lower limit as a percent, taking the maximum output frequency to be 100%.	0.0 to 110.0	0.0%	No	A

■Precautions

Setting Precautions

If multi-function input terminals S3 to S7 are set as follows, operation error OPE03 (Invalid multi-function input selection) will occur:

- Only either the UP command or DOWN command has been set.
- UP/DOWN commands and Acceleration/Deceleration Ramp Hold have been allocated at the same time.

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Application Precautions

- Frequency outputs using UP/DOWN commands are limited by the frequency reference upper and lower limits set in constants d2-01 to d2-03. Here, the frequency value from analog frequency reference input A1 becomes the frequency reference lower limit. If using a combination of the frequency reference from terminal A1 and the frequency reference lower limit set in either constant d2-02 or d2-03, the larger limit value will become the frequency reference lower limit.
- If inputting the run command when using UP/DOWN commands, the output frequency accelerates to the frequency reference lower limits set in d2-02.
- When using UP/DOWN commands, multi-step operations are disabled.
- When d4-01 (Frequency Reference Hold Function Selection) is set to 1, the frequency reference value using the UP/DOWN functions is stored even after the power supply is turned OFF. When the power supply is turned ON and the run command is input, the motor accelerates to the frequency reference that has been stored. To reset (i.e., to 0 Hz) the stored frequency reference, turn ON the UP or DOWN command while the run command is ON.

■Connection Example and Time Chart

The time chart and settings example when the UP command is allocated to the multi-function contact input terminal S3, and the DOWN command is allocated to terminal S4, are shown below.

Constant	Name	Set Value
H1-01	Multi-function input (terminal S3)	10
H1-02	Multi-function input (terminal S4)	11

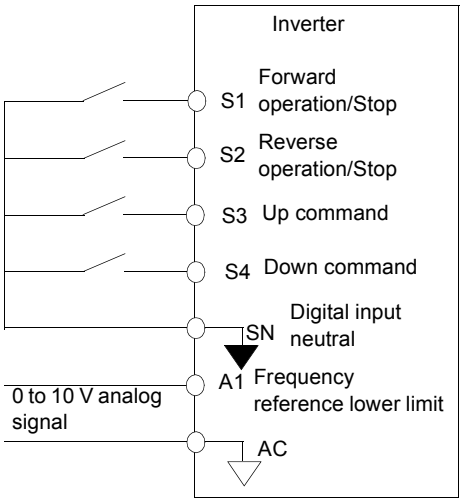
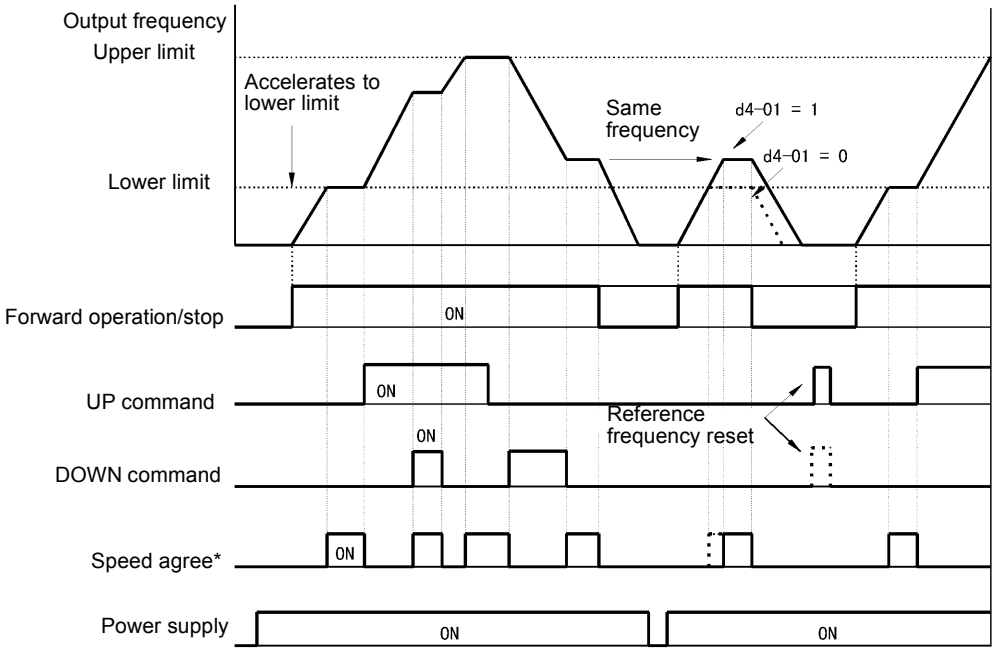


Fig 6.37 Connection Example when UP/DOWN Commands Are Allocated

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* The speed agree signal turns ON when the motor is not accelerating/decelerating while the run command is ON.

Fig 6.38 UP/DOWN Commands Time Chart

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◆ Trim Control Function (+/– Speed)

The +/– speed function increments or decrements the frequency reference from analog input by the value set in constant d4-02 (+/– Speed Limit) using two digital inputs.

To use this function, set two of the constants H1-01 to H1-05 (multi-function contact terminal inputs S3 to S7 function selection) to 1C (Trim Control Increase command) and 1D (Trim Control Decrease command). Be sure to allocate two terminals so that the Trim Control Increase command and Trim Control Decrease command are used as a pair. Otherwise an OPE03 alarm will be displayed.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d4-02	+/- speed limits	Set the frequency to be add to or subtracted from the analog frequency reference as a percent, taking the maximum output frequency to be 100%. Enabled when the increase (+) speed command or decrease (-) speed command is set for a multi-function input.	0 to 100	10%	No	A

■Trim Control Increase/Decrease Command and Frequency Reference

The frequency references using Trim Control Increase/Decrease command ON/OFF operations are shown below.

Frequency Reference	Set Frequency Reference + d4-02	Set Frequency Reference - d4-02	HOLD	
Trim Control Increase Command Terminal	ON	OFF	ON	OFF
Trim Control Decrease Command Terminal	OFF	ON	ON	OFF

■Application Precautions

- Trim Control Increase/Decrease command is enabled when speed reference > 0 and the speed reference source is an analog input (A1 or A2).
- When the analog frequency reference value - d4-02 < 0, the frequency reference is set to 0.
- If only one of the Trim Control Increase command or Trim Control Decrease command has been set for a multi-function contact input terminal, operation error OPE03 (invalid multi-function input selected) will occur.

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◆ Hold Analog Frequency Using User-set Timing

When one of the constants 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 at that frequency.

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

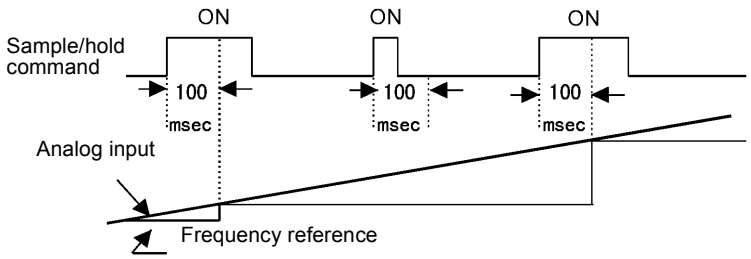


Fig 6.39 Sample/Hold Analog Frequency

■Precautions

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

Setting Precautions

When using sample/hold of analog frequency reference, you cannot use the following commands at the same time. Otherwise operation error OPE03 (invalid multi-function input selection) will occur.

- Acceleration/Deceleration Ramp Hold command
- UP/DOWN command
- Trim Control Increase/Decrease command

Application Precautions

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

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◆ Switching Operation Source to Communication Option Card

The source of frequency reference and RUN command can be switched between a Communication option card and the sources selected in b1-01 and b1-02. Set one of the constants H1-01 to H1-05 (multi-function contact inputs S3 to S7 function selection) to 2 or 36 to enable operation source switchover.

If a RUN command is active, the switchover will not be accepted.

■Setting Precautions

To use the operation source switching function make the following settings:

- Set b1-01 (frequency reference source) to a value different from 3 (option card).
- Set b1-02 (RUN command source) to a value different from 3 (option card).
- Set one of the constants H1-01 to H1-05 to 2 or 36.

Setting for one of H1-01 to H1-05	Terminal Status	Frequency Reference and Run Command Source
2	OFF	Inverter (Frequency reference and Run command source are set in b1-01 and b1-02)
	ON	Communication option card (Frequency reference and run command are input from communications option card)
36	OFF	Communication option card (Frequency reference and run command are input from communications option card)
	ON	Inverter (Frequency reference and Run command source are set in b1-01 and b1-02)

Terminal Status	Frequency Reference and Run Command Selection
OFF	Inverter (Frequency reference and RUN command source are set in b1-01 and b1-02.)
ON	Communications Option Card (Frequency reference and run command are enabled from communications Option Card.)

◆ Switching Operation Source to MEMOBUS communication

The frequency reference and RUN command source can be switched between the MEMOBUS-communication via RS-422/485 and the inverter settings in b1-01 and b1-02. Therefore set one of the parameters H1-01 to H1-05 (multi-function digital inputs S3 to S7) to 6B or 6C.

If a RUN command is active the switchover will not be accepted.

■Setting precautions

To use the operation source switching function make the following settings:

- Set b1-01 (Frequency reference source) to a value different from 3 (option card)
- Set b1-02 (RUN command source) to a value different from 3 (option card)
- Set one of the constants H1-01 to H1-05 to 6B or 6C

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Setting for one of H1-01 to H1-05	Terminal Status	Frequency Reference and Run Command Source
6B	OFF	Inverter (Frequency reference and Run command source are set in b1-01 and b1-02)
	ON	MEMOBUS communication (Frequency reference and run command are input via RS-422/485)
6C	OFF	MEMOBUS communication (Frequency reference and run command are input via RS-422/485)
	ON	Inverter (Frequency reference and Run command source are set in b1-01 and b1-02)

◆ AUTO/HAND Mode Switching by Digital Input

The settings 6D and 6E for H1-01 to H1-05 allow to switch between HAND and AUTO mode by digital input. Both signals cannot both be programmed simultaneously.

If the Auto Mode Selection is programmed into a digital input, the Auto mode will be selected whenever that input is closed. The status of the Auto Mode Selection digital input will override any digital operator selections.

If the Hand Mode Selection is programmed into a digital input, the Hand mode will be selected whenever that input is closed. The status of the Hand Mode Selection digital input will override any digital operator selections.

Using either the Auto Mode Selection or the Hand Mode Selection can only be done when the Drive is stopped.

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

The FJOG/RJOG function operates the inverter at the jog frequency. It can be activated 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	Sets 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)

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■Application Precautions

- Jog frequencies using FJOG and RJOG commands have the 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 on External Device Errors (External Error Function)

The external error function activates the error contact output and stops the Inverter operation. Using this function the inverter operation can be stopped on peripheral devices break down or other errors. The digital operator will display EFx (External error [input terminal Sx]). The x in EFx shows the number of the terminal at which the external error signal is input. 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

Note: 1. Sets the input level at which errors are detected. (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.

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Output Terminal Functions

The digital multifunction outputs can be set for several functions using the H2-01 and H2-02 constants (terminal M1 to M4 function selection). These functions are described in the following section.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
H2-01	Terminal M1-M2 function selection	Multi-function contact output 1	0 to 38	0	No	A
H2-02	Terminal M3-M4 function selection	Multi-function contact output 2	0 to 38	1	No	A

■During Run (Setting: 0) and During Run 2 (Setting: 37)

During Run (Setting: 0)

OFF	The Run command is OFF and there is not output voltage.
ON	The Run command is ON or a voltage is being output.

During Run 2 (Setting: 37)

OFF	The inverter is not outputting a frequency. (Baseblock, DC injection braking or stopped)
ON	The inverter is outputting a frequency.

These outputs can be used to indicate the inverter's operating status.

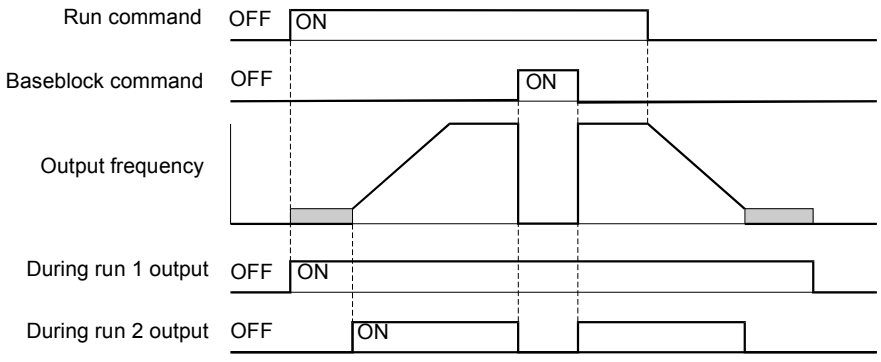


Fig. 6.40 Timing Chart for "During RUN" Output

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■Zero Speed (Setting: 1)

OFF	The output frequency is higher than the zero speed level (b2-01).
ON	The output frequency is lower than the zero speed level (b2-01).

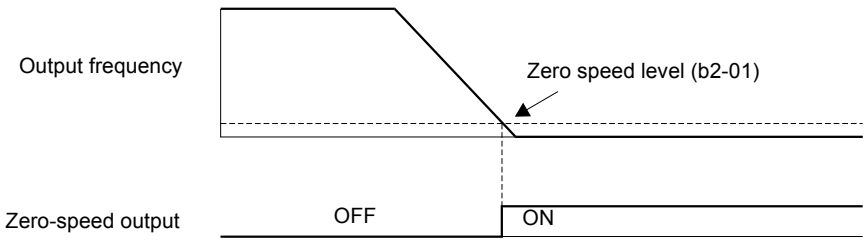


Fig 6.41 Timing Chart for Zero-speed

■Inverter Operation Ready (Setting: 6)

If a multifunction output is programmed for this function the output will be switched ON when the initialisation of the inverter at startup has finished without any faults.

■During DC Bus Undervoltage (Setting: 7)

If a multifunction output is programmed for this function the output is switched ON as long as a DC bus undervoltage is detected.

■During Baseblock (Setting: 8)

If a multifunction output is programmed for this function the output is switched ON as long as the inverter output is base blocked.

■Frequency Reference Source Selection (Setting: 9)

If a multifunction output is programmed for this function the output is ON when the digital operator is selected as frequency reference source. If any other frequency reference is selected the output is switched OFF.

■Run Command Selection Status (Setting: A)

If a multifunction output is programmed for this function the output is switched ON when the digital operator is selected as RUN command source. If any other RUN command source is selected output is switched OFF.

■Fault Output (Setting: E)

If a multifunction output is programmed for this function the output is switched ON when any fault different from CPF00 and CPF01 occurs. The output is also not switched at minor faults. (Refer to *Chapter 7* for a fault list.)

■Minor Fault Output (Setting: 10)

If a multifunction output is programmed for this function the output is switched ON when a minor fault occurs (refer to *Page 7-8* pp.).

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■Fault Reset Command Active (Setting: 11)

If a multifunction output is set for this function the output is switched ON as long as a fault reset command is input at one of the digital inputs.

■Reverse Direction (Setting: 1A)

If a multifunction output is programmed for this function the output is switched ON whenever the drive is turning the motor in the direction that corresponds to reverse direction.

■OH Pre-Alarm (Setting: 20)

The overheat fault function (OH) is designed to protect the drive from excessive temperature damage. Thermistors attached to the heatsink of the drive monitor the temperature and will fault the drive if the temperature reaches 105 °C.

An OH Pre-Alarm digital output will close whenever the heatsink temperature reaches the level specified by parameter L8-02. Parameter L8-03 will determine the drive's response to reaching the OH Pre-Alarm level (besides closing the configured digital output).

■Drive Enabled (Setting: 38)

If a multifunction output is programmed for this function the output is switched ON when the drive is enabled. The drive can be enabled or disabled using a digital multifunction input.

■During oH and Reduced Frequency (Setting: 3A)

If a multifunction output is programmed for this function the output is switched ON when an inverter overheat alarm has occurred and the motor is running at reduced speed.

■RUN Command from Option Card/Communication Option (Setting: 3B)

If a multifunction output is set to 3B the output will be ON when the RUN command is put in from the built-in communication (Memobus, N2, PI) OR from a communication option card (SI-P1, SI-N1, etc.). If both RUN commands are off the output will be open.

■Drive Waiting (Setting: 39)

The digital output will close during the timeout period between the input of a RUN command and the expiring of the delay time specified by b1-11.

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Monitor Constants

This section explains the analog monitor and pulse monitor constants.

◆ Using 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.	1 to 38	2	No	A
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 (FM) voltage level gain. Sets the percentage of the monitor item that is equal to 10V output at terminal FM. Note that the maximum output voltage is 10V.	0 ~ 1000.0%	100%	Yes	Q
H4-03	Bias (terminal FM)	Sets the multi-function analog output 1 voltage level bias. Sets the percentage of the monitor item that is equal to 0V output at terminal FM. The maximum output from the terminal is 10V.	-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-□□) at terminal AM.	1 to 53	8	No	A
H4-05	Gain (terminal AM)	Sets the voltage level gain for multi-function analog output 2. Sets the percentage of the monitor item that is equal to 10V output at terminal AM. Note that the maximum output voltage is 10V.	0 ~ 1000.0%	50%	Yes	Q
H4-06	Bias (terminal AM)	Sets the multi-function analog output 2 voltage level bias. Sets the percentage of the monitor item that is equal to 0V output at terminal AM. The maximum output from the terminal is 10V.	-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 2	0	No	A
H4-08	Analog output signal 2 level selection (AM)	Sets the signal output level for multi-function output 2 (terminal AM) 0: 0 to 10 V output 2: 4 to 20 mA	0 or 2	0	No	A

■Selecting Analog Monitor Items

Some of the digital operator monitor items (U1-□□ [status monitor]) can be output at the multi-function analog output terminals FM-AC and AM-AC. Refer to *Chapter 5 User Constants*, and set the constant number of U1 group (□□ part of U1-□□) for the constants H4-01 respectively H4-04.

■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.

The gain sets the analog output voltage value which is equal to 100% of the monitor item.
The bias sets the analog output voltage value which is equal to 0% of the monitor item.
Note that the maximum output voltage is 10V. A voltage higher than these values can not be output.

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Adjusting the Meter

The influence of the settings of gain and bias on the analog output channel is shown on three examples in *Fig 6.42*.

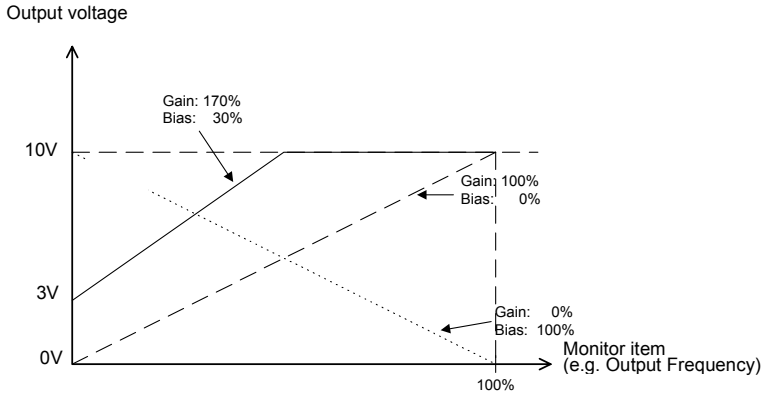


Fig 6.42 Monitor Output Adjustment

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◆ Using MEMOBUS Communications

You can perform serial communications with Programmable Logic Controls (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 only 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. A slave that receives a command from the master performs the specified function and sends a response to the master.

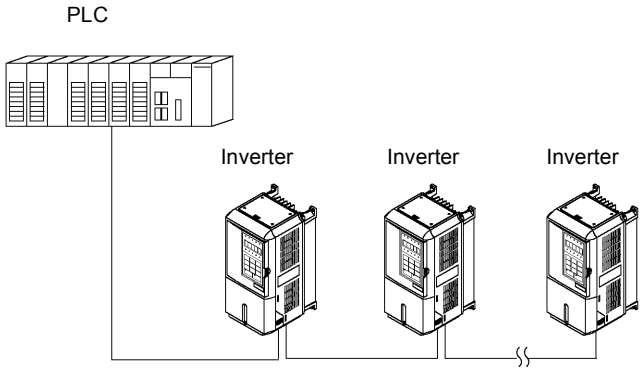


Fig 6.43 Example of Connections between PLC and Inverter

■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.

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■Communications Connection Terminal

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

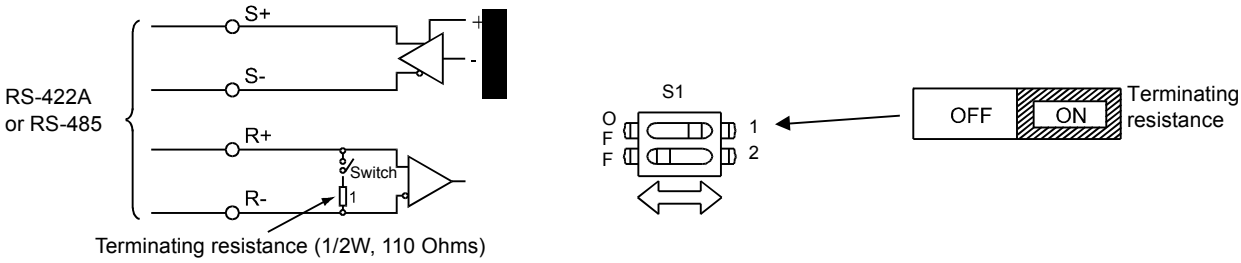
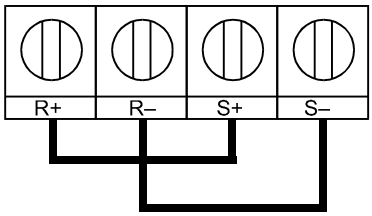


Fig 6.44 Communications Connection Terminal

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 below.



■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 H5-08) 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.

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■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-01	Reference source selection	Sets the frequency reference input source 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q
b1-02	RUN command Source Selection	Sets the run command input source 0: Digital Operator 1: Control circuit terminal (digital multifunction inputs) 2: MEMOBUS communications 3: Option Card	0 to 3	1	No	Q
H5-01	Station address	Sets the Inverter station address [hex].	0 to 20 *	1F	No	A
H5-02	Baud rate selection	Sets the baud rate for 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	Sets the parity for MEMOBUS communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A
H5-04	Communications error detection selection	Sets the stopping method for communications errors. 0: Deceleration to stop using the deceleration time in C1-02 1: Coast to a stop 2: Emergency stop using the deceleration time in C1-09 3: Continue operation 4: Continue operation with the frequency reference set in d1-04.	0 to 4	3	No	A
H5-05	Communications error detection selection	Sets 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	Sets 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	Enables or disables RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A
H5-08	Communications Selection	Selects the Protocol for the Communication 0: Memobus 1: N2 protocol 2: PI protocol	0 to 2	0	No	A
H5-09	CE detection time	Sets the time before CE error (Communication error) is detected when MEMOBUS communication is used.	0.0 to 10.0 sec	2.0 sec	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. (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.)

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■Message Format

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

Slave address
Function code
Data
Error check

The space between messages must meet the following conditions:

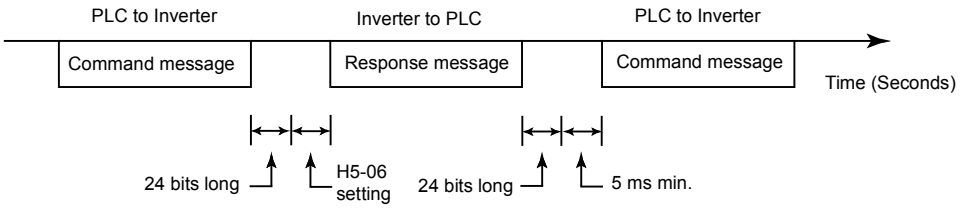


Fig 6.45 Message Spacing

Slave Address

Set the Inverter address from 0 to 32. If you set 0, commands from the master will be received by all slaves. (Refer to “Broadcast Data” on the following pages.)

Function Code

The function code specifies commands. The three function codes shown in the table below are available.

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

Data

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

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Error Check

Errors during communications are detected using CRC-16 (cyclic redundancy check, checksum method).

The result of the checksum calculation is stored in a data-word (16 bit), which starting value is FFFH. The value of this word is manipulated using Exclusive OR- and SHIFT operations together with the data package that should be sent (slave address, function code, data) and the fixed value A001H. At the end of the calculation the data-word contains the checksum value.

The checksum is calculated in the following way:

1. The starting value of the 16 Bit data-word, that is used for the calculation, has to be set to FFFFH.
2. An Exclusive OR operation has to be performed with the starting value and the slave address.
3. The result has to be shifted to the right until the overflow bit becomes 1.
4. When this bit becomes 1, an Esclusive OR operation with the result of step 3 and the fix value A001H has to be performed.
5. After 8 shift operations (every time when the overflow bit becomes 1, an Exclusive OR like in step 4 has to be done), perform an Exclusive OR operation with the result of the former operations and the next data package (8 bit function code). Again the result of this operation has to be shifted 8 times and if needed it has to be interconnected with the fix value A001H using an Exclusive OR operation.
6. The same steps have to be performed with the data, first with the higher byte and then with the lower byte until all data are proceeded.
7. The result of these operations is the checksum. It consists of a high and a low byte.

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The following example clarifies the calculation method. It shows the calculation of a CRC-16 code with the slave address 02H (0000 0010) and the function code 03H (0000 0011). The resulting CRC-16 code is D1H for the lower and 40H for the higher byte. The example calculation in this example is not done completely (normally data would follow the function code).

Calculations	Overflow	Description
1111 1111 1111 1111		Initial value
0000 0010		Address
1111 1111 1111 1101		ExOr Result
0111 1111 1111 1110	1	Shift 1
1010 0000 0000 0001		
1101 1111 1111 1111		ExOr Result
0110 1111 1111 1111	1	Shift 2
1010 0000 0000 0001		
1100 1111 1111 1110		ExOr Result
0110 0111 1111 1111	0	Shift 3
0011 0011 1111 1111	1	Shift 4
1010 0000 0000 0001		
1001 0011 1111 1110		ExOr Result
0100 1001 1111 1111	0	Shift 5
0010 0100 1111 1111	1	Shift 6
1010 0000 0000 0001		
1000 0100 1111 1110		ExOr Result
0100 0010 0111 1111	0	Shift 7
0010 0001 0011 1111	1	Shift 8
1010 0000 0000 0001		
1000 0001 0011 1110		ExOr Result
0000 0011		Function Code
1000 0001 0011 1101		ExOr Result
0100 0000 1001 1110	1	Shift 1
1010 0000 0000 0001		
1110 0000 1001 1111		ExOr Result
0111 0000 0100 1111	1	Shift 2
1010 0000 0000 0001		
1101 0000 0100 1110		ExOr Result
0110 1000 0010 0111	0	Shift 3
0011 0100 0001 0011	1	Shift 4
1010 0000 0000 0001		
1001 0100 0001 0010		ExOr Result
0100 1010 0000 1001	0	Shift 5
0010 0101 0000 0100	1	Shift 6
1010 0000 0000 0001		
1000 0101 0000 0101		ExOr Result
0100 0010 1000 0010	1	Shift 7
1010 0000 0000 0001		
1110 0010 1000 0011		ExOr Result
0111 0001 0100 0001	1	Shift 8
1010 0000 0000 0001		
1101 0001 0100 0000		ExOr Result
D1H 40H		CRC-16 Result
Higher Byte Lower Byte		

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■MEMOBUS Message Example

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

Reading Inverter Memory Register Contents

The content of maximum 16 inverter memory registers can be readout at a time.

Among other things the command message must contain the start address of the first register that is to be read out and the quantity of registers that should be read out. The response message will contain the content of the first and the consecutive number of registers that has been set for the quantity.

The contents of the memory register are separated into higher 8 bits and lower 8 bits.

The following tables show 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

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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 no. 1.

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 Inverter Memory Registers

The writing of inverter memory registers works similar to the reading process, i.e. the address of the first register that is to be written and the quantity of to be written registers must be set in the command message.

The to be written data must be consecutive, starting from the specified address in the command message. The data order must be higher 8 bits, then lower 8 bits. The data must be in memory register address order.

The following table shows an example of a message where a forward operation has been set with a frequency reference of 60.0 Hz for the inverter with the slave address 01H.

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

For the number of data value in the command message the double value of the data quantity must be taken.

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■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. These data can be read and written. They cannot be used for monitoring functions.

Register No.	Contents	
0000H	Reserved	
0001H	Run operation and input commands	
	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	PI target value	
0007H	Analog output 1 setting (-11 V/-726 to 11 V/726) → 10V = 660	
0008H	Analog output 2 setting (-11 V/-726 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	
000FH	Reference selection settings	
	Bit 0	Not used
	Bit 1	Input PI target value 1: Enabled 0: Disabled
	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.

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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 lost (FbL)
	Bit 7	External error (EF, EFO)
	Bit 8	Control board 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	Not used
	Bit E	MEMOBUS communications error (CE)
	Bit F	Operator disconnected (OPR)
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 (U1-06)	
0026H	Output current	U1-03

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Register No.	Contents		
0027H	Output power	U1-08	
0028H	Not used		
0029H	Not used		
002AH	Not used		
002BH	Control terminals input status		
	Bit 0	Input terminal S1 1: ON 0: OFF	
	Bit 1	Input terminal S2 1: ON 0: OFF	
	Bit 2	Multi-function input terminal S3 1: ON 0: OFF	
	Bit 3	Multi-function input terminal S4 1: ON 0: OFF	
	Bit 4	Multi-function input terminal S5 1: ON 0: OFF	
	Bit 5	Multi-function input terminal S6 1: ON 0: OFF	
	Bit 6	Multi-function input terminal S7 1: ON 0: OFF	
	Bits 7 to F	Not used	
002CH	Inverter status		
	Bit 0	Operation	1: Operating
	Bit 1	Zero speed	1: Zero speed
	Bit 2	Frequency agree	1: Agreement
	Bit 3	User-defined speed agree	1: Agreement
	Bit 4	Frequency detection 1	1: Output frequency ≤ L4-01
	Bit 5	Frequency detection 2	1: Output frequency ≥ L4-01
	Bit 6	Inverter startup completed	1: Startup completed
	Bit 7	Undervoltage detection	1: Detected
	Bit 8	Baseblock	1: Inverter output baseblock
	Bit 9	Frequency reference mode	1: Not communication 0: Communication option
	Bit A	Run command mode	1: Not communication 0: Communication option
	Bit B	Overtorque detection	1: Detected
	Bit C	Frequency reference lost	1: Lost
	Bit D	Restart enabled	1: Restarting
	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 (max. output frequency ≙ 100%; resolution 0.1%; without sign)		
0039H	PI input (max. output frequency ≙ 100%; resolution 0.1%; with sign)		
003AH	PI output (max. output frequency ≙ 100%; resolution 0.1%; with sign)		
003BH	CPU software number		

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Register No.	Contents	
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	

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

Broadcast Data

Using broadcast data a command can be given to all slaves at the same time. The slave address in the command message must be set to 00H. All slaves will receive the message. They will not respond.

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
	Bit 5	Error reset 1: Reset command
	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	

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 the ENTER command must be used.

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 the data in RAM.

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

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The ENTER command is enabled by writing 0 to register number 0900H or 0910H.

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

INFO

The maximum number of times you can write to EEPROM is 100,000. Do not frequently execute ENTER commands (0900H) that write into EEPROM.
The ENTER command registers are write-only. Consequently, if these registers should be read out, 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 0001H, or 0002H has been set.
03H	Invalid quantity error • The number of data packets (register content) being read or written is outside the range of 1 to 16. • In write mode, the number of data bytes 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 o2-04 when warning alarm CPF03 (defective EEPROM) has occurred. • Attempting to write read-only data.
23H	Writing during DC bus undervoltage (UV) error • Writing constants to the inverter during UV (DC bus undervoltage) alarm. • Writing via ENTER commands during UV (DC bus 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 gap between two blocks (8 bit) of a message 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.

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■Self-Diagnosis

The Inverter has a built-in function for self-diagnosing the functioning of the serial communication interface circuits. This function is called the self-diagnosis function. It uses the connected communications parts of the send and receive terminals to receive data sent by the Inverter and thereby to check if communication is performed normally.

To perform the self-diagnosis function use the following procedure.

1. Turn ON the inverter power supply, and set 67 (communications test mode) in constant H1-05 (Terminal S7 Function Selection).
2. Turn OFF the inverter power supply.
3. Perform the wiring according to *Fig 6.46*.
4. Turn ON the terminating resistance. (Turn ON pin 1 on DIP switch 1.)
5. Turn ON the inverter power supply.

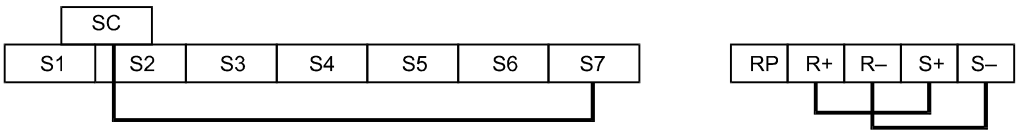


Fig 6.46 Communication Terminals Wiring for Self-Diagnosis

During normal operation, the Digital Operator displays “PASS” on the display.

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.

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◆ Using the Timer Function

The multi-function digital input terminals S3 to S7 can be used as timer function input terminals, and multi-function output terminals M1-M2 and M3-M4 can be used as timer function output terminals. By setting the delay time, you can prevent chattering of the sensors and switches.

- Set one of the constants H1-01 to H1-05 (multi-function contact input terminal S3 to S7) to 18 (timer function input).
- Set H2-01 or H2-02 (multi-function output terminals M1-M2 and M3-M4 function selection) to 12 (timer function output).

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b4-01	Timer function ON-delay time	Set the timer function output ON delay time (dead time) for the timer function input in 1-second units. Enabled when a timer function is set in H1-□□ and H2-□□.	0.0 to 300.0	0.0 s	No	A
b4-02	Timer function OFF-delay time	Set the timer function output OFF delay time (dead time) for the timer function input in 1-second units. Enabled when the timer function is set in H1-□□ and H2-□□.	0.0 to 300.0	0.0 s	No	A

■Setting Example

When the timer function input ON time is longer than the value set in b4-01, the timer output function is turned ON. When the timer function input OFF time is longer than the value set in b4-02, the timer output function is turned OFF. An example of timer function operation is given in the following diagram.

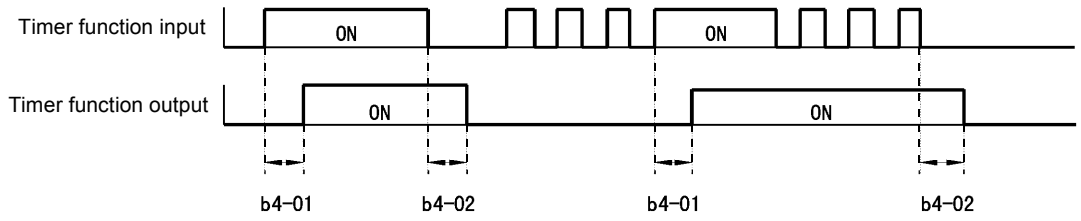


Fig 6.47 Timer Function Operation Example

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◆ 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 system with load fluctuation.

The characteristics of the PI control operations are given below.

P element The output of a P-element is proportional to the input (deviation). With using a P-element alone it is not possible to eliminate the deviation completely.

I element The output of an I-element is the time-integral of the input (deviation). With using a P-element and an I-element together the deviation can be eliminated completely.

■PID Control Operation

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

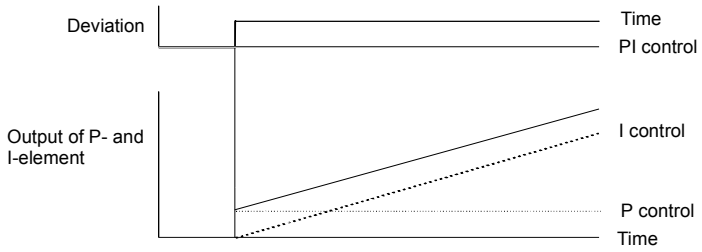


Fig 6.48 PI Control Operation

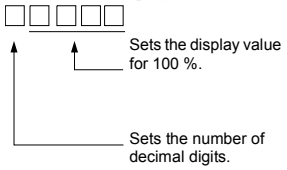
■PI Control Applications

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

Application	Control Details	Example of Sensor Used
Pressure Control	Pressure information is fed back and constant pressure control is performed.	Pressure sensor
Flow Rate Control	Flow rate information is fed back and the flow rate is controled with high accuracy.	Flow rate sensor
Temperature Control	Temperature information is fed back and a temperature adjustment control using a fan can be performed.	• Thermocouple • Thermistor

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■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 3: PI control enabled (frequency reference + PI output)	0, 1, 3	0	No	A
b5-02	Proportional gain (P)	Sets P-control proportional gain. 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 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
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 output frequency.	-100.0 to +100.0	0.0%	Yes	A
b5-08	PI 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
b5-09	PI output characteristics selection	Selects forward/reverse direction for PI output. 0: PI output is forward. 1: PI output is reverse	0 or 1	0	No	A
b5-10	PI output gain	Sets output gain.	0.0 to 25.0	1.0	No	A
b5-11	PI reverse output selection	0: Limit to 0 when PI output is negative. 1: Reverses when PI output is negative. Limit to 0 is also active when reverse prohibit is selected by b1-04.	0 or 1	0	No	A
b5-12	Selection of PI feedback signal loss detection	0: No detection of PI feedback loss. 1: Detection of PI feedback loss. Operation continues during detection, the fault contact is not operated. 2: Detection of PI feedback loss. The motor coasts to stop at detection, and the fault contact operates.	0 to 2	0	No	A
b5-13	PI feedback loss detection level	Sets the PI feedback loss detection level as percentage using the maximum output frequency as 100%.	0 to 100	0%	No	A
b5-14	PI feedback loss detection time	Sets the PI feedback loss detection time.	0.0 to 25.5	1.0 s	No	A
b5-15	Sleep function operation level	Sets the sleep function start level as a frequency.	0.0 to 200.0	0.0 Hz	No	A
b5-16	Sleep operation delay time	Sets the delay time until the sleep function starts.	0.0 to 25.5	0.0 s	No	A
b5-17	Accel/decel time for PI reference	Sets the accel/decel time for the PI Softstarter (SFS).	0.0 to 25.5	0.0 s	No	A
b5-18	PI Setpoint Selection	0: Disabled 1: Enabled	0 to 1	0	No	A
b5-19	PI Setpoint	PI-target value	0.00 to 100.00%	0	Yes	A
b5-20	PI Setpoint Scaling	Sets the unit for b5-19, U1-38 and U1-24 0: 0.01 Hz 1: 0.01% (the maximum output frequency E1-04 is taken as 100%. 2 – 39: rpm, set value is equal to motor poles 40 – 39999: User desired display  	0 to 39999	0	No	A

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Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
b5-21	Sleep Function Selection	Sets the operation method of the PI sleep function 0: Output frequency before Softstarter (SFS) 1: Frequency reference/PI target 2: Snooze	1 to 2	0	No	A
b5-22	Snooze Level	Sets the frequency level at which the snooze operation starts as percentage of the max. output frequency.	0 to 100%	0	Yes	A
b5-23	Snooze Delay Time	Sets a delay timer for the snooze function	0 to 3600 s	0 s	No	A
b5-24	Wake-Up Level	Sets the feedback level at which the inverter wakes up from snooze operation.	0 to 100 %	0	No	A
b5-25	Setpoint Boost	Sets the PI setpoint boost when the snooze mode is acti-vated. If it is reached once the output will be switched off. The value is set as percentage of the PI setpoint.	0 to 100%	0	No	A
b5-26	Maximum Boost Time	Sets the maximum time the boost operation is performed.	0 to 3600 s	0 s	No	A
b5-27	Snooze feedback	PI Snooze function will only be activated when the feed-back value is above this parameter setting. The value is set as percentage of the PI setpoint.	0 to 100%	60%	No	A
b5-28	PI Feedback Square Root Opera-tion	Enables or disables the square root operation for the PI feedback value. 0: Disabled 1: Enabled	0 or 1	0	No	A
b5-29	PI Feedback Square Root Gain	Sets the gain for the feedback when square root operation is enabled.	0 to 2.00	1.00	No	A
b5-30	PI Output Monitor Square Root	Selects whether the PI output monitor is shown as square root value or not. 0: Disable 1: Enable	0 or 1	0	No	A

Monitor Items (U1-□□)

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit
U1-24	PI feedback value	Monitors the feedback value when PI control is used.	10 V: 100% feedback	0.01%
U1-36	PI input volume	PI input volume	10 V: 100% PI input	0.01%
U1-37	PI output volume	PI control output	10 V: 100% PI output	0.01%
U1-38	PI setpoint	PI setpoint	10 V: 100% PI target	0.01%
U1-53	PI feedback 2	Monitors the feedback 2 value when Differential PI is selected.	10 V: 100% PI feedback	0.01%

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

Set Value	Function
19	PI control disable (ON: PI control disabled)
30	PI control integral reset (reset when reset command is input or when stopped during PI control)
31	PI control integral hold (ON: Integral hold)
34	PI soft starter
35	PI input characteristics switch

Multi-Function Analog Input (H3-09)

Set Value	Function	
B	PI feedback	Max. output frequency
C	PI target value	Max. output frequency
16	PI feedback 2	Max. output frequency

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■PI Control Methods

There are four PI control methods. Select the method by setting constant b5-01.

Set Value	Control Method
1	PI output becomes the Inverter output frequency.
3	PI output is added to the frequency reference as compensation value of the Inverter output frequency.

■PI Input Methods

PI Target Value Input Methods

Select the PI control target value input method according to the setting in b1-01 (Reference Selection). Normally, the frequency reference selected in b1-01 is the PI target value, but you can also set the PI target value as shown in the following table.

PI Target Input Method	Setting Conditions
MEMOBUS register 0006H	Set MEMOBUS bit 1 in register address 000FH to 1 (enable/disable PI target value from communications) to be able to use register number 0006H as the PI target value.
Constant setting	If b5-18 is set to 1 the value in b5-19 becomes the PI target value.



NOTE

If the PI function is used, the frequency reference value becomes the target value, which is set and shown in Hz on the operator. Nevertheless, internally the PI target value is used in percent. I.e. the following formula is used:

$$\text{PI target value [\%]} = \frac{\text{frequency reference [Hz]}}{\text{max. output frequency [Hz]}} \cdot 100\ \%$$

PI Feedback Input Methods

Select one of the following PI control feedback input methods

Input Method	Setting Conditions
Analog input A2	Set H3-09 (Multi-function Analog Input Terminal A2 Selection) to B (PI feedback).
Analog input A1 (Differential Mode)	Set H3-09 to 16. Analog input A1 becomes the feedback 1 input and the analog input A2 becomes the feedback 2 input.

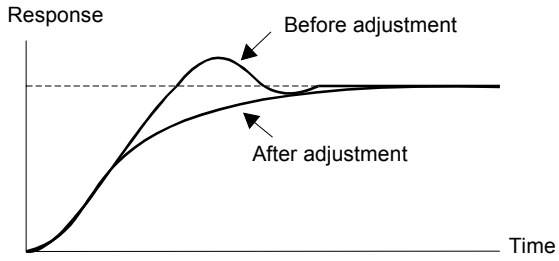
If H3-09 is set to 16, the PI differential mode is activated. Both analog inputs (A1 and A2) become feedback inputs and the difference between both becomes the feedback value for the PI controller. The monitor U1-24 becomes the feedback 1 monitor, U1-53 becomes the feedback 2 monitor.
In this mode the PI target value automatically is taken from the source set in b1-01 or a multistep speed reference (d1-01 to d1-04).

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■PI Adjustment Examples

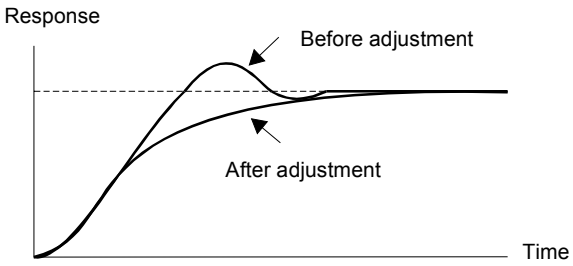
Suppressing Overshoot

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



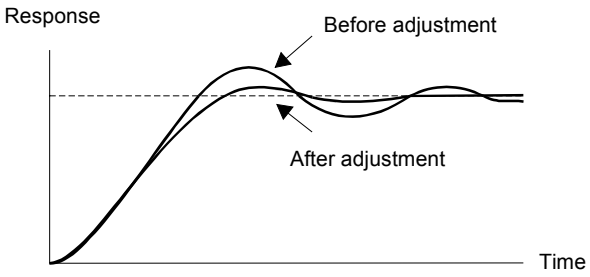
Set a Rapidly Stabilizing Control Condition

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



Suppressing Long-cycle Vibration

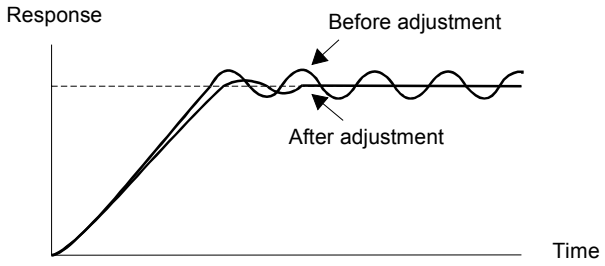
If vibration occurs with a longer cycle than the integral time (I) set value, lengthen the integral time (I) to suppress the vibration.



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Suppressing Short Cycle Vibration

If short cycle vibration occurs 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, the Inverter response is delayed, and the machine might get 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 output value of the the PI control calculation from exceeding a specified amount. The value is set taking the maximum output frequency as 100%.
- The b5-07 constant is used to adjust PI control offset. The value is set in increments of 0.1%, taking the maximum output frequency to be 100%. Normally it is added to the PI output value. If differential PI feedback is selected (H3-09=16), it is added to the difference between both feedback values.
- Set the filter time constant for the PI control output in b5-08 to prevent machinery resonance when machinery friction is great, or rigidity is poor. In this case, set the constant to be higher than the resonance frequency cycle duration. Increase this time constant to reduce Inverter responsiveness.
- Using b5-09, the PI output polarity can be inverted. If now the PI target value increases the output frequency will be lowered. This function is usable e.g. for vacuum pumps.
- Using b5-10 a gain can be applied to the PI control output. Enable this constant to adjust the amount of compensation if adding PI control output to the frequency reference as compensation (b5-01 = 3).
- When PI control output is negative, you can use constant b5-11 to determine what happens to the inverter output. When b1-04 (Prohibition of Reverse Operation) is set to 1 or 3 (enabled), however, the PI output is limited to 0.
- Using the b5-17 constant the PI target value can be raised or lowered with an accel./decel. ramp function (PI soft starter).
  The normally used accel./decel. function (C1-□□ constants) is allocated after PI control so that, depending on the settings, resonance with the PI control and hunting in the machinery may occur. Using b5-17 this behaviour can be prevented.
  The PI soft starter function can also be disabled or enabled using a multifunction digital input (H1-□□ has to be set to 34).

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■PI Control Block

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

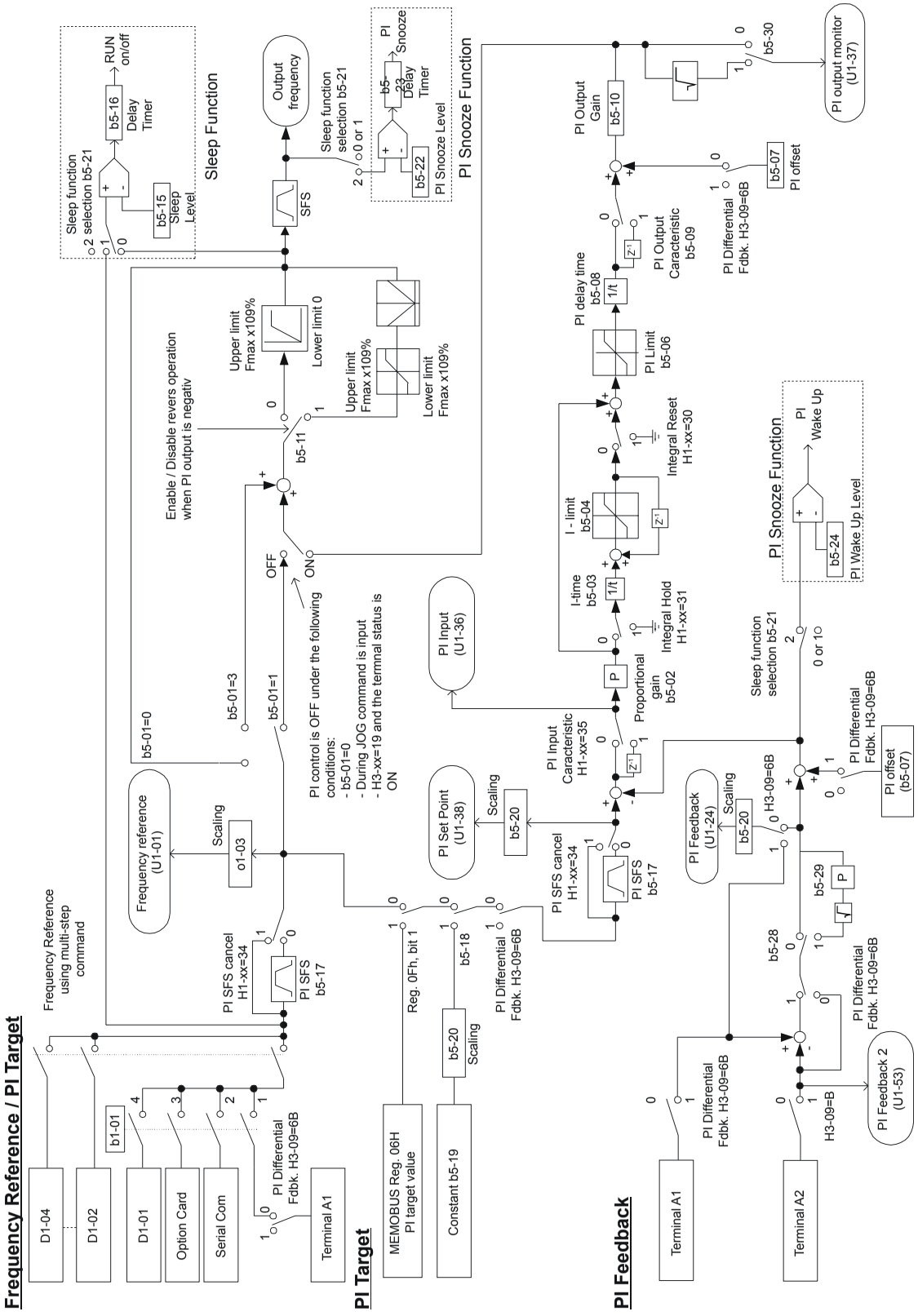


Fig 6.49 PI Control Block Diagram

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■PI Feedback Loss Detection

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

When b5-12 is set to 1 and the PI feedback value falls below the PI feedback loss detection level (b5-13) for a time longer than the PI feedback loss detection time (b5-14), a Fbl alarm (Feedback loss) will be displayed at the operator and inverter operation is continued.

When the same happens and b5-12 is set to 2 a Fbl fault will be displayed on the digital operator and the inverter operation will be stopped. The motor coasts to stop and the fault contact is operated.

The time chart for PI feedback loss detection is shown below.

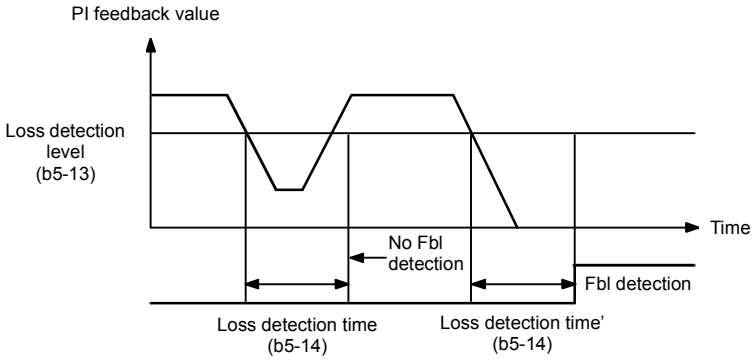


Fig 6.50 PI Feedback Loss Detection Time Chart

■PI Sleep Function

The PI sleep function can be used in two different modes which depends on the setting of b5-21.

If b5-21 is set to 0, the frequency reference/PI target value is taken as an input value for the sleep function. If b2-21 is set to 1, the output frequency before the softstarter (SFS input, C1-□□, C2-□□) is taken as sleep function input value.

If this value falls below the sleep level b5-15 for a longer time than the sleep operation delay time b5-16, the inverter output will be stopped. If the value comes back to a value higher than b5-15 for a time longer than b5-16, the inverter will resume operation.

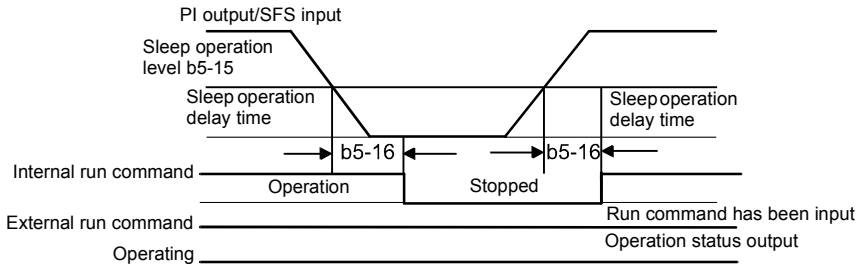


Fig 6.51 PI Sleep Time Chart

The functionality of the Sleep function is also available with deactivated PI controller.

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■PI Snooze Function

By setting b5-21 to 2 the PI snooze function can be enabled. This software observes the output frequency (Softstarter output) and the PI feedback value to turn the inverter ON and OFF automatically as the system requires.

- Snooze Activation
  The inverter stops operation when the output frequency (Softstarter output) falls below the snooze level b5-22 for a longer time than the snooze delay time b5-23 and the feedback value is above the snooze feedback value in b5-27. Before stopping the inverter finally, the PI setpoint is boosted up to temporarily over-satisfy the load and thereby to avoid a short cycle ON and OFF switching of the inverter. The boost level is set in constant b5-25 and it is set as percentage of the PI setpoint value, but the maximum time for boost operation is set in b5-26.
- Wake up
  The inverter resumes the normal PI operation when the PI feedback exceeds the wake up level b5-24. The normal acceleration ramp is used.

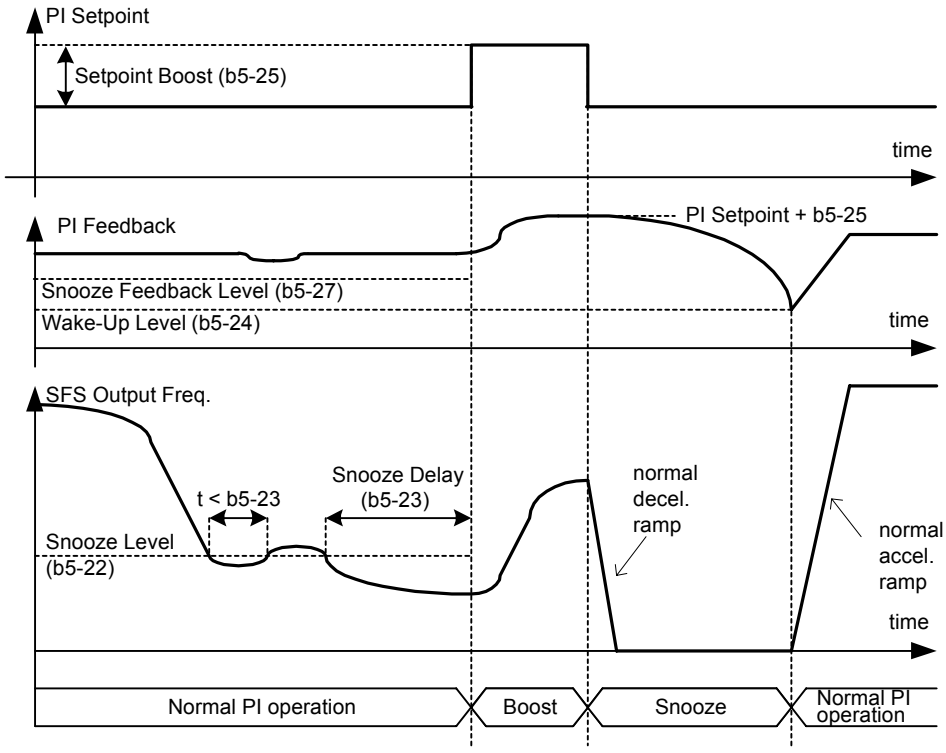


Fig 6.52 PI Snooze Time Chart

NOTE

Using the constant b5-21 either sleep operation or snooze operation can be enabled. It is impossible to enable both functions at the same time.

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■Square Root Feedback Operation

If parameter b5-28 is set to 1 the feedback value is converted into a value that equals the square root of the actual feedback. This can be used to control the flow rate when a pressure sensor is used to generate a feedback value. With parameter b5-29 the square root can be multiplied with a factor. Following formula applies:

$$\text{flow rate} = \text{gain (b5-29)} \times \sqrt{\text{pressure (head)}}$$

So linear connection between the PI target value and the feedback can be realized.

With parameter b5-30 also the feedback monitor can be switched to show a square root value of the actual feedback.

■Multifunction Digital Input Settings: H1-01 to H1-05 (Terminal S3 bis S7)

PI Control Disable: “19”

- When a multifunction input is set for this function it can be used to disable the PI function by switching the input to ON.
- The PI target value becomes the frequency reference value.

PI Control Integral Reset: “30”

- Using this function the integral share value of the PI control can be reset by setting a multifunction input to ON.

PI Control Integral Hold: “31”

- Using this function the integral share value of the PI control can be hold by setting a multifunction input to ON. The value will be hold as long as the input is ON.

PI Softstarter: “34”

- Using this function the PI target value can be raised or lowered slowly using an accel./decel. ramp function. The accel./decel. time can be set in constant b5-17. The function is active when the multifunction input with this function is ON.

PI Input Characteristic Switch: “35”

- Using this function the PI input characteristic can be inverted by setting a multifunction input to ON.

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◆ 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	Sets the Energy-saving coefficient. Adjusts the value in 5% steps until the output power becomes minimal.	0.0 to 655.00*1	*2	No	A
b8-05	Power detection filter time constant	Sets the time constant for output power detection.	0 to 2000	20 ms	No	A
b8-06	Search operation voltage limiter	Sets the limit value of the voltage control range during search operation. Set to 0 to disable the search operation. 100% is the motor rated 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

When the Energy Saving Function is activated the voltage for optimum motor efficiency is calculated and becomes the output voltage reference.

- b8-04 (Energy-saving Coefficient) is preset assuming that motor and inverter capacity are the same. Adjust b8-04 in steps of 5 % until the output power reaches its minimum. The higher the energy-saving coefficient, the higher is the output voltage.
- To improve the responsiveness when the load fluctuates, reduce the power detection filter time constant b8-05. If b8-05 is set too small, however, the motor rotations may become unstable under light load conditions.
- 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 varies the output voltage. Constant b8-06 (Search Operation Voltage Limiter) limits the range for the voltage search operation. For 200 V Class Inverters, a range of 100% is equal to 200 V and for 400 V Class Inverters a range of 100% is equal to 400 V. Set to 0 to disable the search operation voltage limiter.

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◆ Setting Motor Constants

■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. This set value will become the reference value for motor protection and torque limits. It is an input data for autotuning.	0.32 to 6.40 *1	1.90 A *2	No	Q
E2-03	Motor no-load current	Sets the motor no-load current. This constant is automatically set during autotuning.	0.00 to 1.89*3	1,2*2	No	A
E2-05	Motor line-to-line resistance	Sets the motor phase-to-phase resistance. This constant is automatically set during autotuning.	0.000 to 65.000	9.842 Ω *2	No	A

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

* 1. 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).

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

* 3. The setting range depends on the inverter capacity. The values for a 200 V class inverter of 0.4 kW are given.

■Manual Setting of the Motor Constant

Motor Rated Current Setting

Set E2-01 to the rated current value 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.

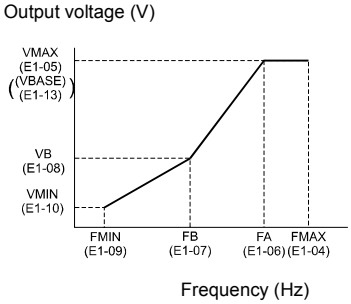
- E-type insulation: [Line-to line resistance (Ω) at 75°C of test report] × 0.92 (Ω)
- B-type insulation: [Line-to line resistance (Ω) at 75°C of test repor]t × 0.92 (Ω)
- F-type insulation: [Line-to line resistance (Ω) at 115°C of test report] × 0.87 (Ω)

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◆ Setting the V/f Pattern

Using the E1-□□ constants the Inverter input voltage and the V/f pattern can be set as needed. It is not recommended to change the settings when the motor is used in open loop vector control mode.

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
E1-01	Input voltage setting	Sets the Inverter input voltage. This setting is used as a reference value for protection functions.	155 to 255 *1	200 V *1	No	Q
E1-03	V/f pattern selection	0 to D: Select from the 14 preset V/f patterns. F: Custom user-set patterns (Applicable for setting of E1-04 to E1-10.)	0 to F	F	No	Q
E1-04	Max. output frequency (FMAX)	 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)	40.0 to 200.0	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 200.0	50.0 Hz	No	Q
E1-07	Mid. output frequency (FB)		0.0 to 200.0	2.5 Hz	No	A
E1-08	Mid. output frequency voltage (VB)		155 to 255*1	15.0 V *1	No	A
E1-09	Min. output frequency (FMIN)		0.0 to 200.0	1.2 Hz	No	Q
E1-10	Min. output frequency voltage (VMIN)		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 200.0	0.0 Hz *2	No	A
E1-12	Mid. output frequency voltage 2		0.0 to 255.0 *1	0.0 V	No	A
E1-13	Base voltage (VBASE)	Sets the output vltage at the base frequency (E1-06)	0.0 to 255.0 *1	0.0 V	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.

■Setting Inverter Input Voltage

Set the Inverter input voltage correctly in E1-01 so that it matches the power supply voltage. This set value will be the reference value for the protection functions and similar functions (overvoltage level, stall level).

■Setting V/f Pattern

The V/f pattern can be selected using constant E1-03. There are two methods of setting the V/f pattern: Select one of the 14 preset pattern types (set value: 0 to E), or set a user-defined V/f pattern (set value: F).

The factory setting for E1-03 is F.

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

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Characteristic	Application	Set Value	Specifications
Constant Torque Characteristic	These patterns are used in general applications where the load torque is fixed, regardless of rotation speed, e.g. 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	These patterns are used for loads with torque proportional to the square or cube of the rotation speed, such as fans and pumps.	4	50 Hz specifications, cubical torque characteristic
		5	50 Hz specifications, quadratic torque characteristic
		6	60 Hz specifications, cubical torque characteristic
		7	60 Hz specifications, quadratic torque characteristic
High Startup Torque*	Select a 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 • An AC reactor is inserted in the Inverter input or output.	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
		E	180 Hz specifications, voltage saturation at 60 Hz

* The high start up torque is provided 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

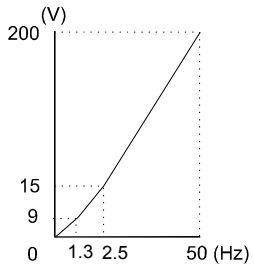
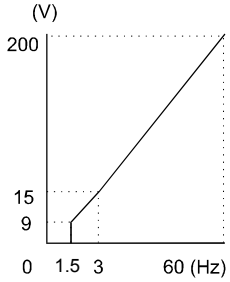
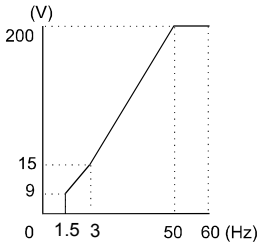
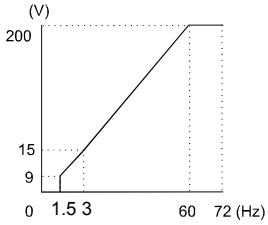
The characteristics diagrams for each are shown in the following pages.

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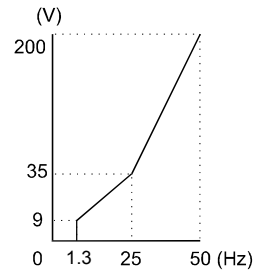
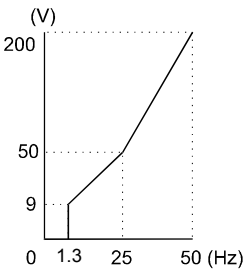
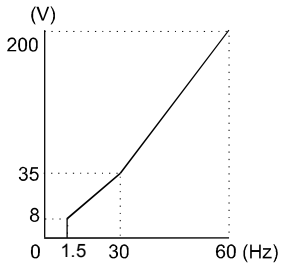
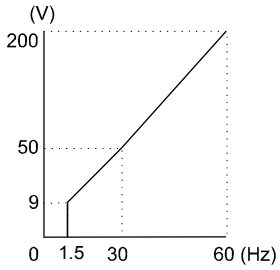
0.4 to 1.5 kW V/f Pattern

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

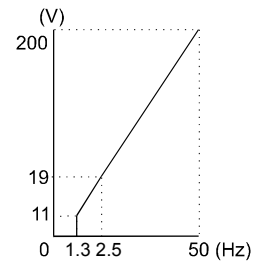
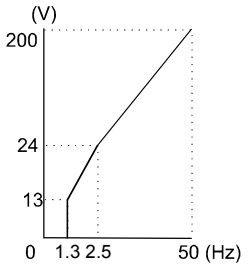
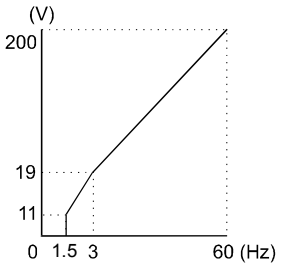
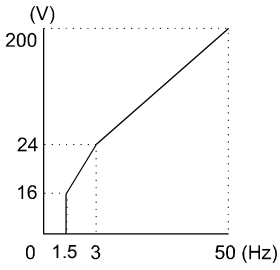
- Constant Torque Characteristics (Set Value: 0 to 3)

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

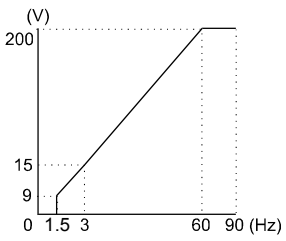
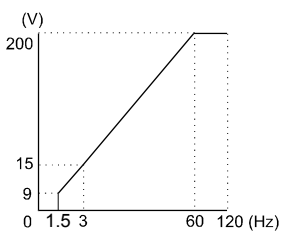
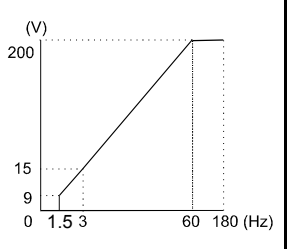
- Variable Torque Characteristics (Set Value: 4 to 7)

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)

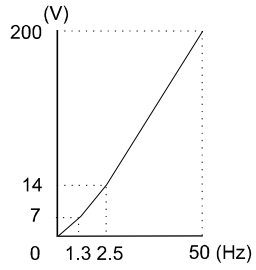
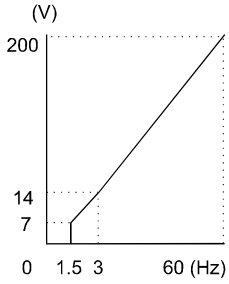
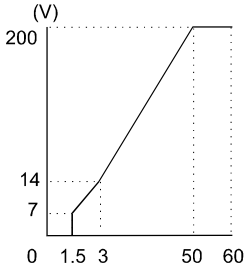
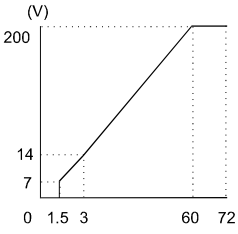
Set Value C	90 Hz	Set Value D	120 Hz	Set Value E	180 Hz
					

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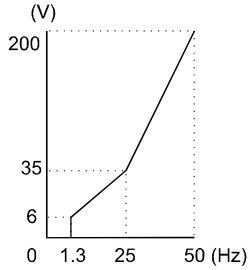
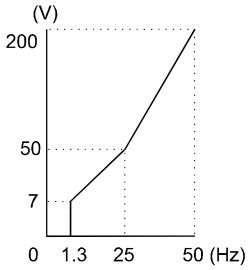
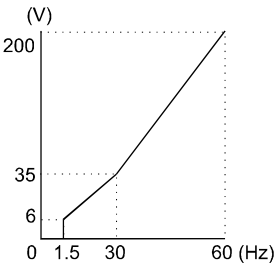
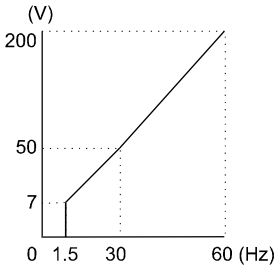
2.2 to 45 kW V/f Pattern

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

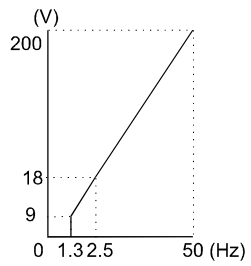
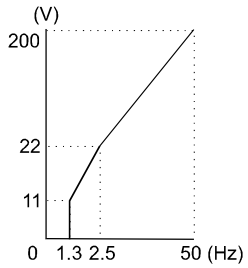
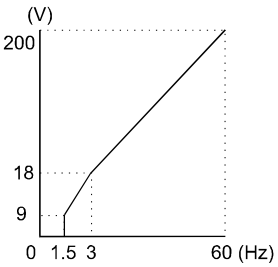
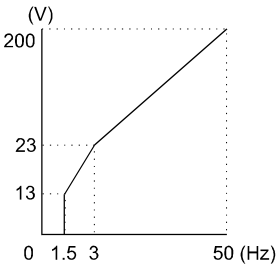
- Constant Torque Characteristics (Set Value: 0 to 3)

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

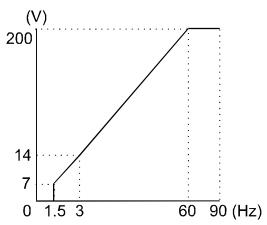
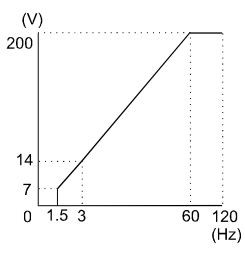
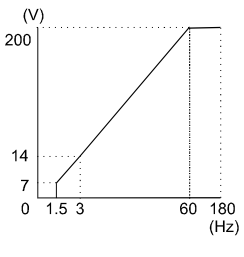
- Variable Torque Characteristics (Set Value: 4 to 7)

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)

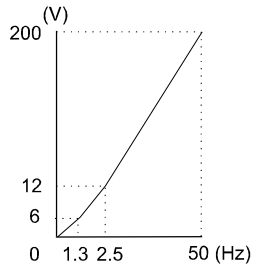
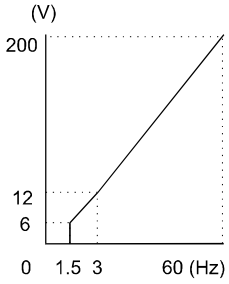
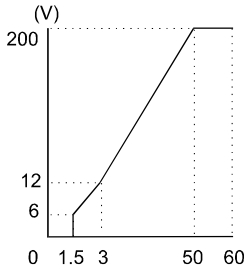
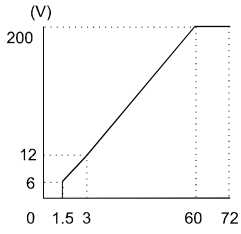
Set Value C	90 Hz	Set Value D	120 Hz	Set Value E	180 Hz
					

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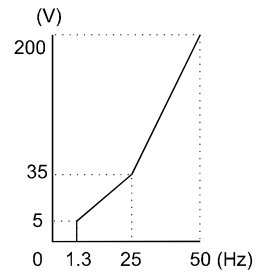
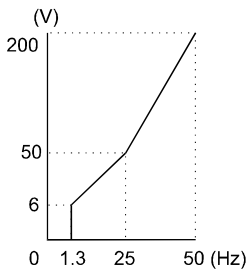
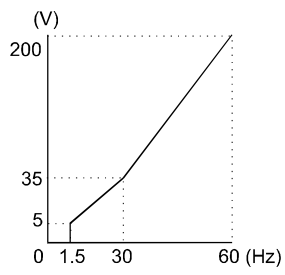
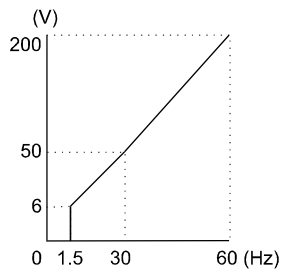
55 to 300 kW V/f Pattern

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

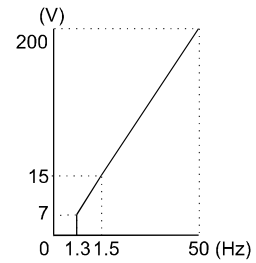
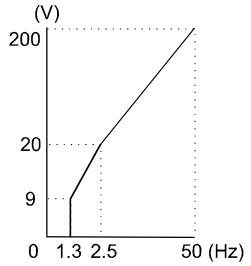
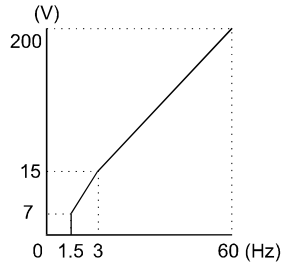
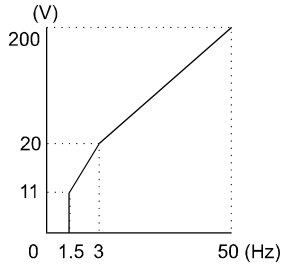
- Constant Torque Characteristics (Set Value: 0 to 3)

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

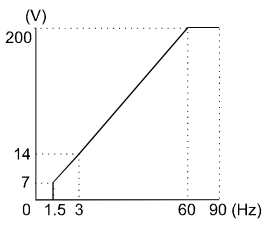
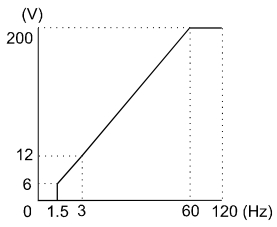
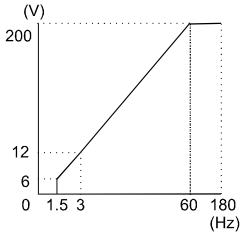
- Variable Torque Characteristics (Set Value: 4 to 7)

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	Set Value E	180 Hz
					

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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 read 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.

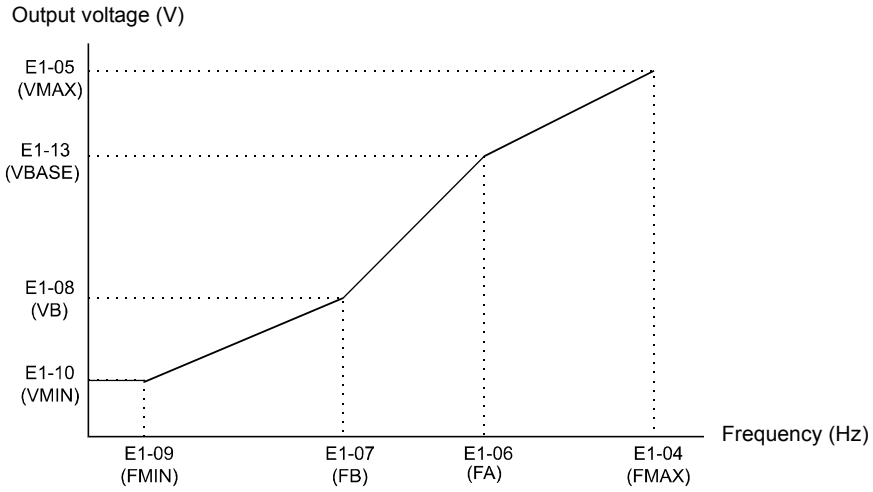


Fig 6.53 User-Set V/f Pattern

■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)

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◆ High Slip Braking

If the load inertia is large the high slip braking function can be used to shorten the deceleration time compared to the normal deceleration time without using a braking option, e.g. for emergency stops.

The function must be activated by a multifunction input.

Note:
- The HSB function is not comparable with the normal deceleration function. It does not use a ramp function.
- HSB should not be used at normal operation instead of a deceleration ramp.

■Related Constants

Constan Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
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
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
N3-03	High-slip braking stop dwell time	Sets the dwell time of the output frequency for FMIN (1.5 Hz) . Effective only during deceleration with high-slip braking.	0.0 to 10.0	1.0 s	No	A
N3-04	High-slip braking OL time	Sets the OL7 time when the output frequency does not change for some reason during deceleration with high-slip braking.	30 to 1200	40 s	No	A

Adjusting the HSB Deceleration Frequency Width (N3-01)

This constant sets the step value that is used for lowering the output frequency to achieve a large negative slip and thereby to brake the motor.

Normally no adjustments should be necessary. Increase the value if DC bus overvoltage faults occur.

Adjusting the HSB Current Limit (N3-02)

The setting of constant N3-02 limits the output current while high slip braking is active. The current limit affects the achievable deceleration time.

The lower the current limit the longer is the deceleration time.

Setting the HSB Dwell Time at Stop (N3-03)

At the end of a high slip braking the output frequency is held at the minimum output frequency for the time set in N3-03. Increase the time if the motor coasts after HSB.

Setting the HSB Overload Time (N3-04)

N3-04 sets the HSB overload time. If the output frequency does not change for any reason although an HSB command is given, an OL7 fault will be displayed and the fault contact will operate.

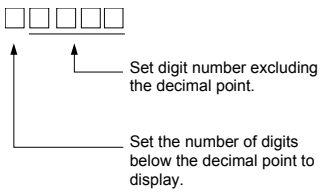
Multifunction Input Settings: H1-01 to H1-05 (Terminal S3 to S7)
High Slip Braking: “68”

If one of the multifunction inputs is set to “68” it can be used to activate the HSB function. The inverter will brake the motor immediately after the HSB command was given. HSB cannot be stopped, i.e. normal inverter operation cannot be resumed.

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◆ Setting Digital Operator Functions

■Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
o1-01	Monitor selection	Set the number of the 3rd. monitor item to be displayed in the Drive Mode. (U1-□□) (Not on LCD operator JVOP-160.)	4 to 33	6	Yes	A
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 or not. 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
o2-06	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 switched off, and fault contact is operated.)	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

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Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
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
o2-09	Initialize Mode	2: Europe 5: PV-E Spec	2 or 5	2	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
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
o2-14	Energy monitor initialize	Resets the monitor parameter U1-29 and U1-30 back to zero. 0: No change 1: Reset to zero	0 or 1	0	No	A
o2-15	HAND key function selection	If set to 0 the HAND button on the digital operator is disabled and the drive will not enter the HAND mode and start to run when the HAND button is pressed. 0: HAND button disabled 1: HAND button enabled	0 or 1	1	No	A

■Monitor Selection (o1-01)

Using constant o1-01 the third monitor item that is displayed in drive mode can be selected. This function has no effect on the optional LCD-operator (JVOP-160).

■Monitor Display when the Power Supply is Turned ON (o1-02)

Using constant o1-02 the monitor item (U1-□□) that is to be displayed on the Digital Operator when the power supply is turned ON can be selected.

■Changing Frequency Reference and Display Units o1-03)

Set the Digital Operator frequency reference and display units using constant o1-03. The setting in o1-03 will affect the display units of the following monitor items:

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

■Disabling the LOCAL/REMOTE Key (o2-01)

Set o2-01 to 0 to disable the LOCAL/REMOTE Key on the Digital Operator.

If the key is disabled, it cannot be used anymore to switch over the frequency reference source or the RUN command source between LOCAL and REMOTE.

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■Disabling the STOP Key (o2-02)

This constant is used to set whether the STOP key on the operator is active during remote control (b1-02 ≠ 0) or not.

If o2-02 is set to 1, a STOP command from the operators STOP key will be accepted. If o2-02 is set to 0 it will be disregarded.

■Initializing Changed Constant Values (o2-03)

You can save the current Inverter constant setting values as user-set constant initial values. Therefore constant o2-03 has to be set to 1.

To initialize the Inverter constants using the user-set initial values in memory set constant A1-03 to 1110. 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 (o2-05)

This function is active when frequency references are input 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.

■Operation Selection when the Digital Operator is Disconnected (o2-06)

This function selects the operation when the digital operator gets disconnected when a RUN command is active.

If o2-06 is set to 0 the operation is continued.
If o2-06 is set to 1 the output is switched off and the motor coasts to stop. The fault contact is operated. When the operator is reconnected an OPR (Operator disconnected) is shown.

■Cumulative Operation Time (o2-07 and o2-08)

The inverter has a function that counts the operation time of the inverter cumulatively.

Using constant o2-07 the cumulative operation time can be changed, e.g. after a replacement of the control board. If constant o2-08 is set to 0 the inverter counts the time whenever the power supply is switched ON. If o2-08 is set to 1 the time when a RUN command is active is counted only. The factory setting is 0.

■Cooling Fan Operation Time (o2-10)

This function counts the operating time of the inverter mounted fan cumulatively.

Using constant o2-10 the counter can be reset, e.g. when the fan was replaced.

■Fault Trace Initialize (o2-12)

This function can be used to initialize the fault trace by setting constant o2-12 to 1.

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■Energy Monitor Initialize (o2-14)

This function can be used to initialize the energy monitor by setting parameter o2-14 to 1.

■HAND Key Funktion Selection (o2-15)

With this parameter the HAND key can be disabled by setting parameter o2-15 to 0. The factory setting is 1, HAND key enabled.

◆ Copying Constants

The Digital Operator can perform the following three functions using a 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 settings (VERIFY)

■Related Constants

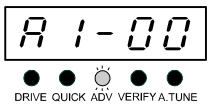
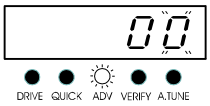
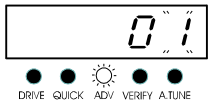
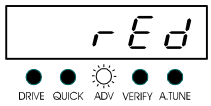
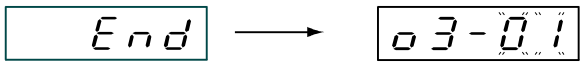
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Access Level
o3-01	Copy function selection	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A
o3-02	Read permitted selection	0: READ prohibited 1: READ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

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■Storing Inverter set values in the Digital Operator (READ)

To store Inverter set values in the Digital Operator use 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 to enter programming mode.
3		Select constant o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4		Press the DATA/ENTER key to enter the constants setting display.
5		Change the set value to 1 using the Increment key.
6		Press 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 the 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 Prohibited

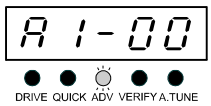
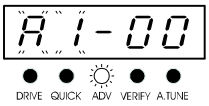
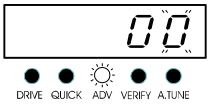
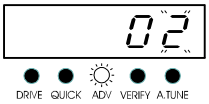
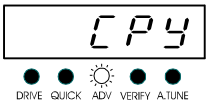
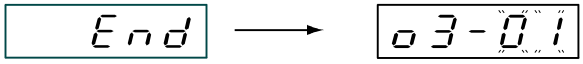
This function prevents overwriting of the data that are stored in the EEPROM of the Digital Operator. When o3-02 is set to 0 and o3-01 is set to 1 to perform a write operation, PrE will be displayed on the Digital Operator and the write operation will be stopped.

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■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, use 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 to enter the programming mode.
3		Select constant o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4		Press the DATA/ENTER key to enter the constants setting display.
5		Change the set value to 2 using the Increment key.
6		Press 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 the Digital Operator Copy Function.)*

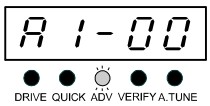
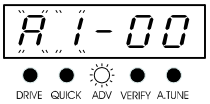
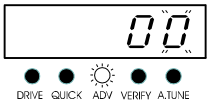
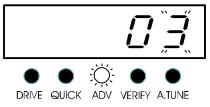
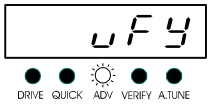
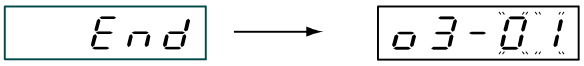
Error Display	Meaning
CPE	Inverter product code or Inverter software number are different.
vAE	Inverter capacity with which you are trying to copy, and the Inverter capacity stored in the Digital Operator are different.
CYE	Comparison between the constant written to the Inverter and the constant in the Digital Operator are different.
CSE	After copying has ended, comparison between the checksum value of the Inverter constant area and the checksum value of the Digital Operator constant area are different.

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■Comparing Inverter Constants and Digital Operator Constant Set Values (VERIFY)

To compare Inverter constants and Digital Operator constant set values, use 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 to enter the constants monitor display.
3		Select constant o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4		Press the DATA/ENTER key to enter the function setting display.
5		Change the set value to 3 using the Increment key.
6		Press 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 the 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

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◆ Prohibiting Writing Constants from the Digital Operator

If you set A1-01 to 0, all constants except A1-01 and A1-04 are write protected, U1-□□, U2-□□, and U3-□□ will be displayed. If A1-01 is set to 1, only the constants A1-01, A1-04 and A2-□□ can be read or written, U1-□□, U2-□□, and U3-□□ will be displayed. All other constants will not be displayed.

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, read the 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.) 1: Used to select user constant (Only constants set in A2-01 to A2-32 can be read and set.) 2: ADVANCED (Constants can be read and set in both quick programming mode and advanced programming mode.)	0 to 2	2	Yes	A

◆ Setting a Password

When a password is set in A1-05, and if the set values in A1-04 and A1-05 do not match, you cannot modify the settings of constants A1-01 to A1-03, or A2-01 to A2-32.

You can prohibit the setting 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.) 1: Used to select user constant (Only constants set in A2-01 to A2-32 can be read and set.) 2: ADVANCED (Constants can be read and set in both quick programming mode and advanced programming mode.)	0 to 2	2	Yes	A
A1-04	Password	Password input when a password has been set in A1-05. This function write-protects constants of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 constants can only be changed after inputting the right password.	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 A1-05 will be displayed.	0 to 9999	0	No	A

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◆ Displaying User-set Constants Only

The A2 constants (user-set constants) and A1-01 (constant access level) can be used to establish a parameter set that contains only the most important parameters.

Set the number of the constant to which you want to refer in A2-01 to A2-32, and then set A1-01 to 1. Using the advanced programming mode you can read and modify A1-01 to A1-03 and the constants set in A2-01 to A2-32 only.

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
A2-01 to A2-32	User setting constants	Used to set the constant numbers that can be set/read. Maximum 32. Effective when the access level (A1-01) is set to User Pro-gram (1). Constants set in A2-01 to A2-32 can be set/read in programming mode.	b1-01 to o2-08	–	No	A

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7

Troubleshooting

This chapter describes the fault displays and countermeasure for Inverter and motor problems.

Protective and Diagnostic Functions 7-2
Troubleshooting 7-12

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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 switched OFF causing the motor to coast to stop. (The stopping method can be selected for some faults.) A fault code is displayed on the Digital Operator.

When a fault has occurred, refer to the following table to identify the fault and to correct the causes.

Use one of the following methods to reset the fault before 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 time is too short. • A special-purpose motor or motor with a capacity that is too large for the Inverter is used. • A magnetic switch was switched at the Inverter output while running.	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 the motor and cables for short circuits or insulation failures. • 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 option.
		The power supply voltage is too high.	Decrease the voltage so that it is within the inverters specifications.

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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 error occurred at 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 inrush current 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 Current Prevention Circuit Fault Overheating occurred in the inrush resistor. The MC did not respond for 10 s after the MC ON signal has been output.	• 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 bus 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 high. • The voltage balance between the phases is bad.	Reset the fault after correcting its cause.
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 105°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 your sales representative.)
	Inverter's Cooling Fan Stopped	The Inverter's cooling fan has stopped.	
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 at terminal A2.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
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 at terminal 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 Setting (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 torque higher than the setting in L6-02 for longer than the time 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 of the connected machine is too large.	Make sure the load is an inertial load.
UL3	Undertorque Detected 1 There has been a torque lower than the setting in L6-02 for longer than the time 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 undertorque.
FbL	PI Feedback Lost A PI feedback loss detection is enabled (b5-12 ≠ 0) 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).	–	• Check the PI feedback signal source for correct operation. • Check the wiring.
EF0	External fault input from Communications Option Card	–	Check the Communications Option Card and communications signals.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
EF3	External fault (Input terminal 3)	An "external fault" was input from a multi-function input terminal (S3 to S7).	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 using the operator as RUN command source.	–	Check the connection to the Digital Operator.
CE	MEMOBUS Communications Error A normal receive was not possible for 2 s or longer after control data were 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.
CPF00	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.
CPF01	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.
CPF02	Baseblock circuit error	–	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF03	EEPROM error	–	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF04	CPU internal A/D converter error	–	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
CPF05	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF06	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.
CPF07	ASIC internal RAM fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF08	Watchdog timer fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF09	CPU-ASIC mutual diagnosis fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF10	ASIC version fault	The Inverter control circuit is faulty	Replace the Inverter.
CPF20	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.
CPF21	Communications Option Card self diagnostic error	Communications Option Card fault.	Replace the Option Card.
CPF22	Communications Option Card model code error		
CPF23	Communications Option Card DPRAM error		

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◆ 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 when the cause of the alarm has been removed.

The Digital Operator display flashes and the alarm can be output at the multi-function outputs (H2-01 or H2-02).

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 inrush current limiting resistor bypass 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.)
oH3 (blinking)	Motor overheating H3-09 is set to "E" 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 terminal A2.
oL3 (blinking)	Overtorque 1 There has been a torque higher than the setting in L6-02 for longer than the time 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.
EF0 (blinking)	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.

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Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
EF3 (blinking)	External fault (Input terminal S3)	An external fault was input from a multi-function input terminal (S3 to S7).	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 Lost A PI feedback loss detection is enabled (b5-12 ≠ 0) 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).	–	–
CE (blinking)	MEMOBUS Communications Error Normal receive 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.
dnE (blinking)	Drive not enabled	An digital input is programmed to 6A (Drive Enable) or 70 (Bypass Drive Enable) and a RUN command was input while the drive was not enabled.	Check the wiring and sequence of the external signals.
CrST (blinking)	Cannot Reset	It is tried to reset a fault while a RUN command is still active.	Remove the RUN command and reset.

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◆ 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.)

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. Check constant o2-04 for the correct setting.
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 H1-05) settings: • The same setting has been selected for two or more multi-function inputs. • An up or down command was selected separately. (They must be used together.) • The up/down commands (10 and 11) and Accel/Decel Ramp Hold (A) were selected at the same time. • Speed Search 1 (61) and Speed Search 2 (62) were selected at the same time for a digital input. • External Baseblock NO (8) and External Baseblock NC (9) were selected at the same time. • The up/down commands (10 and 11) were selected while PI Control (b5-01) was enabled. • 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).
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.
oPE10	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 frequency Gain) > 6 and C6-03 (Carrier Frequency Upper Limit) < C6-04 (Carrier Frequency Lower Limit) • Upper/lower limit error in C6-03 to 04.
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.

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◆ Errors During Autotuning

The errors that can occur during autotuning are given in the following table. If an error is detected, the motor will coast to a stop and 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. The is an error between the no-load current setting and the input motor rated current (when autotuning for only line-to-line resistance is performed for vector control).	• Check the input data. • Check the capacity of the Inverter and motor. • Check the motor rated current and no-load current.
Er-02	Alarm	A minor fault occurred during autotuning.	• 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.
End3	Rated current setting alarm*	The rated current is set too high.	Check the input data (particularly the 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 o3-01 will be displayed. The error contact output and alarm output will not be operated.

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 read constants when the Digital Operator was write-protected (o3-02 = 0).	Set o3-02 to 1 to enable writing constants into the Digital Operators memory.
	iFE	Illegal read data	The read data length does not agree.	Repeat the read. Check the Digital Operator cable. Replace the Digital Operator.
			The read data are incorrect.	
	rdE	Illegal write status	An attempted write of a constant to the EEPROM of the Digital Operator failed.	A low Inverter voltage has been detected. Repeat the read. Replace the Digital Operator.

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Table 7.5 Errors during Copy Function

Function	Display	Meaning	Probable causes	Corrective Actions
Copy	CPE	ID does not match	The Inverter product code or software number is different.	Use the copy function for the same product code and software number only.
	vAE	Inverter capacity does not match	The capacity of the Inverter being copied and the capacity stored in the Digital Operator are different.	Use the copy function for the same Inverter capacity only.
	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 only.
	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.
Verify	vYE	Verify error	The settings in the operator and the inverter do not match.	–

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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 perform the appropriate counter measures.

If the contents of the fault are displayed, refer to *Protective and Diagnostic Functions*.

◆ If Constants 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 off the RUN command 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 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-connect it.

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◆ 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.

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 can be enabled or disabled by setting o2-01. It is enabled when the drive mode is entered and o2-01 is set to 1.

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.

■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 up 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.

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 can be enabled or disabled by setting o2-01. It is enabled when the drive mode is entered and o2-01 is set to 1.

A 3-wire control in effect.

The input method for a 3-wire control is different than when operating by forward/stop and reverse/stop (2-wire control). If a 3 wire control is selected, the motor will not operate when a wiring that is suitable for 2-wire control is used. When using a 3-wire control, refer to the wiring example and timing chart on *Page 6-10* and input the proper signals.

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When using a 2-wire control, 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.

■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 rotates in one direction only.

"Reverse run prohibited" is selected. If b1-04 (Prohibition of Reverse Operation) is set to 1 or 3(reverse run prohibited), the Inverter will not accept reverse run commands. To use both forward and reverse operation, set b1-04 to 0 or 2.

◆ 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, or use constant b1-04 to reverse output direction (in V/f mode only).

◆ 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 very 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 may drop already at low output torque. Check to be sure that the set value is suitable.

◆ If the Motor Operates at Higher Speed than the Frequency Reference

■The analog frequency reference bias or gain setting is wrong.

The frequency reference bias or gain set in constant H3-03 or H3-02 influence the frequency reference. Check to be sure that these set values are suitable.

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■A signal is being input to the multifunction analog input terminal A2.

When “0” (frequency bias) 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

■The deceleration time is long even when a braking option is connected.

The following causes are possible.

"Stall prevention during deceleration enabled" is set.

When a braking option is connected, set constant L3-04 (Stall Prevention Selection during Deceleration) to 0 (disabled). When this constant is set to 1 (enabled), the braking option does not fully work.

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, maybe then the motor's power limit is reached. Consider increasing the motor capacity.

◆ If the Motor Overheats

■The load is too heavy.

If the motor load is too heavy and the motor is used continuously with a torque that exceeds the motor's rated torque, the motor will overheat. Reduce the load amount by lowering the load. 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 be 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 output and the motor coil. Normally the maximum surge voltage is up to 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 higher than the maximum surge voltage.

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◆ If peripheral devices like PLC's or other are influenced by the starting or running inverter

If electrical noise is generated by Inverter perform the following countermeasures:

- Change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency.
- Install an Input Noise Filter at the Inverter's power supply input.
- Install an Output Noise Filter at the Inverter's output.
- Make sure that motor and inverter are grounded properly.
- Separate main circuit wiring from control circuit wiring.

◆ If the Earth Leakage Breaker Operates when a RUN Command is Input

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 higher, with an operating time of 0.1 s or more), or one that incorporates high frequencies (i.e., one designed for use with Inverters). It will also help to some extent to lower the Inverter's Carrier Frequency Selection (C6-02). 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 occur.

The gain and time constant adjustments for the torque compensation may be insufficient. Lower the gain settings and raise the delay time settings. Also adjust the hunting prevention function (N1-□□).

■Oscillation and hunting occur 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 6-86pp.*)

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◆ If the Motor Rotates Even When Inverter Output is Stopped

If the motor coasts at low speed after a deceleration to 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 (Overvoltage) or OC (Overcurrent) is Detected When a Fan is Started, or Fan Stalls

Generation of OV (DC bus overvoltage) or OC (Overcurrent) and stalling can occur if a fan is turning before it is started (e.g. through the windmill effect).

This can be prevented by stopping the fan rotation using DC injection braking before starting the fan. Alternatively the speed search function can be used to catch the rotating motor.

◆ 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.

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8

Maintenance and Inspection

This chapter describes basic maintenance and inspection for the Inverter

Maintenance and Inspection 8-2

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Maintenance and Inspection

◆ Outline of Maintenance

The maintenance period of the Inverter is as follows:

Maintenance Period: Within 18 months from shipping from the factory or within 12 months from 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 x 10^4 to 58.8 x 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 x 10^4 to 58.8 x 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 x 10^4 to 58.8 x 10^4 Pa (4 to 6 kg•cm^2).
Smoothing capacitor	Are there any irregularities, such as discoloration or odour?	Replace the capacitor or Inverter.

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◆ Periodic Maintenance of Parts

The Inverter consists of many parts, and these parts must be operating properly in order to ensure full functioning of the Inverter.

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.)
Soft charge resistor bypass contactor	–	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

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◆ 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 cable.
3. Open the fan cover on the left and right sides and remove the fan cover from the fan.

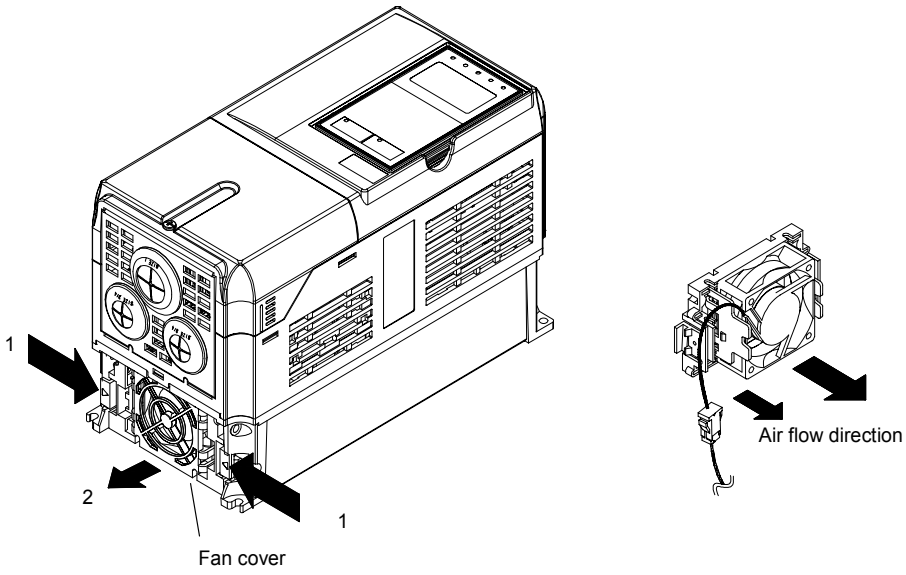


Fig 8.3 Cooling Fan Replacement (Inverters of 18.5 kW or Less)

Mounting the Cooling Fan

1. Attach the fan cover to the cooling fan. Be sure that the air flow direction is correct (see figure above).
2. Connect the cables securely and place the 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 heatsink.

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■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 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, use the above described procedure in reverse order to attach all of the components.

When attaching the cooling fan to the mounting bracket, be sure that the air flow direction faces the top of the Inverter.

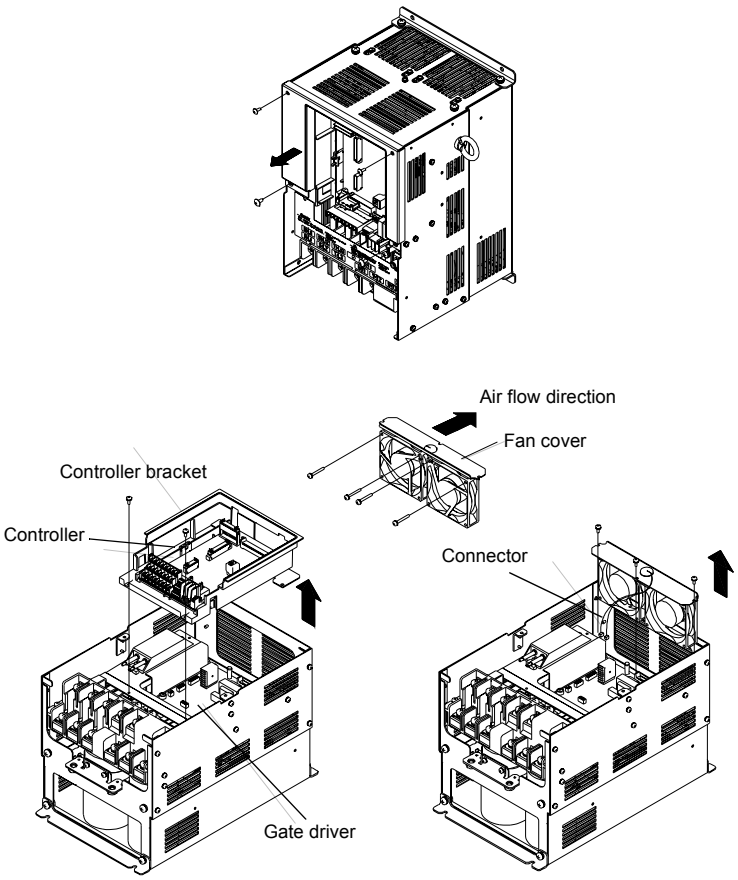


Fig 8.4 Cooling Fan Replacement (Inverters of 22 kW or More)

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◆ Removing and 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 downwars (in direction 2).

■Mounting the Control Circuit Terminal Card

Use the removal procedure in reverse order to mount the terminal card.

Confirm that the terminal circuit card and the controller card properly meet at connector CN5 before pressing into its plan.

The connector pins may be bent if the card is forced into place!

Removing and Mounting the
Control Circuit Terminal Card

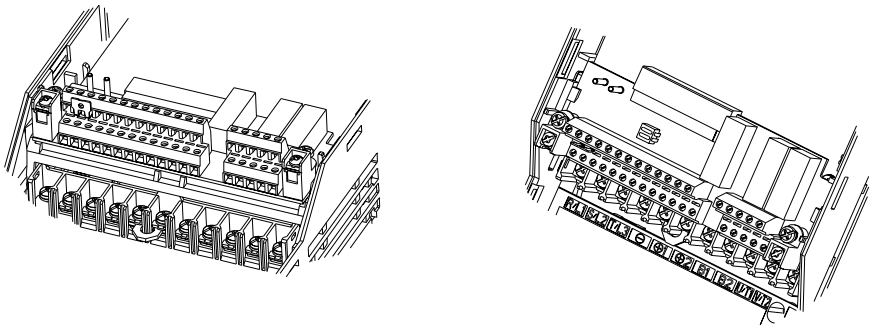


Fig 8.5 Removing the Control Circuit Terminal Card



IMPORTANT

Always confirm that the charge indicator does not light anymore before removing or mounting the control circuit terminal card.

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9

Specifications

This chapter describes the basic specifications of the Inverter and specifications for options and peripheral devices.

Standard Inverter Specifications 9-2

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Standard Inverter Specifications

The standard Inverter specifications are listed by capacity in the following tables.

◆ 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			0.55	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)		120.0																	
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-pulse 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 transformer with dual star-delta secondary is required on the power supply for 12-pulse rectification.

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■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			0.55	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)		120.0										
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)		120.0												
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 standard motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is higher than the motor's rated current.

* 2. A transformer with dual star-delta secondary is required on the power supply for 12-pulse-rectification.

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◆ 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	±3 – 3% (25°C ± 10°C)
	Frequency control range	0.0to 120.0 Hz
	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 (11 bits plus sign)
	Output frequency resolution	0.01 Hz
	Frequency setting signal	0 to +10V, 4 to 20 mA
	Acceleration/Deceleration time	0.01 to 6000.0 s (2 selectable combinations of independent acceleration and deceleration settings)
	Braking torque	Approximately 20%
	Main control functions	Restarting for momentary power loss, speed searches, overtorque detection, 5-speed control (maximum), acceleration/deceleration time changes, S-curve acceleration, 3-wire control, 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 copy function.
Protective functions	Motor protection	Protection by electronic thermal overload relay.
	Instantaneous overcurrent protection	Stops at approx. 200% of rated output current.
	Fuse blown protection	Stops for fuse blown.
	Overload protection*1	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 ridethrough	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.
	Charge indicator	Lights up 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. Increase the Inverter capacity if loads exceeding these current values are expected.

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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

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Inverter Application Precautions

◆ 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 compensating 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.

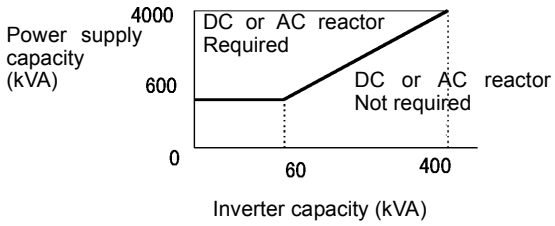


Fig 10.1

■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 characteristic generally is different from those when starting a motor at 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.

■Options

Terminals ⊖, ⊕1, ⊕2, ⊕3 are for connecting only the options specifically provided by Yaskawa. Never connect any other devices to these terminals.

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◆ Installation

Observe the following precautions when installing an Inverter.

■Installation in Enclosures

Either install the Inverter in a clean location where it is not subjected to oil mist, 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 vertical 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 current or braking time is set to a too 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, it might be necessary to increase the acceleration or deceleration time.

To reduce the acceleration or deceleration times, increase the capacity of the motor and Inverter.

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◆ 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 control 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 power supply ON and OFF more than one time every 30 minutes.

■Maintenance and Inspections

After turning OFF the main circuit power supply, always confirm that the CHARGE indicator has gone out before performing maintenance or inspections. The voltage remaining in the capacitor may cause electric shock.

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Motor Application Precautions

◆ Using the Inverter for an Existing Standard Motor

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 of the motor temperature. Therefore, the motor torque should be reduced in the low-speed range whenever using a fan cooled motor.

■Installation Withstand Voltage

If the input voltage is high (480 V or higher) or the wiring distance is long, the motor insulation voltage must be considered. Contact your Yaskawa representative for details.

■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.

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◆ 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 an appropriate Inverter according to the maximum input current of the motor.

■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 voltage drop and thereby motor torque reduction.

■Explosion-proof Motor

When an explosion-proof motor is to be used, it must be subjected 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 damaging. If the motor is to be operated at a speed higher than 50 Hz, consult the manufacturer.

■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 low speeds continuously.

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User Constants

Factory settings are given in the following table. These are factory settings for a 200 V Class Inverter with 0.4 kW (open loop vector control).

Table 10.1 User Constants

No.	Name	Factory Setting	Setting
A1-00	Language selection for digital operator display (JVOP-160)	0	
A1-01	Constant access level	2	
A1-03	Initialize	0	
A1-04	Password	0	
A1-05	Password setting	0	
A2-01 to A2-32	User setting constants	–	
b1-01	Reference source selection	1	
b1-02	RUN command source 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	
b1-11	RUN delay	0 s	
b1-12	HAND Fref Source	0	
b2-01	Zero speed level (DC injection braking starting frequency)	0.5 Hz	
b2-02	DC injection braking current	50 %	
b2-03	DC injection braking time at start	0.00 s	
b2-04	DC injection braking time at stop	0.50 s	
b2-09	Motor pre-heat current	0%	
b3-01	Speed search selection	2	
b3-02	Speed search operating current	120 %*1	
b3-03	Speed search deceleration time	2.0 s	
b3-05	Speed search wait time	0.2 s	
b3-14	Bi-directional speed search selection	1	
b4-01	Timer function ON-delay time	0.0 s	
b4-02	Timer function OFF-delay time	0.0 s	
b5-01	PI control mode selection	0	
b5-02	Proportional gain (P)	1.00	
b5-03	Integral (I) time	1.0 s	
b5-04	Integral (I) limit	100.0 %	
b5-06	PI limit	100.0 %	
b5-07	PI offset adjustment	0.0 %	
b5-08	PI delay time constant	0.00 s	
b5-09	PI output characteristics selection	0	
b5-10	PI output gain	1.0	
b5-11	PI reverse output selection	0	
b5-12	Selection of PI feedback loss detection	0	
b5-13	PI feedback loss detection level	0 %	
b5-14	PI feedback loss detection time	1.0 s	
b5-15	PI sleep function operation level	0.0 Hz	
b5-16	PI sleep operation delay time	0.0 s	
b5-17	Acceleration/deceleration time for PI reference	0.0 s	

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Table 10.1 User Constants

No.	Name	Factory Setting	Setting
b5-18	PI Setpoint Selection	0	
b5-19	PI Setpoint	0.0 %	
b5-20	PI Setpoint Scaling	0	
b5-21	PI Sleep Function Selection	0	
b5-22	Snooze Level	0%	
b5-23	Snooze Delay Time	0s	
b5-24	Wake Up-level	0%	
b5-25	Setpoint Boost	0%	
b5-26	Maximum Boost Time	0 s	
b5-27	Snooze feedback	60 %	
b5-28	PI Feedback Square Root Operation	0	
b5-29	PI Feedback Square Root Gain	1.00	
b5-30	PI Output Monitor Square Root	0	
b8-01	Energy-saving mode selection	0	
b8-04	Energy-saving coefficient	*4	
b8-05	Power detection filter time constant	20 ms	
b8-06	Search operation voltage limiter	0 %	
C1-01	Acceleration time 1	10.0 s	
C1-02	Deceleration time 1	10.0 s	
C1-03	Acceleration time 2	10.0 s	
C1-04	Deceleration time 2	10.0 s	
C1-09	Emergency stop time	10.0 s	
C1-11	Accel/decel time switching frequency	0.0 Hz	
C2-01	S-curve characteristic time at acceleration start	0.20 s	
C2-02	S-curve characteristic time at acceleration end	0.20 s	
C4-01	Torque compensation gain	1.00	
C4-02	Torque compensation time constant	200 ms*1	
C6-02	Carrier frequency selection	6	
C6-03	Carrier Frequency Upper Limit	15 kHz*1	
C6-04	Carrier Frequency Lower Limit	15 kHz*1	
C6-05	Carrier Freq. Proportional Gain	00	
d1-01	Frequency reference 1	0.00 Hz	
d1-02	Frequency reference 2	0.00 Hz	
d1-03	Frequency reference 3	0.00 Hz	
d1-04	Frequency reference 4	0.00 Hz	
d1-17	Jog frequency reference	6.00 Hz	
d2-01	Frequency reference upper limit	100.0 %	
d2-02	Frequency reference lower limit	0.0 %	
d2-03	Master speed reference lower limit	0.0 %	
d3-01	Jump frequency 1	0.0 Hz	
d3-02	Jump frequency 2	0.0 Hz	
d3-03	Jump frequency 3	0.0 Hz	
d3-04	Jump frequency width	1.0 Hz	
d4-01	Frequency reference hold function selection	0	
d4-02	+ - Speed limits	10 %	
E1-01	Input voltage setting	200 V*2	

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Table 10.1 User Constants

No.	Name	Factory Setting	Setting
E1-03	V/f pattern selection	F	
E1-04	Max. output frequency	50.0 Hz	
E1-05	Max. voltage	200.0 V*2	
E1-06	Base frequency	50.0 Hz	
E1-07	Mid. output frequency	2.5 Hz *1	
E1-08	Mid. output frequency voltage	15.0 V*2	
E1-09	Min. output frequency	1.2 Hz	
E1-10	Min. output frequency voltage	9.0 V*2	
E1-11	Mid. output frequency 2	0.0 Hz*3	
E1-12	Mid. output frequency voltage 2	0.0 V*3	
E1-13	Base voltage	0.0 V*4	
E2-01	Motor rated current	1.90 A*1	
E2-03	Motor no-load current	1, 2*2	
E2-05	Motor line-to-line resistance	9.842Ω*3	
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	1	
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	0	
H2-02	Terminal M3-M4 function selection	1	
H3-02	Gain (terminal A1)	100.0 %	
H3-03	Bias (terminal A1)	0.0 %	
H3-08	Multi-function analog input terminal A2 signal level selection	2	
H3-09	Multi-function analog input terminal A2 function selection	0	
H3-10	Gain (terminal A2)	100.0 %	
H3-11	Bias (terminal A2)	0.0 %	
H3-12	Analog input filter time constant	0.00 s	
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	Communications speed selection	3	
H5-03	Communications parity selection	0	

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Table 10.1 User Constants

No.	Name	Factory Setting	Setting
H5-04	Stopping method after communications error	3	
H5-05	Communications error detection selection	1	
H5-06	Send wait time	5 ms	
H5-07	RTS control ON/OFF	1	
H5-08	Communications Selection	0	
H5-09	CE detection time	2.0 sec	
L1-01	Motor protection selection	1	
L1-02	Motor protection time constant	1.0 min	
L1-03	Alarm operation selection during motor overheating	3	
L1-04	Motor overheating operation selection	1	
L1-05	Motor temperature input filter time constant	0.20 s	
L2-01	Momentary power loss detection	0	
L2-02	Momentary power loss ridethru time	0.1 s*1	
L2-03	Min. baseblock time	0.1s *1	
L2-04	Voltage recovery time	0.3 s *1	
L2-05	Undervoltage detection level	190 V*2	
L3-01	Stall prevention selection during acceleration	1	
L3-02	Stall prevention level during acceleration	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 Hz	
L4-02	Speed agreement detection width	2.0 Hz	
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	
L5-03	Fault Retry Time	10.0 x	
L6-01	Torque detection selection 1	0	
L6-02	Torque detection level 1	150 %	
L6-03	Torque detection time 1	0.1 s	
L8-02	Overheat pre-alarm level	95 °C	
L8-03	Operation selection after overheat pre-alarm	3	
L8-06	Input phase loss detection level	5 %	
L8-09	Ground protection selection	1	
L8-10	Cooling fan control selection	0	
L8-11	Cooling fan control delay time	60 s	
L8-12	Ambient temperature	45 °C	
L8-15	OL2 characteristics selection at low speeds	1	
L8-18	Soft CLA selection	1	
L8-19	Frequency reference during OH pre-alarm	20.0 %	
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 s	

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Table 10.1 User Constants

No.	Name	Factory Setting	Setting
N3-04	High-slip braking OL time	40 s	
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	
o1-06	Monitor mode Selection*6	0	
o1-07	2nd monitor selection*6	2	
o1-08	3rd monitor selection*6	2	
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*4	
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 hr	
o2-08	Cumulative operation time selection	0	
o2-09	Initialize mode	2	
o2-10	Fan operation time setting	0 hr	
o2-12	Fault trace initialisation	0	
02-14	Energy monitor initialize	0	
o2-15	HAND key function selection	1	
o3-01	Copy function selection	0	
o3-02	Read permition selection	0	
T1-02	Motor output power	0.40 kW *4	
T1-04	Motor rated current	1.90 A*4	
T1-06	Number of motor poles	4	

* 1. Initial setting depends on Inverter capacity.
* 2. Setting for 200 V class Inverters. For 400 V class Inverters, double the value.
* 3. The contents is ignored if the setting is 0.0.
* 4. E1-13 will have the same value as E1-05 after autotuning.
* 5. Factory setting in the parentheses is for 3-wire sequence.
* 6. Parameter is only effective if HOA operator with LCD (JVOP-162) is used.

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