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Preface

This manual is designed to ensure correct and suitable application of Varispeed F7S-Series Inverters. Read this manual before attempting to install, operate, maintain, or inspect an Inverter and keep it in a safe, convenient location for future reference. Be sure you understand all precautions and safety information before attempting application.

General Precautions

- The diagrams in this manual may be indicated without covers or safety shields to show details. Be sure to restore covers or shields before operating the Units and run the Units according to the instructions described in this manual.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
- When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representatives or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- If nameplates become worn or damaged, order new ones from your Yaskawa representatives or the nearest Yaskawa sales office.

Safety Information

The following conventions are used to indicate precautions in this manual. Failure to heed precautions provided in this manual can result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.



Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.



Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

Failure to heed a precaution classified as a caution can result in serious consequences depending on the situation.



Indicates important information that should be memorized.

Safety Precautions

■ Confirmations upon Delivery

 CAUTION
<ul style="list-style-type: none">• Never install an Inverter that is damaged or missing components. Doing so can result in injury.

■ Installation

 CAUTION
<ul style="list-style-type: none">• Always hold the case when carrying the Inverter. If the Inverter is held by the front cover, the main body of the Inverter may fall, possibly resulting in injury.• Attach the Inverter to a metal or other noncombustible material. Fire can result if the Inverter is attached to a combustible material.• Install a cooling fan or other cooling device when installing more than one Inverter in the same enclosure so that the temperature of the air entering the Inverters is below 45°C. Overheating can result in fires or other accidents.

■ Wiring

 WARNING
<ul style="list-style-type: none">• Always turn OFF the input power supply before wiring terminals. Otherwise, an electric shock or fire can occur.• Wiring must be performed by an authorized person qualified in electrical work. Otherwise, an electric shock or fire can occur.• Be sure to ground the ground terminal. (200 V Class: Ground to 100 Ω or less, 400 V Class: Ground to 10 Ω or less) Otherwise, an electric shock or fire can occur.• Always check the operation of any emergency stop circuits after they are wired. Otherwise, there is the possibility of injury. (Wiring is the responsibility of the user.)• Never touch the output terminals directly with your hands or allow the output lines to come into contact with the Inverter case. Never short the output circuits. Otherwise, an electric shock or ground short can occur.• If the power supply is turned ON during the FWD (or REV) Run Command is given, the motor will start automatically. Turn the power supply ON after verifying that the RUN signal is OFF. Failure to observe this warning may result in injury.• When the 3-wire sequence is set, do not make the wiring for the control circuit unless the multi-function input terminal constant is set. Failure to observe this warning may result in injury.• The IPM motor is a synchronous motor with high-performance magnets mounted in the rotor. Unlike the induction motor, high motor-terminal voltage is generated while the motor is running, even when the Inverter power is OFF. Maintenance, inspection, or wiring must be done while the motor is stopped. Failure to observe this warning may result in an electric shock.• For applications where the overhauling load causes the motor to turn even when the Inverter power is OFF, be sure to connect a low-voltage manual starter on the Inverter's output side. Failure to observe this warning may result in an electric shock.

 **CAUTION**

- Motors of any other type, such as induction motors, can be connected only in the sequence test mode (A1-02=0). This Inverter is used exclusively for IPM motor drives.
Failure to observe this caution may result in damage to the Inverter or the motors.
- If connecting a motor in the sequence test mode (A1-02=0), the motor must be separated from the load (machine, equipment, etc).
Failure to observe this caution may result in injury or damage to the product.
- Check to be sure that the voltage of the main AC power supply satisfies the rated voltage of the Inverter.
Injury or fire can occur if the voltage is not correct.
- Do not perform voltage withstand tests on the Inverter.
Otherwise, semiconductor elements and other devices can be damaged.
- Connect braking resistors, Braking Resistor Units, and Braking Units as shown in the I/O wiring examples.
Otherwise, a fire can occur and the Inverter, braking resistors, Braking Resistor Units, and Braking Units can be damaged.
- Tighten all terminal screws to the specified tightening torque.
Otherwise, a fire may occur.
- Do not connect AC power to output terminals U, V, and W.
The interior parts of the Inverter will be damaged if voltage is applied to the output terminals.
- Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits.
The Inverter can be damaged or interior parts burnt if these devices are connected.
- Do not connect magnetic contactors to the output circuits.
If a load is connected while the Inverter is operating, surge current will cause the overcurrent protection circuit inside the Inverter to operate.
- Do not ground nor connect the AC terminal on the control circuit to the unit.
Doing so may result in a malfunction or a breakdown of the Inverter.

■ **Setting User Constants**

 **CAUTION**

- Disconnect the load (machine, device) from the motor before performing PG home position offset.
The motor may turn, possibly resulting in injury or damage to equipment. Also, motor constants cannot be correctly set with the motor attached to a load.
- Stay clear of the motor until PG home position offset has been successfully completed.
The motor could stop and then start again unexpectedly and this could result in injury.
- Always confirm the following before PG home position offset:
 - The lock key has been removed from the motor shaft.
 - There are neither people nor objects around the motor shaft.
 - The motor is at a complete stop.Failure to do so may result in injury.
- Be careful when handling the shaft and coupling.
Failure to do so may result in injury.
- Be careful not to injure yourself with the key groove when turning the motor shaft by hand.
Failure to do so may result in injury.
- For an initial operation or the first operation after replacing the Inverter or the motor, correctly set the motor constants. Then, be sure to double check if the settings were correctly made.
If the settings are incorrect, the overhauling load might cause the motor to turn because of insufficient torque, or the motor might not run in accordance with an issued command (reverses, does not move, or shortly accelerates).

■ Trial Operation



WARNING

- Check to be sure that the front cover is attached before turning ON the power supply.
An electric shock may occur.
- Do not come close to the machine when the fault reset function is used. If the alarmed is cleared, the machine may start moving suddenly.
Also, design the machine so that human safety is ensured even when it is restarted.
Injury may occur.
- Provide a separate emergency stop switch; the Digital Operator STOP Key is valid only when its function is set.
Injury may occur.
- Reset alarms only after confirming that the RUN signal is OFF.
Injury may occur.



CAUTION

- Don't touch the radiation fins (heatsink), braking resistor, or Braking Resistor Unit. These can become very hot.
Otherwise, a burn injury may occur.
- Be sure that the motor and machine is within the applicable ranges before starting operation.
Otherwise, an injury may occur.
- Provide a separate holding brake if necessary.
Always construct the external sequence to confirm that the holding brake is activated in the event of an emergency, a power failure, or an abnormality in the Inverter.
Failure to observe this caution can result in injury.
- If using an Inverter with an elevator, take safety measures on the elevator to prevent the elevator from dropping.
Failure to observe this caution can result in injury.
- Don't check signals while the Inverter is running.
Otherwise, the equipment may be damaged.
- Be careful when changing Inverter settings. The Inverter is factory set to suitable settings. For the Inverters in the 400 V class of 75 kW or more, however, select the correct connector according to the input voltage.
Otherwise, the equipment may be damaged.
- For the initial operation or the first operation after replacing the motor, set the motor constants before starting operation. Also, reconfirm the motor constants after they have been set.
Improper setting may cause the Inverter to malfunction. Failure to observe this caution may result in damage to the equipments, motors or Inverter.

■ Maintenance and Inspection



WARNING

- Do not touch the Inverter terminals. Some of the terminals carry high voltages and are extremely dangerous.
Doing so can result in electric shock.
- Always have the protective cover in place when power is being supplied to the Inverter. When attaching the cover, always turn OFF power to the Inverter through the MCCB.
Doing so can result in electric shock.
- Turn OFF the main circuit power supply, wait for the time indicated on the front cover, and make sure the CHARGE indicator light has gone out, and then perform maintenance and inspection.
The capacitor will remain charged and is dangerous.

 **WARNING**

- Maintenance or inspection must be done while the motor is stopped.
Failure to observe this warning may result in an electric shock.
- Do not carry out maintenance or inspections for at least 5 minutes after the low-voltage manual switching device on the output side is turned OFF.
Because the IPM motor contains a permanent magnet, voltage occurs between the terminals during rotation even if power is not applied. This voltage is dangerous and may cause electric shock.
- Maintenance, inspection, and replacement of parts must be performed only by authorized personnel.
Remove all metal objects, such as watches and rings, before starting work. Always use grounded tools.
Failure to heed these warning can result in electric shock.
- Provide a separate holding brake if necessary.
Always make any adjustments other than those involving the operation of the Inverter with the holding brake released.
Failure to observe this caution may result in injury.
- If using an Inverter with an elevator, take safety measures on the elevator to prevent the elevator from dropping.
Failure to observe this caution can result in injury.

 **CAUTION**

- A CMOS IC is used in the control board. Handle the control board and CMOS IC carefully.
The CMOS IC can be destroyed by static electricity if touched directly.
- Do not change the wiring, or remove connectors or the Digital Operator, during operation.
Doing so can result in personal injury.

■ Other

 **WARNING**

- Do not attempt to modify or alter the Inverter.
Doing so can result in electrical shock or injury.

 **CAUTION**

- Do not subject the Inverter to halogen gases, such as fluorine, chlorine, bromine, and iodine, at any time even during transportation or installation.
Otherwise, the Inverter can be damaged or interior parts burnt.

Warning Information and Position

There is warning information on the Inverter in the position shown in the following illustration. Always heed the warnings.

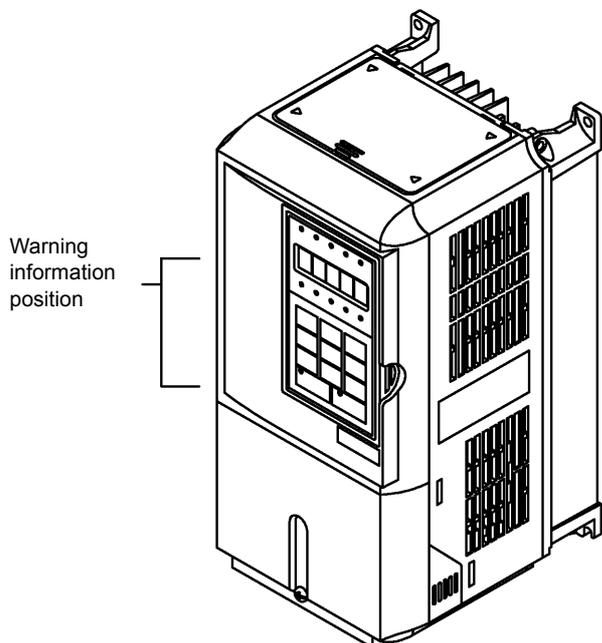


Illustration shows the CIMR-F7S20P4

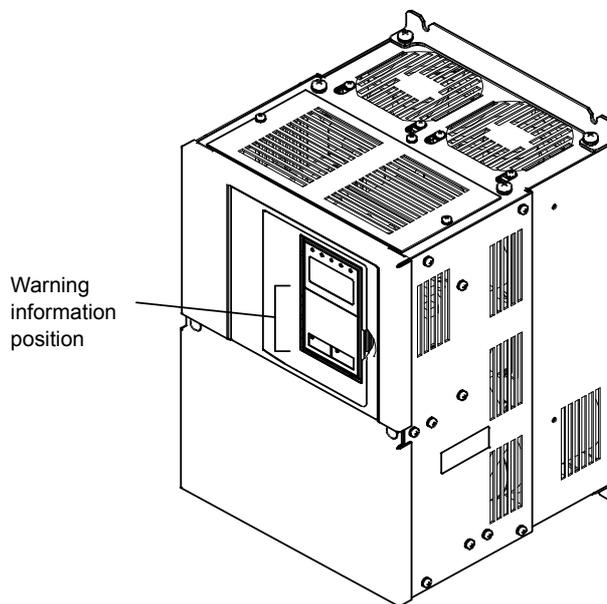


Illustration shows the CIMR-F7S20Z2

Warning Information

WARNING



Risk of electric shock.

- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.
- After opening the manual switch between the drive and motor, please wait 5 minutes before inspecting, performing maintenance or wiring the drive.



AVERTISSEMENT



Risque de décharge électrique.

- Lire le manuel avant l'installation.
- Attendre 5 minutes après la coupure de l'alimentation. Pour permettre la décharge des condensateurs.
- Après avoir déconnecté la protection entre le drive et le moteur, veuillez patienter 5 minutes avant d'inspecter, d'effectuer une opération de montage ou de câblage du variateur.



危険



けが・感電のおそれがあります。

- 据え付け・運転の前には必ず取扱説明書をお読み下さい。
- 通電中及び電源遮断後5分以内はタミナルカバーを外さないで下さい。
- 保守・点検、配線を行う場合は、出力側手動開閉器を遮断後、5分待って実施して下さい。

Warranty Information

■ Free Warranty Period and Scope

Warranty Period

This product is warranted for twelve months after being delivered to Yaskawa's customer or if applicable eighteen months from the date of shipment from Yaskawa's factory whichever comes first.

Scope of Warranty

Inspections

Periodic inspections must be conducted by the customer. However, upon request, Yaskawa or one of Yaskawa's Service Centers can inspect the product for a fee. In this case, if after conferring with the customer, a Yaskawa product is found to be defective due to Yaskawa workmanship or materials and the defect occurs during the warranty period, then this fee will be waived and the problem remedied free of charge.

Repairs

If a Yaskawa product is found to be defective due to Yaskawa workmanship or materials and the defect occurs during the warranty period, Yaskawa will provide a replacement, repair the defective product, and provide shipping to and from the site free of charge.

However, if the Yaskawa Authorized Service Center determines that the problem with a Yaskawa product is not due to defects in Yaskawa's workmanship or materials, then the customer will be responsible for the cost of any necessary repairs. Some problems that are outside the scope of this warranty are:

- Problems due to improper maintenance or handling, carelessness, or other reasons where the customer is determined to be responsible.
- Problems due to additions or modifications made to a Yaskawa product without Yaskawa's understanding.
- Problems due to the use of a Yaskawa product under conditions that do not meet the recommended specifications.
- Problems caused by natural disaster or fire.
- Or other problems not due to defects in Yaskawa workmanship or materials.

Warranty service is only applicable within Japan.

However, after-sales service is available for customers outside of Japan for a reasonable fee. Contact your local Yaskawa representative for more information.

■ Exceptions

Any inconvenience to the customer or damage to non-Yaskawa products due to Yaskawa's defective products whether within or outside the warranty period are NOT covered by this warranty.

■ Restrictions

- The Varispeed F7S was not designed or manufactured for use in devices or systems that may directly affect or threaten human lives or health.
- Customers who intend to use the product described in this manual for devices or systems relating to transportation, health care, space aviation, atomic or electric power, or underwater use must contact their Yaskawa representatives or the nearest Yaskawa sales office beforehand.
- This product has been manufactured under strict quality-control guidelines. However, if this product is to be installed in any location where failure of this product could involve or result in a life-and-death situation or loss of human life or in a facility where failure may cause a serious accident or physical injury, safety devices must be installed to minimize the likelihood of any accident.

Registered Trademarks

The following registered trademarks are used in this manual.

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

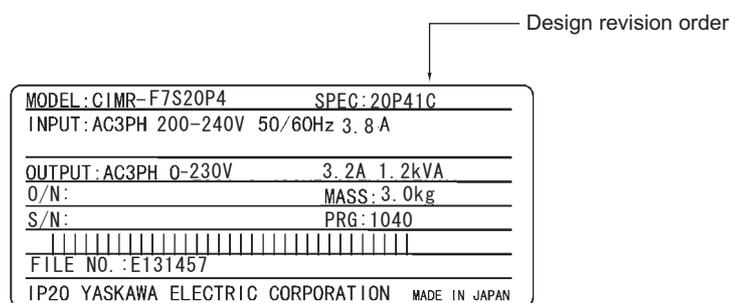
Before Reading This Manual

This manual explains both the conventional Varispeed F7S-Series Inverters and the F7S-series Inverters with SPEC: C or later.

The shaded sections or those specified as being for SPEC: C or later apply only to F7S-series Inverters with SPEC: C or later (Inverter with design revision order of C or later.)

Be certain to check the specification on the Inverter nameplate.

Example of Inverter Nameplate



■ Precautions when Using a F7S-series Inverter with SPEC: B or Earlier

The design revision number and software version of the F7S-series Inverters with SPEC: C or later have been modified as shown in the table below. The design revision order and software version can be found on the Inverter nameplate. When using a F7S-series Inverter with SPEC: B or earlier, observe the following precautions.

Inverter	Design Revision Order	Software Version
Inverter with SPEC: B or earlier	A or B	PRG:103□
Inverter with SPEC: C or later	C or later	PRG:104□

Precautions

- The factory settings of C6-01 (CT/VT selection) and the constants related to C6-01 of the F7S-series Inverter with SPEC: B or earlier are different from those of the F7S-series Inverter with SPEC: C or later.
Refer to *Application and Overload Selections of Chapter 6 Constant Settings by Function*, and set the constants according to your application.
- The COPY function of the Digital Operator for the F7S-series Inverter with SPEC: B or earlier is limited because of the software version different from that of the F7S-series Inverter with SPEC: C or later.
Set the related constants, referring to *Application and Overload Selections of Chapter 6 Constant Settings by Function*.

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Revision History



1

Handling Inverters

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

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Varispeed F7S Introduction

◆ Varispeed F7S Applications

The Varispeed F7S is ideal for the following applications.

- Fan, blower, and pump applications
- Conveyors, pushers, metal tooling machines, etc.

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

◆ Varispeed F7S Models

The Varispeed-F7S Series of Inverters included two Inverters in two voltage classes: 200 V and 400 V. Maximum motor capacities vary from 0.4 to 300 kW (39 models).

Table 1.1 Varispeed F7S Models

Voltage Class	Maximum Motor Capacity kW	Varispeed F7S		Specifications (Always specify through the protective structure when ordering.)	
		Output Capacity kVA	Basic Model Number	Open Chassis (IEC IP00) CIMR-F7S□□□□□□	Enclosed Wall-mounted [IEC IP20, NEMA 1 (Type 1)] CIMR-F7S□□□□□□
200 V Class	0.4	1.2	CIMR-F7S20P4	Remove the top and bottom covers from the Enclosed Wall-mounted model.	20P41□
	0.75	1.6	CIMR-F7S20P7		20P71□
	1.5	2.7	CIMR-F7S21P5		21P51□
	2.2	3.7	CIMR-F7S22P2		22P21□
	3.7	5.7	CIMR-F7S23P7		23P71□
	5.5	8.8	CIMR-F7S25P5		25P51□
	7.5	12	CIMR-F7S27P5		27P51□
	11	17	CIMR-F7S2011		20111□
	15	22	CIMR-F7S2015		20151□
	18.5	27	CIMR-F7S2018		20181□
	22	32	CIMR-F7S2022		20220□
	30	44	CIMR-F7S2030	20300□	20301□
	37	55	CIMR-F7S2037	20370□	20371□
	45	69	CIMR-F7S2045	20450□	20451□
	55	82	CIMR-F7S2055	20550□	20551□
75	110	CIMR-F7S2075	20750□	20751□	

Table 1.1 Varispeed F7S Models (Continued)

Voltage Class	Maximum Motor Capacity kW	Varispeed F7S		Specifications (Always specify through the protective structure when ordering.)	
		Output Capacity kVA	Basic Model Number	Open Chassis (IEC IP00) CIMR-F7S□□□□□□	Enclosed Wall-mounted [IEC IP20, NEMA 1 (Type 1)] CIMR-F7S□□□□□□
400 V Class	0.4	1.4	CIMR-F7S40P4	Remove the top and bottom covers from the Enclosed Wall-mount model.	40P41□
	0.75	1.6	CIMR-F7S40P7		40P71□
	1.5	2.8	CIMR-F7S41P5		41P51□
	2.2	4.0	CIMR-F7S42P2		42P21□
	3.7	5.8	CIMR-F7S43P7		43P71□
	5.5	9.5	CIMR-F7S45P5		45P51□
	7.5	13	CIMR-F7S47P5		47P51□
	11	18	CIMR-F7S4011		40111□
	15	24	CIMR-F7S4015		40151□
	18.5	30	CIMR-F7S4018		40181□
	22	34	CIMR-F7S4022	40220□	40221□
	30	46	CIMR-F7S4030	40300□	40301□
	37	57	CIMR-F7S4037	40370□	40371□
	45	69	CIMR-F7S4045	40450□	40451□
	55	85	CIMR-F7S4055	40550□	40551□
	75	110	CIMR-F7S4075	40750□	40751□
	90	140	CIMR-F7S4090	40900□	40901□
	110	160	CIMR-F7S4110	41100□	41101□
	132	200	CIMR-F7S4132	41320□	41321□
	160	230	CIMR-F7S4160	41600□	41601□
185	280	CIMR-F7S4185	41850□	-	
220	390	CIMR-F7S4220	42200□	-	
300	510	CIMR-F7S4300	43000□	-	

Confirmations upon Delivery

◆ Checks

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

Table 1.2 Checks

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

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

◆ Nameplate Information

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

■ Example Nameplate

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

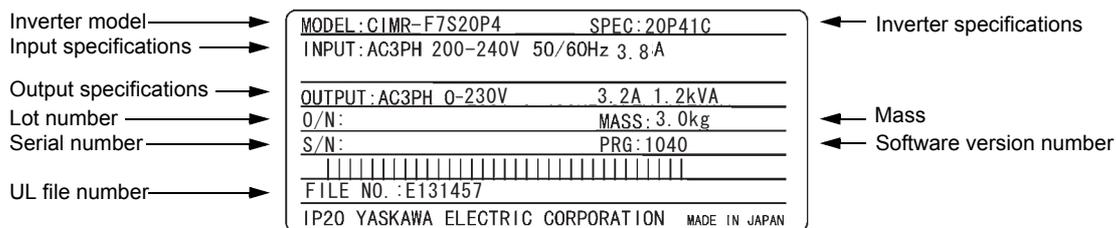


Fig 1.1 Nameplate

■ Inverter Model Numbers

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

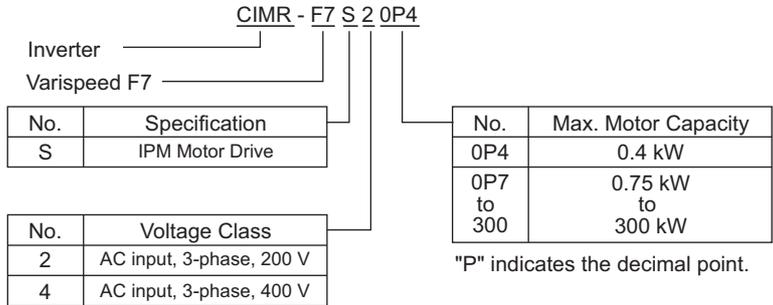


Fig 1.2 Inverter Model Numbers

■ Inverter Specifications

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

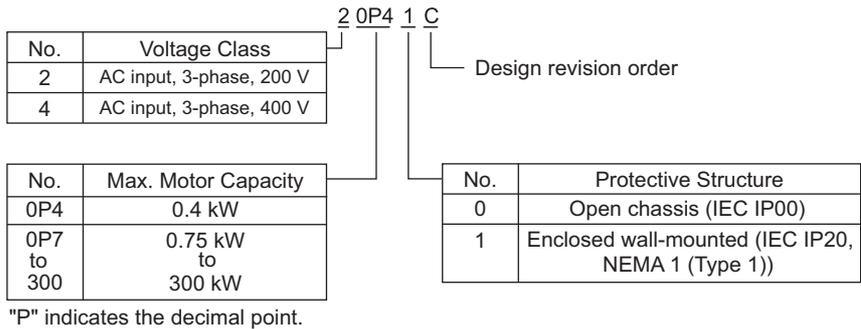


Fig 1.3 Inverter Specifications



TERMS

Open Chassis Type (IEC IP00)

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

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

The Inverter is structured so that the Inverter is shielded from the exterior, and can thus be mounted to the interior wall of a standard building (not necessarily enclosed in a control panel). The protective structure conforms to the standards of NEMA 1 (Type 1) in the USA. The protective covers (see Fig. 1.4) are required for an IEC IP20 or NEMA 1 (Type 1) protective structure.

◆ Component Names

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*.

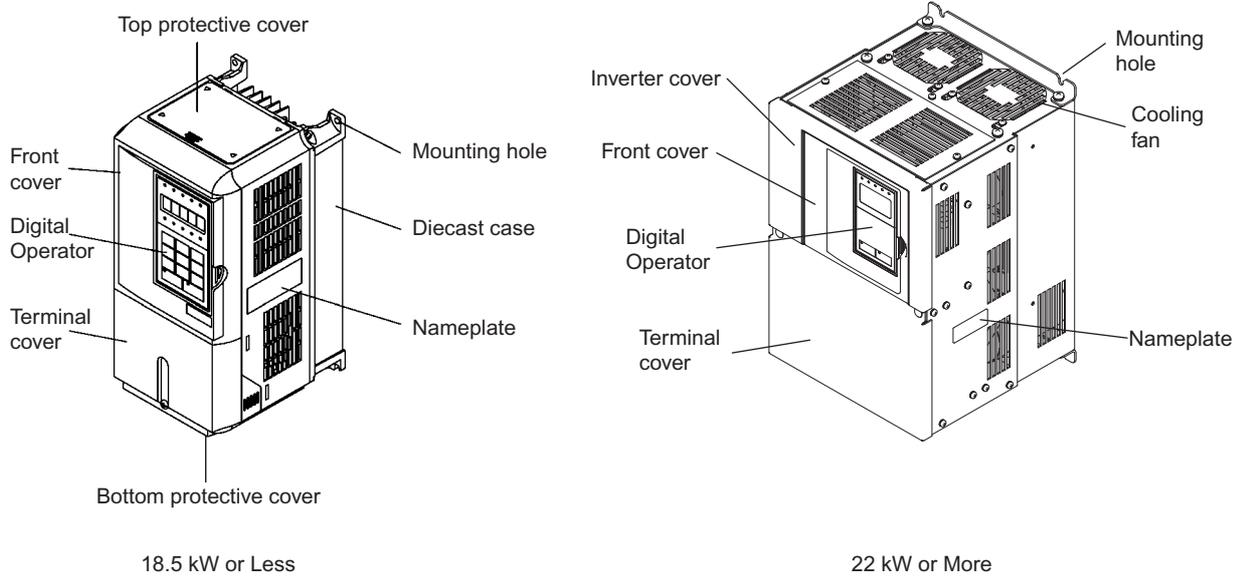


Fig 1.4 Inverter Appearance

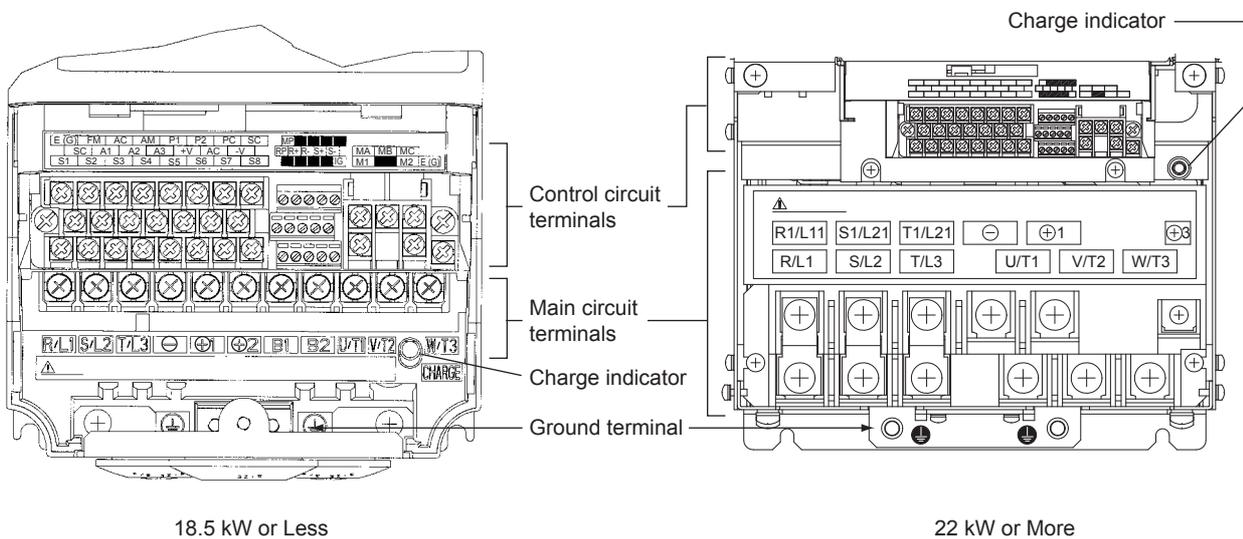
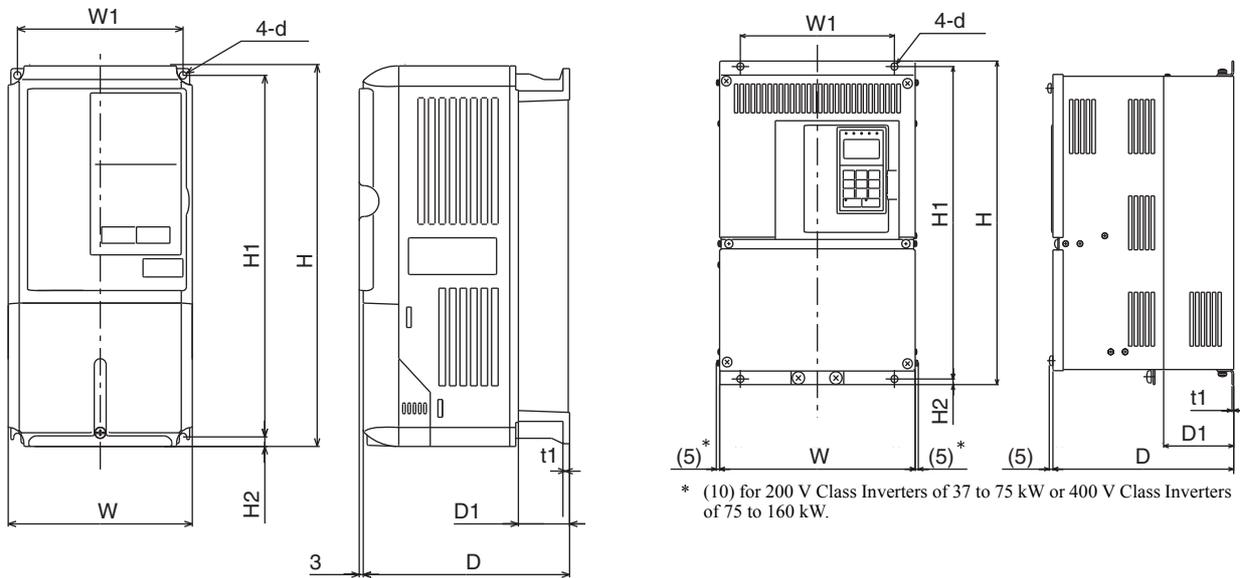


Fig 1.5 Terminal Arrangement (Examples of Inverters with SPEC: C or later)

Exterior and Mounting Dimensions

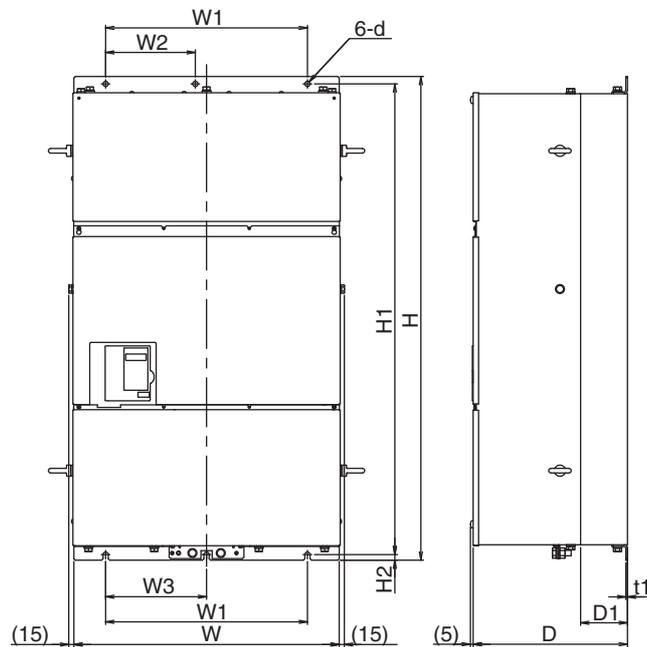
◆ Open Chassis Inverters (IP00)

Exterior diagrams of the Open Chassis Inverters are shown below.



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

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

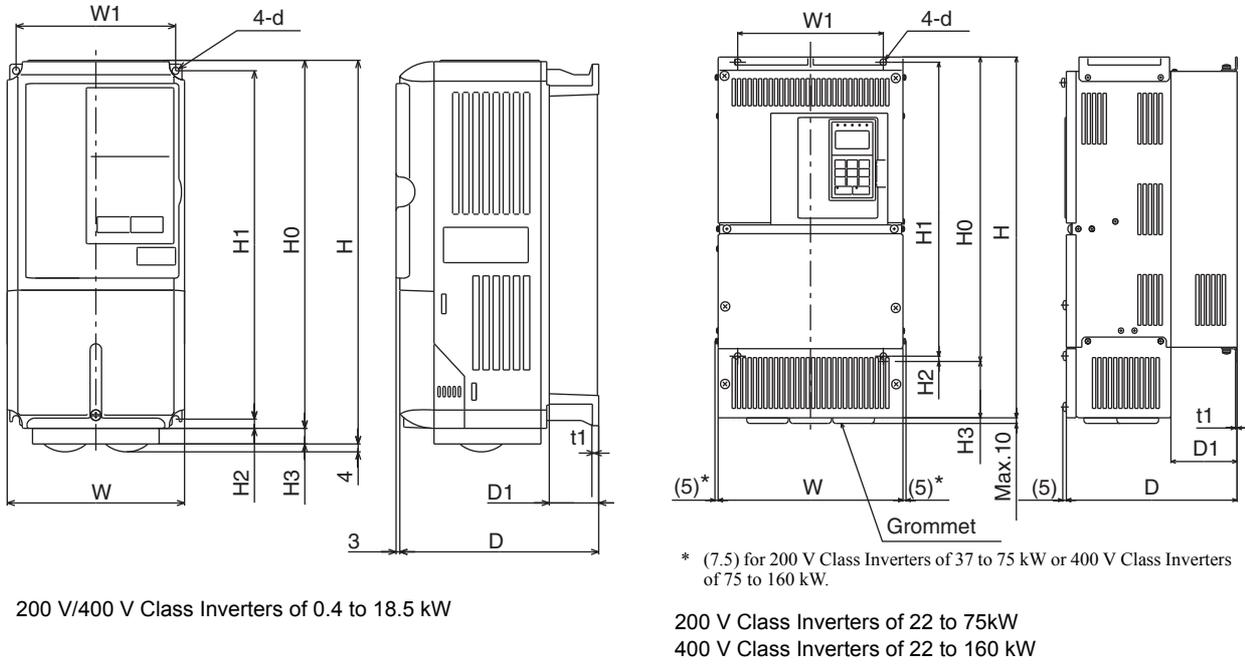


400 V Class Inverters of 185 to 300 kW

Fig 1.6 Exterior Diagrams of Open Chassis Inverters

◆ Enclosed Wall-mounted Inverters [NEMA1 (Type 1)]

Exterior diagrams of the Enclosed Wall-mounted Inverters [NEMA1 (Type 1)] are shown below.



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

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

Fig 1.7 Exterior Diagrams of Enclosed Wall-mounted Inverters

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

Voltage Class	Max. Applicable Motor Output [kW]	Dimensions (mm)																				Caloric Value (W)			Cooling Method		
		Open Chassis (IP00)										Enclosed Wall-mounted [NEMA1 (Type 1)]										External	Internal	Total Heat Generation			
		W	H	D	W1	H1	H2	D1	t1	Ap-prox. Mass	W	H	D	W1	H0	H1	H2	H3	D1	t1	Ap-prox. Mass					Mounting Holes d*	
200 V (3-phase)	0.4	140	280	157	126	266	7	39	5	3	140	280	157	126	280	266	7	0	39	5	3	M5	20	39	59	Natural	
	0.75																						27	42	69		
	1.5																						50	50	100		
	2.2			70				59					129														
	3.7			112				74					186														
	5.5	177	59	4	177	59	4	164	84	248																	
	7.5	200	300	197	186	285	8	65.5	6	200	300	197	186	300	285	8	10	65.5	6	7	11	M6	219	113	332	Fan	
	11																						374	170	544		
	15	240	350	207	216	335	7.5	78	2.3	11	240	350	207	216	350	335	7.5	30	78	2.3	11	M6	429	183	612		
	18.5																						501	211	712		
	22																						250	400	258		195
	30	275	450	258	220	435	100	24	279	615	258	220	450	435	165	100	27	865	352	1217							
	37	375	600	298	250	575	12.5	100	3.2	57	380	809	298	250	600	575	12.5	209	100	3.2	62	M10	1015	411	1426		
	45																						1266	505	1771		
55	450	725	348	325	700	130	86	453	1027	348	325	725	700	302	130	94	302	130	95	M10	1588	619	2207				
75																					2019	838	2857				
400 V (3-phase)	0.4	140	280	157	126	266	7	39	5	3	140	280	157	126	280	266	7	0	39	5	3	M5	14	39	53		Natural
	0.75																						17	41	58		
	1.5																						36	48	84		
	2.2			59				56					115														
	3.7			80				68					148														
	5.5	177	59	4	177	59	4	127	82	209																	
	7.5	200	300	197	186	285	8	65.5	6	200	300	197	186	300	285	8	10	65.5	6	10	24	M6	193	114	307	Fan	
	11																						252	158	410		
	15	240	350	207	216	335	7.5	78	2.3	10	240	350	207	216	350	335	7.5	85	100	2.3	24	M6	326	172	498		
	18.5																						426	208	634		
	22																						275	450	258		220
	30	325	550	283	260	535	105	36	329	715	283	260	550	535	165	105	40	784	317	995							
	37	325	550	283	260	535	105	88	453	1027	348	325	725	700	12.5	302	130	96	130	97	M10	901	415	1316			
	45																					1203	495	1698			
	55	450	725	348	325	700	12.5	89	453	1027	348	325	725	700	12.5	302	130	97	130	97	M10	1399	575	1974			
	75																					1614	671	2285			
	90	500	850	358	370	820	15	102	504	1243	358	370	850	820	15	393	130	122	130	130	M12	2097	853	2950			
	110																					2388	1002	3390			
132	2791																					1147	3938				
160	575	910	378	445	855	46	140	160	579	1324	378	445	916	855	46	408	140	170	170	M12	2791	1147	3938				

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

Table 1.4 400 VAC (185 to 300 kW) Inverter Dimensions (mm) and Masses (kg)

Voltage Class	Max. Applicable Motor Output [kW]	Dimensions (mm)																				Heat Generation (W)			Cooling Method		
		Open Chassis (IP00)										Enclosed Wall-mounted [NEMA1 (Type 1)]										External	Internal	Total Heat Generation			
		W	H	D	W1	W2	W3	H1	H2	D1	t1	Ap-prox. Mass	W	H	D	W1	W2	W3	H1	H2	D1					t1	Ap-prox. Mass
400 V (3-phase)	185	710	1305	413	540	240	270	1270	15	125.5	4.5	260	---										M12	3237	1372	4609	Natural
	220												280	3740	1537	5277											
	300												916	1475	413	730	365	365	1440	15	125.5	4.5		405	5838	2320	

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 and a pollution level of 2 or less (UL standard).

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. Refer to Page 1-17 on how to remove the protection covers.

Observe the following precautions when mounting the Inverter.

- Install the Inverter in a clean location 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.

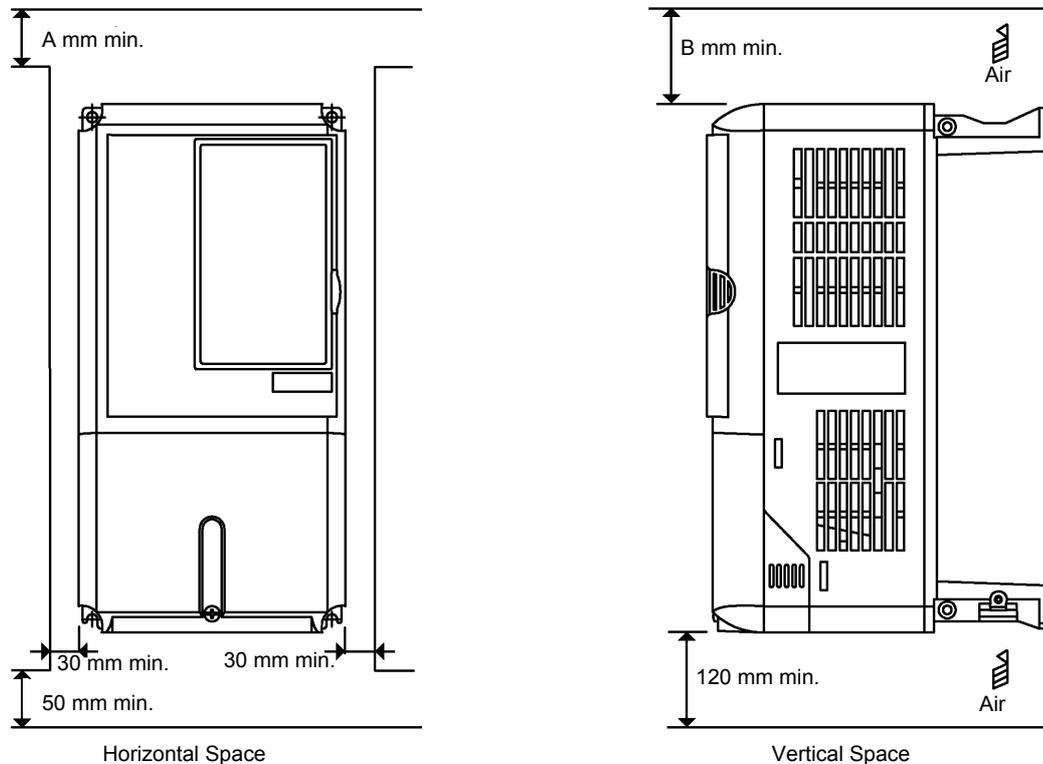
◆ Protecting the Inverter from Foreign Matter

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

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

Installation Orientation and Space

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



400 V Class Inverters of 160 to 220 kW*: A = 120, B = 120

400 V Class Inverters of 300 kW*: A = 300, B = 300

All other Inverters*: A = 50, B = 120

*If, however, there is a fan in the top of the control panel with sufficient exhaust capacity, the following dimensions may be used: A = 50, B = 120.

Fig 1.8 Inverter Installation Orientation and Space



1. The same space is required horizontally and vertically for both Open Chassis (IP00) and Enclosed Wall-mounted [IP20, NEMA 1 (Type 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. Refer to Page 1-17 on how to remove the protection covers. Always provide enough space for suspension eye bolts and the main circuit lines when installing a 200 or 400 V Class Inverter with an output of 22 kW or more in a panel.

Removing and Attaching the Terminal Cover

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

◆ Removing the Terminal Cover

■ Inverters of 18.5 kW or Less

Loosen the screws at the bottom of the terminal cover, press in on the sides of the terminal cover in the direction indicated by arrow 1, and then lift the terminal cover up to an angle of about 30 degrees in the direction indicated by arrow 2.

Remove the terminal cover in the direction indicated by arrow 3.

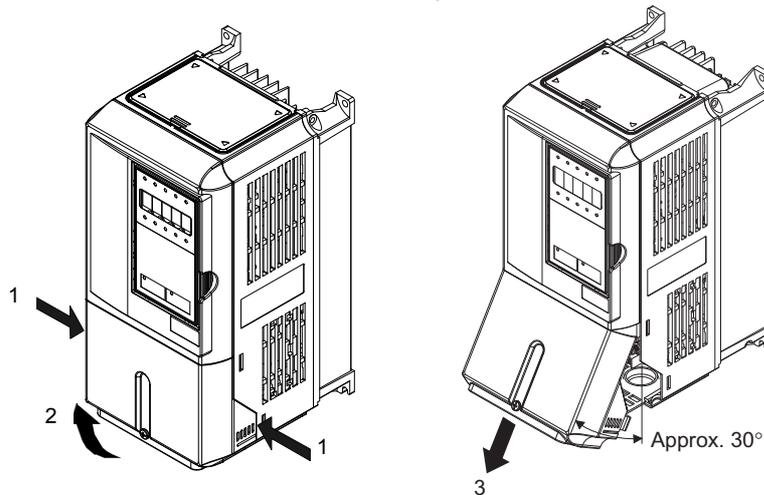


Fig 1.9 Removing the Terminal Cover (Model CIMR-F7S20P4 Shown Above)

■ 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.

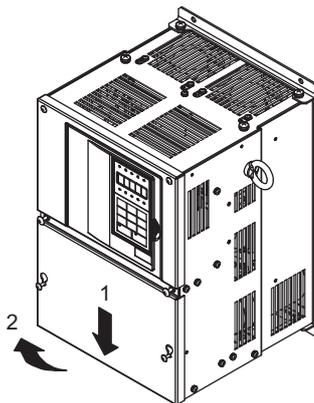


Fig 1.10 Removing the Terminal Cover (Model CIMR-F7S2022 Shown Above)

◆ Attaching the Terminal Cover

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

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

Removing/Attaching the Digital Operator and Front Cover

The methods of removing and attaching the Digital Operator and Front Cover are described in this section.

◆ Inverters of 18.5 kW or Less

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

The removal and attachment procedures are given below.

■ Removing the Digital Operator

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

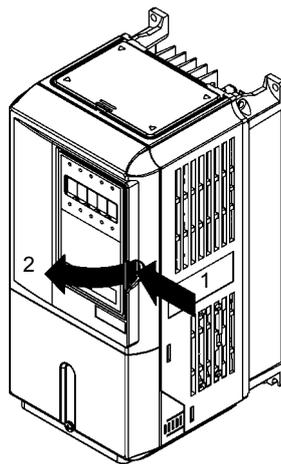


Fig 1.11 Removing the Digital Operator (Model CIMR-F7S40P4 Shown Above)

■ Removing the Front Cover

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

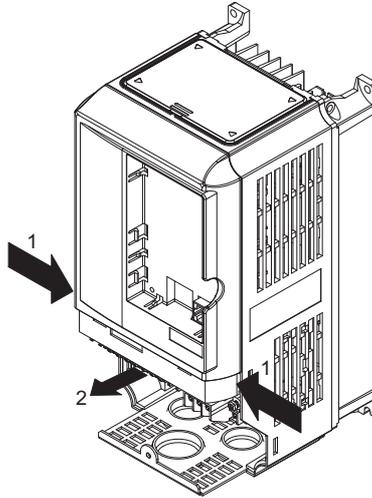


Fig 1.12 Removing the Front Cover (Model CIMR-F7S40P4 Shown Above)

■ Mounting the Front Cover

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

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 Inverting 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).

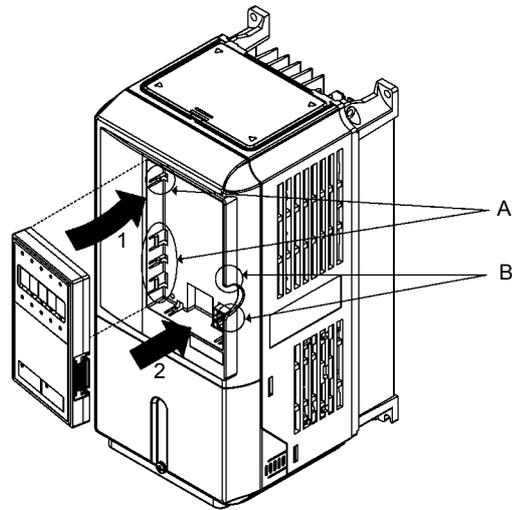


Fig 1.13 Mounting the Digital Operator



IMPORTANT

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

◆ Inverters of 22 kW or More

For Inverter with an output of 22 kW or more, remove the terminal cover and then use the following procedures to remove the Digital Operator and front 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 board in the direction of arrow 2.

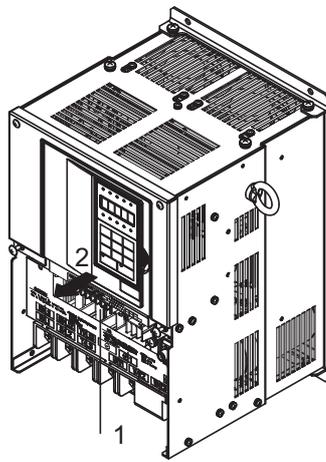


Fig 1.14 Removing the Front Cover (Model CIMR-F7S2022 Shown Above)

■ Attaching the Front Cover

After completing required work, such as mounting an optional board or setting the control circuit terminal board, 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.

Removing and Attaching the Protection Cover

Inverters of 18.5 kW or less have protection covers on the top and bottom as shown in *Fig. 1.4*. Always remove the protection covers before installing an Inverter of 18.5 kW or less in a panel. Use the following procedure to remove and attach a protection cover.

◆ Removing the Protection Cover

■ Top Protection Cover

Insert the tip of the straightedge screwdriver in the slot. Then, lift the cover up in the direction shown by the arrow to remove it.

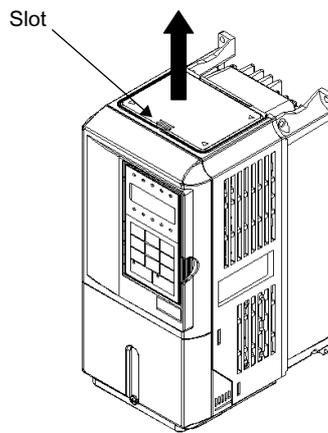


Fig 1.15 Removing the Top Protection Cover (Model CIMR-F7S45P5 Shown Above)

■ Bottom Protection Cover

1. Remove the terminal cover as described on Page 1-12.
2. Loosen the two screws, and remove the protection cover.
3. Return the screws to their original position and tighten (them).
4. Reattach the terminal cover as described on Page 1-12.

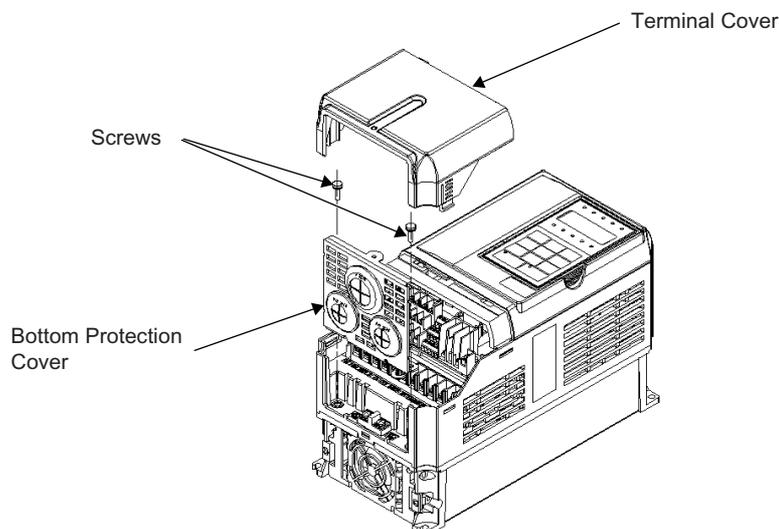


Fig 1.16 Removing the Bottom Protection Cover (Model CIMR-F7S45P5 Shown Above)

◆ Attaching the Protection Cover

■ Top Protection Cover

The protection cover has four hooks: two hooks on the bottom and two on the sides. Fit the bottom hooks into the holes, bend the cover slightly, and press the cover down until the hooks on the side snap.

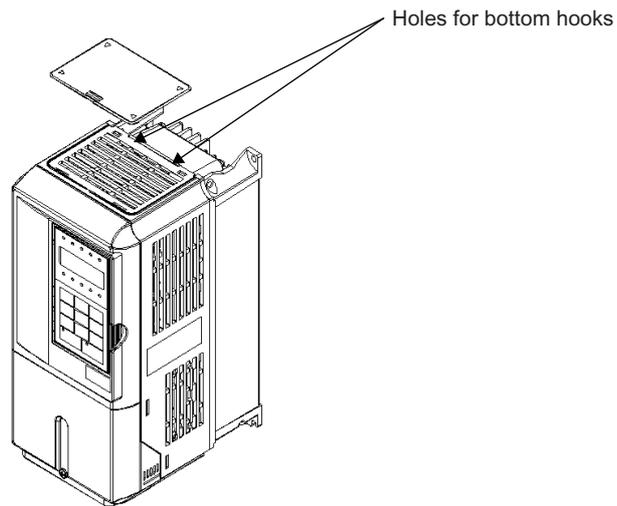


Fig 1.17 Attaching the Top Protection Cover (Model CIMR-F7S45P5 Shown Above)

■ Bottom Protection Cover

To attach the bottom protection cover, reverse the procedure used to remove it.



Wiring

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

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Connections to Peripheral Devices

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

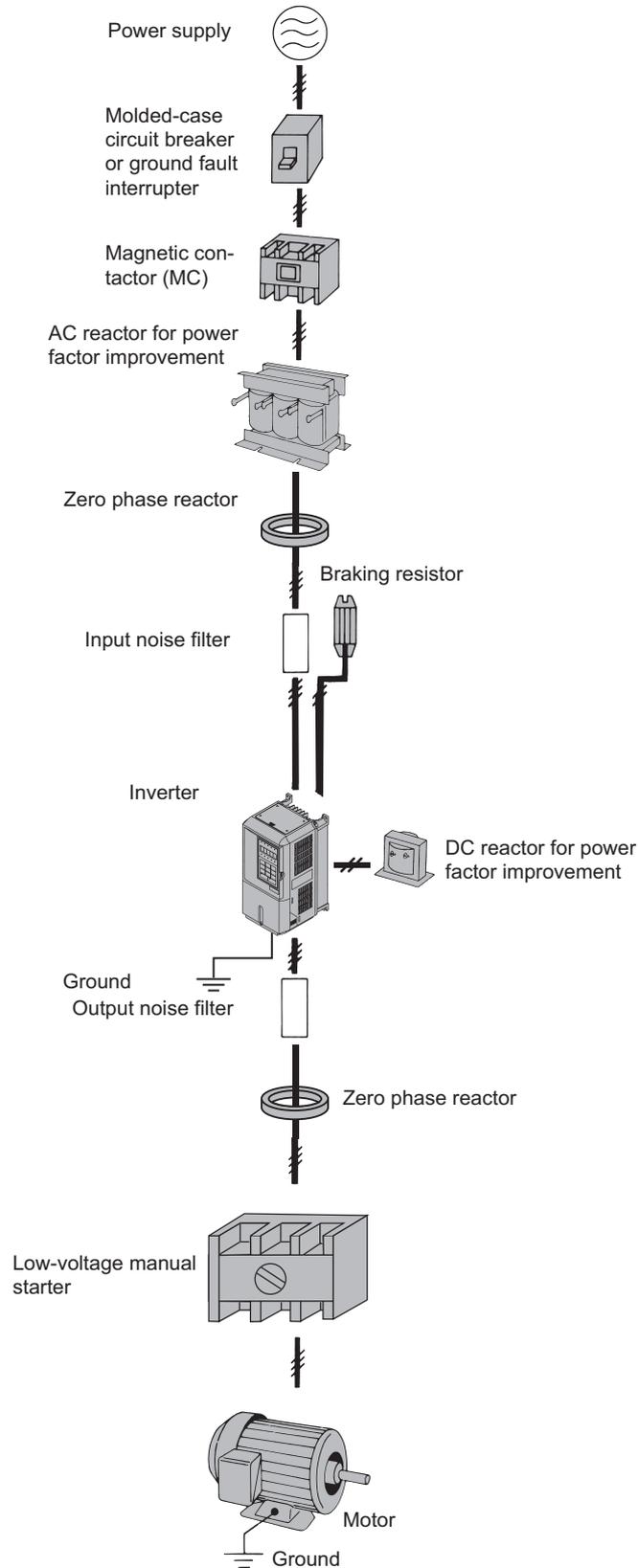


Fig 2.1 Example Connections to Peripheral Devices

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.

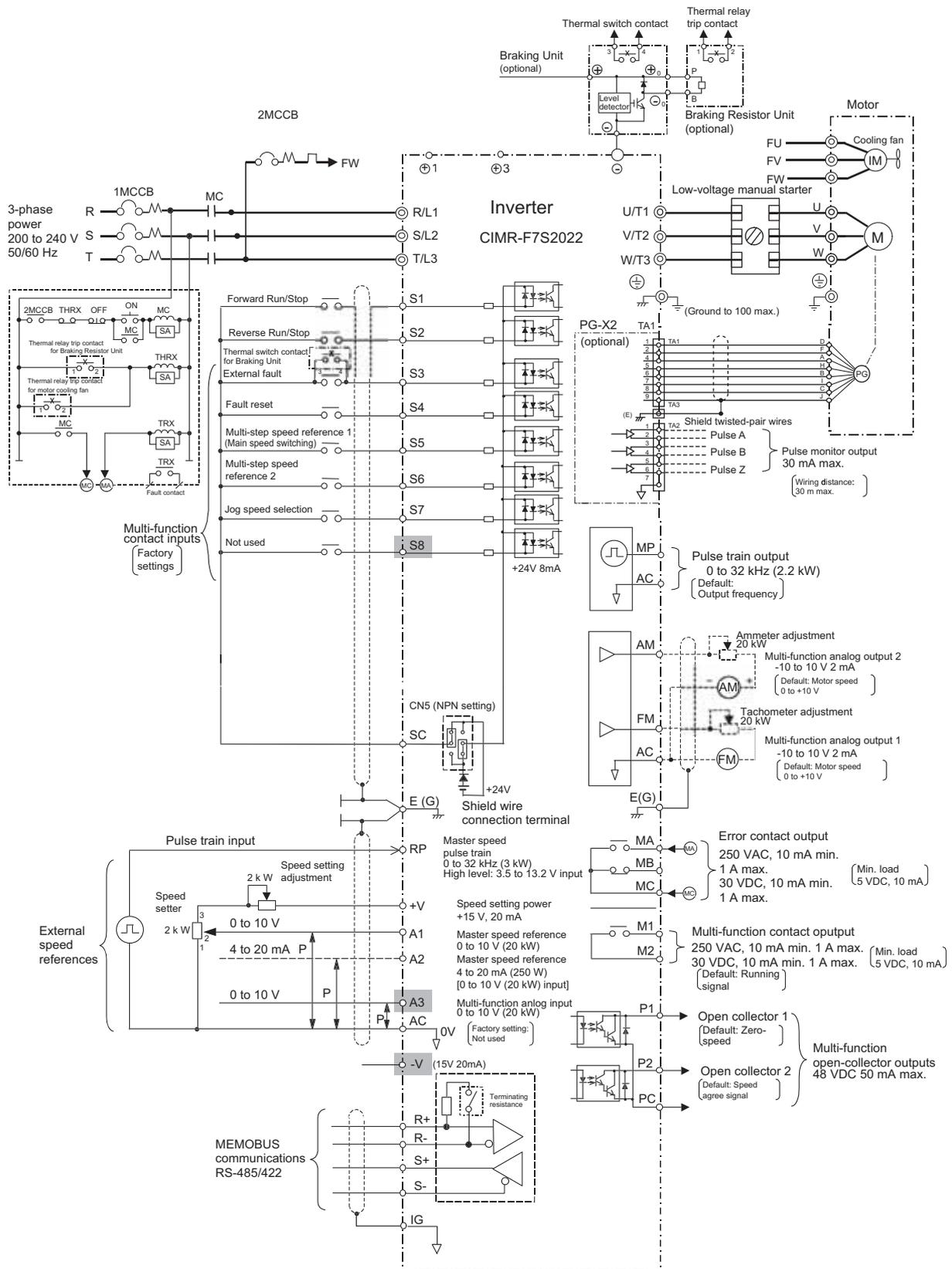


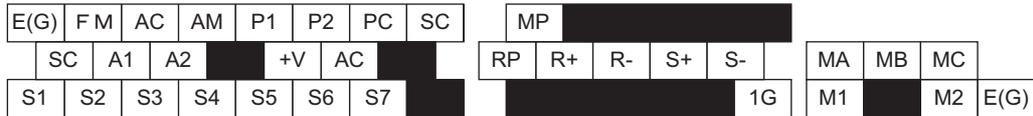
Fig 2.2 Connection Diagram (Model CIMR-F7A2022 Shown Above)



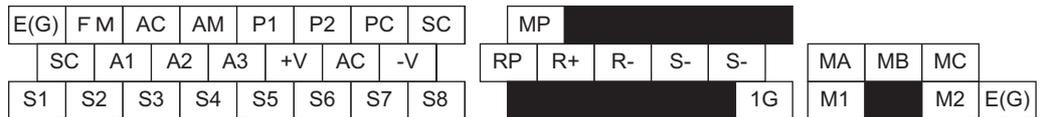
IMPORTANT

1. Control circuit terminals are arranged as shown below.

Inverters with SPEC: B or earlier



Inverters with SPEC: C or later



2. The output current capacity of the +V and -V terminals are 20 mA. Do not short-circuit between the +V, -V, and AC terminals. Doing so may result in a malfunction or a breakdown of the Inverter.
3. Disable the overvoltage inhibit selection during deceleration (set constant L3-11 to 0) when using a Braking Resistor Unit. If this user constant is not changed to disable stall prevention, the system may not stop during deceleration.
4. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.
5. The wiring for a motor with a cooling fan is not required for self-cooling motors.
6. PG circuit wiring (i.e., wiring to the PG-X2 Board) is not required for control without a PG.
7. Sequence input signals S1 to S8 are labeled for sequence connections (0 V common and sinking mode) for no-voltage contacts or NPN transistors. These are the default settings.
For PNP transistor sequence connections (+24V common and sourcing mode) or to provide a 24-V external power supply, refer to Table 2.13.
8. The master speed reference can set to input either a voltage (terminal A1) or current (terminal A2) by changing the setting of parameter H3-13. The default setting is for a voltage reference input.
9. The multi-function analog output is a dedicated meter output for an analog frequency meter, ammeter, voltmeter, wattmeter, etc. Do not use this output for feedback control or for any other control purpose.
10. DC reactors to improve the input power factor are built into 200 V Class Inverters for 22 to 75 kW and 400 V Class Inverters for 22 to 300 kW. A DC reactor is thus an option only for Inverters for 18.5 kW or less.
11. Set parameter L8-01 to 1 when using a braking resistor (ERF). When using a Braking Resistor Unit, a shutoff sequence for the power supply must be made using a thermal relay trip.
12. The permissible load of a multi-function contact output and an error contact output is 10 mA. Use a multi-function open-collector output for a load less than 10 mA.
13. Do not ground nor connect the AC terminal on the control circuit to the unit. Doing so may result in a malfunction or a breakdown of the Inverter.
14.  indicates shield wire and  indicates twisted-pair shield wire.

Terminal Block Configuration

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

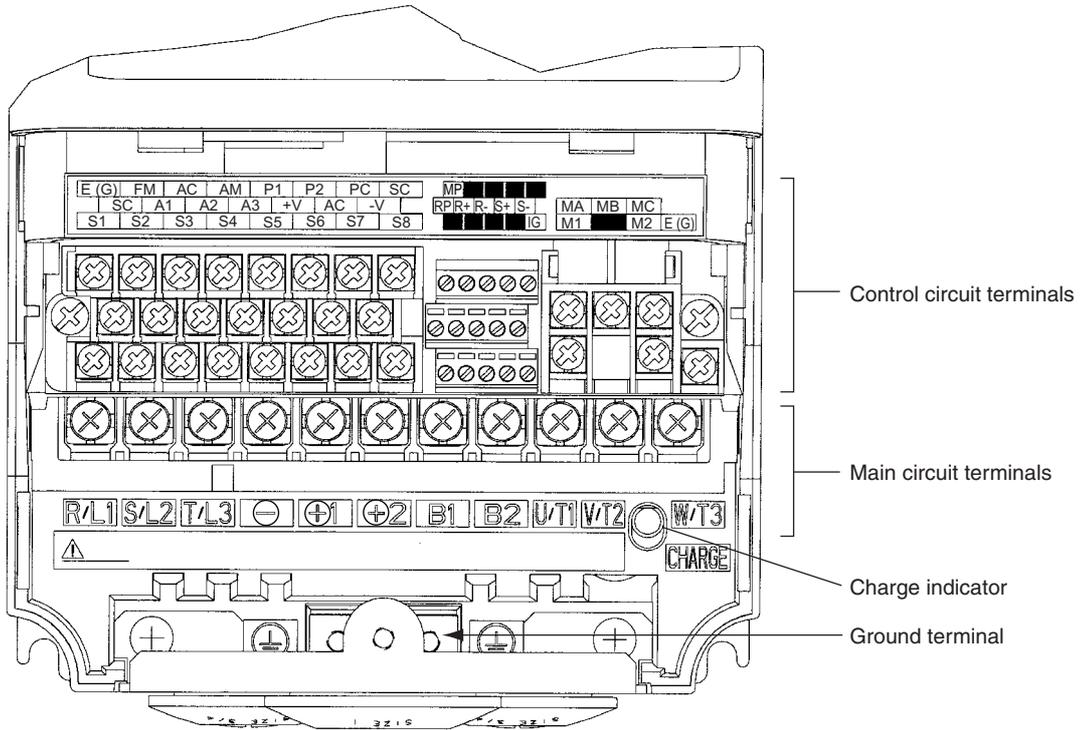


Fig 2.3 Terminal Arrangement (200 V Class Inverter with SPEC: C or later for 0.4 kW Shown Above)

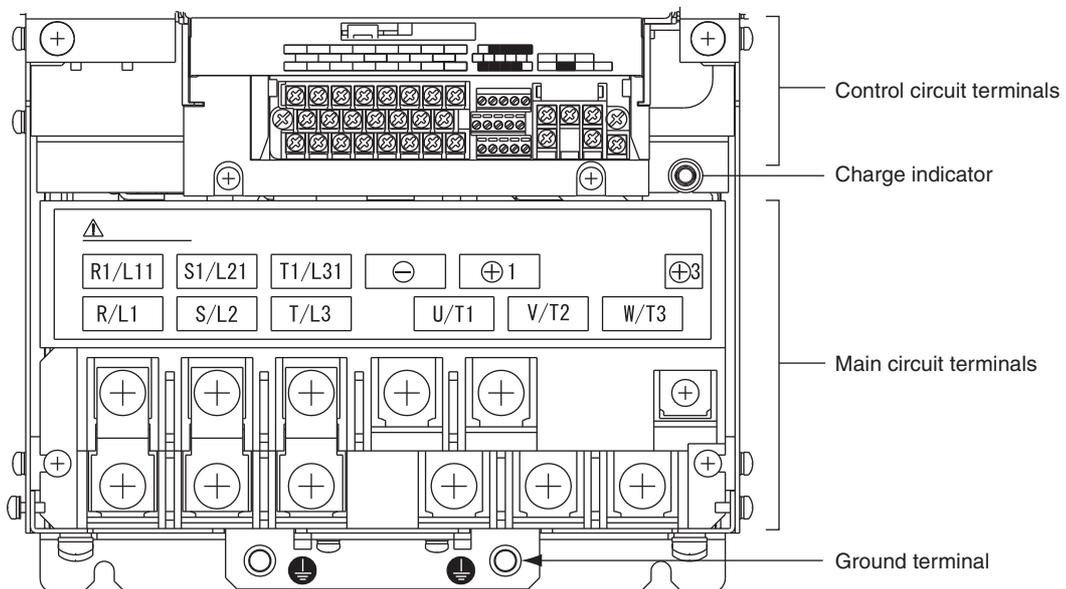


Fig 2.4 Terminal Arrangement (200 V Class Inverter with SPEC: C or later for 22 kW Shown Above)

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 TOBPC72060000 for wire sizes for Braking Resistor Units and Braking Units.

Table 2.1 200 V Class Wire Sizes

Inverter Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N·m)	Possible Wire Sizes mm ² (AWG)	Recommended Wire Size mm ² (AWG)	Wire Type
F7S20P4	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, 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
	⊖					
F7S20P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⊖					
F7S21P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⊖					
F7S22P2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⊖					
F7S23P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
	⊖					
F7S25P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	5.5 (10)	5.5 (10)	
	⊖					
F7S27P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
	⊖					
F7S2011	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	2.5	14 to 22 (6 to 4)	14 (6)	
	⊖					
F7S2015	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)	
	B1, B2	M5	2.5	8 to 14 (8 to 6)	-	
	⊖	M6	4.0 to 5.0	22 (4)	22 (4)	
F7S2018	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)	
	B1, B2	M5	2.5	8 to 14 (8 to 6)	-	
	⊖	M6	4.0 to 5.0	22 (4)	22 (4)	
F7S2022	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)	
F7S2030	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)	

Table 2.1 200 V Class Wire Sizes (Continued)

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
F7S2037	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, ㄥ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S2045	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, ㄥ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S2055	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	17.6 to 22.5	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, ㄥ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S2075	⊖, ⊕1	M12	31.4 to 39.2	80 to 125 (3/0 to 250)	80 × 2P (3/0 × 2P)	
	R/L1, S/L2, T/L3, 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)	-	
	⊖	M12	31.4 to 39.2	100 to 200 (3/0 to 400)	100 (3/0)	
	r/l1, ㄥ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

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

Table 2.2 400 V Class Wire Sizes

Inverter Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm ² (AWG)	Recommended Wire Size mm ² (AWG)	Wire Type
F7S40P4	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, 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
	⊖					
F7S40P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⊖					
F7S41P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⊖					
F7S42P2	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⊖					
F7S43P7	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)	
	⊖				2 (14)	
F7S45P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, 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)	
F7S47P5	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M4	1.8	5.5(10)	5.5 (10)	
	⊖			3.5 to 5.5 (12 to 10)	3.5 (12)	
F7S4011	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	2.5	5.5 to 14 (10 to 6)	8 (8)	
	⊖				5.5 (10)	
F7S4015	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
	⊖	M5 (M6)	(4.0 to 5.0)	5.5 to 14 (10 to 6)	5.5 (10)	
F7S4018	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)	
	B1, B2	M5	2.5	8 (8)	8 (8)	
	⊖	M6	4.0 to 5.0	8 to 22 (8 to 4)	8 (8)	
F7S4022	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)	
F7S4030	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)	
F7S4037	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)	
F7S4045	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	38 to 60 (2 to 1/0)	38 (2)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⊖	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

Table 2.2 400 V Class Wire Sizes (Continued)

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
F7S4055	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	Power cables, e.g., 600 V vinyl power cables
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⊖	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
F7S4075	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	17.6 to 22.5	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	17.6 to 22.5	38 to 60 (2 to 2/0)	38 (2)	
	r/ℓ1, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S4090	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	17.6 to 22.5	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	17.6 to 22.5	50 to 100 (1 to 4/0)	50 (1)	
	r/ℓ1, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S4110	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	17.6 to 22.5	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	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)	60 (2/0)	
	r/ℓ1, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S4132	R/L1, S/L2, T/L3, ⊖, ⊕1	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	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 × 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/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S4160	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/L31	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	8 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/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

Table 2.2 400 V Class Wire Sizes (Continued)

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
F7S4185	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/L31	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, Δ 200/ℓ2200, Δ 400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S4220	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/L31	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, Δ 200/ℓ2200, Δ 400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
F7S4300	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 × 2P (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, Δ 200/ℓ2200, Δ 400/ℓ2400	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 Closed-loop Connector Sizes (JIS C2805) (200 V Class and 400 V Class)

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



IMPORTANT

1. 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:

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

2. Use a closed-loop connector (made by J.S.T. Mfg. Co., Ltd. or an equivalent) for the main circuit input and output terminals of Inverters of 200V 11 kW or more and those of 400V 22 kW or more.

◆ 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)

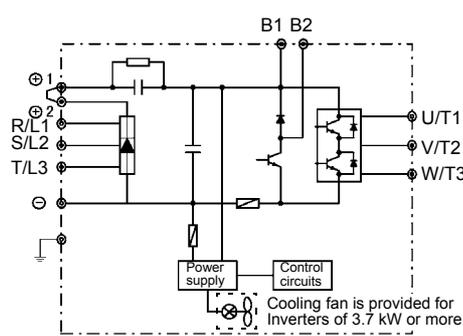
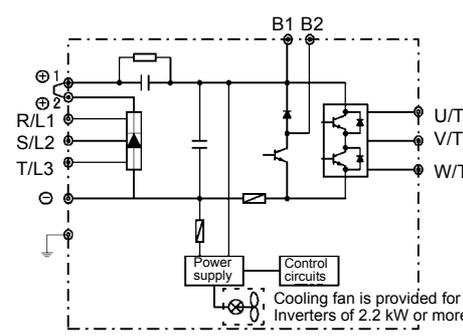
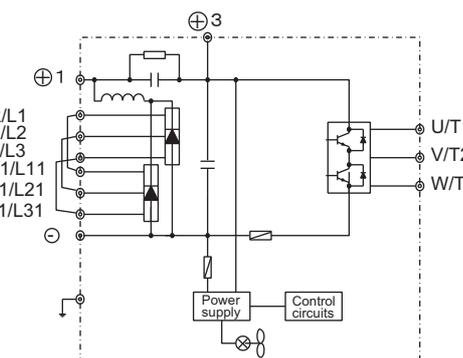
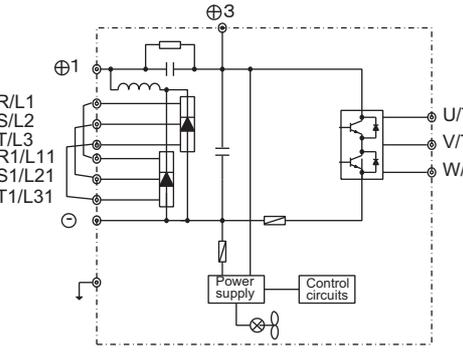
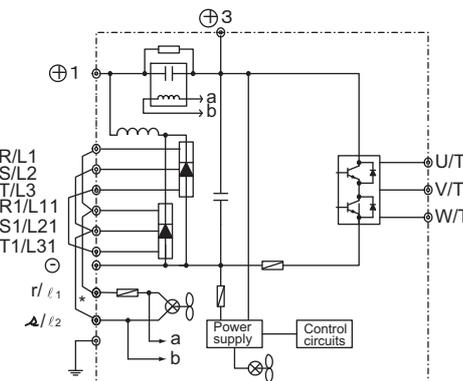
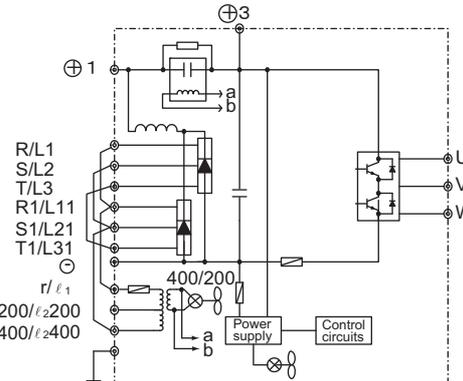
Purpose	Terminal Symbol	Model: CIMR-F7S□	
		200 V Class	400 V Class
Main circuit power input	R/L1, S/L2, T/L3	20P4 to 2075	40P4 to 4300
	R1/L11, S1/L21, T1/L31	2022 to 2075	4022 to 4300
Inverter outputs	U/T1, V/T2, W/T3	20P4 to 2075	40P4 to 4300
DC power input	⊕ 1, ⊖	20P4 to 2075	40P4 to 4300
Braking Resistor Unit connection	B1, B2	20P4 to 2018	40P4 to 4018
DC reactor connection	⊕ 1, ⊕ 2	20P4 to 2018	40P4 to 4018
Braking Unit connection	⊕ 3, ⊖	2022 to 2075	4022 to 4300
Ground	⊕	20P4 to 2075	40P4 to 4300

Note The ⊕ 1 and ⊖ input terminals for the DC power do not conform to UL/cUL standards.

◆ Main Circuit Configurations

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

Table 2.5 Inverter Main Circuit Configurations

200 V Class	400 V Class
<p style="text-align: center;">CIMR-F7S20P4 to 2018</p>  <p style="text-align: center;">Cooling fan is provided for Inverters of 3.7 kW or more.</p>	<p style="text-align: center;">CIMR-F7S40P4 to 4018</p>  <p style="text-align: center;">Cooling fan is provided for Inverters of 2.2 kW or more.</p>
<p style="text-align: center;">CIMR-F7S2022, 2030</p> 	<p style="text-align: center;">CIMR-F7S4022 to 4055</p> 
<p style="text-align: center;">CIMR-F7S2037 to 2075</p> 	<p style="text-align: center;">CIMR-F7S4075 to 4300</p> 

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

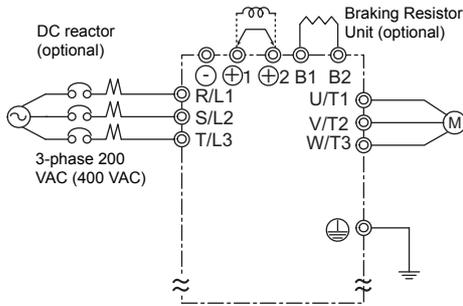
* These terminals are wired before shipment.

◆ Standard Connection Diagrams

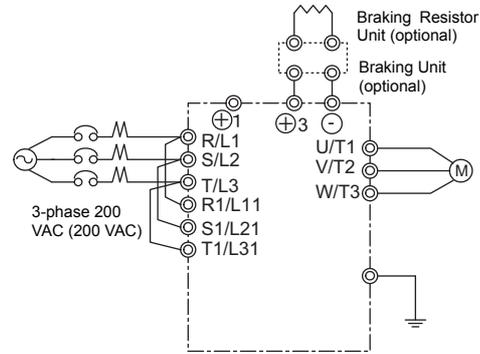
Standard Inverter connection diagrams are shown in *Fig 2.5*. The connections depend on the Inverter capacity.

■ CIMR-F7S20P4 to 2018 and 40P4 to 4018

■ CIMR-F7S2022, 2030, and 4022 to 4055



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



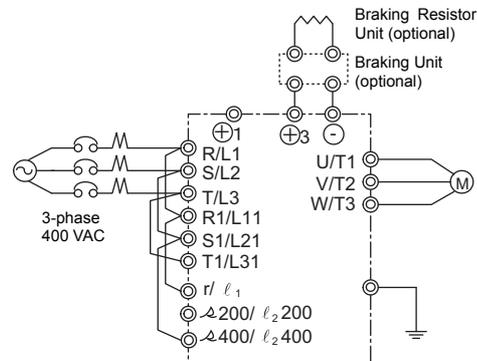
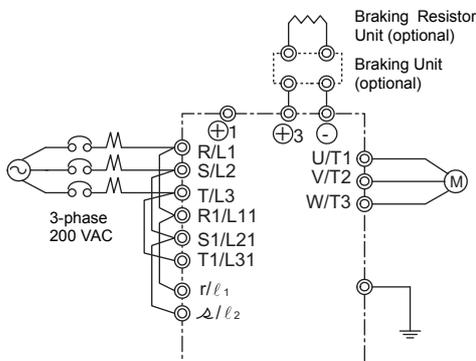
The DC reactor is built in.



When connecting a separately-installed type Braking Unit (model CDBR), connect the B1 terminal of the Inverter to the + terminal of the Braking Unit and connect the – terminal of the Inverter to the – terminal of the Braking Unit. The B2 terminal is not used in this case.

■ CIMR-F7S2037 to 2075

■ CIMR-F7S4075 to 4300



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



If a Braking Unit or a Braking Resistor Unit is connected to a wrong terminal, the Inverter, Braking Unit, or Braking Resistor Unit can be damaged. Refer to *FOR VARISPEED-600 SERIES INVERTER BRAKING UNIT BRAKING RESISTOR UNIT INSTRUCTIONS (TOBPC720600000)* for connecting the Inverter with a Braking Unit or a Braking Resistor Unit.

Fig 2.5 Main Circuit Terminal Connections

◆ Wiring the Main Circuits

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

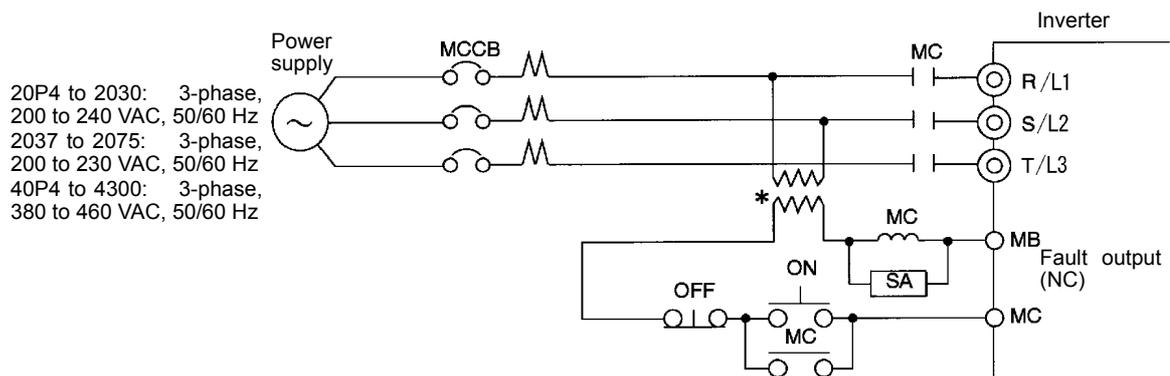
■ Wiring Main Circuit Inputs

Observe the following precautions for wiring the main circuit power supply inputs.

Installing a Molded-case Circuit Breaker

Always connect the power input terminals (R, S, and T) and power supply via a molded-case circuit breaker (MCCB) suitable for the Inverter.

- Choose an MCCB with a capacity of 1.5 to 2 times the Inverter's rated current.
- For the MCCB's time characteristics, be sure to consider the Inverter's overload protection (one minute at 120% of the rated output current).
- If the same MCCB is to be used for more than one Inverter, or other devices, set up a sequence so that the power supply will be turned OFF by a fault output, as shown in Fig 2.6.



* For 400 V Class Inverters, connect a 400/200 V transformer.

Fig 2.6 MCCB Installation

Installing a Ground Fault Interrupter

Inverter outputs use high-speed switching, so high-frequency leakage current is generated. At the Inverter primary side, use a ground fault interrupter for Inverters with a countermeasure against high frequency to detect only the leakage current in the frequency range that is hazardous to humans and to ignore high-frequency leakage current. Use one or several ground fault interrupters with a total cumulative sensitivity amperage of at least 30 mA per Inverter.

Using a ground fault interrupter without a countermeasure against high frequency may result in a malfunction caused by high-frequency leakage current. If a ground fault interrupter without a countermeasure malfunctions, replace it with a ground fault interrupter with a countermeasure against high frequency or reduce the carrier frequency of the Inverter. Alternatively, use one or several ground fault interrupters with a total cumulative sensitivity amperage of at least 200 mA per Inverter.

Installing a Magnetic Contactor

If the power supply for the main circuit is to be shut off during a sequence, a magnetic contactor can be used. When a magnetic contactor is installed on the primary side of the main circuit to forcibly stop the Inverter, however, the regenerative braking does not work and the Inverter will coast to a stop.

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

Connecting Input Power Supply to the Terminal Block

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

Installing an AC Reactor or DC Reactor

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

To prevent this, install an optional AC Reactor on the input side of the Inverter or a DC reactor to the DC reactor connection terminals.

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.

Installing a Noise Filter on Power Supply Side

Install a noise filter to eliminate noise transmitted between the power line and the Inverter.

- Correct Noise Filter Installation

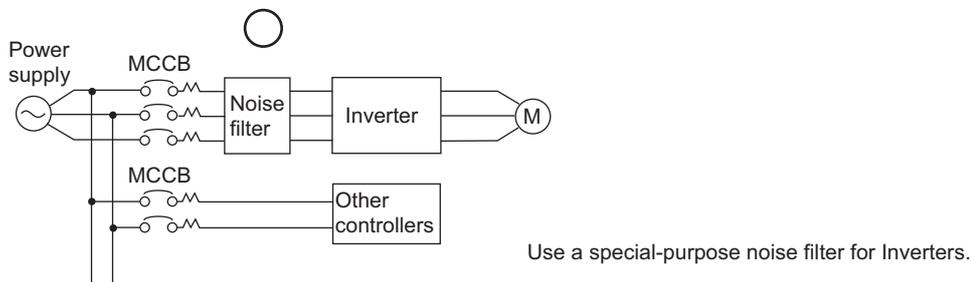


Fig 2.7 Correct Power supply Noise Filter Installation

- Incorrect Noise Filter Installation

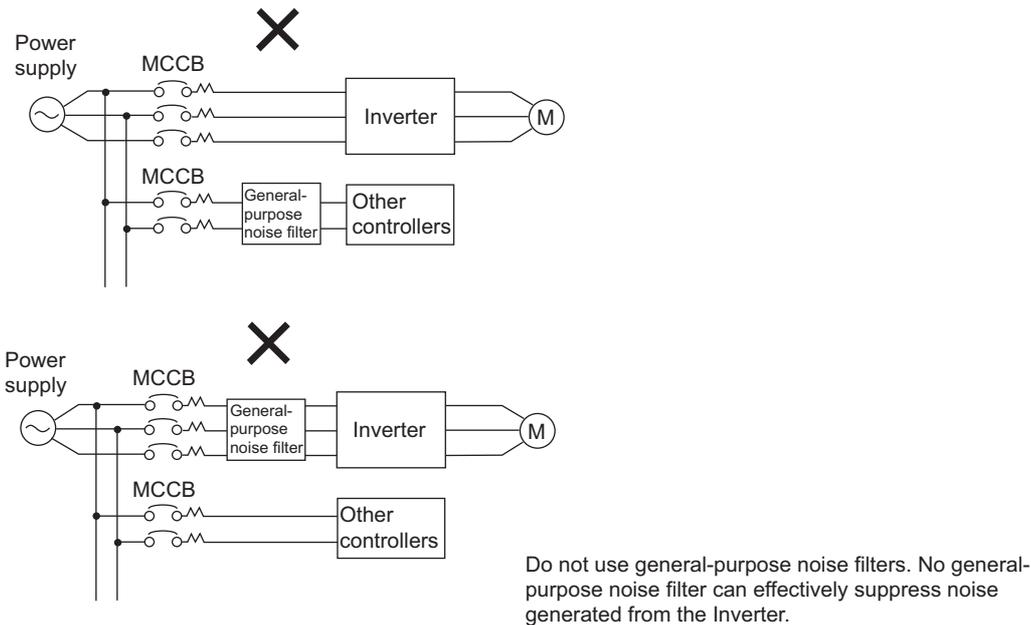


Fig 2.8 Incorrect Power supply Noise Filter Installation

Do not use a Phase Advancing Capacitor

If a phase advancing capacitor or a surge absorber is connected to the input side of the inverter's main circuit to improve the power factor, harmonics from the inverter may cause overheating or damage the phase advancing capacitor or the surge absorber. Also, the inverter may malfunction because of the overcurrent.

■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, V, and W to motor lead wires U, V, and W, respectively.

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, V, and W. If voltage is applied to the output terminals, the internal circuits of the Inverter will be damaged.

Installing a Low-voltage Manual Starter

For applications where the overhauling load causes the motor to turn even when the Inverter power is OFF, be sure to connect a low-voltage manual starter on the Inverter's output side. Be sure to open the low-voltage manual starter when wiring and during maintenance and inspection of the Inverter.

E.g.: AICUT LB Series manufactured by AICHI ELECTRIC CO., LTD.

Never Short or Ground Output Terminals

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

Do Not Use a Phase Advancing Capacitor or Noise Filter

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

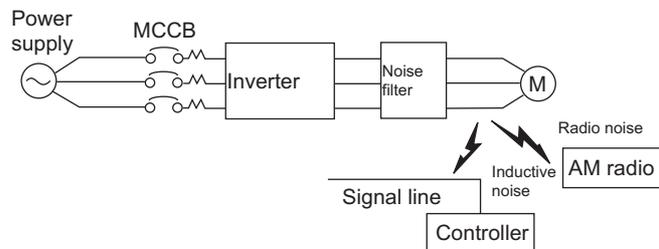
Do Not Switch the Magnetic Starter (Contactor) ON/OFF during Operation

Usually, a magnetic starter should not be connected between the Inverter and the motor. If a magnetic starter must be installed between the Inverter and the motor, never switch ON (close) or OFF (open) during operation, except during an emergency. Confirm that an inverter baseblock has occurred before turning the magnetic starter ON (close) or OFF (open). If the magnetic starter is turned ON (close) or OFF (open) while the Inverter is running and not during a baseblock, an Inverter fault may occur. For example, a large inrush current could flow and activate the Inverter overcurrent protection.

Note The condition of the Inverter baseblock can be checked with the baseblock signal of the multi-function contact output. For details, refer to the *User Constant Tables* in Chapter 5.

Installing a Noise Filter on Output Side

Connect a noise filter to the output side of the Inverter to reduce radio noise and inductive noise.



- Inductive Noise: Electromagnetic induction generates noise on the signal line, causing the controller to malfunction.
- Radio Noise: Electromagnetic waves from the Inverter and cables cause the broadcasting radio receiver to make noise.

Fig 2.9 Installing a Noise Filter on the Output Side

Countermeasures Against Inductive Noise

As described previously, a noise filter can be used to prevent inductive noise from being generated on the output side. Alternatively, cables can be routed through a grounded metal pipe to prevent inductive noise. Keeping the metal pipe at least 30 cm away from the signal line considerably reduces inductive noise.

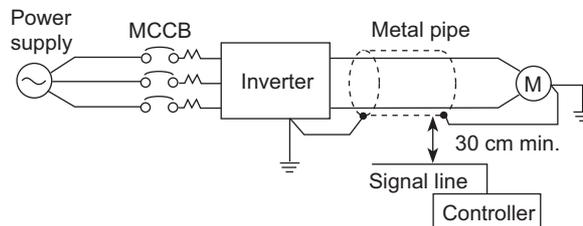


Fig 2.10 Countermeasures Against Inductive Noise

Countermeasures Against Radio Interference

Radio noise is generated from the Inverter as well as from the input and output lines. To reduce radio noise, install noise filters on both input and output sides, and also install the Inverter in a totally enclosed steel box.

The cable between the Inverter and the motor should be as short as possible.

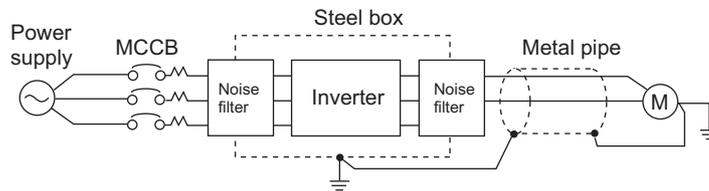


Fig 2.11 Countermeasures Against Radio Interference

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 or motor operations. To prevent this, adjust the carrier frequency (set in C6-01, C6-02) as shown in *Table 2.6*. (For details, refer to *Chapter 5 User Constants*.)

Table 2.6 Cable Length between Inverter and Motor

Cable length	50 m max.	100 m max.	More than 100 m
Carrier frequency	12 kHz max.	8 kHz max.	4 kHz max.

Note With open-loop vector control for PM (A1-02 = 7), the maximum length of the cable between the Inverter and the motor is 100 m, and the maximum carrier frequency is 4 kHz. If not, the performance of the motor might be abnormal.

■ 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 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.

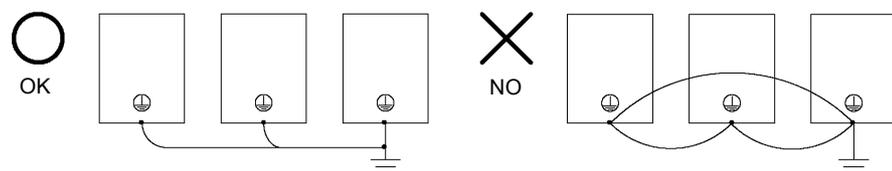


Fig 2.12 Ground Wiring

■Connecting the Braking Resistor (ERF)

A Braking Resistor that mounts to the Inverter can be used with 200 V and 400 V Class Inverters with outputs from 0.4 to 3.7 kW.

Connect the braking resistor as shown in *Fig 2.13*.

Table 2.7

L8-01 (Protect selection for internal DB resistor)	1 (Enables overheat protection)
L3-11 (Overvoltage inhibit selection)	0 (Disables overvoltage inhibit selection)

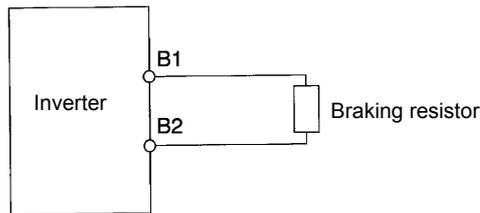


Fig 2.13 Connecting the Braking Resistor



The braking resistor connection terminals are B1 and B2. Do not connect to any other terminals. Connecting to any terminals other than B1 or B2 can cause the resistor to overheat, resulting in damage to the equipment.

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

Use the following settings if using a Braking Resistor Unit and Braking Unit.

A Braking Resistor that mounts to the Inverter can also be used with Inverters with outputs from 0.4 to 3.7 kW.

Table 2.8

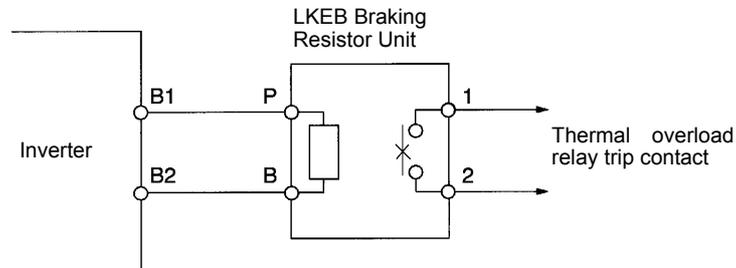
L8-01 (Protect selection for internal DB resistor)	0 (Disables overheat protection)
L3-11 (Overvoltage inhibit selection)	0 (Disables overvoltage inhibit selection)

L8-01 is used when a braking resistor without thermal overload relay trip contacts (ERF type mounted to Inverter) is connected.

When using the braking resistor unit, set L3-11 (Overvoltage inhibit selection) to 0 (Disabled). If L3-11 is not set to 0, the inverter might not stop within the set deceleration time.

To prevent the Unit from overheating, design the sequence to turn OFF the power supply for the thermal overload relay trip contacts of the Unit as shown in *Fig 2.14*.

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



When connecting a separately-installed type Braking Unit (model CDBR), connect the B1 terminal of the Inverter to the + terminal of the Braking Unit and connect the – terminal of the Inverter to the – terminal of the Braking Unit. The B2 terminal is not used in this case.

2

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

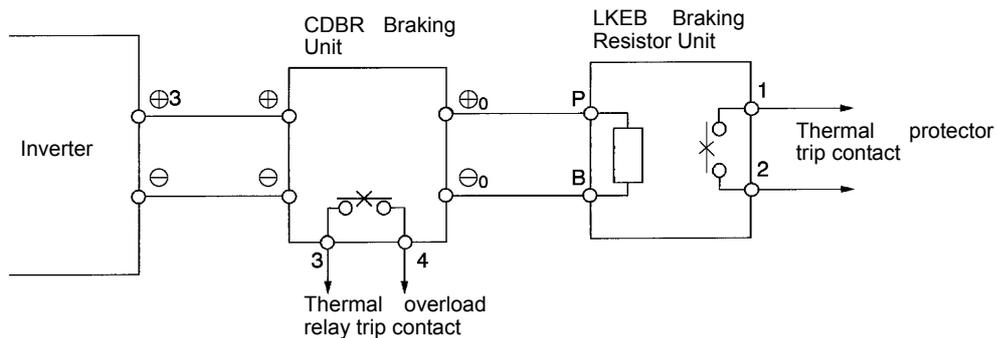


Fig 2.14 Connecting the Braking Resistor Unit and Braking Unit

Connecting Braking Units in Parallel

When connecting two or more Braking Units in parallel, use the wiring and connectors shown in *Fig 2.15*. There are connectors for selecting whether each Braking Unit is to be a Master or Slave. Select “Master” for the first Braking Unit only, and select “Slave” for all other Braking Units (i.e., from the second Unit onwards).

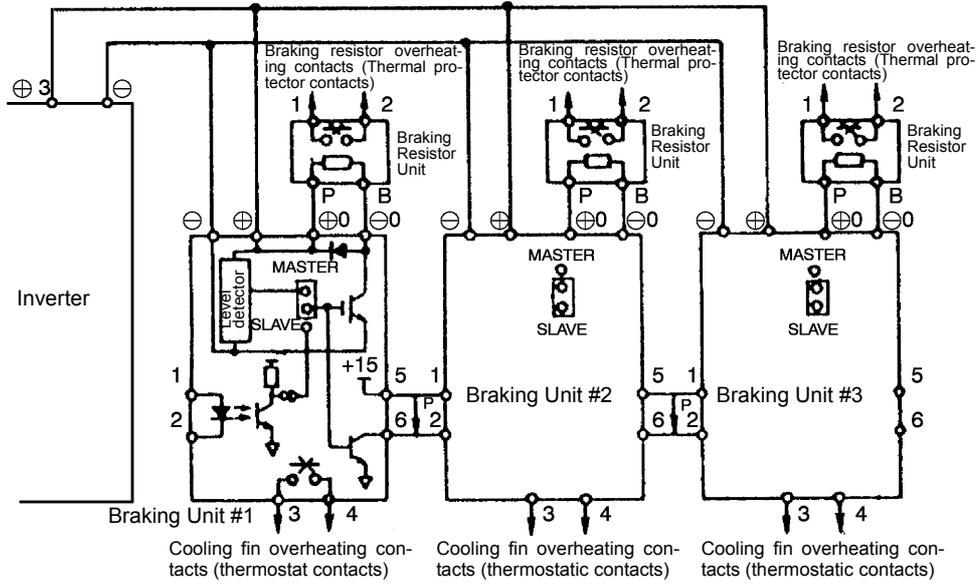
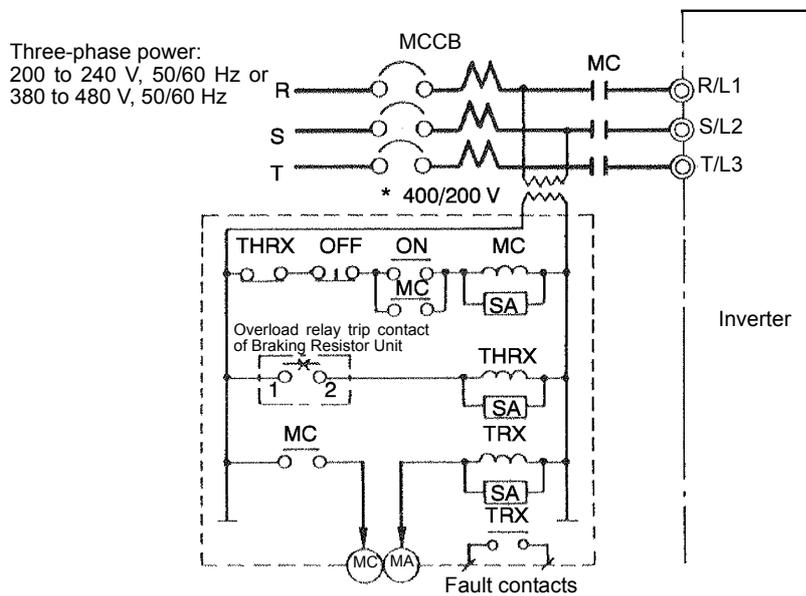


Fig 2.15 Connecting Braking Units in Parallel

Braking Unit Application Precautions

When using a Braking Resistor Unit, create a sequence to detect overheating of the braking resistor and turn OFF the power supply to the Inverter.



* Use a transformer with 200 and 400 V outputs for the power 400 V Inverter.

Fig 2.16 Power Shutoff Sequence

Wiring Control Circuit Terminals

◆ Wire Sizes and Closed-loop Connectors

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

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

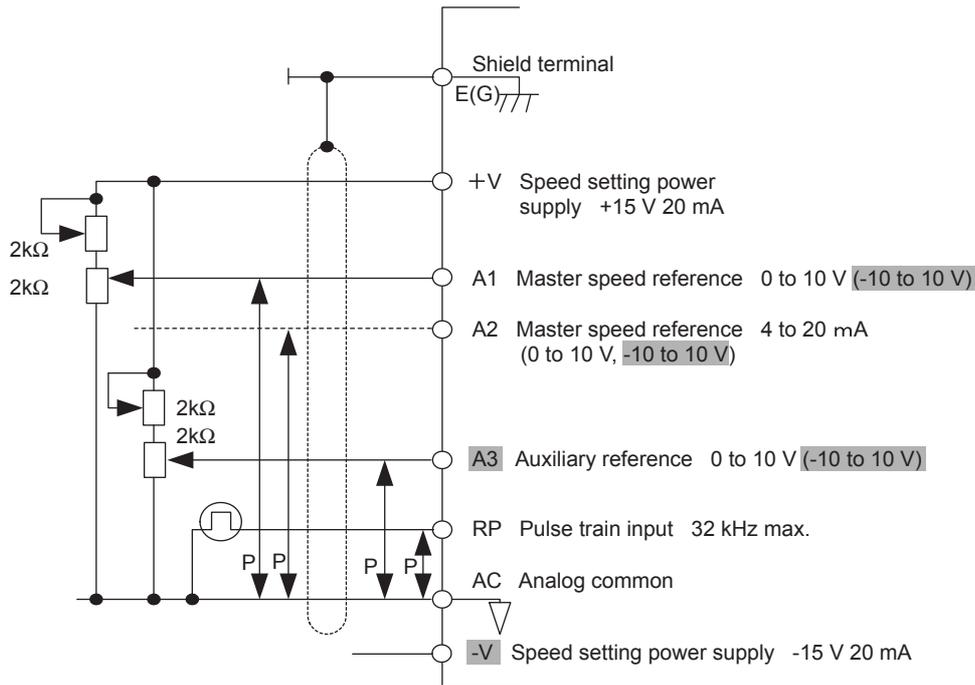


Fig 2.17

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, P1, P2, PC, SC, A1, A2, A3, +V, -V, S1, S2, S3, S4, S5, S6, S7, S8, MA, MB, MC, M1, M2	M3.5	0.8 to 1.0	0.5 to 2* ² (20 to 14)	0.75 (18)	<ul style="list-style-type: none"> • Shielded, twisted-pair wire ^{*1} • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electrical Wire or equivalent)
MP, RP, 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)	
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 speed reference.

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

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

■ Straight Solderless Terminals for Signal Lines

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

Table 2.10 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	

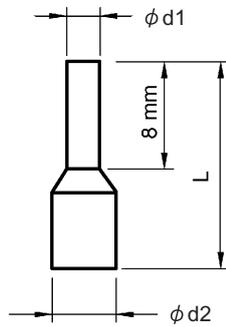


Fig 2.18 Straight Solderless Terminal Sizes

■ 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.

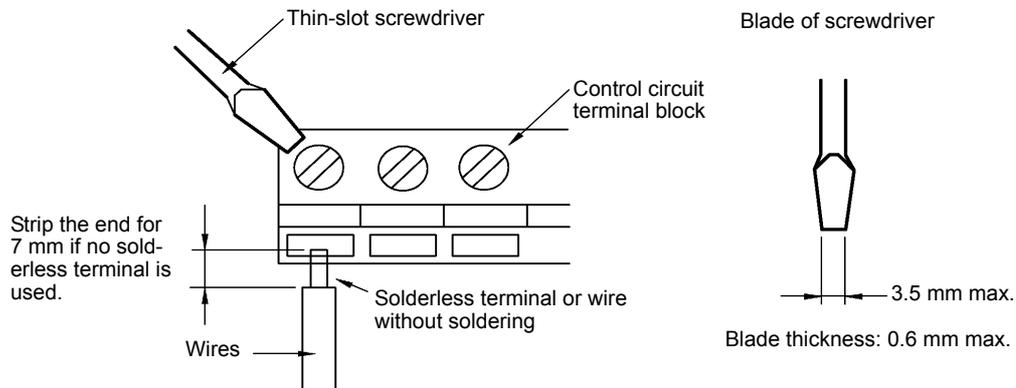


Fig 2.19 Connecting Wires to Terminal Block

◆ 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

Type	No.	Signal Name	Function	Signal Level
Se- quence 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	Multi-function input 1* ¹	Factory setting: External fault when ON.	
	S4	Multi-function input 2* ¹	Factory setting: Fault reset when ON.	
	S5	Multi-function input 3* ¹	Factory setting: Multi-speed reference 1 effective when ON.	
	S6	Multi-function input 4* ¹	Factory setting: Multi-speed reference 2 effective when ON.	
	S7	Multi-function input 5* ¹	Factory setting: Jog frequency selected when ON.	
	S8	Multi-function input 6	Factory setting: Not used (H1-06 = F).	
	SC	Sequence input common	-	
Analog input signals	+V	+15 V power output	+15 V power supply for analog references	+15 V (Max. current: 20 mA)
	-V	-15 V power output	-15 V power supply for analog references	-15 V (Max. current: 20 mA)
	A1	Master speed frequency reference	-10 to +10 V/-100 to 100% 0 to +10 V/100%	-10 to +10 V, 0 to +10 V (Input impedance: 20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100%, -10 to +10 V/-100 to +100%, 0 to +10 V/100% Factory setting: Added to terminal A1 (H3-09 = 0)	4 to 20 mA (Input impedance: 250 Ω) -10 to +10 V, 0 to +10 V (Input impedance: 20 kΩ)
	A3	Multi-function analog input	-10 to +10 V/-100 to +100%, 0 to +10 V/100% Factory setting: Not used (H3-05 = 1F)	-10 to +10 V, 0 to +10 V (Input impedance: 20 kΩ)
	AC	Analog reference common	0 V	-
E(G)	Shield wire, optional ground line connection point	-	-	
Photo- coupler outputs	P1	Multi-function PHC output 1	Factory setting: Zero-speed Zero-speed level (b2-01) or below when ON.	50 mA max. at 48 VDC* ²
	P2	Multi-function PHC output 2	Factory setting: speed agreement detection Frequency within 2% of set speed when ON.	
	PC	Photocoupler output common for P1 and P2	-	

Table 2.11 Control Circuit Terminals (Continued)

Type	No.	Signal Name	Function	Signal Level
Relay outputs	MA	Fault output signal (NO contact)	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC	Dry contacts Contact capacity: 10 mA min., 1 A max. at 250 VAC 10 mA min., 1 A max. at 30 VDC Minimum permissible load: 5 VDC, 10 mA ^{*4}
	MB	Fault output signal (NC contact)		
	MC	Relay contact output common	-	
	M1	Multi-function contact output (NO contact)	Factory setting: Operating Operating when CLOSED across M1 and M2.	
	M2			
Analog monitor outputs	FM	Multi-function analog monitor 1	Factory setting: Motor speed 0 to 10 V/Maximum speed	-10 to +10 VDC ±5% 2 mA max.
	AM	Multi-function analog monitor 2	Factory setting: Current monitor 5 V/Inverter's rated current	
	AC	Analog common	-	
Pulse I/O	RP	Multi-function pulse input ^{*3}	Factory setting: Speed reference input (H6-01 = 0)	0 to 32 kHz (3 kΩ)
	MP	Multi-function pulse monitor	Factory setting: Output frequency (H6-06 = 2)	0 to 32 kHz (2.2 kΩ)
RS-485/422	R+	MEMOBUS communications input	For 2-wire RS-485, short R+ and S+ as well as R- and S-.	Differential input, photocoupler isolation
	R-			
	S+	MEMOBUS communications output		Differential output, photocoupler isolation
	S-			
	IG	Communications shield wire		-

- * 1. For a 3-wire sequence, the default settings are a 3-wire sequence for S5, multi-step speed setting 1 for S6, and multi-step speed setting 2 for S7.
- * 2. When driving a reactive load, such as a relay coil, always insert a flywheel diode as shown in Fig 2.20.
- * 3. Pulse input specifications are given in the following table.
- * 4. Use the photocoupler outputs when the minimum permissible load is 5 VDC or less and 10 mA or less.

Low level voltage	0.0 to 0.8 V
High level voltage	3.5 to 13.2 V
H duty	30% to 70%
Pulse frequency	0 to 32 kHz

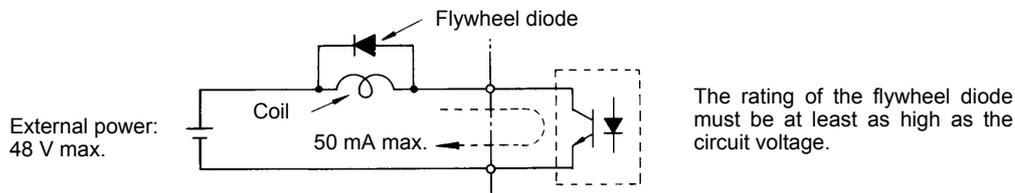


Fig 2.20 Flywheel Diode Connection

■ Shunt Connector CN5 and DIP Switch S1

The shunt connector CN 5 and DIP switch S1 are described in this section.

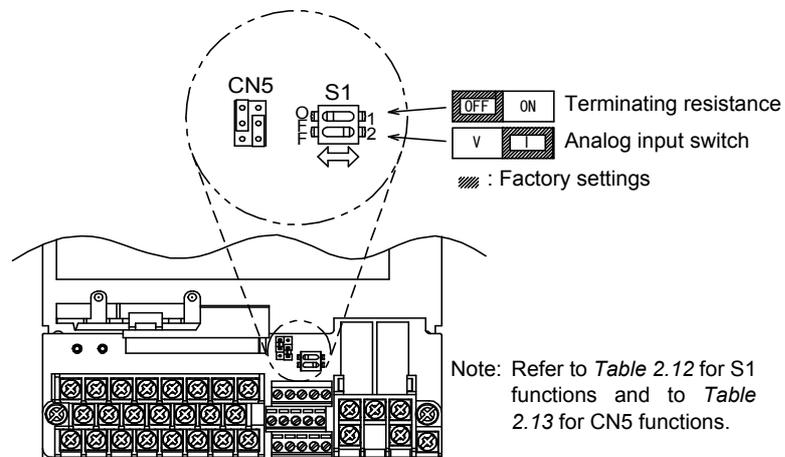


Fig 2.21 Shunt Connector CN5 and DIP Switch S1

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

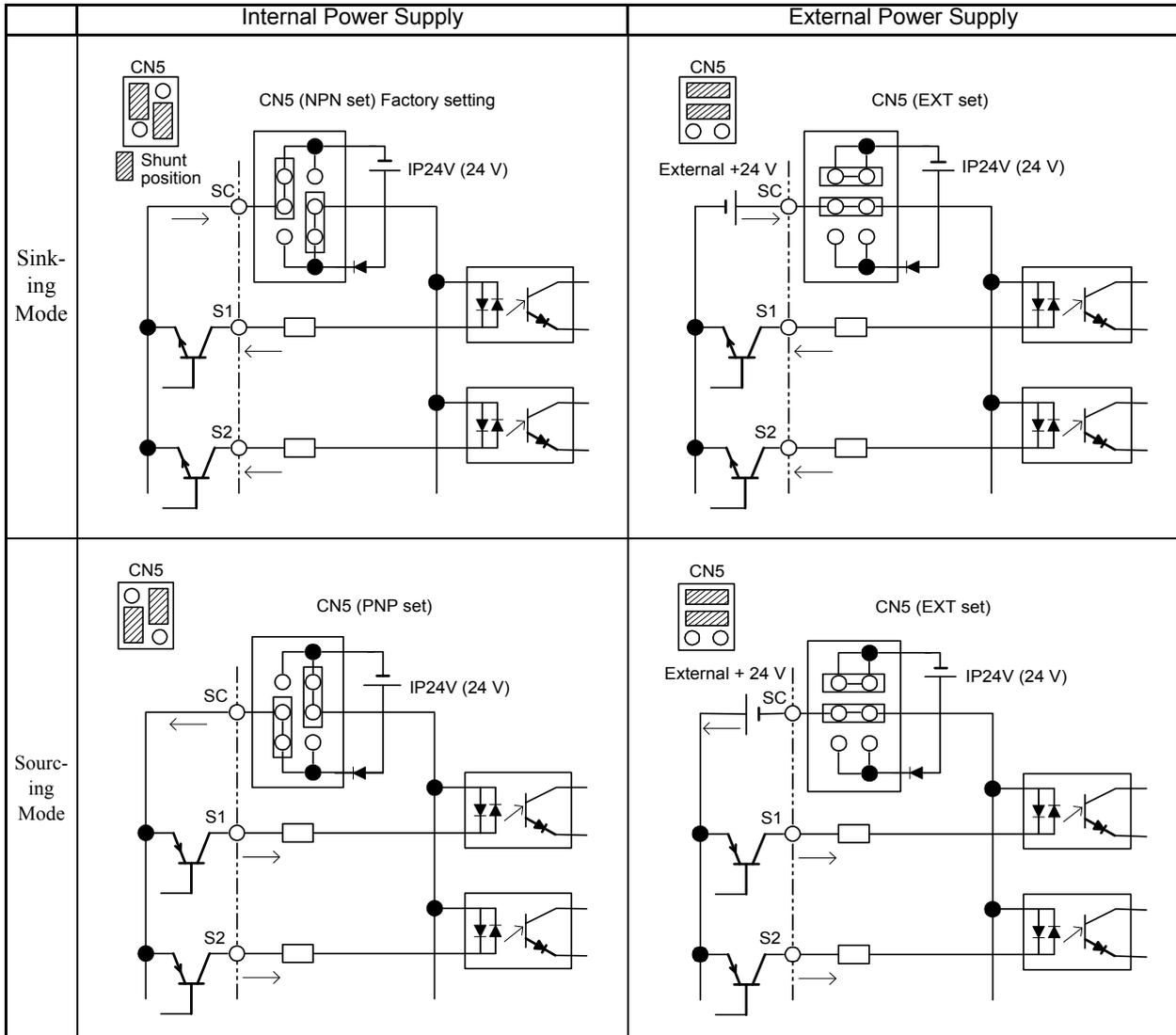
Table 2.12 DIP Switch S1

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

■ Sinking/Sourcing Mode

The input terminal logic can be switched between sinking mode (0-V common) and sourcing mode (+24-V common) if shunt connector CN5 is used. An external 24-V power supply is also supported, providing more freedom in signal input methods.

Table 2.13 Sinking/Sourcing Mode and Input Signals



◆ Control Circuit Terminal Connections

Connections to Inverter control circuit terminals are shown in Fig 2.22.

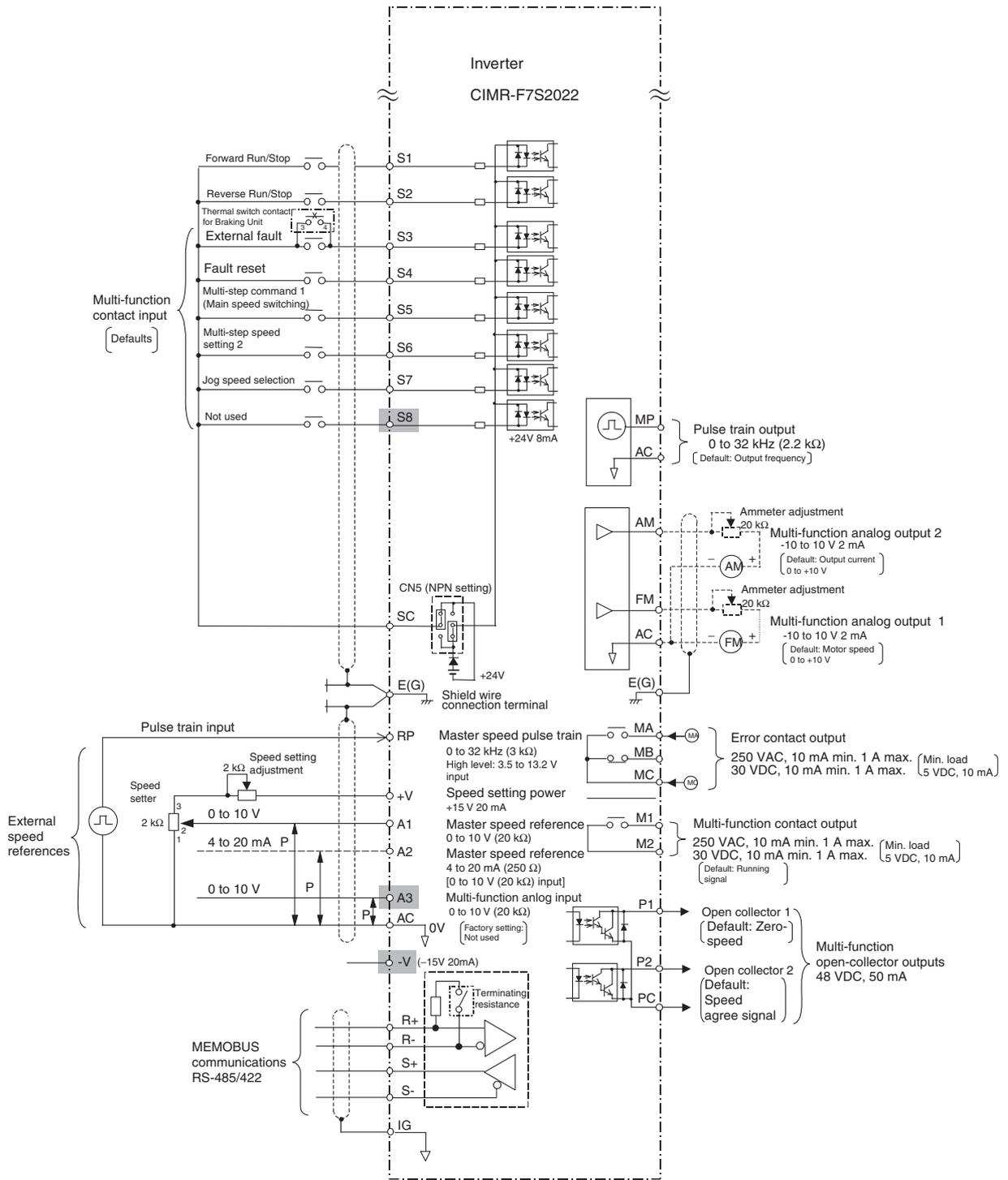


Fig 2.22 Control Circuit Terminal Connections

◆ Control Circuit Wiring Precautions

Observe the following precautions when wiring control circuits.

- Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, \ominus , $\oplus 1$, $\oplus 2$, and $\oplus 3$) and other high-power lines.
- Separate wiring for control circuit terminals MA, MB, MC, M1, and M2 (contact outputs) from wiring to other control circuit terminals.
- Use shielded twisted-pair cables for control circuits to prevent operating faults. Process cable ends as shown in *Fig 2.23*.
- Connect the shield wire to terminal E (G).
- Insulate the shield with tape to prevent contact with other signal lines and equipment.
- Use a class 2 power supply (UL standard) when connecting to the control terminals.

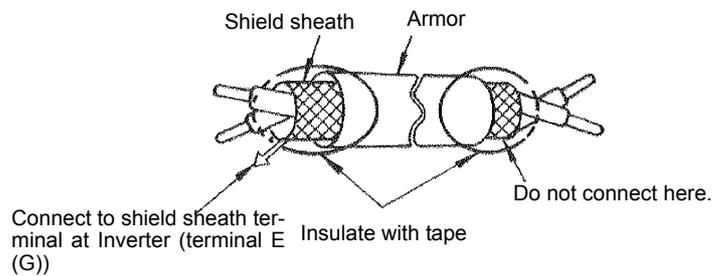


Fig 2.23 Processing the Ends of Shielded Twisted-pair Cables

Wiring Check

◆ Checks

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

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

Installing and Wiring Option Cards

◆ Option Card Models and Specifications

Up to three option cards can be mounted in the Inverter. You can mount up one board into each of the three places on the control board (A, C, and D) shown in *Fig 2.24*.

Table 2.14 lists the type of option cards and their specifications.

Table 2.14 Option Card Specifications

Card	Model	Specifications	Mounting Location
PG Speed Control Card	PG-X2	Phase A/B/Z line-driver inputs	A
Speed Reference Cards	AI-14U	Input signal levels 0 to 10 V DC (20 k Ω), 1 channel 4 to 20 mA (250 Ω), 1 channel Input resolution: 14-bit	C
	AI-14B	Input signal levels 0 to 10 V DC (20 k Ω) 4 to 20 mA (250 Ω), 3 channels Input resolution: 13-bit with sign bit	C
	DI-08	8-bit digital speed reference setting	C
	DI-16H2	16-bit digital speed reference setting	C
DeviceNet Communication Card	SI-N1	DeviceNet communications support	C
CC-Link Interface Card	SI-C	CC-Link communications support	C
LONWORKS Communication Card	SI-J	LONWORKS communications support	C
Analog Monitor Card	AO-08	8-bit analog outputs, 2 channels	D
	AO-12	12-bit analog outputs, 2 channels	D
Digital Output Card	DO-08	Six photocoupler outputs and 2 relay outputs	D
	DO-02C	2 relay outputs	D

◆ Installation

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

The side of the front cover of the Inverter for 200/400 V Class 0.4 to 5.5 kW can be cut out as described in *Fig 2.25* to make wiring of the option card easy. If the side of the front cover is cut out, the protective structure will be open chassis (IEC IP00).

Refer to documentation provided with the option card for actual mounting instructions for option slots A, C, and D.

■ Preventing C and D option card Connectors from Rising

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

Remove the option clip before installing an option card into slot C or D. The option card cannot be installed completely and may not function property if it is installed with the the option clip attached.

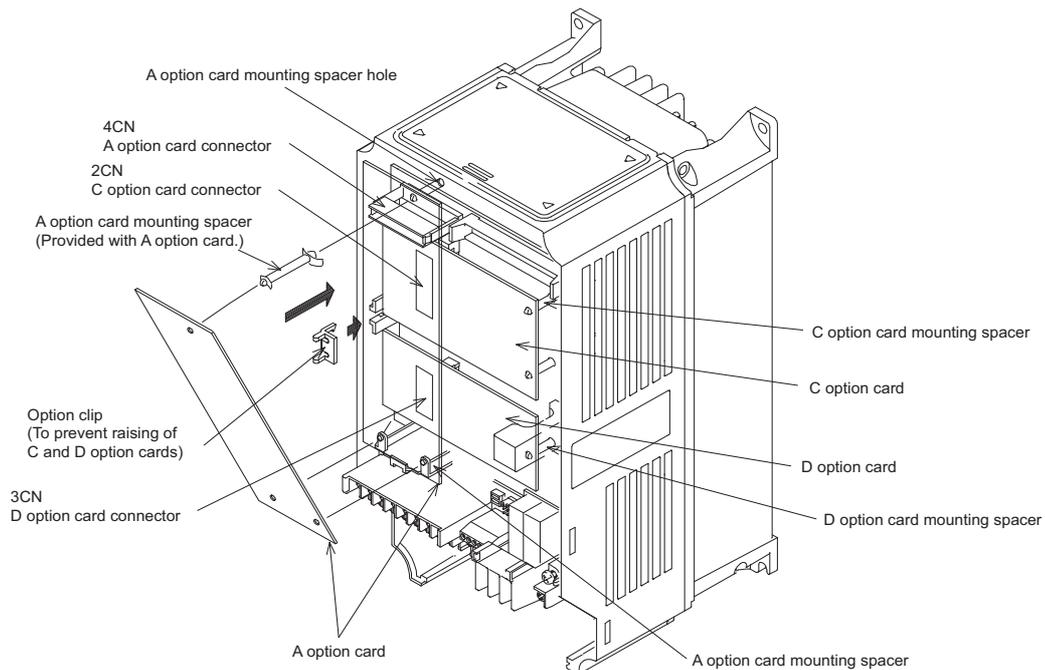


Fig 2.24 Mounting option cards

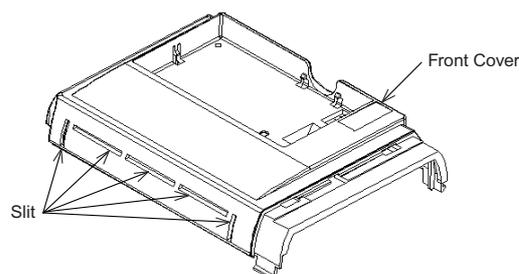


Fig 2.25 Cutting the Front Cover

Cut out the slits on the front cover with nippers. Be careful to avoid injury.

◆ PG Speed Control Card Terminals and Specifications

The terminal specifications for the PG Speed Control Cards are given in the following tables.

■ PG-X2

The terminal specifications for the PG-X2 are given in the following table.

Table 2.15 PG-X2 Terminal Specifications

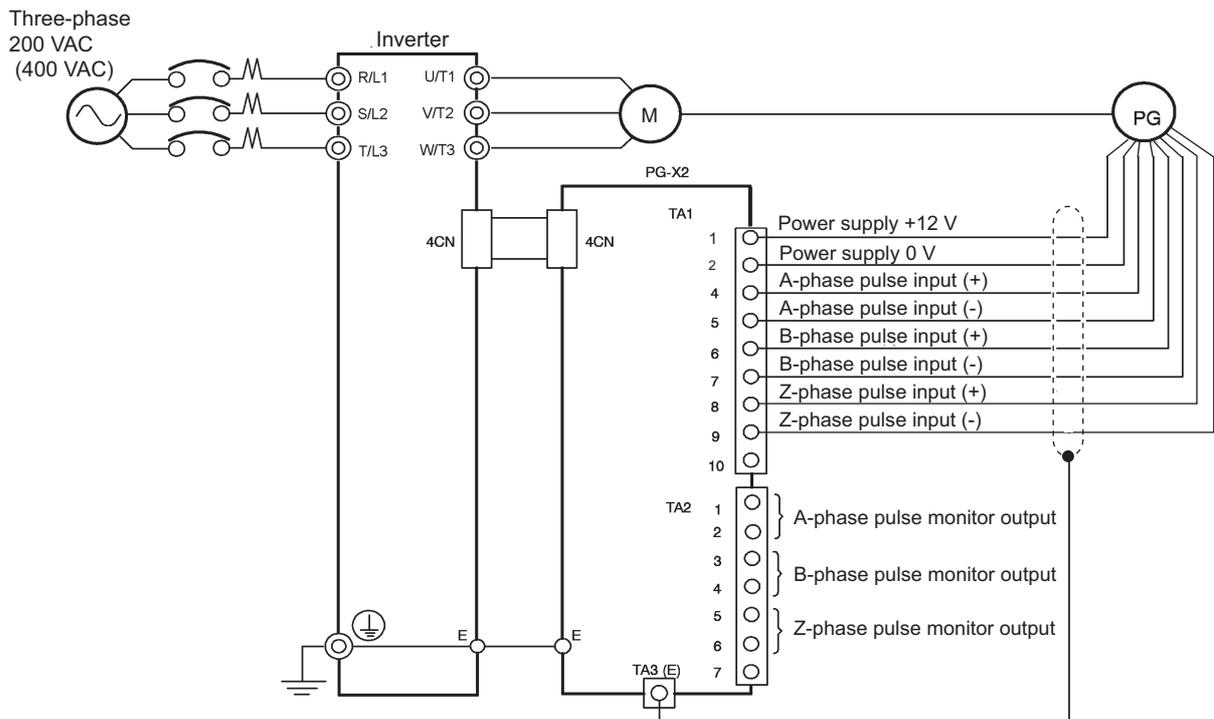
Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC ($\pm 5\%$), 200 mA max.*
	2		0 VDC (GND for power supply)
	3		5 VDC ($\pm 5\%$), 200 mA max.*
	4	A-phase + input terminal	Line driver input (RS-422 level input) Maximum response frequency: 300 kHz
	5	A-phase - input terminal	
	6	B-phase + input terminal	
	7	B-phase - input terminal	
	8	Z-phase + input terminal	
	9	Z-phase - input terminal	
	10	Common terminal	0 VDC (GND for power supply)
TA2	1	A-phase + output terminal	Line driver output (RS-422 level output)
	2	A-phase - output terminal	
	3	B-phase + output terminal	
	4	B-phase - output terminal	
	5	Z-phase + output terminal	
	6	Z-phase - output terminal	
	7	Control circuit common	Control circuit GND
TA3	(E)	Shield connection terminal	-

* 5 VDC and 12 VDC cannot be used at the same time.

◆ Wiring

■ Wiring the PG-X2

Wiring examples are provided in the following illustrations for the PG-X2.



- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator's power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator's wiring must not be more than 100 meters.
- The direction of rotation of the PG can be set in user constant F1-05 (PG Rotation). The factory preset is for motor forward rotation, B-phase advancement.

Fig 2.26 PG-X2 Wiring

◆ Wiring Terminal Blocks

Use no more than 100 meters of wiring for PG (encoder) signal lines, and keep them separate from power lines.

Use shielded, twisted-pair wires for pulse inputs and pulse output monitor wires, and connect the shield to the shield connection terminal.

■ Wire Sizes (Same for All Models)

Terminal wire sizes are shown in *Table 2.16*.

Table 2.16 Wire Sizes

Terminal	Terminal Screws	Wire Thickness (mm ²)	Wire Type
Pulse generator power supply Pulse input terminal Pulse monitor output terminal	-	Stranded wire: 0.5 to 1.25 Single wire: 0.5 to 1.25	<ul style="list-style-type: none"> Shielded, twisted-pair wire Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electric Wire or equivalent)
Shield connection terminal	M3.5	0.5 to 2	

■ Straight Solderless Terminals for Control Circuit Terminals

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

Refer to *Table 2.10 Straight Solderless Terminal Sizes* for specifications.

■ Closed-loop Connector Sizes and Tightening Torque

The closed-loop connectors and tightening torques for various wire sizes are shown in *Table 2.17*.

Table 2.17 Closed-loop Connectors and Tightening Torques

Wire Thickness [mm ²]	Terminal Screws	Crimp Terminal Size	Tightening Torque (N • m)
0.5	M3.5	1.25 - 3.5	0.8
0.75		1.25 - 3.5	
1.25		1.25 - 3.5	
2		2 - 3.5	

■ Wiring Method and Precautions

The wiring method is the same as the one used for straight solderless terminals. Refer to page 2-24. Observe the following precautions when wiring.

- Separate the control signal lines for the PG Speed Control Board from main circuit lines and power lines.
- Connect the shield when connecting to a PG. The shield must be connected to prevent operational errors caused by noise. Also, do not use any lines that are more than 100 m long. Refer to *Fig 2.23* for details on connecting the shield.
- Connect the shield to the shield terminal (E).
- Do not solder the ends of wires. Doing so may cause contact faults.
- When not using straight solderless terminals, strip the wires to a length of approximately 5.5 mm.



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.....	3-5

Digital Operator

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

◆ Digital Operator Display

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

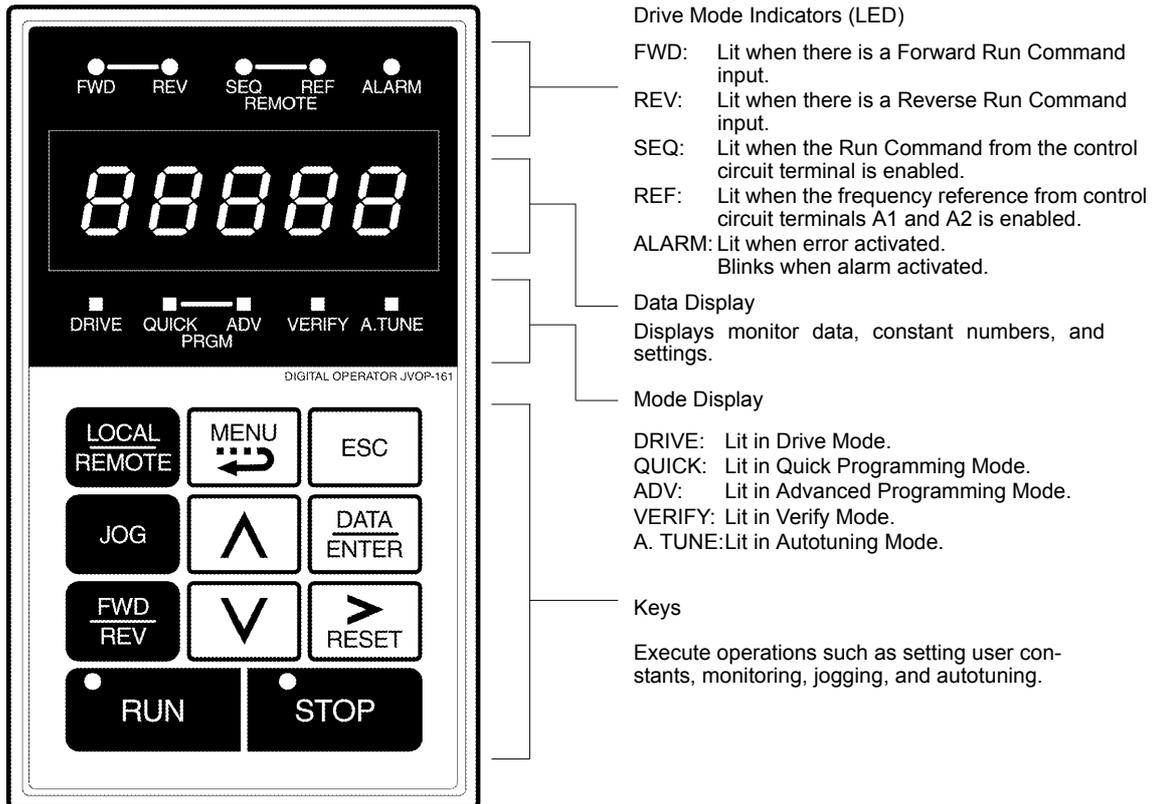


Fig 3.1 Digital Operator Component Names and Functions

◆ Digital Operator Keys

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

Table 3.1 Key Functions

Key	Name	Function
	LOCAL/REMOTE 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 Key	Selects menu items (modes).
	ESC Key	Returns to the status before the DATA/ENTER Key was pressed.

Table 3.1 Key Functions (Continued)

Key	Name	Function
	JOG Key	Enables jog operation when the Inverter is being operated from the Digital Operator.
	FWD/REV Key	Selects the rotation direction of the motor when the Inverter is being operated from the Digital Operator.
	Shift/RESET Key	Sets the number of digits for user constant settings. Also acts as the Reset Key when a fault has occurred.
	Increment Key	Selects menu items, sets user constant numbers, and increments set values. Used to move to the next item or data.
	Decrement Key	Selects menu items, sets user constant numbers, and decrements set values. Used to move to the previous item or data.
	DATA/ENTER Key	Pressed to enter menu items, user constants, and set values. Also used to switch from one screen to another. Constants cannot be changed when Undervoltage (UV) is detected.
	RUN Key	Starts the Inverter operation when the Inverter is being controlled by the Digital Operator.
	STOP Key	Stops Inverter operation. This Key can be enabled or disabled when operating from the control circuit terminal by setting user constant o2-02.

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

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

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

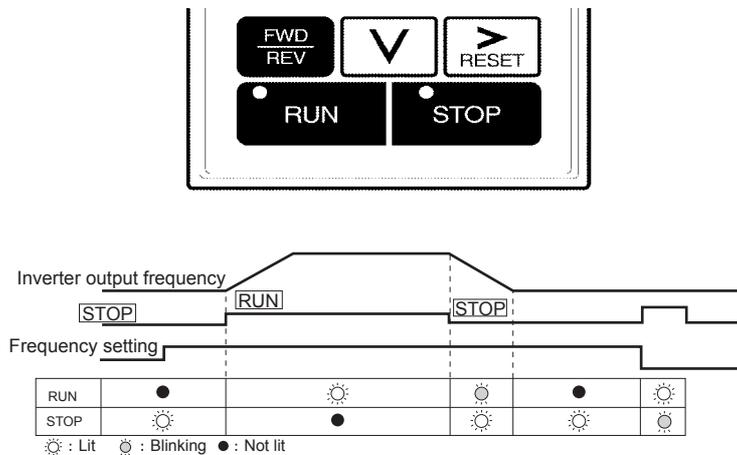


Fig 3.2 RUN and STOP Indicators

The following table shows the relationship between the indicators on the RUN and STOP Keys and the Inverter conditions.

The indicators are lit, unlit or blinking reflecting the order of priority.

Table 3.2 Relation of Inverter to RUN and STOP Indicators

Priority	RUN Indicator	STOP Indicator	Inverter Status	Conditions
1	●	●	Stopped	Power supply is shut down.
2	●	⦿	Stopped*	Emergency stop <ul style="list-style-type: none"> • Stop Command is sent from the Digital Operator when the control circuit terminals were used to operate the Inverter. • Emergency Stop Command is sent from the control circuit terminal. Switched from LOCAL (operation using the Digital Operator) to REMOTE (operation using the control circuit terminals) when the Run Command is sent from the external terminal. Switched from the Quick or Advanced Quick programming mode to the Drive mode when the Run Command is sent from the external terminal.
3	⦿	⦿	Stopped	The Inverter is run at a speed below the minimum speed. The Run Command is carried out when the External Baseblock Command using the multi-function contact input terminal is issued.
4	●	⦿	Stopped	Stopped
5	⦿	⦿	Running	During deceleration to a stop
6	⦿	⦿	Running	During emergency deceleration <ul style="list-style-type: none"> • Stop Command is sent from the Digital Operator when operating the Inverter using the control circuit terminals. • Emergency Stop Command is sent from the control circuit terminal.
7	⦿	●	Running	Run Command is issued.

Note ⦿: Lit ⦿: Blinking ●: Not lit

* If planning to run the Inverter again, first turn OFF the Run Command and Emergency Stop Command from the control circuit terminal and send the Run Command.

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 3.3*.

Table 3.3 Modes

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

◆ Switching Modes

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

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

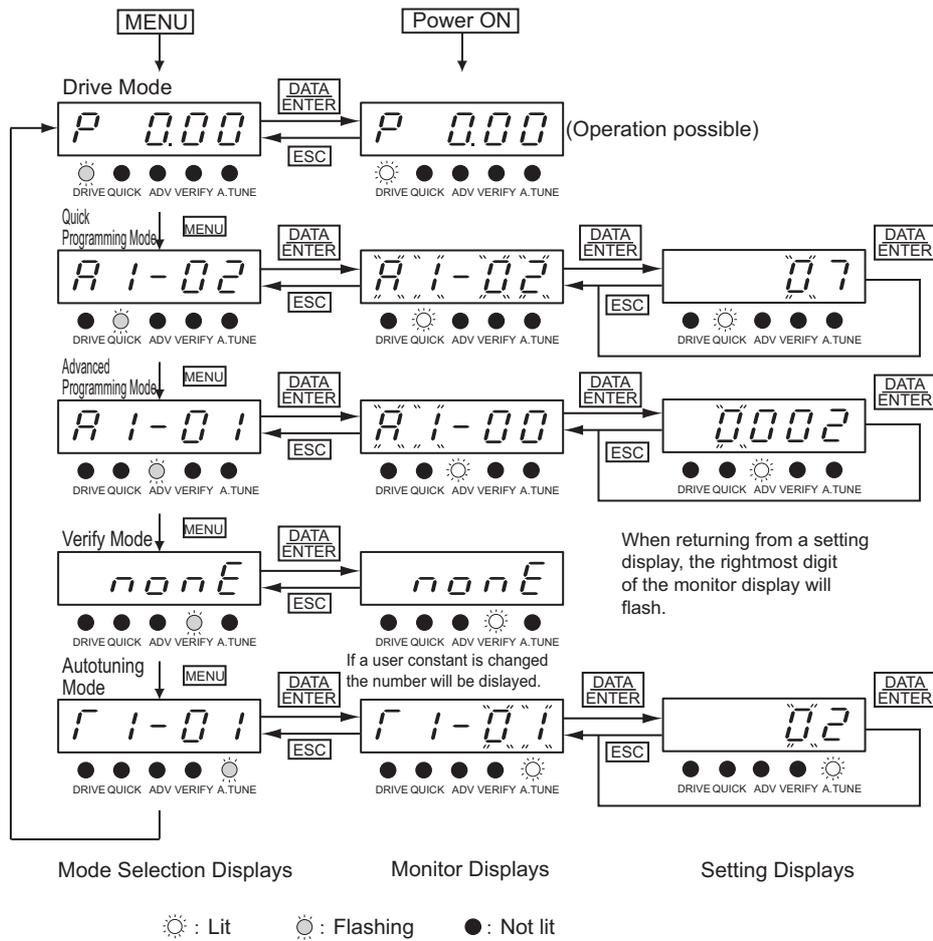


Fig 3.3 Mode Transitions



IMPORTANT

When running the Inverter after using Digital Operator, press the MENU Key to enter the drive mode (DRIVE indicator will flash) and then press the DATA/ENTER Key from the drive mode display to bring up the monitor display (DRIVE indicator will light). Run Commands can't be received from any other display. (Monitor display in the drive mode will appear when the power is turned ON.)

◆ Drive Mode

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

When b1-01 (Reference selection) is set to 0, the speed can be changed from the speed setting display. Use the Increment, Decrement, and Shift/RESET Keys to change the speed. 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.

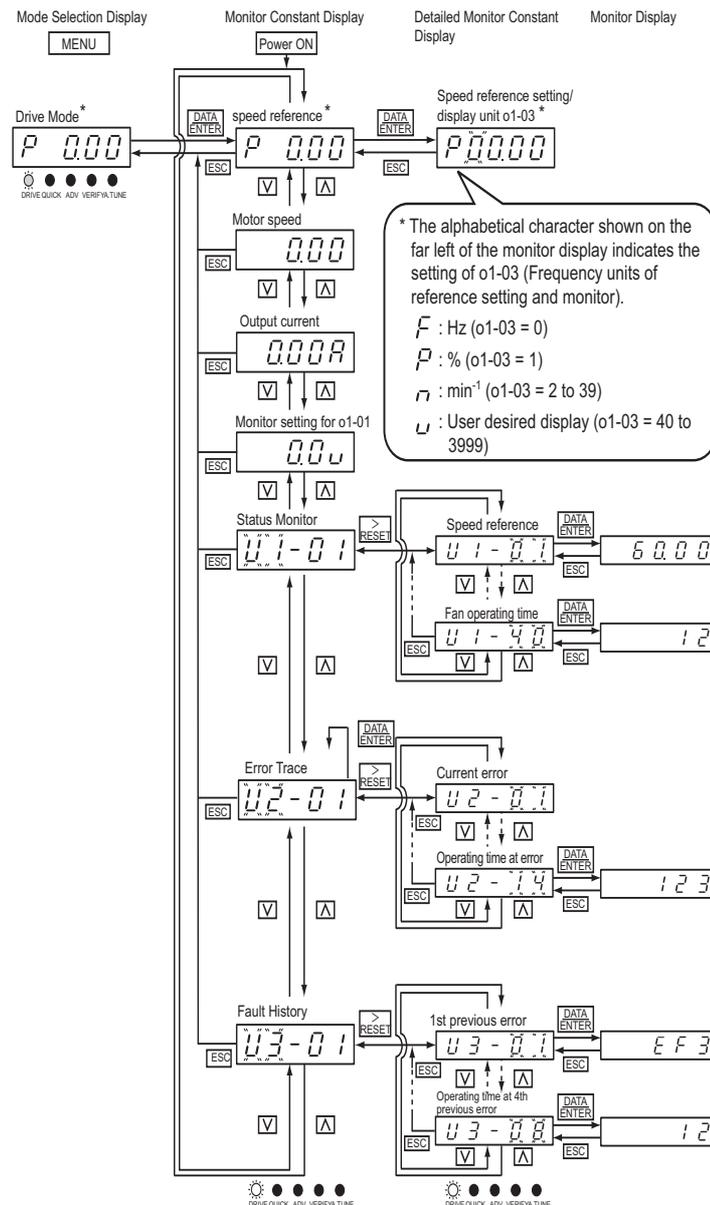


Fig 3.4 Operations in Drive Mode



The display for the first monitor constant (speed reference) will be displayed when power is turned ON. The monitor item displayed at startup can be set in o1-02 (Monitor Selection after Power Up). Operation cannot be started from the mode selection display.

◆ Quick Programming Mode

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

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

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

■ Example Operations

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

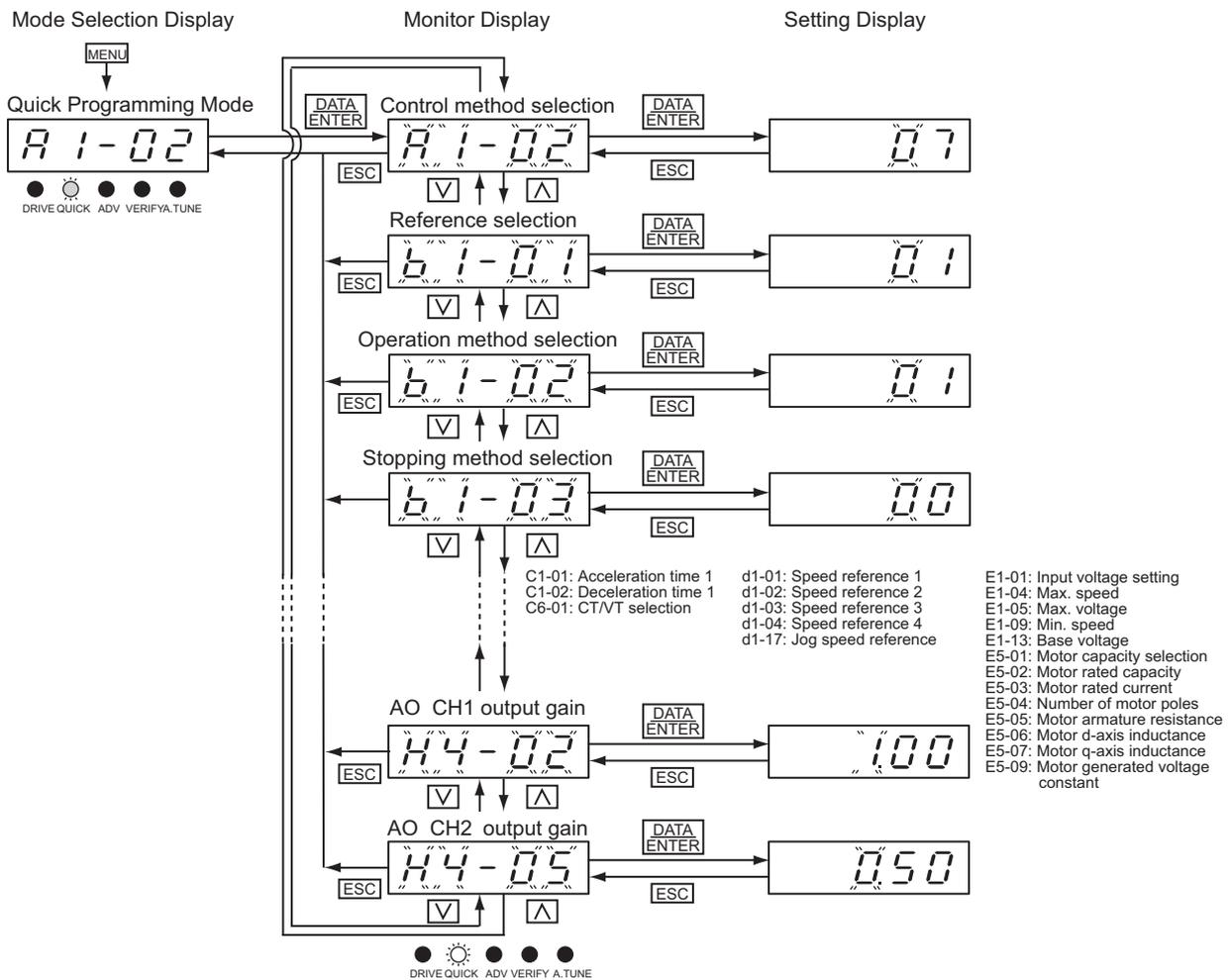


Fig 3.5 Operations in Quick Programming Mode

◆ Advanced Programming Mode

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

Constants can be changed from the setting displays. Use the Increment, Decrement, and Shift/RESET Keys to change the frequency. The user constant will be written and the 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.

■ Example Operations

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

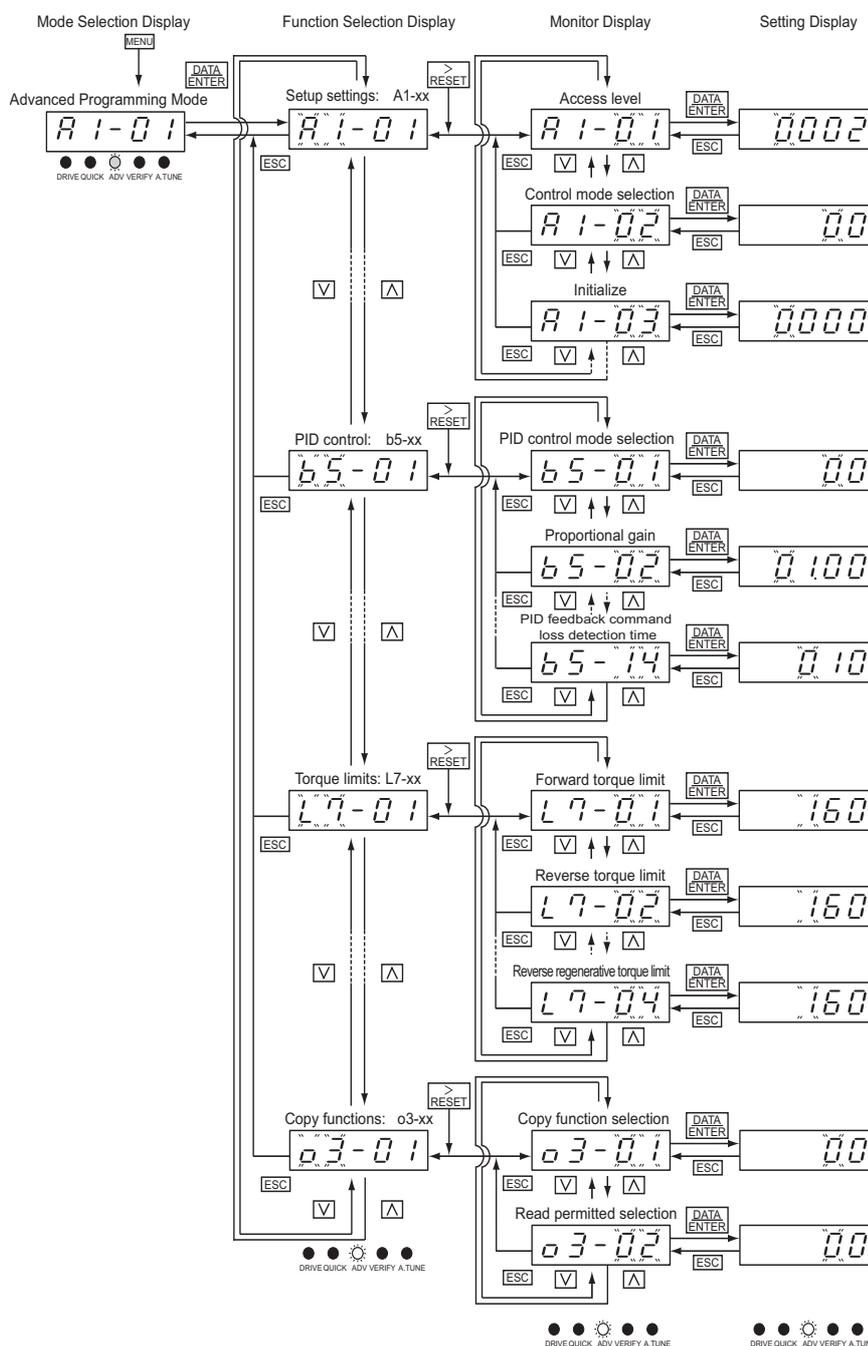
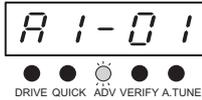


Fig 3.6 Operations in Advanced Programming Mode

■ Setting User Constants

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

Table 3.4 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 (10.0) is displayed.
8		Shift/RESET Key pressed to move the flashing digit to the right.
9		Increment Key pressed to change set value to 20.0 s.
10		DATA/ENTER Key pressed to enter the set data. "END" is displayed for 10 s and then the entered value is displayed for 0.5 s.
11		The monitor display for C1-01 returns.

◆ Verify Mode

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

Of the environment mode settings, only A1-02 will be displayed if it has been changed. Other environment modes settings will not be displayed even if they have been changed from their default settings.

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

■ Example Operations

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

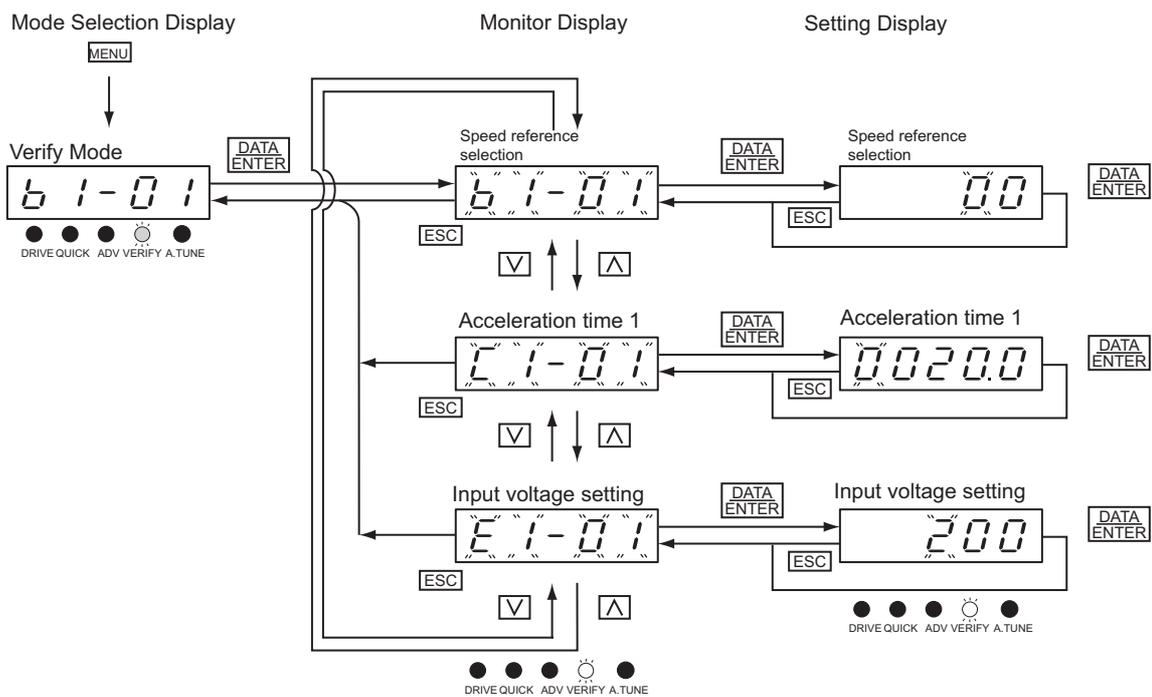
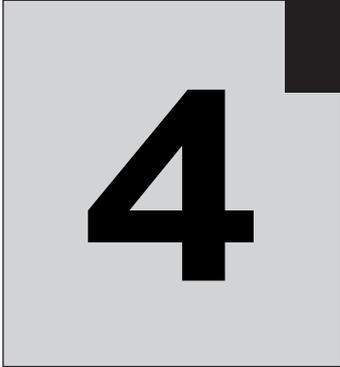


Fig 3.7 Operations in Verify Mode

◆ Autotuning Mode

For examples of autotuning operation, refer to *Chapter 4 Trial Operation*.



4

Trial Operation

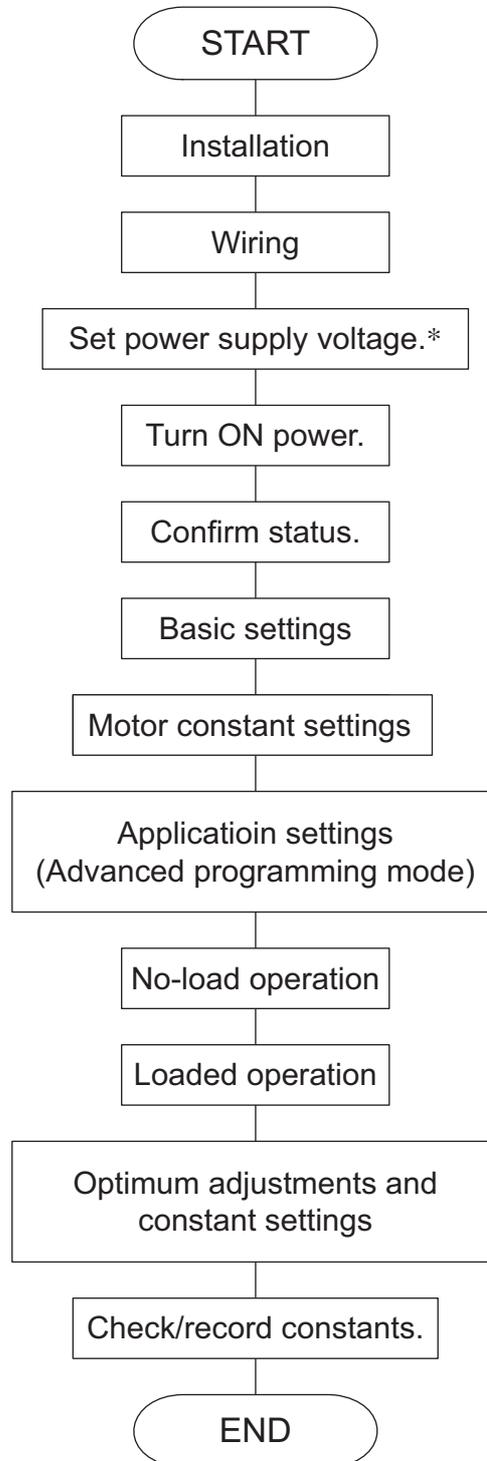
This chapter describes the procedures for trial operation of the Inverter and provides an example of trial operation.

Overview of Trial Operation Procedure.....	4-2
Trial Operation Procedures.....	4-3
Adjustment Suggestions	4-27

Overview of Trial Operation Procedure

Perform trial operation according to the following flowchart. When setting the basic user constants, always set C6-01 (CT/VT Selection) according to the application.

Be sure to set E1-01 (Input voltage setting) to the Inverter input voltage in accordance with the supply voltage being used.



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

Fig 4.1 Trial Operation Flowchart

Trial Operation Procedures

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

◆ Application Confirmation

First, confirm the application before using the Inverter.

- Fan, blower, pump
- Other equipment

For any Inverter application other than a fan, blower, or pump, set C6-01 (CT/VT Selection) to 0 (CT: low carrier, constant torque). The default setting is 1 (VT: high carrier, variable torque).

However, only 1(VT) can be set for 400 V Class 220 kW and 300 kW Inverters with any SPEC.

Note: Inverters with SPEC: B or earlier are used only for applications requiring variable torque.

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

Set the power supply voltage jumper after setting E1-01 (Input Voltage Setting) for 400 V Class Inverters of 75 kW or higher. Insert the jumper into the power tap nearest to the actual power supply voltage. If the wrong connector is selected, the Inverter may be damaged.

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.

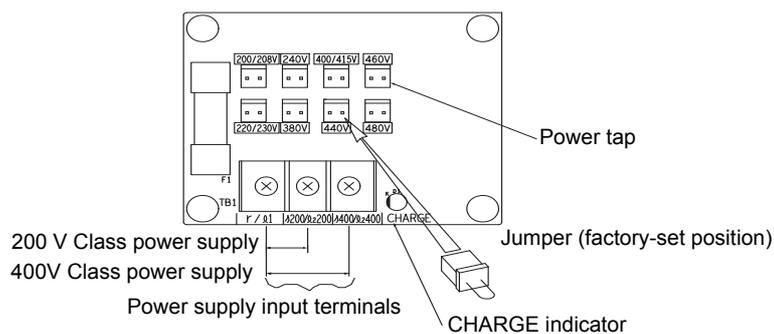


Fig 4.2 Power Supply Voltage Jumper

◆ Power ON

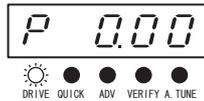
Confirm all of the following items and then turn ON the power supply.

1. Check that the power supply is of the correct voltage.
200V Class: 3-phase 200 to 240 VAC 50/60 Hz
400V Class: 3-phase 380 to 480 VAC 50/60 Hz
For an Inverter of 200 V, 37 kW or more, use one of the following power supplies for the cooling fan.
3-phase 200/208/220 VAC 50 Hz or 3-phase 200/208/220/230 VAC 60 Hz
2. Make sure that the motor output terminals (U, V, W) and the motor are connected correctly.
3. Make sure that the Inverter control circuit terminal and the control device are wired correctly.
4. Set all Inverter control circuit terminals to turn OFF.
5. When using a PG speed control board, make sure that it is wired correctly.
6. Make sure that the motor is not connected to the mechanical system. (No-load condition)

◆ Checking the Display Status

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

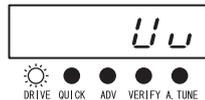
Display for normal operation



The speed reference (%) monitor is displayed in the data display section.

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

Display for fault operation



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

◆ Basic Settings

Switch to the quick programming mode (the QUICK indicator on the Digital Operation should be lit) and then set the following user constants. Refer to *Chapter 3 Digital Operator and Modes* for Digital Operator operating procedures and to *Chapter 5 User Constants* and *Chapter 6 Constant Settings by Function* for details on the user constants.

Constants that must be set are listed in *Table 4.1* and those that are set according to the application are listed in *Table 4.2*.

Table 4.1 Basic Settings of Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Page
A1-02	Control method selection	Used to select the control method for the Inverter 0: Sequence test (This method implements a sequence test with an induction motor connected or any other motor not connected.) 6: Flux vector control for PM 7: Open-loop vector control for PM This constant is not initialized by the initialize operation.	0 or 7	7	5-4
			0, 6, or 7		
b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 3	1	5-10 6-5 6-63 6-83
			0 to 4		
b1-02	Operation method selection	Set the Run Command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option card	0 to 3	1	5-10 6-14 6-63 6-83
C1-01	Acceleration time 1	Sets the acceleration time to accelerate from 0 to the maximum speed, in 1-second units.	0.0 to 6000.0 s *2	10.0 s	5-16 6-20
C1-02	Deceleration time 1	Sets the deceleration time to decelerate from the maximum speed to 0, in 1-second units.	0.0 to 6000.0 s *2	10.0 s	5-16 6-20
C6-01	CT/VT selection	Set to CT (not low noise, maximum current overload: 150%) or VT (low noise, maximum current overload: 120%). 0: CT 1: VT	0 or 1	1*1	5-19 6-2
				0*1	
E1-01	Input voltage setting	Set the Inverter's nominal input voltage in volts. This setting is used as a reference value in protection functions.	155 to 255 V (200 V Class) 310 to 510 V (400 V Class)	200 V (200 V Class) 400 V (400 V Class)	5-25 6-25

* 1. The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times becomes 0.00 to 600.00 seconds.

* 2. Only 1(VT) can be set for 400 V Class 220 kW and 300 kW Inverters.

Table 4.2 Constants That Are Set As Required

Constant Number	Name	Description	Setting Range	Factory Setting	Page
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 3: Coast to stop with timer (Run Commands are disregarded during deceleration.)	0, 1, or 3	0	5-10 6-16
d1-01 to d1-04 and d1-17	Frequency references 1 to 4 and jog frequency reference	Set the required speed references for multi-step speed operation or jogging.	0.00 to 100.00%	d1-01 to d1-04: 0.00 % d1-17: 10.00 %	5-20 6-9
H4-02 and H4-05	FM and AM terminal output gain	Set the voltage level gain for the multi-function analog output 1 (H4-02) and 2 (H4-05). Set the number of multiples of 10 V to be output as the 100% output for the monitor item.	0.00 to 2.50	H4-02: 1.00 H4-05: 0.50	5-42



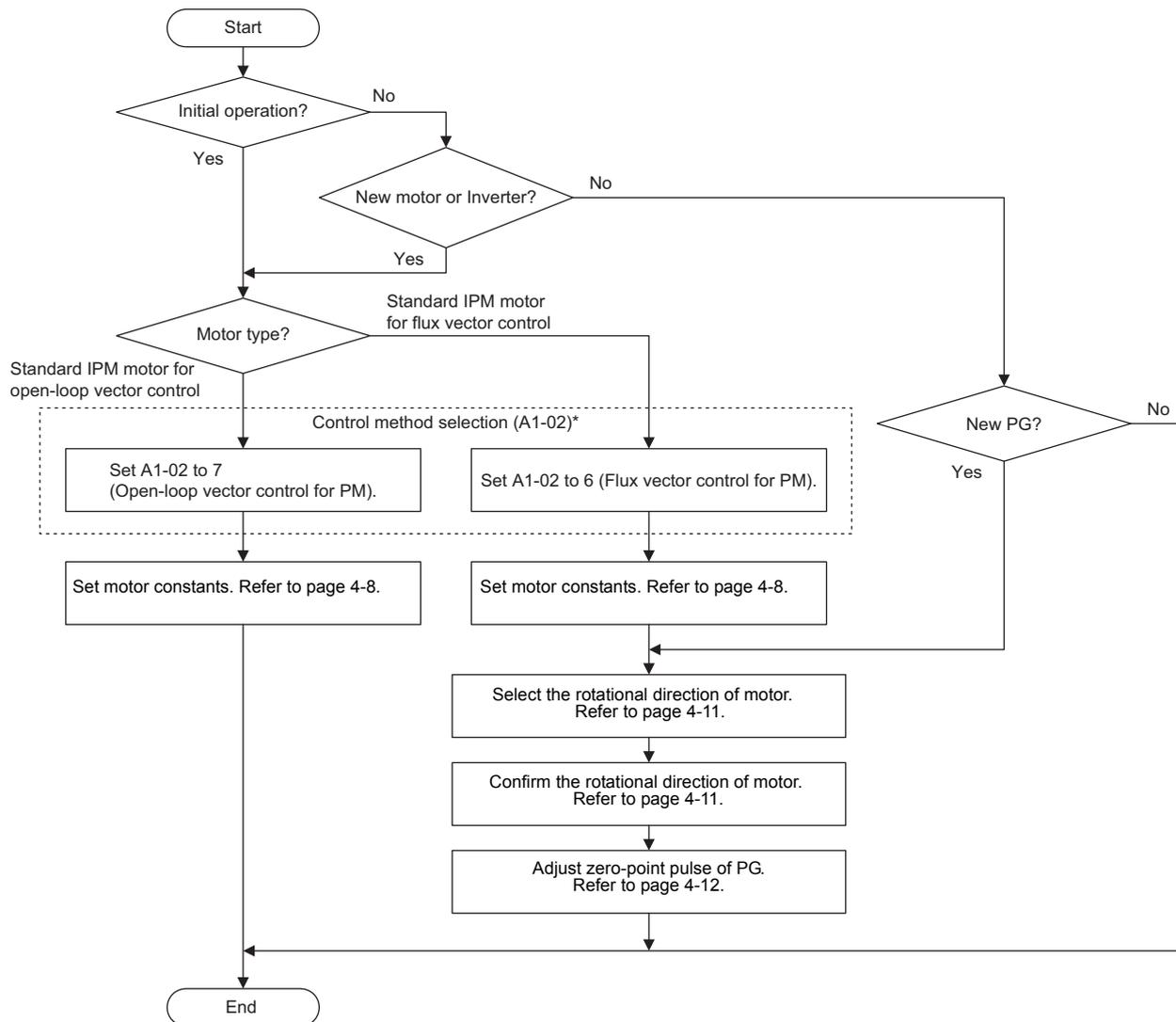
When C6-01 is set to 0 (CT), non-low noise will apply and the Inverter overload withstand ratio will be 150% of the Inverter rating per minute. When C6-01 is set to 1 (VT), low noise will apply and the Inverter overload withstand ratio will be 120% of the Inverter rating per minute. If C6-01 is set to 1 (VT) when overload withstand capability is required by the application, the life of the Inverter may be reduced.

◆ Motor Constant Settings

The procedures for setting motor constants differ in accordance with the following three conditions and the type of motor being used. Follow each step to correctly set the motor constants.

- When using the Varispeed F7S for the first time.
- When replacing the motor or the Inverter.
- When replacing the PG.

Use the following flow chart to set the motor constants.



*Factory setting: A1-02=7 (Open-loop vector control for PM).

Fig 4.3 Flow Chart for Motor Constant Settings

The following sections describe how to select a control method and how to set the motor constants.

■ Control Method Selection

Select the control method in accordance with the type of motor being used.

Table 4.3 Control Method Selection

Control Method	Constant Setting	Applicable Motor ^{*2}
Flux vector control for PM	A1-02 = 6	Standard IPM motor for the flux vector control (Constant torque series: SST4 motors)
Open-loop vector control for PM ^{*1}	A1-02=7 (Default)	Standard IPM motor for the open-loop vector control (Variable torque series: SSR1 motors)

* 1. Only for applications of requiring variable torque. Do not use this control method for elevating machines or applications requiring constant torque.

* 2. Cannot be used for the following applications:
 • Operations switching commercial power supply and Inverter
 • Running more than one motor per Inverter (Multi-motor drive)

■ Motor Constant Settings

Flux vector control for PM (A1-02 = 6)

1. Motor Constant Settings

Check the nameplate (NP) on the motor being used to obtain the required motor constant settings.

Record those values in the NP Value (Setting) columns of Table 4.4.

VARTSPEED											
3-PHASE PERMANENT MAGNET MOTOR											
TYPE SST4-					POLES E5-04						
PROTECTION			COOLING							PARAMETER	
kW	V	Hz	RATING	A	r/min	r _i	E5-05				
E5-02	E1-13			E5-03	E1-04, 06	Ld	E5-06				
						Lq	E5-07				
						Ke	E5-09				
INS.	COOLANT TEMP.				°C	ALTITUDE	m	Δθ	E5-11		
STD					MASS	kg	Δθ'				
BRG NO	DRIVE				OPP						
SER NO	END				END						
					YEAR						
YASKAWA ELECTRIC CORPORATION										JAPAN	

Fig 4.4 Example of the Nameplate on a Standard Yaskawa IPM Motor for the Flux Vector Control

Set the Inverter to the values that were recorded in Table 4.4 starting from the top. After making the settings, confirm that the settings for the motor constants are correct.

Note: If the setting of E5-01 (Motor capacity selection) is changed, the other motor constants being set will return to the factory settings. If so, reset the Inverter to the required settings recorded in Table 4.3 starting from the top.

Table 4.4 Motor Constant Settings

Constant No.	Constant Name	Mark on Motor NP	Remakes	NP Value (Setting)	Confirmed
E5-01	Motor Capacity Selection *1	–	If using a 1750 min ⁻¹ motor, setting is not required. If using a 1450 min ⁻¹ or an 1150 min ⁻¹ motor, setting is required.		
E1-04	Max. Speed	(r/min) or (min ⁻¹)	Set to a value within the allowable range of the fixed output *2. The setting of E1-04 will be the standard value for the 100% speed reference.		
E1-06	Motor base voltage	(r/min) or (min ⁻¹)	–		
E1-13	Motor rated capacity	(V)	If two constants are shown for the voltage (V), use the one in the lower row.		
E5-02	Motor rated capacity	(KW)	–		
E5-03	Motor rated current	(A)	If two constants are shown for the amperes (A), use the one in the lower row.		
E5-04	Number of motor poles	(POLES)	Setting is usually not required. (6: Fixed value)		
E5-05	Motor armature resistance	(r1)	–		
E5-06	Motor d-axis inductance	(Ld)	–		
E5-07	Motor q-axis inductance	(Lq)	–		
E5-09	Motor generated voltage constant	(Ke)	–		
E5-11	PG home position offset	(Δθ)	–		

* 1. Table 4.5 shows the settings of E5-01 (motor capacity selection).

* 2. Table 4.6 shows the allowable range of the fixed output.

Table 4.5 Settings for E5-01 (Motor Capacity Selection)

Motor capacity (kW)	200 V	400 V	200 V	400 V	200 V	400 V
	1750 min ⁻¹	1750 min ⁻¹	1450 min ⁻¹	1450 min ⁻¹	1150 min ⁻¹	1150 min ⁻¹
0.4	000	020	100	120	200	220
0.75	001	021	101	121	201	221
1.50	002	022	102	122	202	222
2.20	003	023	103	123	203	223
3.70	004	024	104	124	204	224
5.50	005	026	105	126	205	226
7.50	006	027	106	127	206	227
11.00	007	028	107	128	207	228
15.00	008	029	108	129	208	229
18.50	009	02A	109	12A	209	22A
22.00	00A	02B	10A	12B	20A	22B
30.00	00B	02C	10B	12C	20B	22C
37.00	00C	02D	10C	12D	20C	22D
45.00	00D	02E	10D	12E	20D	22E
55.00	00E	02F	10E	12F	20E	22F
75.00	00F	030	10F	130	20F	230
90.00	-	031	-	131	-	231
110.00	-	032	-	132	-	232
132.00	-	033	-	133	-	233
160.00	-	034	-	134	-	234
200.00	-	035	-	135	-	235
250.00	-	036	-	136	-	-
300.00	-	037	-	-	-	-

Table 4.6 Allowable Range of Fixed Output

Base Speed (E1-06)		
1750 min ⁻¹	1450 min ⁻¹	1150 min ⁻¹
<ul style="list-style-type: none"> • 1:1.5 (0.4 kW to 75 kW) • 1:1.3 (90 kW to 160 kW) • 1:1.2 (200 kW to 300 kW) 	<ul style="list-style-type: none"> • 1:1.5 (0.4 kW to 55 kW) • 1:1.3 (75 kW to 160 kW) • 1:1.2 (200 kW, 250 kW) 	<ul style="list-style-type: none"> • 1:1.5 (0.4 kW to 45 kW) • 1:1.3 (55 kW to 160 kW) • 1:1.2 (200 kW)

E.g.: When using a motor with a base speed (E1-06) of 1750 min⁻¹ and a capacity of 0.4 kW within a fixed output range of 1: 1.5, use the following equation to calculate the setting of E1-04 (Max. motor speed):
 E1-04=E1-06 × 1.5.

2. Selection of the Rotational Direction of Motor

Select the direction of the motor rotation in F1-05 (PG rotation).

The factory setting of F1-05 is 1 (phase B leads with forward run command).

A forward run is when the motor rotates counterclockwise (CCW) as viewed from the load side. If using a forward run in which the motor rotates clockwise (CW) as viewed from the load side, use the following procedures.

Step1. Rewire the cables between the motor and the Inverter.

Switch the cables to any two of the U, V, or W output terminals.

For example, if the terminals are connected in the order of U, V, and W, then switch the cables of terminal V and W and reconnect them in the order of U, W, and V.

Step2. Change the settings of Inverter constants.

- PG rotation (F1-05)

Change the setting from 1 [phase B leads with forward run command (CCW)] to 0 [phase A leads with forward run command (CW)].

- PG home position offset (E5-11)

Multiply the preset value by negative one and set E5-11 to the resulting value.

For example, if the PG home position offset has already been done, then multiply the value set automatically as PG home position by negative one and set E5-11 to the resulting value.

3. Confirmation of the Rotational Direction of Motor

Follow the procedure outlined in Table 4.7 to view the detected motor speed, and check the following two points.

- When manually rotating the motor shaft, check if the actual rotational direction is in accordance with the displayed polarity .
- Check if the displayed motor speed is correct.



- After confirming that the STOP LED of the Digital Operator is lit, check the rotational direction of the motor.
- Be careful not to get anything caught in the shaft or coupling.
- When manually rotating the coupling, be careful not to hurt yourself with the key slot.

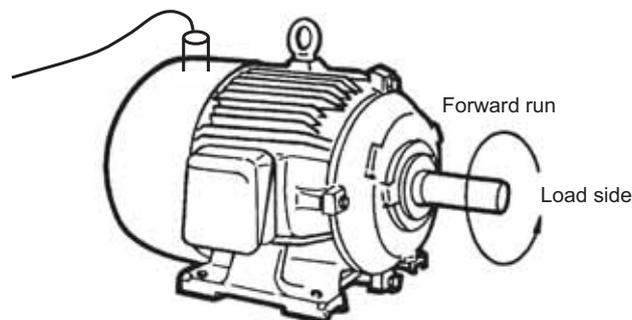


Fig 4.5 Rotational Direction of the Motor

Table 4.7 Confirmation of the Rotational Direction of Motor

No.	Procedure	Example of Digital Operator Display	Confirmation
1	Turn on the power and change the display to the motor speed (U1-05).	U1-05 = 0.00%	–
2	If the direction of the forward run is counterclockwise (CCW), rotate the motor shaft counterclockwise as viewed from the load side.	U1-05 will change from 0.00 % to 3.00%.	Check if the displayed motor speed is a positive value for a forward run and if it is as appropriate as the rotating speed.
	If the direction of the forward run is clockwise (CW), rotate the motor shaft clockwise as viewed from the load side.		
3	If the direction of the forward run is counterclockwise (CCW), rotate the motor shaft clockwise as viewed from the load side.	U1-05 will change from 0.00% to -3.00%.	Check if the displayed motor speed is a negative value for a reverse run and if it is as appropriate as the rotating speed.
	If the direction of the forward run is clockwise (CW), rotate the motor shaft counterclockwise as viewed from the load side.		

If an error was found when checking the motor rotation, correct the problem by carrying out the recommended course of action listed.

Error	Action
Shows motor speed for opposite polarity.	Change the setting for PG rotation (F1-05).
Shows incorrect motor speed or zero.	Check the PG wiring. Refer to <i>Wiring the PG-X2</i> in Chapter 2.

4. Compensation of the Zero-point Pulse of PG

Use autotuning to compensate for the zero-point pulse of a PG.

[Precautions before Autotuning]

Check the following precautions before starting autotuning.

- Autotuning of the Inverter is fundamentally different from that of the servo system. Inverter autotuning automatically adjusts the constants according to the values of the detected motor constants, whereas servo-system autotuning adjusts the constants according to the detected size of the load.
- If autotuning is done with the motor connected to the load, the motor constants that are obtained will be incorrect and the motor may operate in an unusual manner. Be sure to separate the motor from the load before starting autotuning.
- During autotuning, the required data will be measured while the motor is running, so, make sure that the motor is ready to run before starting autotuning. If a switch is installed between the motor and the Inverter, be sure to shut off the switch before autotuning.
- Multi-function analog input terminals do not work during autotuning. Also, multi-function analog output terminals maintain their status that existed before autotuning was started.

[Operation Procedure for Autotuning]

1. In autotuning mode, set the constant for autotuning mode selection (T1-01) to 4 (PG home position offset and line-to-line resistance autotuning).
2. Refer to the nameplate of the motor for setting the following constants in the order in which they are displayed on the digital operator: motor rated capacity, base speed, base voltage, motor rated current, number of motor poles, motor d-axis inductance, motor q-axis inductance, and motor induced voltage.
3. Set T2-11 (Input voltage setting) to the Inverter input current in accordance with the power supply voltage being used.
4. After setting all of the constants, press the RUN key. Automatic measurements used to calculate the compensation value of the zero-point pulse using a PG and the value of the motor armature resistance will start.

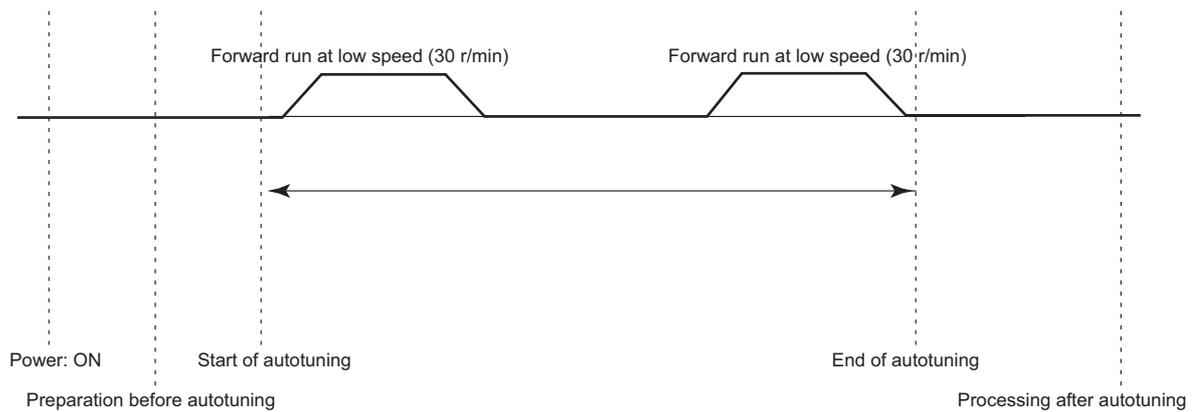


Fig 4.6 Pattern of Operation for Zero-point Pulse Compensation using a PG

[Constant Settings for Autotuning]

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
T1-01	Autotuning mode selection	Set the autotuning mode. 2: Stationary autotuning for line-to-line resistance only 4: PG home position offset and line-to-line resistance autotuning (This selection is only for vector controls with a PG for PM)	2	2 *1	No	No	Yes	Yes	701H
			2, 4						
T2-01	Motor rated capacity (E5-02 correspondence)	Sets the motor rated capacity according to the information on the motor name plate. Only the same or one level less of Inverter capacity can be set. *2	0.40 to 160.00	0.40 kW *3	No	No	Yes	Yes	730H
			0.40 to 300.00						
T2-02	Base speed (E1-06 correspondence)	Sets the motor base speed according to the information on the motor name plate. Only the value of 1750,1450,1150 min ⁻¹ can be set. *2	1150 to 1750	1750 min ⁻¹ *3	No	No	Yes	Yes	731H
T2-03	Base voltage (E1-13 correspondence)	Sets the motor base voltage according to the information on the motor name plate. *2	0.0 to 255.0 *4	190.0 V *3, *4	No	No	Yes	Yes	732H
T2-04	Motor rated current (E5-03 correspondence)	Sets the motor rated current according to the information on the motor name plate. *2	0.00 to 2000.0	1.65 A *3	No	No	Yes	Yes	733H
T2-05	Number of motor poles (E5-04 correspondence)	Sets the number of motor poles according to the information on the motor name plate. Usually setting is not required. (6: Fixed value)	6	6 pole *3	No	No	Yes	Yes	734H
T2-06	Motor d axis inductance (E5-06 correspondence)	Sets the motor d axis inductance according to the information on the motor name plate. *2	0.00 to 300.00	54.84 mH *3	No	No	Yes	Yes	735H
T2-07	Motor q axis inductance (E5-07 correspondence)	Sets the motor q axis inductance according to the information on the motor name plate. *2	0.00 to 600.00	64.10 mH *3	No	No	Yes	Yes	736H
T2-08	Motor generation voltage constant (E5-09 correspondence)	Sets the motor generation voltage according to the information on the motor name plate. *2	50.0 to 2000.0	223.0 mV·sec/rad *3	No	No	Yes	Yes	737H
T2-11	Input voltage setting (E1-01 correspondence)	Sets the Inverter input voltage in units of 1 V. *5	155 to 255 *4	200 V *4	No	No	Yes	Yes	73AH

- * 1. Usually, setting is not required. For the flux vector control for PM, 4 will automatically become the value of the factory setting.
- * 2. Usually, setting is not required. The value used to set the motor constants, as described in *1. Motor Constant Settings* in page 4-8, will automatically become the value of the factory setting. Check that the settings are the same as the values shown on the motor nameplate. If not, set the corresponding T2 constants to the values shown on the motor nameplate.
- * 3. The factory settings vary in accordance with the motor capacity selection (E5-01) or control method selection (A1-02).
(The settings for 0.4 kW 200 V Class standard motors with 1750 min⁻¹, open-loop vector control are given.)
- * 4. The factory setting and the setting range for 200 V Class Inverters are given. Those for 400 V Class Inverters are twice as large.
- * 5. Usually, setting is not required. The values set before autotuning is started will automatically become the value of the factory settings. Check if the settings were correctly made in accordance with the power supply voltage being used. If not, be sure to set T2-11 (Input voltage setting) to the Inverter input voltage in accordance with the power supply voltage being used.

[Operation Example for Autotuning]

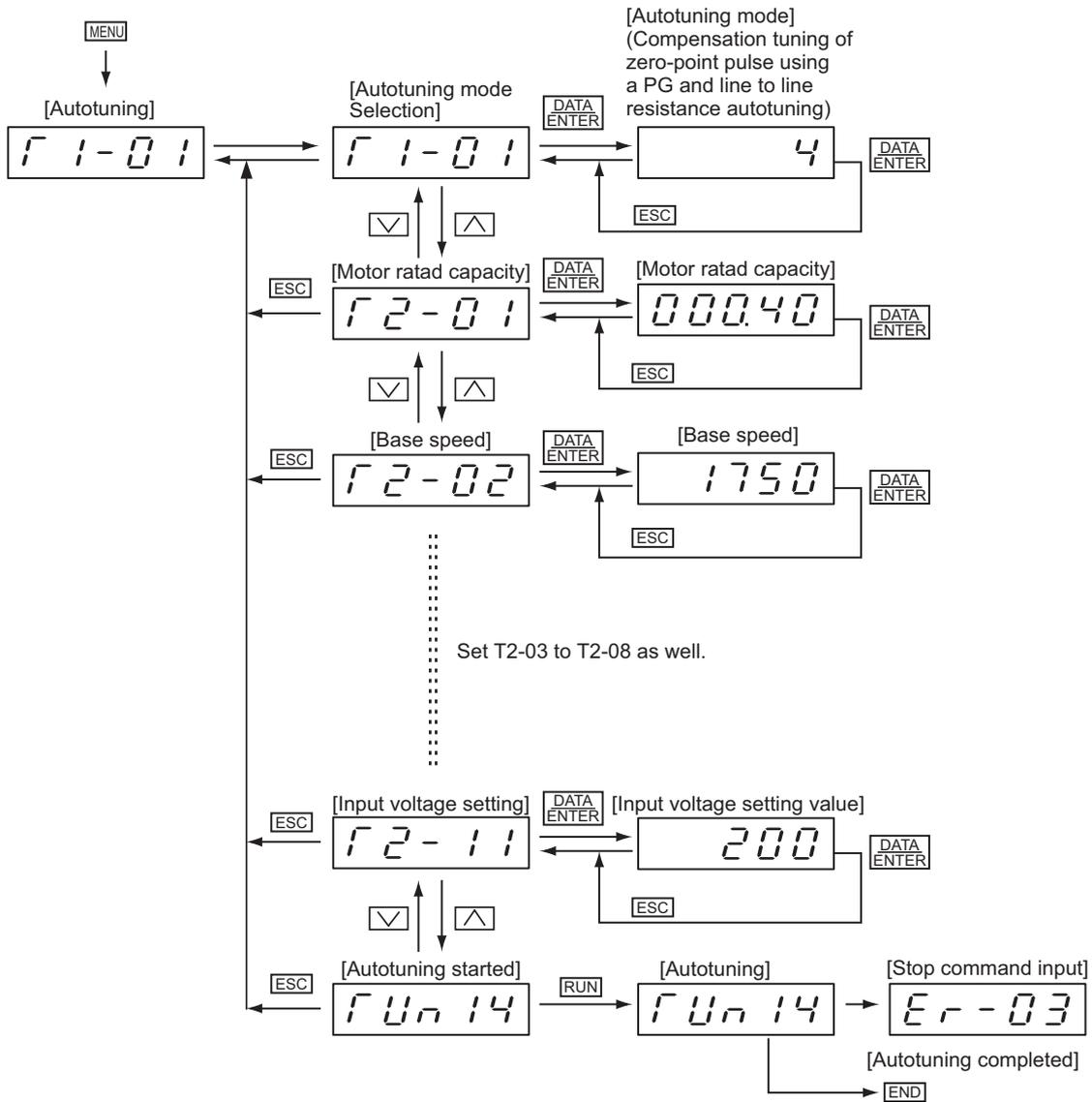
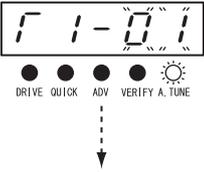
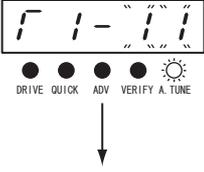
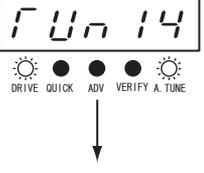
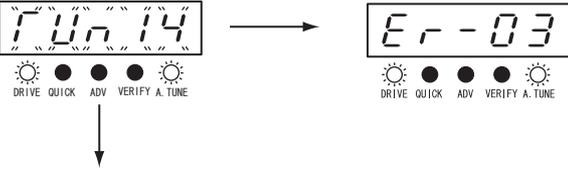
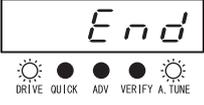


Fig 4.7 Example for Autotuning Mode

[Digital Operator Displays during Autotuning]

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

Table 4.8 Digital Operator Displays during Autotuning

Digital Operator Display	Description
<p>Autotuning mode selection: T1-01</p> 	<p>Using the same procedures as for the programming modes check and set the T1 constants according to information on the previous page. Be sure that T1-01 (Autotuning Mode Selection) is set correctly and check safety around the motor and machine.</p>
<p>Input voltage setting: T1-11</p> 	<p>The autotuning start display will appear when all settings through T1-11 have been completed. The A.TUNE and DRIVE indicators will be lit.</p>
<p>Autotuning started: TUn14</p> 	<p>Autotuning will start when the RUN Key is pressed from the autotuning start display. The right digit in TUn□□ is the setting of the autotuning mode selection (T1-01).</p>
<p>Autotuning → Stop Command input</p> 	<p>If the STOP Key is pressed or a measurement error occurs during autotuning, an error message will be displayed and autotuning will be stopped. Refer to <i>Errors during Autotuning</i> on page 7-18.</p>
<p>Autotuning completed</p> 	<p>END will be displayed after approximately 1 to 2 minutes, indicating that autotuning has been completed.</p>

[Precautions after Autotuning]

- When autotuning is completed
 The measured compensation value of zero-point pulse using a PG will be copied to E5-11 (PG home position offset).
 The measured armature resistance will be copied to E5-05 (Motor armature resistance).
 The setting of T2-01 to T2-11 after autotuning will be reflected to the corresponding constants in *Constant Settings for Autotuning* in page 4-14.

If the maximum speed and the base speed differ, set E1-04 (Max. motor speed) after completion of autotuning. For the upper setting limit of E1-04, refer to Table 4.6 *The Allowable Range of Fixed Output* in page 4-10.

- When autotuning is halted
 If an error occurs during autotuning, autotuning will be halted. Neither the measured value nor the set value will be copied to the constants. The settings will return to be their pre- autotuning values.
 Refer to *Chapter 7 Troubleshooting* and take corrective action. After doing so, once again implement PG home position offset and line-to-line resistance autotuning.

Open-loop vector control for PM (A1-02 = 7)

Motor constant setting has two patterns. Set the motor constants by either manual setting or autotuning mode setting.

Check the nameplate (NP) of the motor being used for the motor constant values.

Fill those values in the NP Value (Setting) columns of Table 4.9.

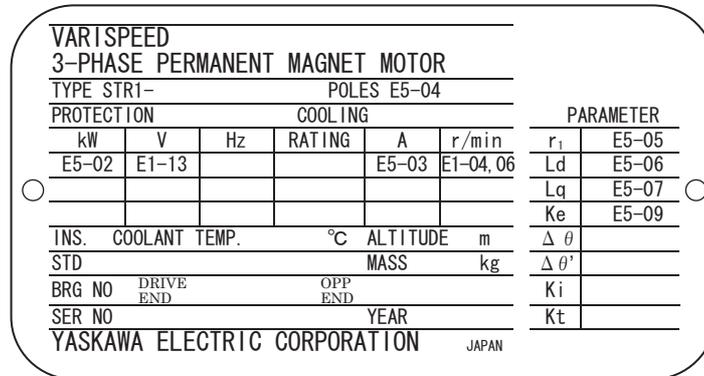


Fig 4.8 Example of the Nameplate on a Standard Yaskawa IPM Motor for the Flux Vector Control

1. Manual Setting Procedure

Set the Inverter to the values that were recorded in Table 4.9 starting from the top. After making the settings, confirm that the settings for the motor constants are correct.

Note If the setting of E5-01 (Motor capacity selection) is changed, the other motor constants being set will return to the factory settings. If so, reset the Inverter to the required settings recorded in Table 4.3 starting from the top.

Table 4.9 Motor Constant Settings

Constant No.	Constant Name	Mark on Motor NP	Remakes	NP Value (Setting)	Confirmed
E5-01	Motor Capacity Selection *1	–	If using a 1750 min ⁻¹ motor, setting is not required. If using a 1450 min ⁻¹ or an 1150 min ⁻¹ motor, setting is required.		
E1-04	Max. Speed	(r/min) or (min ⁻¹)	Set to a value within the allowable range of the fixed output *2. The setting of E1-04 will be the standard value for the 100% speed reference.		
E1-06	Motor base voltage	(r/min) or (min ⁻¹)	–		
E1-13	Motor rated capacity	(V)	If two constants are shown for the voltage (V), use the one in the lower row.		
E5-02	Motor rated capacity	(KW)	–		
E5-03	Motor rated current	(A)	If two constants are shown for the amperes (A), use the one in the lower row.		
E5-04	Number of motor poles	(POLES)	Setting is usually not required. (6: Fixed value)		
E5-05	Motor armature resistance	(r1)	–		
E5-06	Motor d-axis inductance	(Ld)	–		
E5-07	Motor q-axis inductance	(Lq)	–		
E5-09	Motor generated voltage constant	(Ke)	–		

* 1. Table 4.10 shows the settings of E5-01 (motor capacity selection).

* 2. Table 4.12 shows the allowable range of the fixed output.

Table 4.10 Settings for E5-01 (Motor Capacity Selection)

Motor capacity (kW)	200 V 1750 min ⁻¹	400 V 1750 min ⁻¹	200 V 1450 min ⁻¹	400 V 1450 min ⁻¹	200 V 1150 min ⁻¹	400 V 1150 min ⁻¹
0.4	000	020	100	120	200	220
0.75	001	021	101	121	201	221
1.50	002	022	102	122	202	222
2.20	003	023	103	123	203	223
3.70	004	024	104	124	204	224
5.50	005	026	105	126	205	226
7.50	006	027	106	127	206	227
11.00	007	028	107	128	207	228
15.00	008	029	108	129	208	229
18.50	009	02A	109	12A	209	22A
22.00	00A	02B	10A	12B	20A	22B
30.00	00B	02C	10B	12C	20B	22C
37.00	00C	02D	10C	12D	20C	22D
45.00	00D	02E	10D	12E	20D	22E
55.00	00E	02F	10E	12F	–	22F
75.00	00F	030	–	130	–	230
90.00	–	031	–	131	–	231
110.00	–	032	–	132	–	232
132.00	–	033	–	133	–	–
160.00	–	034	–	134	–	–

Table 4.11 Allowable Range of Fixed Output

Base Speed (1-06)		
1750 min ⁻¹	1450 min ⁻¹	1150 min ⁻¹
<ul style="list-style-type: none"> • 1:1.5 (0.4 kW to 75 kW) • 1:1.3 (90 kW to 160 kW) 	<ul style="list-style-type: none"> • 1:1.5 (0.4 kW to 55 kW) • 1:1.3 (75 kW to 160 kW) 	<ul style="list-style-type: none"> • 1:1.5 (0.4 kW to 45 kW) • 1:1.3 (55 kW to 160 kW)

E.g.: When using a motor with a base speed (E1-06) of 1750 min⁻¹ and a capacity of 0.4 kW within a fixed output range of 1: 1.5, use the following equation to calculate the setting of E1-04 (Max. motor speed): E1-04=E1-06×1.5.

2. Autotuning Mode Setting Procedure

Set the motor constants by autotuning.

[Precautions before Autotuning]

Check the following precautions before starting autotuning.

- Autotuning of the Inverter is fundamentally different from that of the servo system. Inverter autotuning automatically adjusts the constants according to the values of the detected motor constants, whereas servo-system autotuning adjusts the constants according to the detected size of the load.
- If autotuning is done with the motor connected to the load, the motor constants that are obtained will be incorrect and the motor may operate in an unusual manner. Be sure to separate the motor from the load before starting autotuning.
- If a switch is installed between the motor and the Inverter, be sure to shut off the switch before autotuning.
- Multi-function analog input terminals do not work during autotuning. Also, multi-function analog output terminals maintain their status that existed before autotuning was started.

[Operation Procedure for Autotuning]

1. Set the motor capacity selection (E5-01). If using a 1750 min^{-1} motor, setting is not required. (Refer to Table 4.9.)
2. In autotuning mode, set the constant for autotuning mode selection (T1-01) to 2 (Stationary autotuning for line-to-line resistance only).
3. Refer to the nameplate of the motor for setting the following constants in the order in which they are displayed on the digital operator: motor rated capacity, base speed, base voltage, motor rated current, number of motor poles, motor d-axis inductance, motor q-axis inductance, and motor induced voltage.
4. Set T2-11 (Input voltage setting) to the Inverter input current in accordance with the power supply voltage being used.
5. After setting all of the constants, press the RUN key. Automatic measurements will start to calculate the value of the motor armature resistance.

[Constant Settings for Autotuning]

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
T1-01	Autotuning mode selection	Set the autotuning mode. 2: Stationary autotuning for line-to-line resistance only 4: PG home position offset and line-to-line resistance autotuning (This selection is only for vector controls with a PG for PM)	2	2 *1	No	No	Yes	Yes	701H
			2, 4						
T2-01	Motor rated capacity (E5-02 correspondence)	Sets the motor rated capacity according to the information on the motor name plate. Only the same or one level less of inverter capacity can be set. *2	0.40 to 160.00	0.40 kW *3	No	No	Yes	Yes	730H
			0.40 to 300.00						
T2-02	Base speed (E1-06 correspondence)	Sets the motor base speed according to the information on the motor name plate. Only the value of 1750, 1450, 1150 min ⁻¹ can be set. *2	1150 to 1750	1750 min ⁻¹ *3	No	No	Yes	Yes	731H
T2-03	Base voltage (E1-13 correspondence)	Sets the motor base voltage according to the information on the motor name plate. *2	0.0 to 255.0 *4	190.0 V *3, *4	No	No	Yes	Yes	732H
T2-04	Motor rated current (E5-03 correspondence)	Sets the motor rated current according to the information on the motor name plate. *2	0.00 to 2000.0	1.65 A *3	No	No	Yes	Yes	733H
T2-05	Number of motor poles (E5-04 correspondence)	Sets the number of motor poles according to the information on the motor name plate. Usually setting is not required. (6: Fixed value)	6	6 pole *3	No	No	Yes	Yes	734H
T2-06	Motor d axis inductance (E5-06 correspondence)	Sets the motor d axis inductance according to the information on the motor name plate. *2	0.00 to 300.00	54.84 mH *3	No	No	Yes	Yes	735H
T2-07	Motor q axis inductance (E5-07 correspondence)	Sets the motor q axis inductance according to the information on the motor name plate. *2	0.00 to 600.00	64.10 mH *3	No	No	Yes	Yes	736H
T2-08	Motor generation voltage constant (E5-09 correspondence)	Sets the motor generation voltage according to the information on the motor name plate. *2	50.0 to 2000.0	223.0 mV•sec/rad *3	No	No	Yes	Yes	737H
T2-11	Input voltage setting (E1-01 correspondence)	Sets the Inverter input voltage in units of 1 V. *5	155 to 255 *4	200 V *4	No	No	Yes	Yes	73AH

- * 1. Usually, setting is not required. For the flux vector control for PM, 4 will automatically become the value of the factory setting.
- * 2. Usually, setting is not required. The value used to set the motor constants, as described in *1. Motor Constant Settings* in page 4-8, will automatically become the value of the factory setting. Check that the settings are the same as the values shown on the motor nameplate. If not, set the corresponding T2 constants to the values shown on the motor nameplate.
- * 3. The factory settings vary in accordance with the motor capacity selection (E5-01) or control method selection (A1-02).
(The settings for 0.4 kW 200 V Class standard motors with 1750 min⁻¹, open-loop vector control are given.)
- * 4. The factory setting and the setting range for 200 V Class Inverters are given. Those for 400 V Class Inverters are twice as large.
- * 5. Usually, setting is not required. The values set before autotuning is started will automatically become the value of the factory settings. Check if the settings were correctly made in accordance with the power supply voltage being used. If not, be sure to set T2-11 (Input voltage setting) to the Inverter input voltage in accordance with the power supply voltage being used.

[Operation Example for Autotuning]

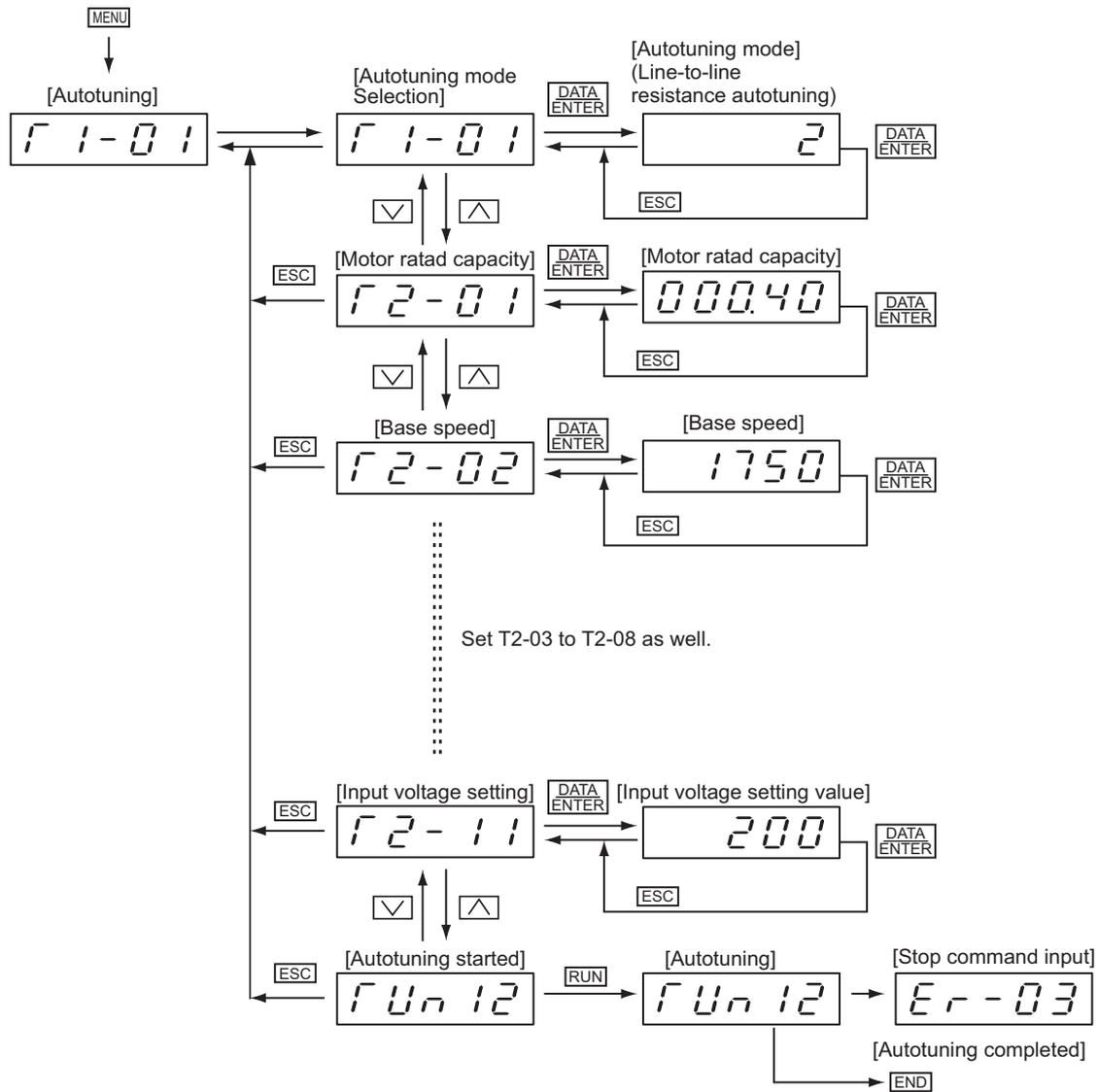
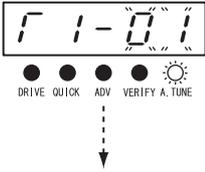
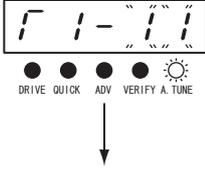
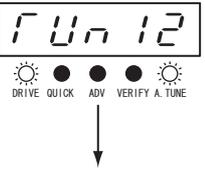
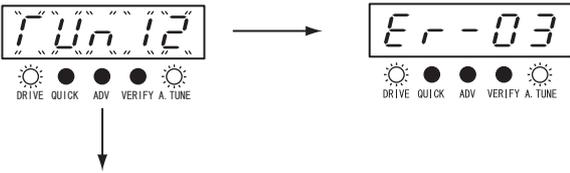


Fig 4.9 Example for Autotuning Mode

[Digital Operator Displays during Autotuning]

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

Table 4.12 Digital Operator Displays during Autotuning

Digital Operator Display	Description
<p>Autotuning mode selection: T1-01</p> 	<p>Using the same procedures as for the programming modes check and set the T1 constants according to information on the previous page. Be sure that T1-01 (Autotuning Mode Selection) is set correctly and check safety around the motor and machine.</p>
<p>Input voltage setting: T1-11</p> 	<p>The autotuning start display will appear when all settings through T1-11 have been completed. The A.TUNE and DRIVE indicators will be lit.</p>
<p>Autotuning started: TUn12</p> 	<p>Autotuning will start when the RUN Key is pressed from the autotuning start display. The right digit in TUn□□ is the setting of the autotuning mode selection (T1-01).</p>
<p>Autotuning → Stop Command input</p> 	<p>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 <i>Errors during Autotuning</i> on page 7-18.</p>
<p>Autotuning completed</p> 	<p>END will be displayed after approximately 1 to 2 minutes, indicating that autotuning has been completed.</p>

[Precautions after Autotuning]

- When autotuning is completed

The measured armature resistance will be copied to E5-05 (Motor armature resistance).

The setting of T2-01 to T2-11 after autotuning will be reflected to the corresponding constants in *Constant Settings for Autotuning* in page 4-21.

If the maximum speed and the base speed differ, set E1-04 (Max. motor speed) after completion of autotuning. For the upper setting limit of E1-04, refer to Table 4.11 *The Allowable Range of Fixed Output* in page 4-19.

- When autotuning is halted

If an error occurs during autotuning, autotuning will be halted. Neither the measured value nor the set value will be copied to the constants. The settings will return to be their pre- autotuning values.

Refer to *Chapter 7 Troubleshooting* and take corrective action. After doing so, once again implement line-to-line resistance autotuning.

◆ Application Settings

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

■ Setting Examples

The following are examples of settings for applications.

- When using an Inverter-mounted braking resistor (ERF), set L8-01 to 1 to enable ERF braking resistor overheating protection.
- To prevent the machine from being operated in reverse, set b1-04 to 1 to disable reverse operation.
- To increase the speed of a 1750 min⁻¹ motor by 10%, set E1-04 to 1925 min⁻¹.
- To use a 0 to 10-V analog signal for a 1750 min⁻¹ motor for variable-speed operation between 0 to 1575 min⁻¹ (0% to 90% speed deduction), set H3-02 to 90.0%.
- To control speed between 20% and 80% to ensure smooth gear operation and limit the maximum speed of the machine, set d2-01 to 80.0% and set d2-02 to 20.0%.
- Change the setting of L3-11 to 0 (Overvoltage inhibit selection disabled) to decrease the speed using a braking unit or braking resistor.
- To enable use with an increased safety, explosion-proof model in the variable torque series of IPM motors, change the setting of L1-01 to 6 [Increased safety, explosion-proof PM motor (variable torque)].

◆ No-load Operation

To begin no-load operation (without connecting the machine and the motor), 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.

Jog Frequency Reference (d1-17, default: 10.00%) can be started and stopped by pressing and releasing the JOG Key on the Digital Operator. If the external sequence 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 terminals). The safety precautions must always be taken before starting the Inverter with the motor connected to the machine.



INFO

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

If a fault caused by braking characteristics, such as hunting or oscillation, occurs during no-load operation, refer to page 4-27 *Adjustment Suggestions* and make adjustments.

◆ Loaded Operation

Connect the machine to the motor and then start operation as described for no-load operation (i.e., from the Digital Operator or by using control circuit terminal signals).

■ Connecting the Load

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

■ Operation using the Digital Operator

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

■ Checking Operating Status

- Having checked that the operating direction is correct and that the machine is operating smoothly at slow speed, increase the speed reference.
- After changing the speed 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 4-27 if hunting, vibration, or other problems originating in the control system occur.

◆ Check and Recording User Constants

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

Any user constants that have been change 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. Later, after Inverter settings have been changed, the user constants can be initialized to the settings saved in the separate memory area when o2-03 was set to 1 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) and used along with A2 constants to display only constants required by the machine or application in a programming mode.

■ Password (A1-04 and A1-05)

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

Adjustment Suggestions

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

Table 4.13 User Constants for Adjustment

Name (Constant Number)	Function	Factory Setting	Recommended Setting	Adjustment Method
ASR proportional (P) gain 1 (C5-01) ASR proportional (P) gain2 (C5-03)	<ul style="list-style-type: none"> Increases torque and speed response Controls hunting and vibration 	20.00 (A1-02=6)	10.00 to 50.00	<ul style="list-style-type: none"> Increase the setting if torque and speed responses are slow. (Increase the setting by increments of 5.) Reduce the setting if hunting or vibration occurs. Note: Optimal value may differ between no-load operation and loaded operation.
		10.00 (A1-02=7)	5.00 to 30.00	
ASR integral (I) time1 (C5-02)(High speeds) ASR integral (I) time2 (C5-04)(Low speeds)	<ul style="list-style-type: none"> Increases torque and speed response Controls hunting and vibration 	0.500 s	0.300 to 1.000 s	<ul style="list-style-type: none"> Reduce the setting if torque and speed responses are slow. Increase the setting if hunting or vibration occurs. Note: Optimal value may differ between no-load operation and loaded operation.
ASR switching speed (C5-07)	Adjusts the ASR proportional gain and integral time in accordance with the motor speed.	0.0 %	0.0 to max. speed	If an ASR proportional gain and an integral time cannot be secured at low or high speeds, change the proportional gain and the integral time in accordance with the motor speed.
ASR primary delay time (C5-06)	Controls hunting and vibration	0.016 s (A1-02=6)	0.016 to 0.035 s	<ul style="list-style-type: none"> Increase the setting if the machine vibrates easily due to low rigidity. (Increase the setting by increments of 0.01.) Note: Optimal value may differ between no-load operation and loaded operation..
		0.004 s (A1-02=7)	0.004 to 0.020 s	
Motor constants (E1 or E5)	Controls hunting and vibration	—	—	Confirm that the settings of the motor constants are correct. Refer to the preceding description of <i>Motor Constant Settings</i> (Table 4.4 or 4.9).

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

Table 4.14 Constants Indirectly Affecting Control and Applications

Name (Constant Number)	Application
CT/VT selection (C6-01)	Sets the maximum torque and overload capability to 120% or 150%.
DWELL function (b6-01 to b6-04)	Used for heavy loads or large machine backlashes.
Droop function (b7-01 to b7-02)	Used to soften the torque or to balance the load between two motors. Can be used when the control method (A1-02) is set to 6.
Acceleration/deceleration times (C1-01 to C1-11)	Adjust torque during acceleration and deceleration.
S-curve characteristics (C2-01 to C2-04)	Used to prevent shock when completing acceleration.
Jump speeds (d3-01 to d3-04)	Used to avoid resonance points during operation.
Analog input filter time constant (H3-12)	Used to prevent fluctuations in analog input signals caused by noise.
Overvoltage inhibit selection (L3-11)	Used to prevent Inverter DC bus overvoltage. Overvoltage inhibit selection is enabled by default and the setting does not normally need to be changed. When using a braking unit or a braking resistor to decrease the speed, however, disable overvoltage inhibit selection by setting L3-11 to 0.
Torque limits (L7-01 to L7-04)	Set the maximum torque during vector control. If a setting is increased, use a motor with higher capacity than the Inverter. If a setting is reduced, stalling can occur under heavy loads.



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	5-8

User Constant Descriptions

This section describes the contents of the user constant tables.

◆ Description of User Constant Tables

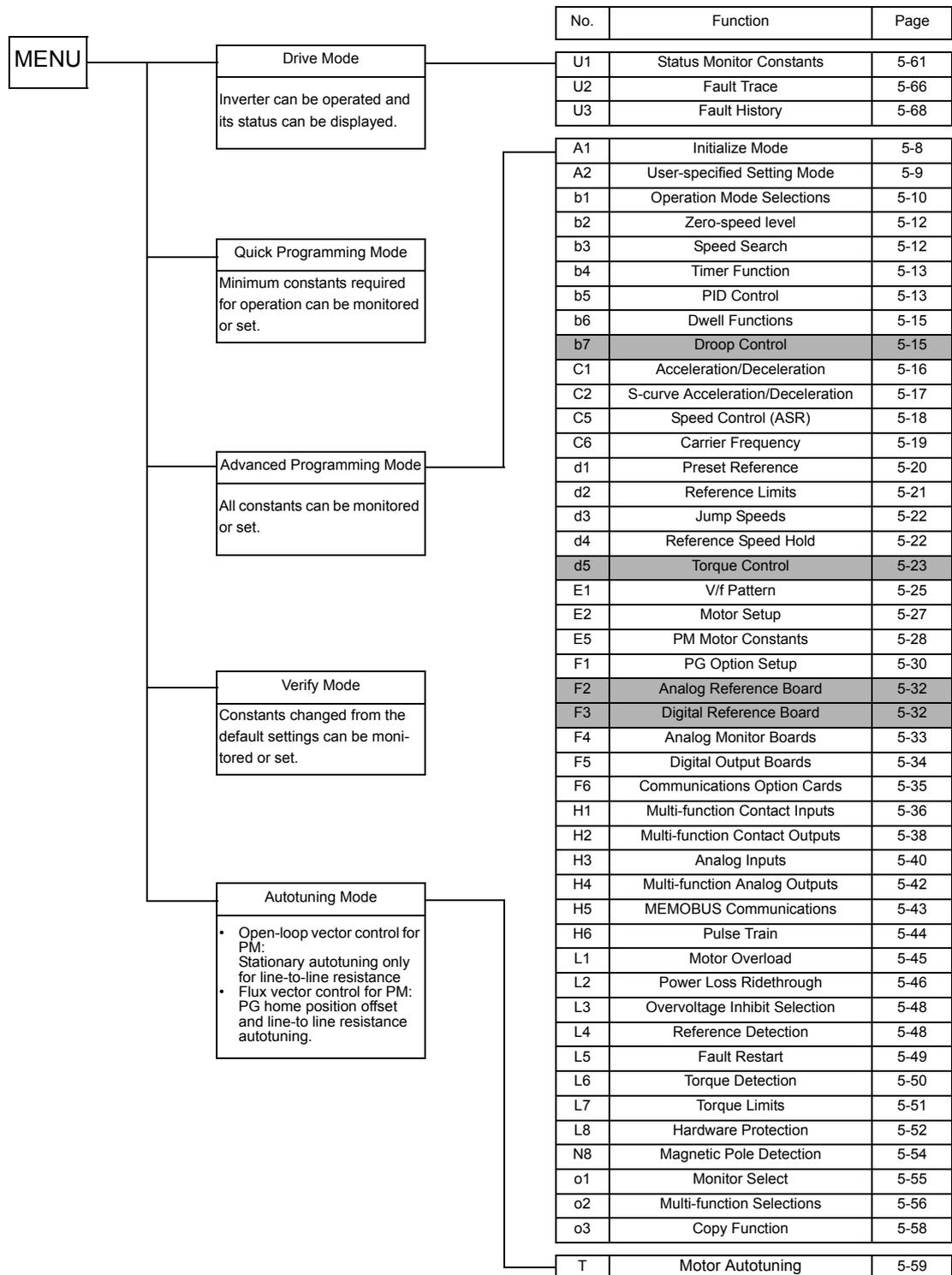
User constant tables are structured as shown below. Here, b1-01 (Reference Selection) is used as an example.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
b1-01	Reference selection	Set the speed reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H	6-63

- Constant Number: The number of the user constant.
- Name: The name of the user constant.
- Description: Details on the function or settings of the user constant.
- Setting Range: The setting range for the user constant.
- Factory Setting: The factory setting (each control method has its own factory setting. Therefore the factory setting changes when the control method is changed.)
Refer to page 5-69 for factory settings by control method.
- Change during Operation: Indicates whether or not the constant can be changed while the Inverter is in operation.
Yes: Changes possible during operation.
No: Changes not possible during operation.
- Control Methods: Indicates the control methods in which the user constant can be monitored or set.
Q: Items which can be monitored and set in either quick programming mode or advanced programming mode.
A: Items which can be monitored and set only in advanced programming mode.
No: Items which cannot be monitored or set for the control method.
- MEMOBUS Register: The register number used for MEMOBUS communications.
- Page: Reference page for more detailed information on the constant.

Digital Operation Display Functions and Levels

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



◆ User Constants Settable in Quick Programming Mode

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

Refer to the overview of modes on page 3-5 for an overview of quick programming mode.

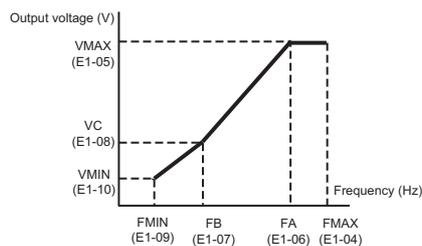
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
A1-02	Control method selection	Used to select the control method for the Inverter 0: Sequence test (This method implements a sequence test with an induction motor connected or any other motor not connected.)	0 or 7	7	No	Q	Q	Q	102H
		6: Flux vector control for PM 7: Open-loop vector control for PM This constant is not initialized by the initialize operation.	0, 6, or 7						
b1-01	Reference selection	Set the speed reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H
b1-02	Operation method selection	Set the Run Command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option card	0 to 3	1	No	Q	Q	Q	181H
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 3: Coast to stop with timer (Run Commands are disregarded during deceleration.)	0, 1, or 3	0	No	Q	Q	Q	182H
C1-01	Acceleration time 1	Sets the acceleration time to accelerate from 0 to the maximum speed, in 1-second units.	0.0 to 6000.0 *1	10.0 s	Yes	Q	Q	Q	200H
C1-02	Deceleration time 1	Sets the deceleration time to decelerate from the maximum speed to 0, in 1-second units.			Yes	Q	Q	Q	201H
C6-01	CT/VT selection	0: Low carrier, constant torque (CT) 1: High carrier, variable torque (VT)	0 or 1 *2	1 *3	No	No	Q	Q	223H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d1-01	Speed reference 1	Sets the speed reference in the units used in o1-03. *4	0.00 to 100.00 *5	0.00%	Yes	Q	Q	Q	280H
d1-02	Speed reference 2	The speed reference when multi-step speed reference 1 is ON for a multi-function input. *4		0.00%	Yes	Q	Q	Q	281H
d1-03	Speed reference 3	The speed reference when multi-step speed reference 2 is ON for a multi-function input. *4		0.00%	Yes	Q	Q	Q	282H
d1-04	Speed reference 4	The speed reference when multi-step speed references 1 and 2 are ON for multi-function inputs. *4		0.00%	Yes	Q	Q	Q	283H
d1-17	Jog speed reference	The speed reference when the jog frequency reference selection, FJOG command, or RJOG command is ON. *4		10.00%	Yes	Q	Q	Q	292H
E1-01	Input voltage setting	Set the Inverter input voltage in the unit of 1 V. This setting is used as a reference value in protection functions.	155 to 255 *7	200 V *6 *7	No	Q	Q	Q	300H
E1-03	V/f pattern selection	0 to E: Select from the 15 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10.) This constant is not initialized by the initialize operation.	0 to F	F	No	Q	No	No	302H
E1-04	Max. speed	Set the maximum motor speed in units of 1 min ⁻¹ . *11 The upper limit of maximum motor speed is 1.5 times greater than the values of the base speed of motor (E1-06).	1000 to 2700 *12	1750 min ⁻¹ *6 *8 *9	No	No	Q	Q	303H
E1-05	Max. voltage	*11	0.0 to 255.0 *7	200.0 V *7	No	Q	No	No	304H
E1-06	Base speed	Set the base speed of motor in units of 1 min ⁻¹ . *11	1000 to 1800 *13	1750 min ⁻¹ *6 *8 *9	No	Q	Q	Q	305H
E1-09	Min. speed	Set the minimal speed of the motor in units of 1 min ⁻¹ . *11 If A1-02 is set to 7, the lower limit of the motor's minimal speed is 10% of the base rotation (E1-06).	100 to 1800 *13 0 to 1800 *13	175 min ⁻¹ *6 *8 *9 *10	No	Q	Q	Q	308H
E1-13	Base voltage	Set the base voltage of the motor in units of 0.1 V.	0.0 to 255.0 *7	190.0 V *6 *7 *8	No	No	Q	Q	30CH

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
E2-01	Motor rated current	Sets the motor rated current in 1 A units.	0.32 to 6.40 *15	1.90 A *14	No	Q	No	No	30EH
E2-11	Motor rated output	Set the rated output of the motor in units of 0.01 kW. This constant is automatically set during autotuning.	0.00 to 650.00	0.40 kW *16	No	Q	No	No	318H
E5-01	Motor capacity selection	Select the motor capacity. By setting E5-01, the constants that vary in accordance with the motor capacity will be automatically set. After making a selection, do not change this setting unless necessary. If changed, the motor constants will be initialized.	0000 to 0230	0000 *17 *18	No	No	Q	Q	329H
			0000 to 0235						
E5-02	Motor rated capacity	Set the motor rated capacity in units of 0.01 kW. The setting is initialized and set to the standard capacity if the selection of the Inverter capacity (o2-04) or that of the motor capacity (E5-01) is changed.	0.40 to 160.00	0.40 kW *17 *19	No	No	Q	Q	32AH
			0.40 to 300.00						
E5-03	Motor rated current	Set the motor rated current in units of 0.01 A for a motor with a capacity of 7.5 kW or less, or in units of 0.1 A for one with a capacity of 11 kW or more.	0.00 to 2000.0	1.65 A *17 *19	No	No	Q	Q	32BH
E5-04	Number of motor poles	Set the number of motor poles.	6	6 pole *17 *19	No	No	Q	Q	32CH
E5-05	Motor armature resistance	Set the resistance per motor phase in units of 0.001 Ω . After setting the resistance, do not change this setting unless necessary.	0.000 to 65.000	8.233 Ω *17 *19	No	No	Q	Q	32DH
E5-06	Motor d-axis inductance	Set the motor d-axis inductance in units of 0.01 mH. After setting the resistance, do not change this setting unless necessary.	0.00 to 300.00	54.84 mH *17 *19	No	No	Q	Q	32EH
E5-07	Motor q-axis inductance	Set the motor q-axis inductance with the motor rated load in units of 0.01 mH.	0.00 to 600.00	64.10 mH *17 *19	No	No	Q	Q	32FH
E5-09	Motor induced voltage constant	Set the peak value of the induced voltage per motor phase in units of 0.1 mV/(rad/s) [electric angle]. Do not change this setting unless necessary.	50.0 to 2000.0	223.0 mV·sec/rad *19	No	No	Q	Q	331H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available. *20	0.00 to 2.50	1.00	Yes	Q	Q	Q	41EH
H4-05	Gain (terminal AM)	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maximum output from the terminal is 10 V. A meter calibration function is available. *20	0.00 to 2.50	0.50	Yes	Q	Q	Q	421H

- * 1. The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times become 0.00 to 600.00 seconds.
- * 2. The setting ranges vary in accordance with the Inverter capacity. With 400 V Class Inverters of 220 kW or 300 kW, C6-01 cannot be set to 0 (CT).
- * 3. The factory settings vary in accordance with the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.
- * 4. A value less than the setting of E1-09 (Min. speed) cannot be set for speed references. If you are having trouble setting the speed reference, check the setting of E1-09.
- * 5. For sequence test (display unit: Hz), the setting ranges change. For open-loop/flux vector control for PM, the upper limits of the setting would be calculated by the following formula: $E1-09 \times E5-04 \div 120$. For sequence test, the upper limits of the setting would be E1-09.
- * 6. In open-loop vector control for PM and the vector control with a PG for PM, this constant is not initialized by the initialize operation.
- * 7. For 200 V Class Inverters. Values for 400 V Class Inverters are twice as large.
- * 8. The factory settings vary in accordance with the setting of the motor capacity selection (E5-01) or control method selection (A1-02). The settings for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min^{-1}) are given.
- * 9. The display units vary in accordance with the control method. The units for open-loop vector control for PM and the vector control with a PG for PM are given. For sequence test, the display unit is Hz.
- * 10. The factory settings vary in accordance with the control method. The setting for open-loop vector control for PM are given. For vector control with a PG for PM, the setting is 30 min^{-1} . For sequence test, the setting is 0.0 Hz.
- * 11. The settings for the sequence test mode (A1-02=0) are calculated by the following formula. To set the V/f characteristics in a straight line, assign the same values for E1-07 and E1-09. If so, the setting of E1-08 is ignored. Use the following formula to set the four rotations:
 $E1-04 (FMAX) \geq E1-06 (FA) > E1-07 (FB) \geq E1-09 (FMIN)$



- * 12. The setting ranges vary in accordance with the control method. The units for open-loop vector control for PM and for vector control with a PG for PM are given. For sequence test, the setting range is 40.0 to 400.0.
- * 13. The setting ranges vary in accordance with the control method. The units for open-loop vector control for PM and for vector control with a PG for PM are given. For sequence test, the setting range is 0.0 to 400.0.
- * 14. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are given.
- * 15. 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. For the motor no-load current, set E2-03 to a value less than that of E2-01.
- * 16. Initialize E2-11 to set the motor capacity to the same value as that for the Inverter capacity.
- * 17. The E5 constants are not initialized by the initialize operation.
- * 18. The factory settings vary in accordance with the setting of the inverter capacity selection (o2-04) or control method selection (A1-02). 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min^{-1}).
- * 19. The factory settings vary in accordance with the setting of the motor capacity selection (E5-01) or control method selection (A1-02). The values for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min^{-1}) are given.
- * 20. To adjust the meter, multiply a value that is equivalent to 100% of the output by the gain setting and add the set bias. Adjustment target is the FM terminal when the H4-02 or H4-03 setting is displayed in quick, advanced, or verify mode while the motor is stopped. Adjustment target is the AM terminal when the H4-05 or H4-06 setting is displayed in quick, advanced, or verify mode while the motor is stopped.

User Constant Tables

◆ A: Setup Settings

The following settings are made with the environment constants (A constants): Language displayed on the Digital Operator, access level, control method, initialization of constants.

■ Initialize Mode: A1

User constants for the environment modes are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
A1-00	Language selection for Digital Operator display	Used to select the language displayed on the Digital Operator (LED). 0: English 1: Japanese This constant is not initialized by the initialize operation.	0 or 1	1	Yes	A	A	A	100H	-
A1-01	Constant access level	Used to set the constant access level (set/read.) 0: Monitoring only (Monitoring and setting the constants for drive mode, 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 (A) mode.)	0 to 2	2	Yes	A	A	A	101H	4-26 6-126 6-127
A1-02	Control method selection	Used to select the control method for the Inverter 0: Sequence test (This method implements a sequence test with an induction motor connected or any other motor not connected.) 6: Flux vector control for PM 7: Open-loop vector control for PM This constant is not initialized by the initialize operation.	0 or 7 0, 6, or 7	7	No	Q	Q	Q	102H	4-5

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
A1-03	Initialize	Used to initialize the constants using the specified method. 0: No initializing 1110: Initializes using the User constants 2220: Initializes using a two-wire sequence. (Initializes to the factory setting.) 3330: Initializes using a three-wire sequence.	0 to 3330	0	No	A	A	A	103H	6-121
A1-04	Password	Password input when a password has been set in A1-05. This function write-protects some constants of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 constants can no longer be changed. (Programming mode constants can be changed.)	0 to 9999	0	No	A	A	A	104H	4-26 6-127
A1-05	Password setting	Used to set a four digit number as the password. This constant is not usually displayed. When the Password (A1-04) is displayed, hold down the RESET Key and press the Menu Key and the password will be displayed.	0 to 9999	0	No	A	A	A	105H	4-26 6-127

■ 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	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
A2-01 to A2-32	User setting constants	Used to set the constant numbers that can be set/read. Maximum 32. Effective when the Constant Access Level (A1-01) is set to User Program (1). Constants set in constants A2-01 to A2-32 can be set/read in programming mode.	b1-01 to o3-02	-	No	A	A	A	106H to 125H	6-128

◆ Application Constants: b

The following settings are made with the application constants (B constants): Operation method selection, zero-speed level, speed searching, timer functions, PID control, dwell functions, and droop control.

■ Operation Mode Selections: b1

User constants for operation mode selection are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
b1-01	Reference selection	Set the speed reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H	4-5 6-5 6-63 6-83
b1-02	Operation method selection	Set the Run Command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option card	0 to 3	1	No	Q	Q	Q	181H	4-5 6-14 6-63 6-83
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 3: Coast to stop with timer (Run Commands are disregarded during deceleration.)	0, 1, or 3	0	No	Q	Q	Q	182H	4-6 6-16
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled	0 or 1	0	No	A	A	A	183H	6-49
b1-05	Operation selection for setting E1-09 or less	Used to set the method of operation when the speed reference input is less than the minimum speed (E1-09). 0: Run at speed reference (E1-09 not effective). 1: STOP (Speeds below E1-09 in the coast to stop state.) 2: Run at min. speed. (E1-09) 3: Run at zero-speed (Speeds below E1-09 are zero)	0 to 3	0	No	No	A	No	184H	6-16

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
b1-06	Read sequence input twice	Used to set the responsiveness of the control inputs (forward/reverse and multi-function inputs.) 0: Two scans every 2 ms (Use for fast responses.) 1: Two scans every 5 ms (Use for possible malfunction due to noise.)	0 or 1	1	No	A	A	A	185H	-
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	A	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)). 2: Cannot operate. (Cannot be in programming mode during operation.)	0 or 1	1	No	A	A	A	187H	-
			0 to 2							

■Zero-speed level: b2

User constants for zero-speed level are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
b2-01	Zero-speed level (Baseblock starting speed)	Sets the speed in units of 0.1% at which a baseblock will be applied if decelerating to stop.	0.0 to 10.0	1.0% *	No	No	A	A	189H	6-16

* The setting value will return to the factory setting if the control method is changed. (The factory settings for open-loop vector control for PM are given.)

■Speed Search: b3

User constants for the speed search are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
b3-01	Speed search selection	Enables/disables the speed search function for the Run Command and sets the speed search method. 0: Disabled 1: Enabled If b3-01 set to 1, the motor speed is calculated at the start of a search, and the motor accelerates or decelerates from this calculated speed to a set speed. (A motor rotational direction search is also possible.)	0, 1	1 *	No	No	No	A	191H	6-53
b3-05	Search wait time	Sets the magnetic contactor operating delay time when there is a magnetic contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	1.0 s	No	No	No	A	195H	6-53

* The setting value will return to the factory setting if the control method is changed.

■Timer Function: b4

User constants for timer functions are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
b4-01	Timer function ON-delay time	Sets the timer function output ON-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-□□ or H2-□□.	0.0 to 300.0	0.0 s	No	No	A	A	1A3H	6-93
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-□□ or H2-□□.	0.0 to 300.0	0.0 s	No	No	A	A	1A4H	6-94

■PID Control: b5

User constants for PID control are shown in the following table.

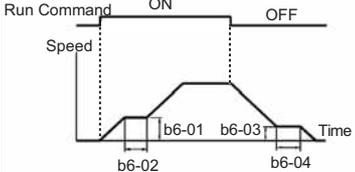
Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
b5-01	PID control method selection	0: Disabled 1: Enabled (Deviation is D-controlled.) 2: Enabled (Feedback value is D-controlled.) 3: PID control enabled (speed reference + PID output, D control of deviation) 4: PID control enabled (speed reference + PID output, D control of feedback value).	0 to 4	0	No	No	A	A	1A5H	6-95
b5-02	Proportional gain (P)	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	No	A	A	1A6H	6-96
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	No	A	A	1A7H	6-96
b5-04	Integral (I) limit	Sets the I-control limit as a percentage of the maximum speed.	0.0 to 100.0	100.0%	Yes	No	A	A	1A8H	6-96
b5-05	Derivative (D) time	Sets D-control derivative time in 1-second units. D-control is not performed when the setting is 0.00.	0.00 to 10.00	0.00 s	Yes	No	A	A	1A9H	6-96

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
b5-06	PID limit	Sets the limit after PID-control as a percentage of the maximum speed.	0.0 to 100.0	100.0%	Yes	No	A	A	1AAH	6-96
b5-07	PID offset adjustment	Sets the offset after PID-control as a percentage of the maximum speed.	-100.0 to +100.0	0.0%	Yes	No	A	A	1ABH	6-96
b5-08	PID primary delay time constant	Sets the time constant for low pass filter for PID-control outputs in 1-second units. Not usually necessary to set.	0.00 to 10.00	0.00 s	Yes	No	A	A	1ACH	6-96
b5-09	PID output characteristics selection	Select forward/reverse for PID output. 0: PID output is forward. 1: PID output is reverse (highlights the output code)	0 or 1	0	No	No	A	A	1ADH	6-96
b5-10	PID output gain	Sets output gain.	0.0 to 25.0	1.0	No	No	A	A	1AEH	6-96
b5-11	PID reverse output selection	0: 0 limit when PID output is negative. 1: Reverses when PID output is negative. 0 limit when reverse prohibit is selected using b1-04.	0 or 1	0	No	No	A	A	1AFH	6-96
b5-12	Selection of PID feedback command loss detection	0: No detection of loss of PID feedback. 1: Detection of loss of PID feedback. Operation continues during detection, with the malfunctioning contact not operating. 2: Detection of loss of PID feedback. Coasts to stop during detection, and fault contact operates.	0 to 2	0	No	No	A	A	1B0H	6-96
b5-13	PID feedback command loss detection level	Sets the PID feedback loss detection level as a percent units, with the maximum speed at 100%.	0 to 100	0%	No	No	A	A	1B1H	6-97
b5-14	PID feedback command loss detection time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	No	A	A	1B2H	6-97
b5-15	PID sleep function operation level	Set the PID sleep function start level as a speed. (Enabled if PID control is not selected.)	0.0 to 100.0	0.0%	No	No	A	A	1B3H	6-97

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
b5-16	PID sleep operation delay time	Set the delay time until the PID sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	No	A	A	1B4H	6-97
b5-17	Accel/decel time for PID reference	Set the accel/decel time for PID reference in seconds.	0.0 to 25.5	0.0 s	No	No	A	A	1B5H	6-97

■Dwell Functions: b6

User constants for dwell functions are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
b6-01	Dwell speed at start	 <p>The dwell function is used to keep the speed temporarily when driving a motor with a heavy load.</p>	0.0 to 100.0	0.0%	No	No	A	A	1B6H	4-28 6-24
b6-02	Dwell time at start		0.0 to 10.0	0.0 s	No	No	A	A	1B7H	4-28 6-24
b6-03	Dwell speed at stop		0.0 to 400.0	0.0%	No	No	A	A	1B8H	4-28 6-24
b6-04	Dwell time at stop		0.0 to 100.0	0.0 s	No	No	A	A	1B9H	4-28 6-24

■Droop Control: b7

User constants for droop functions are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
b7-01	Droop control gain	Sets the speed drop as a percentage of maximum speed when the maximum speed is specified and the rated torque occurs. Droop-control is not performed when the setting is 0.0.	0.0 to 100.0	0.0	Yes	No	A	No	1CAH	4-28 6-117
b7-02	Droop control delay time	Droop control responsiveness constant When hunting or oscillation occurs, increase the value.	0.03 to 2.00	0.05 s	Yes	No	A	No	1CBH	4-28 6-117

◆ Autotuning Constants: C

The following settings are made with the autotuning constants (C constants): Acceleration/deceleration times, s-curve characteristics, speed control, and carrier frequency functions.

■ Acceleration/Deceleration: C1

User constants for acceleration and deceleration times are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
C1-01	Accelera-tion time 1	Sets the acceleration time to accelerate from 0 to the maximum speed, in 1-second units.	0.0 to 6000.0 *1	10.0 s	Yes	Q	Q	Q	200H	4-5 4-28 6-20
C1-02	Decelera-tion time 1	Sets the deceleration time to decelerate from the maximum speed to 0, in 1-second units.			Yes	Q	Q	Q	201H	4-5 4-28 6-20
C1-03	Accelera-tion time 2	The acceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	A	A	202H	4-28 6-20
C1-04	Decelera-tion time 2	The deceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	A	A	203H	4-28 6-20
C1-05	Accelera-tion time 3	The acceleration time when the multi-function input “accel/decel time 2” is set to ON.			No	A	A	A	204H	4-28 6-20
C1-06	Decelera-tion time 3	The deceleration time when the multi-function input “accel/decel time 2” is set to ON.			No	A	A	A	205H	4-28 6-20
C1-07	Accelera-tion time 4	The acceleration time when the multi-function input “accel/decel time 1” and “accel/decel time 2” are set to ON.			No	A	A	A	206H	4-28 6-20
C1-08	Decelera-tion time 4	The deceleration time when the multi-function input “accel/decel time 1” and “accel/decel time 2” are set to ON.			No	A	A	A	207H	4-28 6-20
C1-09	Emergency stop time	The deceleration time when the multi-function input “Emergency (fast) stop” is set to ON. This function can be used as a stopping method when a fault has been detected.			No	A	A	A	208H	4-28 6-19

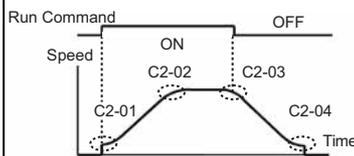
Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
C1-10	Accel/decel time setting unit	0: 0.01-second units 1: 0.1-second units	0 or 1	1	No	A	A	A	209H	4-28 6-20 6-21
C1-11	Accel/decel time switching speed	Sets the speed for automatic acceleration/deceleration switching. Below set speed: Accel/decel time 4 Above set speed: Accel/decel time 1 The multi-function input "accel/decel time 1" or "accel/decel time 2" take priority.	0.0 to 100.0 *3	0.0% *2	No	A	A	A	20AH	4-28 6-20

- * 1. The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times become 0.00 to 600.00 seconds.
- * 2. The display unit varies in accordance with the control method. (The unit for open-loop/flux vector control for PM is given. For sequence test, Hz would be displayed.)
- * 3. The setting ranges vary in accordance with the control method. (The unit for open-loop/flux vector control for PM is given. For sequence test, the setting range would be 0.0 to 400.0.)

■S-curve Acceleration/Deceleration: C2

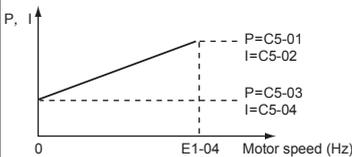
User constants for S-curve characteristics are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
C2-01	S-curve characteristic time at acceleration start	All sections of the S-curve characteristic time are set in seconds units. When the S-curve characteristic time is set, the accel/decel times will increase by only half of the S-curve characteristic times at start and end.	0.00 to 2.50	0.00 s	No	A	A	A	20BH	4-28 6-21
C2-02	S-curve characteristic time at acceleration end		0.00 to 2.50	0.00 s	No	A	A	A	20CH	4-28 6-21
C2-03	S-curve characteristic time at deceleration start		0.00 to 2.50	0.00 s	No	A	A	A	20DH	4-28 6-21
C2-04	S-curve characteristic time at deceleration end		0.00 to 2.50	0.00 s	No	A	A	A	20EH	4-28 6-21



■ Speed Control (ASR): C5

User constants for speed control are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
C5-01	ASR proportional (P) gain 1	Sets the proportional gain of the speed loop (ASR.)	0.00 to 300.00	10.00 *	Yes	No	A	A	21BH	4-27 6-112
C5-02	ASR integral (I) time 1	Sets the integral time of the speed loop (ASR) in 1-second units.	0.000 to 10.000	0.500 s *	Yes	No	A	A	21CH	4-27 6-112
C5-03	ASR proportional (P) gain 2	Usually setting is not necessary. Set to change the rotational speed gain.	0.00 to 300.00	10.00 *	Yes	No	A	A	21DH	4-27 6-112
C5-04	ASR integral (I) time 2		0.000 to 10.000	0.500 s *	Yes	No	A	A	21EH	4-27 6-112
C5-06	ASR primary delay time	Sets the filter time constant for outputting torque references from the speed control loop (ASR). It is set in 1-second units. Usually setting is not necessary.	0.000 to 0.500	0.016 s *	No	No	A	A	220H	4-27 6-112
C5-07	ASR switching frequency	Sets the speed for switching between Proportion Gain 1, 2 and Integral Time 1, 2 in % units. The multi-function input "ASR switching proportional gain" has the priority.	0.0 to 100.0	0.0%	No	No	A	A	221H	4-27 6-113
C5-08	ASR integral (I) limit	Sets the upper limit for the integral (I) amount for the speed control loop (ASR) to a percentage of the rated load.	0 to 400	400%	No	No	A	A	222H	6-113
C5-15	ASR proportional (P) gain at start	Sets the proportional (P) gain at start of operation when magnetic poles are pulled in, in units of 0.01.	0.00 to 300.00	5.00 *	No	No	A	A	238H	-

* The setting value will return to the factory setting if the control method is changed. (The factory settings for open-loop vector control for PM are given.)

■Carrier Frequency: C6

User constants for the carrier frequency are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
C6-01	CT/VT selection	0: Low carrier, constant torque (CT) 1: High carrier, variable torque (VT)	0 or 1 *3	1 *5	No	No	Q	Q	223H	4-5 4-28 6-2
C6-02	Carrier frequency selection	Select carrier frequency.*2 1: 2 kHz 2: 4 kHz	1 or 2	2 *1 *5 *8	No	No	A	A	224H	6-2
		3: 6 kHz 4: 8 kHz 6: 12 kHz	1 to 6 *4 *6 *7							

* 1. The setting value will return to the factory setting if the control method is changed. (The factory settings for open-loop vector control for PM are given.)

* 2. Inverter rated current will be reduced if increasing the carrier frequency.

Be careful because the possibility of an inverter OL error increases as the carrier frequency is increased.

* 3. With 400 V Class Inverters of 220 kW or 300 kW, C6-01 cannot be set to 0 (CT).

* 4. The setting range vary in accordance with the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

* 5. The factory settings vary in accordance with the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

* 6. For open-loop vector control for PM, the setting range is 1 to 4.

* 7. The setting ranges vary in accordance with the setting of C6-01 (CT/VT selection). If C6-01 is set to 0 (CT), C6-02 can only be set to 1 (2 kHz).

* 8. The factory settings vary in accordance with the setting of C6-01 (CT/VT selection). If C6-01 is set to 0 (CT), the factory setting is 1 (2 kHz).

◆ Reference Constants: d

The following settings are made with the reference constants (d constants): Speed references.

■ Preset Reference: d1

User constants for speed references are shown in the following table.

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Oper- ation	Control Methods			MEMO BUS Register	Page
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM		
d1-01	Speed refer- ence 1	Sets the speed reference in the units used in o1-03.	0.00 to 100.00 *	0.00%	Yes	Q	Q	Q	280H	4-6 6-9
d1-02	Speed refer- ence 2	The speed reference when multi-step speed reference 1 is ON for a multi-function input.		0.00%	Yes	Q	Q	Q	281H	4-6 6-9
d1-03	Speed refer- ence 3	The speed reference when multi-step speed reference 2 is ON for a multi-function input.		0.00%	Yes	Q	Q	Q	282H	4-6 6-9
d1-04	Speed refer- ence 4	The speed reference when multi-step speed references 1 and 2 are ON for multi-func- tion inputs.		0.00%	Yes	Q	Q	Q	283H	4-6 6-9
d1-05	Speed refer- ence 5	The speed when multi-step speed reference 3 is ON for a multi-function input.		0.00%	Yes	A	A	A	284H	6-9
d1-06	Speed refer- ence 6	The speed reference when multi-step speed references 1 and 3 are ON for multi-func- tion inputs.		0.00%	Yes	A	A	A	285H	6-9
d1-07	Speed refer- ence 7	The speed reference when multi-step speed references 2 and 3 are ON for multi-func- tion inputs.		0.00%	Yes	A	A	A	286H	6-9
d1-08	Speed refer- ence 8	The speed reference when multi-step speed references 1, 2, and 3 are ON for multi- function inputs.		0.00%	Yes	A	A	A	287H	6-9
d1-09	Speed refer- ence 9	The speed reference when multi-step speed reference 4 is ON for a multi-function input.		0.00%	Yes	A	A	A	288H	-
d1-10	Speed refer- ence 10	The speed reference when multi-step speed references 1 and 4 are ON for multi-func- tion inputs.		0.00%	Yes	A	A	A	28BH	-
d1-11	Speed refer- ence 11	The speed reference when multi-step speed references 2 and 4 are ON for a multi- function inputs.		0.00%	Yes	A	A	A	28CH	-

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
d1-12	Speed reference 12	The speed reference when multi-step speed references 1, 2, and 4 are ON for multi-function inputs.	0.00 to 100.00 *	0.00%	Yes	A	A	A	28DH	-
d1-13	Speed reference 13	The speed reference when multi-step speed references 3 and 4 are ON for multi-function inputs.		0.00%	Yes	A	A	A	28EH	-
d1-14	Speed reference 14	The speed reference when multi-step speed references 1, 3, and 4 are ON for multi-function inputs.		0.00%	Yes	A	A	A	28FH	-
d1-15	Speed reference 15	The speed reference when multi-step speed references 2, 3, and 4 are ON for multi-function inputs.		0.00%	Yes	A	A	A	290H	-
d1-16	Speed reference 16	The speed reference when multi-step speed references 1, 2, 3, and 4 are ON for multi-function inputs.		0.00%	Yes	A	A	A	291H	-
d1-17	Jog speed reference	The speed reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.		10.00%	Yes	Q	Q	Q	292H	4-6 6-9 6-71

Note 1. The unit is set in 01-03 (frequency units of reference setting and monitor), default: 0.01 Hz.

2. A value less than the setting of E1-09 (Min. speed) cannot be set for speed references. If you are having trouble setting the speed reference, check the setting of E1-09.

* If the display unit is Hz, the setting ranges change. For open-loop/flux vector control or vector control with a PG for PM, the upper limits of the setting would be calculated by the following formula: $E1-09 \times E5-04 \div 120$.
For sequence test, the upper limits of the setting would be E1-09.

Reference Limits: d2

User constants for speed reference limits are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
d2-01	Speed reference upper limit	Set the motor speed upper limit as a percentage of the maximum speed.	0.0 to 110.0	100.0%	No	A	A	A	289H	6-33 6-66
d2-02	Speed reference lower limit	Sets the motor speed lower limit as a percentage of the maximum speed.	0.0 to 110.0	0.0%	No	A	A	A	28AH	6-33 6-66
d2-03	Master speed reference lower limit	Set the master speed reference lower limit as a percentage of the maximum speed.	0.0 to 110.0	0.0%	No	A	A	A	293H	6-33 6-66

■ Jump Speeds: d3

User constants for jump speeds are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
d3-01	Jump speed 1	Set the center values of the jump speeds in %. This function is disabled by setting the jump speed to 0 %. Always ensure that the following applies: $d3-01 \geq d3-02 \geq d3-03$ Operation in the jump speed range is prohibited but during acceleration and deceleration, speed changes smoothly without jump.	0.0 to 100.0 *2	0.0% *1	No	A	A	A	294H	4-28 6-30
d3-02	Jump speed 2					A	A	A	295H	4-28 6-30
d3-03	Jump speed 3					A	A	A	296H	4-28 6-30
d3-04	Jump speed width	Sets the jump speed bandwidth in %. The jump speed will be the jump speed \pm d3-04.	0.0 to 100.0 *3	1.0% *1	No	A	A	A	297H	4-28 6-30

* 1. The display units vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the display unit is Hz.

* 2. The setting ranges vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the setting range is 0.0 to 400.0.

* 3. The setting ranges vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the setting range is 0.0 to 20.0.

■ Speed Reference Hold: d4

User constants for the speed reference hold function are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
d4-01	Speed reference hold function selection	<p>Sets whether or not speeds on hold will be recorded.</p> <p>0: Disabled (when operation is stopped or the power is turned on again starts at 0.)</p> <p>1: Enabled (when operation is stopped or the power is turned on again starts at the previous hold speed.)</p> <p>This function is available when the multi-function inputs “accel/decel Ramp Hold” or “up/down” commands are set.</p>	0 or 1	0	No	No	A	A	298H	6-65

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
d4-02	+ - Speed limits	Set the speed to be add to or subtracted from the analog speed reference as a percent, taking the maximum speed 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	No	A	A	299H	6-69

■Torque Control: d5

User constants for the torque control are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
d5-01	Torque control selection	0: Speed control (C5-01 to C5-07) 1: Torque control To use the function for switching between speed and torque control, set to 0 and set the multi-function input to "speed/torque control change."	0 or 1	0	No	No	A	No	29AH	6-104
d5-02	Torque reference delay time	Set the torque reference delay time in ms units. This function can be used to adjust the noise of the torque control signal or the responsiveness with the host controller. When oscillation occurs during torque control, increase the set value.	0 to 1000	0 ms *	No	No	A	No	29BH	6-104
d5-03	Speed limit selection	Set the speed limit command method for the torque control method. 1: The analog input limit from a speed reference (see b1-01) 2: Limited by d5-04 constant setting values.	1 or 2	1	No	No	A	No	29CH	6-104
d5-04	Speed limit	Set the speed limit during torque control as a percentage of the maximum speed. This function is enabled when d5-03 is set to 2. Directions are as follows. +: Run Command direction -: Run Command opposite direction	-120 to +120	0%	No	No	A	No	29DH	6-104

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
d5-05	Speed limit bias	Set the speed limit bias as a percentage of the maximum speed. Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 to 120	5%	No	No	A	No	29EH	6-104
d5-06	Speed/torque control switching timer	Set the delay time from inputting the multi-function input "speed/torque control change" (from On to OFF or OFF to ON) until the control is actually changed, in ms units. This function is enabled when the multi-function input "speed/torque control change" is set. In the speed/torque control switching timer, the analog inputs hold the values of when the "speed/torque control change" changes. Always be sure to allow time for this process to finish completely.	0 to 1000	50 ms	No	No	A	No	29FH	6-105

* The setting values will return to the factory settings if the control method is changed.

◆ Motor Constants: E

The following settings are made with the motor constants (E constants): V/f characteristics and motor constants.

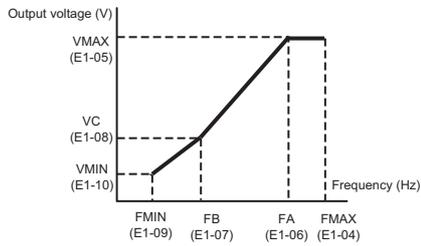
■V/f Pattern: E1

User constants for V/f characteristics are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
E1-01	Input voltage setting	Set the Inverter input voltage in the unit of 1 V. This setting is used as a reference value in protection functions.	155 to 255 *2	200 V *1 *2	No	Q	Q	Q	300H	4-5 6-25
E1-03	V/f pattern selection	0 to E: Select from the 15 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10.) This constant is not initialized by the initialize operation.	0 to F	F	No	Q	No	No	302H	-
E1-04	Max. speed	Set the maximum motor speed in units of 1 min^{-1} . *6 The upper limit of maximum motor speed is 1.5 times greater than the values of the base speed of motor (E1-06).	1000 to 2700 *7	1750 min^{-1} *1 *3 *4	No	No	Q	Q	303H	-
E1-05	Max. voltage	*6	0.0 to 255.0 *2	200.0 V *2	No	Q	No	No	304H	-
E1-06	Base speed	Set the base speed of motor in units of 1 min^{-1} . *6	1000 to 1800 *8	1750 min^{-1} *1 *3 *4	No	Q	Q	Q	305H	-
E1-07	Mid. output speed	*6	0.0 to 400.0	3.0 Hz	No	A	No	No	306H	-
E1-08	Mid. speed voltage	*6	0.0 to 255.0 *2	15.0 V *2	No	A	No	No	307H	-
E1-09	Min. speed	Set the minimum speed of the motor in units of 1 min^{-1} . *5 If A1-02 is set to 7, the lower limit of the motor's minimum speed is 10% of the base speed of motor (E1-06).	100 to 1800 *8 0 to 1800 *8	175 min^{-1} *1 *3 *4 *5	No	Q	Q	Q	308H	-
E1-10	Min. speed voltage	*6	0.0 to 255.0 *2	9.0 V *2	No	A	No	No	309H	-

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
E1-13	Base voltage	Set the base voltage of the motor in units of 0.1 V.	0.0 to 255.0 *2	190.0 V *1 *2 *3	No	No	Q	Q	30CH	-

- * 1. In open-loop/flux vector control for PM, this constant is not initialized by the initialize operation.
- * 2. For 200 V Class Inverters. Values for 400 V Class Inverters are twice as large.
- * 3. The factory settings vary in accordance with the setting of the motor capacity selection (E5-01) or control method selection (A1-02).
The settings for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min⁻¹) are given.
- * 4. The display units vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the display unit is Hz.
- * 5. The factory settings vary in accordance with the control method. The setting for open-loop vector control for PM are given. For flux vector control for PM, the setting is 30 min⁻¹. For sequence test, the setting is 0.0 Hz.
- * 6. The settings for the sequence test method (A1-02=0) are calculated by the following formula.
To set the V/f characteristics in a straight line, assign the same values for E1-07 and E1-09.
If so, the setting of E1-08 is ignored.
Use the following formula to set the four frequencies:
E1-04 (FMAX) ≥ E1-06(FA) > E1-07 (FB) ≥ E1-09 (FMIN)



- * 7. The setting ranges vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the setting range is 40.0 to 400.0.
- * 8. The setting ranges vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the setting range is 0.0 to 400.0.

Motor Setup: E2

User constants for motor 1 are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
E2-01	Motor rated current	Sets the motor rated current in 1 A units.	0.32 to 6.40 *2	1.90 A *1	No	Q	No	No	30EH	-
E2-02	Motor rated slip	Sets the motor rated slip in Hz units. These set values will become the reference values for slip compensation.	0.00 to 20.00	2.90 Hz *1	No	A	No	No	30FH	-
E2-03	Motor no-load current	Sets the motor no-load current in 1 A units.	0.00 to 1.89 *3	1.20 A *1	No	A	No	No	310H	-
E2-05	Motor line-to-line resistance	Sets the motor phase-to-phase resistance in Ω units.	0.000 to 65.000	9.842 Ω *1	No	A	No	No	312H	-
E2-10	Motor iron loss for torque compensation	Sets motor iron loss in W units.	0 to 65535	14 W *1	No	A	No	No	317H	-
E2-11	Motor rated output	Set the rated output of the motor in units of 0.01 kW. This constant is automatically set during autotuning.	0.00 to 650.00	0.40 kW *4	No	Q	No	No	318H	-

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

* 2. The setting range is 10% to 200% of the Inverter's rated output current. The value for a 200 V Class Inverter of 0.4 kW is given.
For the motor no-load current, set E2-03 to a value less than that of E2-01.

* 3. The setting range depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

* 4. Initialize E2-11 to set the same value as that for the Inverter capacity.

■PM Motor Constants: E5

User constants for PM motor are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
E5-01	Motor capacity selection	Select the motor capacity. By setting E5-01, the constants that vary in accordance with motor capacity will be automatically set. After making a selection, do not change this setting unless necessary. If changed, the motor constants will be initialized.	0000 to 0230	0000 *1	No	No	Q	Q	329H	-
			0000 to 0235							
E5-02	Motor rated capacity	Set the motor rated capacity in units of 0.01 kW. The setting is initialized and set to the standard capacity if the selection of the Inverter capacity (o2-04) or that of the motor capacity (E5-01) is changed.	0.40 to 160.00	0.40 kW *2	No	No	Q	Q	32AH	4-9
			0.40 to 300.00							
E5-03	Motor rated current	Set the motor rated current in units of 0.01 A for a motor with a capacity of 7.5 kW or less, or in units of 0.1 A for one with a capacity of 11 kW or more.	0.00 to 2000.0	1.65 A *2	No	No	Q	Q	32BH	4-9
E5-04	Number of motor poles	Set the number of motor poles.	6	6 pole *2	No	No	Q	Q	32CH	4-9
E5-05	Motor armature resistance	Set the resistance per motor phase in units of 0.001 Ω. After setting the resistance, do not change this setting unless necessary.	0.000 to 65.000	8.233 Ω *2	No	No	Q	Q	32DH	4-9
E5-06	Motor d-axis inductance	Set the motor d-axis inductance in units of 0.01 mH. After setting the resistance, do not change this setting unless necessary.	0.00 to 300.00	54.84 mH *2	No	No	Q	Q	32EH	4-9
E5-07	Motor q-axis inductance	Set the motor q-axis inductance with the motor rated load in units of 0.01 mH.	0.00 to 600.00	64.10 mH *2	No	No	Q	Q	32FH	4-9
E5-09	Motor induced voltage constant	Set the peak value of the induced voltage per motor phase in units of 0.1 mV/(rad/s) [electric angle]. Do not change this setting unless necessary.	50.0 to 2000.0	223.0 mV·sec/rad *2	No	No	Q	Q	331H	4-9

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
E5-10	Phase lead compensation	Compensate for the positioning error between the calculated position of the magnetic pole (control axis) and the actual position. Set in units of 0.1 deg (electric angle). Do not change this setting unless necessary.	-180.0 to 180.0	10.0 deg	No	No	No	A	332H	-
E5-11	PG home position offset	Set the amount of pulses to align the home position in units of 0.1 degrees.	-180.0 to 180.0	0.0 deg	No	No	A	No	333H	4-9

Note: The E5 constants are not initialized by the initialize operation.

- * 1. The factory settings vary in accordance with the setting of the Inverter capacity selection (o2-04) or control method selection (A1-02).
The values for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min⁻¹) are given.
- * 2. The factory settings vary in accordance with the setting of the motor capacity selection (E5-01) or control method selection (A1-02).
The values for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min⁻¹) are given.

◆ Option Constants: F

The following settings are made with the option constants (F constants): Settings for option cards

■ PG Option Setup: F1

User constants for the PG Speed Control Board are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
F1-02	Operation selection at PG open circuit (PGO)	Sets the PG disconnection stopping method. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not normally make this setting.)	0 to 3	1	No	No	A	No	381H	6-129
F1-03	Operation selection at overspeed (OS)	Sets the stopping method when an overspeed (OS) fault occurs. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not normally make this setting.)	0 to 3	1 *	No	No	A	No	382H	6-49
F1-04	Operation selection at deviation	Sets the stopping method when a speed deviation (DEV) fault occurs. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (DEV is displayed and operation continued.)	0 to 3	3	No	No	A	A	383H	6-50

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
F1-05	PG rotation	0: Phase A leads with Forward Run Command. (Phase B leads with Reverse Run Command.) 1: Phase B leads with Forward Run Command. (Phase A leads with Reverse Run Command.)	0 or 1	1*	No	No	A	No	384H	6-129
F1-08	Overspeed detection level	Sets the overspeed detection method. Speeds above that set for F1-08 (set as a percentage of the maximum speed) that continue to exceed this speed for the time set in F1-09 (unit: s) are detected as overspeed faults.	0 to 120	115%	No	No	A	A	387H	6-49
F1-09	Overspeed detection delay time		0.0 to 2.0	0.0 s*	No	No	A	A	388H	6-49
F1-10	Excessive speed deviation detection level	Sets the speed deviation detection method. Any speed deviation above the F1-10 set level (set as a percentage of the maximum speed) that continues for the time set in F1-11 is detected as a speed deviation.	0 to 50	10%	No	No	A	A	389H	6-50
F1-11	Excessive speed deviation detection delay time	Speed deviation is the difference between actual motor speed and the reference command speed.	0.0 to 10.0	0.5 s	No	No	A	A	38AH	6-50
F1-14	PG open-circuit detection time	Used to set the PG disconnection detection time. PGO will be detected if the detection time continues beyond the set time.	0.0 to 10.0	2.0 s	No	No	A	No	38DH	6-129
F1-18	DV3 Detection selection	Sets the conditions of DV3 detection (inversion detection). 0: DV3 detection disabled n: DV3 detection enabled if DV3 detection conditions are detected for 5 ms × n times in succession.	0 to 5	5	No	No	A	No	3ADH	6-129
F1-19	DV4 Detection selection	Sets the conditions of DV4 detection (inversion prevention detection). 0: DV4 detection disabled n: DV4 detection enabled if n pulses of A/B phase pulse inverted to the speed reference are detected.	0 to 5000	128	No	No	A	No	3AEH	6-129

* The setting values will return to the factory settings if the control method is changed.

■ Analog Reference Board: F2

User constants for the Analog Reference Board are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
F2-01	Bi-polar or uni-polar input selection	<p>Sets the functions for channel 1 to 3 which are effective when the AI-14B Analog Reference Board is used.</p> <p>0: 3-channel individual (Channel 1: terminal A1, Channel 2: terminal A2, Channel 3: terminal A3)</p> <p>1: 3-channel addition (Addition values are the frequency reference)</p> <p>When set to 0, select 1 for b1-01. In this case the multi-function input "Option/ Inverter selection" cannot be used.</p>	0 or 1	0	No	A	A	A	38FH	6-135

■ Digital Reference Board: F3

User constants for the Digital Reference Board are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
F3-01	Digital input option	<p>Sets the Digital Reference Board input method.</p> <p>0: BCD 1% unit</p> <p>1: BCD 0.1% unit</p> <p>2: BCD 0.01% unit</p> <p>3: BCD 1 Hz unit</p> <p>4: BCD 0.1 Hz unit</p> <p>5: BCD 0.01 Hz unit</p> <p>6: BCD special setting (5-digit input)</p> <p>7: Binary input</p> <p>6 is only effective when the DI-16H2 is used.</p> <p>When o1-03 is set to 2 or higher, the input will be BCD, and the units will change to the o1-03 setting.</p>	0 to 7	0	No	A	A	A	390H	6-135

■Analog Monitor Boards: F4

User constants for the Analog Monitor Board are shown in the following table.

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register	Page
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM		
F4-01	Channel 1 monitor selection	Effective when the Analog Monitor Board is used. Monitor selection: Set the number of the moni- tor item to be output. (U1- □□)	1 to 99	5 *2	No	A	A	A	391H	6-77
F4-02	Channel 1 gain	The monitor items that can be set depends on the control method. Gain: Set the multiple of 10 V for outputting monitor items.	0.00 to 2.50	1.00	Yes	A	A	A	392H	6-77
F4-03	Channel 2 monitor selection	4, 10 to 14, 28 to 30, 34, 39 to 41, 49, 58, 61, 63, 70 to 77, and 79 to 82 cannot be set. 23, 25, 35, 42, 43, 45 to 48, 50 to 57, 59, 60, 62, 64 to 67, and 83 to 99 are not used.	1 to 99	3 *2	No	A	A	A	393H	6-77
F4-04	Channel 2 gain	When the AO-12 Analog Monitor Board is used, out- puts of ± 10 V are possible. To output ± 10 V, set F4-07 or F4-08 to 1. When the AO- 08 Analog Monitor Board is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.*1	0.00 to 2.50	0.50	Yes	A	A	A	394H	6-77
F4-05	Channel 1 output mon- itor bias	Sets the channel 1 item bias to 100%/10 V when the Ana- log Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	395H	6-77
F4-06	Channel 2 output mon- itor bias	Sets the channel 2 item bias to 100%/10 V when the Ana- log Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	396H	6-78
F4-07	Analog out- put signal level for channel 1	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	397H	6-78
F4-08	Analog out- put signal level for channel 2	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	398H	6-78

* 1. Adjustment target is the CH1 output when the F4-02 or F4-05 setting is displayed in quick, advanced, or verify mode while the motor is stopped.
Adjustment target is the CH2 output when the F4-04 or F4-06 setting is displayed in quick, advanced, or verify mode while the motor is stopped.
To adjust the meter, multiply a value equivalent to 100% of the output by the gain setting, and then add the set bias.

* 2. The setting values will return to the factory settings if the control method is changed.

■ Digital Output Boards (DO-02C and DO-08): F5

User constants for the Digital Output Board are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
F5-01	Channel 1 output selection	Effective when a Digital Output Board (DO-02C or DO-08) is used. Set the number of the multi-function output to be output.	0 to 3D	0	No	No	A	A	399H	6-132
F5-02	Channel 2 output selection	Effective when a Digital Output Board (DO-02C or DO-08) is used. Set the number of the multi-function output to be output.	0 to 3D	0F 1	No	No	A	A	39AH	6-132
F5-03	Channel 3 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F 2	No	No	A	A	39BH	6-132
F5-04	Channel 4 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F 4	No	No	A	A	39CH	6-132
F5-05	Channel 5 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F 6	No	No	A	A	39DH	6-133
F5-06	Channel 6 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F 37	No	No	A	A	39EH	6-133
F5-07	Channel 7 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	39FH	6-133
F5-08	Channel 8 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	3A0H	6-133
F5-09	DO-08 output mode selection	Effective when a DO-08 Digital Output Board is used. Set the output mode. 0: 8-channel individual outputs 1: Binary code output 2: Output according to F5-01 to F5-08 settings.	0 to 2	0	No	No	A	A	3A1H	6-133

■ Communications Option Cards: F6

User constants for a Communications Option Card are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
F6-01	Operation selection after communications error	Set the stopping method for communications errors. 0: Deceleration stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	1	No	A	A	A	3A2H	-
F6-02	Input level of external fault from Communications Option Card	0: Always detect 1: Detect during operation	0 or 1	0	No	A	A	A	3A3H	-
F6-03	Stopping method for external fault from Communications Option Card	0: Deceleration stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	1	No	A	A	A	3A4H	-
F6-06	Torque reference/torque limit selection from optical option	0: Torque reference/torque limit from transmission disabled. 1: Torque reference/torque limit from transmission enabled.	0 or 1	0	No	No	A	A	3A7H	-

◆ Terminal Function Constants: H

The following settings are made with the terminal function constants (H constants): Settings for external terminal functions.

■ Multi-function Contact Inputs: H1

User constants for multi-function contact inputs are shown in the following tables.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H1-01	Terminal S3 function selection	Multi-function contact input 1	0 to 78	24	No	A	A	A	400H	-
H1-02	Terminal S4 function selection	Multi-function contact input 2	0 to 768	14	No	A	A	A	401H	-
H1-03	Terminal S5 function selection	Multi-function contact input 3	0 to 78	3 (0)*	No	A	A	A	402H	-
H1-04	Terminal S6 function selection	Multi-function contact input 4	0 to 78	4 (3)*	No	A	A	A	403H	-
H1-05	Terminal S7 function selection	Multi-function contact input 5	0 to 78	6 (4)*	No	A	A	A	404H	-
H1-06	Terminal S8 function selection	Multi-function contact input 6	0 to 78	F	No	A	A	A	4-5H	-

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

Multi-function Contact Input Functions

Setting Value	Function	Control Methods			Page
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
0	3-wire sequence (Forward/Reverse Run Command)	Yes	Yes	Yes	6-15
1	Local/Remote selection (ON: Local, OFF: Remote)	Yes	Yes	Yes	6-63
2	Option/Inverter selection (ON: Option card)	Yes	Yes	Yes	6-70 6-135
3	Multi-step speed reference 1 When H3-09 is set to 2, this function is combined with the master/auxiliary speed switch.	Yes	Yes	Yes	6-9
4	Multi-step speed reference 2	Yes	Yes	Yes	6-9
5	Multi-step speed reference 3	Yes	Yes	Yes	6-9
6	Jog speed command (higher priority than multi-step speed reference)	Yes	Yes	Yes	6-9
7	Accel/decel time 1	Yes	Yes	Yes	6-21
8	External baseblock NO (NO contact: Baseblock at ON)	Yes	Yes	Yes	6-64

Setting Value	Function	Control Methods			Page
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
9	External baseblock NC (NC contact: Baseblock at OFF)	Yes	Yes	Yes	6-64
A	Acceleration/deceleration ramp hold (ON: Acceleration/deceleration stopped, frequency on hold)	No	Yes	Yes	6-65
B	OH2 alarm signal input (ON: OH2 will be displayed)	Yes	Yes	Yes	-
C	Multi-function analog input selection (ON: Enable)	Yes	Yes	Yes	-
E	Speed control integral reset (ON: Integral control disabled)	No	Yes	Yes	6-113
F	Not used (Set when a terminal is not used)	Yes	Yes	Yes	-
10	Up command (Always set with the down command)	No	Yes	Yes	6-66
11	Down command (Always set with the up command)	No	Yes	Yes	6-66
12	FJOG command (ON: Forward run at jog frequency d1-17)	No	Yes	Yes	6-71
13	RJOG command (ON: Reverse run at jog frequency d1-17)	No	Yes	Yes	6-71
14	Fault reset (Reset when turned ON)	Yes	Yes	Yes	7-2
15	Emergency stop. (Normally open condition: Deceleration to stop in deceleration time set in C1-09 when ON.)	Yes	Yes	Yes	6-19
17	Emergency stop (Normally closed condition: Deceleration to stop in deceleration time set in C1-09 when OFF)	Yes	Yes	Yes	6-19
18	Timer function input (Functions are set in b4-01 and b4-02 and the timer function outputs are set in H1-□□ and H2-□□.)	No	Yes	Yes	6-93 7-20
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes	6-98
1A	Accel/Decel time 2	Yes	Yes	Yes	6-21
1B	Constants write enable (ON: All constants can be written-in. OFF: All constants other than speed monitor are write protected.)	Yes	Yes	Yes	6-126 7-20
1C	Trim control increase (ON: d4-02 speed is added to analog speed reference.)	No	No	Yes	6-69
1D	Trim control decrease (ON: d4-02 speed is subtracted from analog speed reference.)	No	No	Yes	6-69
1E	Analog speed reference sample/hold	No	Yes	Yes	6-70
20 to 2F	External fault (Desired settings possible) Input mode: NO contact/NC contact, Detection mode: Normal/during operation	Yes	Yes	Yes	6-72
30	PID control integral reset (reset when reset command is input or when stopped during PID control)	Yes	Yes	Yes	6-98
31	PID control integral hold (ON: Hold)	Yes	Yes	Yes	6-98
32	Multi-step speed reference 4	Yes	Yes	Yes	-
34	PID soft starter ON/OFF	Yes	Yes	Yes	6-98
35	PID input characteristics switch	Yes	Yes	Yes	6-98
61	External search command 1 (ON: Speed search from maximum output frequency)	No	No	Yes	6-53
62	External search command 2 (ON: Speed search from set frequency)	No	No	Yes	6-53
67	Communications test mode ("Pass" is displayed when the communication test is passed.)	Yes	Yes	Yes	6-93
71	Speed/torque control change (ON: Torque control)	No	Yes	No	6-106 6-111
77	Speed control (ASR) proportional gain switch (ON: C5-03)	No	Yes	No	6-113
78	Polarity reversing command for external torque reference	No	Yes	No	6-106

■ Multi-function Contact Outputs: H2

User constants for multi-function outputs are shown in the following tables.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H2-01	Terminal M1-M2 function selection (contact)	Multi-function contact output	0 to 3D	0	No	A	A	A	40BH	-
H2-02	Terminal P1 function selection (open collector)	Multi-function contact output 1	0 to 3D	1	No	A	A	A	40CH	-
H2-03	Terminal P2 function selection (open collector)	Multi-function contact output 2	0 to 3D	2	No	A	A	A	40DH	-
H2-06	Integral power output level selection	Select the output level for the multi-function contact when selecting 39 to one of H2-01 to H2-03. 0: 0.1 kWh 1: 1 kWh 2: 10 kWh 3: 100 kWh 4: 1000 kWh	0 to 4	0	No	A	A	A	437H	6-75

Multi-function Contact Output Functions

Setting Value	Function	Control Methods			Page
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
0	During run (ON: Run Command is ON or voltage is being output)	Yes	Yes	Yes	6-73
1	Zero-speed	Yes	Yes	Yes	6-73
2	Frequency agree 1 (L4-02 used.)	Yes	Yes	Yes	6-39
3	Desired frequency agree 1 (ON: Output frequency = \pm L4-01, L4-02 used and during frequency agree)	Yes	Yes	Yes	6-39
4	Frequency (FOUT) detection 1 (ON: $+L4-01 \geq$ output frequency $\geq -L4-01$, L4-02 used)	Yes	Yes	Yes	6-39
5	Frequency (FOUT) detection 2 (ON: Output frequency $\geq +L4-01$ or output frequency $\leq -L4-01$, L4-02 used)	Yes	Yes	Yes	6-39
6	Inverter operation ready READY: After initialization, no faults	Yes	Yes	Yes	-
7	During DC bus undervoltage (UV) detection	Yes	Yes	Yes	-
8	During baseblock (ON: during baseblock)	Yes	Yes	Yes	-
9	Speed reference selection (ON: Frequency reference from Operator)	Yes	Yes	Yes	-
A	Run Command selection status (ON: Run Command from Operator)	Yes	Yes	Yes	-
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/undertorque detection at ON)	Yes	Yes	Yes	6-42
C	Loss of speed reference (Effective when 1 is set for L4-05)	Yes	Yes	Yes	6-58

Setting Value	Function	Control Methods			Page
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
D	Braking resistor fault (ON: Resistor overheat or braking transistor fault)	Yes	Yes	Yes	6-61
E	Fault (ON: Digital Operator communications error or fault other than CPF00 and CPF01 has occurred.)	Yes	Yes	Yes	-
F	Not used. (Set when the terminals are not used.)	Yes	Yes	Yes	-
10	Minor fault (ON: Alarm displayed)	Yes	Yes	Yes	-
11	Fault reset command active	Yes	Yes	Yes	-
12	Timer function output	No	Yes	Yes	6-93
13	Frequency agree 2 (L4-04 used)	Yes	Yes	Yes	6-39
14	Desired frequency agree 2 (ON: Output frequency = L4-03, L4-04 used, and during frequency agree)	Yes	Yes	Yes	6-39
15	Frequency detection 3 (ON: Output frequency \leq L4-03, L4-04 used)	Yes	Yes	Yes	6-39
16	Frequency detection 4 (ON: Output frequency \geq L4-03, L4-04 used)	Yes	Yes	Yes	6-39
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes	6-42
18	Overtorque/undertorque detection 2 NO (NO Contact: Torque detection at ON)	Yes	Yes	Yes	6-42
19	Overtorque/undertorque detection 2 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes	6-42
1A	During reverse run (ON: During reverse run)	Yes	Yes	Yes	-
1B	During baseblock 2 (OFF: During baseblock)	Yes	Yes	Yes	-
1D	During regeneration (ON: During regeneration)	No	Yes	Yes	-
1E	Restart enabled (ON: Restart enabled)	No	Yes	Yes	6-59
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	Yes	Yes	Yes	6-45 6-74
20	Inverter overheat (OH) pre-alarm (ON: Temperature exceeds L8-02 setting)	Yes	Yes	Yes	6-74
2F	Maintenance timer display (ON: Maintenance timer for capacitors or fans.)	Yes	Yes	Yes	-
30	During torque limit (current limit) (ON: During torque limit)	No	Yes	Yes	-
31	During speed limit (ON: During speed limit)	No	No	Yes	6-74
32	Speed control circuit operating for torque control (except when stopped). Output if the external torque reference is limited (the internal torque reference is less than the external torque reference) when the torque control is selected.	No	Yes	No	6-106
37	During run 2 (ON: Frequency output, OFF: Base block, DC injection braking, initial excitation, operation stop)	Yes	Yes	Yes	6-73
39	The integral power has exceeded the output level set to H2-06. (Contact output for 200 ms.)	Yes	Yes	Yes	6-74
3A	Fan fault alarm (NO contact output)	Yes	Yes	Yes	6-75
3B	Fan fault alarm (NC contact output)	Yes	Yes	Yes	6-75
3C	Magnetic pole detection completed (ON: Magnetic pole detection completed.)	No	Yes	Yes	-
3D	Inverter's Circulation Fan Fault (ON: Fault)	Yes	Yes	Yes	6-60

■ Analog Inputs: H3

User constants for analog inputs are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H3-01	Signal level selection (terminal A1)	0: 0 to 10 V 1: -10 to 10 V	0 or 1	0	No	A	A	A	410H	6-27
H3-02	Gain (terminal A1)	Sets the speed when 10 V is input, as a percentage of the maximum speed.	0.0 to 1000.0	100.0%	Yes	A	A	A	411H	6-27
H3-03	Bias (terminal A1)	Sets the speed when 0 V is input, as a percentage of the maximum speed.	-100.0 to +100.0	0.0%	Yes	A	A	A	412H	6-27
H3-04	Signal level selection (terminal A3)	0: 0 to 10 V 1: -10 to 10 V	0 or 1	0	No	A	A	A	413H	6-27 6-105
H3-05	Multi-function analog input (terminal A3) function selection	Select from the functions listed in the following table. Refer to the next page.	0 to 1F	1F	No	A	A	A	414H	6-27 6-105
H3-06	Gain (terminal A3)	Sets the input gain (level) when 10V is input. Set according to the 100% value selected from H3-05.	0.0 to 1000.0	100.0%	Yes	A	A	A	415H	6-27 6-105
H3-07	Bias (terminal A3)	Sets the input gain (level) when 0V is input. Set according to the 100% value selected from H3-05.	-100.0 to +100.0	0.0%	Yes	A	A	A	416H	6-27 6-105
H3-08	Signal level selection (terminal A2)	0: 0 to +10V, with lower limit 1: -10 to +10 V, without lower limit 2: 4 to 20 mA. Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A	417H	6-27 6-105
H3-09	Multi-function analog input (terminal A2) function selection	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A	418H	6-27 6-105
H3-10	Gain (terminal A2)	Sets the input gain (level) when 10 V (20 mA) is input. Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	419H	6-28 6-105
H3-11	Bias (terminal A2)	Sets the input gain (level) when 0 V (4 mA) is input. Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	41AH	6-28 6-105

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H3-12	Analog input filter time constant	Sets primary delay filter time constant in seconds for the analog input terminal. Effective for noise control etc.	0.00 to 2.00	0.03 s	No	A	A	A	41BH	4-28 6-28
H3-13	Terminal A1/A2 switching	0: Use terminal A1 analog input as main speed reference. 1: Use terminal A2 analog input as main speed reference. Effective when H3-09 is set to 2 and H3-05 is not set to 0 or 2.	0 or 1	0	No	A	A	A	41CH	-

H3-05 and H3-09 Settings

Setting Value	Function	Contents (100%)	Control Methods			Page
			Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
0	Add to terminal A1	Maximum speed	Yes	Yes	Yes	6-29 6-106
1	Speed gain	Speed reference (voltage) command value	Yes	Yes	Yes	6-29
2	2nd step analog (Auxiliary speed reference)	Maximum speed	Yes	Yes	Yes	6-10
5	Accel/decel change (reduction coefficient)	Set acceleration and deceleration times (C1-01 to C1-08)	Yes	Yes	Yes	6-22
7	Overtorque/undertorque detection level	Motor rated torque for vector control Inverter rated output current for sequence test mode	Yes	Yes	Yes	6-44
9	Speed reference lower limit level	Maximum speed	Yes	Yes	Yes	6-34
A	Jump speed	Maximum speed	Yes	Yes	Yes	6-31
B	PID feedback	Maximum speed	Yes	Yes	Yes	6-98
C	PID target value	Maximum speed	Yes	Yes	Yes	6-98
D	Speed bias 2	Maximum speed	Yes	Yes	Yes	6-29
E	Motor temperature input	10 V = 100%	Yes	No	No	-
10	Positive torque limit	Motor's rated torque	No	Yes	Yes	6-35
11	Negative torque limit	Motor's rated torque	No	Yes	Yes	6-35
12	Regenerative torque limit	Motor's rated torque	No	Yes	Yes	6-35
13	Torque reference/torque limit at speed control	Motor's rated torque	No	Yes	Yes	6-106
14	Torque compensation	Motor's rated torque	No	Yes	No	6-106
15	Positive/negative torque limit	Motor's rated torque	No	Yes	Yes	6-35
1F	Analog input not used.	-	Yes	Yes	Yes	6-10
16to1E	Not used	-	-	-	-	-

Multi-function Analog Outputs: H4

User constants for multi-function analog outputs are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
H4-01	Monitor selection (terminal FM)	Sets the number of the monitor item to be output (U1-□□) from terminal FM. The monitor items that can be set depends on the control method. 4, 10 to 14, 28 to 30, 34, 39 to 41, 49, 58, 61, 63, 70 to 77, 79 to 82 cannot be set. 23, 25, 35, 42, 43, 45 to 48, 50 to 57, 60, 62, 64 to 67, 83 to 99 are not used.	1 to 99	5 * ²	No	A	A	A	41DH	6-76
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available. * ¹	0.00 to 2.50	1.00	Yes	Q	Q	Q	41EH	4-6 6-76
H4-03	Bias (terminal FM)	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available. * ¹	-10.0 to +10.0	0.0%	Yes	A	A	A	41FH	6-76
H4-04	Monitor selection (terminal AM)	Sets the number of the monitor item to be output (U1-□□) from terminal AM. The monitor items that can be set depends on the control method. 4, 10 to 14, 28 to 30, 34, 39 to 41, 49, 58, 61, 63, 70 to 77, 79 to 82 cannot be set. 23, 25, 35, 42, 43, 45 to 48, 50 to 57, 60, 62, 64 to 67, 83 to 99 are not used.	1 to 99	3 * ²	No	A	A	A	420H	6-76
H4-05	Gain (terminal AM)	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maximum output from the terminal is 10 V. A meter calibration function is available. * ¹	0.00 to 2.50	0.50	Yes	Q	Q	Q	421H	4-6 6-77

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H4-06	Bias (terminal AM)	Sets the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.* ¹	-10.0 to +10.0	0.0%	Yes	A	A	A	422H	6-77
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 1: -10 to 10 V output	0 or 1	0	No	A	A	A	423H	6-77
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 1: -10 to 10 V output	0 or 1	0	No	A	A	A	424H	-

* 1. Adjustment target is the FM terminal when the H4-02 or H4-03 setting is displayed in quick, advanced, or verify mode while the motor is stopped.
Adjustment target is the AM terminal when the H4-05 or H4-06 setting is displayed in quick, advanced, or verify mode while the motor is stopped.
To adjust the meter, multiply a value that is equivalent to 100% of the output by the gain setting and add the set bias.

* 2. The setting value will return to the factory setting if the control method is changed.

MEMOBUS Communications: H5

User constants for MEMOBUS communications are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H5-01	Slave address	Set the Inverter's slave address.	0 to 20 *	1FH	No	A	A	A	425H	6-83
H5-02	Communication speed selection	Set the baud rate for MEMOBUS communications of communications connection terminals. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	A	A	426H	6-83
H5-03	Communication parity selection	Set the parity for MEMOBUS communications of communications connection terminals. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	A	A	427H	6-83

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H5-04	Stopping method after communication error	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	3	No	A	A	A	428H	6-83
H5-05	Communication error detection selection	Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect. 1: Detect	0 or 1	1	No	A	A	A	429H	6-83
H5-06	Send wait time	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	A	A	42AH	6-83
H5-07	RTS control ON/OFF	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	A	A	42BH	6-84

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

■ Pulse Train I/O: H6

User constants for pulse I/O are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
H6-01	Pulse train input function selection	0: Speed reference 1: PID feedback value 2: PID target value	0 to 2	0	No	No	A	A	42CH	6-5 6-32 6-97
H6-02	Pulse train input scaling	Set the number of pulses in hertz, taking the reference to be 100%.	1000 to 32000	1440 Hz	Yes	No	A	A	42DH	6-5 6-32
H6-03	Pulse train input gain	Set the input gain level as a percent when the pulse train set in H6-02 is input.	0.0 to 1000.0	100.0%	Yes	No	A	A	42EH	6-32
H6-04	Pulse train input bias	Set the input bias when the pulse train is 0.	-100.0 to 100.0	0.0%	Yes	No	A	A	42FH	6-32
H6-05	Pulse train input filter time	Set the pulse train input primary delay filter time constant in seconds.	0.00 to 2.00	0.10 s	Yes	No	A	A	430H	6-32

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
H6-06	Pulse train monitor selection	Select the pulse train monitor output items (value of the □□ part of U1-□□). There are two types of monitor items: Speed-related items and PID-related items.	1, 2, 5, 20, 24, 36	2	Yes	No	A	A	431H	6-79
H6-07	Pulse train monitor scaling	Set the number of pulses output when speed is 100% in Hz. Set H6-06 to 2, and H6-07 to 0, to make the pulse train monitor output synchronously to the motor speed.	0 to 32000	1440 Hz	Yes	No	A	A	432H	6-79

◆ Protection Function Constants: L

The following settings are made with the protection function constants (L constants): Motor protection selection, power loss ride through function, overvoltage inhibit selection function, speed detection, fault restart, torque detection, torque limits, and hardware protection.

■ Motor Overload: L1

User constants for motor overloads are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
L1-01	Motor protection selection	Sets whether the motor overload protection function is enabled or disabled at electric thermal overload relay. 0: Disabled 4: Variable torque PM motor 5: Constant torque PM motor 6: Increased safety, explosion-proof PM motor (variable torque) In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this constant is set to 4, 5, or 6 (Motor protection function enabled), protection may not be effective.	0 or 4	4 *1 *2	No	No	A	A	480H	6-45
			0, 4, 5, 6							

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
L1-02	Motor protection time constant	Sets the electric thermal detection time in seconds units. Usually setting is not necessary. The factory setting is 150% overload for one minute. When the motor's overload resistance is known, also set the overload resistance protection time for when the motor is hot started.	0.1 to 5.0	1.0 min	No	A	A	A	481H	6-45

* 1. This constant is not unitized by the initialize operation.

* 2. The setting values will return to the factory settings if the control method is changed.

■ Power Loss Ridethrough: L2

User constants for power loss ridethroughs are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
L2-01	Momentary power loss detection	0: Disabled (UV fault detection at momentary power loss) 1: Enabled (Restart if power returns within the time set in L2- 02. UV fault detection if the time exceeds that set in L2-02.) 2: Enabled during CPU operation (Restart if power returns during CPU operation. No UV fault detection.) 3: KEB operation (Restart if power returns within the time set in L2-02. UV fault detection if the time exceeds that set in L2-02.) 4: KEB operation during CPU operation (Restart if power returns during CPU operation. No UV fault detection.)	0 to 4	0 ^{*3}	No	No	A	A	485H	6-52
L2-02	Momentary power loss ridethru time	Sets the Ridethrough time in units of seconds, when Momentary Power Loss Selection (L2-01) is set to 1 or 3.	0 to 60.0	0.1 s ^{*1}	No	No	A	A	486H	6-52
L2-03	Min. base-block time	Sets the Inverter's minimum baseblock time in units of one second, when the Inverter is restarted after power loss ride through.	0.1 to 5.0	0.1 s ^{*1}	No	No	No	A	487H	6-52

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L2-05	Undervoltage detection level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage) in V units. Usually setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	No	A	A	489H	6-52
L2-06	KEB deceleration time	Enabled when L2-01 is set to 3 or 4. Sets the deceleration time in seconds from the maximum speed to zero-speed at momentary power loss command (KEB). Controller power supply will be extended if deceleration time is shortened.	0.0 to 200.0	30.0 s *3	No	No	A	A	48AH	-

* 1. The factory settings vary in accordance with the Inverter capacity. (The settings for 0.4 kW 200 V Class Inverters are given.)

* 2. These are values for 200 V Class Inverters. Values for 400 V Class Inverter are twice as large.

* 3. The setting values will return to the factory settings if the control method is changed.

■ Overvoltage Inhibit Selection: L3

User constants for the overvoltage inhibit selection function are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L3-11	Overvoltage inhibit selection	<p>Sets the function to inhibit overvoltage in the Inverter DC bus.</p> <p>0: Disabled 1: Enabled</p> <p>Reduces the regenerative torque limit automatically, depending on the DC bus voltage, to prevent the overvoltage (OV). Deceleration time might be longer than the setting due to auto-adjustment of the decelerating rate.</p> <p>If decelerating with a braking unit or braking resistor, set L3-11 to 0 (Disabled). If this is not done, deceleration cannot be achieved in the desired deceleration time.</p>	0 or 1	1	No	No	A	A	4C7H	4-28 6-25 7-3

■ Speed Detection: L4

User constants for the reference detection function are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L4-01	Speed agreement detection level	<p>Effective when “Desired speed agree 1”, “Speed detection 1>”, or “Speed detection 1<” is set for a multi-function output. Speeds to be detected are set as a percentage of maximum speed.</p>	0.0 to 100.0	0.0%	No	No	A	A	499H	6-38
L4-02	Speed agreement detection width	<p>Effective when “Speed agree 1,” “Desired speed agree 1,” or “Speed detection 1<” is set for a multi-function output. Sets the speed detection width as a percentage of maximum speed.</p>	0.0 to 40.0	4.0%	No	No	A	A	49AH	6-38

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
L4-03	Speed agreement detection level (+/-)	Effective when “Desired speed agree 2”, “Desired speed agree1”, “Speed detection3>” or “Speed detection 4<” is set for a multi-function output. Speed that should be detected is set as a percentage of maximum speed.	-100.0 to +100.0	0.0%	No	No	A	A	49BH	6-38
L4-04	Speed agreement detection width (+/-)	Effective when “Speed agree 2”, “Desired speed agree 1”, or “Speed detection 4<” is set for a multi-function output. Speed detection width is set as a percentage of maximum speed.	0.0 to 40.0	4.0%	No	No	A	A	49CH	6-38
L4-05	Operation when speed reference is missing	0: Stop (Operation follows the speed reference.) 1: Operation at 80% speed continues. (At 80% of speed before the speed reference was lost) Speed reference is lost: Speed reference dropped over 90% in 400 ms.	0 or 1	0	No	No	A	A	49DH	6-58

■ Fault Restart: L5

User constants for restarting faults are shown in the following table.

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
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 speed.	0 to 10	0	No	No	A	A	49EH	6-59
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	No	A	A	49FH	6-59

■ Torque Detection: L6

User constants for the torque detection function are shown in the following table.

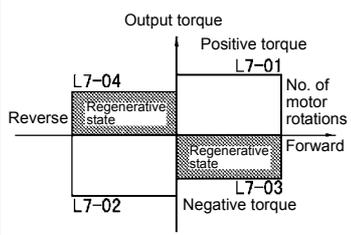
Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
L6-01	Torque detection selection 1	<p>0: Overtorque/undertorque detection disabled.</p> <p>1: Overtorque detection only with speed agreement; operation continues after overtorque (warning).</p> <p>2: Overtorque detected continuously during operation; operation continues after overtorque (warning).</p> <p>3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation).</p> <p>4: Overtorque detected continuously during operation; output stopped upon detection (protected operation).</p> <p>5: Undertorque detection only with speed agreement; operation continues after overtorque (warning).</p> <p>6: Undertorque detected continuously during operation; operation continues after overtorque (warning).</p> <p>7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation).</p> <p>8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).</p>	0 to 8	0	No	No	A	A	4A1H	6-41
L6-02	Torque detection level 1	Motor rated torque is set as 100%.	0 to 300	150%	No	No	A	A	4A2H	6-42
L6-03	Torque detection time 1	Sets the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	No	A	A	4A3H	6-42

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L6-04	Torque detection selection 2	Torque detection 1 is output from the multi-function output by setting the over-torque/undertorque detection 1NO (B) or 1NC (17) to the multi-function output (H2-□□).	0 to 8	0	No	No	A	A	4A4H	6-42
L6-05	Torque detection level 2	Torque detection 2 is output from the multi-function output by setting the over-torque/undertorque detection 2NO (18) or 2NC (19) to the multi-function output (H2-□□).	0 to 300	150%	No	No	A	A	4A5H	6-42
L6-06	Torque detection time 2		0.0 to 10.0	0.1 s	No	A	No	A	4A6H	6-42

■Torque Limits: L7

User constants for torque limits are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L7-01	Forward drive torque limit	Sets the torque limit value as a percentage of the motor rated torque. Four individual regions can be set.	0 to 160	160%	No	No	A	A	4A7H	4-28 6-35
			0 to 300							
L7-02	Reverse drive torque limit		0 to 160	160%	No	No	A	A	4A8H	4-28 6-35
			0 to 300							
L7-03	Forward regenerative torque limit		0 to 160	160%	No	No	A	A	4A9H	4-28 6-35
			0 to 300							
L7-04	Reverse regenerative torque limit		0 to 160	160%	No	No	A	A	4AAH	4-28 6-35
			0 to 300							



Note: To protect the Inverter, the upper torque limit will be reduced automatically.
The upper torque limit depends on the setting of the carrier frequency (C6-02).

■ Hardware Protection: L8

User constants for hardware protection functions are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L8-01	Protect selection for internal DB resistor (Type ERF)	0: Disabled (no overheating protection) 1: Enabled (overheating protection)	0 or 1	0	No	A	A	A	4ADH	6-61
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 *1	No	A	A	A	4AEH	6-62
L8-03	Operation selection after over-heat pre-alarm	Sets the operation for when the Inverter overheat pre-alarm goes ON. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	A	A	4AFH	6-62
L8-05	Input open-phase protection selection	0: Disabled 1: Enabled (Detects if input current open-phase, power supply voltage imbalance or main circuit electrostatic capacitor deterioration occurs.)	0 or 1	0	No	A	A	A	4B1H	-
L8-07	Output open-phase protection selection	0: Disabled 1: Enabled (Detects one output open-phase.) 2: Enabled (Detects more than one output open-phases) When applied motor capacity is small for Inverter capacity, output open-phase may be detected inadvertently or open-phase may not be detected. In this case, set to 0.	0 or 1	0 *2	No	No	A	No	4B3H	-
			0 to 2					A		
L8-08	Output open-phase detection level	Output open-phase will be detected if any U, V, W phase output current has been under the setting level of the L8-08 for 500 ms or more when output current > 30% and soft-starter output ≥ 1.0 Hz. UP/DOWN counter counts this 500 ms.	0.0 to 20.0	5.0% *2	No	No	A	A	4B4H	-

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L8-09	Ground protection selection	0: Disabled 1: Enabled	0 or 1	1	No	A	A	A	4B5H	-
L8-10	Cooling fan control selection	Set the ON/OFF control for the cooling fan. 0: ON only when Inverter is ON 1: ON whenever power is ON	0 or 1	0	No	A	A	A	4B6H	-
L8-11	Cooling fan control delay time	Set the time in seconds to delay turning OFF the cooling fan after the cooling fan OFF command is received.	0 to 300	60 s	No	A	A	A	4B7H	-
L8-12	Ambient temperature	Set the ambient temperature. If set to 60 °C, the Inverter overload protection function (OL2) will start 20% earlier.	45 to 60	45 °C	No	A	A	A	4B8H	-
L8-15	OL2 characteristics selection at low speeds	0: OL2 characteristics at low speeds disabled. 1: OL2 characteristics at low speeds enabled. Usually, setting is not required.	0 or 1	1	No	A	A	A	4BBH	-
L8-29	Current imbalance protection selection	Stops the Inverter if three-phase output current imbalance occurs due to a photocoupler fault or open-phase. 0: Disabled 1: Enabled	0 or 1	1	No	No	A	A	4DFH	-
L8-32	OH1 detection of Inverter's cooling fan	0: Disabled (FAN minor fault detection) 1: Enabled (OH1 major fault detection)	0 or 1	1	No	A	A	A	4E2H	6-60

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

* 2. The setting value will return to the factory setting if the control method is changed.

◆ N: Special Adjustments

The following settings are unique to each control methods.

■ Magnetic Pole Detection: N8

User constants for magnetic pole detection are shown in the following table.

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register	Page
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM		
N8-01	Current of magnetic pole calculation at start	Set the current of magnetic pole calculation at start as a percentage of the motor rated current (E5-03). Normally, setting adjustments are not required. If the "Si" value is written on the motor name plate, set the Si value to the N8-01.	0 to 100	50%	No	No	No	A	540H	-
N8-02	Magnetic pole pull-in current	Set the current pulling in the magnetic pole at start as a percentage of the motor rated current (E5-03). To increase the starting torque, change the setting to a larger value.	0 to 150	80% *	No	No	No	A	541H	-

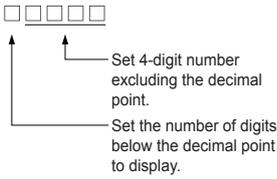
* The setting value will return to be the factory setting if control method is changed.

◆ Digital Operator Constants: o

The following settings are made with the Digital Operator constants (o constants): Multi-function selections and the copy function.

■ Monitor Select: o1

User constants for Digital Operator Displays are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM		
o1-01	Monitor selection	Set the number of the monitor item to be displayed in the earliest 4 monitor items. (U1-□□) The output monitor voltage (factory setting) can be changed.	4 to 99	6	Yes	A	A	A	500H	-
o1-02	Monitor selection after power up	Sets the monitor item to be displayed when the power is turned on. 1: Speed reference 2: Motor speed 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	A	A	501H	6-119
o1-03	Frequency units of reference setting and monitor	Sets the units that will be set and displayed for the speed reference and speed monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: min ⁻¹ units (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	1	No	A	A	A	502H	6-119 6-136
o1-05	LCD brightness adjustment LCD Contrast	Set a smaller value to lighten the LCD and a larger value to darken the LCD (standard: 3).	0 to 5	3	Yes	A	A	A	504H	-

Multi-function Selections: o2

User constants for Digital Operator key functions are shown in the following table.

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register	Page
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM		
o2-01	LOCAL/ REMOTE key enable/ disable	Sets the Digital Operator Local/Remote Key 0: Disabled 1: Enabled (Switches between the Digital Operator and the constant settings.)	0 or 1	1	No	A	A	A	505H	6-119
o2-02	STOP key during con- trol circuit terminal operation	Sets the Stop Key in the run mode. 0: Disabled (When the Run Command is issued from and external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	A	A	506H	6-120
o2-03	User con- stant 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 val- ues, 1110 will be set in A1- 03.	0 to 2	0	No	A	A	A	507H	4-26 6-120
o2-04	kVA selec- tion	This constant is set at fac- tory. Usually, setting is not required.	0 to FF	0 *	No	A	A	A	508H	-
o2-05	Speed refer- ence setting method selection	When the speed reference is set on the Digital Operator speed reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the speed reference without Enter Key operation.	0 or 1	0	No	A	A	A	509H	6-120
o2-06	Operation selection when digi- tal operator is discon- nected	Sets the operation when the Digital Operator is discon- nected. 0: Disabled (Operation continues even if the Digital Operator is disconnected.) 1: Enabled (OPR is detected at Digital Operator disconnection. Inverter output is cut off, and fault contact is operated.)	0 or 1	0	No	A	A	A	50AH	-

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
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	A	A	50BH	6-120
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	A	A	50CH	-
o2-10	Fan operation time setting	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	A	A	50EH	6-120
o2-12	Fault trace/fault history clear function	0: Disabled (U2 and U3 constants are on hold.) 1: Enabled (Initializes U2 and U3 constants.)	0 or 1	0	No	A	A	A	510H	-
o2-14	Output power monitor clear selection	0: Holds output power monitor. 1: Initializes output power monitor. (Returns to 0.)	0 or 1	0	No	No	A	A	512H	5-64
o2-18	Capacitor maintenance setting	Clears the electrolytic capacitor maintenance (U1-61) [setting:0] and sets the setting value in % unit.	0 to 150	0%	No	A	A	A	51DH	-

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

■ 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	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
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	A	A	515H	6-122
o3-02	Read permitted selection	0: Read prohibited 1: Read permitted	0 or 1	0	No	A	A	A	516H	6-122

◆ T: Motor Autotuning

■ Autotuning Mode: T1

The following setting is for autotuning.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
T1-01	Autotuning mode selection	Set the autotuning mode. 2: Stationary autotuning for line-to-line resistance only	2	2 *	No	No	Yes	Yes	701H	4-14 4-21
		4: PG home position offset and line-to-line resistance autotuning (This selection is only for flux vector control for PM)	2, 4							

* The factory settings vary in accordance with the control method. (The factory settings of open-loop vector control for PM are given. For flux vector control for PM, the setting is 4.)

■ Motor Constants For Autotuning: T2

Motor constants for autotuning are shown in the following table.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
T2-01	Motor rated capacity (E5-02 correspondence)	Sets the motor rated capacity according to the information on the motor name plate. Only that or one frame smaller than the Inverter capacity can be set.	0.40 to 160.00	0.40 kW *2	No	No	Yes	Yes	730H	4-14 4-21
			0.40 to 300.00							
T2-02	Base speed (E1-06 correspondence)	Sets the motor base speed according to the information on the motor name plate. Only the value of 1750, 1450, or 1150 min ⁻¹ can be set.	1150 to 1750	1750 min ⁻¹ *2	No	No	Yes	Yes	731H	4-14 4-21
T2-03	Base voltage (E1-13 correspondence)	Sets the motor base voltage according to the information on the motor name plate.	0.0 to 255.0 *1	190.0 V *2	No	No	Yes	Yes	732H	4-14 4-21
T2-04	Motor rated current (E5-03 correspondence)	Sets the motor rated current according to the information on the motor name plate.	0.00 to 2000.0	1.65 A *2	No	No	Yes	Yes	733H	4-14 4-21

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
T2-05	Number of motor poles (E5-04 correspondence)	Sets the number of motor poles according to the information on the motor name plate.	6	6 pole *2	No	No	Yes	Yes	734H	4-14 4-21
T2-06	Motor d axis inductance (E5-06 correspondence)	Sets the motor d-axis inductance according to the information on the motor name plate.	0.00 to 300.00	54.84 mH *2	No	No	Yes	Yes	735H	4-14 4-21
T2-07	Motor q axis inductance (E5-07 correspondence)	Sets the motor q-axis inductance according to the information on the motor name plate.	0.00 to 600.00	64.10 mH *2	No	No	Yes	Yes	736H	4-14 4-21
T2-08	Motor induced voltage constant (E5-09 correspondence)	Sets the motor induced voltage according to the information on the motor name plate.	50.0 to 2000.0	223.0 mV·sec/rad *2	No	No	Yes	Yes	737H	4-14 4-21
T2-11	Input voltage setting (E1-01 correspondence)	Sets the Inverter input voltage in units of 1 V.	155 to 255 *1	200 V *1	No	No	Yes	Yes	73AH	4-14 4-21

* 1. These are values for 200 V Class Inverters. Values for 400 V Class Inverters are twice as large.

* 2. The factory settings vary in accordance with the motor capacity selection (E5-01) or control method selection (A1-02).
The settings for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min⁻¹) are given.

◆ U: Monitor Constants

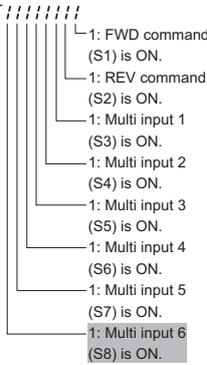
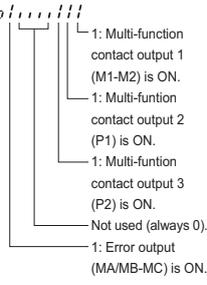
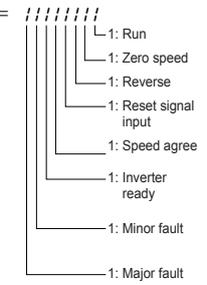
The following settings are made with the monitor constants (U constants): Setting constants for monitoring in drive mode.

■ Status Monitor Constants: U1

The constants used for monitoring status are listed in the following table.

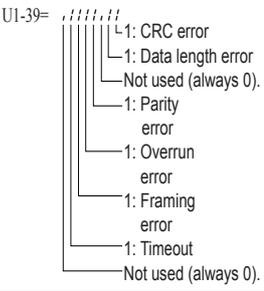
Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-01	Speed reference	Monitors/sets the speed reference value.*	10 V: Max. speed (–10 to 10 V possible)	0.01 %	A	A	A	40H
U1-02	Output frequency	Monitors the output frequency.*	10 V: Max. speed (–10 to 10 V possible)	0.01 %	A	A	A	41H
U1-03	Output current	Monitors the output current.	10 V: Inverter rated output current (0 to +10 V, absolute value output)	0.1 A	A	A	A	42H
U1-04	Control method	Checks the current control method.	(Cannot be output.)	-	A	A	A	43H
U1-05	Motor speed	Monitors the detected motor speed.*	10 V: Max. speed (–10 to 10 V possible)	0.01 %	No	A	A	44H
U1-06	Output voltage	Monitors the output voltage reference value in the Inverter.	10 V: 200 VAC (400 VAC) (0 to +10 V output)	0.1 VAC	A	A	A	45H
U1-07	DC bus voltage	Monitors the main DC voltage in the Inverter.	10 V: 400 VDC (800 VDC) (0 to +10 V output)	1 VDC	A	A	A	46H
U1-08	Output power	Monitors the output power (internally detected value).	10 V: Motor capacity (During closed loop vector control and open loop vector control for PM) 10 V: Inverter capacity (Sequence test) (max. applicable motor capacity) (–10 to 10 V possible)	0.1 kW	A	A	A	47H
U1-09	Torque reference	Monitor in internal torque reference value for vector control.	10 V: Motor rated torque (–10 to 10 V possible)	0.1%	No	A	A	48H

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

Con- stant Number	Name	Description	Output Signal Level Dur- ing Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Regis- ter
					Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-10	Input termi- nal status	Shows input ON/OFF status U1-10=ε 	(Cannot be output.)	-	A	A	A	49H
U1-11	Output ter- minal status	Shows output ON/OFF sta- tus. U1-11=σ 	(Cannot be output.)	-	A	A	A	4AH
U1-12	Operation status	Inverter operating status. U1-12=ε 	(Cannot be output.)	-	A	A	A	4BH
U1-13	Cumulative operation time	Monitors the total operat- ing time of the Inverter. The initial value and the operating time/power ON time selection can be set in o2-07 and o2-08.	(Cannot be output.)	1 hr	A	A	A	4CH
U1-14	Software No. (flash memory)	(Manufacturer's ID num- ber)	(Cannot be output.)	-	A	A	A	4DH
U1-15	Terminal A1 input voltage	Monitors the input voltage of the voltage speed refer- ence. An input of 10 V cor- responds to 100%.	10 V: 100% (10 V input) (-10 to 10 V possible)	0.1%	A	A	A	4EH
U1-16	Terminal A2 input current (voltage)	Monitors the input current of the multi-function analog input. An input of 10 V corre- sponds to 100%.	10 V: 100% (10 V input) (-10 to 10 V possible)	0.1%	A	A	A	4FH

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-17	Terminal A3 input voltage	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (-10 to 10 V possible)	0.1%	A	A	A	050H
U1-18	Motor q-axis current (Iq)	Monitors the calculated value of the motor q-axis current. The motor rated current corresponds to 100%.	10 V: Motor rated current (-10 to 10 V output)	0.1%	A	A	A	51H
U1-19	Motor d-axis current (Id)	Monitors the calculated value of the motor d-axis current. The motor rated current corresponds to 100%.	10 V: Motor rated current (-10 to 10 V output)	0.1%	No	A	A	52H
U1-20	Speed reference after soft-start	Monitors the speed reference after soft-start. The speed reference given does not include compensations, such as slip compensation.*	10 V: Max. speed (-10 to 10 V possible)	0.01Hz	A	A	A	53H
U1-21	ASR input	Monitors the input to the speed control loop. The maximum speed corresponds to 100%.*	10 V: Max. speed (-10 to 10 V possible)	0.01%	No	A	A	54H
U1-22	ASR output	Monitors the output from the speed control loop. (Primary delay filter output value.) The motor rated torque corresponds to 100%.	10 V: Motor rated torque (-10 to 10 V possible)	0.01%	No	A	A	55H
U1-24	PID feedback value	Monitors the feedback value when PID control is used. The input for the maximum speed corresponds to 100%.*	10 V: Max. speed (-10 to 10 V possible)	0.01%	A	A	A	57H
U1-26	Output voltage reference (Vq)	Monitors the Inverter internal voltage reference for motor q-axis current control.	10 V: 200 VAC (400 VAC) (-10 to 10 V possible)	0.1 VAC	No	A	A	59H
U1-27	Output voltage reference (Vd)	Monitors the Inverter internal voltage reference for motor d-axis current control.	10 V: 200 VAC (400 VAC) (-10 to 10 V possible)	0.1 VAC	No	A	A	5AH
U1-28	Software No. (CPU)	(Manufacturer's CPU software No.)	(Cannot be output.)	-	A	A	A	5BH

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

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-29	Output power lower 4 digits	Monitors the Inverter's output power. The display is split into upper digits and lower digits in the following way.	(Cannot be output.)	0.1 kWh	No	A	A	5CH
U1-30	Output power upper 5 digits	<p> □□□□□ □□□.□ kWh U1-30 U1-29 </p> <p>Example: If the output power is 12345678.9 kWh, the display will be as follows: U1-29: 678.9 kWh U1-30: 12345 MWh</p>		1 MWh	No	A	A	5DH
U1-31	LED check	Lights all LEDs on the Digital Operator (JVOP-161).	(Cannot be output.)	-	A	A	A	3CH
U1-32	ACR output of q axis	Monitors the current control output value for the motor q-axis current.	10 V: 100% (-10 to 10 V possible)	0.1 %	No	A	A	5FH
U1-33	ACR output of d axis	Monitors the current control output value for the motor d-axis current.	10 V: 100% (-10 to 10 V possible)	0.1 %	No	A	A	60H
U1-34	OPE fault constant	Shows the first constant number where an OPE fault was detected.	(Cannot be output.)	-	A	A	A	61H
U1-36	PID input volume	PID feedback volume Given as maximum speed/ 100%	10 V: Max. speed (-10 to 10 V possible)	0.01 %	A	A	A	63H
U1-37	PID output volume	PID control output Given as maximum speed/ 100%	10 V: Max. speed (-10 to 10 V possible)	0.01 %	A	A	A	64H
U1-38	PID target value	PID target value Given as maximum speed/ 100%	10 V: Max. speed	0.01 %	A	A	A	65H
U1-39	MEMO-BUS communications error code	<p>Shows MEMOBUS errors.</p> <p>U1-39= </p>	(Cannot be output.)	-	A	A	A	66H
U1-40	Cooling fan operating time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	(Cannot be output.)	1 hr	A	A	A	67H

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-44	ASR output 2	Monitors output from the speed control loop. (Primary delay filter input value) Displays 100% at the motor rated current.	10 V: Motor rated current (-10 to 10 V)	0.01 %	No	A	A	6BH
U1-61	Electrolytic capacitor maintenance	Displays the estimated time for the electrolytic capacitor maintenance in % units. (Can be set in o2-18.) (100% is the estimated time for replacement.)	(Cannot be output.)	1%	A	A	A	7CH
U1-63	Cooling fan maintenance timer	Cooling fan maintenance timer (100% is the estimated time for replacement.)	(Cannot be output.)	1%	A	A	A	7EH
U1-68	Lead-in phase compensation ($\Delta\theta$ cmp)	Displays the compensation volume estimated by the shaft displacement calculation.	-5 to 5 V: -180 to 180 deg (Output absolute value, if 0 to 10 V is output.)	0.1 deg	No	No	A	7C0H
U1-69	Control shaft displacement volume ($\Delta\theta$)	Displays the displacement volume between γ , δ shaft for motor control and actual d, q shaft.	-5 to 5 V: -180 to 180 deg (Output absolute value, if 0 to 10 V is output.)	0.1 deg	No	No	A	7C1H
U1-78	Magnetic pole position detected value (with PG)	Monitors the magnetic pole position detected value (Sensor)	10 V/360 deg	0.1 deg	No	A	No	7CAH

■ Fault Trace: U2

User constants for error tracing are shown in the following table.

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
U2-01	Current fault	The contents of the current fault.	(Cannot be output.)	-	A	A	A	80H
U2-02	Previous fault	The contents of the error that occurred just prior to the current fault.		-	A	A	A	81H
U2-03	Speed reference at fault	The speed reference when the previous fault occurred.		0.01 Hz	A	A	A	82H
U2-04	Output frequency at fault	The output frequency when the previous fault occurred.		0.01 Hz	A	A	A	83H
U2-05	Output current at fault	The output current when the previous fault occurred.		0.1 A	A	A	A	84H
U2-06	Motor speed at fault	The motor speed when the previous fault occurred.		0.01 Hz	No	A	A	85H
U2-07	Output voltage reference at fault	The output reference voltage when the previous fault occurred.		0.1 V	A	A	A	86H
U2-08	DC bus voltage at fault	The main current DC voltage when the previous fault occurred.		1 V	A	A	A	87H
U2-09	Output power at fault	The output power when the previous fault occurred.		0.1 kW	A	A	A	88H
U2-10	Torque reference at fault	The reference torque when the previous fault occurred. The motor rated torque corresponds to 100%.		0.1%	No	A	A	89H
U2-11	Input terminal status at fault	The input terminal status when the previous fault occurred. The format is the same as for U1-10.		-	A	A	A	8AH
U2-12	Output terminal status at fault	The output terminal status when the previous fault occurred. The format is the same as for U1-11.		-	A	A	A	8BH
U2-13	Operation status at fault	The operating status when the previous fault occurred. The format is the same as for U1-12.		-	A	A	A	8CH
U2-14	Cumulative operation time at fault	The operating time when the previous fault occurred.		1 hr	A	A	A	8DH

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
U2-15	Speed reference after soft-start at fault	The Speed reference after soft-start when the previous fault occurs. Displays the same state as U1-20.	(Cannot be output.)	0.01 Hz	No	A	A	7E0H
U2-16	Motor q-axis inductance at fault	The Motor q-axis inductance when the previous fault occurs. Displays the same state as U1-18.		0.1%	No	A	A	7E1H
U2-17	Motor d-axis inductance at fault	The Motor d-axis inductance when the previous fault occurs. Displays the same state as U1-19.		0.1%	No	A	A	7E2H
U2-18	ASR output 2 at fault	The ASR output 2 when the previous fault occurs. Displays the same state as U1-44.		0.01 %	No	A	A	7E3H
U2-20	Heatsink temperature at fault	The Heatsink temperature when the previous fault occurs.		1 °C	A	A	A	8EH
U2-30	Control shaft displacement volume ($\Delta\theta$) at fault	The Control shaft displacement volume ($\Delta\theta$) when the previous fault occurs. Displays the same state as U1-69.		0.1 deg	No	No	A	7EFH

Note: The following faults are not included in the fault trace: CPF00, CPF01, CPF02, CPF03, UV1, and UV2.

■ Fault History: U3

User constants for the error log are shown in the following table.

Con- stant Number	Name	Description	Output Signal Level Dur- ing Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Regis- ter
					Se- quenc- es test	Flux Vec- tor	Open Loop Vec- tor	
U3-01	Most recent fault	The error contents of 1st previous fault.	(Cannot be output.)	-	A	A	A	90H
U3-02	Second most recent fault	The error contents of 2nd previous fault.		-	A	A	A	91H
U3-03	Third most recent fault	The error contents of 3rd previous fault.		-	A	A	A	92H
U3-04	Fourth most recent fault	The error contents of 4th previous fault.		-	A	A	A	93H
U3-05	Cumulative operation time at fault	The total operating time when the 1st previous fault occurred.		1 hr	A	A	A	94H
U3-06	Accumu- lated time of second fault	The total operating time when the 2nd previous fault occurred.		1 hr	A	A	A	95H
U3-07	Accumu- lated time of third fault	The total operating time when the 3rd previous fault occurred.		1 hr	A	A	A	96H
U3-08	Accumu- lated time of fourth fault	The total operating time when the 4th previous fault occurred.		1 hr	A	A	A	97H

Note: The following errors are not recorded in the error log: CPF00, CPF01, CPF02, CPF03, UV1, and UV2.

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

The factory settings of the following user constants will change if the control method (A1-02) is changed.

Constant No.	Name	Unit	Factory setting		
			Sequence test A1-02=0	Open-loop vector control for PM A1-02=6	Flux vector control for PM A1-02=7
b2-01	Zero-speed level (Baseblock starting speed)	%	-	0.5	1.0
C5-01	ASR proportional (P) gain 1	-	-	20.00	10.00
C5-03	ASR proportional (P) gain 2	-	-	20.00	10.00
C5-06	ASR primary delay time	s	-	0.004	0.016
C6-02	Carrier frequency selection	-	-	1 (2 kHz)	2 (4 kHz)
E1-09	Min. speed	-	1.5 Hz	30 min ⁻¹	10% of the base speed of motor (E1-06)
F4-01	Channel 1 monitor selection	-	2	5	5
H4-01	Monitor selection (terminal FM)	-	3	5	5
L1-01	Motor protection selection	-	-	5	4
T1-01	Autotuning mode selection	-	-	4	2

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

The factory settings of the following user constants will change if the Inverter capacity (o2-04) is changed.

■ 200 V Class

Constant No.	Name	Unit	Factory setting						
-	Inverter capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
o2-04	kVA selection	-	00	01	02	03	04	05	06
E5-01	Motor capacity selection	-	0000	0001	0002	0003	0004	0005	0006
C6-01	CT/VT selection	-	1	1	1	1	1	1	1
C6-02	Carrier frequency selection (when VT is selected) *1 *2 *3	-	2	2	2	2	2	2	2
-	Carrier frequency selection upper limit (when VT is selected) *3	-	4 *4	4 *4	4 *4	4 *4	4 *4	4 *4	4 *4
E2-01	Motor rated current	A	1.90	3.30	6.20	8.50	14.00	19.60	26.60
E2-02	Motor rated slip	Hz	2.90	2.50	2.60	2.90	2.73	1.50	1.30
E2-03	Motor no-load current	A	1.20	1.80	2.80	3.00	4.50	5.10	8.00
E2-05	Motor line-to-line resistance	Ω	9.842	5.156	1.997	1.601	0.771	0.399	0.288
E2-10	Motor iron loss for torque compensation	-	14	26	53	77	112	172	262
L2-02	Momentary power loss ride-through time	s	0.1	0.1	0.2	0.3	0.5	1.0	1.0
L2-03	Min. baseblock time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.7
L8-02	Overheat pre-alarm level	°C	95	95	95	100	95	95	95

Constant No.	Name	Unit	Factory setting						
-	Inverter capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
o2-04	kVA selection	-	07	08	09	0A	0B	0C	0D
E5-01	Motor capacity selection	-	0007	0008	0009	000A	000B	000C	000D
C6-01	CT/VT selection	-	1	1	1	1	1	1	1
C6-02	Carrier frequency selection (when VT is selected) *1 *2 *3	-	2	2	2	2	2 *6	2 *6	2 *6
-	Carrier frequency selection upper limit (when VT is selected) *3	-	4 *4	4 *4	4 *4	4 *4	4 *4	3 *5	3 *5
E2-01	Motor rated current	A	39.7	53.0	65.8	77.2	105.0	131.0	160.0
E2-02	Motor rated slip	Hz	1.70	1.60	1.67	1.70	1.80	1.33	1.60
E2-03	Motor no-load current	A	11.2	15.2	15.7	18.5	21.9	38.2	44.0
E2-05	Motor line-to-line resistance	Ω	0.230	0.138	0.101	0.079	0.064	0.039	0.030
E2-10	Motor iron loss for torque compensation	-	245	272	505	538	699	823	852

Constant No.	Name	Unit	Factory setting						
-	Inverter capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
o2-04	kVA selection	-	07	08	09	0A	0B	0C	0D
L2-02	Momentary power loss ridethru time	s	1.0	2.0	2.0	0.7	2.0	0.7	2.0
L2-03	Min. baseblock time	s	0.8	0.9	1.0	1.0	1.1	1.1	1.2
L8-02	Overheat pre-alarm level	°C	95	90	100	90	90	95	100

Constant No.	Name	Unit	Factory setting	
-	Inverter capacity	kW	55.00	75.00
o2-04	kVA selection	-	0E	0F
E5-01	Motor capacity selection	-	000E	000F
C6-01	CT/VT selection	-	1	1
C6-02	Carrier frequency selection (when VT is selected) *1 *2 *3	-	2 *6	1 *6
-	Carrier frequency selection upper limit (when VT is selected) *3	-	3 *5	3 *5
E2-01	Motor rated current	A	190.0	260.0
E2-02	Motor rated slip	Hz	1.43	1.39
E2-03	Motor no-load current	A	45.6	72.0
E2-05	Motor line-to-line resistance	Ω	0.022	0.023
E2-10	Motor iron loss for torque compensation	-	960	1200
L2-02	Momentary power loss ridethru time	s	0.7	0.7
L2-03	Min. baseblock time	s	1.2	1.3
L8-02	Overheat pre-alarm level	°C	105	110

* 1. The setting of C6-02 determines the carrier frequencies as follows: 1: 2.0 kHz, 2: 4.0 kHz, 3: 6.0 kHz, 4: 8.0 kHz, 6: 12.0 kHz

* 2. The factory settings vary in accordance with the control method. The factory settings of open-loop vector control for PM are given. For flux vector control for PM, the setting would be 1 (2 kHz).

* 3. The factory settings and upper limits vary in accordance with the CT/VT selection (C6-01). If C6-01=0 (CT), both factory settings and upper limits are 1 (2 kHz).

* 4. The upper limit for open-loop vector control for PM is given.[For flux vector control for PM, the upper limit would be 6 (12.0 kHz).]

* 5. The upper limit for open-loop vector control for PM is given.[For flux vector control for PM, the upper limit would be 4 (8.0 kHz).]

* 6. For a 200 V Class Inverter of 30 kW or more, reduce the Inverter rated current if carrier frequency must be set to a larger value than the factory setting.

■400 V Class

Constant No.	Name	Unit	Factory setting						
-	Inverter capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
o2-04	kVA selection	-	20	21	22	23	24	26	27
E5-01	Motor capacity selection	-	0020	0021	0022	0023	0024	0026	0027
C6-01	CT/VT selection	-	1	1	1	1	1	1	1
C6-02	Carrier frequency selection (when VT is selected) *1 *2 *3	-	2	2	2	2	2	2	2
-	Carrier frequency selection upper limit (when VT is selected) *3	-	4 *6	4 *6	4 *6	4 *6	4 *6	4 *6	4 *6
E2-01	Motor rated current	A	1.00	1.60	3.10	4.20	7.00	9.80	13.30
E2-02	Motor rated slip	Hz	2.90	2.60	2.50	3.00	2.70	1.50	1.30
E2-03	Motor no-load current	A	0.60	0.80	1.40	1.50	2.30	2.60	4.00
E2-05	Motor line-to-line resistance	Ω	38.198	22.459	10.100	6.495	3.333	1.595	1.152
E2-10	Motor iron loss for torque compensation	-	14	26	53	77	130	193	263
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	0.8	0.8
L2-03	Min. baseblock time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.7
L8-02	Overheat pre-alarm level	°C	95	95	95	90	95	95	90

Constant No.	Name	Unit	Factory setting						
-	Inverter capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
o2-04	kVA selection	-	28	29	2A	2B	2C	2D	2E
E5-01	Motor capacity selection	-	0028	0029	002A	002B	002C	002D	002E
C6-01	CT/VT selection	-	1	1	1	1	1	1	1
C6-02	Carrier frequency selection (when VT is selected) *1 *2 *3	-	2	2	2	2	2 *9	2 *9	2 *9
-	Carrier frequency selection upper limit (when VT is selected) *3	-	4 *6	4 *6	4 *6	4 *6	4 *6	4 *6	4 *6
E2-01	Motor rated current	A	19.9	26.5	32.9	38.6	52.3	65.6	79.7
E2-02	Motor rated slip	Hz	1.70	1.60	1.67	1.70	1.80	1.33	1.60
E2-03	Motor no-load current	A	5.6	7.6	7.8	9.2	10.9	19.1	22.0
E2-05	Motor line-to-line resistance	Ω	0.922	0.550	0.403	0.316	0.269	0.155	0.122
E2-10	Motor iron loss for torque compensation	-	385	440	508	586	750	925	1125
L2-02	Momentary power loss ridethru time	s	1.0	2.0	2.0	0.7	2.0	0.7	2.0
L2-03	Min. baseblock time	s	0.8	0.9	1.0	1.0	1.1	1.1	1.2
L8-02	Overheat pre-alarm level	°C	95	95	98	78	85	85	90

Constant No.	Name	Unit	Factory setting					
-	Inverter capacity	kW	55.00	75.00	90.00	110.00	132.00	160.00
o2-04	kVA selection	-	2F	30	31	32	33	34
E5-01	Motor capacity selection	-	002F	0030	0031	0032	0033	0034
C6-01	CT/VT selection	-	1	1	1	1	1	1
C6-02	Carrier frequency selection (when VT is selected) *1 *2 *3	-	2 *9	2 *9	2 *9	2 *9	1 *9	1 *9
-	Carrier frequency selection upper limit (when VT is selected) *3	-	4 *6	3 *7	3 *7	3 *7	3 *7	3 *7
E2-01	Motor rated current	A	95.0	130.0	156.0	190.0	223.0	270.0
E2-02	Motor rated slip	Hz	1.46	1.39	1.40	1.40	1.38	1.35
E2-03	Motor no-load current	A	24.0	36.0	40.0	49.0	58.0	70.0
E2-05	Motor line-to-line resistance	Ω	0.088	0.092	0.056	0.046	0.035	0.029
E2-10	Motor iron loss for torque compensation	-	1260	1600	1760	2150	2350	2850
L2-02	Momentary power loss ride-through time	s	0.7	0.7	2.0	2.0	2.0	2.0
L2-03	Min. baseblock time	s	1.2	1.3	1.5	1.7	1.7	1.8
L8-02	Overheat pre-alarm level	°C	90	98	108	100	110	108

Constant No.	Name	Unit	Factory setting		
-	Inverter capacity	kW	185.00	220.00	300.00
o2-04	kVA selection	-	35 ^{*5}	36 ^{*5}	37 ^{*5}
E5-01	Motor capacity selection	-	0034	0035	0037
C6-01	CT/VT selection	-	1	1 ^{*4}	1 ^{*4}
C6-02	Carrier frequency selection (when VT is selected) ^{*1 *2 *3}	-	1	1	1
-	Carrier frequency selection upper limit (when VT is selected) ^{*3}	-	1 ^{*8}	1	2 ^{*10}
E2-01	Motor rated current	A	310.0	370.0	500.0
E2-02	Motor rated slip	Hz	1.30	1.30	1.25
E2-03	Motor no-load current	A	81.0	96.0	130.0
E2-05	Motor line-to-line resistance	Ω	0.025	0.020	0.014
E2-10	Motor iron loss for torque compensation	-	3200	3700	4700
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0
L2-03	Min. baseblock time	s	1.9	2.0	2.1
L8-02	Overheat pre-alarm level	°C	95	100	108

- * 1. The setting of C6-02 determines the carrier frequencies as follows: 1: 2.0 kHz, 2: 4.0 kHz, 3: 6.0 kHz, 4: 8.0 kHz, 6: 12.0 kHz.
- * 2. The factory settings vary in accordance with the control method. The factory settings of open-loop vector control for PM are given. For flux vector control for PM, the setting would be 1 (2 kHz).
- * 3. The factory settings and upper limits vary in accordance with the CT/VT selection (C6-01). If C6-01=0 (CT), both factory settings and upper limits are 1 (2 kHz).
- * 4. For 220 and 300 kW Inverters, C6-01 is fixed value 1 (VT).
- * 5. In open-loop vector control for PM, capacity selection cannot be performed.
- * 6. The upper limit for open-loop vector control for PM is given.[For flux vector control for PM, the upper limit would be 6 (12.0 kHz).]
- * 7. The upper limit for open-loop vector control for PM is given.[For flux vector control for PM, the upper limit would be 4 (8.0 kHz).]
- * 8. The upper limit for open-loop vector control for PM is given.[For flux vector control for PM, the upper limit would be 2 (4.0 kHz).]
- * 9. For a 400 V Class Inverter of 30 kW or more, reduce the Inverter rated current if carrier frequency must be set to a larger value than the factory setting
- * 10. In software PRG 1040, the setting is fixed to 1 (2 kHz). In software PRG 1041 or later, settings 1 (2 kHz) and 2 (4 kHz) are selectable.

◆ Factory Settings that Change with Inverter Capacity Selection (o2-04) and Motor Capacity Selection (E5-01)

■ 200 V Class Standard Motor for Open-loop Vector Control (1750 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	000	001	002	003	004	005	006
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	175	175	175	175	175	175	175
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	1.65	2.97	5.50	8.10	13.40	19.80	27.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	8.233	2.284	1.501	0.827	0.455	0.246	0.198
E5-06	Motor d axis inductance	mH	54.84	23.02	17.08	8.61	7.20	4.86	4.15
E5-07	Motor q axis inductance	mH	64.10	29.89	21.39	13.50	10.02	7.43	5.91
E5-09	Motor generation voltage constant	mV·sec/rad	233.0	229.5	250.9	247.9	248.6	249.6	269.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	007	008	009	00A	00B	00C	00D
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	175	175	175	175	175	175	175
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	39.7	53.2	65.5	77.4	100.2	126.4	155.9
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.094	0.066	0.052	0.037	0.030	0.020	0.014
E5-06	Motor d axis inductance	mH	3.40	2.65	2.17	1.71	1.34	0.99	0.83
E5-07	Motor q axis inductance	mH	3.91	3.11	2.55	2.06	1.78	1.28	1.05
E5-09	Motor generation voltage constant	mV·sec/rad	249.3	266.6	265.1	262.9	291.2	275.2	271.6

Constant No.	Name	Unit	Factory setting	
E5-02	Motor rated capacity	kW	55.00	75.00
E5-01	Motor capacity selection	-	00E	00F
E1-04	Max. speed	min ⁻¹	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750
E1-09	Min. speed	min ⁻¹	175	175
E1-13	Base voltage	V	190.0	190.0
E5-03	Motor rated current	A	186.2	259.8
E5-04	Number of motor poles	pole	6	6
E5-05	Motor armature resistance	Ω	0.012	0.006
E5-06	Motor d axis inductance	mH	0.81	0.44
E5-07	Motor q axis inductance	mH	1.22	0.56
E5-09	Motor generation voltage constant	mV·sec/rad	299.6	259.6

■ 400 V Class Standard Motor for Open-loop Vector Control (1750 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	020	021	022	023	024	026	027
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	175	175	175	175	175	175	175
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	0.83	1.49	2.75	4.05	6.80	9.90	13.10
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	32.932	9.136	6.004	3.297	1.798	0.982	0.786
E5-06	Motor d axis inductance	mH	219.36	92.08	68.32	40.39	32.93	22.70	16.49
E5-07	Motor q axis inductance	mH	256.40	119.56	85.56	48.82	37.70	26.80	23.46
E5-09	Motor generation voltage constant	mV·sec/rad	466.0	459.0	501.8	485.7	498.7	498.0	541.7

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	028	029	02A	02B	02C	02D	02E
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	175	175	175	175	175	175	175
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	19.9	26.4	32.1	38.7	49.9	63.2	74.4
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.368	0.263	0.202	0.148	0.235	0.076	0.054
E5-06	Motor d axis inductance	mH	13.38	10.51	8.56	6.84	5.40	3.96	3.36
E5-07	Motor q axis inductance	mH	16.99	12.77	11.22	8.24	7.26	5.12	3.94
E5-09	Motor generation voltage constant	mV·sec/rad	508.7	531.9	536.4	525.8	585.1	555.2	581.4

Constant No.	Name	Unit	Factory setting					
E5-02	Motor rated capacity	kW	55.00	75.00	90.00	110.00	132.00	160.00
E5-01	Motor capacity selection	-	02F	030	031	032	033	034
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	175	175	175	175	175	175
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	89.0	121.5	152.0	181.0	219.0	255.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.049	0.029	0.019	0.016	0.011	0.008
E5-06	Motor d axis inductance	mH	3.16	2.12	1.52	1.46	1.12	0.95
E5-07	Motor q axis inductance	mH	3.88	2.61	2.53	2.27	1.74	1.48
E5-09	Motor generation voltage constant	mV·sec/rad	649.8	619.3	543.0	589.9	567.4	627.7

■ 200 V Class Standard Motor for Open-loop Vector Control (1450 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	100	101	102	103	104	105	106
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	145	145	145	145	145	145	145
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	1.78	3.12	5.88	8.00	14.10	20.00	26.60
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	4.405	2.425	1.647	0.665	0.462	0.341	0.184
E5-06	Motor d axis inductance	mH	26.62	19.14	14.53	12.27	7.10	5.90	6.91
E5-07	Motor q axis inductance	mH	41.70	29.98	19.98	14.77	10.14	8.42	8.37
E5-09	Motor generation voltage constant	mV·sec/rad	262.6	276.3	291.0	299.1	294.3	306.6	325.1

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	107	108	109	10A	10B	10C	10D
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	145	145	145	145	145	145	145
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	38.0	53.3	63.0	75.0	100.8	124.4	148.6
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.099	0.075	0.057	0.041	0.034	0.028	0.021
E5-06	Motor d axis inductance	mH	4.07	3.29	2.53	2.02	1.75	1.18	0.99
E5-07	Motor q axis inductance	mH	5.25	4.57	3.01	2.70	2.17	1.84	1.54
E5-09	Motor generation voltage constant	mV·sec/rad	316.6	332.2	313.4	326.1	369.0	323.1	331.7

Constant No.	Name	Unit	Factory setting
E5-02	Motor rated capacity	kW	55.00
E5-01	Motor capacity selection	-	10E
E1-04	Max. speed	min ⁻¹	1450
E1-06	Base speed	min ⁻¹	1450
E1-09	Min. speed	min ⁻¹	145
E1-13	Base voltage	V	190.0
E5-03	Motor rated current	A	172.7
E5-04	Number of motor poles	pole	6
E5-05	Motor armature resistance	Ω	0.016
E5-06	Motor d axis inductance	mH	0.83
E5-07	Motor q axis inductance	mH	1.30
E5-09	Motor generation voltage constant	mV·sec/rad	362.8

■ 400 V Class Standard Motor for Open-loop Vector Control (1450 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	120	121	122	123	124	126	127
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	145	145	145	145	145	145	145
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	0.89	1.50	2.70	4.10	6.70	9.80	13.30
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	17.620	7.421	4.825	2.656	1.353	0.999	0.713
E5-06	Motor d axis inductance	mH	106.50	85.11	58.87	46.42	31.73	26.20	27.06
E5-07	Motor q axis inductance	mH	166.80	113.19	80.59	60.32	40.45	30.94	33.45
E5-09	Motor generation voltage constant	mV·sec/rad	525.2	566.9	592.2	579.4	586.4	612.1	640.4

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	128	129	12A	12B	12C	12D	12E
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	145	145	145	145	145	145	145
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	18.7	26.3	31.6	36.1	49.8	60.7	73.3
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.396	0.295	0.223	0.165	0.136	0.093	0.059
E5-06	Motor d axis inductance	mH	15.22	12.65	9.87	7.92	7.11	5.93	4.06
E5-07	Motor q axis inductance	mH	19.63	15.87	12.40	10.38	9.03	6.79	5.22
E5-09	Motor generation voltage constant	mV·sec/rad	643.5	650.6	635.8	728.2	735.6	770.0	727.5

Constant No.	Name	Unit	Factory setting				
E5-02	Motor rated capacity	kW	55.00	75.00	90.00	110.00	132.00
E5-01	Motor capacity selection	-	12F	130	131	132	133
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	145	145	145	145	145
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	89.8	127.0	148.0	181.0	214.0
E5-04	Number of motor poles	pole	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.048	0.027	0.023	0.018	0.010
E5-06	Motor d axis inductance	mH	3.39	2.19	2.11	1.76	1.20
E5-07	Motor q axis inductance	mH	4.66	3.64	3.27	2.72	1.88
E5-09	Motor generation voltage constant	mV·sec/rad	716.5	651.6	707.7	709.1	706.2

■ 200 V Class Standard Motor for Open-loop Vector Control (1150 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	200	201	202	203	204	205	206
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	115	115	115	115	115	115	115
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	1.74	3.17	5.90	8.84	13.70	18.60	25.80
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	6.763	3.660	1.480	0.696	0.412	0.414	0.262
E5-06	Motor d axis inductance	mH	42.88	28.59	17.64	10.40	7.94	10.60	7.53
E5-07	Motor q axis inductance	mH	67.17	44.78	24.23	14.85	11.86	14.92	10.97
E5-09	Motor generation voltage constant	mV·sec/rad	333.3	337.7	365.5	356.2	359.2	428.2	410.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	207	208	209	20A	20B	20C	20D
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	115	115	115	115	115	115	115
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	38.6	53.4	63.8	74.1	100.6	124.7	148.9
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.149	0.084	0.083	0.048	0.046	0.032	0.021
E5-06	Motor d axis inductance	mH	4.49	3.83	2.78	2.38	1.91	1.47	1.09
E5-07	Motor q axis inductance	mH	6.82	4.65	4.39	3.15	2.98	2.30	1.70
E5-09	Motor generation voltage constant	mV·sec/rad	389.8	387.6	392.6	453.2	411.2	405.5	414.7

■400V Class Standard Motor for Open-loop Vector Control (1150 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	220	221	222	223	224	226	227
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	115	115	115	115	115	115	115
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	0.87	1.59	2.95	4.42	6.80	9.70	12.60
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	27.050	14.640	5.921	2.783	1.480	1.220	0.655
E5-06	Motor d axis inductance	mH	171.50	114.40	70.56	41.61	38.39	45.97	25.46
E5-07	Motor q axis inductance	mH	268.70	179.10	96.90	59.41	47.65	56.26	33.63
E5-09	Motor generation voltage constant	mV·sec/rad	666.9	675.5	731.0	712.4	792.7	859.9	820.2

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	228	229	22A	22B	22C	22D	22E
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	115	115	115	115	115	115	115
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	19.1	26.7	31.9	37.0	49.4	62.3	74.4
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.443	0.334	0.332	0.261	0.134	0.129	0.086
E5-06	Motor d axis inductance	mH	18.84	15.27	11.10	9.41	8.04	5.89	4.36
E5-07	Motor q axis inductance	mH	24.68	18.56	17.56	14.89	9.63	9.18	6.80
E5-09	Motor generation voltage constant	mV·sec/rad	805.4	796.4	785.1	811.4	897.6	811.0	829.6

Constant No.	Name	Unit	Factory setting			
E5-02	Motor rated capacity	kW	55.00	75.00	90.00	110.00
E5-01	Motor capacity selection	-	22F	230	231	232
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	115	115	115	115
E1-13	Base voltage	V	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	90.6	127.0	151.0	181.0
E5-04	Number of motor poles	pole	6	6	6	6
E5-05	Motor armature resistance	Ω	0.049	0.032	0.026	0.015
E5-06	Motor d axis inductance	mH	3.89	2.87	2.53	1.79
E5-07	Motor q axis inductance	mH	6.46	4.45	3.92	2.80
E5-09	Motor generation voltage constant	mV·sec/rad	868.5	825.5	850.8	863.3

■ 200 V Class Standard Motor for Flux vector control (1750 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	000	001	002	003	004	005	006
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	1.60	3.20	6.00	8.20	13.40	18.80	25.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	2.236	1.146	0.774	0.475	0.237	0.268	0.161
E5-06	Motor d axis inductance	mH	16.75	10.30	6.13	6.63	4.45	4.98	3.30
E5-07	Motor q axis inductance	mH	27.63	16.68	10.05	10.35	6.90	7.30	4.93
E5-09	Motor generation voltage constant	mV·sec/rad	211.0	208.0	226.0	235.5	245.0	251.0	241.5

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	007	008	009	00A	00B	00C	00D
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	38.0	52.0	64.0	74.0	99.0	126.0	149.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.110	0.071	0.049	0.040	0.030	0.019	0.013
E5-06	Motor d axis inductance	mH	3.40	2.41	1.86	1.66	1.15	0.81	0.68
E5-07	Motor q axis inductance	mH	4.78	3.45	2.70	2.41	1.64	1.17	1.03
E5-09	Motor generation voltage constant	mV·sec/rad	262.5	257.5	251.0	262.5	285.0	277.0	275.0

Constant No.	Name	Unit	Factory setting	
E5-02	Motor rated capacity	kW	55.00	75.00
E5-01	Motor capacity selection	-	00E	00F
E1-04	Max. speed	min ⁻¹	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750
E1-09	Min. speed	min ⁻¹	30	30
E1-13	Base voltage	V	190.0	190.0
E5-03	Motor rated current	A	186.0	252.0
E5-04	Number of motor poles	pole	6	6
E5-05	Motor armature resistance	Ω	0.009	0.006
E5-06	Motor d axis inductance	mH	0.51	0.37
E5-07	Motor q axis inductance	mH	0.79	0.57
E5-09	Motor generation voltage constant	mV·sec/rad	267.0	267.0

■400V Class Standard Motor for Flux vector control (1750 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	020	021	022	023	024	026	027
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	0.80	1.60	3.00	4.10	6.70	9.40	12.50
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	8.945	4.584	3.095	1.901	0.949	1.070	0.645
E5-06	Motor d axis inductance	mH	67.00	41.20	24.50	26.50	17.80	19.90	13.20
E5-07	Motor q axis inductance	mH	110.50	66.70	40.20	41.40	27.60	29.20	19.70
E5-09	Motor generation voltage constant	mV·sec/rad	422.0	416.0	452.0	471.0	490.0	502.0	483.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	028	029	02A	02B	02C	02D	02E
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	19.0	26.0	32.0	37.0	49.5	63.0	74.5
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.438	0.283	0.194	0.161	0.118	0.077	0.052
E5-06	Motor d axis inductance	mH	13.60	9.63	7.43	6.65	4.58	3.22	2.70
E5-07	Motor q axis inductance	mH	19.10	13.80	10.80	9.65	6.54	4.68	4.10
E5-09	Motor generation voltage constant	mV·sec/rad	525.0	515.0	502.0	525.0	570.0	554.0	550.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	55.00	75.00	90.00	110.00	132.00	160.00	200.00
E5-01	Motor capacity selection	-	02F	030	031	032	033	034	035
E1-04	Max. speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750	1750	1750	1750	1750	1750
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V000000	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	93.0	126.0	145.0	180.0	220.0	260.0	340.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.036	0.023	0.019	0.016	0.011	0.008	0.004
E5-06	Motor d axis inductance	mH	2.04	1.46	1.46	1.40	1.08	0.88	0.62
E5-07	Motor q axis inductance	mH	3.14	2.27	2.38	2.05	1.59	1.42	1.00
E5-09	Motor generation voltage constant	mV·sec/rad	534.0	534.0	545.0	614.0	563.0	613.0	588.0

Constant No.	Name	Unit	Factory setting	
E5-02	Motor rated capacity	kW	250.00	300.00
E5-01	Motor capacity selection	-	036	037
E1-04	Max. speed	min ⁻¹	1750	1750
E1-06	Base speed	min ⁻¹	1750	1750
E1-09	Min. speed	min ⁻¹	30	30
E1-13	Base voltage	V	380.0	380.0
E5-03	Motor rated current	A	420.0	500.0
E5-04	Number of motor poles	pole	6	6
E5-05	Motor armature resistance	Ω	0.004	0.002
E5-06	Motor d axis inductance	mH	0.68	0.41
E5-07	Motor q axis inductance	mH	0.79	0.57
E5-09	Motor generation voltage constant	mV·sec/rad	607.0	505.0

■ 200 V Class Standard Motor for Flux vector control (1450 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	100	101	102	103	104	105	106
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	1.50	3.00	5.40	8.00	13.80	19.40	26.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	3.160	1.834	0.686	0.305	0.378	0.278	0.176
E5-06	Motor d axis inductance	mH	23.68	17.13	9.10	5.65	6.90	5.93	5.53
E5-07	Motor q axis inductance	mH	33.75	26.75	14.48	8.90	10.20	9.05	8.10
E5-09	Motor generation voltage constant	mV·sec/rad	258.0	268.0	282.5	271.5	302.0	322.0	334.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	107	108	109	10A	10B	10C	10D
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	39.0	53.0	66.0	73.0	101.0	127.0	151.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.057	0.073	0.055	0.047	0.033	0.023	0.018
E5-06	Motor d axis inductance	mH	3.35	2.80	2.23	1.79	1.43	1.20	0.84
E5-07	Motor q axis inductance	mH	4.90	3.95	3.15	2.55	1.96	1.70	1.25
E5-09	Motor generation voltage constant	mV·sec/rad	303.5	310.5	303.5	369.5	369.5	367.0	344.0

Constant No.	Name	Unit	Factory setting	
E5-02	Motor rated capacity	kW	55.00	75.00
E5-01	Motor capacity selection	-	10E	10F
E1-04	Max. speed	min ⁻¹	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450
E1-09	Min. speed	min ⁻¹	30	30
E1-13	Base voltage	V	190.0	190.0
E5-03	Motor rated current	A	184.0	240.0
E5-04	Number of motor poles	pole	6	6
E5-05	Motor armature resistance	Ω	0.012	0.007
E5-06	Motor d axis inductance	mH	0.72	0.53
E5-07	Motor q axis inductance	mH	1.09	0.86
E5-09	Motor generation voltage constant	mV·sec/rad	374.5	327.0

■ 400 V Class Standard Motor for Flux vector control (1450 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	120	121	122	123	124	126	127
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	0.75	1.50	2.70	4.00	6.90	9.70	13.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	12.640	7.336	2.745	1.220	1.511	1.113	0.704
E5-06	Motor d axis inductance	mH	94.70	68.50	36.40	22.60	27.60	23.70	22.10
E5-07	Motor q axis inductance	mH	135.00	107.00	57.90	35.60	40.80	36.20	32.40
E5-09	Motor generation voltage constant	mV·sec/rad	516.0	536.0	565.0	543.0	604.0	644.0	668.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	128	129	12A	12B	12C	12D	12E
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	19.5	26.5	33.0	36.5	50.5	63.5	75.5
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.228	0.292	0.220	0.188	0.133	0.091	0.072
E5-06	Motor d axis inductance	mH	13.40	11.20	8.90	7.15	5.70	4.78	3.37
E5-07	Motor q axis inductance	mH	19.60	15.80	12.60	10.20	7.83	6.78	5.00
E5-09	Motor generation voltage constant	mV·sec/rad	607.0	621.0	607.0	739.0	739.0	734.0	688.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	55.00	75.00	90.00	110.00	132.00	160.00	200.00
E5-01	Motor capacity selection	-	12F	130	131	132	133	134	135
E1-04	Max. speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-06	Base speed	min ⁻¹	1450	1450	1450	1450	1450	1450	1450
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	92.0	120.0	145.0	184.0	215.0	255.0	340.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.047	0.028	0.024	0.015	0.011	0.007	0.006
E5-06	Motor d axis inductance	mH	2.86	2.11	2.02	1.36	1.11	0.85	0.94
E5-07	Motor q axis inductance	mH	4.36	3.43	2.89	2.08	1.84	1.51	1.14
E5-09	Motor generation voltage constant	mV·sec/rad	749.0	654.0	738.0	664.0	705.0	686.0	708.0

Constant No.	Name	Unit	Factory setting
E5-02	Motor rated capacity	kW	250.00
E5-01	Motor capacity selection	-	136
E1-04	Max. speed	min ⁻¹	1450
E1-06	Base speed	min ⁻¹	1450
E1-09	Min. speed	min ⁻¹	30
E1-13	Base voltage	V	380.0
E5-03	Motor rated current	A	420.0
E5-04	Number of motor poles	pole	6
E5-05	Motor armature resistance	Ω	0.003
E5-06	Motor d axis inductance	mH	0.64
E5-07	Motor q axis inductance	mH	0.87
E5-09	Motor generation voltage constant	mV·sec/rad	674.0

■ 200 V Class Standard Motor for Flux vector control (1150 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	200	201	202	203	204	205	206
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	1.50	2.80	5.60	8.40	13.40	19.20	26.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	2.708	1.511	1.084	0.540	0.358	0.299	0.162
E5-06	Motor d axis inductance	mH	25.25	16.15	14.33	10.00	7.48	9.15	5.45
E5-07	Motor q axis inductance	mH	41.50	26.00	21.68	15.68	11.45	13.50	8.58
E5-09	Motor generation voltage constant	mV·sec/rad	327.5	328.5	353.5	362.5	362.5	430.0	386.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	207	208	209	20A	20B	20C	20D
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E5-03	Motor rated current	A	40.0	54.0	63.0	75.0	100.0	126.0	150.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.129	0.081	0.065	0.052	0.036	0.026	0.019
E5-06	Motor d axis inductance	mH	4.20	3.35	2.58	2.23	1.87	1.50	1.18
E5-07	Motor q axis inductance	mH	6.33	4.90	3.73	3.28	2.73	2.17	1.80
E5-09	Motor generation voltage constant	mV·sec/rad	379.0	372.5	443.0	461.5	458.5	458.5	481.5

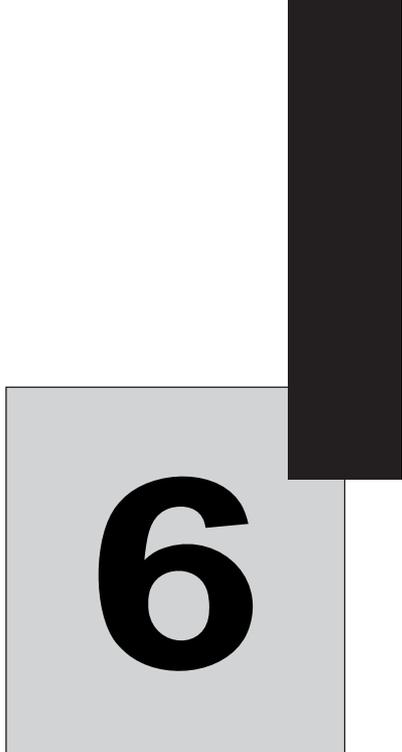
Constant No.	Name	Unit	Factory setting	
E5-02	Motor rated capacity	kW	55.00	75.00
E5-01	Motor capacity selection	-	20E	20F
E1-04	Max. speed	min ⁻¹	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150
E1-09	Min. speed	min ⁻¹	30	30
E1-13	Base voltage	V	190.0	190.0
E5-03	Motor rated current	A	179.0	250.0
E5-04	Number of motor poles	pole	6	6
E5-05	Motor armature resistance	Ω	0.013	0.008
E5-06	Motor d axis inductance	mH	0.94	0.69
E5-07	Motor q axis inductance	mH	1.51	1.02
E5-09	Motor generation voltage constant	mV·sec/rad	436.0	430.5

■ 400 V Class Standard Motor for Flux vector control (1150 min⁻¹)

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	0.40	0.75	1.50	2.20	3.70	5.50	7.50
E5-01	Motor capacity selection	-	220	221	222	223	224	226	227
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	0.75	1.40	2.80	4.20	6.70	9.60	13.00
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	10.830	6.044	4.336	2.161	1.431	1.197	0.648
E5-06	Motor d axis inductance	mH	101.00	64.60	57.32	40.00	29.90	36.60	21.80
E5-07	Motor q axis inductance	mH	166.00	104.00	86.70	62.72	45.80	54.00	34.30
E5-09	Motor generation voltage constant	mV·sec/rad	655.0	657.0	707.0	725.0	725.0	860.0	772.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	11.00	15.00	18.50	22.00	30.00	37.00	45.00
E5-01	Motor capacity selection	-	228	229	22A	22B	22C	22D	22E
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	20.0	27.0	31.5	37.5	50.0	63.0	75.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.517	0.325	0.261	0.207	0.142	0.104	0.074
E5-06	Motor d axis inductance	mH	16.80	13.40	10.30	8.90	7.49	5.99	4.73
E5-07	Motor q axis inductance	mH	25.30	19.60	14.90	13.10	10.90	8.67	7.18
E5-09	Motor generation voltage constant	mV·sec/rad	758.0	745.0	886.0	923.0	917.0	917.0	963.0

Constant No.	Name	Unit	Factory setting						
E5-02	Motor rated capacity	kW	55.00	75.00	90.00	110.00	132.00	160.00	200.00
E5-01	Motor capacity selection	-	22F	230	231	232	233	234	235
E1-04	Max. speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-06	Base speed	min ⁻¹	1150	1150	1150	1150	1150	1150	1150
E1-09	Min. speed	min ⁻¹	30	30	30	30	30	30	30
E1-13	Base voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E5-03	Motor rated current	A	89.5	125.0	150.0	180.0	215.0	250.0	320.0
E5-04	Number of motor poles	pole	6	6	6	6	6	6	6
E5-05	Motor armature resistance	Ω	0.051	0.033	0.026	0.015	0.012	0.009	0.007
E5-06	Motor d axis inductance	mH	3.74	2.75	2.42	1.66	1.39	1.55	1.25
E5-07	Motor q axis inductance	mH	6.02	4.07	3.61	2.73	2.28	1.92	1.53
E5-09	Motor generation voltage constant	mV·sec/rad	872.0	861.0	885.0	862.0	882.0	911.0	944.0



6

Constant Settings by Function

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Application and Overload Selections

◆ Select the Overload to Suit the Application

Set C6-01 (CT: Low carrier constant torque, VT: High carrier variable torque) depending on the application for which the Inverter is used. The setting ranges for the Inverter carrier frequency, and overload tolerance depend on the setting in C6-01.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
C6-01	CT/VT selection	0: Low carrier, constant torque (CT) 1: High carrier, variable torque (VT)	0 or 1 *3	1 *5	No	No	Q	Q	223H	4-5 4-28 6-2
C6-02	Carrier frequency selection	Select carrier frequency.*2 1: 2 kHz 2: 4 kHz 3: 6 kHz 4: 8 kHz 6: 12 kHz	1 or 2	2 *1 *5 *8	No	No	A	A	224H	4-27 6-2
			1 to 6 *4 *6 *7							

* 1. The setting value will return to the factory setting if the control method is changed. (The factory settings for open-loop vector control for PM are given.)

* 2. Inverter rated current will be reduced if increasing the carrier frequency.

Be careful because the possibility of an inverter OL error increases as the carrier frequency is increased.

* 3. With 400 V Class Inverters of 220 kW or 300 kW, C6-01 cannot be set to 0 (CT).

* 4. The setting range vary in accordance with the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

* 5. The factory settings vary in accordance with the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

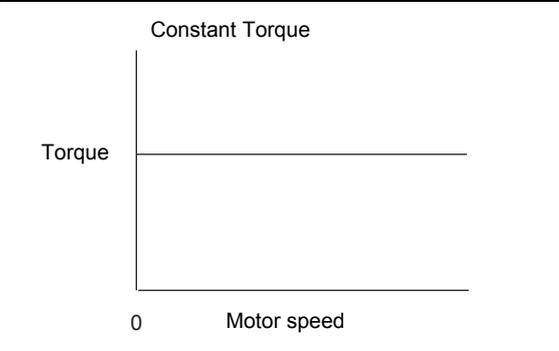
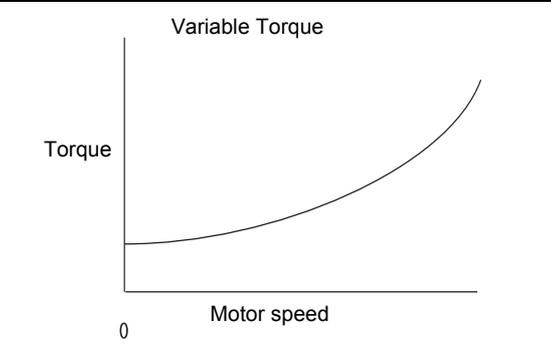
* 6. For open-loop vector control for PM, the setting range is 1 to 4.

* 7. The setting ranges vary in accordance with the setting of C6-01 (CT/VT selection). If C6-01 is set to 0 (CT), C6-02 can only be set to 1 (2 kHz).

* 8. The factory settings vary in accordance with the setting of C6-01 (CT/VT selection). If C6-01 is set to 0 (CT), the factory setting is 1 (2 kHz).

■ Difference Between CT and VT

The characteristics of CT (low carrier, constant torque) and VT (high carrier, variable torque) are shown below.

CT: Low Carrier, Constant Torque	VT: High Carrier, Variable Torque
 <p>Constant Torque</p> <p>Torque</p> <p>0 Motor speed</p>	 <p>Variable Torque</p> <p>Torque</p> <p>0 Motor speed</p>
<p>Constant torque means a constant load torque for all motor speed, and it requires overload resistance capability. Applications include pushers, conveyors, cranes, and other friction or heavy loads.</p>	<p>Variable torque means that the load torque will decrease as the speed decreases. Normally, overload resistance capability is not required. Applications include fans and pumps.</p>
<p>Low carrier: Electromagnetic noise is present.</p>	<p>High carrier: Electromagnetic noise is not present.</p>

■ Setting Precautions

C6-01 (CT/VT Selection)

When setting C6-01, observe the following precautions.

- Depending on the set value in C6-01, the setting range of the related constants is limited as follows:

C6-01 Set Value	0 (Low Carrier, Constant Torque)	1 (High Carrier, Variable Torque)
Inverter Overload Protection Level	150% Inverter rated current/1 min.	120% Inverter rated current/1 min.
C6-02 (Carrier Frequency Selection)	1: Carrier 2.0 kHz	1: Carrier 2.0 kHz * 2: Carrier 4.0 kHz 3: Carrier 6.0 kHz 4: Carrier 8.0 kHz 6: Carrier 12.0 kHz

* The factory setting vary in accordance with the control method and the Inverter capacity.

Carrier Frequency

When selecting the carrier frequency, observe the following precautions items.

- When using a device with C6-01 set to 1 (VT), adjust the carrier frequency according to the cases shown below.

If the wiring distance between Inverter and motor is long: Set the carrier frequency low. (Use the following values as guidelines.

Wiring Length	50 m or less	100 m or less	Over 100 m
C6-02 (carrier frequency) setting	0 to 6 (12 kHz)	0 to 4 (8 kHz)	0 to 2 (4 kHz)

Note With open-loop vector control for PM (A1-02 = 7), the maximum length of the cable between the Inverter and the motor is 100 m, and the maximum carrier frequency is 4 kHz. If not, the performance of the motor might be abnormal.

If speed and torque are inconsistent at low speeds: Set the carrier frequency low.

If Inverter noise is affecting peripheral devices: Set the carrier frequency low.

If leakage current from the Inverter is large: Set the carrier frequency low.

If metallic noise from the motor is large: Set the carrier frequency high.

- For applications with repetitive loads (cranes, elevators, presses, washing machines, etc.), if a current exceeding 125% of the Inverter rated current or more flows repeatedly, the IGBT in the Inverter will be subject to heat stress, resulting in a shortened life span. In this case, select CT instead of VT and reduce the load, lengthen the acceleration/deceleration time, or increase the frame size of the Inverter so that the peak current for repetitive operation will drop to less than 125% of the Inverter rated current. If performing a trial operation with repetitive loads, make sure that the peak current for repetitive operation is less than 125% of the Inverter rated current.
- If particularly low noise is not required, do not increase the Inverter's carrier frequency to reduce the influence of heat stress.

Carrier frequency upper limit depends on the Inverter capacity. Refer to *Factory Settings that Change with the Inverter Capacity (o2-04)* on page 5-70.

Carrier Frequency and Inverter Overload Current Level

When C6-01 is set to 1, the Inverter overload level will be reduced. Even when the overload current falls to below 120% constant 1 min, OL2 (Inverter overload) will be detected. The Inverter overload current reduction level is shown below.

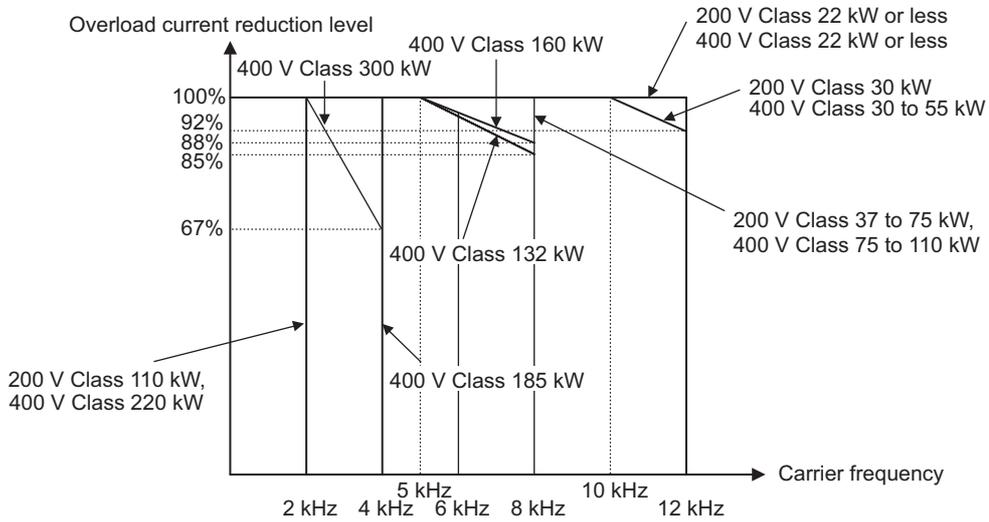


Fig 6.1 Overload Current Reduction Level for Flux Vector Control for PM

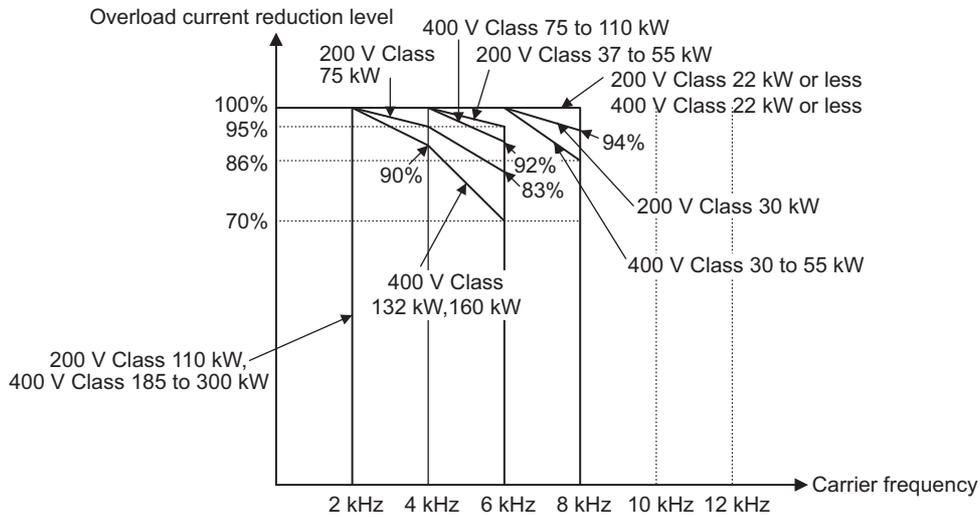


Fig 6.2 Overload Current Reduction Level for Open-loop Vector Control for PM

Speed Reference

This section explains how to input the speed reference.

◆ Selecting the Speed Reference Source

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

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b1-01	Reference selection	Set the speed reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H
H6-01	Pulse train input function selection	0: Speed reference 1: PID feedback value 2: PID target value	0 to 2	0	No	No	A	A	42CH
H6-02	Pulse train input scaling	Set the number of pulses in hertz, taking the reference to be 100%.	1000 to 32000	1440 Hz	Yes	No	A	A	42DH

■ Input the Speed Reference from the Digital Operator

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

Input the frequency reference from the Digital Operator's speed reference setting display.

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



Fig 6.3 Speed Setting Display

■ Inputting the Speed Reference Using Control Circuit Terminal (Analog Setting)

When b1-01 is set to 1, you can input the speed reference from control circuit terminal A1 (voltage input), control circuit terminal A2 (voltage or current input) or control circuit terminal A3 (voltage input).

Inputting Master Speed Reference Only (Voltage Input)

When inputting a voltage for the master speed reference, input the voltage to control circuit terminal A1.

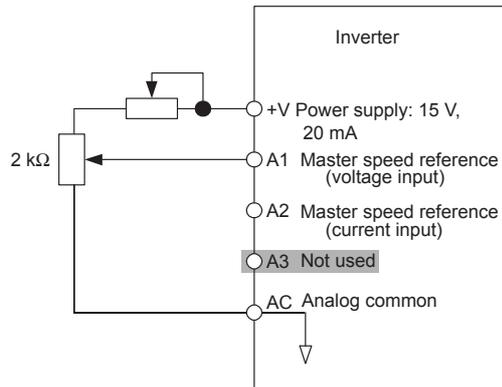


Fig 6.4 Voltage Input for Master Speed Reference

Inputting Master Speed Reference Only (Current Input)

When inputting a current for the master speed reference, input the current to control circuit terminal A2, input 0 V to terminal A1, and make either of the following settings.

- Set H3-08 (Multi-function analog input terminal A2 signal level selection) to 2 (current input), and set H3-09 (Multi-function analog input terminal A2 function selection) to 0 (Add to terminal A1).
- Set H3-09 (Multi-function analog input terminal A2 function selection) to 2 (Auxiliary speed reference 1), and set H3-13 (Terminal A1/A2 switching) to 1 (Use terminal A2 analog input as the main speed reference).

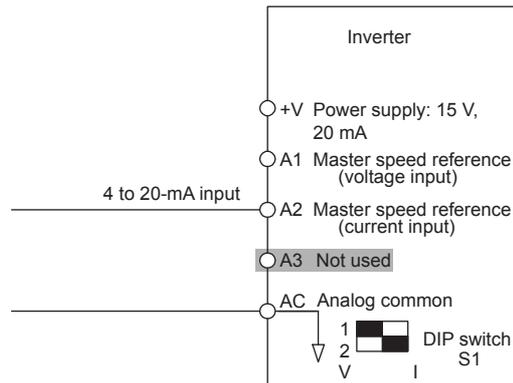


Fig 6.5 Current Input for Master Speed Reference



Turn ON pin 2 of DIP switch S1 (toward I), the voltage/current switch, when inputting a current to terminal A2. Turn OFF pin 2 of DIP switch S1 (toward V), the voltage/current switch, when inputting a voltage to terminal A2. Set H3-08 to the correct setting for the type of input signal being used.

Switch between 2 Step Speeds: Master/Auxiliary Speeds

When switching between the master and auxiliary speeds, input the master speed reference to control circuit terminal A1 and the auxiliary speed reference to control circuit terminal A2 or A3. The master speed reference input to terminal A1 will be used for the Inverter speed reference when the master speed reference 1 allocated to multi-function input terminal (factory setting: S5) is OFF, and the auxiliary speed reference input to terminal A2 or A3 will be used for the Inverter speed reference when the multi-speed reference 1 allocated to multi-function input terminal is ON.

When using terminal A2 as the input terminal of auxiliary speed reference, set H3-09 (Multi-function analog input terminal A2 function selection) to 2 [Auxiliary speed reference (2nd speed analog)].

When using terminal A3 as the input terminal of auxiliary speed reference, set H3-05 (Multi-function analog input terminal A3 function selection) to 2 [Auxiliary speed reference (2nd speed analog)].

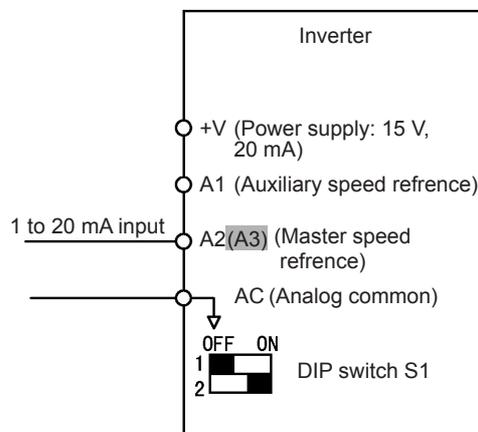


Fig 6.6 Switching between Master and Auxiliary Speeds

Precautions on Setting DIP Switches and Constants

- When inputting voltage signals to terminal A2, set the pin 2 of the current/voltage switching DIP switch S1-2 to OFF side (factory setting: ON).
- When inputting current signals to terminal A2, set the pin 2 of the current/voltage switching DIP switch S1-2 to ON side (factory setting: ON).
- When setting terminal A2 as the master speed input terminal and terminal A1 as the auxiliary speed input terminal, set the H3-09 (Multi-function analog input terminal A2 function selection) to 2 and H3-05 (Multi-function analog input terminal A3 function selection) to a number other than 0 and H3-05 (Multi-function analog input terminal A3 function selection) to a number other than 0 and 2. And then, set H3-13 (Terminal A1/A2 switching) to 1.
- H3-09 and H3-05 cannot be set to 2 at the same time.

■ Setting Speed Reference Using Pulse Train Signals

When b1-01 is set to 4, the pulse train input to control circuit terminal RP is used as the speed reference.

Set H6-01 (Pulse Train Input Function Selection) to 0 (speed reference), and then set the 100% reference pulse frequency to H6-02 (Pulse Train Input Scaling).

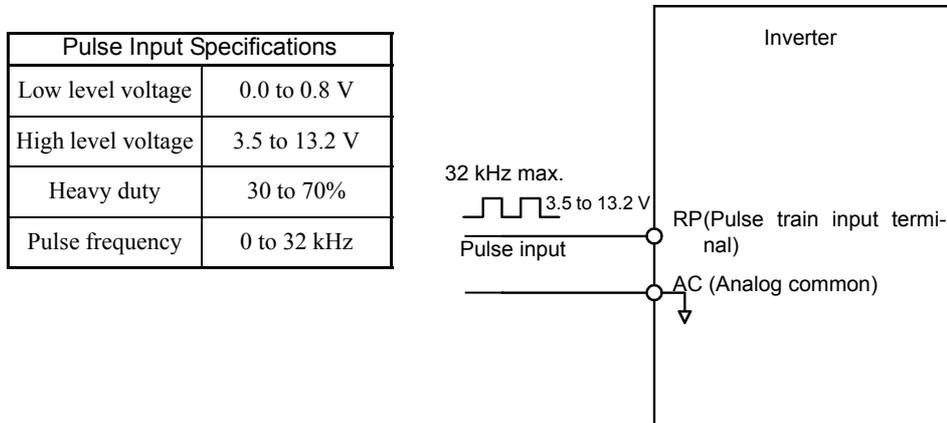


Fig 6.7 Speed Reference Using Pulse Train Input

◆ Using Multi-Step Speed Operation

With Varispeed-F7 series Inverters, you can change the speed to a maximum of 17 steps, using 16 speed references, and one jog speed reference.

The following example of a multi-function input terminal function shows a 9-step operation using multi-step references 1, 2 and jog speed selection functions.

■ Related Constants

To switch speed references, set multi-step speed references 1 to 3 and the jog speed reference selection in the multi-function contact inputs (any of the terminals S3 to S8). Setting examples are shown below. The unused terminals need not be set.

Multi-function Contact Inputs (H1-01 to H1-06)

Terminal	Constant Number	Set Value	Details
S5	H1-03	3	Multi-step speed reference 1 [Also used for master speed/auxiliary speed switching when multi-function analog input H3-09 or H3-05 is set to 2 (auxiliary speed reference).]
S6	H1-04	4	Multi-step speed reference 2
S7	H1-05	5	Multi-step speed reference 3
S8	H1-06	6	Jog speed selection (given priority over multi-step speed reference)

Combination of Multi-Function References and Multi-Function Contact Inputs. In the Above Setting Example

You can change the selected speed reference by combining the ON/OFF status of S5 to S8 (multi-function contact input terminals) to set multi-step speed references 1 to 3 and the jog speed selection. The following table shows the possible combinations.

Speed	TerminalS5	TerminalS6	TerminalS7	TerminalS8	Selected Frequency
	Multi-step Speed Reference 1	Multi-step Speed Reference 2	Multi-step Speed Reference 3	Jog Speed Selection	
1	OFF	OFF	OFF	OFF	Speed reference 1 d1-01, master speed
2	ON	OFF	OFF	OFF	Speed reference 2 d1-02, auxiliary speed
3	OFF	ON	OFF	OFF	Speed reference 3 d1-03
4	ON	ON	OFF	OFF	Speed reference 4 d1-04
5	OFF	OFF	ON	OFF	Speed reference 5 d1-05
6	ON	OFF	ON	OFF	Speed reference 6 d1-06
7	OFF	ON	ON	OFF	Speed reference 7 d1-07
8	ON	ON	ON	OFF	Speed reference 8 d1-08
9	-	-	-	ON*	Jog speed d1-17

* Terminal S8's jog speed selection is given priority over multi-step speed references.

Setting Precautions

Refer to the following to set step 1 and step 2 to analog inputs.

- **Step 1**

When setting terminal A1's analog input to step 1, set b1-01 to 1, and when setting d1-01 (Speed Reference 1) to step 1, set b1-01 to 0.

- **Step 2**

When setting terminal A2's (or A3's) analog input to step 2, set H3-09 (H3-05 when A3 is used) to 2 (auxiliary speed reference 1). When setting d1-02 (Speed Reference 2) to step 2, do not set H3-09 (H3-05 when A3 is used) to 2.

■ Connection Example and Time Chart

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

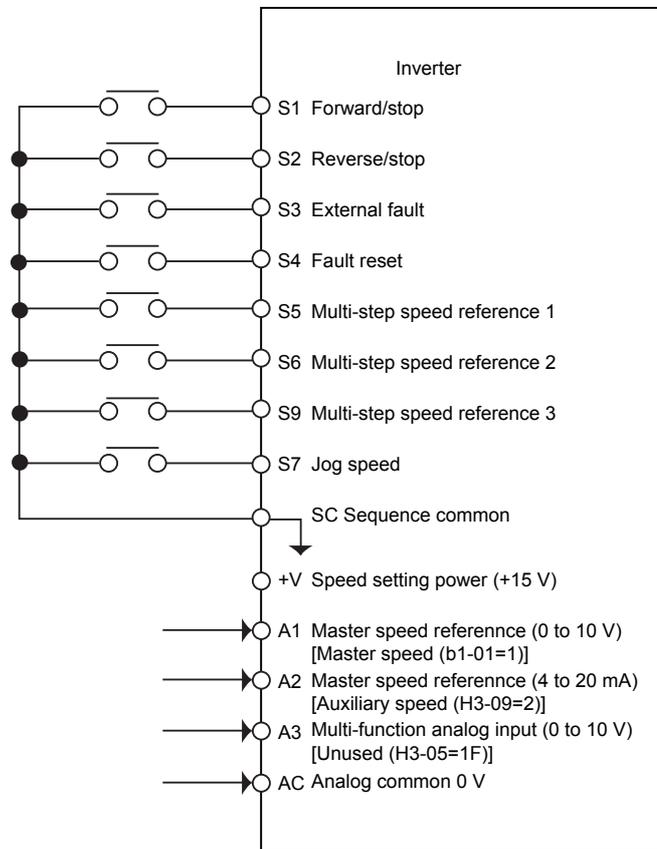


Fig 6.8 Control Circuit Terminal During 9-step Operation

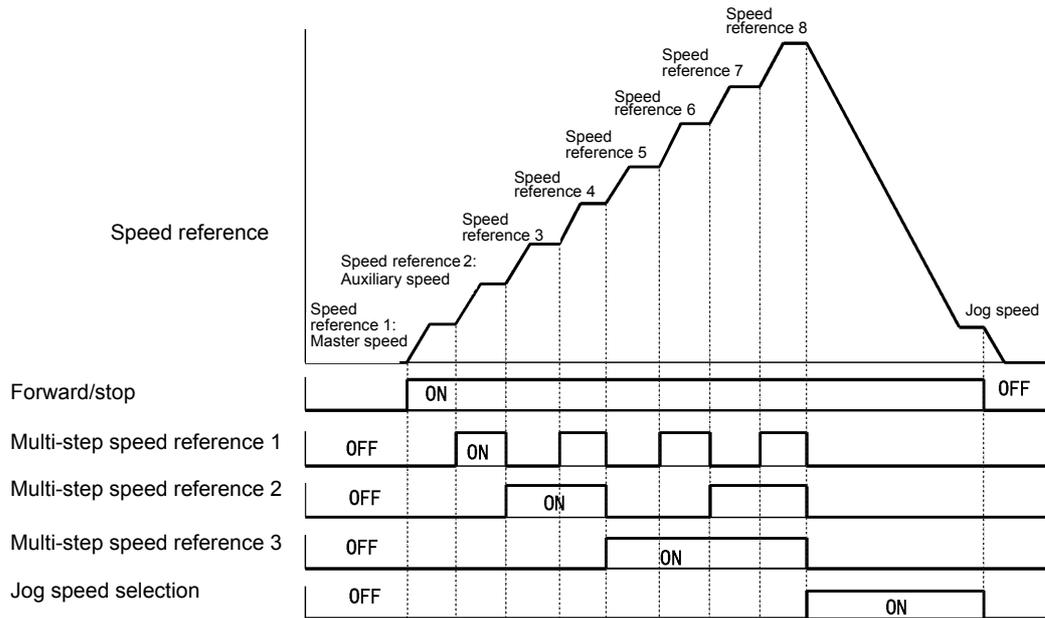


Fig 6.9 Multi-step Speed Reference/Jog Speed Selection Time Chart

◆ Varispeed F7S Function Block

The following diagram shows the function block diagram of Varispeed F7S. The shaded sections apply only to Inverters with SPEC: C or later.

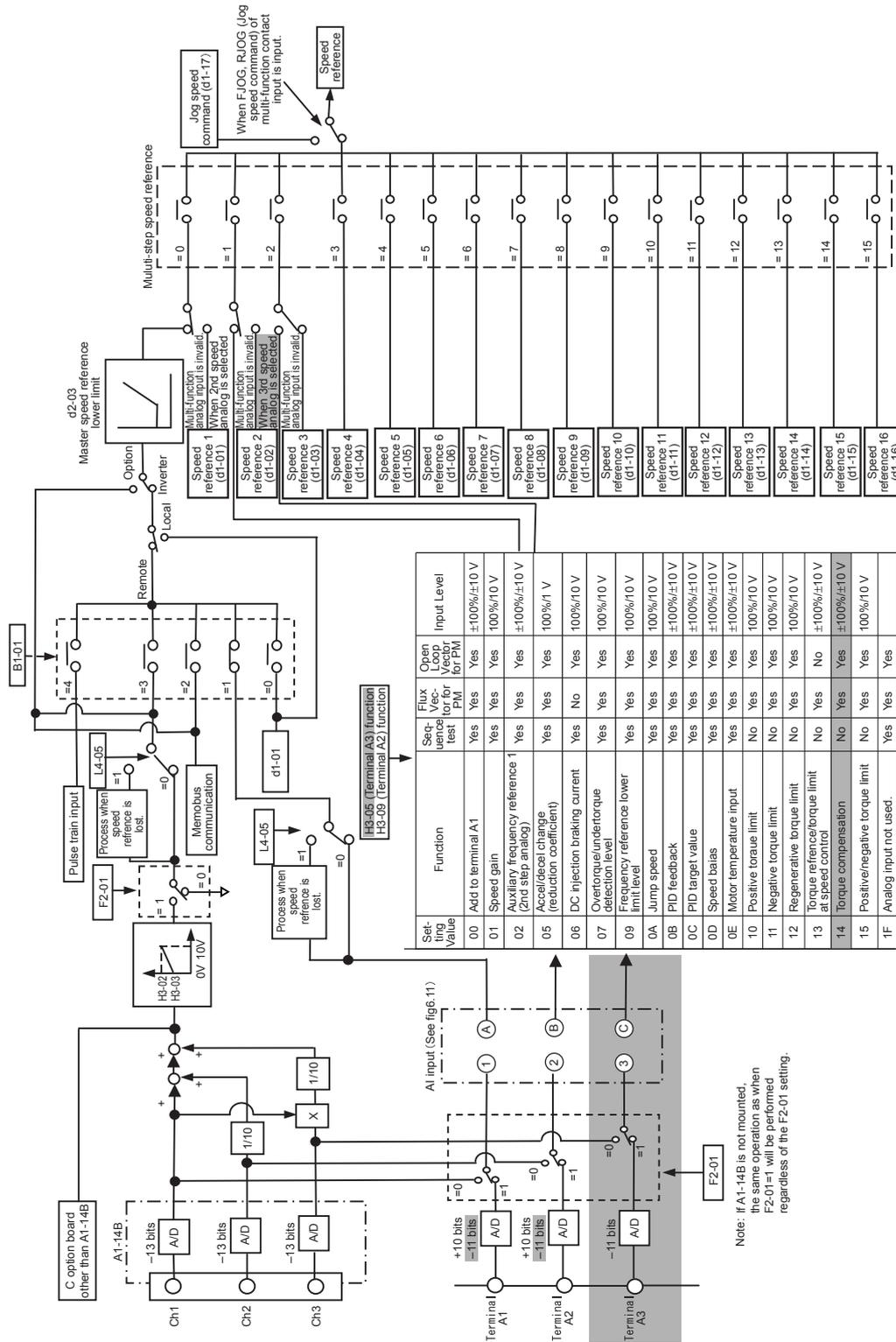
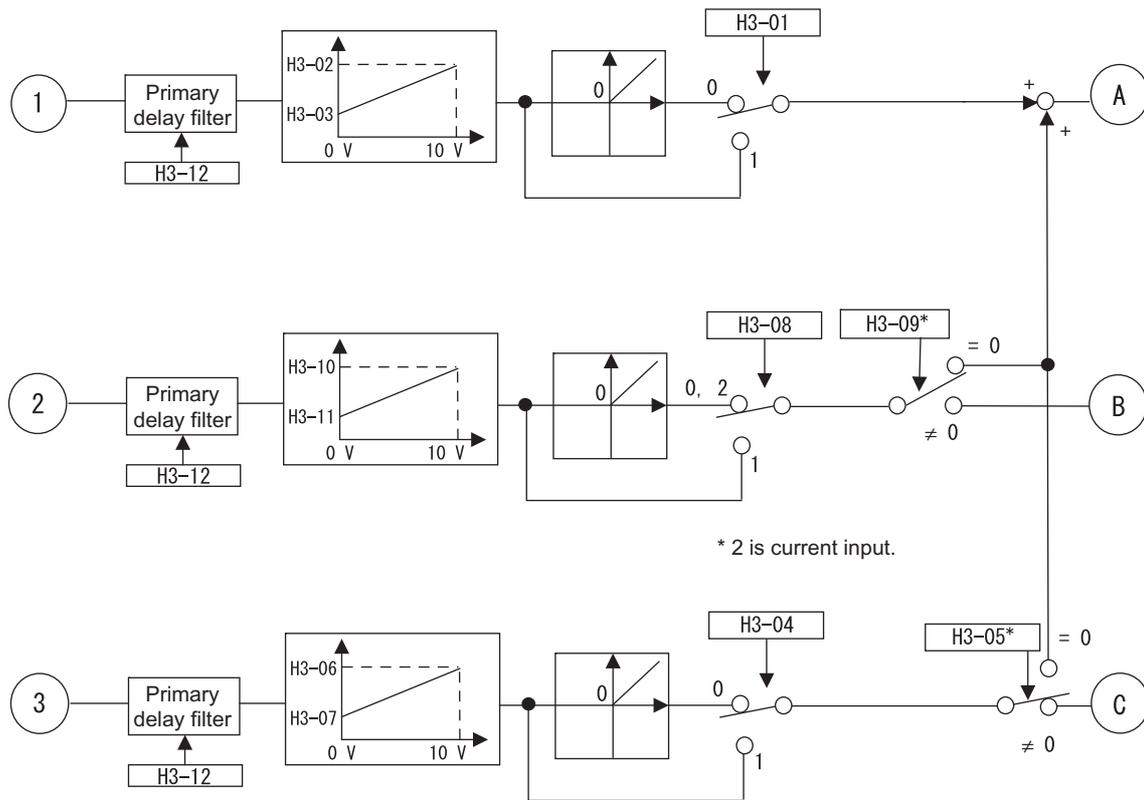


Fig 6.10 Varispeed F7S Function Block



* The same value can not be set in H3-05 and H3-09.

Fig 6.11 AI Input Detailed Diagram

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	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b1-02	Operation method selection	Set the Run Command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option card	0 to 3	1	No	Q	Q	Q	181H

■ Performing Operations Using a Digital Operator

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

■ Performing Operations Using Control Circuit Terminals

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

Performing Operations Using a 2-wire Sequence

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

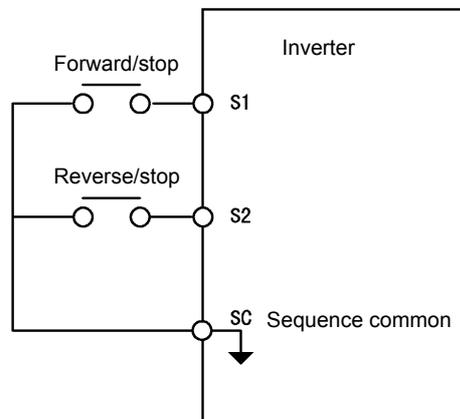


Fig 6.12 2-wire Sequence Wiring Example

Performing Operations Using a 3-wire Sequence

When any constant from H1-01 to H1-06 (multi-function contact input terminals S3 to S8) is set to 0, terminals S1 and S2 are used for a 3-wire sequence, and the multi-function input terminal that has been set functions as a Forward/Reverse Run Command terminal.

When the Inverter is initialized for 3-wire sequence control with A1-03, multi-function input 3 (terminal S5) becomes the input terminal for the Forward/Reverse Run Command.

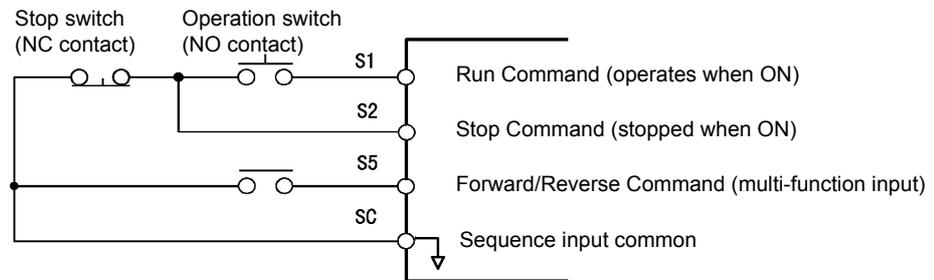


Fig 6.13 3-wire Sequence Wiring Example

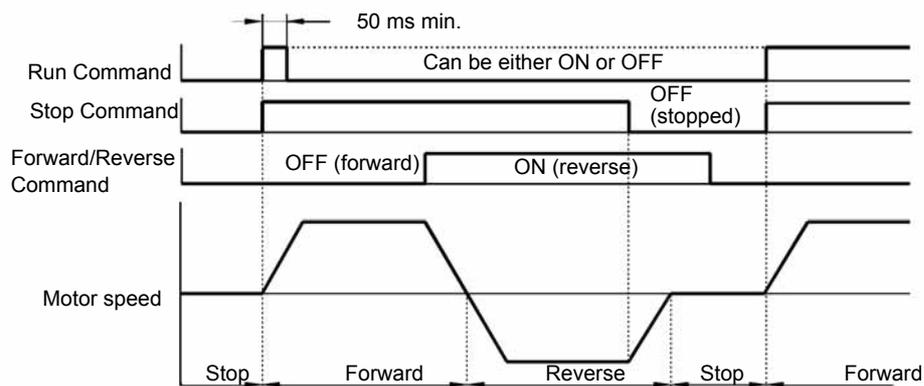


Fig 6.14 Three-wire Sequence Time Chart



INFO

1. Use a sequence that turns ON terminal S1 for 50 ms or longer for the Run Command. This will make the Run Command self-holding in the Inverter.
2. When the 3-wire sequence is set, do not make the wiring for the control circuit unless the multi-function input terminal constant is set. Failure to observe this warning may result in injury.

Stopping Methods

This section explains methods of stopping the Inverter.

◆ Selecting the Stopping Method when a Stop Command is Sent

There are three methods of stopping the Inverter when a Stop Command is sent:

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

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

■ Related Constants

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
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 3: Coast to stop with timer (Run Commands are disregarded during deceleration.)	0, 1, or 3	0	No	Q	Q	Q	182H
b1-05	Operation selection for setting E1- 09 or less	Used to set the method of operation when the speed ref- erence input is less than the minimum speed (E1-09). 0: Run at speed reference (E1-09 not effective). 1: STOP (Speeds below E1- 09 in the coast to stop state.) 2: Run at min. speed. (E1-09) 3: Run at zero-speed (Speeds below E1-09 are zero)	0 to 3	0	No	No	A	No	184H
b2-01	Zero-speed level (DC injection braking starting speed)	Sets the speed in units of 0.1% at which a baseblock will be applied if decelerating to stop.	0.0 to 10.0	1.0% *	No	No	A	A	189H

* The setting value will return to the factory setting if the control method is changed. (The factory settings for open-loop vector control for PM are given.)

Deceleration to Stop

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

If the motor speed when decelerating to a stop falls below b2-01, the baseblock will be applied.

For deceleration time settings, refer to page 6-20 *Setting Acceleration and Deceleration Times*.

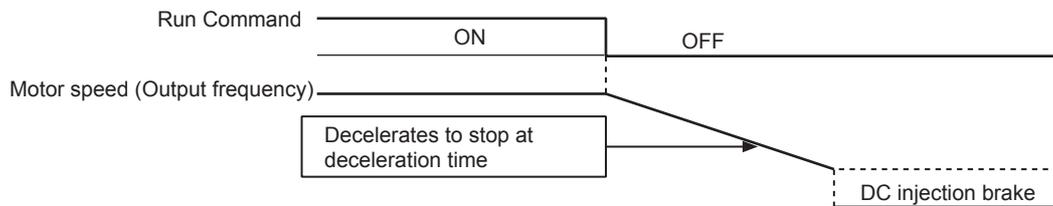


Fig 6.15 Deceleration to Stop

The following only applies to Inverters with SPEC: C or later.

The operation after starting or stopping depends on the setting of b1-05 when flux vector control for PM is selected (A1-02 = 6).

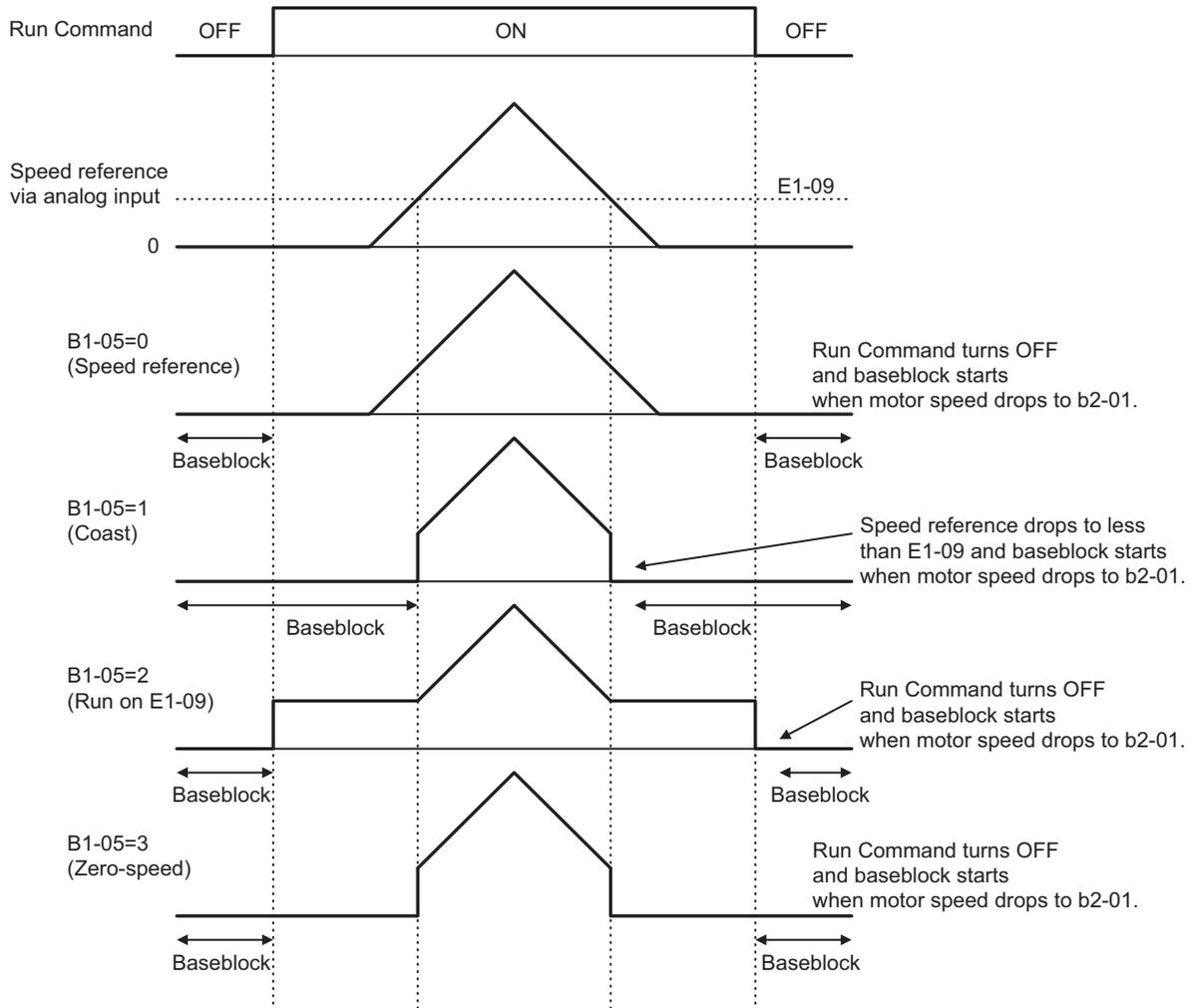


Fig 6.16 Deceleration to Stop (for Flux Vector Control for PM)

Coast to Stop

If the Stop Command is input (i.e., the Run Command is turned OFF) when b1-03 is set to 1, the Inverter output voltage is interrupted. The motor coasts to a stop at the deceleration rate that counterbalances damage to the machine and inertia including the load.

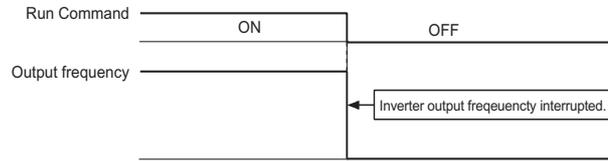


Fig 6.17 Coast to Stop



INFO

After the Stop Command is input, Run Commands are ignored until the Minimum Baseblock Time (L2-03) has elapsed.

Coast to Stop with Timer

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

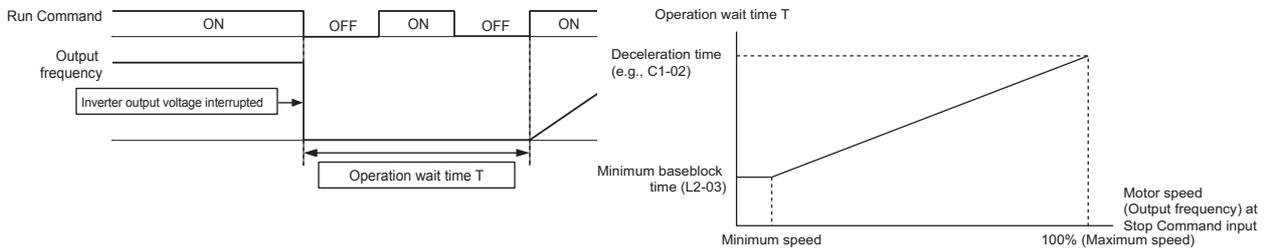


Fig 6.18 Coast to Stop with Timer

◆ Using an Emergency Stop

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

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
C1-09	Emergency stop time	The deceleration time when the multi-function input "Emergency (fast) stop" is set to ON. This function can be used as a stopping method when a fault has been detected.	0.0 to 6000.0 *1	10.0 s	No	A	A	A	208H	4-28 6-19

* The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times becomes 0.00 to 600.00 seconds.

Acceleration and Deceleration Characteristics

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

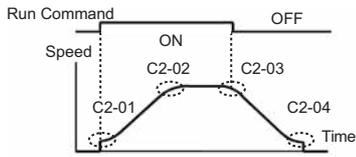
◆ Setting Acceleration and Deceleration Times

Acceleration time indicates the time taken for the motor speed (output frequency) to climb from 0% to 100% of maximum speed. Deceleration time indicates the time taken for the motor speed (output frequency) to reduce from 100% to 0% of maximum speed. The factory setting of the acceleration time is C1-01, and the factory setting of the deceleration time is C1-02.

■ Related Parameters

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
C1-01	Accelera-tion time 1	Sets the acceleration time to accelerate from 0 to the maximum speed, in 1-second units.	0.0 to 6000.0*1	10.0 s	Yes	Q	Q	Q	200H
C1-02	Decelera-tion time 1	Sets the deceleration time to decelerate from the maximum speed to 0, in 1-second units.			Yes	Q	Q	Q	201H
C1-03	Accelera-tion time 2	The acceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	A	A	202H
C1-04	Decelera-tion time 2	The deceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	A	A	203H
C1-05	Accelera-tion time 3	The acceleration time when the multi-function input “accel/decel time 2” is set to ON.			No	A	A	A	204H
C1-06	Decelera-tion time 3	The deceleration time when the multi-function input “accel/decel time 2” is set to ON.			No	A	A	A	205H
C1-07	Accelera-tion time 4	The acceleration time when the multi-function input “accel/decel time 1” and “accel/decel time 2” are set to ON.			No	A	A	A	206H
C1-08	Decelera-tion time 4	The deceleration time when the multi-function input “accel/decel time 1” and “accel/decel time 2” are set to ON.			No	A	A	A	207H
C1-10	Accel/ decel time setting unit	0: 0.01-second units 1: 0.1-second units	0 or 1	1	No	A	A	A	209H
C1-11	Accel/ decel time switching speed	Sets the speed for automatic accelera-tion/deceleration switching. Below set speed: Accel/decel time 4 Above set speed: Accel/decel time 1 The multi-function input “accel/decel time 1” or “accel/decel time 2” take priority.	0.0 to 100.0*3	0.0%*2	No	A	A	A	20AH

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
C2-01	S-curve characteristic time at acceleration start	All sections of the S-curve characteristic time are set in seconds units. When the S-curve characteristic time is set, the accel/decel times will increase by only half of the S-curve characteristic times at start and end.	0.00 to 2.50	0.00 s	No	A	A	A	20BH
C2-02	S-curve characteristic time at acceleration end		0.00 to 2.50	0.00 s	No	A	A	A	20CH
C2-03	S-curve characteristic time at deceleration start		0.00 to 2.50	0.00 s	No	A	A	A	20DH
C2-04	S-curve characteristic time at deceleration end		0.00 to 2.50	0.00 s	No	A	A	A	20EH



- * 1. The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times become 0.00 to 600.00 seconds.
- * 2. The display unit varies in accordance with the control method. (The unit for open-loop/flux vector control for PM is given. For sequence test, Hz would be displayed.)
- * 3. The setting ranges vary in accordance with the control method. (The unit for open-loop/flux vector control for PM is given. For sequence test, the setting range would be 0.0 to 400.0.)

■Setting Acceleration and Deceleration Time Units

Set the acceleration/deceleration time units using C1-10. Constant C1-10 is set to 1 at the factory.

Set value	Details
0	The acceleration/deceleration time settings range is 0.00 to 600.00 in units of 0.01 s.
1	The acceleration/deceleration time settings range is 0.00 to 6000.0 in units of 0.1 s.

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

Using the Inverter, you can set four acceleration times and four deceleration times. When the multi-function input terminals (H1-□□) are set to 7 (acceleration/deceleration time selection 1) and 1A (acceleration/deceleration time selection 2), you can switch the acceleration/deceleration time even during operation by combining the ON/OFF status of the terminals.

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

Acceleration/Deceleration Time Selection 1 Terminal	Acceleration/Deceleration Time Selection 2 Terminal	Acceleration Time	Deceleration Time
OFF	OFF	C1-01	C1-02
ON	OFF	C1-03	C1-04
OFF	ON	C1-05	C1-06
ON	ON	C1-07	C1-08

■ Switching Acceleration and Deceleration Time Automatically

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

When the motor speed (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%. If C1-11 is set to 0.0%, the function will be disabled.

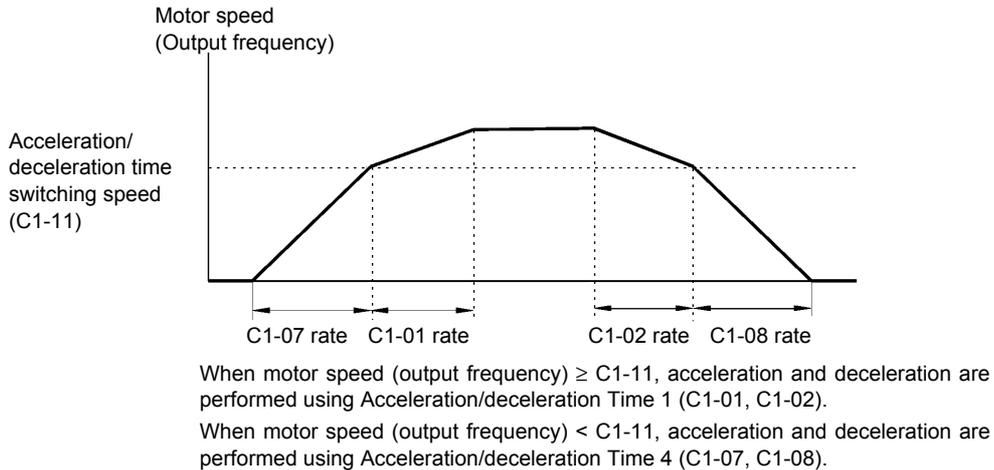


Fig 6.19 Acceleration/deceleration Time Switching Speed

■ Adjusting Acceleration and Deceleration Time Using an Analog Input

If you set H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to 5 (acceleration/deceleration time gain), you can adjust the acceleration/deceleration time using terminal A2's or A3's input voltage.

The Inverter's acceleration time when the acceleration time has been set in C1-01 is as follows:

Acceleration time = C1-01 set value \times acceleration/deceleration time gain

Acceleration/deceleration time gain (set value: 5)

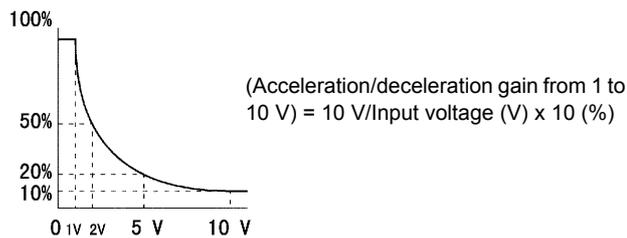


Fig 6.20 Acceleration/Deceleration Time Gain Using an Analog Input

■ 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.

Using the Inverter, you can set an S-curve characteristic time for each of the following: Acceleration start time, deceleration start time, acceleration end time, and deceleration end time.



INFO

Set the S-curve characteristic time to lengthen acceleration/deceleration time as follows:

$$\text{Acceleration time} = \text{Selected acceleration time} + (\text{Acceleration start time S-curve characteristic time} + \text{Acceleration end time S-curve characteristic time}) / 2$$

$$\text{Deceleration time} = \text{Selected deceleration time} + (\text{Deceleration start time S-curve characteristic time} + \text{Deceleration end time S-curve characteristic time}) / 2$$

Setting Example

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

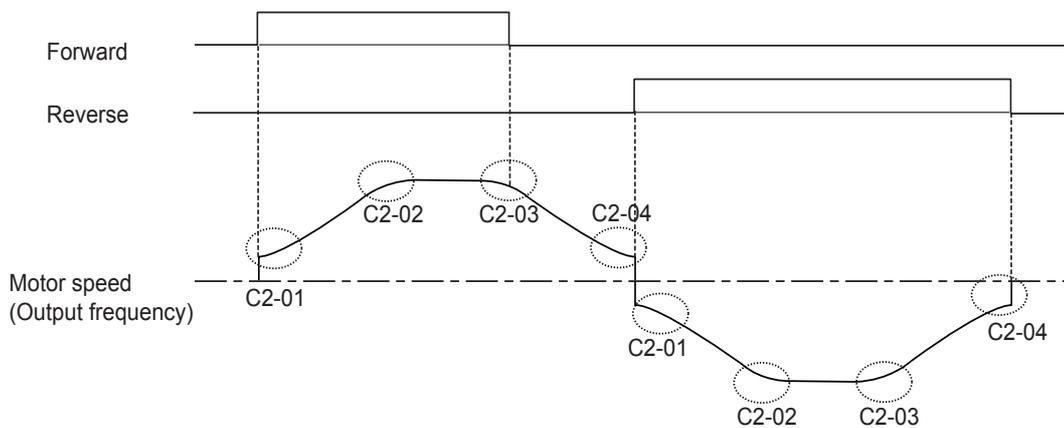
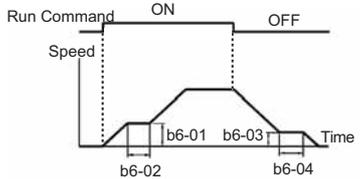


Fig 6.21 S-curve Characteristic during Operation Switching

◆ Accelerating and Decelerating Heavy Loads (Dwell Function)

The dwell function stores the speed when starting or stopping heavy loads. By temporarily storing the speed, you can prevent the motor from stalling. When using the dwell function, you must select a deceleration stop. Set b1-03 (Stopping Method Selection) to 0.

■ Related Parameters

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Regis- ter
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
b6-01	Dwell speed at start	 <p>The dwell function is used to keep the speed temporarily when driving a motor with a heavy load.</p>	0.0 to 100.0	0.0%	No	No	A	A	1B6H
b6-02	Dwell time at start		0.0 to 10.0	0.0 s	No	No	A	A	1B7H
b6-03	Dwell speed at stop		0.0 to 400.0	0.0%	No	No	A	A	1B8H
b6-04	Dwell time at stop		0.0 to 100.0	0.0 s	No	No	A	A	1B9H

◆ Preventing Overvoltage During Run

The overvoltage inhibit function automatically reduces the regenerative torque limit to suppress the voltage rise of the DC bus, if the voltage rises while the motor is running. While the motor is decelerating, the deceleration time will be automatically set to a longer time, and then the actual deceleration time may be longer than the set value.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
E1-01	Input voltage setting	Set the Inverter input voltage in the unit of 1 V. This setting is used as a reference value in protection functions.	155 to 255 *2	200 V *1 *2	No	Q	Q	Q	300H
L3-11	Overvoltage inhibit selection	Sets the function to inhibit overvoltage in the Inverter DC bus. 0: Disabled 1: Enabled Reduces the regenerative torque limit automatically, depending on the DC bus voltage, to prevent the overvoltage (OV). Deceleration time might be longer than the setting due to auto-adjustment of the decelerating rate. If decelerating with a braking unit or braking resistor, set L3-11 to 0 (Disabled). If this is not done, deceleration cannot be achieved in the desired deceleration time.	0 or 1	1	No	No	A	A	4C7H

* 1. In open-loop/flux vector control for PM, this constant is not initialized by the initialize operation.

* 2. For 200 V Class Inverters. Values for 400 V Class Inverters are twice as large.

■ Setting Example

An example of stall prevention during deceleration when L3-11 is set to 1 is shown.

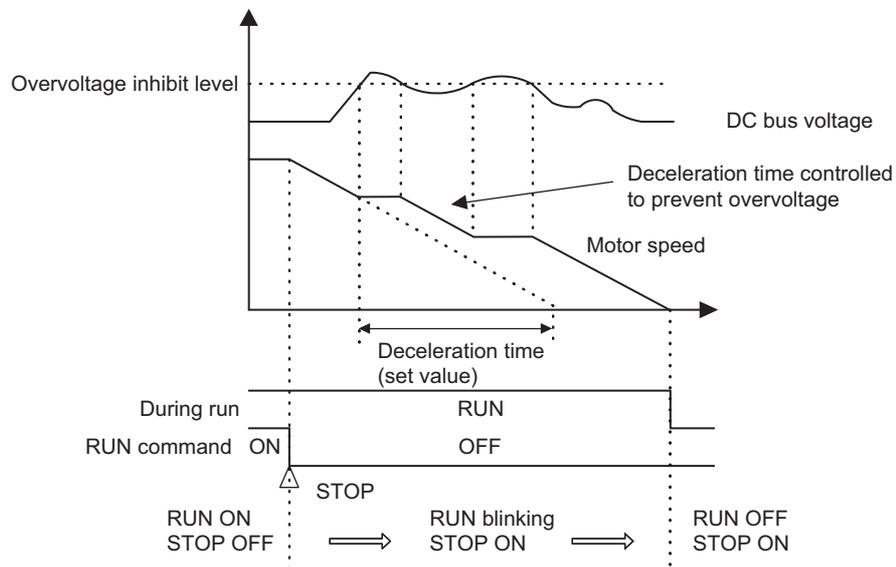


Fig 6.22 Overvoltage Inhibit Operation

■ Setting Precautions

- If using a braking option, such as the braking resistor, braking resistor units, or braking units, set L3-11 to 0. If L3-11 is not set to 0, the motor may not stop within the preset allowable deceleration time.
- The overvoltage inhibit function automatically adjusts the deceleration rate based on the set value of E1-01 (Input voltage setting). So, make sure that E1-01 is correctly set in accordance with the supply voltage. If not, the motor may not stop, depending on the conditions of the supply voltage.

Adjusting Speed References

This section explains methods of adjusting speed references.

◆ Adjusting Analog Speed 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	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H3-01	Signal level selection (terminal A1)	0: 0 to 10 V 1: -10 to 10 V	0 or 1	0	No	A	A	A	410H
H3-02	Gain (terminal A1)	Sets the speed when 10 V is input, as a percentage of the maximum speed.	0.0 to 1000.0	100.0%	Yes	A	A	A	411H
H3-03	Bias (terminal A1)	Sets the speed when 0 V is input, as a percentage of the maximum speed.	-100.0 to +100.0	0.0%	Yes	A	A	A	412H
H3-04	Signal level selection (terminal A3)	0: 0 to 10 V 1: -10 to 10 V	0 or 1	0	No	A	A	A	413H
H3-05	Multi-function analog input (terminal A3) function selection	Select from the functions listed in the following table. Refer to the next page.	0 to 1F	1F	No	A	A	A	414H
H3-06	Gain (terminal A3)	Sets the input gain (level) when 10V is input. Set according to the 100% value selected from H3-05.	0.0 to 1000.0	100.0%	Yes	A	A	A	415H
H3-07	Bias (terminal A3)	Sets the input gain (level) when 0V is input. Set according to the 100% value selected from H3-05.	-100.0 to +100.0	0.0%	Yes	A	A	A	416H
H3-08	Signal level selection (terminal A2)	0: 0 to +10V, with lower limit 1: -10 to +10 V, without lower limit 2: 4 to 20 mA. Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A	417H
H3-09	Multi-function analog input (terminal A2) function selection	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A	418H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H3-10	Gain (terminal A2)	Sets the input gain (level) when 10 V (20 mA) is input. Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	419H
H3-11	Bias (terminal A2)	Sets the input gain (level) when 0 V (4 mA) is input. Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	41AH
H3-12	Analog input filter time constant	Sets primary delay filter time constant in seconds for the analog input terminal. Effective for noise control etc.	0.00 to 2.00	0.03 s	No	A	A	A	41BH

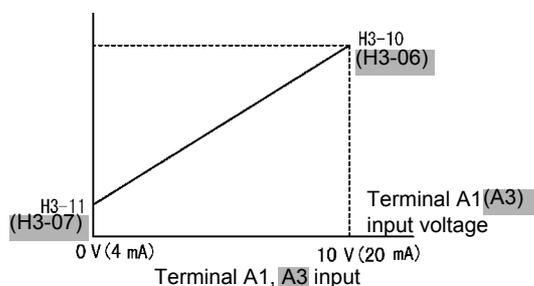
■ Adjusting Analog Speed Reference Using Constants

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

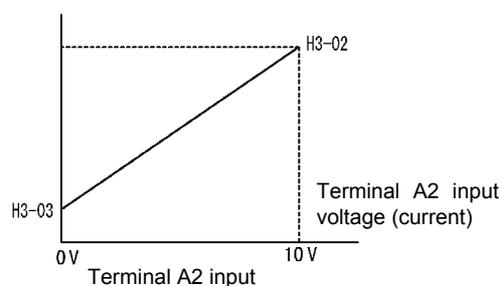
If using speed reference terminal A1 as an input terminal, perform adjustments using constants H3-02 and H3-03. If using multi-function analog input terminal A2 as a speed reference terminal, perform adjustments using H3-10 and H3-11.

Adjustment can be made using H3-06 and H3-07 when multi-function analog input terminal A3 is used as a speed reference terminal.

Speed reference



Speed reference



Note: () is for when terminal A3 is used.

Fig 6.23 Terminals A1 and A2 Inputs

■ Adjusting Speed Gain Using an Analog Input

When H3-09 or H3-05 is set to 1 (speed gain), you can adjust the speed gain using the analog input terminal A2 or A3.

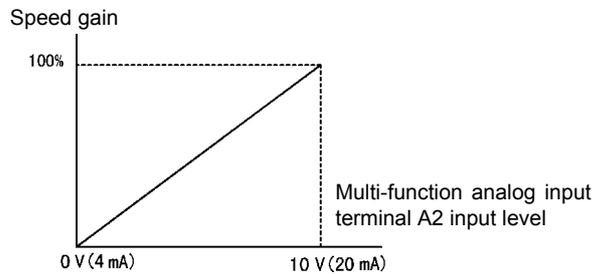
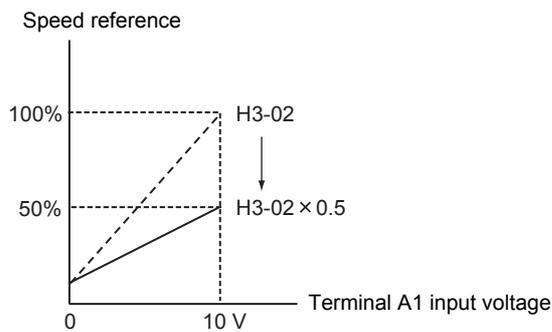


Fig 6.24 Speed Gain Adjustment (Terminal A2 Input)

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



■ Adjusting Speed Bias Using an Analog Input

When constant H3-09 or H3-05 is set to 0 (add to terminal A1), the speed equivalent to the terminal A2 or A3 input voltage is added to A1 as a bias.

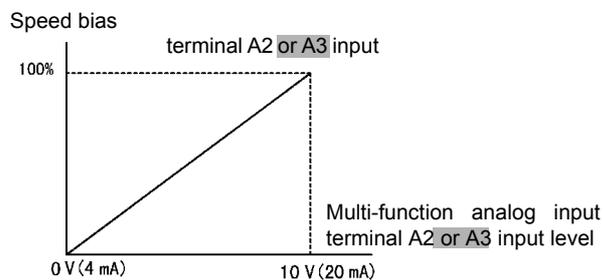
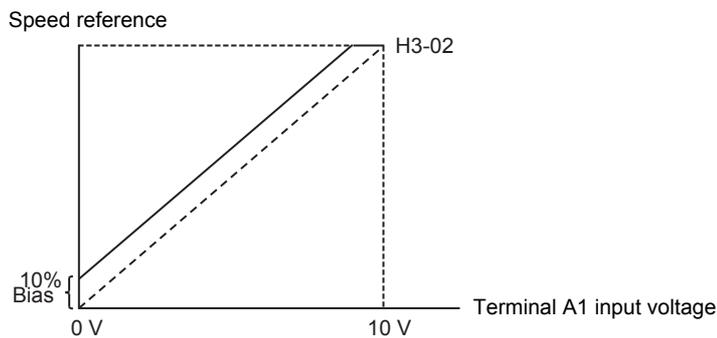


Fig 6.25 Speed Bias Adjustment (Terminal A2 or A3 or A3 Input)

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



When constant H3-09 or H3-05 is set to D (speed bias 2), the speed equivalent to the terminal A2 or A3 A3 input voltage is added to A1 as a bias.

◆ Operation Avoiding Resonance (Jump Speed Function)

The jump speed function operates the motor while avoiding resonance caused by characteristic speeds in the machinery.

This function is effective in creating a speed reference dead band.

During constant-speed operation, operation within the jump speed range is prohibited. Smooth operation still used during acceleration and deceleration, i.e., jumps are not performed.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
d3-01	Jump speed 1	Set the center values of the jump speeds in %. This function is disabled by setting the jump speed to 0 %. Always ensure that the following applies: $d3-01 \geq d3-02 \geq d3-03$ Operation in the jump speed range is prohibited but during acceleration and deceleration, speed changes smoothly without jump.	0.0 to 100.0 *2	0.0% *1	No	A	A	A	294H
d3-02	Jump speed 2					A	A	A	295H
d3-03	Jump speed 3					A	A	A	296H
d3-04	Jump speed width	Sets the jump speed bandwidth in %. The jump speed will be the jump speed \pm d3-04.	0.0 to 100.0 *3	1.0% *1	No	A	A	A	297H

* 1. The display units vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence testes display unit is Hz.

* 2. The setting ranges vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence testes setting range is 0.0 to 400.0.

* 3. The setting ranges vary in accordance with the control method. The units for open-loop/flux vector control for PM are given. For sequence test, the setting range is 0.0 to 20.0.

The relationship between the motor speed (output frequency) and the jump speed reference is as follows:

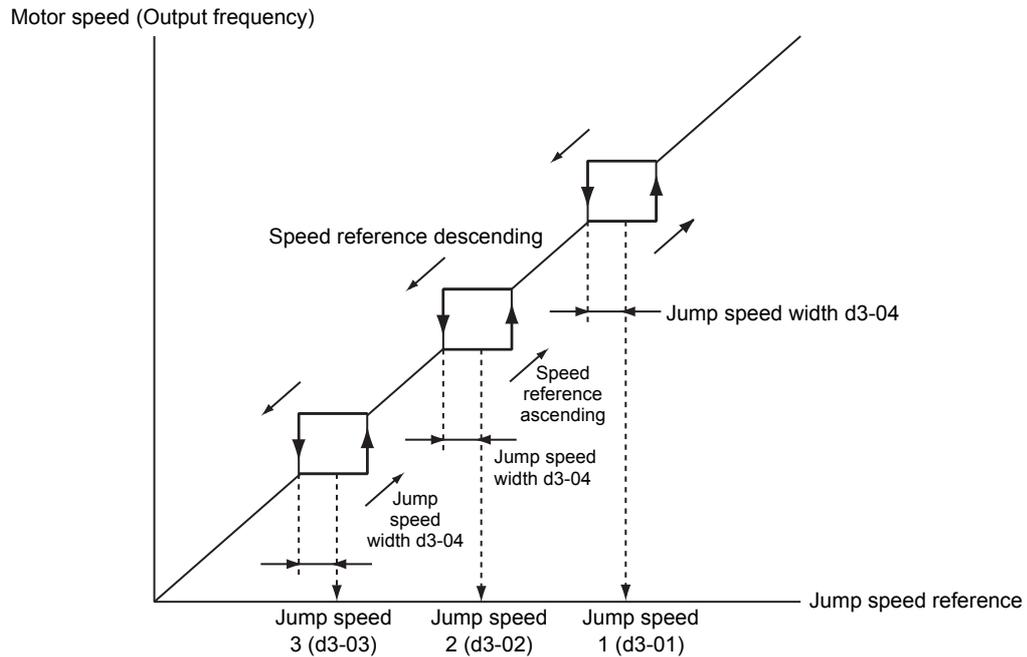


Fig 6.26 Jump speed

■ Setting Jump Speed Reference Using an Analog Input

When constant H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) is set to A (jump speed), you can change the jump speed using the terminal A2 or A3 input level.

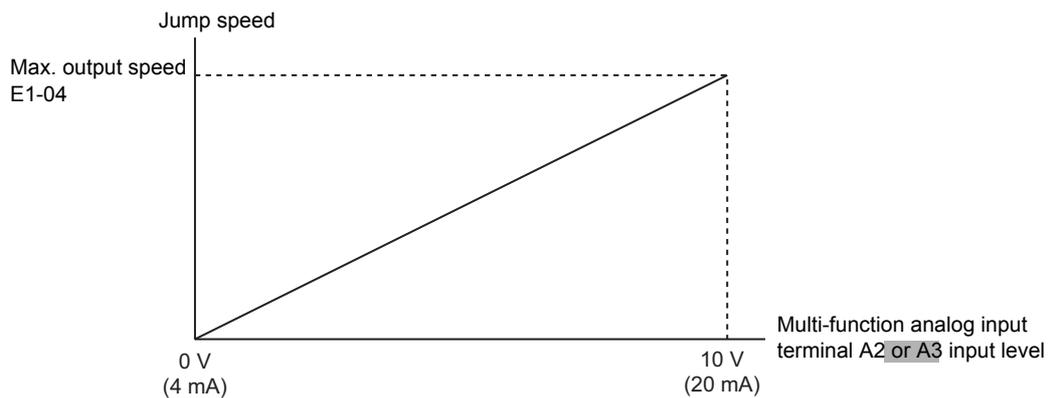


Fig 6.27 Jump Speed Setting Using an Analog Input

■ Setting Precautions

- Set the jump speed according to the following formula: $d3-01 \geq d3-02 \geq d3-03 > \text{Analog input}$.
- When constants d3-01 to d3-03 are set to 0%, the jump speed function is disabled.

◆ Adjusting Speed Reference Using Pulse Train Inputs

The speed reference can be adjusted when b1-01 (Reference Selection) is set to 4 (Pulse Train Input). Set the pulse frequency in constant H6-02 to 100% reference, and then adjust the gain and bias accordingly using H6-03 and H6-04.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H6-01	Pulse train input function selection	0: Speed reference 1: PID feedback value 2: PID target value	0 to 2	0	No	No	A	A	42CH
H6-02	Pulse train input scaling	Set the number of pulses in hertz, taking the reference to be 100%.	1000 to 32000	1440 Hz	Yes	No	A	A	42DH
H6-03	Pulse train input gain	Set the input gain level as a percent when the pulse train set in H6-02 is input.	0.0 to 1000.0	100.0%	Yes	No	A	A	42EH
H6-04	Pulse train input bias	Set the input bias when the pulse train is 0.	-100.0 to 100.0	0.0%	Yes	No	A	A	42FH
H6-05	Pulse train input filter time	Set the pulse train input primary delay filter time constant in seconds.	0.00 to 2.00	0.10 s	Yes	No	A	A	430H

The following diagram shows the method for adjusting the speed reference using pulse inputs.

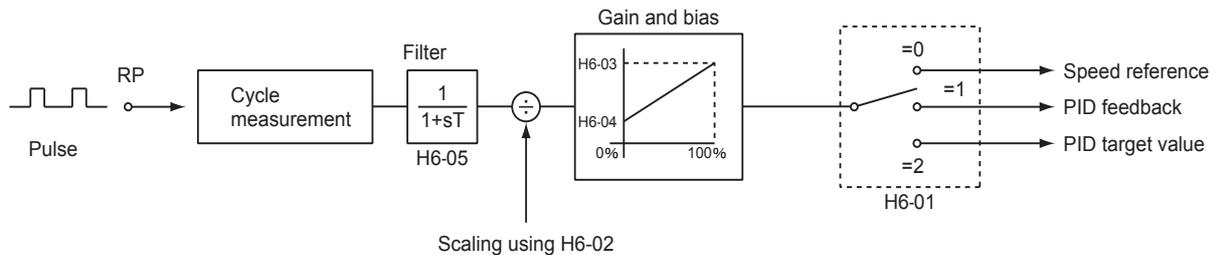


Fig 6.28 Speed Reference Adjustments Using Pulse Train Inputs

Speed Limit (Speed Reference Limit Function)

This section explains how to limit the motor speed.

◆ Limiting Maximum Speed

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

Set the upper limit value of the Inverter speed reference as a percent, taking E1-04 (Maximum speed) to be 100%.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d2-01	Speed reference upper limit	Set the motor speed upper limit as a percentage of the maximum speed.	0.0 to 110.0	100.0%	No	A	A	A	289H

◆ Limiting Minimum Speed

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

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

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

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d2-02	Speed reference lower limit	Sets the motor speed lower limit as a percentage of the maximum speed.	0.0 to 110.0	0.0%	No	A	A	A	28AH
d2-03	Master speed reference lower limit	Set the master speed reference lower limit as a percentage of the maximum speed.	0.0 to 110.0	0.0%	No	A	A	A	293H

■ Adjusting Speed Lower Limit Using an Analog Input

If you set constant H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to 9 (speed reference lower level), you can adjust the speed reference lower level using the terminal A2 or A3 input level.

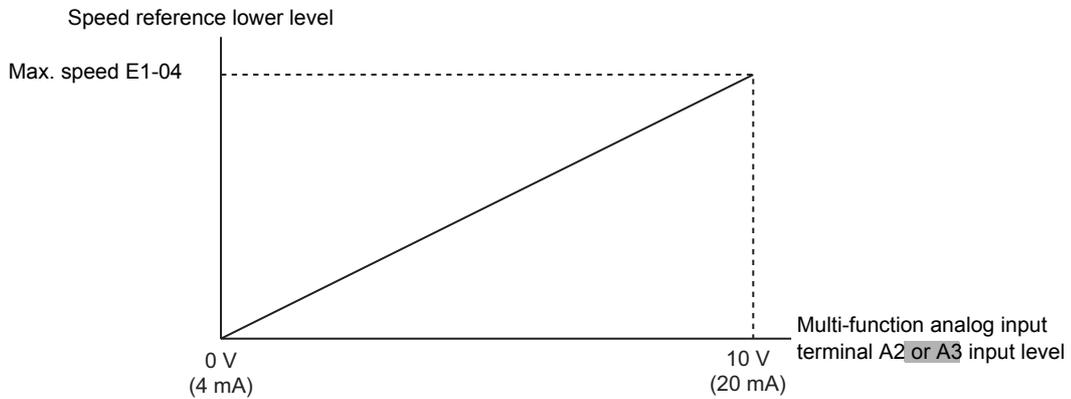


Fig 6.29 Speed Lower Level for Multi-function Analog Input



INFO

If constant d2-02 and terminal A2 speed reference lower level have been set at the same time, the larger set value will become the speed reference lower limit.

Machine Protection

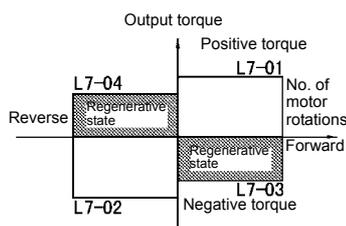
This section explains functions for protecting the machine.

◆ Limiting Motor Torque (Torque Limit Function)

Enable this function if you do not want a torque above a specified amount to be applied to the load, or if you do not want a regeneration value above a specified amount to occur. The user-set value is applied to the torque limit.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
L7-01	Forward drive torque limit	Sets the torque limit value as a percentage of the motor rated torque. Four individual regions can be set.	0 to 160	160%	No	No	A	A	4A7H	
			0 to 300							
L7-02	Reverse drive torque limit		0 to 160	160%	No	No	A	A		4A8H
			0 to 300							
L7-03	Forward regenerative torque limit	0 to 160	160%	No	No	A	A	4A9H		
		0 to 300								
L7-04	Reverse regenerative torque limit	0 to 160	160%	No	No	A	A		4AAH	
		0 to 300								



Multi-function Analog Input (H3-05,H3-09)

Setting Value	Function	Contents (100%)	Control Methods		
			Sequence Test	Flux Vector for PM	Open Loop Vector for PM
10	Positive torque limit	Motor's rated torque	No	Yes	Yes
11	Negative torque limit	Motor's rated torque	No	Yes	Yes
12	Regenerative torque limit	Motor's rated torque	No	Yes	Yes
15	Positive/negative torque limit	Motor's rated torque	No	Yes	Yes

■ Setting the Torque Limit in Constants

Using L7-01 to L7-04, you can set individually four torque limits in the following directions: Forward drive, reverse drive, forward regeneration, and reverse regeneration.

■ Set the Torque Limit Value Using an Analog Input

You can change the analog input level torque limit value by setting the torque limit in multi-function analog input terminals A2 and A3.

The analog input terminal signal level is factory-set as follows:

Multi-function analog input terminal A2: 4 to 20 mA

Multi-function analog input terminal A3: 0 to 10

The following diagram shows the relationship between the torque limits.

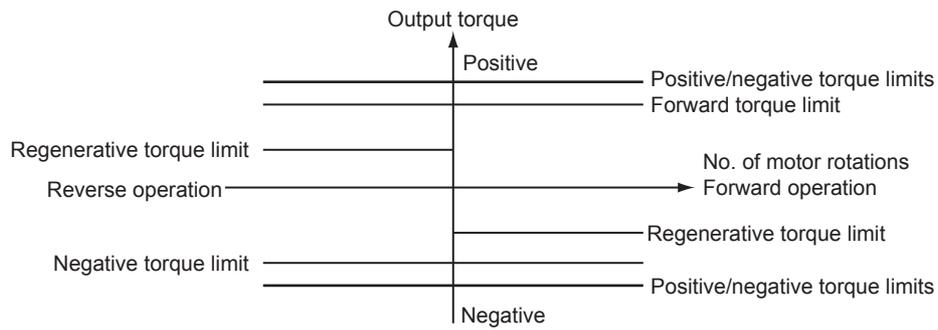


Fig 6.30 Torque Limit by Analog Input

■ Setting Torque Limits Using Constants and an Analog Input

The following block diagram shows the relationship between torque limit using constants and torque limit using an analog input.

The lowest torque limit set from among the following is enabled: The torque limit using constants, the torque limit using an analog input, or the torque limit calculated by the inverter's current rating in accordance with the carrier frequency setting.

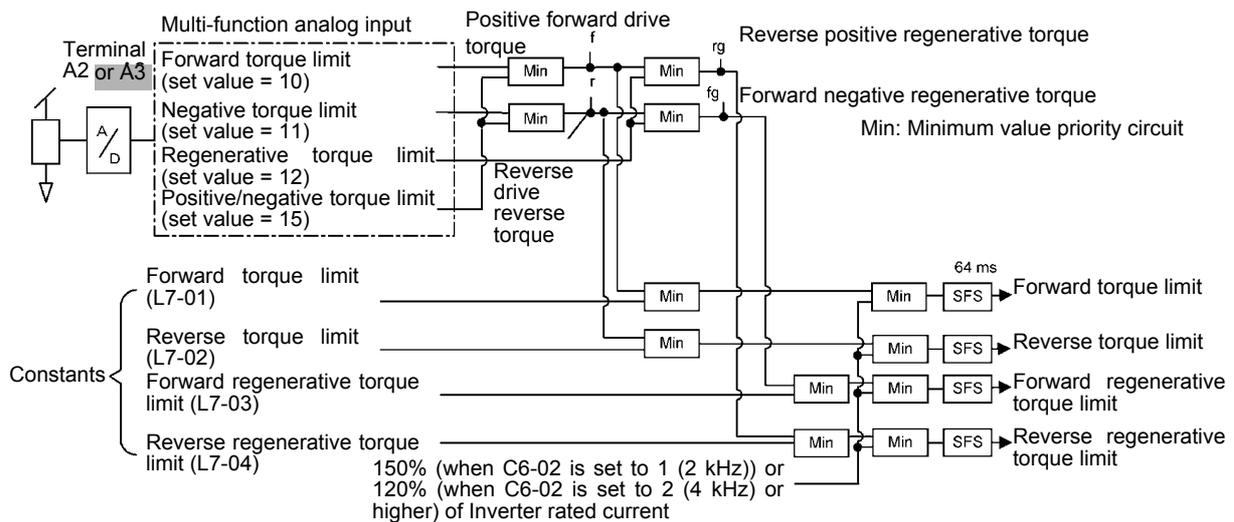


Fig 6.31 Torque Limit Using Constants and an Analog Input

■ Setting Precautions

- When the torque limit function is operating, control and compensation of the motor speed is disabled because torque control is given priority. Therefore, the acceleration and deceleration times may increase or the number of motor rotations may decrease.
- When using the torque limit to raise and lower loads, do not carelessly lower the torque limit value, as this may result in the motor falling or slipping.
- Torque limits using an analog input are the upper limit value (during 10 V or 20 mA input) of 100% of the motor rated torque. To make the torque limit value during 10 V or 20 mA input 150% of the rated torque, set the input terminal gain to 150.0 (%). Adjust the gain for multi-function analog input terminal A2 using H3-10 and for multi-function analog input terminal A3 using H3-06.
- The torque limit accuracy is $\pm 5\%$ at the motor speed of 10% or above. When motor speed is less than 10%, accuracy is lowered.
- When the torque is limited while L7-07 is set to 1 (integral control), the acceleration and deceleration times may increase or the motor speed may not agree with the speed reference value.

◆ Using Speed Detection

Set these constants when outputting one of the speed agree, desired speed agree, or speed detection signals from a multi-function output. **When using flux vector control, the motor speed is detected.**

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L4-01	Speed agreement detection level	Effective when “Desired speed agree 1”, “Speed detection 1>”, or “Speed detection 1<” is set for a multi-function output. Speeds to be detected are set as a percentage of maximum speed.	0.0 to 100.0	0.0%	No	No	A	A	499H
L4-02	Speed agreement detection width	Effective when “Speed agree 1”, “Desired speed agree 1”, or “Speed detection 1<” is set for a multi-function output. Sets the speed detection width as a percentage of maximum speed.	0.0 to 40.0	4.0%	No	No	A	A	49AH
L4-03	Speed agreement detection level (+/-)	Effective when “Desired speed agree 2”, “Desired speed agree 1”, “Speed detection 3>” or “Speed detection 4<” is set for a multi-function output. Speed that should be detected is set as a percentage of maximum speed.	-100.0 to +100.0	0.0%	No	No	A	A	49BH
L4-04	Speed agreement detection width (+/-)	Effective when “Speed agree 2”, “Desired speed agree 1”, or “Speed detection 4<” is set for a multi-function output. Speed detection width is set as a percentage of maximum speed.	0.0 to 40.0	4.0%	No	No	A	A	49CH

■ Constants and Output Signals

User Constant Number	Name	Function
L4-01	Speed agree detection level	Desired frequency (speed) Agree 1 Frequency (FOUT) Detection 1 Frequency (FOUT) Detection 2 Frequency (FOUT) Detection 5
L4-02	Speed agree detection width	Frequency (speed) Agree 1 Desired frequency (speed) Agree 1 Frequency (FOUT) Detection 1 Frequency (FOUT) Detection 2 Frequency (FOUT) Detection 5
L4-03	Speed agree detection level (+/-)	Desired frequency (speed) Agree 2 Frequency (FOUT) Detection 3 Frequency (FOUT) Detection 4
L4-04	Speed agree detection width (+/-)	Frequency (speed) Agree 2 Desired frequency (speed) Agree 2 Frequency (FOUT) Detection 3 Frequency (FOUT) Detection 4

Set the corresponding setting in the multi-function output (H2-01 to H2-03) to output the frequency (speed) agree signal, desired frequency (speed) agree signal, or frequency (speed) detection signal.

Function	Setting
Frequency (speed) Agree 1	2
Desired frequency (speed) Agree 1	3
Frequency (FOUT) Detection 1	4
Frequency (FOUT) Detection 2	5
Frequency (speed) Agree 2	13
Desired frequency (speed) Agree 2	14
Frequency (FOUT) Detection 3	15
Frequency (FOUT) Detection 4	16
Frequency (FOUT) Detection 5	36

Timing Chart for Speed Detection Operation

Related constant	L4-01: Speed Agree Level L4-02: Speed Agree Width	L4-03: Speed Agree Level +/- L4-04: Speed Agree Width +/-
Frequency (speed) Agree	<p>Frequency (speed) Agree 1</p> <p>Speed reference</p> <p>Output frequency or motor speed</p> <p>Frequency (speed) Agree 1 (Multi-function output setting = 2)</p>	<p>Frequency (speed) Agree 2</p> <p>Speed reference</p> <p>Output frequency or motor speed</p> <p>Frequency (speed) Agree 2 (Multi-function output setting = 13)</p>
	<p>Desired frequency (speed) Agree 1 (ON at the following conditions during speed agree)</p> <p>Output frequency or motor speed</p> <p>Desired frequency (speed) Agree 1 (Multi-function output setting = 3)</p>	<p>Desired frequency (speed) Agree 2 (ON at the following conditions during speed agree)</p> <p>Output frequency or motor speed</p> <p>Desired frequency (speed) Agree 2 (Multi-function output setting = 14)</p>
Frequency Detection	<p>Frequency (FOUT) Detection 1 (L4-01 > Output frequency)</p> <p>Output frequency or motor speed</p> <p>Freq. (FOUT) Detection 1 (Multi-function output setting = 4)</p>	<p>Frequency (FOUT) Detection 3 (L4-03 > Output frequency)</p> <p>Output frequency or motor speed</p> <p>Freq. (FOUT) Detection 3 (Multi-function output setting = 15)</p>
	<p>Frequency (FOUT) Detection 2 (L4-01 < Output frequency)</p> <p>Output frequency or motor speed</p> <p>Freq. (FOUT) Detection 2 (Multi-function output setting = 5)</p>	<p>Frequency (FOUT) Detection 4 (L4-01 < Output frequency)</p> <p>Output frequency or motor speed</p> <p>Freq. (FOUT) Detection 4 (Multi-function output setting = 16)</p>
	<p>Frequency (FOUT) Detection 5 (L4-01 < Output frequency)</p> <p>Output frequency or motor speed</p> <p>Freq. (FOUT) Detection 5 (Multi-function output setting = 36) OFF during baseblock</p>	

◆ Detecting Motor Torque

If an excessive load is placed on the machinery (overtorque) or the load is suddenly lightened (undertorque), you can output an alarm signal to multi-function output terminal M1-M2, P1-PC, or P2-PC.

To use the overtorque/undertorque detection function, set B, 17, 18, 19 (overtorque/undertorque detection NO/NC) in one of the following constants: H2-01 to H2-03 (multi-function output terminals M1-M2, P1-PC, and P2-PC function selection).

The overtorque/undertorque detection level is the motor torque (motor rated torque 100%).

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L6-01	Torque detection selection 1	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	No	A	A	4A1H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L6-02	Torque detection level 1	Motor rated torque is set as 100%.	0 to 300	150%	No	No	A	A	4A2H
L6-03	Torque detection time 1	Sets the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	No	A	A	4A3H
L6-04	Torque detection selection 2	Torque detection 1 is output from the multi-function output by setting the overtorque/undertorque detection 1NO (B) or 1NC (17) to the multi-function output (H2-□□).	0 to 8	0	No	No	A	A	4A4H
L6-05	Torque detection level 2	Torque detection 2 is output from the multi-function output by setting the overtorque/undertorque detection 2NO (18) or 2NC (19) to the multi-function output (H2-□□).	0 to 300	150%	No	No	A	A	4A5H
L6-06	Torque detection time 2		0.0 to 10.0	0.1 s	No	A	No	A	4A6H

Multi-function Output (H2-01 to H2-03)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/undertorque detection at ON)	Yes	Yes	Yes
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes
18	Overtorque/undertorque detection 2 NO (NO Contact: Torque detection at ON)	Yes	Yes	Yes
19	Overtorque/undertorque detection 2 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes

■ L6-01 and L6-04 Set Values and LED Indications

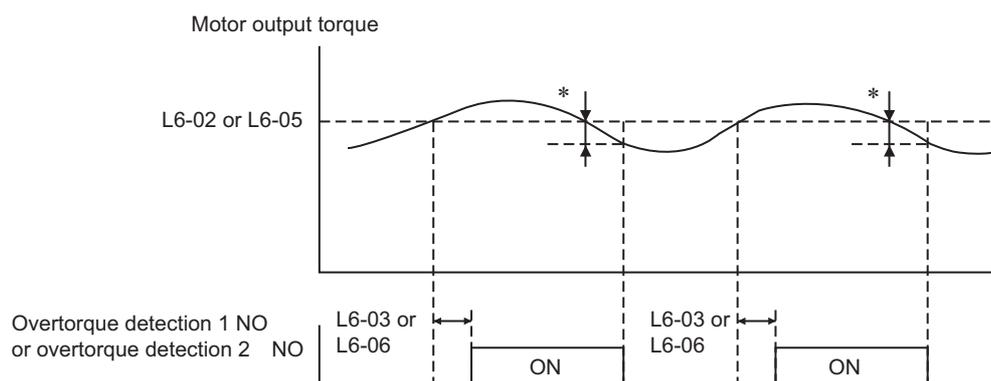
The relationship between alarms displayed by the Digital Operator when overtorque or undertorque is detected, and the set values in L6-01 and L6-04, is shown in the following table.

Set Value	Function	LED Indications	
		Overtorque/ Undertorque Detection 1	Overtorque/ Undertorque Detection 2
0	Overtorque/undertorque detection disabled.	-	-
1	Overtorque detection only with speed matching; operation continues after overtorque (warning).	OL3 flashes	OL4 flashes
2	Overtorque detected continuously during operation; operation continues after overtorque (warning).	OL3 flashes	OL4 flashes
3	Overtorque detection only with speed matching; output stopped upon detection (protected operation).	OL3 lit	OL4 lit
4	Overtorque detected continuously during operation; output stopped upon detection (protected operation).	OL3 lit	OL4 lit
5	Undertorque detection only with speed matching; operation continues after overtorque (warning).	UL3 flashes	UL4 flashes
6	Undertorque detected continuously during operation; operation continues after overtorque (warning).	UL3 flashes	UL4 flashes
7	Undertorque detection only with speed matching; output stopped upon detection (protected operation).	UL3 lit	UL4 lit
8	Undertorque detected continuously during operation; output stopped upon detection (protected operation).	UL3 lit	UL4 lit

■ Setting Example

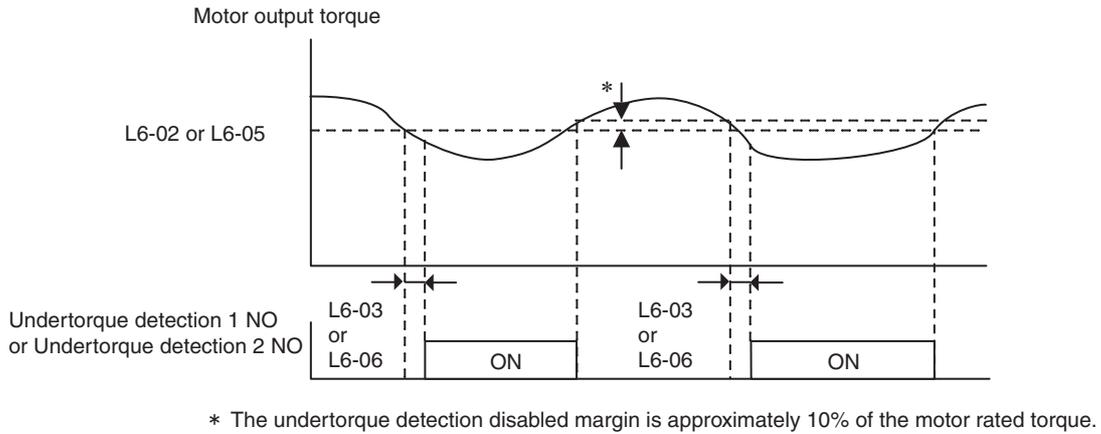
The following diagram shows the time chart for overtorque and undertorque detection.

- Overtorque Detection



* Overtorque detection disabled band is approximately 10% of the motor rated torque.

- Undertorque Detection



◆ Changing Overtorque and Undertorque Detection Levels Using an Analog Input

If you set constant H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to 7 (overtorque/undertorque detection level), you can change the overtorque/undertorque detection level.

If you change the overtorque/undertorque detection level using the multi-function analog input, only overtorque/undertorque detection level 1 will be enabled.

The following diagram shows the overtorque/undertorque detection level using an analog input.

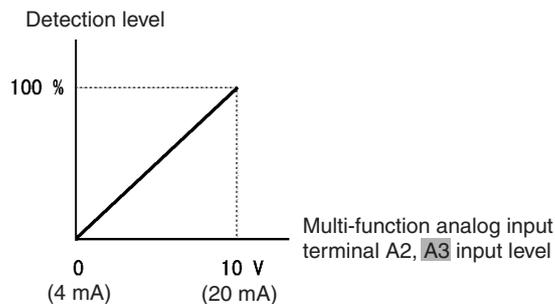


Fig 6.32 Overtorque/Undertorque Detection Level Using an Analog Input

Multi-Function Analog Input (H3-05, H3-09)

Setting Value	Function	Contents (100%)	Control Methods		
			Sequence Test	Flux Vector for PM	Open Loop Vector for PM
7	Overtorque/undertorque detection level	Motor rated torque for vector control Inverter rated output current for sequence test mode	Yes	Yes	Yes

◆ Motor Overload Protection

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

■ Related Constants

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
E5-03	Motor rated current	Set the motor rated current in units of 0.01 A for a motor with a capacity of 7.5 kW or less, or in units of 0.1 A for one with a capacity of 11 kW or more.	0.00 to 2000.0	1.65 A *1	No	No	Q	Q	32BH
L1-01	Motor pro- tection selection	Sets whether the motor overload protection function is enabled or disabled at electric thermal overload relay. 0: Disabled 4: Variable torque PM motor 5: Constant torque PM motor 6: Increased safety, explosion-proof PM motor (variable torque) In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this constant is set to 4, 5, or 6 (Motor protection function enabled), protection may not be effective.	0 or 4	4 *1 *2	No	No	A	A	480H
			0, 4, 5, 6						
L1-02	Motor pro- tection time con- stant	Sets the electric thermal detection time in seconds units. Usually setting is not necessary. The factory setting is 150% overload for one minute. When the motor's overload resistance is known, also set the overload resistance protection time for when the motor is hot started.	0.1 to 5.0	1.0 min	No	A	A	A	481H

* 1. The factory settings vary in accordance with the setting of the motor capacity selection (E5-01) or control method selection (A1-02).
The values for 0.4 kW 200 V Class standard motors for open-loop vector control (1750 min⁻¹) are given.

* 2. This constant is not initialized by the initialize operation.

* 3. The setting values will return to the factory settings if the control method is changed.

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

Set- ting Value	Function	Control Methods		
		Se- quence Test	Flux Vector for PM	Open Loop Vector for PM
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	Yes	Yes	Yes

■ Setting Motor Rated Current

Set the rated current value on the motor nameplate in constants E5-03 (motor rated current). This set value is the electronic thermal base current.

■ Setting Motor Overload Protection Characteristics

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

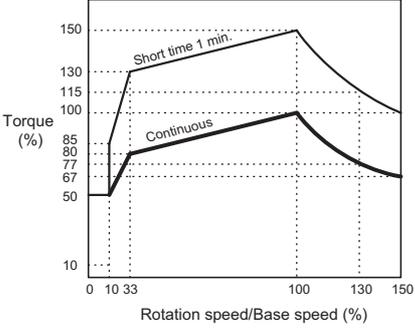
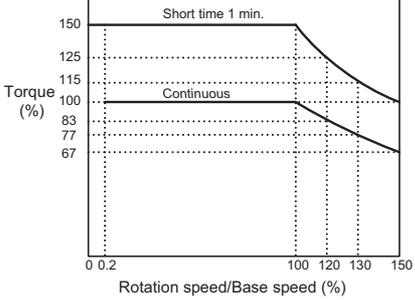
The Varispeed F7S is for use only with variable torque motors and constant torque motors.

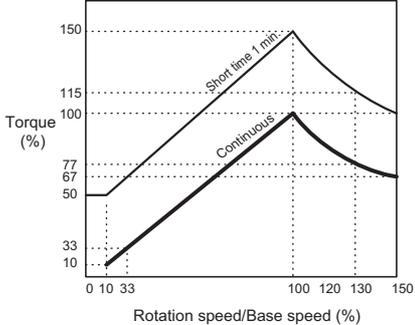
For use with variable torque IPM motors, set L1-01 to 4 (Variable torque PM motor).

For use with constant torque IPM motors, set L1-01 to 5 (Constant torque PM motor).

For use with increased safety, explosion-proof IPM motors (variable torque), set L1-01 to 6 [Increased safety, explosion-proof PM motor (variable torque)]

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

L1-01 Set Value	Motor Type and Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
4	<p>Variable torque PM motor</p>  <p>Normal operation at 10% speed or less is not possible. The allowable tolerance of the impact load is within the range defined by the continuous ratings.</p>	This motor yields its best cooling effect if running at the base speed or higher.	Detect the motor overload protection (OL1), if operating continuously at the base speed or less with 100% torque or more. The Inverter will output a contact when a fault occurred, and the motor will coast to a stop.
5	<p>Constant torque PM motor</p> 	This motor yields its cooling effect if running at low speeds (approximately 0.2% of the base speed).	Operate continuously at 0.2% to 100% of the base speed.

L1-01 Set Value	Motor Type and Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
6	<p>Increased safety, explosion-proof PM motor (variable torque)</p>  <ul style="list-style-type: none"> Increased safety, explosion-proof motor has explosion protection equivalent to Exe II T3, eG3. Cannot be used in some hazardous locations, depending on the level of hazard. Normal operation at 10% speed or less is not possible. The allowable tolerance of the impact load is within the range defined by the continuous ratings. The Inverter itself is not explosion-proof. Install the Inverter in a nonhazardous location. 	<p>This motor yields its best cooling effect if running at the base speed or higher.</p>	<p>Detect the motor overload protection (OL1), if operating continuously at the base speed or less with 100% torque or more. The Inverter will output a contact when a fault occurred, and the motor will coast to a stop.</p>

◆ Setting Motor Protection Operation Time

Set the motor protection operation time in L1-02.

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

The following diagram shows an example of the characteristics of the electronic thermal protection operation time (L1-02 = 1.0 min., operation at base speed, variable torque PM motor characteristics, when L1-01 is set to 4).

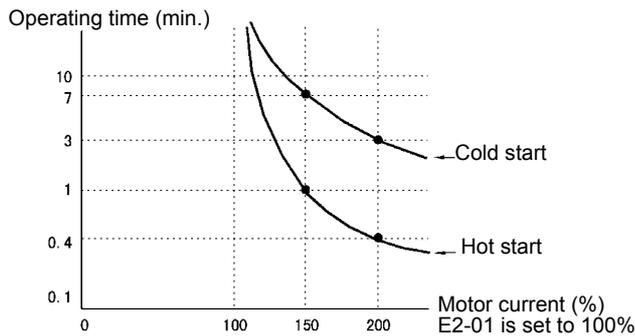


Fig 6.33 Motor Protection Operation Time

■ Setting Precautions

- With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this constant has been set to 4 or 5 (enabled), because the thermal value will be reset.
- To detect overloads in good time, set the set value in constant L1-02 to a low setting.
- When using a variable torque IPM motor, the cooling ability will be lowered by operating under the base speed. Consequently, the frequency may cause motor overload protection (OL1) to occur, even below the rated current.

■ Setting the Motor Overload Pre-Alarm

If the motor overload protection function is enabled (i.e., L1-01 is set to other than 0) and you set H2-01 to H2-03 (multi-function output terminals M1-M2, P1-PC, and P2-PC function selection) to 1F (motor overload OL1 pre-alarm), the motor overload pre-alarm will be enabled. If the electronic thermal value reaches minimum 90% of the overload detection level, the output terminal that has been set will be turned ON.

◆ Limiting Motor Rotation Direction

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

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled	0 or 1	0	No	A	A	A	183H

◆ Detecting Motor Overspeed

An error is detected when the number of motor rotations exceeds the regulated limit. An overspeed (OS) is detected when a speed that exceeds the set value in F1-08 continues for longer than the time set in F1-09. In flux vector control for PM, the Inverter will stop according to the setting in F1-03 after detecting an overspeed (OS). In open-loop vector control for PM, Inverter output will be shut down (baseblock) after detecting an overspeed (OS) fault, and the motor will coast to a stop.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F1-03	Operation selection at overspeed (OS)	Sets the stopping method when an overspeed (OS) fault occurs. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not normally make this setting.)	0 to 3	1 *	No	No	A	No	382H
F1-08	Overspeed detection level	Sets the overspeed detection method. Speeds above that set for F1-08 (set as a percentage of the maximum speed) that continue to exceed this speed for the time set in F1-09 (unit: s) are detected as overspeed faults.	0 to 120	115%	No	No	A	A	387H
F1-09	Overspeed detection delay time		0.0 to 2.0	0.0 s *	No	No	A	A	388H

* The setting values will return to the factory settings if the control method is changed.

◆ Detecting Speed Difference between the Motor and Speed Reference

An error is detected when the speed deviation (i.e., the difference between the designated speed and the actual motor speed) is too great. Speed deviation (DEV) is detected after a speed agreement is detected and when the speed reference and actual workpiece speed are within the setting of L4-02, if a speed deviation great than the set value in F1-10 continues for longer than the time set in F1-11. After a speed deviation is detected, the Inverter stops according to the setting in F1-04.

■ Related Contents

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F1-04	Operation selection at deviation	Sets the stopping method when a speed deviation (DEV) fault occurs. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (DEV is displayed and operation continued.)	0 to 3	3	No	No	A	A	383H
F1-10	Excessive speed deviation detection level	Sets the speed deviation detection method. Any speed deviation above the F1-10 set level (set as a percentage of the maximum speed) that continues for the time set in F1-11 is detected as a speed deviation.	0 to 50	10%	No	No	A	A	389H
F1-11	Excessive speed deviation detection delay time	Speed deviation is the difference between actual motor speed and the reference command speed.	0.0 to 10.0	0.5 s	No	No	A	A	38AH
L4-02	Speed agreement detection width	Effective when "Speed agree 1," "Desired speed agree 1," or "Speed detection 1<" is set for a multi-function output. Sets the speed detection width as a percentage of maximum speed.	0.0 to 40.0	4.0%	No	No	A	A	49AH

Continuing Operation

This section explains functions for continuing or automatically restarting Inverter operation using speed search even if an error occurs.

◆ Restarting Automatically After Power Is Restored

Even if a momentary power loss occurs, you can restart the Inverter automatically after power is restored to continue motor operation. To restart the Inverter after power has been restored, set L2-01 to the any of 1 to 4. Make settings of L2-01 to L2-05 for related details of restarting.

- If L2-01 is set to 1:
After a momentary power loss, if the power is restored within the time set at L2-02, the inverter will restart. If not, alarm UV1 will occur.
If using an Inverter with a large capacity (200-V class of 37 kW or more and 400-V class of 75 kW or more), and L2-02 is set to 10 s or more, alarm UV3 (Inrush prevent circuit fault) will occur if the power is not restored within 10 s.
- If L2-01 is set to 2:
After a momentary power loss, if the main power is restored while the supply voltage for the control board is maintained, the inverter will restart, and Alarm UV1 will not occur.
- If L2-01 is set to 3:
After a momentary power loss, the Inverter will continue operating with Kinetic Energy Braking (KEB) until undervoltage conditions in the main circuit are detected. If the power is restored within the time set at L2-02, the Inverter will restart. If not, alarm UV1 will occur.
- If L2-01 is set to 4:
After a momentary power loss, the Inverter will continue operating with KEB until undervoltage conditions in the main circuit are detected.
If the main power is restored while the supply voltage for the control board is maintained, the Inverter will restart, and alarm UV1 will not occur.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L2-01	Momentary power loss detection	0: Disabled (UV fault detection at momentary power loss) 1: Enabled (Restart if power returns within the time set in L2-02. UV fault detection if the time exceeds that set in L2-02.) 2: Enabled during CPU operation (Restart if power returns during CPU operation. No UV fault detection.) 3: KEB operation (Restart if power returns within the time set in L2-02. UV fault detection if the time exceeds that set in L2-02.) 4: KEB operation during CPU operation (Restart if power returns during CPU operation. No UV fault detection.)	0 to 4	0 *3	No	No	A	A	485H
L2-02	Momentary power loss ride-thru time	Sets the Ride-through time in units of seconds, when Momentary Power Loss Selection (L2-01) is set to 1 or 3.	0 to 60.0	0.1 s *1	No	No	A	A	486H
L2-03	Min. base-block time	Sets the Inverter's minimum baseblock time in units of one second, when the Inverter is restarted after power loss ride-through.	0.1 to 5.0	0.1 s *1	No	No	No	A	487H
L2-05	Undervoltage detection level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage) in V units. Usually setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	No	A	A	489H

* 1. The factory settings vary in accordance with the Inverter capacity. (The settings for 0.4 kW 200 V Class Inverters are given.)

* 2. These are values for 200 V Class Inverters. Values for 400 V Class Inverter are twice as large.

* 3. The setting values will return to the factory settings if the control method is changed.

■ Setting Precautions

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

- If using elevating machines, disable momentary power loss detection (L2-01=0) to prevent the motor from coasting to a stop with the brake disengaged during a momentary power loss.

◆ Speed Search

The speed search function finds the actual speed of the motor that is rotating on inertia, and then starts smoothly from that speed. When restoring power after a temporary power loss, the speed search function is useful to restart the fan that is rotating on inertia.

■ Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
b3-01	Speed search selection	Enables/disables the speed search function for the Run Command and sets the speed search method. 0: Disabled 1: Enabled If b3-01 set to 1, the motor speed is calculated at the start of a search, and the motor accelerates or decelerates from this calculated speed to a set speed. (A motor rotational direction search is also possible.)	0, 1	1 *	No	No	No	A	191H
b3-05	Search wait time	Sets the magnetic contactor operating delay time when there is a magnetic contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	1.0 s	No	No	No	A	195H

* The setting value will return to the factory setting if the control method is changed.

Multi-function Contact Inputs (H1-01 to H1-06)

Set-ting Value	Function	Control Methods		
		Se-quence Test	Flux Vector for PM	Open Loop Vector for PM
61	External search command 1 (ON: Speed search from maximum output frequency)	No	No	Yes
62	External search command 2 (ON: Speed search from set frequency)	No	No	Yes

■Setting Precautions

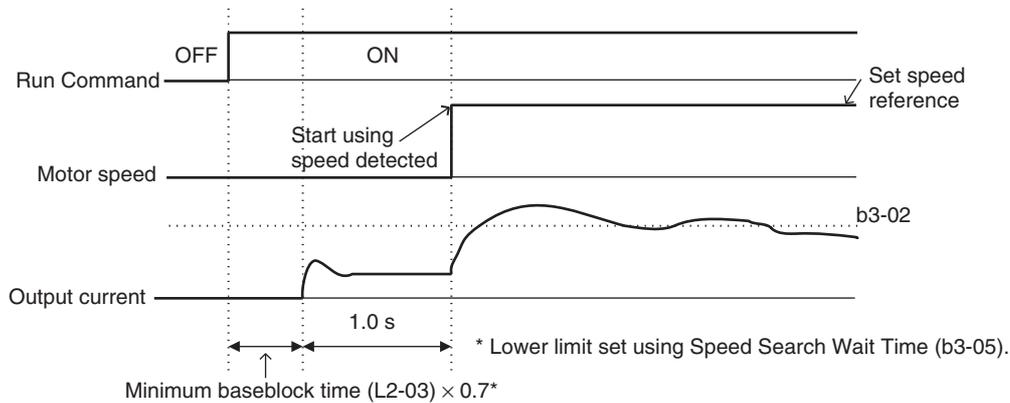
- When both external search commands 1 and 2 are set for the multi-function contact terminals, an OPE03 (invalid multi-function input selection) operation error may occur. Set either external search command 1 or external search command 2.
- If performing speed search using external search commands, add an external sequence so that the period when the Run Command and external search command are both ON is at the very least the Minimum Baseblock Time (L2-03).
- If the Inverter output is equipped with a contact, set the contact operation delay time in the Speed Search Wait Time (b3-05). The factory setting is 1.0 s. After waiting for the speed search wait time, the Inverter starts the speed search. If the delay time is less than 1.0 s, the speed search may not start properly. Make sure that the delay time is set to 1.0 s or more.
- During a high-speed rotation of 100 Hz or more, a speed search cannot be performed, and an overcurrent (OC) or overvoltage (OV) fault may be detected.
- If one of these faults is detected during a speed search after recovery from a momentary power loss, take the following measures.
 - Extend the search wait time (b3-05).
 - Enable the number of auto restart attempts (L5-01) for use together with a speed search.
 - Switch the speed search to momentary power loss detection (L2-01=3 or 4).

■Time Chart

The time chart for speed searches is shown below.

Search at Startup

The time chart when speed search at startup or external speed search command of multi-function inputs has been selected 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 after the short baseblock.

Fig 6.34 Speed Search at Startup

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

The time chart when the Inverter operation is restarted after power has been restored is shown below.

- Loss Time Shorter Than the Minimum Baseblock Time (L2-03)

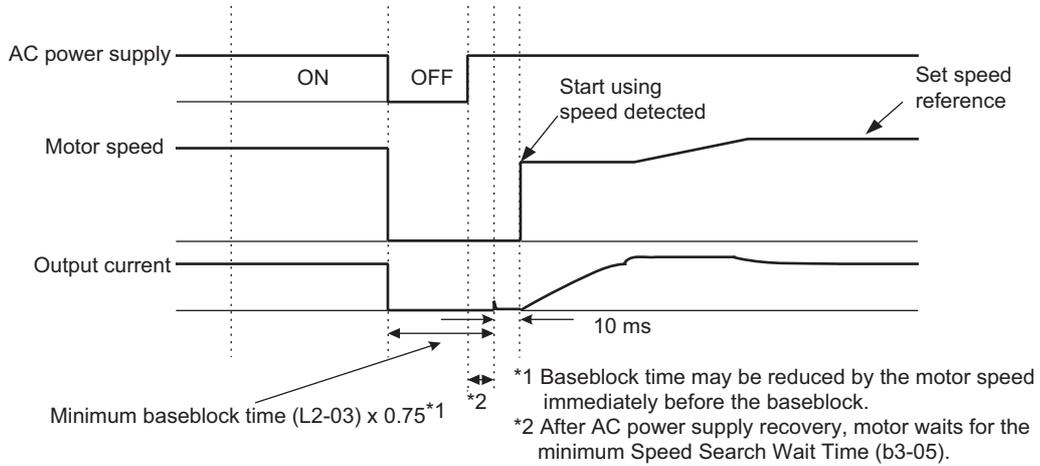
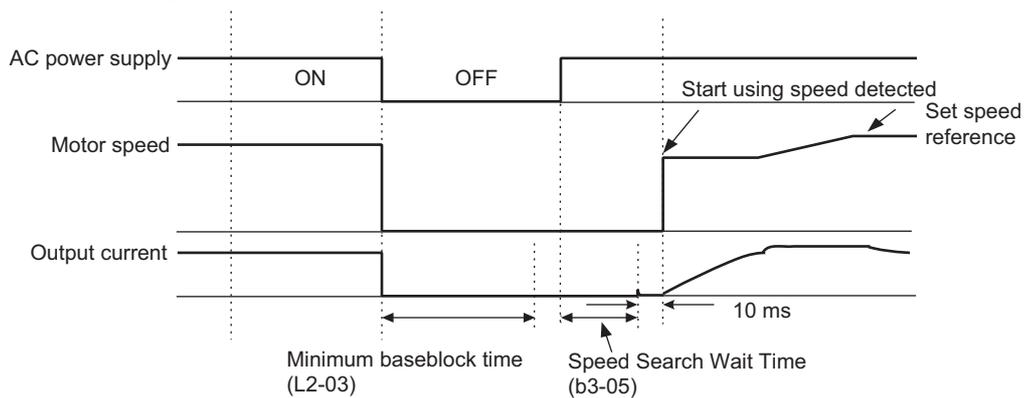


Fig 6.35 Speed Search after Baseblock (When Loss Time Is Set in L2-03)

- 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 at start.

Fig 6.36 Speed Search After Baseblock (Loss Time > L2-03)

◆ Continuing Operation During Momentary Power Loss

If L2-01 is set to 3 or 4, Kinetic Energy Braking (KEB) will be performed after a momentary power loss. With KEB, the motor decelerates to a stop when a momentary power loss occurs and the Inverter continues to be controlled with the energy regenerated during deceleration. KEB control continues while the motor decelerates and the regeneration energy is reduced, until the DC voltage of the main circuit falls below the undervoltage detection level (L2-05).

■ Related Contents

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L2-01	Momentary power loss detection	0: Disabled (UV fault detection at momentary power loss) 1: Enabled (Restart if power returns within the time set in L2-02. UV fault detection if the time exceeds that set in L2-02.) 2: Enabled during CPU operation (Restart if power returns during CPU operation. No UV fault detection.) 3: KEB operation (Restart if power returns within the time set in L2-02. UV fault detection if the time exceeds that set in L2-02.) 4: KEB operation during CPU operation (Restart if power returns during CPU operation. No UV fault detection.)	0 to 4	0 *3	No	No	A	A	485H
L2-02	Momentary power loss ridethru time	Sets the Ridethrough time in units of seconds, when Momentary Power Loss Selection (L2-01) is set to 1 or 3.	0 to 60.0	0.1 s *1	No	No	A	A	486H
L2-05	Undervoltage detection level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage) in V units. Usually setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	No	A	A	489H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L2-06	KEB deceleration time	Enabled when L2-01 is set to 3 or 4. Sets the deceleration time in seconds from the maximum speed to zero-speed at momentary power loss command (KEB). Controller power supply will be extended if deceleration time is shortened.	0.0 to 200.0	30.0 s *3	No	No	A	A	48AH

- * 1. The factory settings vary in accordance with the Inverter capacity. (The settings for 0.4 kW 200 V Class Inverters are given.)
- * 2. These are values for 200 V Class Inverters. Values for 400 V Class Inverter are twice as large.
- * 3. The setting values will return to the factory settings if the control method is changed.

■ Operation Example

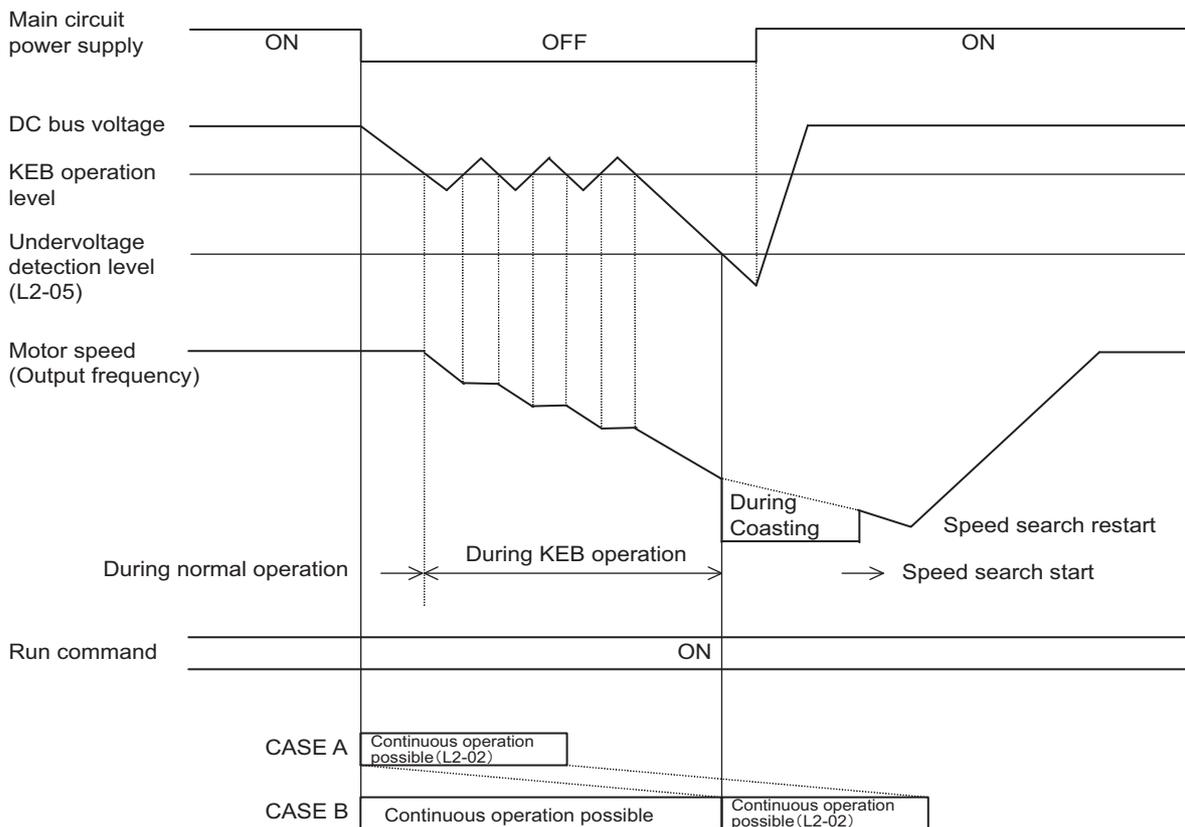


Fig 6.37 KEB Operation

- The KEB operation levels are calculated by the following equations.
 200 V class: KEB level = Set value (L2-05) + 50 (V)
 400 V class: KEB level = Set value (L2-05) + 100 (V)
- Possible duration for continuous operation
 - If L2-01 is set to 3, the Inverter will restart (reaccelerate) if the power supply of the main circuit is restored within the time assigned to L2-02 after a momentary power loss, as shown by Case A in the preceding figure. If using Inverters of 30 kW or less in the 200-V class or 55 kW or less in the 400-V class, the time assigned to L2-02 will start to be measured after the DC voltage of the main circuit falls

below the undervoltage detection level set at L2-05. So, the possible duration for continuous operation can be longer than that for Inverters of other capacities, as shown by Case B in the preceding figure.

- If L2-01 is set to 4, the Inverter will restart (reaccelerate) if the main power is restored while the power supply for the control board is maintained after a momentary power loss.
- Shorten the KEB deceleration time at L2-06 if the inertia of the machine is low and an STO alarm or other similar alarm occurs after the power supply is restored.

■ Setting Precautions

- Error output signals are not output during momentary power loss recovery.
- To continue Inverter operation after power has been restored, make settings so that Run Commands from the control main circuit terminal are stored even while power is suspended.
- If the momentary power loss operation selection is set to 0 (Disabled), when the momentary power loss exceeds 15 ms during operation, alarm UV1 (main circuit undervoltage) will be detected.
- Kinetic Energy Braking (KEB) cannot be used to restart a motor driven by rotational inertia.



If using the 200-V class Inverter with a capacity of 37 kW to 75 kW or a 400-V class inverter with a capacity of 75 kW to 300 kW and set L2-01 to 2, 3, or 4, do not change the wiring of the control power-supply terminals (200V class: r/l_1 , $200/l_2$ \rightarrow 200, 400V class: r/l_1 , \rightarrow 400/ l_2 400). Leave the terminals at their factory settings. For example, if the control power-supply terminals (r/l_1 and \rightarrow l_2) are separated from the power supply lines (R/L1 and S/L2) and the control power is supplied from different lines, then do not set L2-01 to 2, 3, or 4. If these settings are used, the Inverter may be damaged. Refer to the *Main Circuit Configurations* on page 2-13 and the *Standard Connection Diagrams* on page 2-14.

◆ Continuing Operation at Constant Speed When Speed Reference Is Lost

The speed reference loss detection function continues operation using 80% speed of the speed reference before loss when the speed reference using an master speed analog input* is reduced 90% or more in 400 ms.

When the error signal during speed reference loss is output externally, set H2-01 to H2-03 (multi-function contact output terminal M1-M2, P1-PC, and P2-PC function selection) to C (speed reference lost).

* Speed references using the following master speed analog inputs are used to detect a frequency loss.

- Analog input using terminal A1
- Analog input using terminal A2 when H3-09 (Multi-function analog input terminal A2 function selection) is set to 0 (Add to terminal A1).
- Analog input using terminal A2 when H3-09 (Multi-function analog input terminal A2 function selection) is set to 2 (Auxiliary speed reference 1) and H3-13 (Terminal A1/A2 switching) is set to 1 (Use terminal A2 analog input as the master speed reference).

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
L4-05	Operation when speed reference is missing	0: Stop (Operation follows the speed reference.) 1: Operation at 80% speed continues. (At 80% of speed before the speed reference was lost) Speed reference is lost: Speed reference dropped over 90% in 400 ms.	0 or 1	0	No	No	A	A	49DH

◆ Restarting Operation After Transient Fault (Auto Restart Function)

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

Set the number of auto restarts in constant L5-01. A fault reset is attempted every 5 ms after a fault occurs and minimum baseblock time has passed. The number of auto restarts is counted when the Inverter attempts a fault reset and restarts operation. The protection function will operate if a fault continues to occur after auto restarting the number of times set in L5-01.

The auto restart function can be applied to the following faults. If a fault not listed below occurs, the protection function will operate and the auto restart function will not.

- OC (Overcurrent)
- GF (Ground fault)
- PUF (Fuse blown)
- OV (Main circuit overvoltage)
- UV1 (Main Circuit Undervoltage, Main Circuit Magnetic Contactor Operation Failure)*
- PF (Main circuit voltage fault)
- LF (Output phase failure)
- RH (Braking resistor overheating)
- RR (Braking transistor error)
- OL1 (Motor overload)
- OL2 (Inverter overload)
- OH1 (Cooling fan overheating)
- OL3 (Overtorque)
- OL4 (Overtorque)

* If L2-01 (Momentary power loss detection) is set to 0 (Disabled), the protection function will be activated, not the auto restart function.

■ Auto Restart External Outputs

To output auto restart signals externally, set H2-01 to H2-03 (multi-function contact output terminals M1-M2, P1-PC, and P2-PC function selection) to 1E (auto restart).

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
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 speed.	0 to 10	0	No	No	A	A	49EH
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	No	A	A	49FH

■ Application Precautions

- The number of auto restarts count is reset under the following conditions:
 - After auto restart, normal operation has continued for 10 minutes.
 - After the protection operation has been performed, and the fault has been verified, and an fault reset has been input.
 - After the power supply is turned OFF, and then ON again.

- Do not use the auto restart function for applications using elevating machines (Set L5-01 to 0). If so, motor will be coasting to a stop with the brake disengaged when a fault occur during run.

◆ Operation Selection After Cooling Fan Fault (SPEC: C or Later Only)

Use the constant setting to select the operation of the motor after a cooling fan fault occurs. This function can be used for times when a motor should not be stopped quickly (with an emergency stop.)

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L8-32	OH1 detection of Inverter's cooling fan	0: Disabled (FAN minor fault detection) 1: Enabled (OH1 major fault detection)	0 or 1	1	No	A	A	A	4E2H

The following table describes the operation of the motor and the display of the Digital Operator in accordance with the settings of the L8-32 if a cooling fan fault occurred.

Setting Value	Fault	Digital Operator	Motor Operation	Multi-function Contact Output
0	Cooling Fin Overheating	OH1 (lit)	Coast to a stop	Fault
	Inverter's Cooling Fan Fault	FAN (blink)	Continue operation*	Minor fault
1	Cooling Fin Overheating	OH (lit)	Coast to a stop	Fault
	Inverter's Cooling Fan Fault	OH1 (lit)	Coast to a stop	Fault

* If L8-32 is set to 0, the motor will continue running even if a cooling fan fault occurred. However, the Inverter rated output current and the overload capacity will be reduced. The rated output current will be reduced to 80% if the normal rated output current is 100%, and the overload capacity will be reduced to the values as follows.
When CT is selected: 100% per every 3 minutes, 150% per every 30 seconds.
When VT is selected: 100% per every 37 seconds, 120% per every 13 seconds.



IMPORTANT

If L8-32 is set to 0, be sure to set H2-01 to H2-03 multi-function contact outputs to 10 (minor fault) or to 3D (Inverter's cooling fan fault.) If a cooling fan fault occurs, stop the Inverter immediately and replace the cooling fan. If the Inverter continues to run while a cooling fan fault occurs, the Inverter's cooling ability will be affected and the Inverter's internal temperature will increase and shorten the Inverter's life.
During a cooling fan fault, the cooling fan stops for about 3 seconds every minute (interval operation.)

Inverter Protection

This section explains the functions for protecting the Inverter and the braking resistor.

◆ Performing Overheating Protection on Mounted Braking Resistors

Perform overheating protection on Inverter-mounted braking resistors (Model: ERF-150WJ □□).

When overheating in a mounted braking resistor is detected, an alarm RH (Mounted braking resistor overheating) is displayed on the Digital Operator, and the motor coasts to a stop.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
L8-01	Protect selection for internal DB resistor (Type ERF)	0: Disabled (no overheating protection) 1: Enabled (overheating protection)	0 or 1	0	No	A	A	A	4ADH

Multi-function Contact Outputs (H2-01 to H2-03)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
D	Braking resistor fault (ON: Resistor overheat or braking transistor fault)	Yes	Yes	Yes



INFO

The most likely causes of RH (Mounted braking resistor overheating) being detected are that the deceleration time is too short or that the motor regeneration energy is too large. In these cases, lengthen the deceleration time or replace the Braking Resistor Unit with one with a higher breaking capacity.

When using a braking resistor other than the Braking Resistor Unit, provide a sequence with a thermal overload relay or similar means to turn off the power input to the Inverter when it detects resistor overheating. See the Connection Diagram on page 2-3 for this sequence circuit.

◆ Reducing Inverter Overheating Pre-Alarm Warning Levels

The Inverter detects the temperature of the cooling fins using the thermistor, and protects the Inverter from overheating. You can receive Inverter overheating pre-alarms in units of 1°C.

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

■ Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
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	A	A	4AEH
L8-03	Operation selection after over-heat pre-alarm	Sets the operation for when the Inverter overheat pre-alarm goes ON. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	A	A	4AFH

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

Input Terminal Functions

This section explains input terminal functions, which set operating methods by switching functions for the multi-function contact input terminals (S3 to S8).

◆ Temporarily Switching Operation between Digital Operator and Control Circuit Terminals

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

You can switch between local and remote by turning ON and OFF the terminals if an output from H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) has been set to 1 (local/remote selection).

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

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b1-01	Reference selection	Set the speed reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H
b1-02	Operation method selection	Set the Run Command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option card	0 to 3	1	No	Q	Q	Q	181H



INFO

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

◆ Blocking Inverter Outputs (Baseblock Commands)

Set 8 or 9 (Baseblock command NO/NC) in one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) to perform baseblock commands using the terminal's ON/OFF operation, and prohibit Inverter output using the baseblock commands. At this time, the motor will be coasting and “BB” will blink on the Digital Operator.

Clear the baseblock command to restart the operating using speed search.

Multi-function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods		
		Se-quence Test	Flux Vector for PM	Open Loop Vector for PM
8	External baseblock NO (NO contact: Baseblock at ON)	Yes	Yes	Yes
9	External baseblock NC (NC contact: Baseblock at OFF)	Yes	Yes	Yes

■ Time Chart

The time chart when using baseblock commands is shown below.

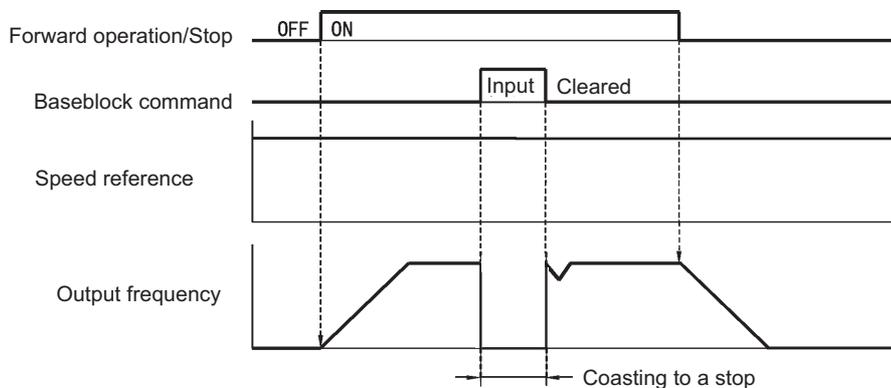


Fig 6.38 Baseblock Commands



- If using baseblock commands with a variable load, do not frequently input baseblock commands during operation, as this may cause the motor to suddenly start coasting, and may result in the motor falling or slipping.
- If the baseblock command is cleared when the output frequency is high (100 Hz or more), OC, OV, or STO alarm may occur. Clear the baseblock command when the output frequency is less than 100 Hz.

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

The acceleration/deceleration ramp hold function stops acceleration and deceleration, stores the motor speed (output frequency) at that point in time, and then continues operation.

Set one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) to A (acceleration/deceleration ramp hold) to stop acceleration and deceleration when the terminal is turned ON and to store the motor speed (output frequency) at that point in time. Acceleration and deceleration will restart when the terminal is turned OFF.

If d4-01 is set to 1 and the Acceleration/Deceleration Ramp Hold command is input, the motor speed (output frequency) is still stored even after the power supply is turned OFF.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d4-01	Speed reference hold function selection	Sets whether or not speeds on hold will be recorded. 0: Disabled (when operation is stopped or the power is turned on again starts at 0.) 1: Enabled (when operation is stopped or the power is turned on again starts at the previous hold speed.) This function is available when the multi-function inputs “accel/decel Ramp Hold” or “up/down” commands are set.	0 or 1	0	No	No	A	A	298H

■ Time Chart

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

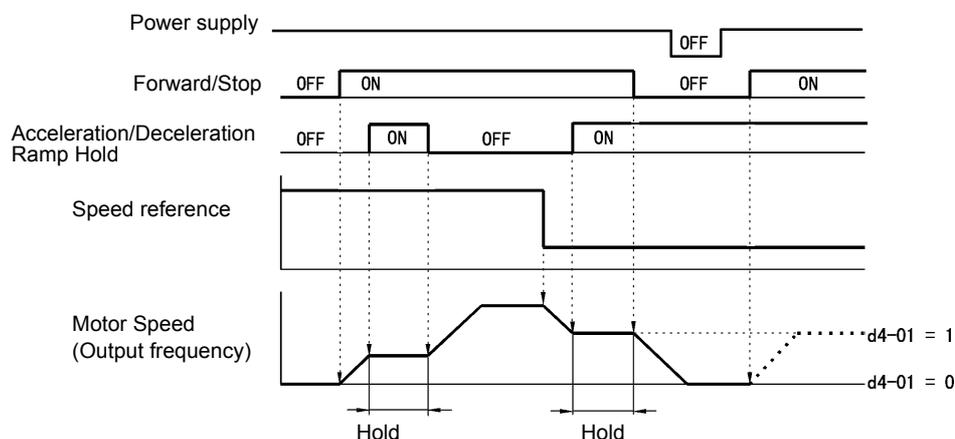


Fig 6.39 Acceleration/Deceleration Ramp Hold

■ Application Precautions

- When d4-01 is set to 1, the motor speed (output frequency) on hold is stored even after the power supply is turned OFF. If performing operations using this speed (frequency) after the Inverter has also been turned OFF, input the Run Command with the Acceleration/Deceleration Ramp Hold turned ON.
- When d4-01 is set to 0 and a Run Command is input while the Acceleration/Deceleration Ramp Hold is turned ON, the motor speed (output frequency) will be set to zero.
- If you input an Acceleration/Deceleration Ramp Hold command by error when decelerating during positioning, deceleration may be canceled.

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

The UP and DOWN commands raise and lower Inverter speed references by turning ON and OFF a multi-function contact input terminal S3 to S8.

To use this function, set one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) to 10 (UP command) and 11 (DOWN command). Be sure to allocate two terminals so that the UP and DOWN commands can be used as a pair.

The motor speed (output frequency) depends on the acceleration and deceleration time. 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	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d2-01	Speed reference upper limit	Set the motor speed upper limit as a percentage of the maximum speed.	0.0 to 110.0	100.0%	No	A	A	A	289H
d2-02	Speed reference lower limit	Sets the motor speed lower limit as a percentage of the maximum speed.	0.0 to 110.0	0.0%	No	A	A	A	28AH
d2-03	Master speed reference lower limit	Set the master speed reference lower limit as a percentage of the maximum speed.	0.0 to 110.0	0.0%	No	A	A	A	293H

■ Precautions

When setting and using UP and DOWN commands, observe the following precautions.

Setting Precautions

If multi-function input terminals S3 to S8 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.

Application Precautions

- Speed outputs using UP/DOWN commands are limited by the speed reference upper and lower limits set in constants d2-01 to d2-03. Here, speed references from analog speed reference terminal A1 becomes the speed reference lower limit. If using a combination of the speed reference from terminal A1 and the speed reference lower limit set in either constant d2-02 or d2-03, the larger lower limit will become the speed reference lower limit.
- If inputting the Run Command when using UP/DOWN commands, the motor speed (output frequency) accelerates to the speed reference lower limit.
- When using UP/DOWN commands, multi-step operations are disabled.
- When d4-01 (Speed Reference Hold Function Selection) is set to 1, the speed reference held 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 speed reference that has been stored. To reset (clear to 0) the stored speed reference, turn ON the UP or DOWN command while the Run Command is OFF.

■ 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

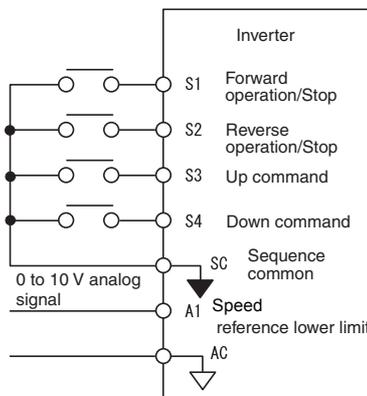
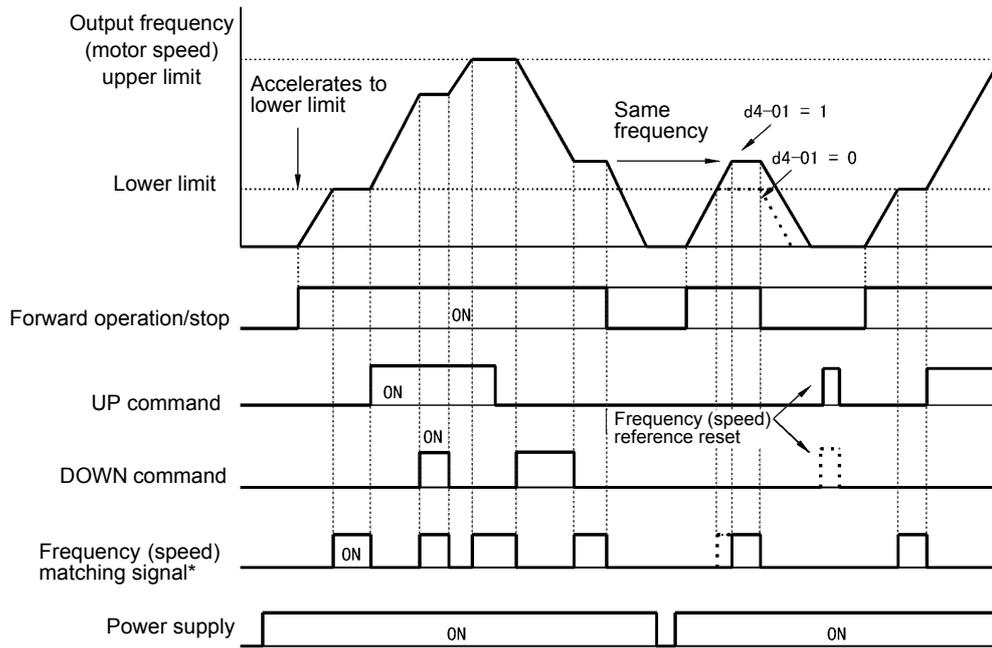


Fig 6.40 Connection Example when UP/DOWN Commands Are Allocated



* The frequency (speed) matching signal turns ON when the motor is not accelerating/ decelerating while the Run Command is ON.

Fig 6.41 UP/DOWN Commands Time Chart

◆ Accelerating and Decelerating Constant Speeds in the Analog References (+/- Speed)

The +/- speed function increments or decrements the speed set in analog speed reference d4-02 (+/- Speed Limit) using two contact signal inputs.

To use this function, set One of the constants H1-01 to H1-06 (multi-function contact terminal inputs S3 to S8 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 can be used as a pair.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d4-02	+ - Speed limits	Set the speed to be add to or subtracted from the analog speed reference as a percent, taking the maximum speed 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	No	A	A	299H

■ Trim Control Increase/Decrease Command and Speed Reference

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

Speed Reference	Set Speed Reference + d4-02	Set Speed Reference - d4-02	Set Speed Command	
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 is from an analog input.
- When the analog speed reference value - d4-02 < 0, the speed reference is set to 0.
- If only the Trim Control Increase command or Trim Control Decrease command has been set for a multi-function contact input terminal S3 to S8, operation error OPE03 (invalid multi-function input selected) will occur.

◆ Hold Analog Speed Using User-set Timing

When one of H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) is set to 1E (sample/hold analog speed command), the analog speed reference will be held from 100 ms after the terminal is turned ON, and operation will continue thereafter at that speed.

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

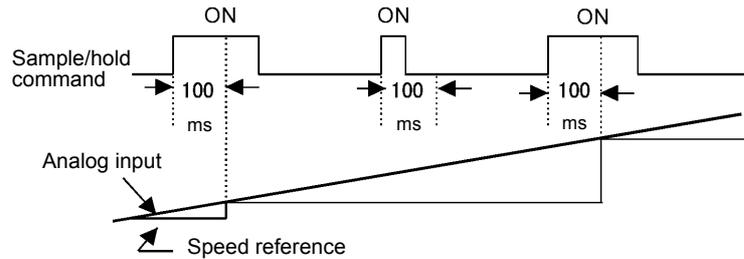


Fig 6.42 Sample/hold Analog Speed

■ Precautions

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

Setting Precautions

When using sample/hold of analog speed reference, you cannot use the following commands at the same time. If these commands are used at the same time, 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 speed references, be sure to store references of 100 ms minimum. If the reference time is less than 100 ms, the speed reference will not be held.
- The analog speed reference that is held will be deleted when the power supply is turned OFF.

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

You can switch reference input between the Communications option card and the control circuit terminals. Set one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) to 2 (Option/Inverter selection) to enable switching reference input using the terminal ON/OFF status when the Inverter is stopped.

■ Setting Precautions

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

- Set b1-01 (Reference Selection) to 1 (Control circuit terminal [analog input])
- Set b1-02 (Operation Method Selection) to 1 (Control circuit terminal (sequence inputs))
- Set one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) to 2 (Option/Inverter selection).

Terminal Status	Speed Reference and Run Command Selection
OFF	Inverter (Can be operated from speed reference or control circuit terminal from analog input terminal.)
ON	Communications option card (Speed reference and Run Command are enabled from Communications option card.)

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

The FJOG/RJOG command functions operate the Inverter using jog speeds 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 H1-06 (multi-function contact input terminal S3 to S8 function selection) to 12 (FJOG command) or 13 (RJOG command).

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d1-17	Jog speed reference	The speed reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.	0.00 to 100.00 *	10.00%	Yes	Q	Q	Q	292H

* For sequence test (display unit: Hz), the setting ranges change. For open-loop/flux vector control or vector control with a PG for PM, the upper limits of the setting would be calculated by the following formula: $E1-09 \times E5-04 + 120$. For sequence test, the upper limits of the setting would be E1-09.

Multi-Function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
12	FJOG command (ON: Forward run at jog frequency d1-17)	No	Yes	Yes
13	RJOG command (ON: Reverse run at jog frequency d1-17)	No	Yes	Yes

■ Application Precautions

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

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

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

To use the external fault function, set one of the values 20 to 2F in one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection).

Select the value to be set in H1-01 to H1-06 from a combination of any of the following three conditions.

- Signal input level from peripheral devices
- External fault detection method
- Operation during external fault 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. Set the input level to detect errors using either signal ON or signal OFF. (NO contact: External fault when ON; NC contact: External fault 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.

Output Terminal Functions

The output terminal function, which sets the output methods by switching the settings of H2-01 to H2-03 (Multi-function contact output terminals M1-M2, P1-PC, and P2-PC), is described here.

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	Baseblock, DC injection braking, initial excitation, operation stop, or during initial magnetic pole calculation.
ON	The Inverter is outputting a frequency.

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

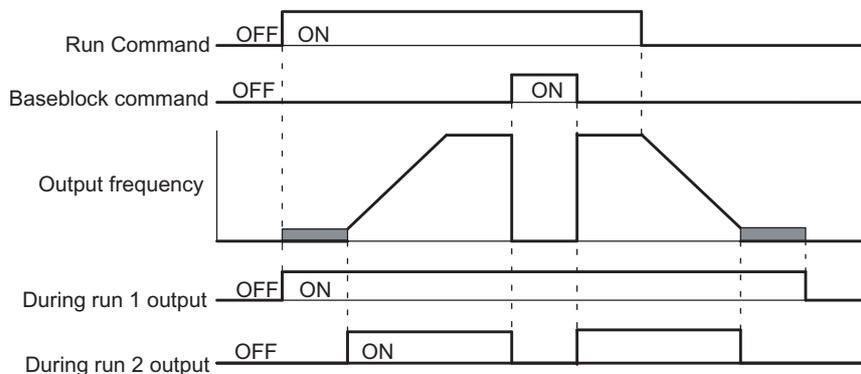


Fig 6.43 Timing Chart for "During RUN" Output

Zero-speed (Setting: 1)

OFF	The motor speed (output frequency) is greater than the minimum speed (E1-09). [With flux vector control for PM, is greater than the zero-speed level]
ON	The motor speed (output frequency) is less than the minimum speed (E1-09). [With flux vector control for PM, is less than the zero-speed level (b2-01).]

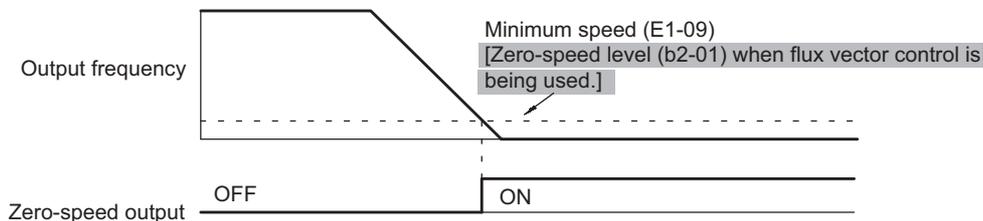


Fig 6.44 Timing Chart for Zero-speed

Motor Overload (OL1) Pre-alarm (Setting: 1F)

OFF	The motor protection function's electronic thermal value is less than 90% of the detection level.
ON	The motor protection function's electronic thermal value is greater than 90% of the detection level.

- This output function is valid when the motor overload protection function is enabled (L1-01 =1).
- This output can be used to warn of overheating before the protection function itself operates.

Inverter Overheat (OH) Pre-alarm (Setting: 20)

OFF	The cooling fin temperature is less than the "OH Pre-Alarm Level" set in L8-02.
ON	The cooling fin temperature exceeds the "OH Pre-Alarm Level" set in L8-02.

- This output function indicates that the temperature of the cooling fins reaches the temperature set in L8-02 (the Inverter overheating alarm detection level).

Speed reference limit (Setting: 31)

OFF	Other than ON condition
ON	<p>Enables the speed reference limit in the following conditions:</p> <ul style="list-style-type: none"> • Speed reference \geq Speed reference upper limit (d2-01) • Speed reference \leq Speed reference lower limit (d2-02) • Speed reference \geq Speed reference lower limit of the multi-function analog input (Setting: 9) • The speed reference is the Min. Speed (E1-09) or less in open-loop vector control for PM. • The speed reference is the Min. Speed (E1-09) or less, and b1-05 is set to 1, 2, or 3 in flux vector control for PM.

Integral power (Setting: 39) (SPEC: C or later)

ON	The integral power has exceeded the output level set to H2-06. (Contact output for 200 ms.)
----	---

The contact output function with integral power will integrate the power used to run the Inverter every 100 ms. If the power surpasses the level set at H2-06, the multi-function output terminal will send a signal for 0.2 seconds to indicate that the power is too high.

The following diagram shows an example of the Multi-function contact output.



INFO

- The power will not be integrated, if the power value is negative, indicating a regenerative state.
- The integral power value will be maintained while control power is being supplied. If control power is cut off because of a momentary power loss or other reason, however, the integral power value will be reset.

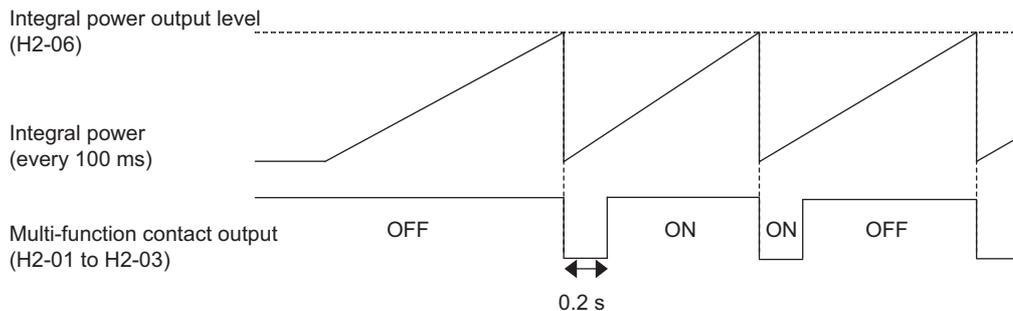


Fig 6.45 Example of Multi-function Contact Output when Integral Power is ON

Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H2-06	Integral power output level selection	Select the output level for the multi-function contact when selecting 39 to one of H2-01 to H2-03. 0: 0.1 kWh 1: 1 kWh 2: 10 kWh 3: 100 kWh 4: 1000 kWh	0 to 4	0	No	A	A	A	437H



INFO

- If the integral power output level selection (H2-06) is changed, the integral power value will be automatically reset.
- If the integral power value has exceeded the set level while the integral power (multi-function contact output) is still on, then the multi-function contact output will remain on.

Fan fault alarm (Setting: 3A or 3B) (SPEC: C or later)

To enable the contact output for the fan fault alarm, set one of H2-01 to H2-03 to 3A or 3B.

3A	ON	Fan fault alarm (NO contact output)
3B	ON	Fan fault alarm (NC contact output)

The fan fault alarm contact will be on if any fan-related fault or alarm, such as Overheat (OH), OH1, OH2, or FAN occurs. For details on individual faults or alarms, refer to *Chapter 7 Troubleshooting*.

Monitor Constants

This section explains the analog monitor and pulse monitor constants.

◆ Using the Analog Monitor Constants

This section explains the analog monitor constants.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H4-01	Monitor selection (terminal FM)	Sets the number of the monitor item to be output (U1-□□) from terminal FM. The monitor items that can be set depends on the control method. 4, 10 to 14, 28 to 30, 34, 39 to 41, 49, 58, 61, 63, 70 to 77, 79 to 82 cannot be set. 23, 25, 35, 42, 43, 45 to 48, 50 to 57, 60, 62, 64 to 67, 83 to 99 are not used.	1 to 99	5 *2	No	A	A	A	41DH
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available. *1	0.00 to 2.50	1.00	Yes	Q	Q	Q	41EH
H4-03	Bias (terminal FM)	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available. *1	-10.0 to +10.0	0.0%	Yes	A	A	A	41FH
H4-04	Monitor selection (terminal AM)	Sets the number of the monitor item to be output (U1-□□) from terminal AM. The monitor items that can be set depends on the control method. 4, 10 to 14, 28 to 30, 34, 39 to 41, 49, 58, 61, 63, 70 to 77, 79 to 82 cannot be set. 23, 25, 35, 42, 43, 45 to 48, 50 to 57, 60, 62, 64 to 67, 83 to 99 are not used.	1 to 99	3 *2	No	A	A	A	420H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H4-05	Gain (terminal AM)	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maximum output from the terminal is 10 V. A meter calibration function is available.* ¹	0.00 to 2.50	0.50	Yes	Q	Q	Q	421H
H4-06	Bias (terminal AM)	Sets the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.* ¹	-10.0 to +10.0	0.0%	Yes	A	A	A	422H
H4-07	Analog output 1 signal level selection	Sets the signal output level for multi-function output 1 (terminal FM) 0: 0 to +10 V output 1: -10 to 10 V output	0 or 1	0	No	A	A	A	423H
F4-01	Channel 1 monitor selection	Effective when the Analog Monitor Board is used. Monitor selection: Set the number of the monitor item to be output. (U1-□□) The monitor items that can be set depends on the control method.	1 to 99	5 * ²	No	A	A	A	391H
F4-02	Channel 1 gain	Gain: Set the multiple of 10 V for outputting monitor items.	0.00 to 2.50	1.00	Yes	A	A	A	392H
F4-03	Channel 2 monitor selection	4, 10 to 14, 28 to 30, 34, 39 to 41, 49, 58, 61, 63, 70 to 77, and 79 to 82 cannot be set. 23, 25, 35, 42, 43, 45 to 48, 50 to 57, 59, 60, 62, 64 to 67, and 83 to 99 are not used. When the AO-12 Analog Monitor Board is used, outputs of ± 10 V are possible. To output ± 10 V, set F4-07 or F4-08 to 1.	1 to 99	3 * ²	No	A	A	A	393H
F4-04	Channel 2 gain	When the AO-08 Analog Monitor Board is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.* ³	0.00 to 2.50	0.50	Yes	A	A	A	394H
F4-05	Channel 1 output monitor bias	Sets the channel 1 item bias to 100%/10 V when the Analog Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	395H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F4-06	Channel 2 output monitor bias	Sets the channel 2 item bias to 100%/10 V when the Analog Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	396H
F4-07	Analog output signal level for channel 1	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	397H
F4-08	Analog output signal level for channel 2	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	398H

- * 1. Adjustment target is the FM terminal when the H4-02 or H4-03 setting is displayed in quick, advanced, or verify mode while the motor is stopped. Adjustment target is the AM terminal when the H4-05 or H4-06 setting is displayed in quick, advanced, or verify mode while the motor is stopped. To adjust the meter, multiply a value that is equivalent to 100% of the output by the gain setting and add the set bias.
- * 2. The setting value will return to the factory setting if the control method is changed.
- * 3. Adjustment target is the CH1 output when the F4-02 or F4-05 setting is displayed in quick, advanced, or verify mode while the motor is stopped. Adjustment target is the CH2 output when the F4-04 or F4-06 setting is displayed in quick, advanced, or verify mode while the motor is stopped. To adjust the meter, multiply a value equivalent to 100% of the output by the gain setting, and then add the set bias.

■ Selecting Analog Monitor Items

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

Alternatively, you can output monitor items (U1-□□ [status monitor]) from analog output option terminal channels 1 and 2 on analog monitor boards AO-08 and AO-12. Refer to the table of constants, and set the values.

■ 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. Also, adjust the output voltage for output channels 1 and 2 of Analog Output option cards AO-08 and AO-12 using the gain and bias in F4-02, F4-04, F4-05, and F4-06.

Adjusting the Meter

The output voltage for terminals FM-AC and AM-AC and output channels 1 and 2 of the AO option card can be adjusted while the Inverter is stopped. For example, just pressing the Enter Key and displaying the data setting display for H4-02 or H4-03 will cause the following voltage to be output by the FM-AC terminals.

$$10 \text{ V}/100\% \text{ monitor output} \times \text{output gain (H4-02)} + \text{output bias (H4-03)}$$

Just pressing the Enter Key and displaying the data setting display for F4-02 or F4-05 will cause the following voltage to be output to channel 1 of the AO option card.

$$10 \text{ V}/100\% \text{ monitor output} \times \text{output gain (F4-02)} + \text{output bias (F4-05)}$$

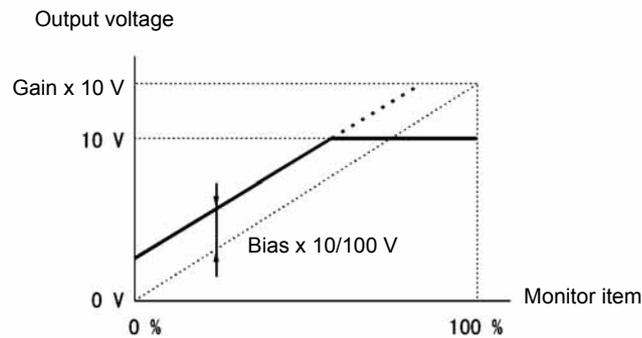


Fig 6.46 Monitor Output Adjustment

■ Switching Analog Monitor Signal Levels

Monitor items corresponding to -10 to 10 V output 0 to 10 V signals when the monitor value is positive (+), and 0 to -10 V signals when the monitor value is negative (-). For monitor items corresponding to -10 to 10 V, refer to *Chapter 5 User Constants*.



INFO

You can select the signal levels separately for multi-function analog output terminals and analog output option terminals.

◆ Using Pulse Train Monitor Contents

This section explains pulse monitor constants.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
H6-06	Pulse train monitor selection	Select the pulse train monitor output items (value of the □□ part of U1-□□). There are two types of monitor items: Speed-related items and PID-related items.	1, 2, 5, 20, 24, 36	2	Yes	No	A	A	431H
H6-07	Pulse train monitor scaling	Set the number of pulses output when speed is 100% in Hz. Set H6-06 to 2, and H6-07 to 0, to make the pulse train monitor output synchronously to the motor speed.	0 to 32000	1440 Hz	Yes	No	A	A	432H

■ Selecting Pulse Monitor Items

Output digital operator monitor items (U1-□□ [status monitor]) from pulse monitor terminal MP-AC. Refer to *Chapter 5 User Constants*, and set the □□ part of U1-□□ (Status monitor). The possible monitor selections are limited as follows: U1-01, 02, 05, 20, 24, 36.

■ Adjusting the Pulse Monitor Items

Adjust the pulse frequency output from pulse monitor terminal MP-AC. Set the pulse frequency output when 100% frequency is output to H6-07.

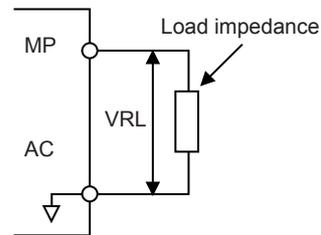
Set H6-06 to 2, and H6-07 to 0, to output the frequency synchronous with the Inverter's U-phase output.

■ Application Precautions

When using a pulse monitor constant, connect a peripheral device according to the following load conditions. If the load conditions are different, there is a risk of characteristic insufficiency or damage to the machinery.

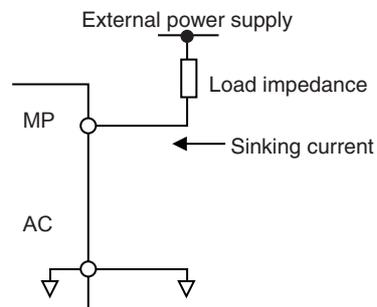
Using a Sourcing Output

Output Voltage (Isolated) VRL (V)	Load Impedance (kΩ)
+5 V min.	1.5 kΩ min.
+8 V min.	3.5 kΩ min.
+10 V min.	10 kΩ min.



Using a Sinking Input

External Power Supply (V)	12 VDC±10%, 15 VDC±10%
Sink Current (mA)	16 mA Max



Individual Functions

This section explains the individual functions used in special applications.

◆ Using MEMOBUS Communications

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

■ MEMOBUS Communications Configuration

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

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

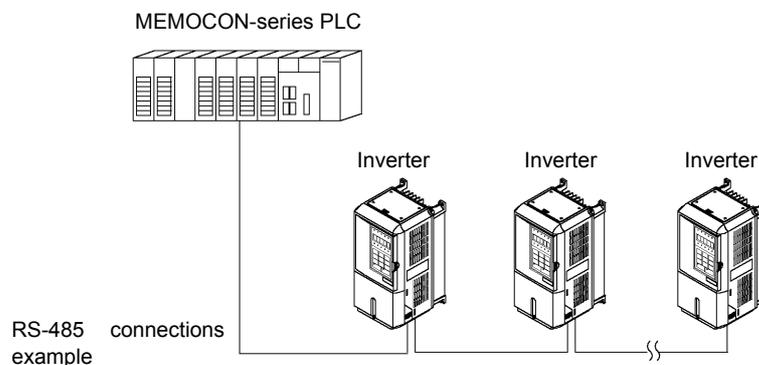


Fig 6.47 Example of Connections between PLC and Inverter

■ 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 fixed
Communications Protocol	MEMOBUS (RTU mode only)
Number of Connectable Units	31 units max. (when using RS-485)

■ Communications Connection Terminal

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

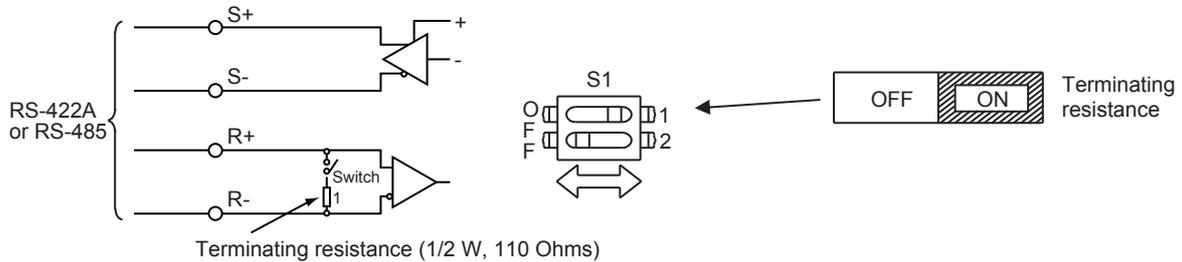
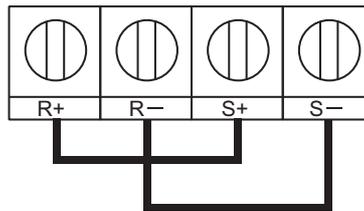


Fig 6.48 Communications Connection Terminal



IMPORTANT

1. Separate the communication cables from the main circuit cables and other wiring and power cables.
2. Use shielded cables for the communication cables, connect the shield cover to the Inverter earth terminal, and arrange the terminals so that the other end is not connected to prevent operating errors due to noise.
3. When using RS-485 communications, connect S+ to R+, and S- to R-, on the Inverter exterior.



■ Procedure for Communicating with the PLC

Use the following procedure to perform communications with the PLC.

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



INFO

Set the timer on the master to monitor response time from the slave. Set the master so that if the slave does not respond to the master within the set time, the same command message will be sent from the master again.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b1-01	Reference selection	Set the speed reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: MEMOBUS communications 3: Option card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H
b1-02	Operation method selection	Set the Run Command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: MEMOBUS communications 3: Option card	0 to 3	1	No	Q	Q	Q	181H
H5-01	Slave address	Set the Inverter's slave address.	0 to 20 *	1FH	No	A	A	A	425H
H5-02	Communication speed selection	Set the baud rate for MEMOBUS communications of communications connection terminals. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	A	A	426H
H5-03	Communication parity selection	Set the parity for MEMOBUS communications of communications connection terminals. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	A	A	427H
H5-04	Stopping method after communication error	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	3	No	A	A	A	428H
H5-05	Communication error detection selection	Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect. 1: Detect	0 or 1	1	No	A	A	A	429H
H5-06	Send wait time	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	A	A	42AH

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
H5-07	RTS control ON/OFF	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	A	A	42BH

* 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 from the PLC
- 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 S8.

■ Message Format

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

Slave address
Function code
Data
Error check

The space between messages must support the following.

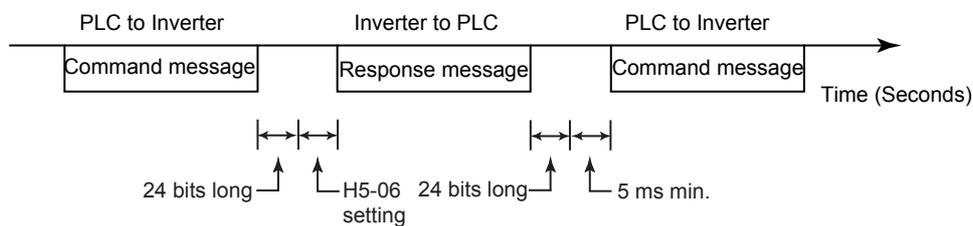


Fig 6.49 Message Spacing

Slave Address

Set the Inverter address from 0 to 20 Hex. If you set 0, commands from the master will be broadcast (i.e., the Inverter will not return responses).

■Function Code

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

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

Data

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

Error Check

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

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

MEMOBUS Message Example

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

Reading Storage Register Contents

Read the contents of the storage register only for specified quantities whose addresses are consecutive, starting from a specified address. The contents of the storage register are separated into higher place 8 bits and lower place 8 bits, and comprise the data within response messages in address order.

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

Command Message			Response Message (During Normal Operation)			Response Message (During Error)		
Slave Address		02H	Slave Address		02H	Slave Address		02H
Function Code		03H	Function Code		03H	Function Code		83H
Start Address	Higher place	00H	Data quantity		08H	Error code		03H
	Lower place	20H	Lead storage register	Higher place	00H	CRC-16	Higher place	F1H
Quantity	Higher place	00H		Lower place	65H		Lower place	31H
	Lower place	04H	Next storage register	Higher place	00H			
CRC-16	Higher place	45H		Lower place	00H			
	Lower place	F0H	Next storage register	Higher place	00H			
				Lower place	00H			
			Next storage register	Higher place	01H			
				Lower place	F4H			
			CRC-16	Higher place	AFH			
				Lower place	82H			

Loopback Test

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

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

Command Message			Response Message (During Normal Operation)			Response Message (During Error)		
Slave address		01H	Slave address		01H	Slave address		01H
Function code		08H	Function code		08H	Function code		89H
Test Code	Higher place	00H	Test Code	Higher place	00H	Error Code		01H
	Lower place	00H		Data	Lower place	00H	CRC-16	Higher place
Data	Higher place	A5H	Data		Higher place	A5H		CRC-16
	Lower place	37H		CRC-16	Lower place	37H		
CRC-16	Higher place	DAH	CRC-16		Higher place	DAH		
	Lower place	8DH		CRC-16	Lower place	8DH		

Writing to Multiple Storage Registers

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

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

Command Message			Response Message (During Normal Operation)			Response Message (During Error)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		10H	Function Code		10H	Function Code		90H
Start Address	Higher place	00H	Start Address	Higher place	00H	Error code		02H
	Lower place	01H		Quantity	Lower place	01H	CRC-16	Higher place
Quantity	Higher place	00H	Quantity		Higher place	00H		CRC-16
	Lower place	02H		CRC-16	Lower place	02H		
No. of data		04H	CRC-16		Higher place	10H		
Lead data	Higher place	00H		CRC-16	Lower place	08H		
	Lower place	01H						
Next data	Higher place	02H						
	Lower place	58H						
CRC-16	Higher place	63H						
	Lower place	39H						



INFO

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

■ Data Tables

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

Reference Data

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

Register No.	Contents	
0000H	Not used	
0001H	Speed (frequency) reference	
	Bit 0	Forward Run/Stop Command 1: Forward run 0: Stop
	Bit 1	Reverse Run/Stop Command 1: Reverse run 0: Stop
	Bit 2	External fault 1: Error (EFO)
	Bit 3	Fault 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
	Bit B	Multi-function input command 8
Bit C to F	Not used	
0002H	Speed (frequency) reference (Set units using constant 01-03)	
0003H	Not used	
0004H	Not used	
0005H	Not used	
0006H	PID target value	
0007H	Analog output 1 setting (-11 V/-1540 to 11 V/1540)	
0008H	Analog output 2 setting (-11 V/-1540 to 11 V/1540)	
0009H	Multi-function contact output setting	
	Bit 0	Contact output (Terminal M1-M2) 1: ON 0: OFF
	Bit 1	PHC1(Contact P1-PC) 1: ON 0: OFF
	Bit 2	PHC2(Contact P2-PC) 1: ON 0: OFF
	Bit 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	Use MEMOBUS 0006H PID target value 1: Enabled 0: Disabled
	Bits 2 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	Broadcast data terminal S8 input 1: Enabled 0: Disabled

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

Monitor Data

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

Register No.	Contents	
0020H	Inverter status	
	Bit 0	Operation 1: Operating 0: Stopped
	Bit 1	Reverse operation 1: Reverse operation 0: Forward operation
	Bit 2	Inverter startup complete 1: Completed 2: Not completed
	Bit 3	Error 1: Error
	Bit 4	Data setting error 1: Error
	Bit 5	Multi-function contact output (terminal M1 - M2) 1: ON 0: OFF
	Bit 6	Multi-function PHC output 1 (terminal P1 - PC) 1: ON 0: OFF
	Bit 7	Multi-function PHC output 2 (terminal P2 - PC) 1: ON 0: OFF
	Bits 8 to B	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	Injection brake transistor resistance overheat (rr, rH)
	Bit 5	Fuse blown (PUF)
	Bit 6	PID feedback reference lost (FbL)
	Bit 7	External fault (EF, EFO)
	Bit 8	Hardware error (CPF)
	Bit 9	Motor overload (OL1), overtorque 1 (OL3) detected, or overtorque 2 (OL4) detected
	Bit A	PG broken wire detected (PGO), Overspeed (OS), Speed deviation (DEV)
	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	Main Circuit Voltage Fault (PF), Output Open-phase (LF)	
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	Speed reference (U1-01)	
0024H	Output frequency (U1-02)	
0025H	Output voltage reference (U1-06)	
0026H	Output current (U1-03) (Unit: 1/0.1A)	
0027H	Output power (U1-08)	
0028H	Torque reference (U1-09)	
0029H	Not used	
002AH	Not used	
002BH	Sequence input status	
	Bit 0	Multi-function contact input terminal S1 1: ON, 0: OFF
	Bit 1	Multi-function contact input terminal S2 1: ON, 0: OFF
	Bit 2	Multi-function contact input terminal S3 1: ON, 0: OFF
	Bit 3	Multi-function contact input terminal S4 1: ON, 0: OFF
	Bit 4	Multi-function contact input terminal S5 1: ON, 0: OFF
	Bit 5	Multi-function contact input terminal S6 1: ON, 0: OFF
	Bit 6	Multi-function contact input terminal S7 1: ON, 0: OFF
	Bit 7	Multi-function contact input terminal S8 1: ON, 0: OFF
	Bits 8 to F	Not used

Register No.	Contents	
002CH	Inverter status	
	Bit 0	Operation 1: Operating
	Bit 1	Zero-speed 1: Zero-speed
	Bit 2	Frequency (speed) matching 1: Matched
	Bit 3	User-defined speed matching 1: Matched
	Bit 4	Frequency detection 1 1: Output frequency ≤ L4-01
	Bit 5	Frequency detection 2 1: Output frequency ≥ L4-01
	Bit 6	Inverter startup completed 1: Startup completed
	Bit 7	Low voltage detection 1: Detected
	Bit 8	Baseblock 1: Inverter output baseblock
	Bit 9	Speed (frequency) reference mode 1: Not communications 0: Communications
	Bit A	Run Command mode 1: Not communications 0: Communications
	Bit B	Overtorque detection 1: Detected
	Bit C	Speed (frequency) reference lost 1: Lost
	Bit D	Retrying error 1: Retrying
Bit E	Error (including MEMOBUS communications time-out) 1: Error occurred	
Bit F	MEMOBUS communications time-out 1: Timed out	
002DH	Multi-function contact output status	
	Bit 0	Multi-function contact output (terminal M1-M2) 1: ON 0: OFF
	Bit 1	Multi-function PHC output 1 (terminal P1 - PC) 1: ON 0: OFF
	Bit 2	Multi-function PHC output 2 (terminal P2 - PC) 1: ON 0: OFF
	Bits 3 to F	Not used
002EH - 0030H	Not used	
0031H	Main circuit DC voltage	
0032H	Torque monitor (Unit: 1/0.1%)	
0033H	Output power (U1-08)	
0034H - 0037H	Not used	
0038H	PID feedback quantity (Input equivalent to 100%/Max. speed; 10/1%; without sign)	
0039H	PID input quantity (±100%/±Max. speed; 10/1%; with sign)	
003AH	PID output quantity (±100%/±Max. speed; 10/1%; with sign)	
003BH	CPU software number	
003CH	Flash software number	
003DH	Communications error details	
	Bit 0	CRC error
	Bit 1	Invalid data length
	Bit 2	Not used
	Bit 3	Parity error
	Bit 4	Overrun error
	Bit 5	Framing error
	Bit 6	Time-out
Bits 7 to F	Not used	
003EH	kVA setting	
003FH	Control method	

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

Broadcast Data

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

Register Address	Contents	
0001H	Operation signal	
	Bit 0	Run Command 1: Operating 0: Stopped
	Bit 1	Reverse operation command 1: Reverse 0: Forward
	Bits 2 and 3	Not used
	Bit 4	External fault 1: Error (set using H1-01)
	Bit 5	Fault reset 1: Reset command (set using H1-02)
	Bits 6 to B	Not used
	Bit C	Multi-function contact input terminal S5 input
	Bit D	Multi-function contact input terminal S6 input
	Bit E	Multi-function contact input terminal S7 input
	Bit F	Multi-function contact input terminal S8 input
0002H	Frequency reference	30000/100%

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

■ENTER Command

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

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

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

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

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



INFO

The maximum number of times you can write to EEPROM using the Inverter is 100 thousand. Do not frequently execute ENTER commands (0900H) written to EEPROM.

The ENTER command registers are write-only. Consequently, if reading these registers, the register address will become invalid (Error code: 02H).

■ Error Codes

The following table shows MEMOBUS communications error codes.

Error Code	Contents
01H	Function code error A function code other than 03H, 08H, or 10H has been set by the PLC.
02H	Invalid register number error <ul style="list-style-type: none">• The register address you are attempting to access is not recorded anywhere.• With broadcast sending, a start address other than 0000H, 0001H, or 0002H has been set.
03H	Invalid quantity error <ul style="list-style-type: none">• The number of data packets being read or written is outside the range 1 to 16.• In write mode, the number of data packets in the message is not No. of packets x 2.
21H	Data setting error <ul style="list-style-type: none">• 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 <ul style="list-style-type: none">• Attempting to write constants from the PLC during operation.• Attempting to write via ENTER commands from the PLC during operation.• Attempting to write constants other than A1-00 to A1-05, E1-03, or 02-04 when warning alarm CPF03 (defective EEPROM) has occurred.• Attempting to write read-only data.
23H	Writing during main circuit undervoltage (UV) error <ul style="list-style-type: none">• Writing constants from the PLC during UV (main circuit undervoltage) alarm.• Writing via ENTER commands from the PLC during UV (main circuit undervoltage) alarm.
24H	Writing error during constants processing Attempting to write constants from the PLC while processing constants in the Inverter.

■ Slave Not Responding

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

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

Application Precautions

Set a timer in the master to monitor response time from the slaves. Make the setting so that if no response is sent to the master from the slave within the set time, the same command message is sent again from the master.

■ Self-Diagnosis

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

Perform the self-diagnosis function using the following procedure.

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

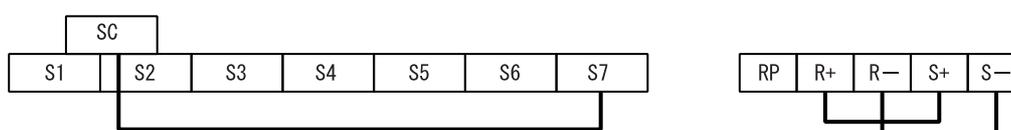


Fig 6.50 Details of Communications Terminals

“Pass” will be displayed if self-diagnosis is completed without an error occurring.

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

◆ Using the Timer Function

Multi-function contact input terminals S3 to S8 can be designated as timer function input terminals, and multi-function output terminals M1-M2, P1-PC, and P2-PC can be designated as timer function output terminals. By setting the delay time, you can erase chattering from the sensors and switches.

- Set one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8) to 18 (timer function input).
- Set H2-01 to H2-03 (multi-function output terminals M1-M2, P1-PC, and P2-PC function selection) to 12 (timer function output).

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b4-01	Timer function ON-delay time	Sets the timer function output ON-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-□□ or H2-□□.	0.0 to 300.0	0.0 s	No	No	A	A	1A3H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
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-□□ or H2-□□.	0.0 to 300.0	0.0 s	No	No	A	A	1A4H

■ 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.

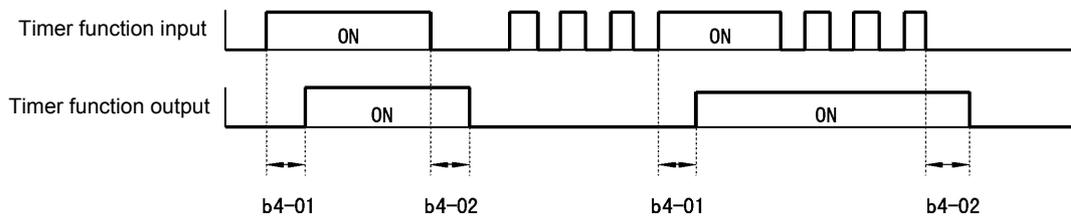


Fig 6.51 Timer Function Operation Example

◆ Using PID Control

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

The characteristics of the PID control operations are given below.

- P control Outputs the amount of operation proportional to the deviation. You cannot, however, set the deviation to zero using P control alone.
- I control Outputs the amount of operation that integrates the deviation. Used for matching feedback value to the target value. I control is not suited, however, to rapid variations.
- D control Outputs the amount of operation derived from the deviation. Can respond promptly to rapid variations.

■PID Control Operation

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

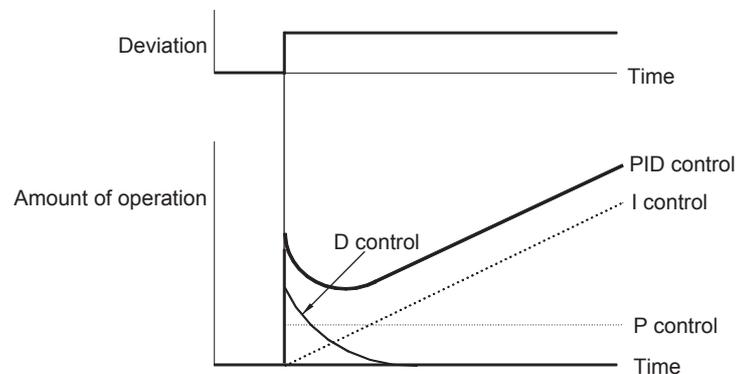


Fig 6.52 PID Control Operation

■PID Control Applications

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

Applica-tion	Control Details	Example of Sen-sor Used
Speed Control	<ul style="list-style-type: none"> Feeds back machinery speed information, and matches speed to the target value. Inputs speed information from other machinery as the target value, and performs synchronous control using the actual speed feedback. 	Tachometer genera-tor
Pressure Control	Feeds back pressure information, and performs constant pressure control.	Pressure sensor
Flow Rate Control	Feeds back flow rate information, and controls the flow rate highly accurately.	Flow rate sensor
Tempera-ture Con-trol	Feeds back temperature information, and performs temperature adjustment control by rotating the fan.	<ul style="list-style-type: none"> Thermocouple Thermistor

■Related Constants

Con-stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
b5-01	PID control method selection	0: Disabled 1: Enabled (Deviation is D-controlled.) 2: Enabled (Feedback value is D-controlled.) 3: PID control enabled (speed reference + PID output, D control of deviation) 4: PID control enabled (speed reference + PID output, D control of feedback value).	0 to 4	0	No	No	A	A	1A5H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b5-02	Proportional gain (P)	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	No	A	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	No	A	A	1A7H
b5-04	Integral (I) limit	Sets the I-control limit as a percentage of the maximum speed.	0.0 to 100.0	100.0%	Yes	No	A	A	1A8H
b5-05	Derivative (D) time	Sets D-control derivative time in 1-second units. D-control is not performed when the setting is 0.00.	0.00 to 10.00	0.00 s	Yes	No	A	A	1A9H
b5-06	PID limit	Sets the limit after PID-control as a percentage of the maximum speed.	0.0 to 100.0	100.0%	Yes	No	A	A	1AAH
b5-07	PID offset adjustment	Sets the offset after PID-control as a percentage of the maximum speed.	-100.0 to +100.0	0.0%	Yes	No	A	A	1ABH
b5-08	PID primary delay time constant	Sets the time constant for low pass filter for PID-control outputs in 1-second units. Not usually necessary to set.	0.00 to 10.00	0.00 s	Yes	No	A	A	1ACH
b5-09	PID output characteristics selection	Select forward/reverse for PID output. 0: PID output is forward. 1: PID output is reverse (highlights the output code)	0 or 1	0	No	No	A	A	1ADH
b5-10	PID output gain	Sets output gain.	0.0 to 25.0	1.0	No	No	A	A	1AEH
b5-11	PID reverse output selection	0: 0 limit when PID output is negative. 1: Reverses when PID output is negative. 0 limit when reverse prohibit is selected using b1-04.	0 or 1	0	No	No	A	A	1AFH
b5-12	Selection of PID feedback command loss detection	0: No detection of loss of PID feedback. 1: Detection of loss of PID feedback. Operation continues during detection, with the malfunctioning contact not operating. 2: Detection of loss of PID feedback. Coasts to stop during detection, and fault contact operates.	0 to 2	0	No	No	A	A	1B0H

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
b5-13	PID feed- back com- mand loss detection level	Sets the PID feedback loss detection level as a percent units, with the maximum speed at 100%.	0 to 100	0%	No	No	A	A	1B1H
b5-14	PID feed- back com- mand loss detection time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	No	A	A	1B2H
b5-15	PID sleep function operation level	Set the PID sleep function start level as a speed. (Enabled if PID control is not selected.)	0.0 to 100.0	0.0%	No	No	A	A	1B3H
b5-16	PID sleep operation delay time	Set the delay time until the PID sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	No	A	A	1B4H
b5-17	Accel/decel time for PID reference	Set the accel/decel time for PID reference in seconds.	0.0 to 25.5	0.0 s	No	No	A	A	1B5H
H6-01	Pulse train input func- tion selec- tion	0: Speed reference 1: PID feedback value 2: PID target value	0 to 2	0	No	No	A	A	42CH

■ Monitor Functions

Con- stant Number	Name	Description	Output Signal Level Dur- ing Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Regis- ter
					Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-24	PID feed- back value	Monitors the feedback value when PID control is used. The input for the maximum speed corresponds to 100%.*	10 V: Max. speed (-10 to 10 V possible)	0.01 %	A	A	A	57H
U1-36	PID input volume	PID feedback volume Given as maximum speed/ 100%	10 V: Max. speed (-10 to 10 V possible)	0.01 %	A	A	A	63H
U1-37	PID output volume	PID control output Given as maximum speed/ 100%	10 V: Max. speed (-10 to 10 V possible)	0.01 %	A	A	A	64H
U1-38	PID target value	PID target value Given as maximum speed/ 100%	10 V: Max. speed	0.01 %	A	A	A	65H

* The unit is set in 01-03 (frequency units of reference setting and monitor).

Multi-Function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes
30	PID control integral reset (reset when reset command is input or when stopped during PID control)	Yes	Yes	Yes
31	PID control integral hold (ON: Hold)	Yes	Yes	Yes
34	PID soft starter ON/OFF	Yes	Yes	Yes
35	PID input characteristics switch	Yes	Yes	Yes

Multi-Function Analog Input (H3-05, H3-09)

Setting Value	Function	Contents (100%)	Control Methods		
			Sequence Test	Flux Vector for PM	Open Loop Vector for PM
B	PID feedback	Maximum speed	Yes	Yes	Yes
C	PID target value	Maximum speed	Yes	Yes	Yes

■PID Control Methods

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

Set Value	Control Method
1	PID output becomes the Inverter output frequency, and D control is used in the difference between PID target value and feedback value.
2	PID output becomes the Inverter output frequency, and D control is used in the PID feedback value.
3	PID output is added as compensation value of the Inverter output frequency, and D control is used in the difference between PID target value and feedback value.
4	PID output is added as compensation value of the Inverter output frequency, and D control is used in the PID feedback value.

■PID Input Methods

Enable PID control using constant b5-01, and set the PID target value and PID feedback value.

PID Target Value Input Methods

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

PID Target Input Method	Setting Conditions
Multi-Function Analog Terminal A2, or A3 Input	Set H3-05 or H3-09 to C (PID target value). Also, be sure to set H6-01 (pulse train input function selection) to 1 (PID feedback value). The negative inputs cannot be used for target values.
MEMOBUS register 0006H	Set MEMOBUS bit 1 in register address 000FH to 1 (enable/disable PID target value from communications) to be able to use register number 0006H as the PID target value.
Pulse train input	Set H6-01 to 2 (PID target value).

PID Feedback Input Methods

Select one of the following PID control feedback input methods.

Input Method	Setting Conditions
Multi-function analog input	Set H3-09 (Multi-function Analog Input Terminal A2 Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to B (PID feedback).
Pulse train input	Set H6-01 to 1 (PID feedback).



INFO

Adjust PID target value and PID feedback value using the following items.

- Analog input: Adjust using the analog input terminal gain and bias.
- Pulse train input: Adjust using pulse train scaling, pulse train input gain, and pulse train input bias.

■PID Adjustment Methods

Use the following procedure to adjust PID while performing PID control and measuring the response waveform.

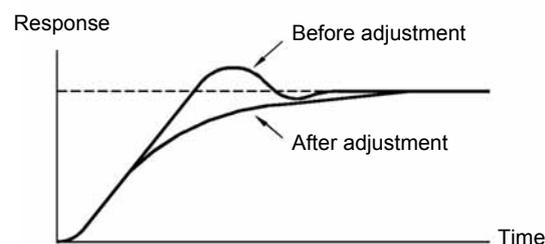
1. Set b5-01 (PID Control Method Selection) to 1 or 2 (PID control enabled).
2. Increase b5-02 (Proportional Gain (P)) to within a range that does not vibrate.
3. Reduce b5-03 (Integral (I) time) to within a range that does not vibrate.
4. Increase b5-05 (Derivative (D) time) to within a range that does not vibrate.

■PID Fine Adjustment Methods

This section explains the fine adjustment of PID after setting the PID control constants.

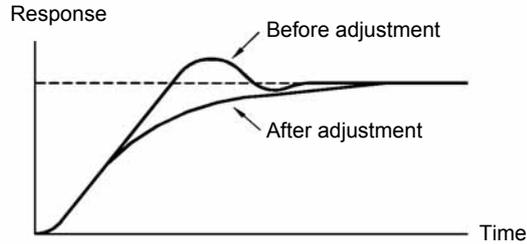
Suppressing Overshoot

If overshoot occurs, reduce derivative time (D), and increase integral time (I).



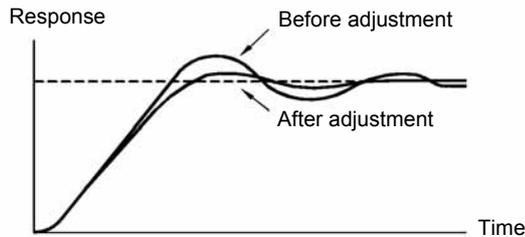
Set a Rapidly Stabilizing Control Condition

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



Suppressing Long-cycle Vibration

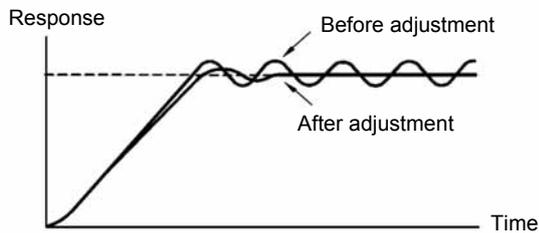
If vibration occurs with a longer cycle than the integral time (I) set value, the integral operation is too strong. Lengthen the integral time (I) to suppress the vibration.



Suppressing Short Cycle Vibration

If vibration occurs when the vibration cycle is short, and the cycle is almost identical to the derivative time (D) set value, the differential operation is too strong. Shorten the derivative time (D) to suppress the vibration.

If vibration continues even when the derivative time (D) is set to 0.00 (D control disabled), reduce the proportional gain (P), or increase the PID primary delay time constant.



■ Setting Precautions

- In PID control, the b5-04 constant is used to prevent the calculated integral control value from exceeding a specified amount. If the load changes rapidly, the machine may be damaged or the motor may stall because of unpredictable response from the Inverter. In this case, reduce the set value.
- The b5-06 constant is used to prevent the arithmetic operation following the PID control calculation from exceeding a specified amount. Set taking the maximum output frequency to be 100%.
- The b5-07 constant is used to adjust PID control offset. Set in increments of 0.1%, taking the maximum speed to be 100%.
- Set the low pass filter time constant for the PID control output in b5-08. Enable this constant to prevent machinery resonance from occurring when machinery adhesive abrasion is great, or rigidity is poor. In this case, set the constant to be greater than the resonance frequency cycle. Increase this time constant to reduce Inverter responsiveness.
- Using b5-09, you can invert the PID output polarity. Consequently, if you increase the PID target value, you can apply this constant to applications to lower the Inverter output frequency.
- Using b5-10, you can apply gain to the PID control output. Enable this constant to adjust the amount of compensation if adding PID control output to the speed reference as compensation.
- When PID control output is negative, you can use constant b5-11 to invert the Inverter. When b1-04 (Prohibition of Reverse Operation) is set to 1 (enabled), however, PID output limit is 0.
- With the Inverter, by setting an independent acceleration/deceleration time in constant b5-17, you can increase or decrease the PID target value using the acceleration/deceleration time. The acceleration/deceleration function (constant C1) used normally, however, is allocated after PID control, so depending on the settings, resonance with PID control and hunting in the machinery may occur. If this happens, reduce constant C1 until hunting does not occur, and maintain the acceleration/deceleration time using b5-17. Also, you can disable the set value in b5-17 from the external terminals during operation using multi-function input set value 34 (PID soft starter).

■PID Control Block

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

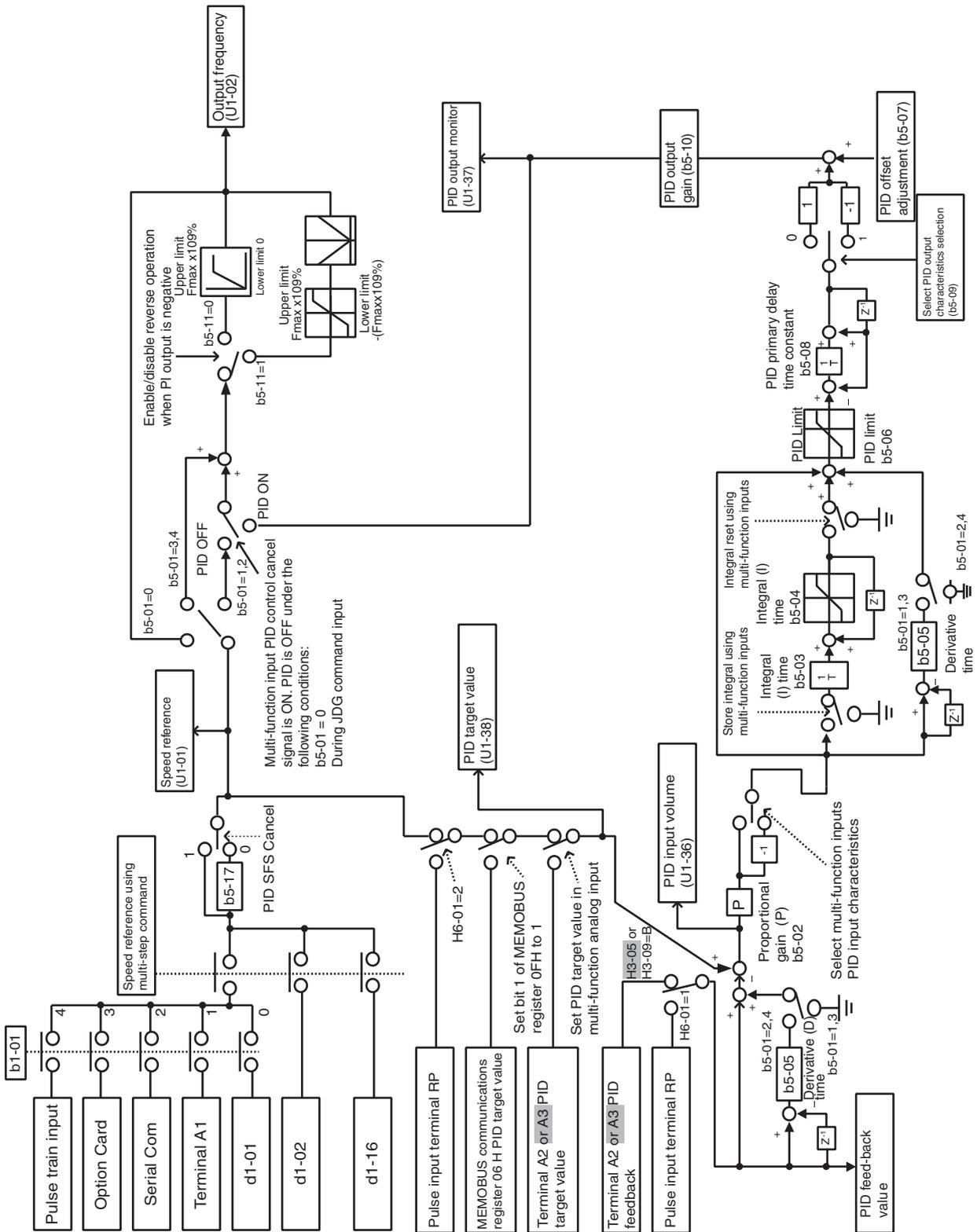


Fig 6.53 PID Control Block

■PID Feedback Loss Detection

When performing PID control, be sure to use the PID feedback loss detection function. If PID feedback is lost, the Inverter speed reference may accelerate to the maximum speed.

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

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

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

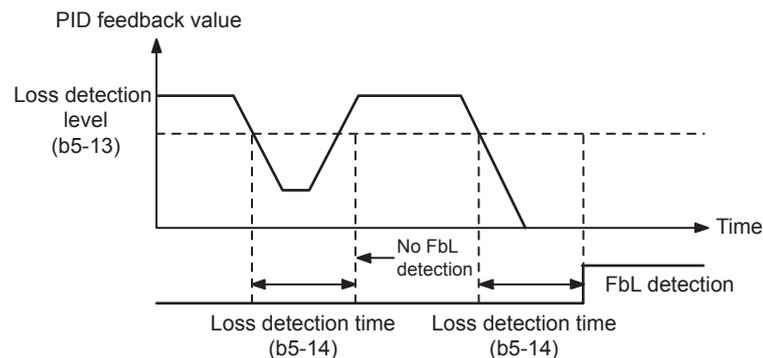


Fig 6.54 PID Feedback Loss Detection Time Chart

■PID Sleep

The PID sleep function stops the Inverter when the PID sleep function delay time continues while the PID control target value is at an insufficient level to operate the PID sleep function. When the PID sleep delay time continues and the PID control target value is above the PID sleep function operation level, Inverter operation will automatically resume.

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

The PID sleep time chart is shown below.

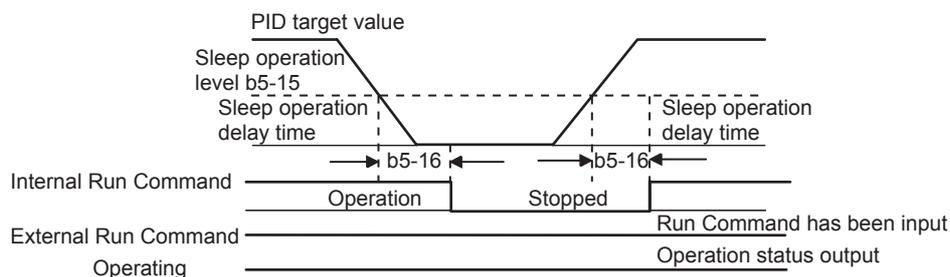


Fig 6.55 PID Sleep Time Chart

◆ Torque Control (SPEC: C or Later Only)

With flux vector control for PM, the motor's output torque can be controlled by a torque reference from an analog input. Set d5-01 to 1 to control torque.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d5-01	Torque control selection	0: Speed control (C5-01 to C5-07) 1: Torque control To use the function for switching between speed and torque control, set to 0 and set the multi-function input to "speed/torque control change."	0 or 1	0	No	No	A	No	29AH
d5-02	Torque reference delay time	Set the torque reference delay time in ms units. This function can be used to adjust the noise of the torque control signal or the responsiveness with the host controller. When oscillation occurs during torque control, increase the set value.	0 to 1000	0 ms *	No	No	A	No	29BH
d5-03	Speed limit selection	Set the speed limit command method for the torque control method. 1: The analog input limit from a speed reference (see b1-01) 2: Limited by d5-04 constant setting values.	1 or 2	1	No	No	A	No	29CH
d5-04	Speed limit	Set the speed limit during torque control as a percentage of the maximum speed. This function is enabled when d5-03 is set to 2. Directions are as follows. +: Run Command direction -: Run Command opposite direction	-120 to +120	0%	No	No	A	No	29DH
d5-05	Speed limit bias	Set the speed limit bias as a percentage of the maximum speed. Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 to 120	5%	No	No	A	No	29EH

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
d5-06	Speed/torque control switching timer	Set the delay time from inputting the multi-function input "speed/torque control change" (from On to OFF or OFF to ON) until the control is actually changed, in ms units. This function is enabled when the multi-function input "speed/torque control change" is set. In the speed/torque control switching timer, the analog inputs hold the values of when the "speed/torque control change" changes. Always be sure to allow time for this process to finish completely.	0 to 1000	50 ms	No	No	A	No	29FH
H3-04	Signal level selection (terminal A3)	0: 0 to 10 V 1: -10 to 10 V	0 or 1	0	No	A	A	A	413H
H3-05	Multi-function analog input (terminal A3) function selection	Select from the functions listed in the following table. Refer to the next page.	0 to 1F	1F	No	A	A	A	414H
H3-06	Gain (terminal A3)	Sets the input gain (level) when 10V is input. Set according to the 100% value selected from H3-05.	0.0 to 1000.0	100.0%	Yes	A	A	A	415H
H3-07	Bias (terminal A3)	Sets the input gain (level) when 0V is input. Set according to the 100% value selected from H3-05.	-100.0 to +100.0	0.0%	Yes	A	A	A	416H
H3-08	Signal level selection (terminal A2)	0: 0 to +10V, with lower limit 1: -10 to +10 V, without lower limit 2: 4 to 20 mA. Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A	417H
H3-09	Multi-function analog input (terminal A2) function selection	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A	418H
H3-10	Gain (terminal A2)	Sets the input gain (level) when 10 V (20 mA) is input. Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	419H
H3-11	Bias (terminal A2)	Sets the input gain (level) when 0 V (4 mA) is input. Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	41AH

Multi-function Contact Input Functions (H1-01 to H1-06)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
71	Speed/torque control change (ON: Torque control)	No	Yes	No
78	Polarity reversing command for external torque reference	No	Yes	No

Multi-function Contact Output Functions (H2-01 to H2-03)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
32	Speed control circuit operating for torque control (except when stopped). Output if the external torque reference is limited (the internal torque reference is less than the external torque reference) when the torque control is selected.	No	Yes	No

Multi-function Analog Inputs (H3-05, H3-09)

Setting Value	Function	Contents (100%)	Control Methods		
			Sequence Test	Flux Vector for PM	Open Loop Vector for PM
0	Add to terminal A1	Maximum speed	Yes	Yes	Yes
13	Torque reference/torque limit at speed control	Motor's rated torque	No	Yes	Yes
14	Torque compensation	Motor's rated torque	No	Yes	No

Monitor Function

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-09	Torque reference	Monitor in internal torque reference value for vector control.	10 V: Motor rated torque (-10 to 10 V possible)	0.1%	No	A	A	48H

■ Inputting Torque References and Torque Reference Directions

The torque reference can be changed according to an analog input by setting H3-09 (Multi-function analog input terminal A2 selection) or H3-05 (Multi-function analog input terminal A3 selection) to 13 (torque reference) or 14 (torque compensation). The torque reference input methods are listed in the following table.

Torque Reference Input Method	Reference Location	Selection Method	Remarks
Voltage input (−10 to 10 V)	Between A3 and AC	H3-04 = 1 H3-05 = 13	Set H3-04 to 0 for a 0 to 10-V torque reference. To switch the torque reference between positive and negative torque, set a multi-function analog input to 78.
	Between A2 and AC (Turn OFF pin 2 of SW1.)	H3-08 = 1 H3-09 = 13	Set H3-08 to 0 for a 0 to 10-V torque reference. To switch the torque reference between positive and negative torque, set a multi-function analog input to 78. The input can be used for torque compensation by setting H3-09 to 14.
Current input (4 to 20 mA)	Between A2 and AC (Turn ON pin 2 of SW1.)	H3-08 = 2 H3-09 = 13	To switch the torque reference between positive and negative torque, set a multi-function analog input to 78. The input can be used for torque compensation by setting H3-09 to 14.
Option card (AI-14B) (−10 to 10 V)	Between TC2 and TC4	F2-01 = 0 H3-08 = 1 H3-09 = 13	The input can be used for torque compensation by setting H3-05 to 14.

The direction of the torque output from the motor will be determined by the sign of the analog signal input. It does not depend on the direction of the Run Command. The direction of torque will be as follows:

- Positive analog reference: Torque reference for forward motor rotation (counterclockwise as viewed from the motor output axis).
- Negative analog reference: Torque reference for reverse motor rotation (clockwise as viewed from the motor output axis).

Application Precautions

If the analog signal input level is 0 to 10 V or 4 to 20 mA, a forward torque reference will not be applied. To apply reverse torque, use an input level of -10 V to 10 V or switch the direction using a multi-function input set to 78 (polarity Reverse Command for external torque reference).

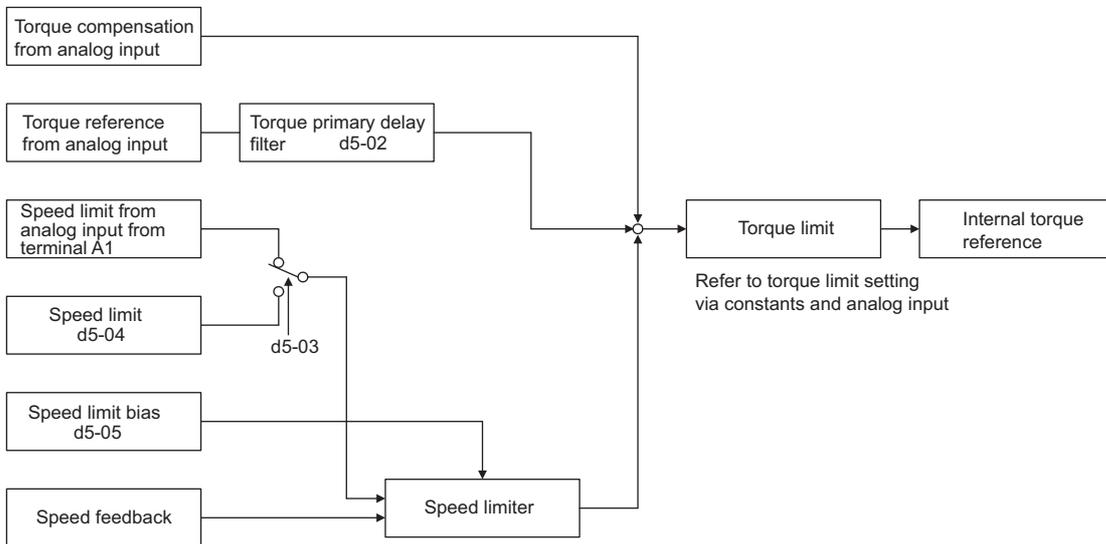


Fig 6.56 Torque Control Block Diagram

■ Speed Limiter (Speed Limit Function)

If the external torque reference and load are not balanced during torque control, the motor will accelerate in either the forward or reverse direction. The speed limit function is used to limit the speed to a specified value and it consists of the speed limiter circuit.

When the motor speed exceeds the speed limit value during torque control, the speed limiter circuit generates the suppression torque proportional to the speed above the limit value and adds to the torque reference.

Application Precautions

There are two ways to set a speed limit: using an input from an analog input terminal and setting a speed limit in d5-04. The inputs methods for a speed limit are listed in the following table.

Speed Limit Input Method	Location of Reference	Constant Settings	Remarks
Voltage input (-10 to 10 V)	Set in d5-04	d5-03 = 2	-
	Between A1 and AC	b1-01 = 1 H3-01 = 1	Set H3-01 to 0 if the speed limit is always to be positive.
	Between A2 and AC	b1-01 = 0 H3-08 = 1 H3-09 = 1	The value will be added to the value input on A1 to determine the speed limit. Set H3-03 to 0 if the speed limit input on A2 is always to be positive. Turn OFF (V side) pin 2 of DIP switch S1 on the terminal board.
Current input (4 to 20 mA)	Between A2 and AC	b1-01 = 0 H3-08 = 2 H3-09 = 1	The value will be added to the value input on A1 to determine the speed limit. Turn ON (I side) pin 2 of DIP switch S1 on the terminal board.
Option card (AI-14B) (-10 to 10 V)	Between TC1 and TC4	b1-01 = 3 F2-01 = 0	If H3-09 is set to 0, the sum of the input between TC2 and TC4 will be added the input between TC1 and TC4 to determine the speed limit.



IMPORTANT

The direction in which speed is controlled is determined by the sign of the speed limit signal and the direction of the Run Command.

- Positive voltage applied: The speed in the forward direction will be limited for forward operation.
- Negative voltage applied: The speed in the reverse direction will be limited for reverse operation.

If the direction of motor rotation and the command direction are not the same, speed will be limited to 0 as long as b5-05 is set to 0.

■ Torque Limit Operation Examples

Operation examples will be described separately for winding operation, in which the speed and motor torque are in the same directions, and rewinding operation, in which the speed and motor torque are in opposite directions.

Winding Operation

In a winding operation, the line (speed) and torque generated by the motor are in the same direction. For the winding operation, both the speed limit and the torque reference input are positive. The motor will accelerate when the torque reference input is larger than the load and will decelerate when it is smaller than the load. If the motor turns faster than the sum of the speed limit and d5-05 (speed limit bias), a negative compensation value is output from the speed limiter circuit. When the speed then drops below the speed limit, a positive compensation value is output. The torque compensation is proportional to the ASR proportional gain. When the sum of the torque reference and the torque compensation output by the speed limiter is the same as the actual load, the motor will stop accelerating and run at a constant speed.

Rewinding Operation

In a rewinding operation, the line (speed) and torque generated by the motor are in the opposite directions. (In this example, we'll assume that the line speed is positive and the torque reference input is negative.) For the rewinding operation, the speed limit is positive and the torque reference input is negative. If the motor turns faster than the speed limit, a negative compensation value is output from the speed limiter circuit. If the motor is rotating in reverse, a negative compensation value is output. If the speed is 0 or is below the sum of the

speed limit and d5-05 (speed limit bias), a 0 compensation value is output. In this way, the output from the speed limiter is used to maintain the motor speed between 0 and the speed limit. When the sum of the torque reference and the torque compensation output by the speed limiter is the same as the actual load, the motor will stop accelerating and run at a constant speed.

	Winding Operation		Rewinding Operation	
Configuration				
Normal Rotation Direction	Forward	Reverse	Forward	Reverse
Torque Reference Polarity (TREF)	+	-	-	+
Speed Limit Polarity (SLIM)	+	-	+	-
Generated Torque	$\Delta N (\%) = \frac{TREF (\%)}{C5-01}$			

■ Torque Reference Adjustment

Consider the following information when adjusting the torque.

Torque Reference Delay Time: d5-02

The time constant of the primary filter in the torque reference section can be adjusted. This constant is used to eliminate noise in the torque reference signal and adjust the responsiveness to the host controller. Increase the setting if oscillation occurs during torque control.

Setting the Torque Compensation

Set multi-function analog input A2 or A3 to torque compensation (setting 14). When the amount of torque loss for mechanical loss or other factor at the load is input to one of these terminals, it is added to the torque reference to compensate for the loss. The direction of torque will be as follows:

- Positive voltage (current): Torque compensation reference for forward motor rotation (counterclockwise as viewed from the motor output axis).
- Negative voltage: Torque compensation reference for reverse motor rotation (clockwise as viewed from the motor output axis).

Since the polarity of the voltage input determines the direction, only forward torque compensation can be input when the 0 to 10 V or 4 to 20 mA signal level has been selected. If you want to input reverse torque compensation, be sure to select the -10 to 10 V signal level.

■Speed/Torque Control Switching Function

It is possible to switch between speed control and torque control when one of the multi-function inputs (H1-01 to H1-06) is set to 71 (Speed/Torque Control Change). Speed control is performed when the input is OFF and torque control is performed when the input is ON. Set d5-01 to switch speed/torque control.

■Setting the Speed/Torque Control Switching Timer

The delay between a change in the speed/control switching function input (ON to OFF or OFF to ON) and the corresponding change in the control method can be set in d5-06. During the timer delay, the value of the 3 analog inputs will retain the values they had when the ON/OFF status of speed/torque control switching signal was changed. Use this delay to complete any changes required in external signals.

Application Precautions

- The speed reference (during speed control) is set in b1-01. The speed limit during torque control is set in d5-03.
- If the torque reference has been assigned to a multi-function analog input, terminal A2, or terminal A3, the input function changes when the control method is switched between torque control and speed control.
During speed control: The analog input terminal is used as the torque limit input.
During torque control: The analog input terminal is used as the torque reference input.
- When the Run Command turns OFF, the control method when stopped will be for speed control. Even from the torque control method, the system will automatically change to speed control and decelerate to a stop when the Run Command turns OFF.
- When A1-02 (control method selection) is set to 3 (flux vector control), the speed/torque change command (a setting of 71) can be set for a multi-function input (H1-01 to H1-06) to switch between speed and torque control during operation. An example is shown below.

Terminal No.	User Constant No.	Factory Setting	Setting	Function
S8	H1-06	8	71	Speed/torque control change
A1	b1-01	1	1	Speed reference selection (terminals A1, A2)
	d5-03	1	1	Speed limit (terminals A1, A2)
A3	H3-05	0	13	Torque reference/torque limit

A timing chart for switching between speed and torque control is shown in the following figure.

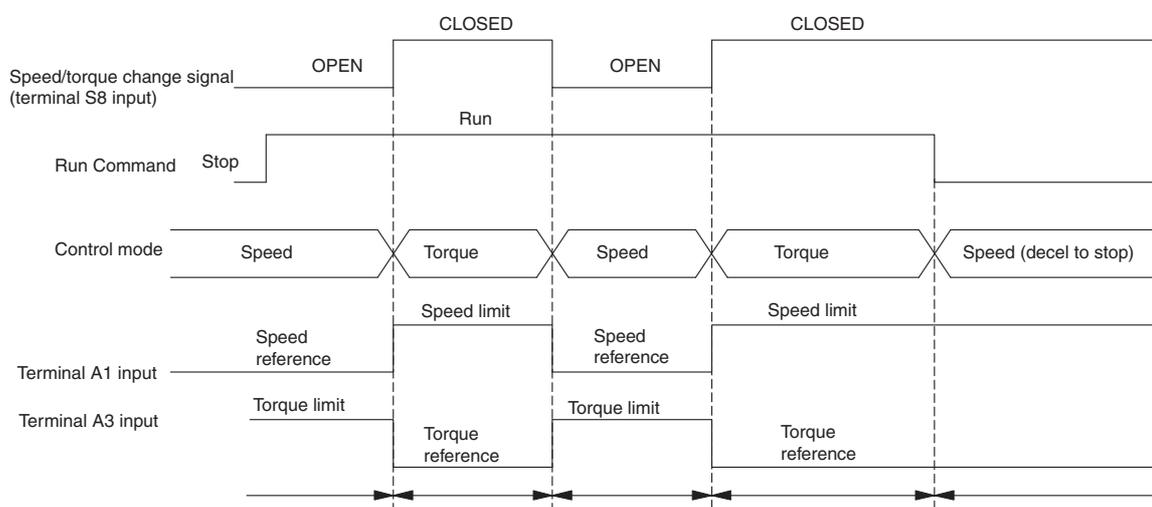


Fig 6.57 Speed/Torque Control Switching Time Chart.

◆ Speed Control (ASR) Structure

Speed control (ASR) adjusts the torque reference so that the deviation between the speed reference and the estimated speed (PG feedback) is 0.

The following block diagram shows the structure of the speed control.

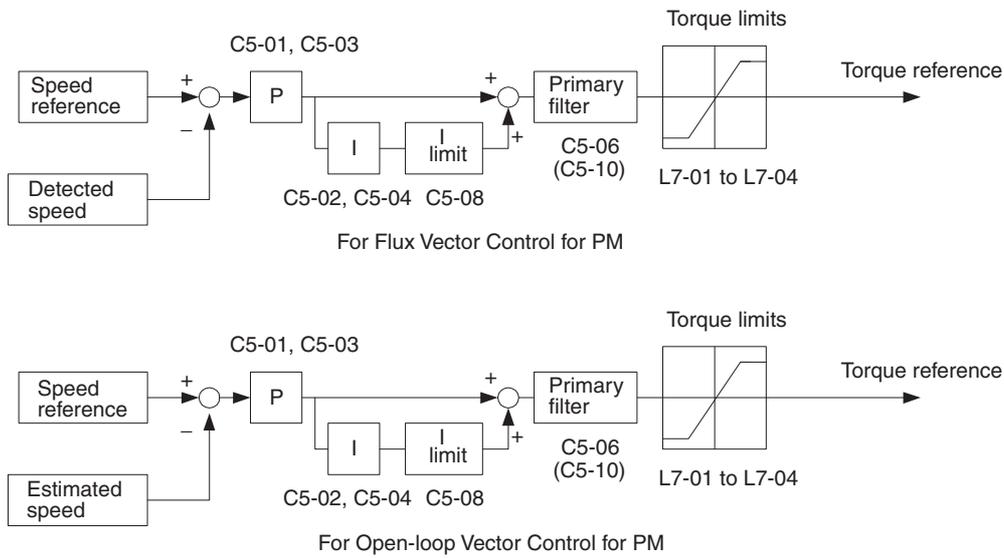


Fig 6.58 Speed Control Block Diagrams

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Se-quence Test	Flux Vector for PM	Open Loop Vector for PM	
C5-01	ASR proportional (P) gain 1	Sets the proportional gain of the speed loop (ASR.)	0.00 to 300.00	10.00 *	Yes	No	A	A	21BH
C5-02	ASR integral (I) time 1	Sets the integral time of the speed loop (ASR) in 1-second units.	0.000 to 10.000	0.500 s *	Yes	No	A	A	21CH
C5-03	ASR proportional (P) gain 2	Usually setting is not necessary. Set to change the rotational speed gain.	0.00 to 300.00	10.00 *	Yes	No	A	A	21DH
C5-04	ASR integral (I) time 2		0.000 to 10.000	0.500 s *	Yes	No	A	A	21EH
C5-06	ASR primary delay time	Sets the filter time constant for outputting torque references from the speed control loop (ASR). It is set in 1-second units. Usually setting is not necessary.	0.000 to 0.500	0.016 s *	No	No	A	A	220H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
C5-07	ASR switching frequency	Sets the speed for switching between Proportion Gain 1, 2 and Integral Time 1, 2 in % units. The multi-function input "ASR switching proportional gain" has the priority.	0.0 to 100.0	0.0%	No	No	A	A	221H
C5-08	ASR integral (I) limit	Sets the upper limit for the integral (I) amount for the speed control loop (ASR) to a percentage of the rated load.	0 to 400	400%	No	No	A	A	222H

* The setting value will return to the factory setting if the control method is changed.

Multi-function Contact Input Functions (H1-01 to H1-06)

Setting Value	Function	Control Methods		
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM
E	Speed control integral reset (ON: Integral control disabled)	No	Yes	Yes
77	Speed control (ASR) proportional gain switch (ON: C5-03)	No	Yes	No

■ Speed Control (ASR) Gain Adjustment

Use the following procedure to adjust C5-01 and C5-03 with the mechanical system and actual load connected.

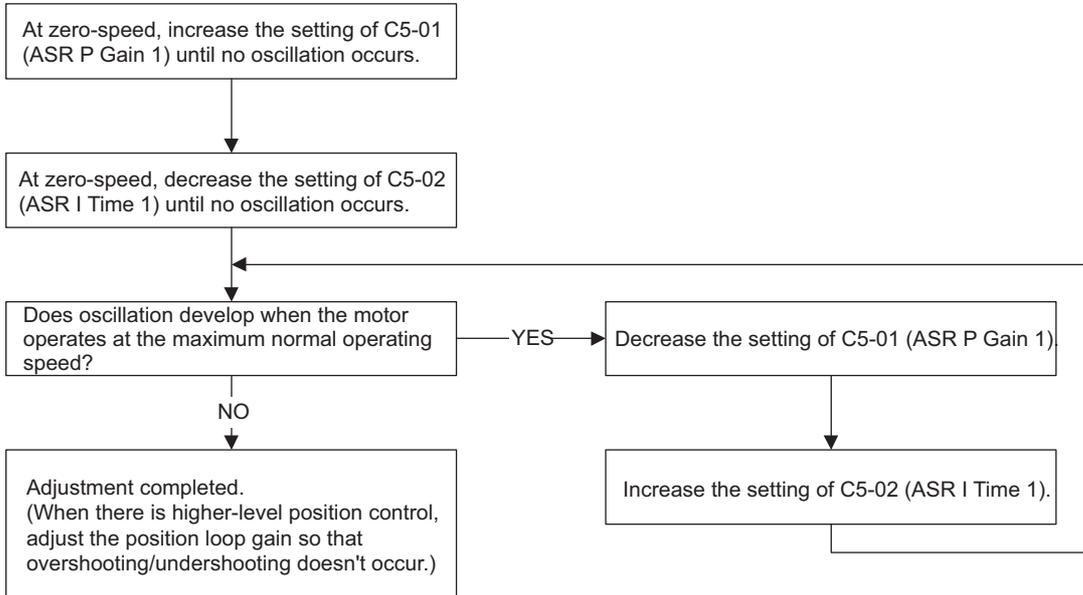


Fig 6.59 Adjustment for Flux Vector Control for PM

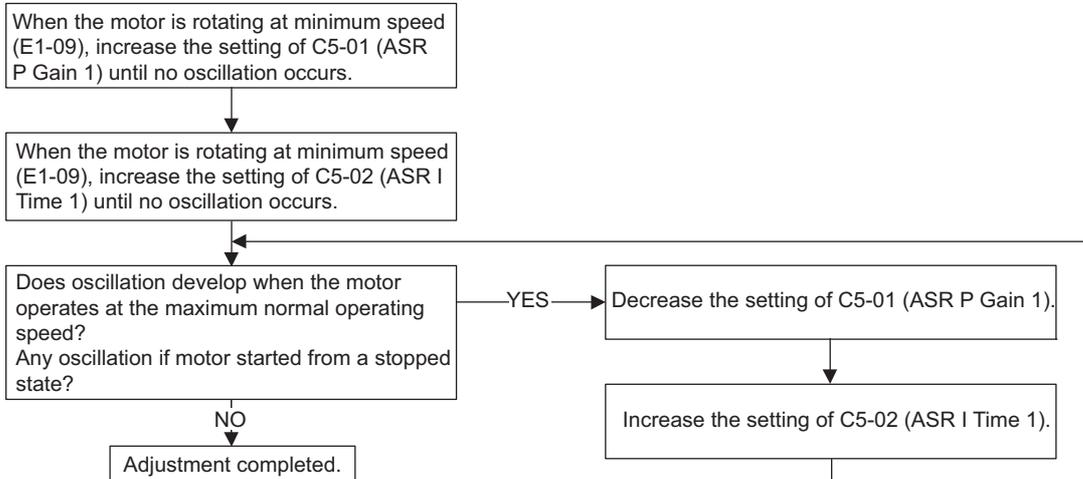


Fig 6.60 Adjustment for Open-loop Vector Control for PM



INFO

For oscillation, increasing the setting of C5-06 (ASR primary delay time) may be effective. By increasing the setting, the control responsiveness may slow down, so make adjustments until the control responsiveness is within the range necessary for the machines.

Fine Adjustments

When you want even finer gain adjustment, adjust the gain while observing the speed waveform. Constant settings like those shown in the following table will be necessary to monitor the speed waveform.

Constant No.	Name	Setting	Explanation
H4-01	Multi-function analog output 1 terminal FM monitor selection	20	Settings that allow multi-function analog output 1 to be used to monitor the speed reference after a soft-start.
H4-02	Multi-function analog output 1 terminal FM output gain	1.00	
H4-03	Multi-function analog output 1 terminal FM bias	0.0	
H4-04	Multi-function analog output 2 terminal AM monitor selection	5	Settings that allow multi-function analog output 2 to be used to monitor the motor speed.
H4-05	Multi-function analog output 2 terminal AM output gain	1.00	
H4-06	Multi-function analog output 2 terminal AM bias selection	0.00	
H4-07	Multi-function analog output 1 terminal signal level selection	1	Settings that allow a -10 to 10 V signal range to be monitored.
H4-08	Multi-function analog output 2 terminal signal level selection	1	

The multi-function analog outputs have the following functions with these constant settings.

- Multi-function analog output 1 (terminal FM): Outputs speed reference after a soft-start (-10 to 10 V).
- Multi-function analog output 2 (terminal AM): Outputs actual motor speed (-10 to 10 V).

Terminal AC is the multi-function analog output common.

We recommend monitoring both the speed reference after a soft-start and the motor speed to monitor the response delay or deviations from the reference value, as shown in the following diagram.

Adjusting ASR Proportional Gain 1 (C5-01)

This gain setting adjusts the responsiveness of the speed control (ASR). The responsiveness is increased when this setting is increased. Usually this setting is higher for larger loads. Oscillation will occur if this setting is increased too much.

The following diagram shows the type of changes that can occur in the response when the ASR proportional gain is changed.

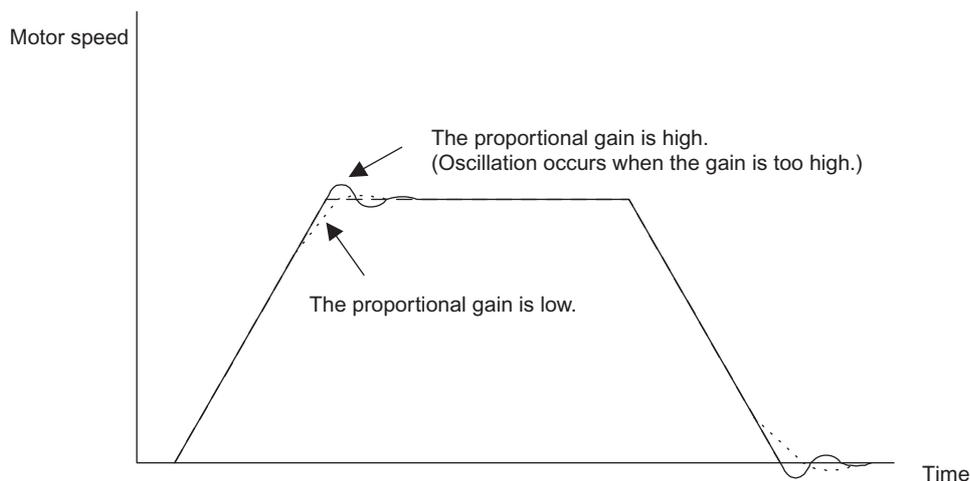


Fig 6.61 Responsiveness for Proportional Gain

Adjusting ASR Integral Time 1 (C5-02)

This constant sets the speed control (ASR) integral time.

Lengthening the integral time lowers the responsiveness, and weakens the resistance to external influences. Oscillation will occur if this setting is too short. The following diagram shows the type of changes that can occur in the response when the ASR integral time is changed.

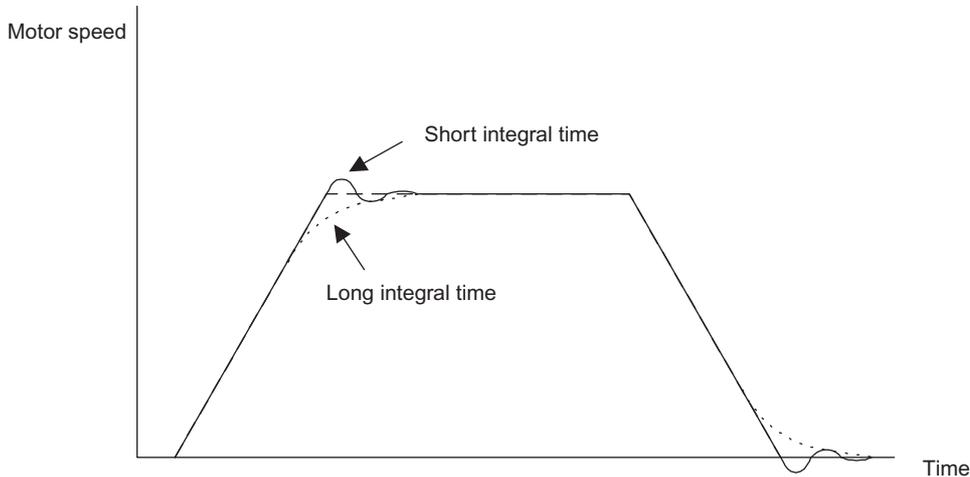


Fig 6.62 Responsiveness for Integral Time

Different Gain Settings for Low-speed and High-speed

Switch between low-speed and high-speed gain when oscillation occurs because of resonance with the mechanical system at low speed or high speed. The proportional gain P and integral time I can be switched according to the motor speed, as shown below.

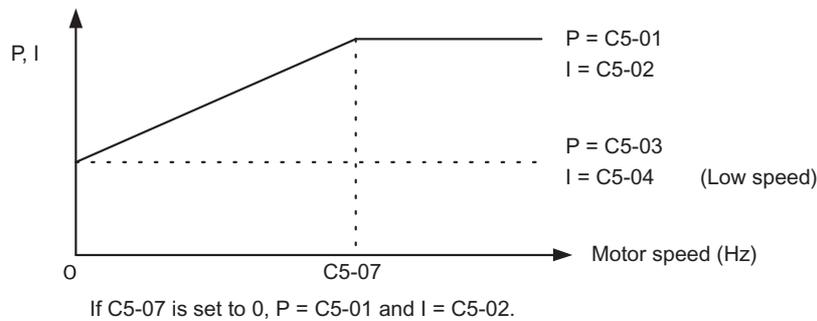


Fig 6.63 Low-speed and High-speed Gain Settings

Setting the Gain Switching Speed (C5-07)

Set the switching speed to about 80% of the motor operating speed or the speed at which oscillation occurs.

Low-speed Gain Adjustments (C5-03, C5-04)

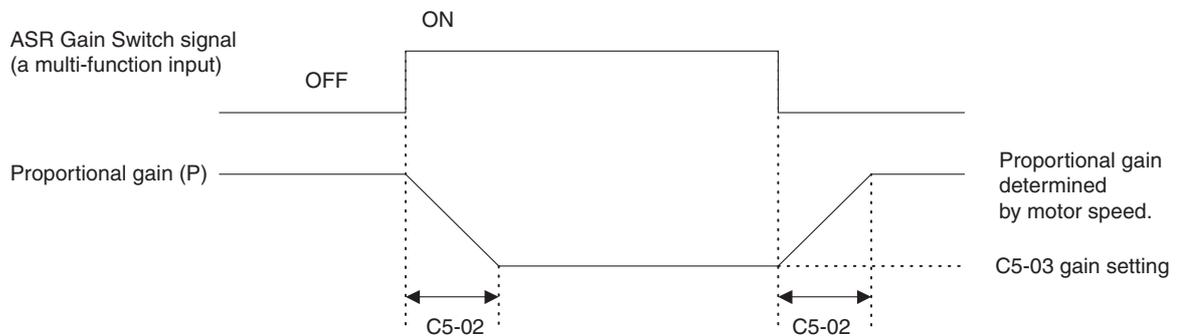
Connect the actual load and adjust these constants at zero-speed operation in the flux vector control for PM or at minimum speed operation in the open-loop vector control for PM. Increase C5-03 (ASR proportional gain 2) until there is no oscillation. Decrease C5-04 (ASR integral time 2) until there is no oscillation.

High-speed Gain Adjustments (C5-01, C5-02)

Adjust these constants at normal operating speed. Increase C5-01 (ASR proportional gain 1) until there is no oscillation. Decrease C5-02 (ASR integral time 1) until there is no oscillation. Refer to *Fine Adjustments* on page 6-115 for details on making fine adjustments of high-speed operation.

ASR Proportional Gain Switch Setting

When one of the multi-function inputs (H1-01 to H1-06) is set to 77, the input can be used to switch between C5-01 (proportional gain 1) and C5-03 (proportional gain 2). Proportional gain 2 is used when the multi-function input is ON. This input has higher priority than the ASR switching frequency set in C5-07.



The gain is changed linearly in integral time 1 (C5-02).

Fig 6.64 ASR Proportional Gain Switch

◆ Droop Control Function (SPEC: C or Later Only)

Droop control allows the motor to have speed drooping characteristics commensurate with the load torque.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
b7-01	Droop control gain	Sets the speed drop as a percentage of maximum speed when the maximum speed is specified and the rated torque occurs. Droop-control is not performed when the setting is 0.0.	0.0 to 100.0	0.0	Yes	No	A	No	1CAH
b7-02	Droop control delay time	Droop control responsiveness constant. When hunting or oscillation occurs, increase the value.	0.03 to 2.00	0.05 s	Yes	No	A	No	1CBH

■ Setting Precautions

- Droop control is disabled if b7-01 is set to 0.0.
- Set b7-01 to the amount of speed in %, as a percentage of the maximum speed, when the rated torque is generated.
- Constant b7-02 is used to adjust the responsiveness of droop control. Increase this setting if oscillation or hunting occur.

■ Setting the Droop Control Gain

Set the droop control gain as the speed reduction at a 100% motor torque, as a percentage of the maximum speed.

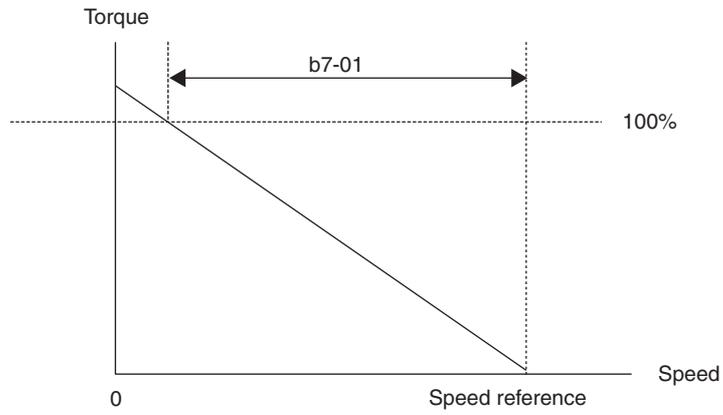


Fig 6.65 Droop Control Gain

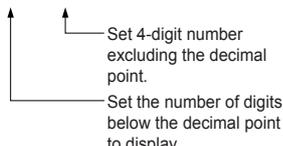
Digital Operator Functions

This section explains the Digital Operator functions.

◆ Setting Digital Operator Functions

You can set Digital Operator-related constants such as selecting the Digital Operator display, multi-function selections, and copy functions.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
o1-02	Monitor selection after power up	Sets the monitor item to be displayed when the power is turned on. 1: Speed reference 2: Motor speed 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	A	A	501H
o1-03	Frequency units of reference setting and monitor	Sets the units that will be set and displayed for the speed reference and speed monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: min ⁻¹ units (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	1	No	A	A	A	502H
o2-01	LOCAL/REMOTE key enable/disable	Sets the Digital Operator Local/Remote Key 0: Disabled 1: Enabled (Switches between the Digital Operator and the constant settings.)	0 or 1	1	No	A	A	A	505H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
o2-02	STOP key during control circuit terminal operation	Sets the Stop Key in the run mode. 0: Disabled (When the Run Command is issued from and external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	A	A	506H
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	A	A	507H
o2-05	Speed reference setting method selection	When the speed reference is set on the Digital Operator speed reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the speed reference without Enter Key operation.	0 or 1	0	No	A	A	A	509H
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	A	A	50BH
o2-10	Fan operation time setting	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	A	A	50EH

■ Changing Speed Reference and Display Units

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

- U1-01 (Speed reference)
- U1-02 (Output frequency)
- U1-05 (Motor speed)
- U1-20 (Speed reference after soft start)
- d1-01 to d1-17 (Speed references)

■ Switching Monitors when the Power Supply Is ON

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

■ Setting Precautions

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

■ Disabling the STOP Key

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

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

■ Disabling the LOCAL/REMOTE Key

Set o2-01 to 0 to disable the LOCAL/REMOTE Key on the Digital Operator. You cannot switch Inverter reference inputs set using reference inputs from the Digital Operator, b1-01 (Reference Selection), or b1-02 (Operation Method Selection).

■ Initializing Changed Constant Values

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

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

■ Setting the Speed Reference using the UP and DOWN Keys without Using the Enter Key

Use this function when inputting speed references from the Digital Operator. When o2-05 is set to 1, you can increment and decrement the speed reference using the UP and DOWN Keys without using the Enter Key.

For example, enter the Run Command using a 0% reference, and then continuously press the UP Key to increment the speed reference by 0.01% only for the first 0.5 s, and then by 0.01% every 80 ms for 3 s thereafter. Press and hold down the UP Key for 3 s minimum to reach the maximum speed 10 s after that. The speed reference that has been set will be stored in memory 5 s after the UP or DOWN Keys are released.

■ Clearing Cumulative Operation Time

Set the cumulative operation time initial value in time units in constant o2-07. Set o2-07 to 0 to clear U1-13 (Inverter Operating Time).

■ Clearing Inverter Cooling Fan Operation Time

Set the fan operation time initial value in time units in constant o2-10. Set o2-10 to 0 to clear U1-40 (Cooling Fan Operating Time).

◆ Copying Constants

The Digital Operator can perform the following three functions using the built-in EEPROM (non-volatile memory).

- Store Inverter constant set values in the Digital Operator (READ)
- Write constant set values stored in the Digital Operator to the Inverter (COPY)
- Compare constant set values stored in the Digital Operator with Inverter constants (VERIFY)

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
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	A	A	515H
o3-02	Read permitted selection	0: Read prohibited 1: Read permitted	0 or 1	0	No	A	A	A	516H

■ COPY Function Selection (SPEC: C or Later Only)

The available COPY functions (o3-01 “Copy function selection”) differ depending on the SPEC of Inverter as shown in the table below.

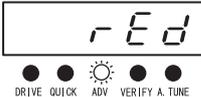
READ Source	Inverter with SPEC: B or earlier (PRG:103□)	Inverter with SPEC: B or earlier (PRG:103□)	Inverter with SPEC: C or earlier (PRG:104□)	Inverter with SPEC: C or earlier (PRG:104□)
COPY Destination	Inverter with SPEC: B or earlier (PRG:103□)	Inverter with SPEC: C or earlier (PRG:104□)	Inverter with SPEC: B or earlier (PRG:103□)	Inverter with SPEC: C or earlier (PRG:104□)
READ (Inverter → Operator)	Available	Available	Available	Available
READ (Inverter → Operator)	Available	Available*	N/A	Available
VERIFY	Available	N/A	N/A	Available

* The initial values of user constants that have been stored using the constant o2-03 cannot be copied.

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

To store Inverter set values in the Digital Operator, make the settings using the following method. Set 03-02 (Read permitted selection) to 1 (read permitted).

Table 6.1 READ Function Procedure

Step No.	Digital Operator Display	Explanation
1		Press the Menu Key, and select advanced programming mode.
2		Press the DATA/ENTER Key, and select the constants monitor display.
3		Display 03-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4		Press the DATA/ENTER Key, and select the constants setting display.
5		Change the set value to 1 using the Increment Key.
6		Set the changed data using the DATA/ENTER Key. The READ function will start.
7		If the READ function ends normally, End is displayed on the Digital Operator. Constant 03-01 is automatically reset to 0, and then the display returns to 03-01.

An error may occur while saving to memory. If an error is displayed, press any key to cancel the error display and return to the 03-01 display. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.*)

Error Display	Meaning
<i>PrE</i>	You are attempting to set 03-01 to 1 while 03-02 is set to 0.
<i>,FE</i>	Read data length mismatch or read data error.
<i>r dE</i>	Tried to write constants to EEPROM on the Digital Operator, but unable to perform write operation.

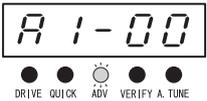
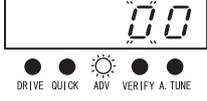
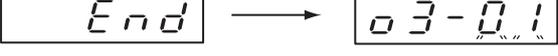
Select READ Permitted

Prevent overwriting the data stored in EEPROM in the Digital Operator by mistake. With 03-02 set to 0, if you set 03-01 to 1, and perform the write operation, PrE will be displayed on the Digital Operator, and the write operation will be stopped.

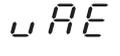
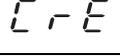
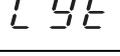
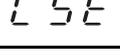
■ Writing Constant Set Values Stored in the Digital Operator to the Inverter (COPY)

To write constant set values stored in the Digital Operator to the Inverter, make the settings using the following method.

Table 6.2 COPY Function Procedure

Step No.	Digital Operator Display	Explanation
1		Press the MENU Key, and select advanced programming mode.
2		Press the DATA/ENTER Key, and select the constants monitor display.
3		Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4		Press the DATA/ENTER Key, and select the constants setting display.
5		Change the set value to 2 using the Increment Key.
6		Set the changed data using the DATA/ENTER Key. The COPY function will start.
7		If the COPY function ends normally, End is displayed on the Digital Operator. Constant o3-01 is automatically reset to 0, and then the display returns to o3-01.

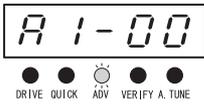
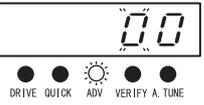
During the copy operation, errors may occur. If an error is displayed, set the constants again. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.*)

Error Display	Meaning
	Inverter product code and Inverter software number are different.
	Inverter capacity with which you are trying to copy, and the Inverter capacity stored in the Digital Operator are different.
	The Inverter control method in which you are trying to copy, and the Inverter control method stored in the Digital Operator are different.
	Comparison between the constant written to the Inverter and the constant in the Digital Operator shows they are different.
	After copying has ended, comparison between the sum value of the Inverter constant area and the sum value of the Digital Operator constant area shows they are different.

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

To compare Inverter constants and Digital Operator constant set values, make the settings using the following method.

Table 6.3 VERIFY Function Procedure

Step No.	Digital Operator Display	Explanation
1		Press the MENU Key, and select advanced programming mode.
2		Press the DATA/ENTER Key, and select the constants monitor display.
3		Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4		Press the DATA/ENTER Key, and select the function setting display.
5		Change the set value to 3 using the Increment Key.
6		Set the changed data using the DATA/ENTER Key. The VERIFY function will start.
7		If the VERIFY function ends normally, End is displayed on the Digital Operator. Constant o3-01 is automatically reset to 0, and then the display returns to o3-01.

An error may occur during the comparison. If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.*)

Error Display	Meaning
	Verify error (Settings in the Digital Operator and the Inverter do not match).

■Application Precautions

- When using the copy function, check that the following settings are the same between the Inverter and the Digital Operator.
 - Inverter product and type
 - Software number
 - Inverter capacity and voltage
 - Control method
- Use the copy function off-line or with a communications option card removed.
- A CPF03 fault (EEPROM error) can occur if the power is shut down while the Inverter constants are being copied. Do not shut down the power while copying the constants.

◆ Prohibiting Writing Constants from the Digital Operator

If you set A1-01 to 0, you can refer to and set the A1 and A2 constant groups, and refer to drive mode, using the Digital Operator.

If you set one of the constants H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection) to 1B (write constants permitted), you can write constants from the digital operator when the terminal that has been set is ON. When the set terminal is OFF, writing constants other than the speed reference is prohibited. You can, however, reference constants.

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
A1-01	Constant access level	Used to set the constant access level (set/read.) 0: Monitoring only (Monitoring and setting the constants for drive mode, 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 (A) mode.)	0 to 2	2	Yes	A	A	A	101H

◆ Setting a Password

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

You can prohibit the setting and referencing of all constants except A1-00 by using the password function in combination with setting A1-01 to 0 (Monitor only).

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
A1-01	Constant access level	Used to set the constant access level (set/read.) 0: Monitoring only (Monitoring and setting the constants for drive mode, 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 (A) mode.)	0 to 2	2	Yes	A	A	A	101H
A1-04	Password	Password input when a password has been set in A1-05. This function write-protects some constants of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 constants can no longer be changed. (Programming mode constants can be changed.)	0 to 9999	0	No	A	A	A	104H
A1-05	Password setting	Used to set a four digit number as the password. This constant is not usually displayed. When the Password (A1-04) is displayed, hold down the RESET Key and press the Menu Key and the password will be displayed.	0 to 9999	0	No	A	A	A	105H

■ Setting Precautions

Constant A1-05 cannot be displayed using normal key operations. To display A1-05, hold down the RESET Key and press the MENU Key while A1-04 is displayed.

◆ Displaying User-set Constants Only

You can set and refer to constants necessary to the Inverter only, using the A2 constants (user-set constants) and A1-01 (Constants Access Level).

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. You can set and refer to constants set in A1-01 to A1-03 and A2-01 to A2-32 only, using advanced programming mode.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
A2-01 to A2-32	User setting constants	Used to set the constant numbers that can be set/read. Maximum 32. Effective when the Constant Access Level (A1-01) is set to User Program (1). Constants set in constants A2-01 to A2-32 can be set/read in programming mode.	b1-01 to o3-02	-	No	A	A	A	106H to 125H

Options

This section explains the Inverter option functions.

◆ Performing Speed Control with PG

This section explains functions with flux vector control for PM.

■ Related Constants

Con- stant Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			MEMO BUS Register
						Se- quence Test	Flux Vector for PM	Open Loop Vector for PM	
F1-02	Operation selection at PG open circuit (PGO)	Sets the PG disconnection stopping method. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not normally make this setting.)	0 to 3	1	No	No	A	No	381H
F1-05	PG rotation	0: Phase A leads with Forward Run Command. (Phase B leads with Reverse Run Command.) 1: Phase B leads with Forward Run Command. (Phase A leads with Reverse Run Command.)	0 or 1	1 *	No	No	A	No	384H
F1-14	PG open-circuit detection time	Used to set the PG disconnection detection time. PGO will be detected if the detection time continues beyond the set time.	0.0 to 10.0	2.0 s	No	No	A	No	38DH
F1-18	DV3 Detection selection	Sets the conditions of DV3 detection (inversion detection). 0: DV3 detection disabled n: DV3 detection enabled if DV3 detection conditions are detected for 5 ms × n times in succession.	0 to 5	5	No	No	A	No	3ADH
F1-19	DV4 Detection selection	Sets the conditions of DV4 detection (inversion prevention detection). 0: DV4 detection disabled n: DV4 detection enabled if n pulses of A/B phase pulse inverted to the speed reference are detected.	0 to 5000	128	No	No	A	No	3AEH

* The setting values will return to the factory settings if the control method is changed.

■Using PG Speed Control Board

The following PG Speed Control Board can be used.

- PG-X2: A/B/Z-phase pulse input, compatible with line drivers.

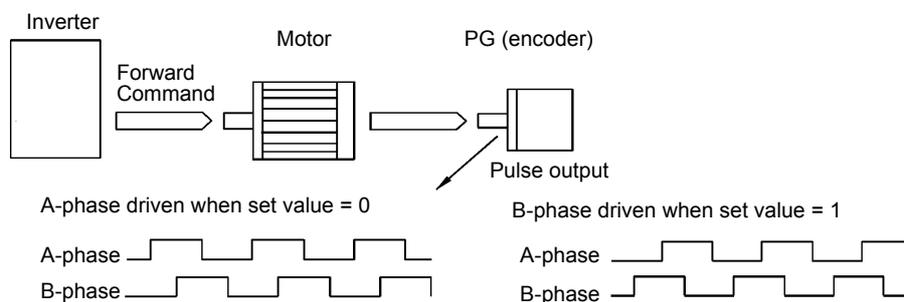
For the connection diagram, refer to page 2-35 to 2-35.

■Number of PG Pulses

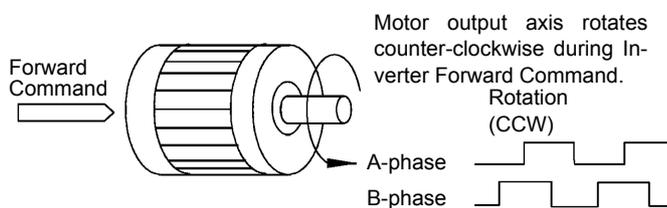
Yaskawa's standard PG (pulse generator or encoder) has a pulse number of 1024 PPR.

■ Matching PG Rotation Direction and Motor Rotation Direction

Constant F1-05 matches the PG rotation direction and the motor rotation direction. If the motor is rotating forwards, set whether it is A-phase driven or B-phase driven.



Example: Forward rotation of standard Yaskawa motor (PG used: Samtack (KK))



Yaskawa standard PG used is B-phase driven (CCW) when motor rotation is forward.

Fig 6.66 PG Rotation Direction Setting

■ Detecting PG Open Circuit

Select the stopping method when PG cable disconnected is detected and the PG open circuit (PGO) detection time.

When the Inverter is operating with the speed reference set to 1% minimum, if the speed feedback from PG is greater than the time setting in F1-14, PGO is detected.

■ Detecting Z-phase Pulse Fall

If a Z-phase pulse is not detected during one full turn of the motor, the Z-phase pulse fault (DV1) alarm will be activated.

■ Detecting Z-phase Noise Fault

If a Z-phase pulse is detected with improper timing (the difference in the Z-phase between this rotation and the last rotation is outside the allowable range of discrepancy per single turn of the motor ± 5 degrees) in a succession exceeding the setting of F1-17, then the Z-phase noise fault (DV2) alarm will be activated.

■ Detecting Motor Inversion

- During Inverter operation, if the torque reference is positive and the acceleration speed is negative, or vice versa, and the difference between the speed reference and the motor speed is greater than 30% and this condition is detected in succession more times than the time multiplication of the setting of F1-18 by 5 ms ($F1-18 \times 5$ ms), then the motor inversion fault (DV3) alarm will be activated.

- During Inverter operation, if the n pulses (setting of F1-19) of A/B-phase pulse inverted to the speed reference (F1-19) are detected, the inversion protection fault (DV4) alarm will be activated.

◆ Using Digital Output Boards

There are two types of Inverter digital output boards:

- DO-02C
Relay contact output (DPDT contact)
- DO-08
6 photocoupler output channels (shared commons)
2 (independent) relay contact output channels (NC contact)

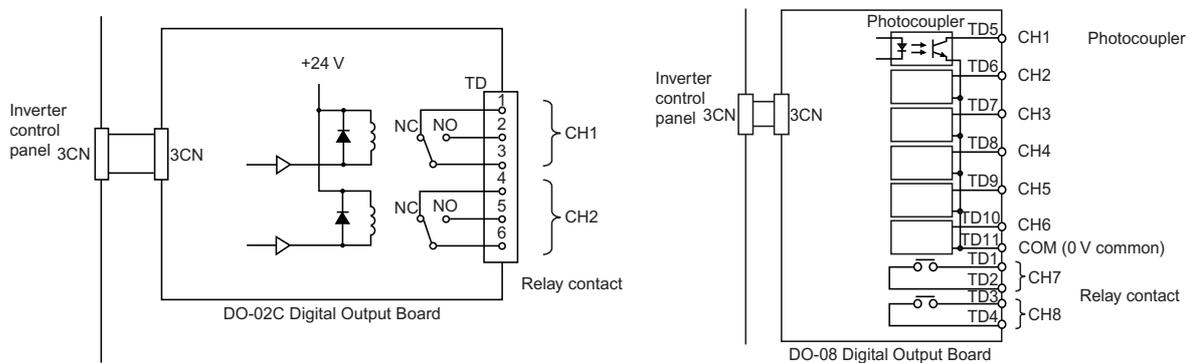


Fig 6.67 Digital Output Boards

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F5-01	Channel 1 output selection	Effective when a Digital Output Board (DO-02C or DO-08) is used. Set the number of the multi-function output to be output.	0 to 3D	0	No	No	A	A	399H
F5-02	Channel 2 output selection	Effective when a Digital Output Board (DO-02C or DO-08) is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	39AH
				1					
F5-03	Channel 3 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	39BH
				2					
F5-04	Channel 4 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	39CH
				4					

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F5-05	Channel 5 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F 6	No	No	A	A	39DH
F5-06	Channel 6 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F 37	No	No	A	A	39EH
F5-07	Channel 7 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	39FH
F5-08	Channel 8 output selection	Effective when a DO-08 Digital Output Board is used. Set the number of the multi-function output to be output.	0 to 3D	0F	No	No	A	A	3A0H
F5-09	DO-08 output mode selection	Effective when a DO-08 Digital Output Board is used. Set the output mode. 0: 8-channel individual outputs 1: Binary code output 2: Output according to F5-01 to F5-08 settings.	0 to 2	0	No	No	A	A	3A1H

■ Setting Output Items for the DO-02C Digital Output Board

If using DO-02C Digital Output Board, set the output items using F5-01 and F5-02.

■ Setting Output Items for the DO-08 Digital Output Board

If using DO-08 Digital Output Board, select one of the following three output modes according to the setting in F5-09.

F5-09 Set to 0

Set Value	Terminal Number	Output Details
0: 8 separate outputs	TD5-TD11	Overcurrent (SC, OC, GF)
	TD6-TD11	Overvoltage (OV)
	TD7-TD11	Inverter overload (OL2)
	TD8-TD11	Fuse blown (PUF)
	TD9-TD11	Overspeed (OS)
	TD10-TD11	Inverter overheated (OH1) or motor overload (OL1)
	TD1-TD2	Zero-speed detected
	TD3-TD4	Speed agreement

F5-09 Set to 1

Set Value	Terminal Number	Output Details	
1: Binary code output	TD5-TD11	bit 0	Encoded output (Refer to table below)
	TD6-TD11	bit 1	
	TD7-TD11	bit 2	
	TD8-TD11	bit 3	
	TD9-TD11	Zero-speed detected	
	TD10-TD11	Speed agreement	
	TD1-TD2	Operating	
	TD3-TD4	Minor fault	

The following table shows the code outputs.

Bits 3, 2, 1, and 0	Output Details	Bits 3, 2, 1, and 0	Output Details
0000	No error	1000	External fault (EFxx)
0001	Overcurrent (SC, OC, GF)	1001	Control board error (CPFxx)
0010	Overvoltage (OV)	1010	Motor overload (OL1)
0011	Inverter overload (OL2)	1011	Not used
0100	Inverter overheated (OH, OH1)	1100	Power loss (UV1, UV2, or UV3)
0101	Overspeed (OS)	1101	Speed deviation (DEV)
0110	Fuse blown (PUF)	1110	PG open circuit (PGO)
0111	Dynamic braking resistor (RH) Injection brake transistor error (RR)	1111	Not used

F5-09 Set to 2

Output depends on the settings in F5-01 to F5-08.

◆ Using an Analog Reference Board (SPEC: C or Later Only)

AI-14B provides 3 channels of bi-polar inputs with 13-bit A/D conversion accuracy (and a + sign bit). The function of each channel is determined by the setting of F2-01.

AI-14U provides 2 channels of bi-polar inputs with 14-bit A/D conversion accuracy. Channel 1 is a voltage input and channel 2 is a current input. The sum of channels 1 and 2 is a frequency input. F2-01 does not need to be set for the AI-14U.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F2-01	Bi-polar or uni-polar input selection	Sets the functions for channel 1 to 3 which are effective when the AI-14B Analog Reference Board is used. 0: 3-channel individual (Channel 1: terminal A1, Channel 2: terminal A2, Channel 3: terminal A3) 1: 3-channel addition (Addition values are the frequency reference) When set to 0, select 1 for b1-01. In this case the multi-function input "Option/Inverter selection" cannot be used.	0 or 1	0	No	A	A	A	38FH

■ Setting Precautions

Always set b1-01 (Reference selection) to 1 (control circuit terminal) when using the AI-14B for three channels of independent inputs. When this is done, H1-01 to H1-06 (multi-function contact inputs) cannot be set to 2 (Option/Inverter selection).

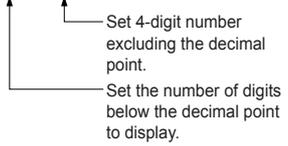
◆ Using a Digital Reference Board (SPEC: C or Later Only)

When using a DI-08 or DI-16H2 Digital Reference Board, set b1-01 (Reference selection) to 3 (Option Card).

The DI-16H2 can be used to set a speed using a 16-bit digital reference. The DI-08 can be used to set a speed using a 8-bit digital reference.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
F3-01	Digital input option	Sets the Digital Reference Board input method. 0: BCD 1% unit 1: BCD 0.1% unit 2: BCD 0.01% unit 3: BCD 1 Hz unit 4: BCD 0.1 Hz unit 5: BCD 0.01 Hz unit 6: BCD special setting (5-digit input) 7: Binary input 6 is only effective when the DI-16H2 is used. When o1-03 is set to 2 or higher, the input will be BCD, and the units will change to the o1-03 setting.	0 to 7	0	No	A	A	A	390H

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
o1-03	Frequency units of reference setting and monitor	<p>Sets the units that will be set and displayed for the speed reference and speed monitor.</p> <p>0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: min⁻¹ units (Sets the motor poles.) 40 to 39999: User desired display</p> <p>Set the desired values for setting and display for the max. output frequency.</p> <p>□□□□□</p>  <p>Example: When the max. output frequency value is 200.0, set 12000</p>	0 to 39999	1	No	A	A	A	502H

■Selecting Input Terminal Functions for the DI-16H2 Digital Reference Board

The speed reference from the DI-16H2 Board is determined by the setting of F3-01 and the 12/16-bit switch on the option card. The possible settings are listed in the following table.

Terminal	Pin No.	12-bit Binary with Sign	16-bit Binary with Sign	3-digit BCD with Sign	4-digit BCD with Sign	5-digit BCD without Sign		
		F3-01 = 7 S1: 12 bit	F3-01 = 7 S1: 16 bit	F3-01 = 0 to 5 S1: 12 bit	F3-01 = 0 to 5 S1: 16 bit	F3-01 = 6 S1: 16 bit		
TC1	1	Bit 1 (2^0)	Bit 1 (2^0)	1	BCD digit 1 (0 to 9)	1	BCD digit 1 (0, 2, 4, 6, 8)	
	2	Bit 1 (2^1)	Bit 1 (2^1)	2		2		4
	3	Bit 1 (2^2)	Bit 1 (2^2)	4		4		8
	4	Bit 1 (2^3)	Bit 1 (2^3)	8		8		1
	5	Bit 1 (2^4)	Bit 1 (2^4)	1	BCD digit 2 (0 to 9)	1	BCD digit 2 (0 to 9)	
	6	Bit 1 (2^5)	Bit 1 (2^5)	2		2		4
	7	Bit 1 (2^6)	Bit 1 (2^6)	4		4		8
	8	Bit 1 (2^7)	Bit 1 (2^7)	8		8		1
	9	Bit 1 (2^8)	Bit 1 (2^8)	1	BCD digit 3 (0 to 9)	1	BCD digit 3 (0 to 9)	
	10	Bit 1 (2^9)	Bit 1 (2^9)	2		2		4
			4	4		8		
TC2	1	Bit 1 (2^{10})	Bit 1 (2^{10})	4	BCD digit 4 (0 to 9)	4	BCD digit 4 (0 to 9)	
	2	Bit 1 (2^{11})	Bit 1 (2^{11})	8		8		1
	3	-	Bit 1 (2^{12})		-	1	BCD digit 4 (0 to 9)	
	4	-	Bit 1 (2^{13})		-	2		
	5	-	Bit 1 (2^{14})		-	4		
	6	-	Bit 1 (2^{15})		-	8	1	BCD digit 5 (0 to 3)
	7	Sign signal (0: Forward, 1: Reverse)					2	
	8	SET (read) signal (1: Read)						
9	Input signal common (0 V)							
TC3	Shield wire connection terminal							

■Application Precautions

- The maximum speed reference will be used when the binary input is set (setting: 6 or 7) and all bits are 1.
- Setting F3-01 to 6 is valid only when the DI-16H2 is used. Using this setting, a frequency from 0.00 to 399.8 Hz can be set in BCD. The sign bit is used as a data bit, so only positive (plus) data can be set. Also, the digit starts from 0, so the minimum setting is 0.02 Hz.

■ Selecting the Input Terminal Function for a DI-08 Digital Reference Board

The speed reference from a DI-08 Board is determined by the setting of F3-01, as shown in the following table.

Terminal	Pin No.	8-bit Binary with Sign	2-digit BCD with Sign		
		F3-01 = 7	F3-01 = 0 to 5		
TC	1	Bit 1 (2^0)	1	BCD digit 1 (0 to 9)	
	2	Bit 1 (2^1)	2		
	3	Bit 1 (2^2)	4		
	4	Bit 1 (2^3)	8		
	5	Bit 1 (2^4)	1	BCD digit 2 (0 to 15)	
	6	Bit 1 (2^5)	2		
	7	Bit 1 (2^6)	4		
	8	Bit 1 (2^7)	8		
	9	Sign signal			
	10	SET (read) signal			
	11	Reference common signal (0 V)			

■ Application Precautions

The DI-08 will not function if F3-01 is set to 6

■ Selecting the Digital Reference

The range of the digital references is determined by the combination of the settings of o1-03 and F3-01. The information monitored in U1-01 (Speed reference) will also change.

DI-16H2 Reference Ranges

When using the DI-16H2, the following ranges can be set depending on the settings of the constants.

o1-03	F3-01	Switch S1	Reference Input Mode	Reference Setting Range	U1-01 Monitor Unit	
					o1-03 = 0	o1-03 = 1
0 or 1	0	12 bits	3-digit BCD with sign, 1%	-110 to 110%	0.01 Hz	0.01%
		16 bits	4-digit BCD with sign, 1%	-110 to 110%		
	1	12 bits	3-digit BCD with sign, 0.1%	-110.0 to 110.0%		
		16 bits	4-digit BCD with sign, 0.1%	-110.0 to 110.0%		
	2	12 bits	3-digit BCD with sign, 0.01%	-15.99 to 15.99%		
		16 bits	4-digit BCD with sign, 0.01%	-110.0 to 110.0%		
	3	12 bits	3-digit BCD with sign, 1 Hz	-400 to 400 Hz		
		16 bits	4-digit BCD with sign, 1 Hz	-400 to 400 Hz		
	4	12 bits	3-digit BCD with sign, 0.1 Hz	-159.9 to 159.9 Hz		
		16 bits	4-digit BCD with sign, 0.1 Hz	-400.0 to 400.0 Hz		
	5	12 bits	3-digit BCD with sign, 0.01 Hz	-15.99 to 15.99 Hz		
		16 bits	4-digit BCD with sign, 0.01 Hz	-159.99 to 159.99 Hz		
	6	16 bits	5-digit BCD without sign, 0.01 Hz	000.00 to 399.98 Hz		
	7	12 bits	12-bit binary with sign, 100%/4095	-4095 to 4095		
16 bits		16-bit binary with sign, 100%/30000	-33000 to 33000			
2 to 39	-	12 bits	3-digit BCD with sign, 1 rpm	-1599 to 1599 rpm	1 rpm	
		16 bits	4-digit BCD with sign, 1 rpm	-15999 to 15999 rpm	1 rpm	
x0040 to x9999 (x = 0 to 3)	-	12 bits	3-digit BCD with sign, 100%/(1- to 4-digit setting of o1-03)	-1599 to 1599	5th digit of o1-03 setting: X = 0, unit: 1 X = 1, unit: 0.1 X = 2, unit: 0.01 X = 3, unit: 0.001	
		16 bits	4-digit BCD with sign, 100%/(1- to 4-digit setting of o1-03)	-9999 to 9999 (when o1-03 = 9999)		
x1000 (x = 1 to 3)	-	16 bits	4-digit BCD with sign, 100%/10000	-1000 to 1000		

DI-08 Reference Ranges

When using the DI-08, the following ranges can be set depending on the settings of the constants.

F3-01	Reference Input Mode	Reference Setting Range	U1-01 Monitor Unit	
			o1-03 = 0	o1-03 = 1
0	2-digit BCD with sign, 1%	-110 to 110%	0.01 Hz	0.01%
1	2-digit BCD with sign, 0.1%	-15.9 to 15.9%		
2	2-digit BCD with sign, 0.01%	-1.59 to 1.59%		
3	2-digit BCD with sign, 1 Hz	-159 to 159 Hz		
4	2-digit BCD with sign, 0.1 Hz	-15.9 to 15.9 Hz		
5	2-digit BCD with sign, 0.01 Hz	-1.59 to 1.59 Hz		
6	-	-		
7	8-bit binary with sign, 100%/255	-255 to 255		

Maintenance Timer Display Function (SPEC: C or Later Only)

This function indicates that the estimated performance life of the cooling fan and electrolytic capacitor have been reached.



The maintenance time periods displayed in the monitors as a percentage to the total life are only an estimate, not an exact prediction of actual performance life. Use them as guidelines for replacement.

◆ Settings Required to Use Maintenance Timer Display Function

Set H2-□□ to 2F to use a multi-function contact output for this function and display an alarm on the Digital Operator (the constants U1-61 and U1-63).

■ Multi-function Contact Outputs (H2-01 to H2-03)

The maintenance time period for the cooling fan or electrolytic capacitor can be output from the multi-function contact terminal by setting H2-□□ to 2F. Minor faults will not be output.

Setting Value	Function	Control Methods			Page
		Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
2F	Maintenance timer display (ON: Maintenance timer for capacitors or fans.)	Yes	Yes	Yes	-

Refer to *Multi-function Contact Output Functions* in *Chapter 5 User Constants* for information on multi-function contact outputs.

■ Related Status Monitoring Constants

Constant Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			MEMO BUS Register
					Sequence Test	Flux Vector for PM	Open Loop Vector for PM	
U1-40	Cooling fan operating time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	(Cannot be output.)	1 hr	A	A	A	67H
U1-61	Electrolytic capacitor maintenance	Displays the estimated time for the electrolytic capacitor maintenance in % units. (Can be set in o2-18.) (100% is the estimated time for replacement.)	(Cannot be output.)	1%	A	A	A	7CH
U1-63	Cooling fan maintenance timer	Cooling fan maintenance timer (100% is the estimated time for replacement.)	(Cannot be output.)	1%	A	A	A	7EH

■ Related Alarm Displays

When setting a multi-function contact output H2-□□ to 2F, the alarm is displayed on the Digital Operator as shown below.

Display	Meaning	Probable causes	Corrective Actions
⌒ ⌒ - ⌒ (blinking)	Electrolytic Capacitor Maintenance Timer Monitor U1-61 has reached 100%.	The electrolytic capacitors have reached their estimated maintenance time period.	Reset o2-18 to “0%” after replacing the electrolytic capacitors.
⌒ ⌒ - ⌒ (blinking)	Cooling Fan Maintenance Timer Monitor U1-63 has reached 100%.	The cooling fan has reached its estimated maintenance time period.	Replace the cooling fan and set o2-10 to “0H”.

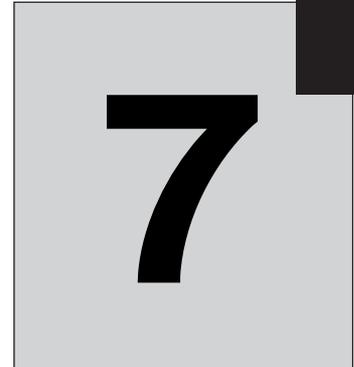
◆ Settings Required After Replacement of Cooling Fan or Electrolytic Capacitor

- Set o2-10 to 0 after replacing the cooling fan.
- Set o2-18 to 0 after replacing the electrolytic bus capacitor.

Refer to *Chapter 8 Maintenance and Inspection* for the replacement procedure.

■ Related Constants

Constant Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods			MEMO BUS Register	Page
						Sequence Test	Flux Vector for PM	Open Loop Vector for PM		
o2-10	Fan operation time setting	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	A	A	50EH	6-120
o2-18	Capacitor maintenance setting	Clears the electrolytic capacitor maintenance (U1-61) [setting:0] and sets the setting value in % unit.	0 to 150	0%	No	A	A	A	51DH	-



Troubleshooting

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

Protective and Diagnostic Functions	7-2
Troubleshooting	7-20

Protective and Diagnostic Functions

This section describes the alarm functions of the Inverter. The alarm functions include fault detection, alarm detection, operation error detection, and autotuning error detection.

◆ Fault Detection

When the Inverter detects a fault, the fault contact output operates, and the Inverter output is shut OFF causing the motor to coast to a stop. (The stopping method can be selected for some faults, and the selected stopping method will be used with these faults.) A fault code is displayed on the Digital Operator.

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

Be sure to turn Run Command to OFF first, use one of the following methods to reset the fault before restarting the Inverter.

- Set a multi-function contact input (H1-01 to H1-06) to 14 (Fault Reset) and turn ON the fault 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. (200% of rated current)	<ul style="list-style-type: none"> • A short-circuit or ground fault occurred at the Inverter output. (A short or ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.) • The load is too large or the acceleration/deceleration time is too short. • A special-purpose motor or motor with a capacity too large for the Inverter is being used. • A magnetic contactor was switched at the Inverter output. 	Reset the fault after correcting its cause. Note) Before turning the power ON again, make sure that no short-circuit or ground fault occurs at the Inverter output.
		<ul style="list-style-type: none"> • A short-circuit between +V, -V, and AC terminals occurred. • Overload in the control circuit terminal. 	<ul style="list-style-type: none"> • Make sure that incorrect wiring has not been done. • Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
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. Note) Before turning the power ON again, make sure that no short-circuit or ground fault occurs at the Inverter output.
		<ul style="list-style-type: none"> • A short-circuit between +V, -V, and AC terminals occurred. • Overload in the control circuit terminal. 	<ul style="list-style-type: none"> • Make sure that incorrect wiring has not been done. • Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)

* The ground fault here is one which occurs in the motor wiring while the motor is running. A ground fault may not be detected in the following cases.

- A ground fault with low resistance which occurs in motor cables or terminals.
- A ground fault occurs when the power is turned ON.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
<i>P U F</i>	Fuse Blown The fuse in the main circuit is blown.	<ul style="list-style-type: none"> The output transistor has failed because of a short-circuit or ground fault at the Inverter output. Check whether there is a short-circuit between the following terminals. A short-circuit will damage the output transistor: B1 (⊕3) ↔ U, V, W ⊖ ↔ U, V, W Input power was supplied from the output side. (Improper wiring, the sequence for switching commercial power supply was wrong, etc.) 	Replace the Inverter after correcting the cause.
<i>□ U</i>	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 (E1-01 ≥ 400 V) Approx. 720 V (E1-01 < 400 V)	The deceleration time is too short and the regenerative energy from the motor is too large.	Increase the deceleration time or connect a braking resistor (or Braking Resistor Unit).
		Motor ground fault (Ground fault current flowed to the capacitor in the control circuit of the Inverter through the power supply.)	Check the output cable, relay terminal, or motor terminal box and correct the cause of ground fault.
		Improper PG cable connection (PG noise, PG disconnection)	Check to see if the PG cable is connected properly.
		The power supply voltage is too high.	Decrease the voltage so it's within specifications.
<i>U U 1</i>	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 Magnetic Connector Operation Failure The magnetic connector stopped responding during Inverter operation. Applicable Inverter Capacities 200 V Class: 37 to 75 kW 400 V Class: 75 to 300 kW	<ul style="list-style-type: none"> An open-phase occurred with the input power supply. A momentary power loss occurred. The wiring terminals for the input power supply are loose. The voltage fluctuations in the input power supply are too large. A fault occurred in the surge prevention circuit. The magnetic contactor in the control circuit was released (Contact failure in the auxiliary contact). The contact of the magnetic contactor in the control circuit was corroded due to environmental dust or gas. 	<ul style="list-style-type: none"> Reset the fault after correcting its cause. Improve the power supply environment. (Check to see if the correct power tap is selected.) Improve the operating environment. Replace the Inverter.
<i>U U 2</i>	Control Power Fault The control power supply voltage dropped.	<ul style="list-style-type: none"> The wiring of the control power circuit is incorrect. A Backup Capacitor Unit for Momentary Power Loss is not attached to a 200 V/400 V Class Inverter of 11 kW or less and the value of the Momentary power loss ride-through time (L2-02) factory setting has been changed to the larger value. 	<ul style="list-style-type: none"> Fix the wiring. Try turning the power supply off and on. Replace the Inverter if the fault continues to occur. Attach a Backup Capacitor Unit for Momentary Power Loss.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
<i>U U 3</i>	Inrush Prevention Circuit Fault Malfunction in the inrush prevention circuit. The magnetic contactor did not respond for 10 s even though the magnetic contactor ON signal has been output. Applicable Inverter Capacities 200 V Class: 37 to 75 kW 400 V Class: 75 to 300 kW	<ul style="list-style-type: none"> The magnetic contactor in the main circuit failed. The magnetic contactor excitation coil is burned out. 	<ul style="list-style-type: none"> Try turning the power supply off and on. Replace the Inverter if the fault continues to occur.
<i>P F</i>	Main Circuit Voltage Fault The main circuit DC voltage oscillates unusually (not when regenerating). This fault is detected when L8-05 is set to 1.	<ul style="list-style-type: none"> An open-phase occurred in the input power supply. A momentary power loss occurred. The wiring terminals for the input power supply are loose. The voltage fluctuations in the input power supply are too large. The voltage balance between phases is bad. 	Reset the fault after correcting its cause.
<i>L F</i>	Output Open-phase An open-phase occurred at the Inverter output. This fault is detected when L8-07 is set to 1 or 2.	<ul style="list-style-type: none"> There is a broken wire in the output cable. There is a broken wire in the motor-winding. The output terminals are loose. 	Reset the fault after correcting its cause.
		The motor being used has a capacity less than 5% of the Inverter maximum applicable motor output.	Check the motor and Inverter capacity.
<i>L F 2</i>	Output Current Imbalance Each or one of the three phases of the output current is imbalanced or unequal.	<ul style="list-style-type: none"> An open phase in the Inverter wiring on the output side. An open phase of the gate drive signal. An imbalance in the motor's three-phase impedance. 	<ul style="list-style-type: none"> Correct the wiring on the Inverter's output side. Tighten the terminal screw. Replace the gate drive board. Replace the motor. Contact your Yaskawa representative for more information on replacing the gate drive board or the motor.
<i>OH</i> (<i>OH I</i>)	Cooling Fin Overheating The temperature of the Inverter's cooling fins exceeded the setting in L8-02 or the overheat protection level. OH: The temperature exceeded the setting in L8-02 (Stopping method can be changed by L8-03.). OH1: The temperature exceeded 100°C (Stopping method: Coast to stop).	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
		<ul style="list-style-type: none"> A short-circuit between +V, -V, and AC terminals occurred. Overload in the control circuit terminal. 	<ul style="list-style-type: none"> Make sure that incorrect wiring has not been done. Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
	Inverter's Cooling Fan Fault (11 kW or more) This fault is detected when L8-32 is set to 1.	<ul style="list-style-type: none"> The Inverter's cooling fan has stopped. The heatsink is clogged. 	<ul style="list-style-type: none"> Replace the cooling fan. (Contact our sales representative.) Clean the heatsink.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
<i>F R n</i>	Inverter's Cooling Fan Fault An Inverter's cooling fan fault was detected, and the Inverter-overload protection was activated based on the internal electric thermal value. This fault is detected when L8-32 is set to 0.	The Inverter continued running with an overload after the cooling fan stopped.	Replace the cooling fan. (Contact our sales representative.)
<i>o H 4</i>	Motor Overheating Fault E was set for H3-05 or H3-09 and the motor temperature thermistor input exceeded the fault detection level.	The motor has overheated.	<p>Check the size of the load and the length of the acceleration, deceleration, and cycle times.</p> <p>Check the V/f characteristics.</p> <p>Check the motor temperature input on terminals A2 and A3.</p> <p>Check the setting of motor rated current (E2-01).</p>
<i>r H</i>	Installed Braking Resistor Overheating The braking resistor is overheated and the protection function has operated if it has been enabled in L8-01.	The deceleration time is too short and the regenerative energy from the motor is too large.	<ul style="list-style-type: none"> Reduce the load, increase the deceleration time, or reduce the motor speed. Change to a Braking Resistor Unit.
<i>r r</i>	Internal Braking Transistor Fault The braking transistor is not operating properly.	<ul style="list-style-type: none"> The braking transistor is damaged. The Inverter's control circuits are faulty. 	<ul style="list-style-type: none"> Try turning the power supply off and on. Replace the Inverter if the fault continues to occur.
<i>o L 1</i>	Motor Overload The motor overload protection function has operated based on the internal electronic thermal value.	<p>The load is too heavy. The acceleration time, deceleration time, and cycle time are too short.</p> <p>Motor overload occurred when running at low speed. (If a variable torque PM motor is used, motor overload can occur when running at low speed even if running within the rated current.)</p> <p>The directions of the motor and PG are different. (Only in flux vector control)</p> <p>The V/f characteristics voltage is too high or too low.</p> <p>The setting of the Motor Rated Current (E5-03) is incorrect.</p> <ul style="list-style-type: none"> A short-circuit between +V, -V, and AC terminals occurred. Overload in the control circuit terminal. 	<p>Check the size of the load and the length of the acceleration, deceleration, and cycle times.</p> <ul style="list-style-type: none"> Check the size of the load. Check the setting of L1-01. Increase the frame size of the Inverter. Correct the PG wiring. Correct the motor wiring. Change the setting of PG rotation (F1-05). <p>Check the V/f characteristics.</p> <p>Check the setting of the Motor Rated Current (E5-03).</p> <ul style="list-style-type: none"> Make sure that incorrect wiring has not been done. Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
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 directions of the motor and PG are different. (Only in flux vector control)	<ul style="list-style-type: none"> • Correct the PG wiring. • Correct the motor wiring. • Change the setting of PG rotation (F1-05).
		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.
		<ul style="list-style-type: none"> • A short-circuit between +V, -V, and AC terminals occurred. • Overload in the control circuit terminal. 	<ul style="list-style-type: none"> • Make sure that incorrect wiring has not been done. • Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
		Inverter overload occurred when running at a low speed of 6 Hz or less.	<ul style="list-style-type: none"> • Reduce the load. • Increase the frame size of the Inverter. • Lower the carrier frequency.
OL3	Overtorque Detected 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	<ul style="list-style-type: none"> • Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OL4	Overtorque Detected 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	-	<ul style="list-style-type: none"> • Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
UL3	Undertorque Detected 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	<ul style="list-style-type: none"> • Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
UL4	Undertorque Detected 2 There has been a current less than the setting in L6-05 for longer than the setting in L6-06.	-	<ul style="list-style-type: none"> • Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OS	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/Undershooting are occurring.	Adjust the gain again.
		The reference speed is too high.	Check the reference circuit and reference gain.
		The settings in F1-08 and F1-09 aren't appropriate.	Check the settings in F1-08 and F1-09.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
<i>PGo</i>	PG Disconnection Detected PG pulses were input when the Inverter was outputting a frequency.	There is a break in the PG wiring.	Fix the broken/disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power isn't being supplied to the PG.	Supply power to the PG properly.
		Brake is applied to the motor.	Check for open circuit when using brake (motor).
<i>dEu</i>	Excessive Speed Deviation The speed deviation has been greater than the setting in F1-10 for longer than the setting in F1-11.	The load is too heavy.	Reduce the load.
		The acceleration time and deceleration time are too short.	Lengthen the acceleration time and deceleration time.
		The load is locked.	Check the mechanical system.
		The settings in F1-10 and F1-11 aren't appropriate.	Check the settings in F1-10 and F1-11.
		Brake is applied to the motor.	Check for open circuit when using brake (motor).
<i>Sfo</i>	Motor hunting and vibration Motor control was lost due to hunting and vibration.	-	<ul style="list-style-type: none"> • Check the settings of the motor constants. • Check the motor's working temperature. • Decrease the ASR Gain (C5-01). • Extend the acceleration time (C1-01).
<i>dv1</i>	Z-phase pulse fall detection (Always detected when applying current.) Z-phase pulse was not detected during one turn of the motor.	<ul style="list-style-type: none"> • Incorrect wiring of PG cables. • Disconnected PG cables. • Damage of PG on the motor side. 	<ul style="list-style-type: none"> • Correct the wiring. • Reconnect the PG cables. • If the dv1 fault is detected even after taking preventative measures, replace the PG card or the PG. Contact your Yaskawa representative for more information.
<i>dv2</i>	Z-phase noise fault detection (Always detected when applying current.) The Z-phase pulse was detected at the improper timing (The difference of the Z-phase detection between this time and last time is outside the allowable range of one turn of the motor ± 5 degrees) in succession for more than the number of times assigned to F1-17.	<ul style="list-style-type: none"> • Noise interference affected the PG cables (Z-phase). • Disconnected PG cables. • Damaged PG card. • Damage of PG on the motor side. 	<ul style="list-style-type: none"> • Separate the PG wiring from the noise source (Inverter output line) by more than 30 cm. • Correct the wiring. • Reconnect the PG cables. • If the dv2 fault is detected even after taking preventative measures, replace the PG card or the PG. Contact your Yaskawa representative for more information.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
<i>dv3</i>	Inversion detection (Only detected while running.) Occurs when the torque reference is positive and the acceleration speed is negative or vice versa, and the difference between the speed reference and the motor speed is greater than 30% and this condition is detected in succession for more than the number of times assigned to F1-18.	<ul style="list-style-type: none"> • Incorrect setting for the compensation amount of the zero-point pulse using a PG (E5-11). • Noise interference affected the PG cables (A/B-phase). • Incorrect wiring of PG cables. • Disconnected PG cables. • Damaged PG card. • Damage of PG on the motor side. • The PG rotation (F1-05) is set to the phase opposite that of the main wiring of the motor. 	<ul style="list-style-type: none"> • Reset the compensation amount of the zero-point pulse using a PG (E5-11) to that for Delta Theta ($\Delta\theta$) on the motor's nameplate. If replacing the PG or changing the rotational direction of the motor, make an adjustment for the zero-point pulse of the PG. • Check that the rotational direction of the motor is correct. • Check to see if the load is overhauling the motor. If so, remove the cause and correct the operating conditions. • Correct the wiring. • Reconnect the PG cables. • Correctly connect the main wiring of the motor to the U, V, or W-phase.
<i>dv4</i>	Inversion prevention detection (Only detected while running.) The motor rotated in the opposite direction to that of the speed reference for the number of times assigned to F1-19.	<ul style="list-style-type: none"> • Incorrect setting for the compensation amount of the zero-point pulse using a PG (E5-11). • Noise interference affected the PG cables (A/B-phase). • Incorrect wiring of PG cables. • Disconnected PG cables. • Damaged PG card. • Damage of PG on the motor side. 	<ul style="list-style-type: none"> • In an application in which an overhauling load causes the motor to rotate in the opposite direction of the speed reference, disable the dv4 fault detection (F1-19=0). • Take the same measures as for a dv3 fault.
<i>FbL</i>	PID Feedback Reference Lost A PID feedback reference loss was detected (b5-12 = 2) and the PID feedback input was less than b5-13 (PID feedback loss detection level) for longer than the time set in b5-14 (PID feedback loss detection time).	The settings in b5-13 and b5-14 aren't appropriate.	Check the settings in b5-13 and b5-14.
		The wiring of the PID feedback circuit is incorrect.	Fix the wiring.
<i>EF0</i>	External Fault input from Communications Option Card	-	Check the Communications Option Card and communications signals.
<i>EF3</i>	External Fault (Input Terminal S3)	An "external fault" was input from a multi-function input terminal (S3 to S8).	<ul style="list-style-type: none"> • Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
<i>EF4</i>	External Fault (Input Terminal S4)		
<i>EF5</i>	External Fault (Input Terminal S5)		
<i>EF6</i>	External Fault (Input Terminal S6)		
<i>EF7</i>	External Fault (Input Terminal S7)		
<i>EF8</i>	External Fault (Input Terminal S8)		
<i>OPr</i>	Digital Operator Connection Fault The connection to the Digital Operator was broken during operation for a Run Command from the Digital Operator.	-	Check the connection to the Digital Operator.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
<i>CE</i>	MEMOBUS Communications Error A normal reception was not possible for 2 s or longer after control data was received once.	-	Check the communications devices and communications signals.
<i>bUS</i>	Option Communications Error A communications error was detected during a Run Command or while setting a speed reference from a Communications Option Card.	-	Check the communications devices and communications signals.
<i>CPFD0</i>	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.
<i>CPFD1</i>	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.
<i>CPFD2</i>	Baseblock Circuit Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
<i>CPFD3</i>	EEPROM Error	-	Try turning the power supply off and on again.
		The Inverter power supply was shut off while writing data to the Inverter constants.	Initialize the constant settings (A1-03).
		The control circuit is damaged.	Replace the Inverter.
<i>CPFD4</i>	CPU Internal A/D Converter Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
		<ul style="list-style-type: none"> A short-circuit between +V, -V, and AC terminals occurred. Overload in the control circuit terminal. 	<ul style="list-style-type: none"> Make sure that incorrect wiring has not been done. Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
[PF05]	CPU External A/D Converter Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
		<ul style="list-style-type: none"> A short-circuit between +V, -V, and AC terminals occurred. Overload in the control circuit terminal. 	<ul style="list-style-type: none"> Make sure that incorrect wiring has not been done. Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
[PF06]	Option Card Connection Error	The option card is not connected properly.	Turn off the power and insert the board again.
		The Inverter or option card is faulty.	Replace the option card or the Inverter.
[PF07]	ASIC Internal RAM Fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
[PF08]	Watchdog Timer Fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
[PF09]	CPU-ASIC Mutual Diagnosis Fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
[PF10]	ASIC Version Fault	The Inverter control circuit is faulty	Replace the Inverter.
[PF20]	Communications Option Card A/D Converter Error	The option card is not connected properly.	Turn off the power and insert the board again.
		The option card's A/D converter is faulty.	Replace the Communications Option Card.
[PF21]	Communications Option Card Self Diagnostic Error	Communications Option Card fault.	Replace the option card.
[PF22]	Communications Option Card Model Code Error		
[PF23]	Communications Option Card DPRAM Error	Communications Option Card fault.	Replace the option card.
		The copy function of the Digital Operator was used during communications.	<ul style="list-style-type: none"> Use the copy function off-line. Use the copy function with an option card removed.
		The option card is not connected properly.	Turn off the power and insert the board again.

Table 7.2 Causes and Corrective Actions When the Digital Operator Goes Dark

Display	Meaning	Probable Causes	Corrective Actions
No display	There was a drop in control power voltage.	<ul style="list-style-type: none"> • A short-circuit between +V, -V, and AC terminals occurred. • Overload in the control circuit terminal. 	<ul style="list-style-type: none"> • Make sure that incorrect wiring has not been done. • Check the resistance and wiring for the frequency setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
		The short-circuit bar between +1 and +2 terminals in the control circuit has been removed.	Attach the short-circuit bar.
		P terminal and N terminal of the Braking Unit are connected in reverse.	<ul style="list-style-type: none"> • Check the wiring for the Braking Unit, including cables connected to the Braking Unit and relay terminals. • Replace the Inverter.
		Control power circuit failure	Charge indicator is lit: <ul style="list-style-type: none"> • Replace the Digital Operator. • Replace the control circuit terminal board or the Inverter. Charge indicator is not lit: <ul style="list-style-type: none"> • Check the input power supply voltage. • Replace the Inverter.
		Malfunction occurred in the control power circuit.	Turn OFF the power, wait for 5 minutes, and turn ON the power again.

◆ Alarm Detection

Alarms are detected as a type of Inverter protection function that do not operate the fault contact output. The system will automatically returned to its original status once the cause of the alarm has been removed.

The Digital Operator display blinks and an alarm is sent from the multi-function outputs (H2-01 to H2-03) if selected.

When an alarm occurs, take appropriate countermeasures according to the table below.

Table 7.3 Alarm Displays and Processing

Display	Meaning	Probable causes	Corrective Actions
$\mathcal{E} F$ (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.
$\mathcal{U} \mathcal{U}$ (blinking)	Main Circuit Undervoltage The following conditions occurred when there was no Run signal. <ul style="list-style-type: none"> The main circuit DC voltage was below the Undervoltage Detection Level Setting (L2-05). The surge current limiting magnetic 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.
$\mathcal{O} \mathcal{U}$ (blinking)	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 (E1-01 \geq 400 V) Approx. 720 V (E1-01 $<$ 400 V)	The power supply voltage is too high.	Decrease the voltage so it's within specifications.
$\mathcal{O} H$ (blinking)	Cooling Fin Overheating The temperature of the Inverter's cooling fins 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.)
		<ul style="list-style-type: none"> A short-circuit between +V, -V, and AC terminals occurred. Overload in the control circuit terminal. 	<ul style="list-style-type: none"> Make sure that incorrect wiring has not been done. Check the resistance and wiring for the speed setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
$F F n$ (blinking)	Inverter's Cooling Fan Fault An Inverter's cooling fan fault was detected. This fault is detected when L8-32 is set to 0.	The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)

Table 7.3 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
$\square H2$ (blinking)	Inverter Overheating Pre-alarm An OH2 alarm signal (Inverter overheating alarm signal) was input from a multi-function input terminal (S3 to S8).	-	Clear the multi-function input terminal's overheating alarm input.
$\square H3$ (blinking)	Motor Overheating E was set for H3-05 or H3-09 and the motor temperature thermistor input exceeded the alarm detection level.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A2 and A3.
$\square L3$ (blinking)	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	<ul style="list-style-type: none"> Make sure that the settings in L6-02 and L6-03 are appropriate. Check the mechanical system and correct the cause of the overtorque.
$\square L4$ (blinking)	Overtorque 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	-	<ul style="list-style-type: none"> Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. Check the mechanical system and correct the cause of the overtorque.
$\square L3$ (blinking)	Undertorque 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	<ul style="list-style-type: none"> Make sure that the settings in L6-02 and L6-03 are appropriate. Check the mechanical system and correct the cause of the overtorque.
$\square L4$ (blinking)	Undertorque 2 There has been a current less than the setting in L6-05 for longer than the setting in L6-06.	-	<ul style="list-style-type: none"> Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. Check the mechanical system and correct the cause of the overtorque.
$\square 5$ (blinking)	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/undershooting are occurring.	Adjust the gain again.
		The reference speed is too high.	Check the reference circuit and reference gain.
		The settings in F1-08 and F1-09 aren't appropriate.	Check the settings in F1-08 and F1-09.
$\square \square \square$ (blinking)	The PG is Disconnected The Inverter is outputting a frequency, but PG pulses aren't being input.	There is a break in the PG wiring.	Fix the broken/disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power isn't being supplied to the PG.	Supply power to the PG properly.
		Brake is applied to the motor.	Check for open circuit when using brake (motor).

Table 7.3 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
<i>d E u</i> (blinking)	Excessive Speed Deviation The speed deviation has been greater than the setting in F1-10 for longer than the setting in F1-11.	The load is too large.	Reduce the load.
		The acceleration time and deceleration time are too short.	Lengthen the acceleration time and deceleration time.
		The load is locked.	Check the mechanical system.
		The settings in F1-10 and F1-11 aren't appropriate.	Check the settings in F1-10 and F1-11.
		Brake is applied to the motor.	Check for open circuit when using brake (motor).
<i>E F 0</i> (blinking)	External Fault Input from Communications Option Card 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.
<i>E F 3</i> (blinking)	External Fault (Input Terminal S3)	An external fault was input from a multi-function input terminal (S3 to S8).	<ul style="list-style-type: none"> Reset external fault inputs to the multi-function inputs. Remove the cause of the external fault.
<i>E F 4</i> (blinking)	External Fault (Input Terminal S4)		
<i>E F 5</i> (blinking)	External Fault (Input Terminal S5)		
<i>E F 6</i> (blinking)	External Fault (Input Terminal S6)		
<i>E F 7</i> (blinking)	External Fault (Input Terminal S7)		
<i>E F 8</i> (blinking)	External Fault (Input Terminal S8)		
<i>F b L</i> (blinking)	PID Feedback Reference Lost A PID feedback reference loss was detected (b5-12 = 2) and the PID feedback input was less than b5-13 (PID feedback loss detection level) for longer than the time set in b5-14 (PID feedback loss detection time).		
		The wiring of the PID feedback circuit is incorrect.	Fix the wiring.
<i>CE</i> (blinking)	MEMOBUS Communications Error Normal reception was not possible for 2 s or longer after received control data.	-	Check the communications devices and signals.

Table 7.3 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
<i>b U S</i> (blinking)	Option Card Communications Error A communications error occurred in a mode where the Run Command or a speed reference is set from a Communications Option Card.	-	Check the communications devices and signals.
<i>ε R L L</i> (blinking)	Communications on Standby Control data was not normally received when power was turned ON.	-	Check the communications devices and signals.
<i>L F - ε</i> (blinking)	Electrolytic Capacitor Maintenance Timer Monitor U1-61 has reached 100%.	The electrolytic capacitors have reached their estimated maintenance time period.	Reset o2-18 to "0%" after replacing the electrolytic capacitors.
<i>L F - F</i> (blinking)	Cooling Fan Maintenance Timer Monitor U1-63 has reached 100%.	The cooling fan has reached its estimated maintenance time period.	Replace the cooling fan and set o2-10 to "OH".
<i>ε r S F</i> (blinking)	Reset during Run Command Input Error The reset signal was input during Run Command input from an external terminal or other source.	-	Check that a Run Command is not being input from an external terminal or other source.
<i>b b</i> (blinking)	Receiving External Baseblock Command External baseblock was input from external terminal again while it was input.	-	-
<i>S E</i> (blinking)	Communications Test Mode Error A Run Command was entered during a communications test.	-	-

◆ Operation Errors

An operation error will occur if there is an invalid setting or a contradiction between two constant settings. It won't be possible to start the Inverter until the constants have been set correctly. (The alarm output and fault contact outputs will not operate either.)

When an operation error has occurred, refer to the following table to identify and correct the cause of the errors.

Table 7.4 Operation Error Displays and Incorrect Settings

Display	Meaning	Incorrect settings
oPE01	Incorrect Inverter Capacity Setting	<ul style="list-style-type: none"> The Inverter capacity setting does not match the Unit. Contact your Yaskawa representative. The Inverter model does not support the version of the software being used. Check the Inverter nameplate for applicable software versions. Contact your Yaskawa representative for more information.
oPE02	Constant Setting Range Error	The constant setting is outside of the valid setting range. Press the ENTER Key on the Digital Operator to display OPE fault constant (U1-34).*
oPE03	Multi-function Input Selection Error	<p>One of the following errors has been made in the multi-function input (H1-01 to H1-06) settings:</p> <ul style="list-style-type: none"> The same setting has been selected for two or more multi-function inputs. (0F: Unused, 20 to 2F: Except for the external fault) An up or down command was selected independently. (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, maximum output frequency) and Speed Search 2 (62, set frequency) were selected at the same time. The up/down commands (10 and 11) were selected while PID Control Method Selection (b5-01) was enabled. Positive and negative speed commands have not been set at the same time. 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 speed reference source by setting b1-01 to 3, but an option card isn't connected (C option).
oPE06	Control Method Selection Error	6 (flux vector control for PM) was selected in A1-02, but a PG Speed Control Card is not connected.
oPE07	Multi-function Analog Input Selection Error	<p>The same setting has been selected for the analog input selection and the PID function selection.</p> <ul style="list-style-type: none"> H3-09 or H3-05 = B and H6-01 = 1 H3-09 or H3-05 = C and H6-01 = 2 <p>b1-01 (Reference Selection) is set to 4 (pulse input) and H6-01 (Pulse Train Input Function Selection) is set to a value other than 0 (speed reference). H3-13 (Terminal A1/A2 switching) is set to 1 and H3-09 is set to other than 2 or H3-05 is set to 0 or 2. The same value is set to H3-05 and H3-09.</p>
oPE08	Constant Selection Error	<p>A setting has been made that is not required in the current control method. Ex.: A function used only with open-loop vector control for PM was selected for sequence test mode.</p> <p>Press the ENTER Key on the Digital Operator to display OPE fault constant (U1-34).*</p>

Table 7.4 Operation Error Displays and Incorrect Settings (Continued)

Display	Meaning	Incorrect settings
<i>oPE09</i>	PID Control Selection Error	The following settings have been made at the same time. <ul style="list-style-type: none"> • b5-01 (PID Control Method Selection) has been set to a value other than 0. • b5-15 (PID 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.
<i>oPE10</i>	V/f Data Setting Error	Constants E1-04, E1-06, E1-07, and E1-09 do not satisfy the following conditions: For the open loop vector or flux vector control for PM <ul style="list-style-type: none"> • E1-04 (FMAX) \geq E1-06 (FA) > E1-09 (FMIN) For the sequence test mode <ul style="list-style-type: none"> • E1-04 (FMAX) \geq E1-06 (FA) > E1-07 (FB) \geq E1-09 (FMIN)
<i>oPE11</i>	Constant Setting Error	The values of the carrier frequency and on-delay time were outside the allowable setting range. Contact your Yaskawa representative for more information.
<i>oPE13</i>	Energy-saving Constants Setting Error	The values of the energy-saving constants were outside the allowable setting range. Check if the set values for the motor constants (E5 constants) are the same as the values shown on the motor's nameplate.
<i>Err</i>	EEPROM Write Error	A verification error occurred when writing EEPROM. <ul style="list-style-type: none"> • Try turning the power supply off and on again. • Try setting the constants again.

* Displayed only on the LCD operator (JVOP-160).

Note If the settings for the constants of an Inverter with a different version of software are copied, an OPE error can occur. Contact your Yaskawa representative if wanting to copy the settings with a different software version.

◆ 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 7.5 Errors During Autotuning

Display	Meaning	Probable causes	Corrective Actions
<i>Er-01</i>	Motor data error	There is an error in the data input for autotuning.	<ul style="list-style-type: none"> • Check the input data. • Check the capacity of the Inverter and motor.
<i>Er-02</i>	Alarm	The alarm was detected before autotuning was started or during autotuning.	<ul style="list-style-type: none"> • Check the input data. • Check wiring and the machine. • Check the load.
<i>Er-03</i>	STOP key input	The STOP Key was pressed to cancel autotuning.	<ul style="list-style-type: none"> • Check the input data. • Check the capacities of the Inverter and the motor. • Check the motor wiring.
<i>Er-15</i>	Resistance error	<ul style="list-style-type: none"> • Autotuning was not completed in the allowable set time. • The autotuning results were outside the allowable range. 	<ul style="list-style-type: none"> • Check the input data. • Check the capacities of the Inverter and the motor. • Check the motor wiring.
<i>Er-22</i>	Zero-point pulse of PG adjustment error	<ul style="list-style-type: none"> • Autotuning was started while the motor was running at more than 30 min⁻¹. • Autotuning was not completed in the allowable set time. • The difference of measurement results between the first time and the second time was more than 3.0 degrees (electric angle). 	<ul style="list-style-type: none"> • Check the motor wiring. • Separate the motor from the mechanical system if connected. • Check if the wiring of the PG card is correct.

◆ Errors when Using the Digital Operator Copy Function

The errors that can occur when using the copy function from the Digital Operator are given in the following table. An error code will be displayed on the Digital Operator. If a Digital Operator key is pressed when an error code is being displayed, the display will be cleared and 03-01 will be displayed. The error contact output and alarm output will not function.

Table 7.6 Errors during Copy Function

Function	Display	Meaning	Probable causes	Corrective Actions
Read	<i>PrE</i>	Digital Operator write-protected	o3-01 was set to 1 to write a constant when the Digital Operator was write-protected (o3-02 = 0).	Set o3-02 to 1 to enable writing constants with the Digital Operator.
	<i>,fE</i>	Illegal read data	<ul style="list-style-type: none"> • The read data length does not agree. • The write data is incorrect. 	<ul style="list-style-type: none"> • Repeat the read. • Check the Digital Operator cable. • Replace the Digital Operator.
	<i>r dE</i>	Illegal write status	An attempted write of a constant to EEPROM on the Digital Writer failed.	<ul style="list-style-type: none"> • A low Inverter voltage has been detected. • Repeat the read. • Replace the Digital Operator.

Table 7.6 Errors during Copy Function (Continued)

Function	Display	Meaning	Probable causes	Corrective Actions
Copy	<i>CPE</i>	ID not matched	The Inverter product code or software number is different.	Use the copy function for the same product code and software number.
	<i>URE</i>	Inverter capacity matched	The capacity of the Inverter being copied and the capacity in the Digital Operator are different.	Use the copy function for the same Inverter capacity.
	<i>CRE</i>	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.
	<i>CYE</i>	Verify error	The constant written to the Inverter was compared with the constant in the Digital Operator and they were different.	Retry the copy.
	<i>CSE</i>	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	<i>UYE</i>	Verify error	The Digital Operator and Inverter settings do not agree.	Retry the copy and verify again.

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 should occur, use this section as a reference and apply the appropriate measures.

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

◆ If Inverter Constants Cannot Be Set

Use the following information if an Inverter constant cannot be set.

■ The display does not change when the Increment and Decrement Keys are pressed.

The following causes are possible.

The Inverter is operating (drive mode).

There are some constants that cannot be set during operation. Turn the Inverter off and then make the settings.

Constant write enable is input.

This occurs when "constant write enable" (set value: 1B) is set for a multi-function input terminal (H1-01 to H1-06). If the constant write enable input is OFF, the constants cannot be changed. Turn it ON and then set the constants.

Passwords do not match. (Only when a password is set.)

If the constant A1-04 (Password) and A1-05 (Password Setting) numbers are different, the constants for the initialize mode cannot be changed. Reset the password.

If you cannot remember the password, display A1-05 (Password Setting) by pressing the Reset/Select Key and the Menu Key simultaneously while in the A1-04 display. Then reset the password. (Input the reset password in constant A1-04.)

■ OPE01 through OPE13 is displayed.

The set value for the constant is wrong. Refer to *Operation Errors* in this chapter and correct the setting.

■ CPF00 or CPF01 is displayed.

This is a Digital Operator communications error. The connection between the Digital Operator and the Inverter may be faulty. Remove the Digital Operator and then re-install it.

◆ If the Motor Does Not Operate

Use the following information if the motor does not operate.

■ The motor does not operate when the RUN Key on the Digital Operator is pressed.

The following causes are possible.



IMPORTANT

If the Inverter is not in drive mode and the DRIVE indicator on the Digital Operator (JVOP-161) does not light up, the Inverter will remain in ready status and will not start. Press the Menu Key to make the DRIVE indicator flash, and enter the drive mode by pressing the DATA/ENTER Key. The DRIVE indicator will light when drive mode is entered.

The operation method setting is wrong.

If constant b1-02 (Operation Method Selection) is set to 1 (control circuit terminal), the motor will not operate when the Run Key is pressed. Either press the LOCAL/REMOTE Key* to switch to Digital Operator operation or set b1-02 to 0 (Digital Operator).



INFO

The LOCAL/REMOTE Key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the drive mode is entered.

The speed reference is too low.

If the speed reference is set below the speed set in E1-09 (Min. speed), the Inverter will not operate.

Raise the speed reference to at least the minimum speed.

There is a multi-function analog input setting error.

If H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) is set to 1 (speed gain), and if no voltage (current) is input, then the speed reference will be zero. Check to be sure that the set value and analog input value are correct.

■ The motor does not operate when an external operation signal is input.

The following causes are possible.

The Inverter is not in drive mode.

If the Inverter is not in drive mode and the DRIVE indicator on the Digital Operator (JVOP-161) does not light up, the Inverter will remain in ready status and will not start. Press the MENU Key make the DRIVE indicator flash, and enter the drive mode by pressing the DATA/ENTER Key. The DRIVE indicator will light when drive mode is entered.

The operation method selection is wrong.

If constant b1-02 (reference selection) is set to 0 (Digital Operator), the motor will not operate when an external operation signal is input. Set b1-02 to 1 (control circuit terminal) and try again.

Similarly, the motor will also not operate if the LOCAL/REMOTE Key has been pressed to switch to Digital Operator operation. In that case press the LOCAL/REMOTE Key* again to return to the original setting.



INFO

The LOCAL/REMOTE Key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the drive mode is entered.

A 3-wire sequence is in effect.

The input method for a 3-wire sequence is different than when operating by forward/stop and reverse/stop (2-wire sequence). When 3-wire sequence is set, the motor will not operate even when an input terminal suitable for forward run/stop and reverse run/stop is turned ON.

When using a 3-wire sequence, refer to the timing chart, set the multi-function input terminal (H1-01 through H1-06, terminals S3 to S8) to 0, and input the proper signals.

When using a 2-wire sequence, set the multi-function input terminal (H1-01 through H1-06, terminals S3 to S8) to a value other than 0.

The speed reference is too low.

If the speed reference is set below the speed set in E1-09 (Min. speed), the Inverter will not operate. Raise the speed reference to at least the minimum output speed.

There is a multi-function analog input setting error.

If multi-function analog inputs H3-05 or H3-09 is set to 1 (speed gain), and if no voltage (current) is input, then the speed reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor stops during acceleration or when a load is connected.

The motor responsiveness limit can 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 Inverter does not operate.

Probable Causes	Descriptions	Corrective Actions
Run command is not sent.	Inverter does not operate if a Run command is not sent.	If the indicator on the RUN Key is not lit, the Run Command is not sent. Input the Run Command.
The operation method selection is wrong.	b1-02 has to be set according to the Run Command input method to be used. b1-02= 0: Digital Operator 1: Control circuit terminal (factory setting) 2: MEMOBUS communications 3: Option card 4: Pulse train input	Set b1-02 according to the Run Command input method to be used.
The speed reference is too low.	The speed reference has to be set above the frequency set in E1-09 (Min. speed).	If the indicator on the STOP Key is flashing, check the speed reference monitor (U1-01) and set the speed reference above the speed set in E1-09.

Probable Causes	Descriptions	Corrective Actions
The speed reference selection is wrong.	b1-01 has to be set according to the speed reference input method to be used. b1-01= 0: Digital Operator 1: Control circuit terminal (factory setting) 2: MEMOBUS communications 3: Option card 4: Pulse train input	Set b1-01 according to the speed reference input method to be used.
The MENU Key was pressed.	If the MENU Key is pressed once or the ESC Key is pressed twice, the Inverter will exit the drive mode and will not operate. If the MENU Key is pressed during operation, the Inverter will not start even if the Run Command is sent at the next operation.	<ul style="list-style-type: none"> • Press the DATA/ENTER Key. • Try turning the power supply off and on again. • Set b8-01 (Run Command selection in programming modes) to 1 (Cannot operate) to remain in the drive mode and continue operation even if the MENU Key or ESC Key is pressed.
The ESC Key was pressed twice.		
The LOCAL/REMOTE Key was pressed.	If the LOCAL/REMOTE Key is pressed while the Inverter is stopped, the Inverter will switch to Digital Operator operation and cannot be operated with the external input terminals.	<ul style="list-style-type: none"> • Press the LOCAL/REMOTE Key. • Try turning the power supply off and on again. • Set o2-01 (LOCAL/REMOTE Key enable/disable) to 0 (Disabled) to disable the LOCAL/REMOTE Key.
The STOP Key was pressed.	If the STOP Key is pressed during operation, the Inverter will decelerate to a stop.	<ul style="list-style-type: none"> • Turn the Run Command off and then on again. • Set o2-02 (STOP key during control circuit terminal operation) to 0 (Disabled) to disable the STOP Key.
Wrong selection of a 2-wire or a 3-wire sequence.	If 0 is set to one of H1-01 to H1-06, a 3-wire sequence is set.	Make sure that H1-01 to H1-06 are set to a value other than 0 to use a 2-wire sequence.
"Reverse run prohibited" is selected.	If b1-04 (Prohibition of reverse operation) is set to 1 (Reverse disabled), the motor will not start if the Reverse Run Command is sent.	Check the setting of b1-04.
Autotuning has just been completed.	The Inverter remains in the autotuning mode right after autotuning has been completed and cannot be operated even if the Run Command is sent.	Press the MENU Key to display the drive mode on the Digital Operator and press the DATA/ENTER Key to enter the drive mode.

■ **The motor does not accelerate.**

If the torque limit settings (L7-01 to L7-04) or the torque reference input (torque control) are too small, the motor may not be able to accelerate. Check the settings and input values.

■ **The motor only rotates in one direction.**

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

◆ If the Direction of the Motor Rotation is Reversed

If the motor operates in the wrong direction, the motor output wiring is faulty. When the Inverter T1(U), T2(V), and T3(W) are properly connected to the motor T1(U), T2(V), and T3(W), the motor operates in a forward direction when a Forward Run Command is executed. The forward direction depends on the manufacturer and the motor type, so be sure to check the specifications.

The direction of rotation can be reversed by switching two wires among T1(U), T2(V), and T3(W).

◆ If the Motor Does Not Put Out Torque or If Acceleration is Slow

Use the following information if the motor does not output torque or if acceleration is too slow.

■ The torque limit has been reached.

When a torque limit has been set in constants L7-01 to L7-04, no torque will be output beyond that limit. This can cause the torque to be insufficient, or the acceleration time to be too long. Check to be sure that the value set for the torque limit is suitable.

If torque limits have been set for the multi-function analog input (H3-09 or H3-05 = 10 to 12 or 15), check to be sure that the analog input value is suitable.

◆ If the Motor Operates Higher Than the Reference

Use the following information if the motor operates higher than the reference.

■ The analog speed reference bias setting is wrong (the gain setting is wrong).

The speed reference bias set in constant H3-03 is added to the speed reference. Check to be sure that the set value is suitable.

■ A signal is being input to the speed reference terminal A2 or A3.

When 0 (Add to terminal A1) is set for constant H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection), a speed corresponding to the terminal A2 or A3 input voltage (current) is added to the speed reference. Check to be sure that the set value and analog input value are suitable.

◆ If Motor Deceleration is Slow

Use the following information when the motor deceleration is slow.

■ The deceleration time is long even when braking resistor is connected.

The following causes are possible.

"Overvoltage inhibit selection enabled" is set.

When braking resistor is connected, set constant L3-11 (Overvoltage inhibit selection) to 0 (disabled). When this constant is set to 1 (enabled, the factory setting), braking resistor does not fully function.

The deceleration time setting is too long.

Check the deceleration time setting (constants C1-02, C1-04, C1-06, and C1-08).

Motor torque is insufficient.

If the constants are correct and there is no overvoltage fault, then the motor's power is limited. Consider increasing the motor capacity.

The torque limit has been reached.

When a torque limit has been set in constants L7-01 to L7-04, no torque will be output beyond that limit. This can cause the deceleration time to be too long. Check to be sure that the value set for the torque limit is suitable.

If H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) is set to 10, 11, 12 or 15 (positive and negative torque limit), check to be sure that the analog input value is suitable.

◆ If the Motor Overheats

Take the following steps if the motor overheats.

■ The load is too big.

If the motor load is too heavy and the motor is used with the effective torque exceeding the motor's rated torque, the motor will overheat. Some motor ratings are given for short period performance and are not continuous ratings. Reduce the load amount by either lightening the load or lengthening the acceleration/deceleration time. Also consider increasing the motor capacity.

■ The ambient temperature is too high.

The motor rating is determined within a particular ambient operating temperature range. The motor will burn out if it is run continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded. Lower the motor's ambient temperature to within the acceptable ambient operating temperature range.

◆ If There is Noise When the Inverter is Started or From an AM Radio

If noise is generated by Inverter switching, implement the following countermeasures:

- Change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. This will help to some extent by reducing the amount of internal switching.
- Install an Input Noise Filter at the Inverter's power supply input area.
- Install an Output Noise Filter at the Inverter's power supply output area.
- Use metal tubing. Electric waves can be shielded by metal, so encase the Inverter with metal (steel).
- Ground the Inverter and motor.
- Separate main circuit wiring from control wiring.

◆ If the Ground Fault Interrupter Operates When the Inverter is Run

The Inverter performs internal switching, so there is a certain amount of leakage current. This may cause the ground fault interrupter to operate and cut off the power supply. Change to a ground fault interrupter with a high leakage detection level (i.e., a sensitivity current of 200 mA or greater per Unit, with an operating time of 0.1 s or more), or one that incorporates high frequency countermeasures (i.e., one designed for use with Inverters). It will also help to some extent to change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. In addition, remember that the leakage current increases as the cable is lengthened.

◆ If There is Mechanical Oscillation

Use the following information when 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.

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 speed functions in constants d3-01 to d3-04 or install rubber padding on the motor base to reduce oscillation.

■ Oscillation and hunting are occurring with PID control.

If there is oscillation or hunting during PID control, check the oscillation cycle and individually adjust P, I, and D constants. (Refer to page 6-99.)

◆ If Motor Speed Does Not Rise to Speed Reference

Use the following information if the motor speed does not rise to the speed reference.

■ The speed reference is within the jump speed range.

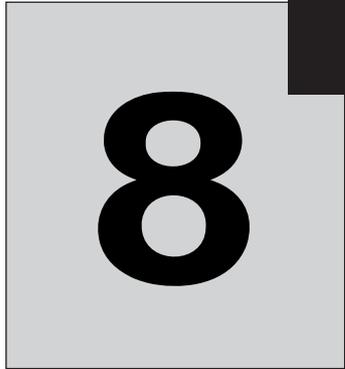
When the jump speed function is used, the motor speed does not change within the jump speed range. Check to be sure that the jump speed (constants d3-01 to d3-03) and jump speed width (constant d3-04) settings are suitable.

■ The speed reference upper limit has been reached.

The speed upper limit is determined by the following formula:

Maximum Speed (E1-04) × Speed Reference Upper Limit (d2-01) / 100

Check to be sure that the constant E1-04 and d2-01 settings are suitable.



8

Maintenance and Inspection

This chapter describes basic maintenance and inspection for the Inverter.

Maintenance and Inspection.....8-2

Maintenance and Inspection

◆ Outline of Free Warranty

The free warranty period of the Inverter is as follows:

Free warranty Period: This product is warranted for twelve months after being delivered to Yaskawa's customer or if applicable eighteen months from the date of shipment from Yaskawa's factory 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. Turn OFF the main circuit power supply, wait for the time indicated on the front cover, and make sure the CHARGE indicator light has gone out, and then perform maintenance and inspection. Be sure not to touch terminals right after the power has been turned off. Doing so can result in electric shock.

Table 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.
Heatsinks	Are the fins dirty or dusty?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm ²).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm ²). Replace the boards if they cannot be made clean.
Cooling fan	Is there any abnormal noise or vibration or has the total operating time exceeded 20,000 hours?	Replace the cooling fan.
Power elements	Is there any conductive dirt or oil mist on the elements?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm ²).
Smoothing capacitor	Are there any irregularities, such as discoloration or odor?	Replace the capacitor or Inverter.

◆ Periodic Maintenance of Parts

The Inverter is configured of many parts, and these parts must be operating properly in order to make full use of the Inverter functions.

Among the electronic components, there are some that require maintenance depending on their usage conditions. In order to keep the Inverter operating normally over a long period of time, it is necessary to perform period inspections and replace parts according to their service life.

Periodic inspection standards vary depending the Inverter's installation environment and usage conditions. The Inverter's maintenance periods are noted below. Keep them as reference.

Refer to *Cooling Fan Replacement Outline* (Page 8-5) for replacing a cooling fan and *Circulation Fan Replacement Outline* (Page 8-14) for replacing a circulation fan.

To replace other parts, contact your Yaskawa representative or YASKAWA ELECTRIC ENGINEERING CORPORATION for details on preventive maintenance for Inverters.

Table 8.2 Part Replacement Guidelines

Part	Standard Replacement Period	Replacement Method
Cooling fan	2 to 3 years	Replace with new part.
Smoothing capacitor	5 years	Replace with new part. (Determine need by inspection.)
Breaker relays	-	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

Note The standard replacement period is based on the following usage conditions:
 Ambient temperature: Yearly average of 30°C
 Load factor: 80% max.
 Operating rate: 12 hours max. per day

◆ Types and Number of Cooling Fans Used in the Drive

Cooling fans used for the Drive has two types; Heatsink cooling fan and heatsink circulation fan. Heatsink cooling fan blows air to the Drive cooling fin. Heatsink circulation fan stirs up the air inside the Drive unit.

Table 8.3 shows the number of cooling fans used in the Drive. For more information on models and specifications of cooling fans, contact your Yaskawa representative or YASKAWA ELECTRIC ENGINEERING CORPORATION.

When replacing the fan, use the specified type of the fan. If the inapplicable fans are used, performance of the Drive will not be fully obtained.

Table 8.3 Number of Cooling Fans to be Used

Maximum Motor Capacity (kW)	200 V Class		400 V Class	
	Heatsink Cooling Fan	Heatsink Circulation Fan	Heatsink Cooling Fan	Heatsink Circulation Fan
0.4	-	-	-	-
0.75	-	-	-	-
1.5	-	-	-	-
2.2	-	-	1	-
3.7	1	-	1	-

Table 8.3 Number of Cooling Fans to be Used (Continued)

Maximum Motor Capacity (kW)	200 V Class		400 V Class	
	Heatsink Cooling Fan	Heatsink Circulation Fan	Heatsink Cooling Fan	Heatsink Circulation Fan
5.5	1	-	1	-
7.5	2	-	2	-
11	2	1	2	1
15	2	-	2	-
18.5	2	1	2	1
22	2	-	2	-
30	2	-	2	-
37	2	1	2	-
45	2	1	2	-
55	2	1	2	-
75	2	1	2	1
90	-		2	1
110			2	1
132			2	1
160			2	1
185			4	2
220			4	2
300			5	2

◆ 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 pull the fan out in the direction of arrow 2.
2. Pull out the cable connected to the fan from the fan cover and disconnect the relay connector.
3. Open the fan cover on the left and right sides and remove the fan cover from the fan.

Mounting the Cooling Fan

1. Attach the fan cover to the cooling fan. Be sure that the airflow direction indicated by the arrows above faces into the Inverter.
2. Connect the relay connector securely and place the relay connector and cable into the fan cover.
3. Mount the fan cover on the Inverter. Be sure that the tabs on the sides of the fan cover click into place on the Inverter.

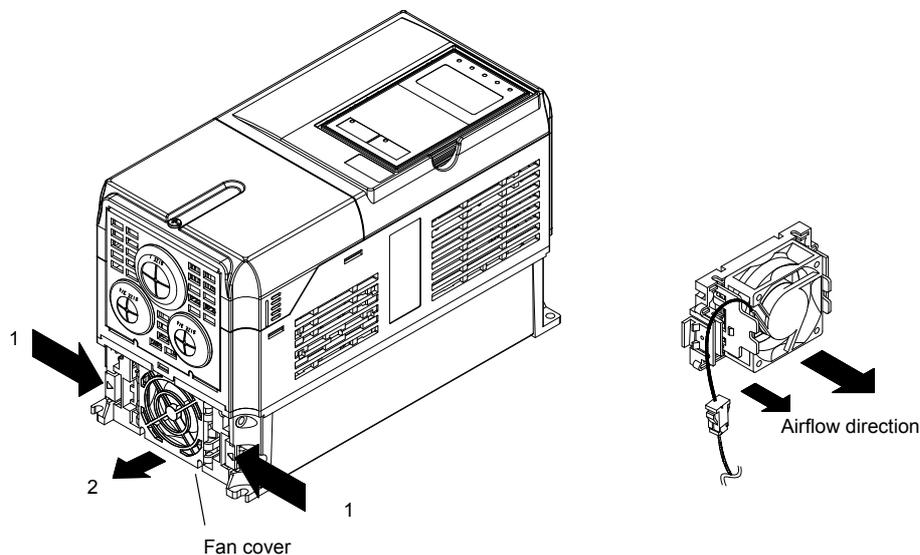


Fig 8.1 Cooling Fan Replacement (200 V Class Inverters of 5.5 kW)

■ 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.

200 V Class Inverters of 22 kW, 30kW and 400 V Class Inverters of 22 kW to 55 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove the control board bracket to which the boards are mounted. Remove all cables connected to the control board. The cables connected to the control circuit terminals can be removed at the same time by removing them together with the control circuit terminal board. This procedure is not required for 400 V Class Inverters of 37 kW, 45 kW, and 55 kW. (Refer to page 8-18.)
3. Remove the cooling fan power cable connector (CN26 and CN27) from the gate drive board 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 and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components. Refer to the next page for attaching the fan cover.

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

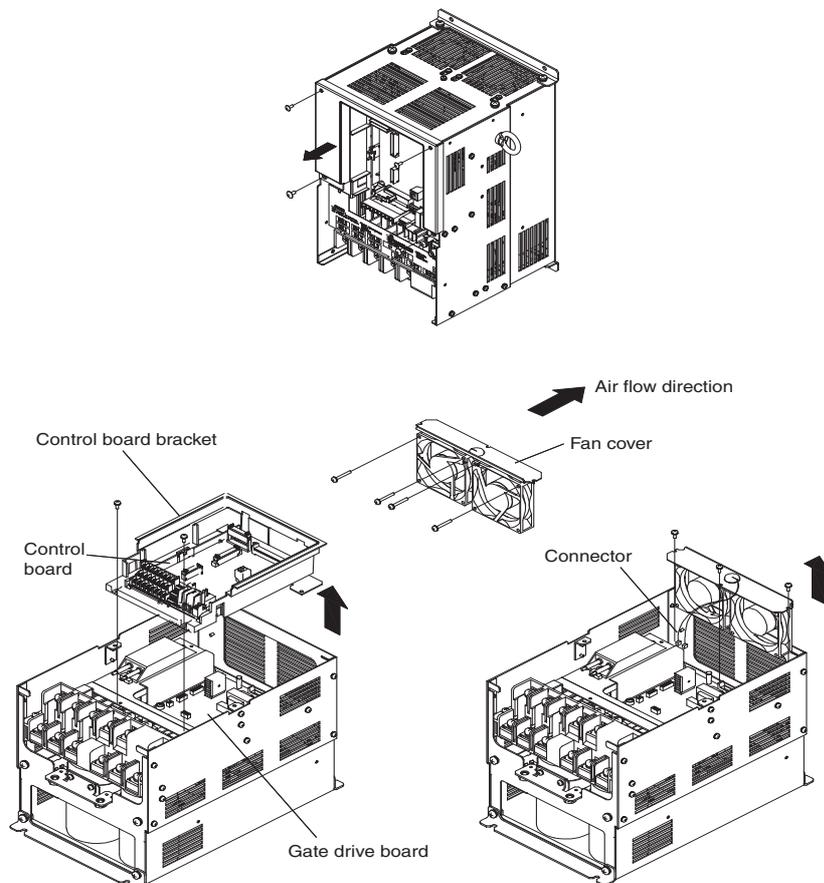


Fig 8.2 Cooling Fan Replacement (200 V Class Inverters of 22 kW)

Attaching the Fan Cover

1. Tilt the fan cover toward the bottom of the Inverter as shown in Fig 8.3 and insert it to the mounting hole until it meets with A.

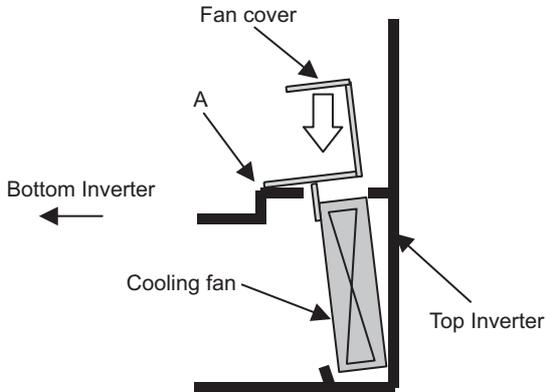


Fig 8.3

2. Push the fan cover toward the top of the Inverter.

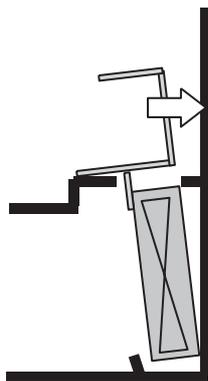


Fig 8.4

3. Make sure that there is no gap between the fan cover and A. Then screw it in place with the three screws.

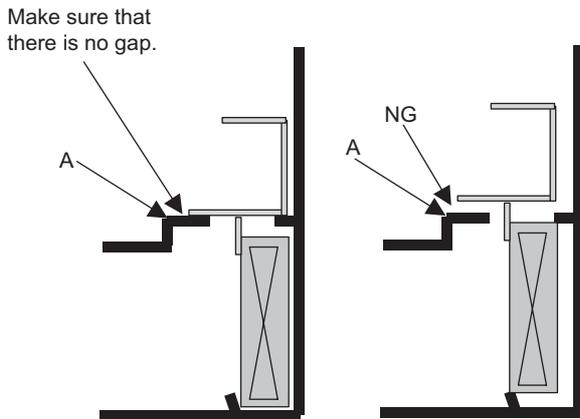


Fig 8.5

200 V Class Inverters of 55 kW, 75 kW and 400 V Class Inverters of 75 kW, 90 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Pull the cooling fan power cable connector that extends from the fan cover cable hole out of the cooling fan power relay board.
3. Only for 400 V Class Inverters of 75 kW and 90 kW, loosen the resistor unit mounting screws and slide the resistor unit to remove it. Take care as the resistor unit is hot.
4. Remove the fan cover screws and pull out the fan cover from the Inverter.
5. Remove the cooling fan from the fan cover and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.
When attaching the cooling fan to the mounting bracket, be sure that the airflow faces the top of the Inverter.

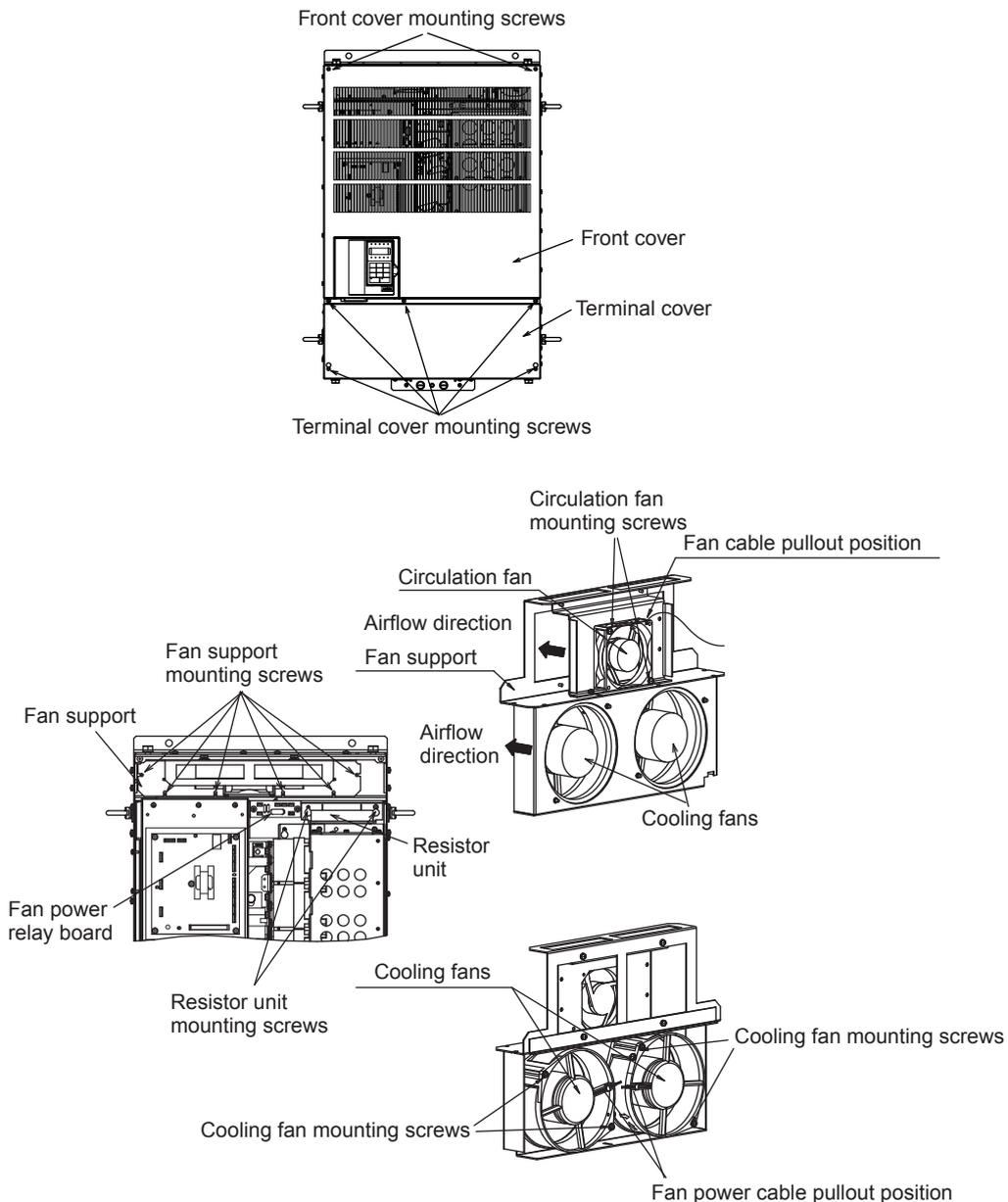


Fig 8.6 Cooling Fan Replacement (400 V Class Inverters of 75 kW and 90 kW)

200 V Class Inverters of 37 kW and 45 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove the panel to which the control board, the gate drive board, and the cooling fan power relay board are mounted. Remove any cables that are connected to the control board, the gate drive board, and the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-18.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.

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

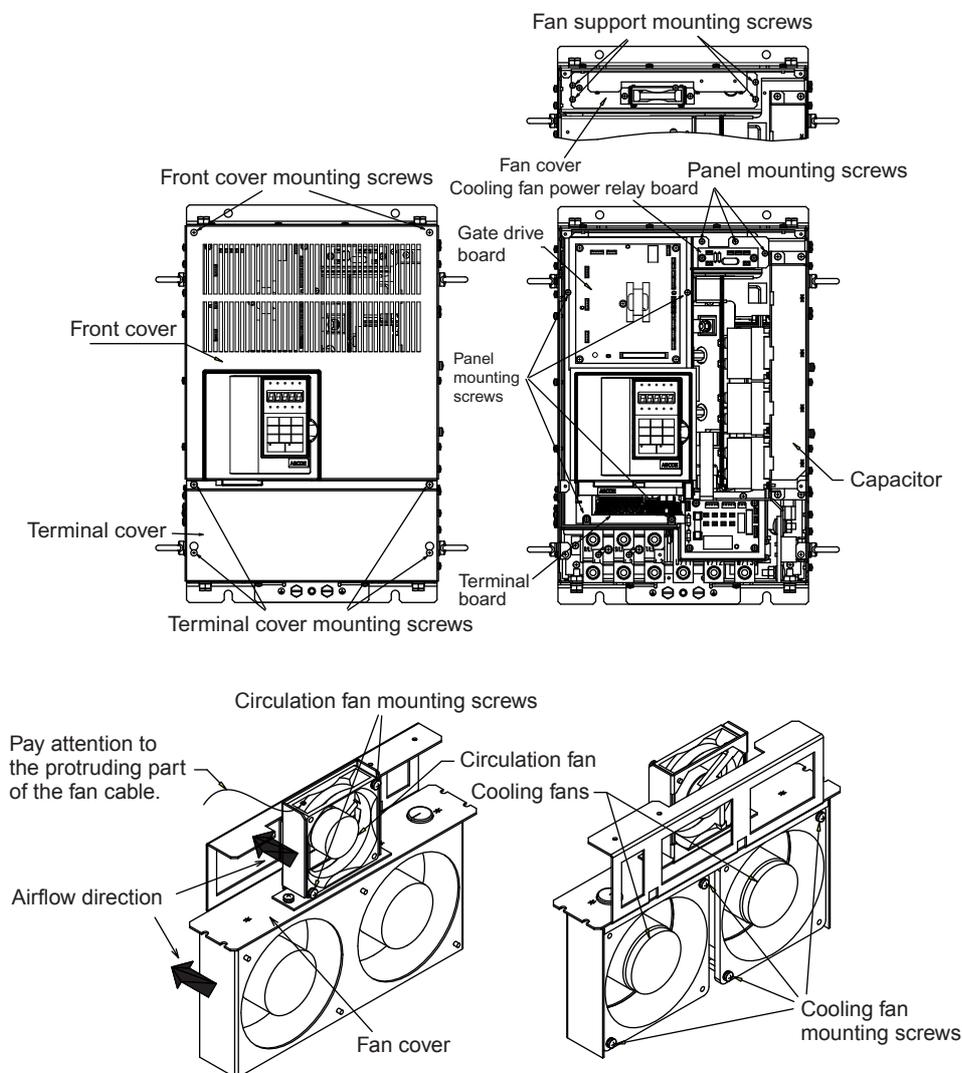


Fig 8.7 Cooling Fan Replacement (200 V Class Inverters of 37 kW and 45 kW)

400 V Class Inverters of 110 kW and 132 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-18.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.
When attaching the cooling fan to the mounting bracket, be sure that the airflow faces the top of the Inverter.

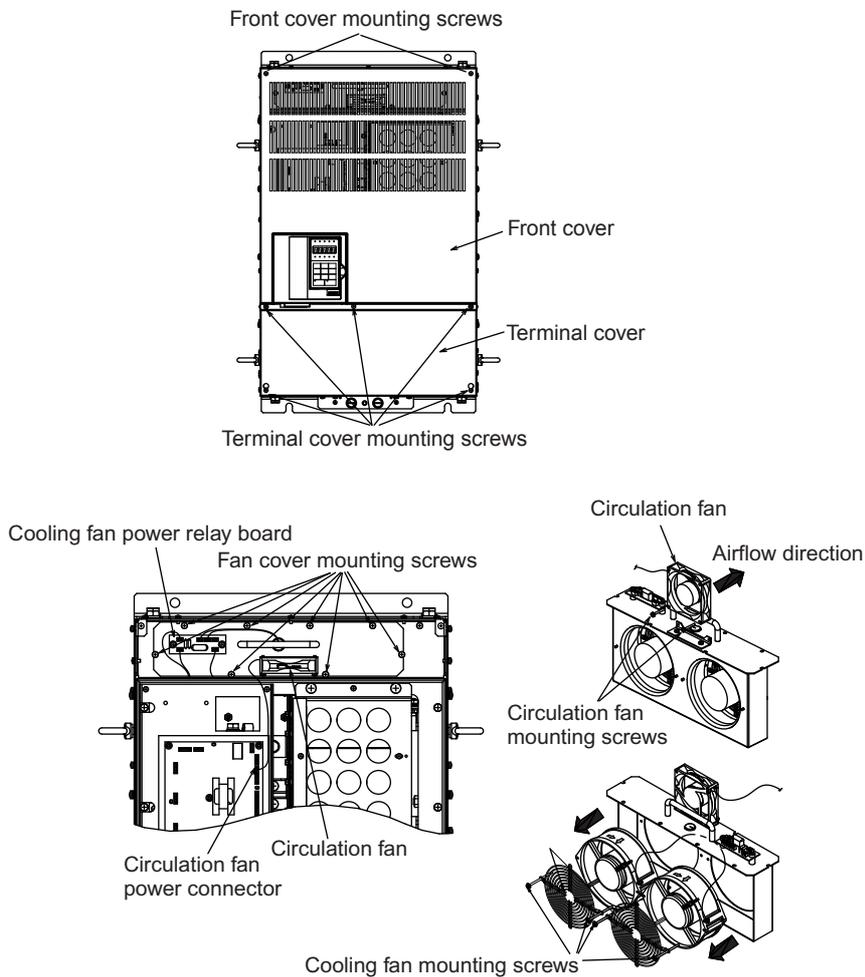


Fig 8.8 Cooling Fan Replacement (400 V Class Inverters of 110 kW)

400 V Class Inverters of 160 kW

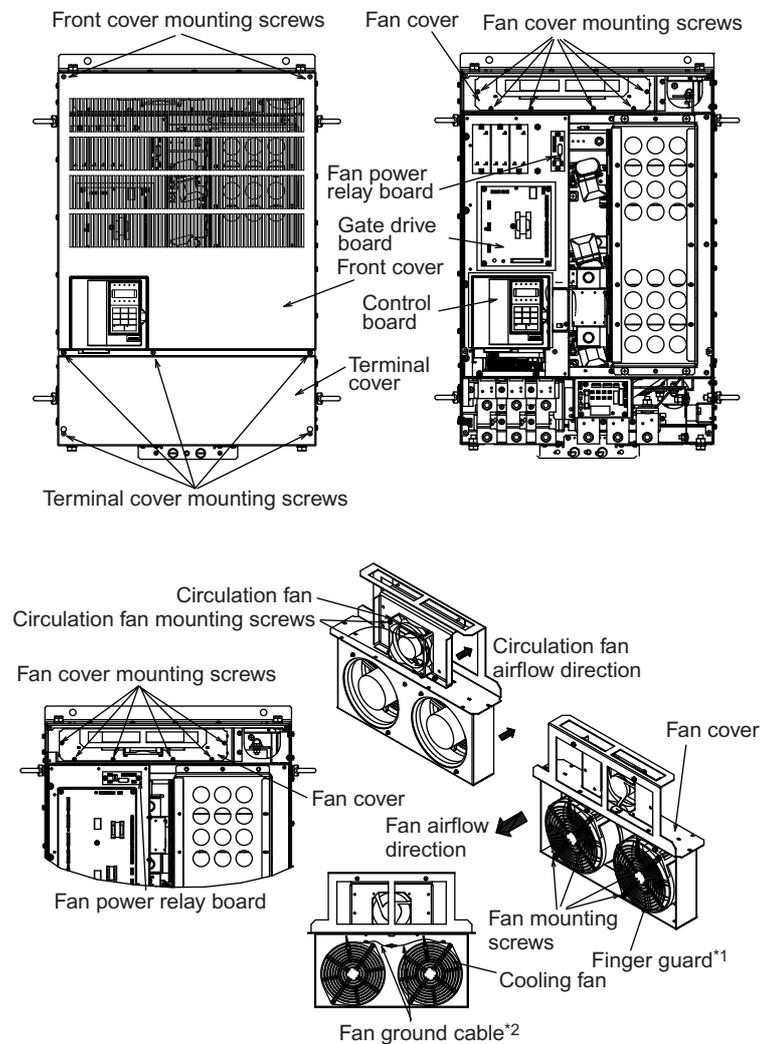
Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-18.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.

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



* 1. There is no finger guard mounted to the fan for some capacities. (There is a guard on the Inverter side.)

* 2. There is no fan ground cable for the capacities without a finger guard.

Fig 8.9 Cooling Fan Replacement (400 V Class Inverters of 110 kW)

400 V Class Inverters of 185 kW and 220 kW

Removing the Cooling Fan

1. Remove the terminal cover and top and bottom front covers from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board.
3. Remove the fan cover screws and pull out the fan covers from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components. When attaching the cooling fan to the mounting bracket, be sure that the airflow faces the top of the Inverter. Make sure that the fan cable and the fan ground cable are not tangled or pinched.

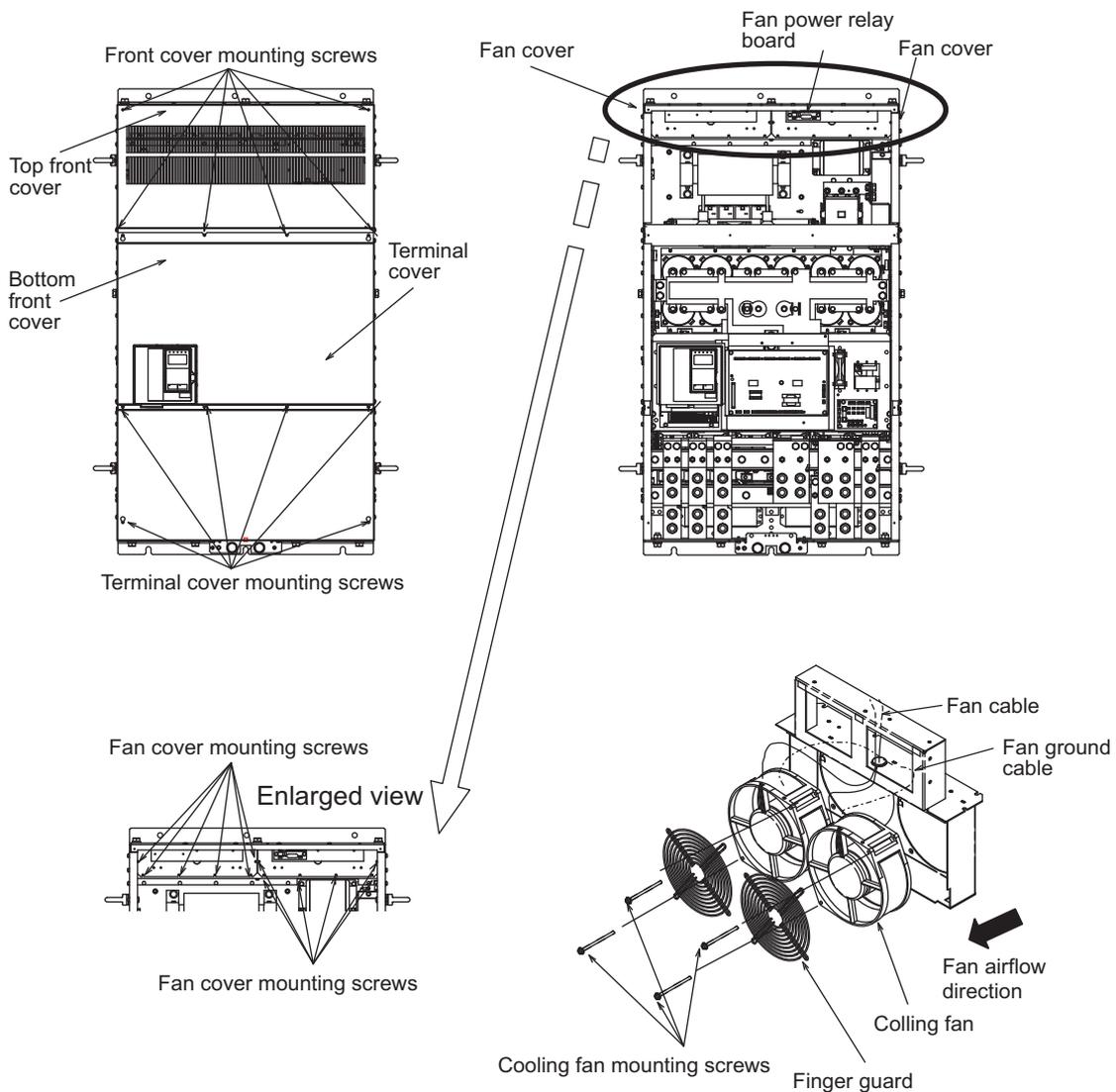


Fig 8.10 Cooling Fan Replacement (400 V Class Inverters of 185 kW and 220 kW)

400 V Class Inverters of 300 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board. The cable that is connected to the terminal board can be removed together with the terminal board.
3. Remove the fan unit screws and pull out the fan units from the Inverter.
4. Replace the fan units with new ones.
And, remove the screws for the fan power relay board and attach this board to the new unit.

Mounting the Cooling Fan

After attaching a new cooling fan unit, reverse the above procedure to attach all of the components.

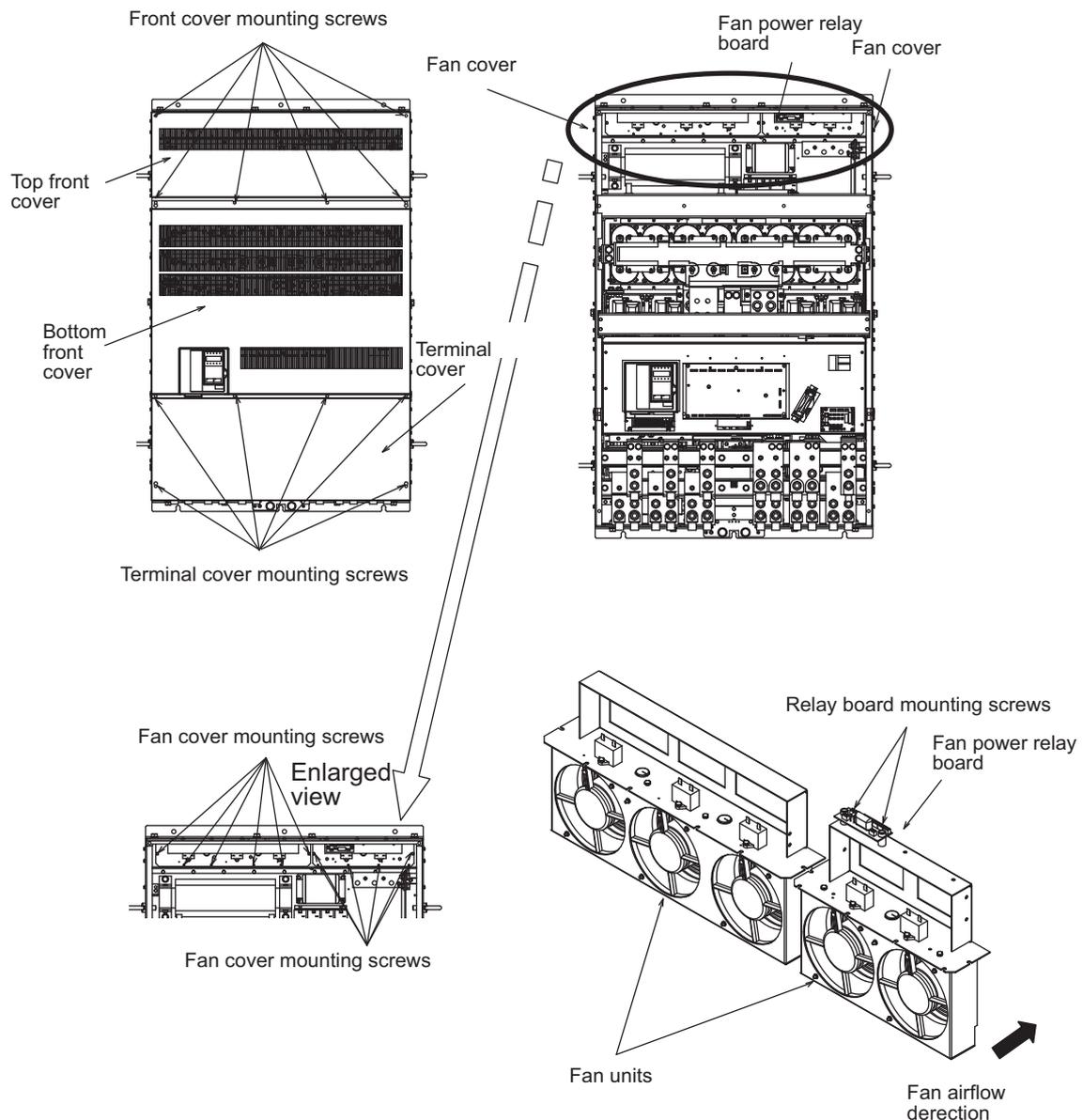


Fig 8.11 Cooling Fan Replacement (400 V Class Inverters of 300 kW)

◆ Circulation Fan Replacement Outline

With some capacities, there is a small fan installed inside the Inverter for the purpose of increasing circulation in areas where heat has built up. These fans have built-in fan sensors that output an alarm when the rotation rate of the fan drops to indicate that replacement is necessary.

■ 200 V and 400 V Class Inverters of 11 kW

The circulation fan is installed behind the control circuit terminal board inside the Inverter.

The circulation fan can be replaced by removing the control circuit terminal board.

Removing the Circulation Fan

1. Remove the Digital Operator, the terminal cover, and the front cover.
2. Remove the control circuit terminal board. Remove the cables connected to the terminals if necessary.
3. While pushing the two tabs (A) in direction 1, pull the fan out in direction 2.
4. Remove the relay connector connected to the fan.

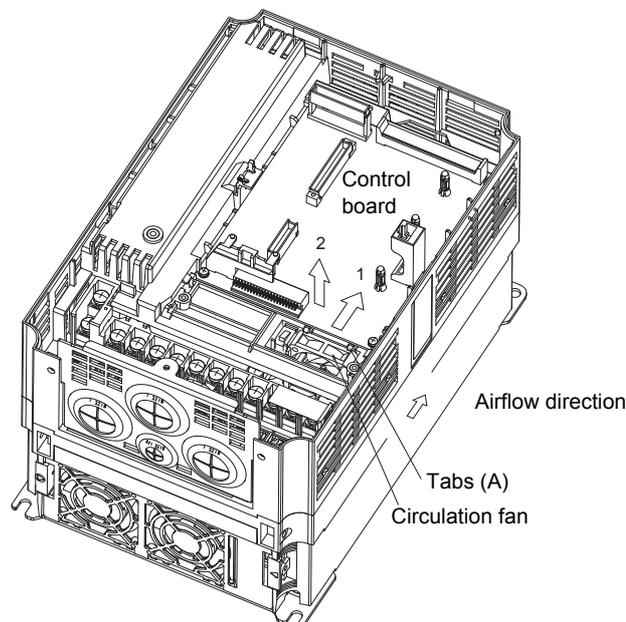
Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows towards the top of the Inverter (direction indicated by the arrow).

Mount the fan securely using the tabs (A).

Confirm that there are no cables in contact with the fan's rotating parts.



Inverter with Control Circuit Terminal Board Removed

Fig 8.12 Circulation Fan Replacement (200 V and 400 V Class Inverters of 11 kW)

■200 V and 400 V Class Inverters of 18.5 kW

The circulation fan is installed at the top-left corner of the Inverter interior.

Removing the Circulation Fan

1. Remove the Digital Operator, the terminal cover, and the front cover.
2. While pushing the relay connector tab (A) in direction 1, pull the relay connector out in direction 2.
3. While pushing the fan tabs (B) in direction 3, pull the fan out in direction 2.
4. Remove the relay connector connected to the fan.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows towards the bottom of the Inverter (direction indicated by the arrow).

Mount the fan securely using the fan tabs (B).

Confirm that there are no cables in contact with the fan's rotating parts.

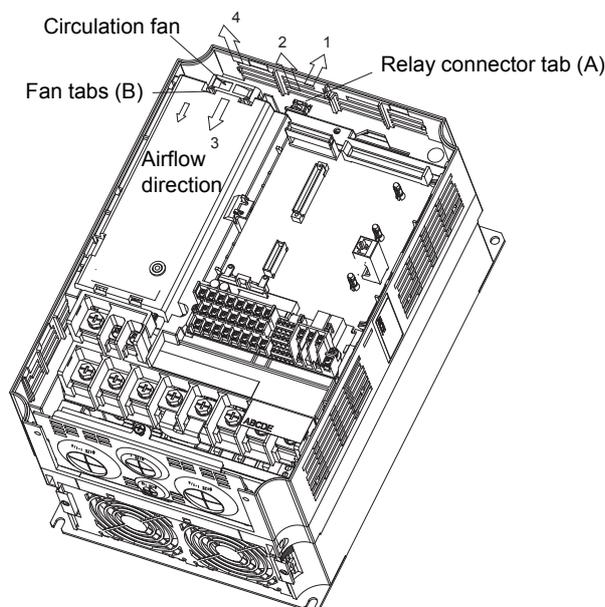


Fig 8.13 Circulation Fan Replacement (200 V and 400 V Class Inverters of 18.5 kW)

■200 V Class Inverters of 37 kW or More and 400 V Class Inverters of 75 to 160 kW

The circulation fan is installed in front of the fan cover inside the Inverter. Remove the circulation fan using the procedure for replacing the cooling fan and replace it with the new fan. (The installation position for 200 V Class Inverters of 75 kW is different.)

400 V Class Inverters of 185 kW and 220 kW

Two circulation fans are installed as described in the following sections.

Removing the Circulation Fan

1. Remove the terminal cover and top and bottom front covers.
2. Unscrew the frame fixing screws and take off the frame.
3. Remove the relay connector connected to the fan.
4. Remove the fan cover mounting screws and pull the fan cover out.
5. Remove the fan from the fan cover and replace it with a new one.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows in the direction indicated by the arrow in the corresponding diagram.

Confirm that there are no cables in contact with the fan's rotating parts.

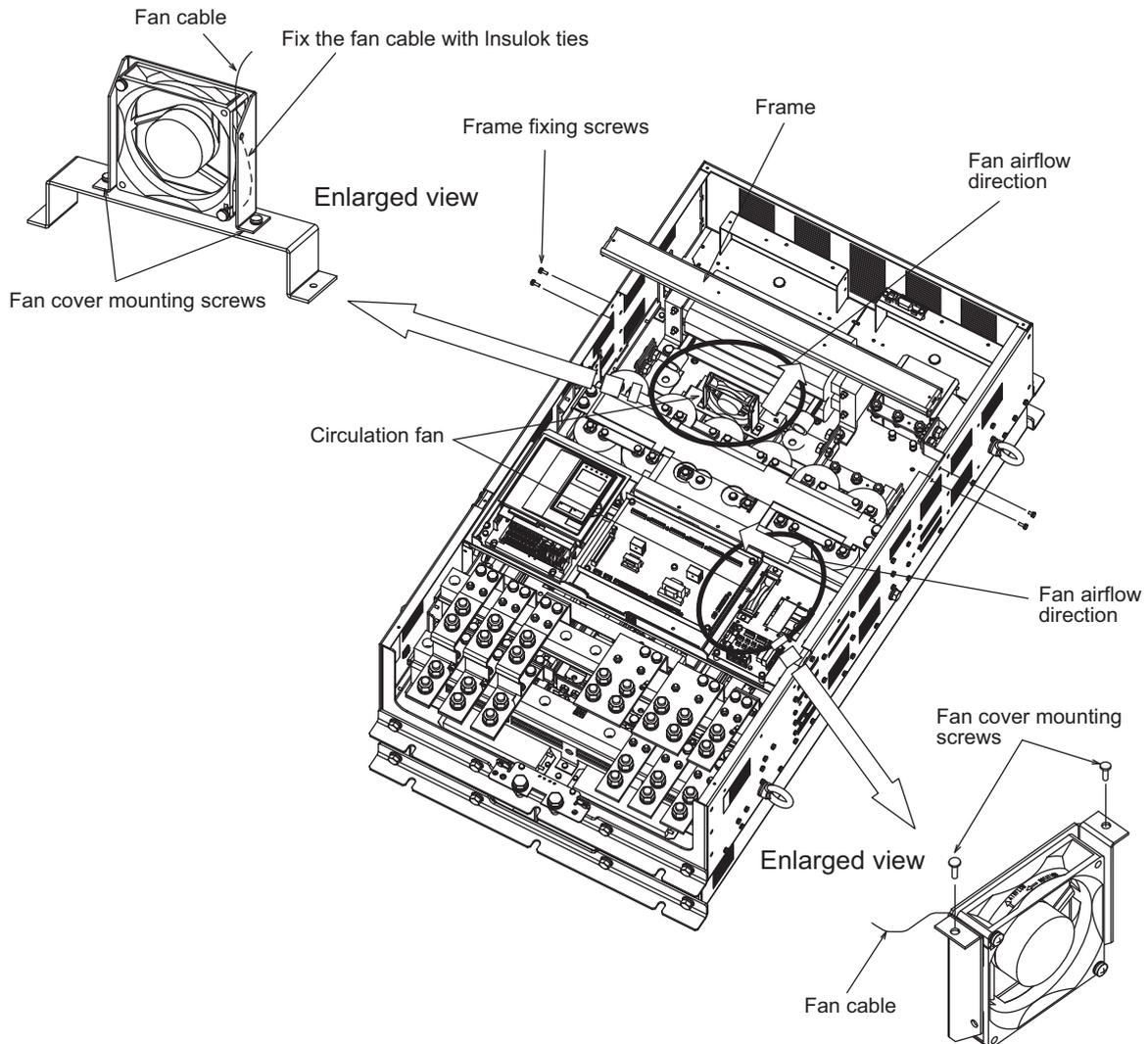


Fig 8.14 Circulation Fan Replacement (400 V Class Inverters of 185 kW and 220 kW)

400 V Class Inverters of 300 kW

Two circulation fans are installed as described in the following sections.

Removing the Circulation Fan

1. Remove the terminal cover and top and bottom front covers.
2. Unscrew the frame fixing screws and takeoff the frame.
3. Remove the relay connector connected to the fan.
4. Remove the fan cover mounting screws and pull the fan cover out.
5. Remove the fan from the fan cover and replace it with a new one.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows in the direction indicated by the arrow in the corresponding diagram.

Confirm that there are no cables in contact with the fan's rotating parts.

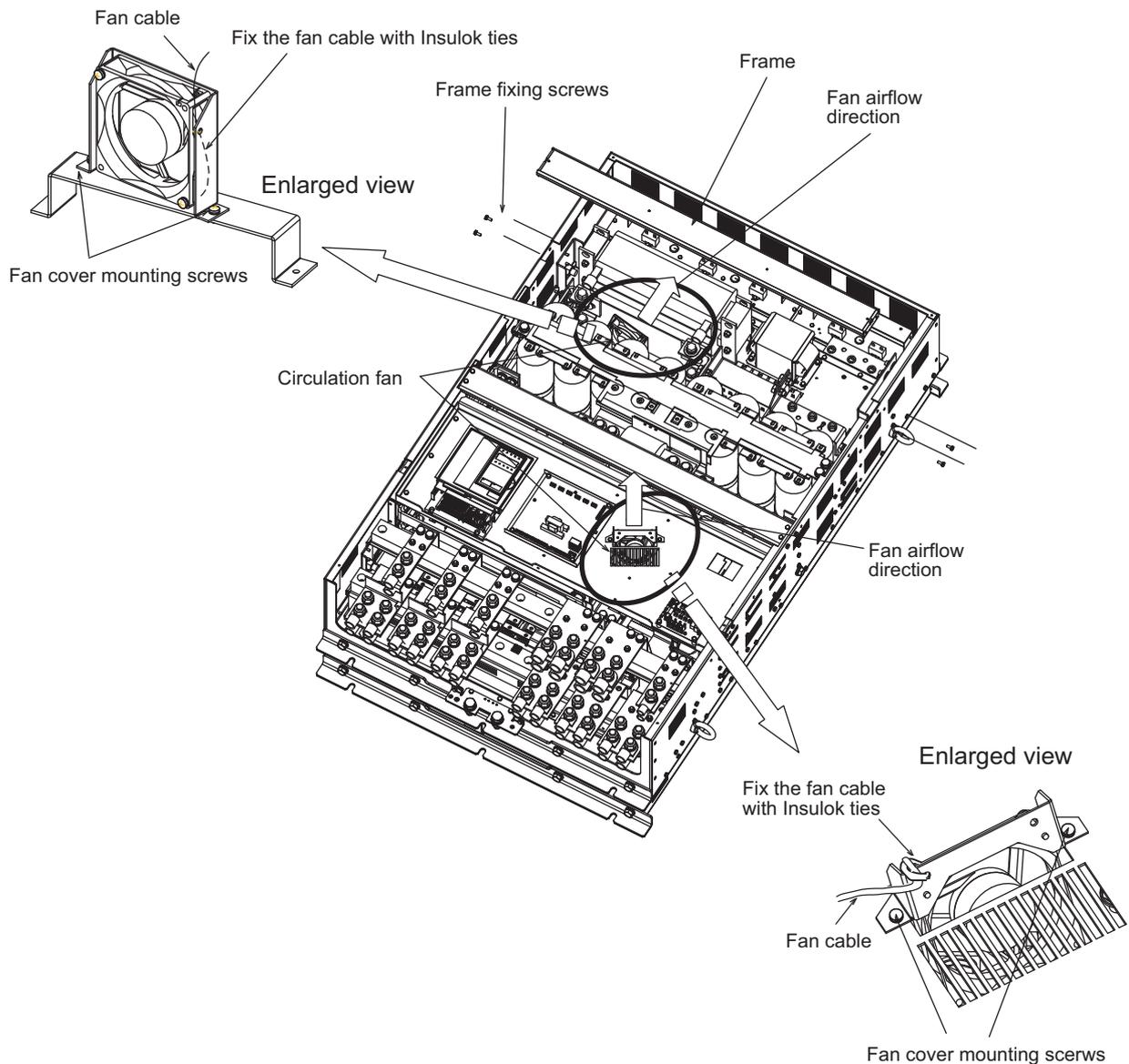


Fig 8.15 Circulation Fan Replacement (400 V Class Inverters of 300 kW)

◆ Removing and Mounting the Control Circuit Terminal Board

The control circuit terminal board can be removed and mounted without disconnecting the cables.



Always confirm that the charge indicator is not lit before removing or mounting the control circuit terminal board.

■ Removing the Control Circuit Terminal Board

1. Remove the Digital Operator and front cover.
2. Remove the connecting line connectors connected to FE and NC on the control circuit terminal board.
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 board out sideways (in direction 2) with the screws sticking out from the board.

■ Mounting the Control Circuit Terminal Board

Reverse the removal procedure to mount the terminal board.

Confirm that the control circuit terminal board and the control board properly meet at connector CN5 before pressing in on the board.

The connector pins may be bent if the board is forced into place, possibly preventing correct Inverter operation.

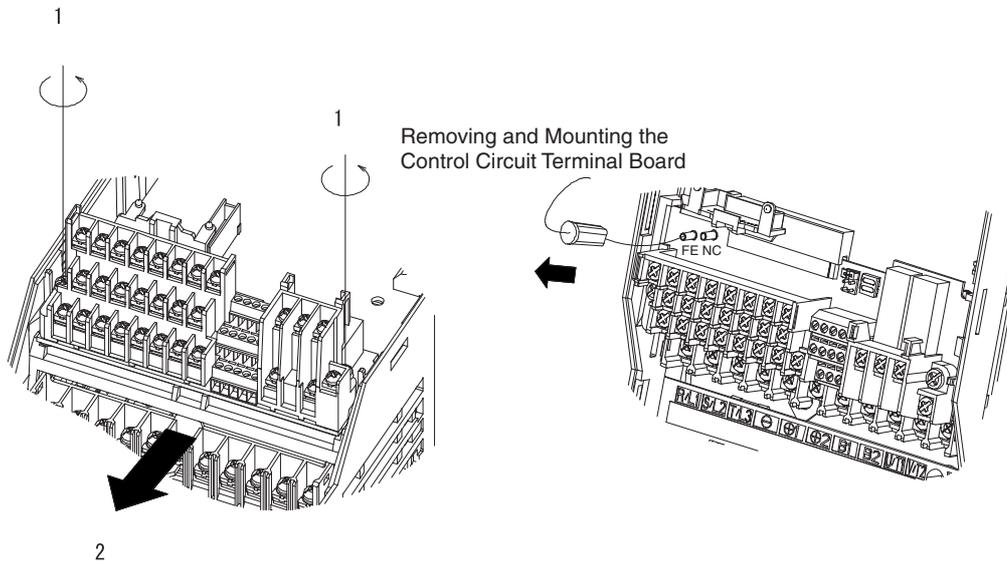
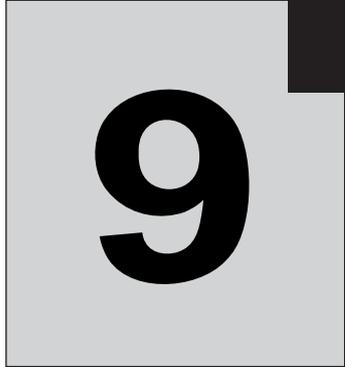


Fig 8.16 Removing the Control Circuit Terminal Board



9

Specifications

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

Standard Inverter Specifications	9-2
Specifications of Options and Peripheral Devices	9-6

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-F7S□	20P4	20P7	21P5	22P2	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037	2045	2055	2075	
Max. applicable motor output (kW)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	
Rated input current (A)	3.8	4.9	8.4	11.5	18	24	37	52	68	84	94	120	160	198	237	317	
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	110	
	Rated output current (A)	3.2	4.1	7.0	9.6	15	23	31	45	58	71	85	115	145	180	215	283
	Max. output voltage (V)	3-phase; 200, 208, 220, 230, or 240 VAC (Proportional to input voltage.)															
	Max. output frequency (Hz)	CT selected (low carrier, constant torque applications): 150 Hz max. 300 Hz max. VT selected (high carrier, variable torque applications): 400 Hz max.															
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)	3-phase, 200/208/220/230/240 VAC, 50/60 Hz															
	Allowable voltage fluctuation	+ 10%, - 15%															
	Allowable frequency fluctuation	±5%															
Control characteristics	Measures for power supply harmonics	DC reactor	Optional									Built in					
	12-phase rectification	Not possible									Possible ^{*3}						

* 1. The maximum applicable motor output is given for a standard 6-pole IPM motor manufactured by Yaskawa. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

* 2. The startup torque for a 200 V Class Inverter for 110 kW is 120% (low carrier).

* 3. A 3-wire transformer is required on the power supply for 12-phase rectification.

■400 V Class

Table 9.2 400 V Class Inverters

Model Number CIMR-F7S□		40P4	40P7	41P5	42P2	43P7	45P5	47P5	4011	4015	4018
Max. applicable motor output (kW) *1		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5
Rated input current (A)		2.2	2.5	4.4	6.4	9.0	15	20	29	37	47
Output ratings	Rated output capacity (kVA)	1.4	1.6	2.8	4.0	5.8	9.5	13	18	24	30
	Rated output current (A)	1.8	2.1	3.7	5.3	7.6	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)		CT selected (low carrier, constant torque applications): 150 Hz max. 300 Hz max. VT selected (high carrier, variable torque applications): 400 Hz max.									
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 possible								

Model Number CIMR-F7S□		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
Rated input current (A)		50	66	83	100	120	165	198	238	286	334	407	557	743
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)		CT selected (low carrier, constant torque applications): 150 Hz max. 300 Hz max. VT selected (high carrier, variable torque applications): 400 Hz max.												
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 6-pole IPM motor manufactured by Yaskawa. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

* 2. A 3-wire transformer is required on the power supply for 12-phase rectification.

◆ Common Specifications

The following specifications apply to both 200 V and 400 V Class Inverters.

Table 9.3 Common Specifications

Model Number CIMR-F7S□	Specification	
Control characteristics	Control method	Sine wave PWM, Open-loop vector control for PM, Flux vector control for PM
	Torque characteristics	50% (Open-loop vector control for PM) CT selected (low carrier, constant torque applications): 150% (Flux vector control for PM) VT selected (high carrier, variable torque applications): 120% (Flux vector control for PM)
	Speed control range	1:10 (Open-loop vector control for PM), 1:500 (Flux vector control for PM)
	Speed control accuracy *3	±0.2% (Open-loop vector control for PM), ±0.02% (Flux vector control for PM)
	Torque limits	Provided (4 quadrant steps can be changed by constant settings.)
	Torque accuracy *3	±10% (Open-loop vector control for PM), ±5% (Flux vector control for PM)
	Speed accuracy (temperature characteristics)	Digital references: ± 0.01% (-10°C to +40°C)
		Analog references: ±0.1% (25°C ±10°C)
	Speed setting resolution	Digital references: 0.01 %
		Analog references: 0.1% (+10 bit), 0.05 % (±11 bit)
	Output frequency resolution	0.001 Hz
	Overload capacity and maximum current *1	CT selected (low carrier, constant torque applications): 150% of rated output current per minute *2, *5, *7 VT selected (high carrier, variable torque applications): 120% of rated output current per minute *5, *7
	Speed setting signal	-10 to +10V , 0 to 10 V, 4 to 20 mA, pulse train
	Acceleration/Deceleration time	0.01 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
Braking torque	Approximately 20% (Approximately 125% with Braking Resistor option *4, braking transformer built into 200 V and 400 V Class Inverters for 18.5 kW or less.)	
Main control functions	Restarting for momentary power loss, speed searches, overtorque detection, torque limits, 17-speed control (maximum), acceleration/deceleration time changes, S-curve acceleration/deceleration, 3-wire sequence, autotuning (line-to-line resistance or Zero-point pulse), dwell functions, cooling fan ON/OFF control, jump speeds, upper and lower limits for speed references, PID control (with sleep function), energy-saving control, MEMOBUS communications (RS-485/422, 19.2 kbps maximum), fault reset, Droop control , function copying, torque control , speed/torque control switching , etc.	
Protective functions	Motor protection	Protection by electronic thermal overload relay. (This protection function, however, does not protect the irreversible magnetization of the magnet in the PM motor.)
	Instantaneous overcurrent protection	Stops at approx. 200% of rated output current.
	Fuse blown protection	Stops for fuse blown.
	Overload protection	CT selected (low carrier, constant torque applications): 150% of rated output current per minute *2 VT selected (high carrier, variable torque applications): 120% of rated output current per minute
	Overvoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is above approx. 410 V. 400 Class Inverter: Stops when main-circuit DC voltage is above approx. 820 V if E1-01 ≥ 400 V or approx. 720 V if E1-01 < 400 V.
	Undervoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is below approx. 190 V. 400 Class Inverter: Stops when main-circuit DC voltage is below approx. 380 V.
	Momentary power loss ride-thru *8	Stops for 15 ms or more. With a suitable constant setting, operation can be continued if power is restored within 2 s.
	Cooling fin overheating	Protection by thermistor.
	Overvoltage inhibit	Overvoltage inhibit during running.
	Grounding protection *6	Protection by electronic circuits. (Overcurrent level)
Environment	Charge indicator	Lit when the main circuit DC voltage is approx. 50 V or more.
	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.)
	Vibration	Altitude 1000 m max. 10 to 20 Hz: 9.8 m/s ² 20 to 50 Hz: 2.0 m/s ²

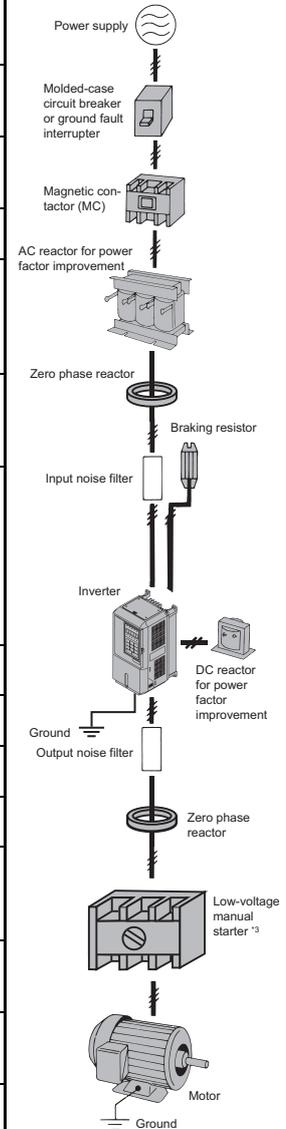
- * 1. Increase the Inverter capacity if loads exceeding these current values are expected.
- * 2. Only VT can be set for 400 V Class 220 kW and 300 kW Inverters.
- * 3. The speed control accuracy depends on the installation condition and types of motor used. Contact your Yaskawa representative for details.
- * 4. When connecting a Braking Resistor or Braking Resistor Unit, set L3-11 (Overvoltage inhibit selection) to 0 (disabled). Stopping may not be possible in the specified deceleration time if this function is not disabled.
- * 5. Derating is required for applications that use repetitive loads. (Refer to page 10-6 for details.)
- * 6. The ground fault here is one which occurs in the motor wiring while the motor is running. A ground fault may not be detected in the following cases.
 - A ground fault with low resistance which occurs in motor cables or terminals.
 - A ground fault occurs when the power is turned ON.
- * 7. If running at a speed of 6 Hz or less, the overload protection function can operate even if running within 150% of rated output current per minute when CT is selected, 120% of rated output current per minute when VT is selected.
- * 8. Attach a Backup Capacitor Unit for Momentary Power Loss if compensation for power interruptions of up to 2.0 seconds is required for 200 V/400 V Class Inverters with outputs of 0.4 to 11 kW.

Specifications of Options and Peripheral Devices

The following options and peripheral devices can be used for the Inverter. Select them according to the application.

Table 9.4 Options and Peripheral Devices

Purpose	Name	Model (Code)	Descriptions
Protect Inverter wiring	MCCB or Ground Fault Interrupter*1	NF□	Always connect a breaker to the power supply line to protect Inverter wiring. Use a ground fault interrupter suitable for high frequencies.
Prevents burning when a Braking Resistor is used.	Magnetic Contactor	SC series	Install to prevent the braking resistor from burning out when one is used. Always attach a surge absorber to the coil.
Contains switching surge	Surge Absorber	DCR2-□	Absorbs surge from the magnetic contactor and control relays. Connect surge absorbers to all magnetic contactors and relays near the Inverter.
Isolates I/O signals	Isolator	DGP□	Isolates the I/O signals of the Inverter and is effective against inductive noise.
Improve the input power factor of the Inverter	DC Reactor AC Reactor	UZDA-□ UZBA-□	Used to improve the input power factor of the Inverter. All Inverters of 22 kW or higher contain built-in DC reactors. These are optional for Inverters of 18.5 kW or less. Install DC and AC reactors for applications with a large power supply capacity (600 kVA or higher).
Reduce the affects of radio and control device noise	Input Noise Filter	LNFD-□ FN-□	Reduces noise coming into the Inverter from the power supply line and to reduce noise flowing from the Inverter into the power supply line. Connect as close to the Inverter as possible.
	Finemet zero-phase reactor to reduce radio noise*2	F6045GB (FIL001098) F11080GB (FIL001097) F200160BP (300-001-041)	Reduces noise from the line that sneaks into the Inverter input power system. Insert as close to the Inverter as possible. Can be use on both the input side and output side.
	Output Noise Filter	LF-□	Reduces noise generated by the Inverter. Connect as close to the Inverter as possible.
Enable stopping the machine in a set time	Braking Resistor	ERF-150WJ□□ (R00□□□□)	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 3% ED).
	Braking Resistor Unit	LKEB-□ (75600-K□□□0)	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED).
	Braking Unit	CDBR-□ (72600-R□□□0)	Used with a Braking Resistor Unit to reduce the deceleration time of the motor.
Operates the Inverter externally	Digital Operator Connection Cable	1 m cable: (72616-WV001) 3 m cable: (72616-WV003)	Extension cable to use a Digital Operator remotely. Cable length: 1 m or 3 m
Controls an Inverter system	VS System Module	JGSM-□	A system controller that can be match to the automatic control system to produce an optimum system configuration.
Provides Inverter momentary power loss recovery time	Backup Capacitor Unit for Momentary Power Loss	P00□0 (73600-P00□0)	Handles momentary power losses for the control power supply for models 11 kW or less (maintains power for 2 s).
Set/monitor speeds and voltages externally.	Tachometer	DCF-6A	Devices to set or monitor speeds externally.
	Speed Setter	RV30YN20S (2 kΩ)	
	Speed Setter Knob	CM-3S	
Correct speed reference input, tachometer, ammeter scales	Output Voltmeter	SCF-12NH	Measures the output voltage externally and designed for use with a PWM Inverter.
	Variable Resistor Board for Speed Reference	2 kΩ (ETX003270) 20 kΩ (ETX003120)	Connected to the control circuit terminals to input a speed reference.
	Tachometer Scale Correction Resistor	(RH000850)	Calibrates the scale of tachometers and ammeters.



- * 1. Use a ground fault interrupter with a current sensitivity of 200 mA minimum and an operating time of 0.1 s minimum to prevent operating errors. The interrupter must be suitable for high-frequency operation.
Example: NV series by Mitsubishi Electric Corporation (manufactured in or after 1988)
EG, SG series by Fuji Electric Co., Ltd. (manufactured in or after 1984)
- * 2. The Finemet Zero-phase Reactor is manufactured by Hitachi Metals, Ltd.
- * 3. For selection of the low-voltage manual starter, refer to the Varispeed F7S catalogue or contact your Yaskawa representative.
Example: AICUT LB series manufactured by AICHI ELECTRIC CO., LTD.

The following option cards are available

Table 9.5 Option Cards

Type	Name	Code Number	Function	Document Number	
Built-in (connect to connector)	Speed (Frequency) Reference Option Cards	Analog Reference Board AI-14U	73600-C001X	Enables high-precision, high-resolution setting of analog speed references. <ul style="list-style-type: none"> Input signal ranges: 0 to 10 V (20 kΩ), 1 channel 4 to 20 mA (250 Ω), 1 channel Input resolution: 14-bit (1/16384) 	TOE-C736-30.13
		Analog Reference Board AI-14B	73600-C002X	Enables high-precision, high-resolution setting of analog speed references. <ul style="list-style-type: none"> Input signal ranges: -10 to 10 V (20 kΩ) 4 to 20 mA (500 Ω), 3 channels Input resolution: 13-bit + sign (1/8192) 	TOE-C736-30.14
		Digital Reference Board DI-08	73600-C003X	Enables 8-bit digital setting of speed references. <ul style="list-style-type: none"> Input signal: 8-bit binary 2-digit BCD + sign signal + set signal Input voltage: +24 V (isolated) Input current: 8 mA 	TOE-C736-30.15
		Digital Reference Board DI-16H2	73600-C016X	Enables 16-bit digital setting of speed references. <ul style="list-style-type: none"> Input signal: 16-bit binary 4-digit BCD + sign signal + set signal Input voltage: +24 V (isolated) Input current: 8 mA With 16-bit/12-bit switch.	TOE-C736-40.7
	Monitoring Option Cards	Analog Monitor Board AO-08	73600-D001X	Converts analog signals to monitor the Inverter's output status (output frequency, output current, etc.) to absolute values and outputs them. <ul style="list-style-type: none"> Output resolution: 8 bits (1/256) Output voltage: 0 to +10 V (not insulated) Output channels: 2 channels 	TOE-C736-30.21
		Analog Monitor Board AO-12	73600-D002X	Output analog signals to monitor the Inverter's output status (output frequency, output current, etc.). <ul style="list-style-type: none"> Output resolution: 11 bits (1/2048) + sign Output voltage: -10 to +10 V (not insulated) Output channels: 2 channels 	TOE-C736-30.22
		Digital Output Board DO-08	73600-D004X	Outputs isolated digital signals to monitor the Inverters operating status (alarm signals, zero-speed detection, etc.) Output form: Photocoupler output, 6 channels (48 V, 50 mA max.) Relay contact outputs, 2 channels (250 VAC: 1 A max., 30VDC: 1 A max.)	TOE-C736-30.24
		2C-Relay Output Board DO-02C	73600-D007X	Provides two multi-function outputs (DPDT relay contacts) in addition to those provided by the Inverter.	TOE-C736-40.8
	PG Speed Control Cards	PG-X2	73600-A015X	<ul style="list-style-type: none"> A-, B-, Z-phase pulse (differential pulse) input Maximum input frequency: 300 kHz Input: Conforms to RS-422 Pulse monitor output: RS-422 (PG power supply output: +5 or +12 V, 200 mA max.) 	TOE-C736-40.4

Table 9.5 Option Cards (Continued)

Type		Name	Code Number	Function	Document Number
Built-in (connected to connector)	Communications Option Cards	DeviceNet Communications Interface Board SI-N1	73600-C021X	Used to communicate with an Inverter from a host computer using DeviceNet communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		CC-Link Interface Card SI-C	73600-C032X	Used to communicate with an Inverter from a host computer using CC-Link communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-
		LONWORKS Communications Interface Board SI-J	73600-C035X	Used to communicate with an Inverter from a host computer using LONWORKS communications to start/stop Inverter operation, read/set parameters, and read/set monitor constants (output frequencies, output currents, etc.).	-



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
Conformance to UL Standard	10-6
Conformance to CE Markings.....	10-8
Wiring Examples.....	10-15
User Constants	10-23

Inverter Application Precautions

This section provides precautions for selecting, installing, setting, and handling Inverters.

◆ Selection

Observe the following precautions in selecting an Inverter.

■ Installing Reactors

A large peak current will flow in the power input circuit when the Inverter is connected to a large-capacity power transformer (600 kVA or higher) or when switching a phase advancing 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 75 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.

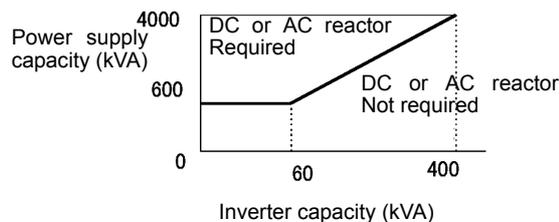


Fig 10.1

■ Applications with Repetitive Loads

Applications with repetitive loads (cranes, elevators, presses, washing machines, etc.) using Inverters require derating for the repetitive load [reducing carrier frequency and current (changing accel/decel timing, increasing the frame size of the Inverter)]. Contact your Yaskawa representative for details.

■ Starting Torque

The overload current ratings of the Inverter and the type of motor being used restrict motor startup and acceleration characteristics depending on the amount of torque the load required. The load torque must be within the range that the Inverter can handle in combination with the IPM motor.

■ Emergency Stop

Although the Inverter's protective functions will stop operation when a fault occurs, the motor will not stop immediately. Always provide mechanical stop and protection mechanisms on equipment requiring an emergency stop.

■ Options

Terminals B1, B2, ⊖, ⊕1, ⊕2, ⊕3 are for connecting only the options specifically provided by Yaskawa. Never connect any other devices to these terminals.

◆ Installation

Observe the following precautions when installing an Inverter.

■ Installation in Enclosures

Either install the Inverter in a clean location not subject to oil mist, air-bourne matter, dust, and other contaminants, or install the Inverter in a completely enclosed panel. Provide cooling measures and sufficient panel space so that the temperature surrounding the Inverter does not go beyond the allowable temperature. Do not install the Inverter on wood or other combustible materials.

■ Installation Direction

Mount the Inverter vertically to a wall or other horizontal surface.

◆ Settings

Observe the following precautions when making settings for an Inverter.

■ Motor Maximum Speed

The maximum speed of the motor is determined by the settings for the motor's maximum speed (E1-04) and the number of motor poles (E5-04). If the settings are incorrect, the machine or the machine operator may be harmed. Check the motor nameplate to select the correct settings.

■ Deceleration Time

The motor's deceleration time is determined by the torque generated by the motor, the load torque, and the load's inertial moment ($GD^2/4$). If the overvoltage inhibit selections are activated during deceleration, increase the deceleration time. The overvoltage inhibit selections will increase the deceleration time by the amount of time the overvoltage inhibit selection is active.

To reduce the deceleration time, increase the capacity of the motor and Inverter.

◆ Handling

Observe the following precautions when wiring or performing maintenance for an Inverter.

■ Wiring Check

The Inverter will be internally damaged if the power supply voltage is applied to output terminal U, V, or W. Check wiring for any mistakes before supplying power. Check all wiring and sequences carefully.

■ Magnetic Contactor Installation

Do not start and stop operation frequently with a magnetic contactor installed on the power supply line. Doing so can cause the Inverter to malfunction. Do not turn the Inverter ON and OFF with a magnetic contactor more than one time every 30 minutes.

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

If the jumper is inserted into a power tap that does not match the actual power supply voltage, the lifetime of the transformer for the power supply or the wind capacity of the cooling fan may be reduced.

If the jumper is inserted and the voltage setting is too low for the actual power supply, a power surge may occur on the transformer for the power supply and reduce the lifetime of the transformer.

If the jumper is inserted and the voltage setting is too high for the actual power supply, the wind capacity of the cooling fan is reduced.

Insert the jumper into the power tap with the voltage setting nearest to the voltage of the actual power supply.

Refer to *Chapter 4 Trial Operation* for the procedure.

■ Maintenance and Inspections

After turn OFF the main circuit power supply, always confirm that the CHARGE indicator is not lit before performing maintenance or inspections. The voltage remaining in the capacitor may cause electric shock.

Motor Application Precautions

This section provides precautions for motor application.

◆ Applicable Motor

To the Varispeed F7S-Series Inverter, apply the dedicated IPM motor.

◆ Power Transmission Mechanism (Speed Reducers, Belts, and Chains)

If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, oil lubrication will be affected when the motor operates only in the low speed range. The power transmission mechanism will make noise and experience problems with service life and durability if the motor is operated at a speed higher than the rated speed.

Conformance to UL Standard

To comply with UL standard, follow the appropriate installation instructions.

Note Yaskawa IPM motor does not conform to UL/cUL standards.

■ Installation Site

Install the Inverter in a pollution degree 2 environment or equivalent.

■ Specification of Closed-Loop Connector

The closed-loop connectors must be installed on conductors before installing to terminal blocks.

Use UL Listed closed-loop connectors shown below.

Table 10.1 JST Closed-Loop Connector Model

Inverter Model CIMR-F7S	JST Kit P/N	
	Input	Output
2011	14-5	14-5
2015	38-6	22-6
2018	38-8	38-8
2022	60-8	38-8
2030	60-8	60-8
2037	100-10	100-10
2045	150-10	150-10
2055	60-10 (2perPh)	60-10 (2perPh)
2075	100-10 (2perPh)	80-10 (2perPh)
4022	22-6	14-6
4030	38-6	22-6
4037	38-8	38-8
4045	60-8	60-8
4055	70-8	70-8
4075	100-10	80-10
4090	60-10 (2perPh)	100-10
4110	70-10 (2perPh)	60-10 (2perPh)
4132	70-10 (2perPh)	70-10 (2perPh)
4160	80-12 (2perPh)	80-12 (2perPh)
4185	150-16 (2perPh)	150-16 (2perPh)
4220	325-16 (2perPh)	200-16 (2perPh)
4300	150-16 (4perPh)	150-16 (4perPh)

■ Control Circuit Terminal

A UL Listed, Class 2 power supply must be used for the control circuits. See below table.

Table 10.2 Power Supply for Control Circuits

Input/Output	Terminal	Power Supply
Open Collector Outputs	P1, P2, PC	Class 2 power supply
Digital Inputs	S1, S2, S3, S4, S5, S6, S7, S8, SC	LVLC power supply when using internal power supply. Class 2 power supply when using external power supply.
Analog Inputs	RP, +V, -V, A1, A2, A3, AC	

■ Interrupting Rating

Varispeed F7S is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240 VAC maximum (200 V Class) and 480 VAC maximum (400 V Class).

Use a circuit breaker or fuses having an interrupting rating not less than 100,000 RMS symmetrical amperes, 600 VAC maximum.

■ Motor Overheat Protection

To protect the motor from overheating, set the E5-03 constant in the Inverter to the same value as the level of the motor rated current.

Conformance to CE Markings

Points regarding conformance to CE markings are given below.

Note Yaskawa IPM motor does not conform to CE Markings.

◆ CE Markings

CE markings indicate conformance to safety and environmental standards that apply to business transactions (including production, imports, and sales) in Europe. There are unified European standards for mechanical products (Machine Directive), electrical products (Low Voltage Directive), and electrical noise (EMC Directive). CE markings are required for business transactions in Europe (including production, imports, and sales).

The Varispeed F7S-Series Inverters bear CE markings indicating conformance to the Low Voltage Directive and the EMC Directive.

- Low Voltage Directive: 73/23/EEC
93/68/EEC
- EMC Directive: 89/336/EEC
92/31/EEC
93/68/EEC

Machinery and installations that incorporate the Inverter are also subject to CE markings. It is ultimately the responsibility of customers making products incorporating the Inverter to attach CE markings to the finished products. The customer must confirm that the finished products (machines or installations) conform to the European Standards.

◆ Requirements for Conformance to CE Markings

■ Low Voltage Directive

Varispeed F7S-Series Inverters satisfy testing for conformance to the Low Voltage Directive under the conditions described in European Standard EN50178.

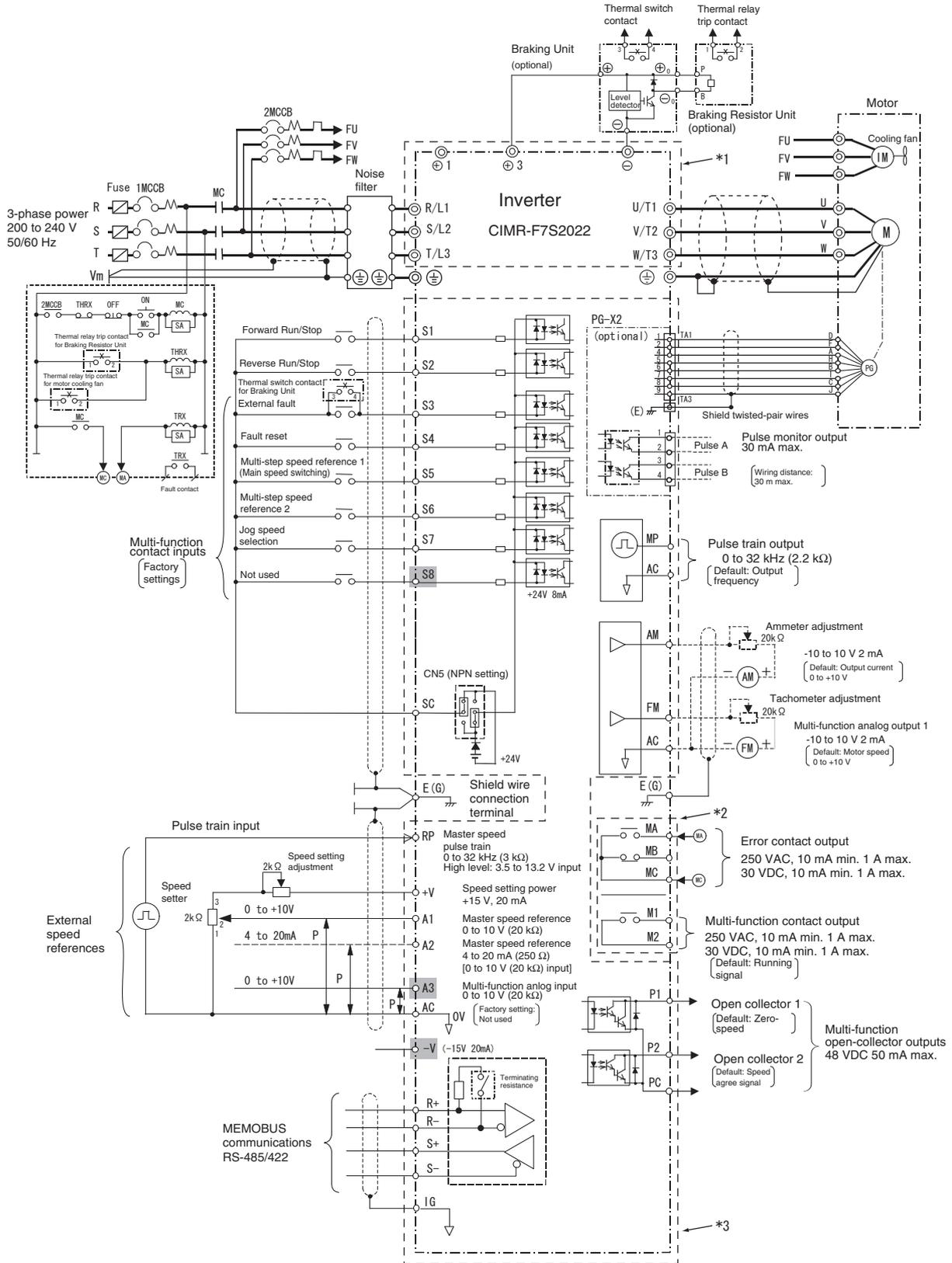
Requirements for Conformance to the Low Voltage Directive

Varispeed F7S-Series Inverters must satisfy the following conditions in order to conform to the Low Voltage Directive.

- It must be used under conditions corresponding to overvoltage category 3 or less and pollution degree 2 or less as specified in IEC664.
- Input fuses:
For details on selecting fuses, refer to *Table 10.3 Selection Requirements for Input Fuses with Examples*.
- With Inverters CIMR-F7S2022 to 2075 and CIMR-F7S4022 to 4300, an enclosure preventing foreign matter from entering from the top or front sides is required (IP4X or higher: panel installation).

Wiring Example

This example shows wiring for conforming to undervoltage reference.



- * 1. The main circuit is separated from the terminal cover for safety reasons.
- * 2. The contact output circuit is separated from the main circuit and the control circuit by reinforced insulation. It can be connected to extra-low voltage circuits or circuits that are 250 VAC 1 A, 30 VDC 1 A or less.
- * 3. The control circuit is an extra-low voltage circuit and separated from the main circuit and the contact output circuit by reinforced insulation. Always connect it to extra-low voltage circuits.

Fig 10.2

Input Fuses

In order to conform to the Low Voltage Directive, fuses must be provided for inputs. Use UL-compatible input fuses with ratings higher than the voltages and currents, and fusing I^2t specifications within the ranges shown in the table below.

Table 10.3 Selection Requirements for Input Fuses with Examples

Voltage Class	Inverter Model Number CIMR-F7S	Selection Requirements			Input Fuse (Examples)			
		Voltage (V)	Current (A)	Fusing I^2t (A ² sec)	Model Number	Manufacturer	Ratings	Fusing I^2t (A ² sec)
200 V Class	20P4	240	10	12 to 25	A60Q12-2	FERRAZ	600 V 12 A	17
	20P7	240	10	12 to 25	A60Q12-2	FERRAZ	600 V 12 A	17
	21P5	240	15	23 to 55	CR2LS-20/UL	FUJI	250 V 20 A	27
	22P2	240	20	34 to 98	CR2LS-30/UL	FUJI	250 V 30 A	60
	23P7	240	30	82 to 220	CR2LS-50/UL	FUJI	250 V 50 A	200
	25P5	240	40	220 to 610	CR2LS-75/UL	FUJI	250 V 75 A	276
	27P5	240	60	290 to 1300	CR2LS-75/UL	FUJI	250 V 75 A	560
	2011	240	80	450 to 5000	CR2LS-100/UL	FUJI	250 V 100 A	810
	2015	240	100	1200 to 7200	CR2L-125/UL	FUJI	250 V 125 A	1570
	2018	240	130	1800 to 7200	CR2L-150/UL	FUJI	250 V 150 A	2260
	2022	240	150	870 to 16200	CR2L-150/UL	FUJI	250 V 150 A	2260
	2030	240	180	1500 to 23000	CR2L-200/UL	FUJI	250 V 200 A	4010
	2037	240	240	2100 to 19000	CR2L-260/UL	FUJI	250 V 260 A	7320
	2045	240	300	2700 to 55000	CR2L-300/UL	FUJI	250 V 300 A	9630
	2055	240	350	4000 to 55000	CR2L-350/UL	FUJI	250 V 350 A	16000
2075	240	450	7100 to 64000	CR2L-450/UL	FUJI	250 V 450 A	31000	

Table 10.3 Selection Requirements for Input Fuses with Examples (Continued)

Voltage Class	Inverter Model Number CIMR-F7S	Selection Requirements			Input Fuse (Examples)			
		Voltage (V)	Current (A)	Fusing I^2t (A^2sec)	Model Number	Manufacturer	Rated	Fusing I^2t (A^2sec)
400 V Class	40P4	480	5	6 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	40P7	480	5	6 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	41P5	480	10	10 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	42P2	480	10	18 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	43P7	480	15	34 to 72	CR6L-30/UL	FUJI	600 V 30 A	59
	44P0	480	20	50 to 570	CR6L-30/UL	FUJI	600 V 30 A	59
	45P5	480	25	100 to 570	CR6L-50/UL	FUJI	600 V 50 A	317
	47P5	480	30	100 to 640	CR6L-50/UL	FUJI	600 V 50 A	317
	4011	480	50	150 to 1300	CR6L-50/UL	FUJI	600 V 50 A	317
	4015	480	60	400 to 1800	CR6L-75/UL	FUJI	600 V 75 A	564
	4018	480	70	700 to 4100	CR6L-100/UL	FUJI	600 V 100 A	1022
	4022	480	80	240 to 5800	CR6L-100/UL	FUJI	600 V 100 A	1022
	4030	480	100	500 to 5800	CR6L-100/UL	FUJI	600 V 100 A	1022
	4037	480	125	750 to 5800	CR6L-150/UL	FUJI	600 V 150 A	3070
	4045	480	150	920 to 13000	CR6L-150/UL	FUJI	600 V 150 A	3070
	4055	480	150	1500 to 13000	CR6L-200/UL	FUJI	600 V 200 A	5200
	4075	480	250	3000 to 55000	CR6L-300/UL	FUJI	600 V 300 A	17700
	4090	480	300	3800 to 55000	CR6L-300/UL	FUJI	600 V 300 A	17700
	4110	480	350	5400 to 23000	A70P350-4	FERRAZ	700 V 350 A	15000
	4132	480	400	7900 to 64000	A70P400-4	FERRAZ	700 V 400 A	19000
	4160	480	450	14000 to 250000	A70P450-4	FERRAZ	700 V 450 A	24000
4185	480	600	20000 to 250000	A70P600-4	FERRAZ	700 V 600 A	43000	
4220	480	700	34000 to 400000	A70P700-4	FERRAZ	700 V 700 A	59000	
4300	480	900	52000 to 920000	A70P900-4	FERRAZ	700 V 900 A	97000	

■ EMC Directive

Varispeed F7-Series Inverters satisfy testing for conformance to the EMC Directive under the conditions described in European Standard EN61800-3.

Installation Method

In order to ensure that the machinery or installation incorporating the Inverter conforms to the EMC Directive, perform installation according to the method below.

- Install a noise filter that conforms to European Standards on the input side. (Refer to *Table 10.4 EMC Noise Filters*).
- Use a shielded line or metal piping for wiring between the Inverter and Motor. Make the wiring as short as possible.
- To suppress harmonics, install a DC reactor in CIMR-F7S20P4, 20P7, 40P4, and 40P7 models. (Refer to *Table 10.5 DC Reactors for Suppressing Harmonics*.)

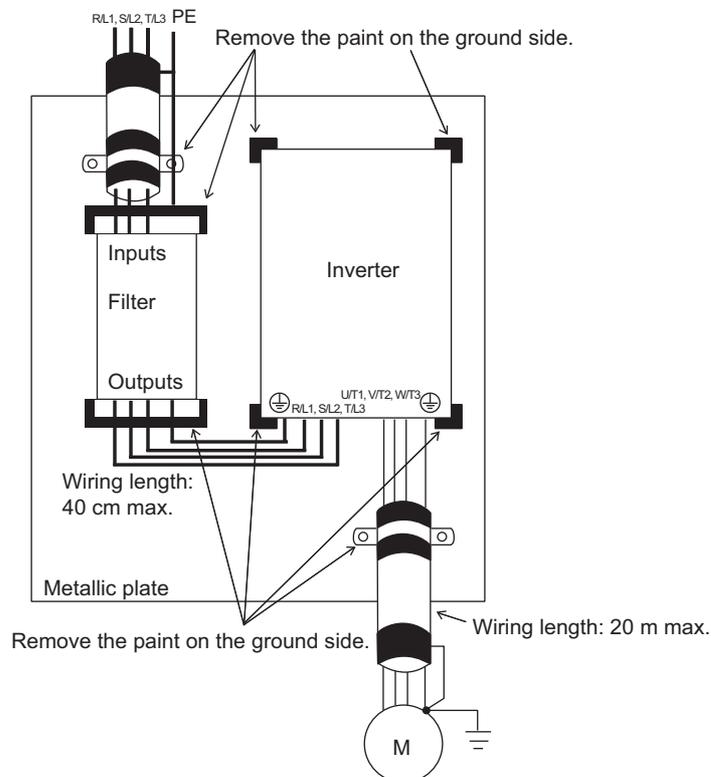


Fig 10.3 Installation Method for Filter and Inverter (CIMR-F7S20P4 to 2018, 40P4 to 4018)

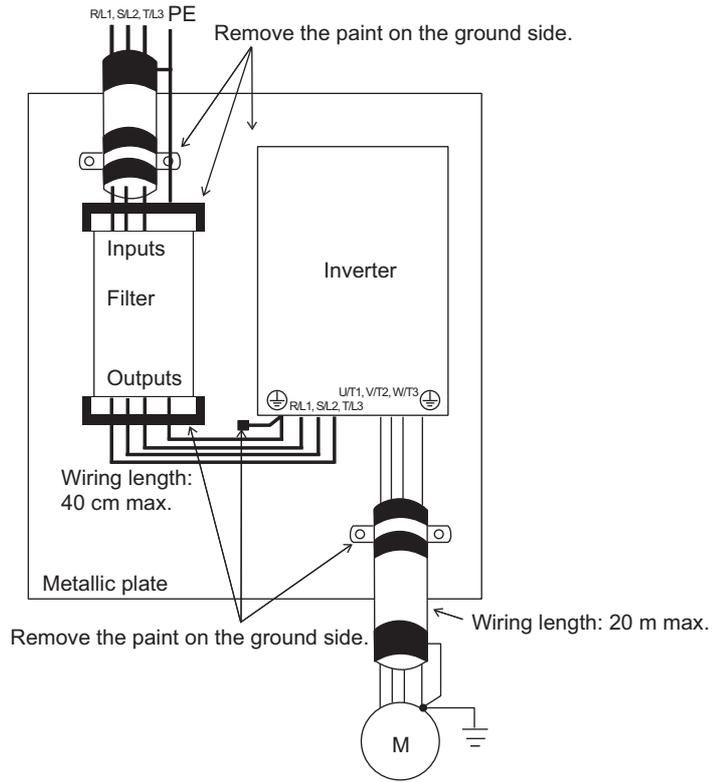


Fig 10.4 Installation Method for Filter and Inverter (CIMR-F7S2022 to 2110, 4022 to 4300)

Table 10.4 EMC Noise Filters

Voltage Class	Inverter Model Number CIMR-F7S	Noise Filter (Made by Shaffner)			
		Model Number	Rated Current (A)	Weight (kg)	Dimensions (mm) W × D × H
200V Class	20P4	FS5972-10-07	10	1.2	141 × 46 × 330
	20P7				
	21P5				
	22P2	FS5972-18-07	18	1.7	141 × 46 × 330
	23P7	FS5973-35-07	35	1.4	141 × 46 × 330
	25P5				
	27P5	FS5973-60-07	60	3	206 × 60 × 355
	2011				
	2015	FS5973-100-07	100	4.9	236 × 80 × 408
	2018				
	2022	FS5973-130-35	130	4.3	90 × 180 × 370
	2030				
	2037	FS5973-160-40	160	6	120 × 170 × 451
	2045	FS5973-240-37	240	11	130 × 240 × 610
	2055				
2075	FS5972-410-99	410	10.5	260 × 115 × 386	

Table 10.4 EMC Noise Filters (Continued)

Voltage Class	Inverter Model Number CIMR-F7S	Noise Filter (Made by Shaffner)			
		Model Number	Rated Current (A)	Weight (kg)	Dimensions (mm) W × D × H
400V Class	40P4	FS5972-10-07	10	1.2	141 × 46 × 330
	40P7				
	41P5				
	42P2				
	43P7				
	44P0	FS5972-18-07	18	1.3	141 × 46 × 330
	45P5				
	47P5	FS5972-21-07	21	1.8	206 × 50 × 355
	4011	FS5972-35-07	35	2.1	206 × 50 × 355
	4015	FS5972-60-07	60	4	236 × 65 × 408
	4018				
	4022	FS5972-70-52	70	3.4	80 × 185 × 329
	4030				
	4037	FS5972-100-35	100	4.5	90 × 150 × 330
	4045				
	4055	FS5972-130-35	130	4.7	90 × 180 × 370
	4075	FS5972-170-40	170	6	120 × 170 × 451
	4090	FN3359-250-28	250	7	230 × 125 × 300
	4110				
	4132	FS5972-410-99	410	10.5	260 × 115 × 386
4160					
4185					
4220	FS5972-600-99	600	11	260 × 135 × 386	
4300	FS5972-800-99	800	31	300 × 160 × 716	

Table 10.5 DC Reactors for Suppressing Harmonics

Voltage Class	Inverter Model Number CIMR-F7S	DC Reactor			
		Model Number	Manufacturer	Ratings	Code Number
200 V Class	20P4	UZDA-B	YASKAWA	5.4 A 8 mH	X010084
	20P7				
400 V Class	40P4	UZDA-B	YASKAWA	3.2 A 28 mH	X010052
	40P7				

Wiring Examples

This section provides wiring examples to connect a Braking Unit and other peripheral devices to the main circuits, examples of wiring a transformer to Inverter I/O, and other aspects of Inverter wiring.

◆ Using a Braking Resistor Unit

This example shows wiring for a Braking Resistor Unit.

CIMR-F7A20P4 to -F7A2018 (200 V Class Inverters of 0.4 to 18.5 kW)

CIMR-F7A40P4 to -F7A4018 (400 V Class Inverters of 0.4 to 18.5 kW)

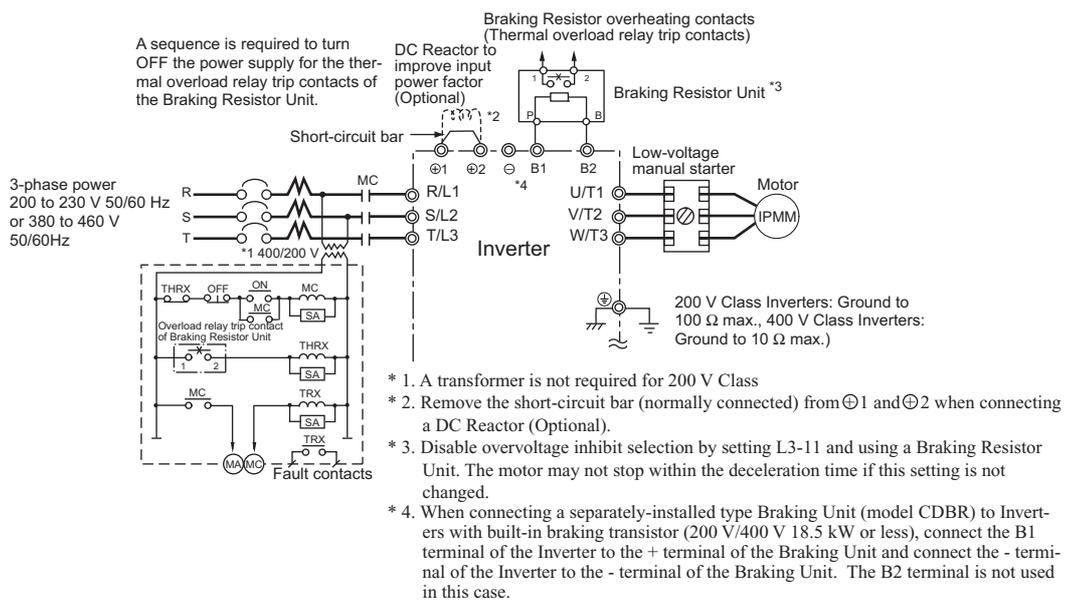


Fig 10.5

◆ Using a Braking Unit and Braking Resistor Unit

This example shows wiring for a Braking Unit and Braking Resistor Unit.

CIMR-F7A2022, -F7A2030 (200 V Class Inverters of 22 kW, 30 kW)

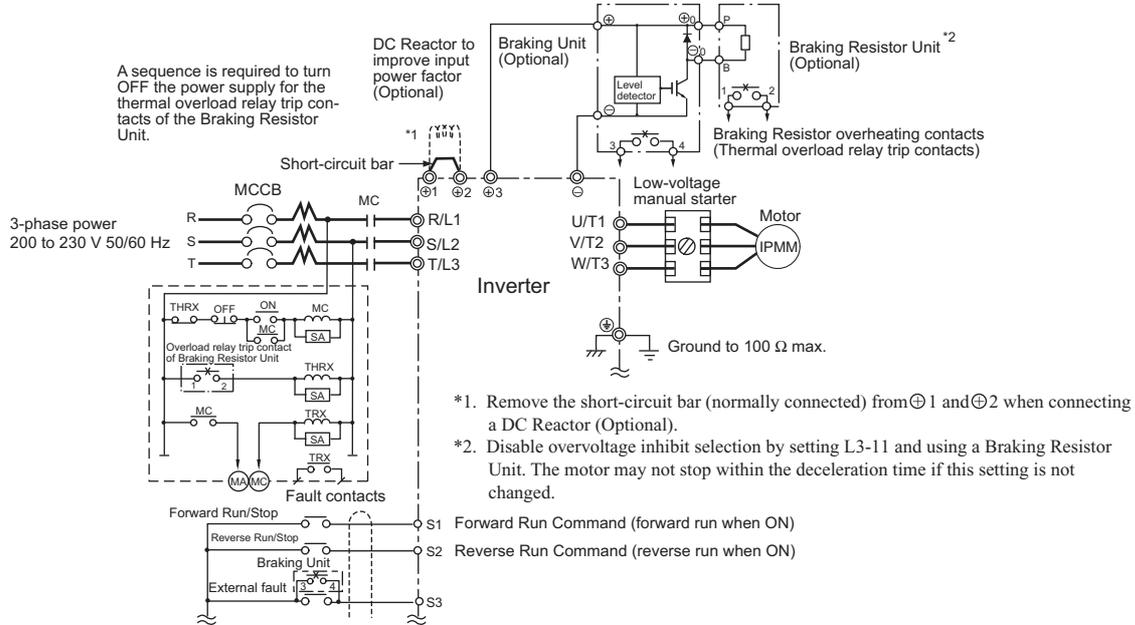


Fig 10.6

◆ Using Transistors for Input Signals and a 0-V Common in Sinking Mode with an Internal Power Supply

Set CN5 (shunt connector) on the control board to NPN as shown below for a sequence that uses an NPN transistor for an input signal (0-V command and sinking mode) and an internal +24-V power supply.

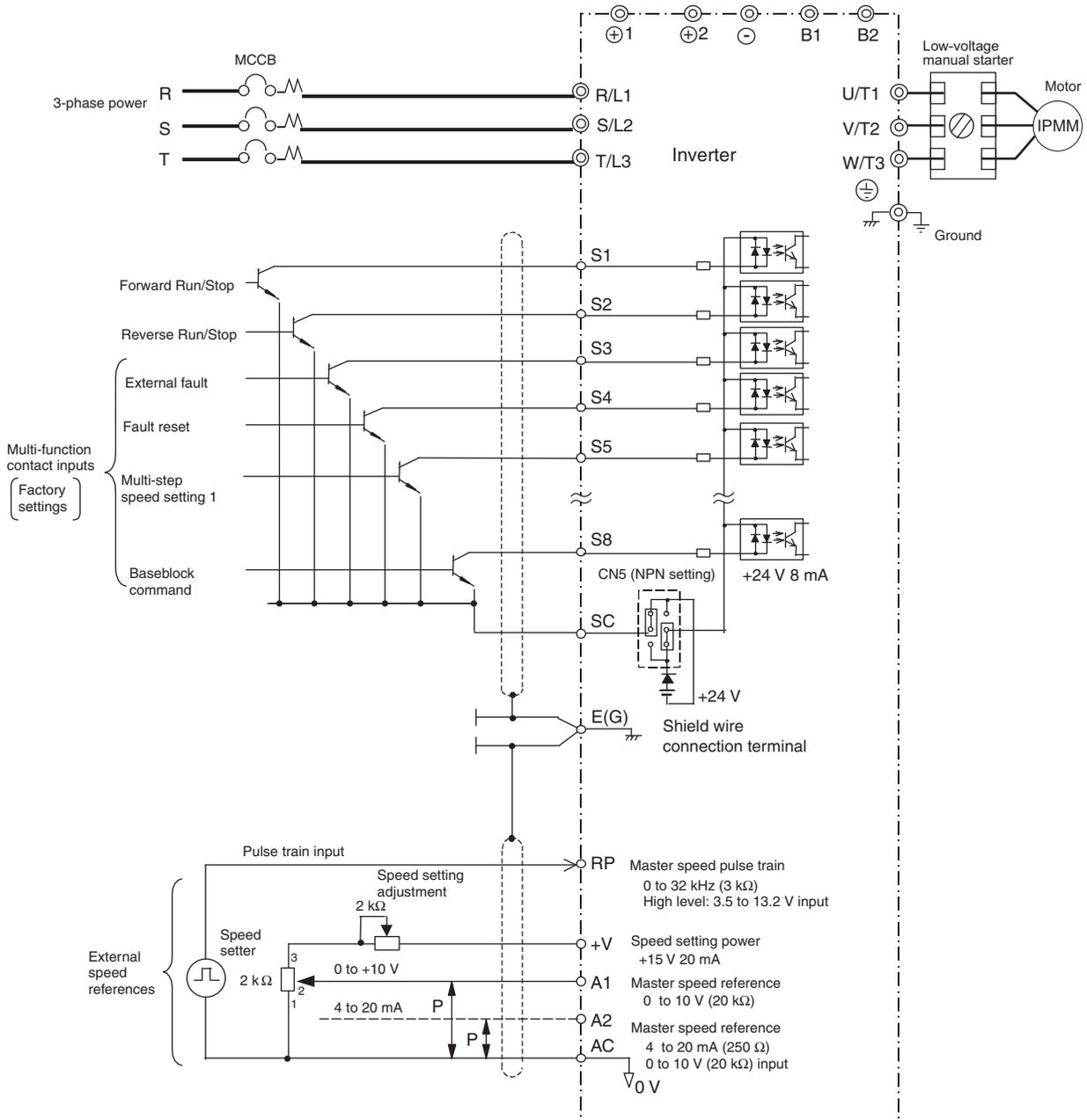


Fig 10.9

◆ Using Transistors for Input Signals and a +24-V Common in Sourcing Mode

Set CN5 (shunt connector) on the control board to PNP as shown below for a sequence that uses a PNP transistor for an input signal (+24-V common and sourcing mode) and an internal +24-V power supply.

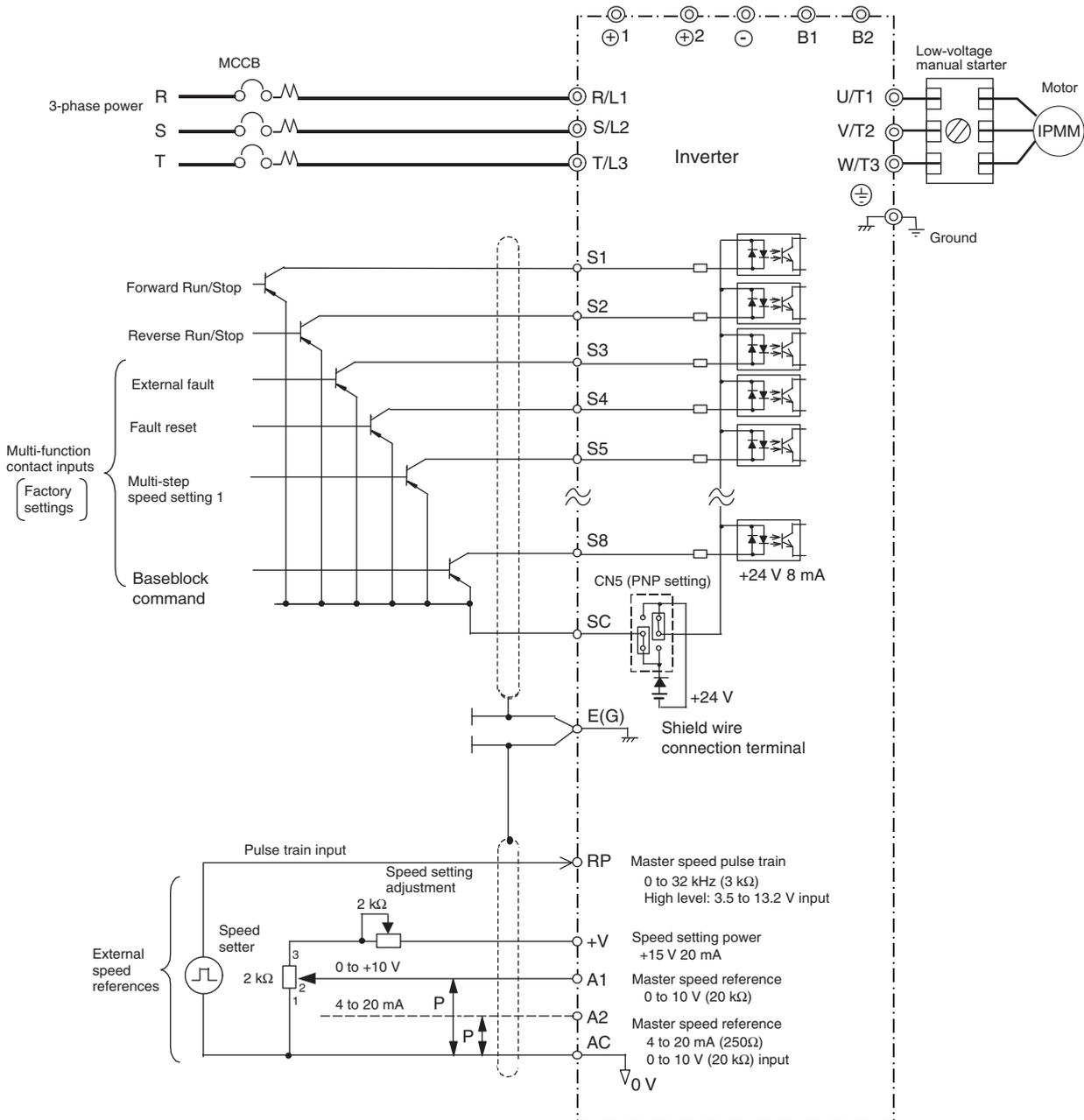
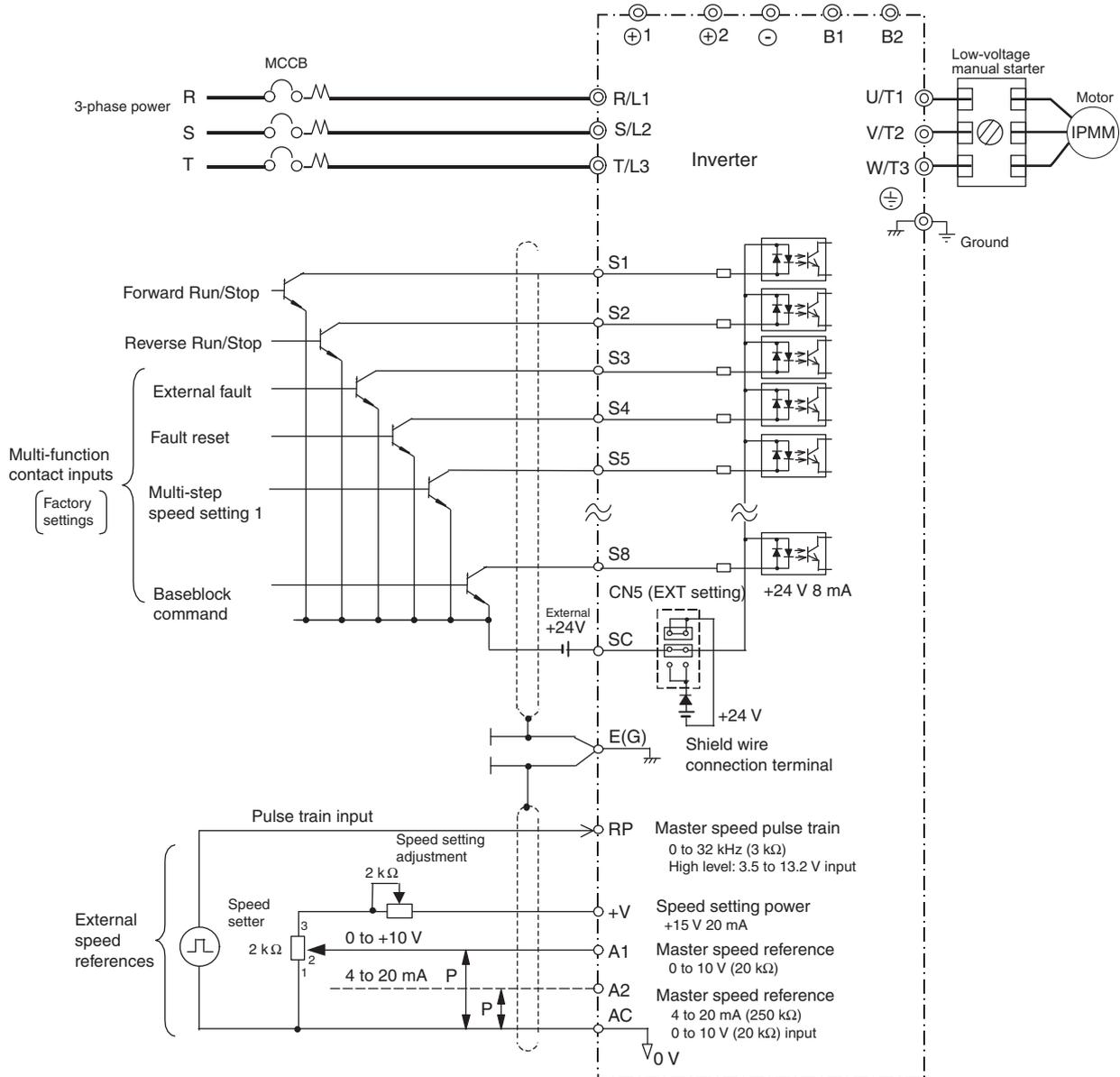


Fig 10.10

◆ Using Transistors for Input Signals and a 0-V Common in Sinking Mode with an External Power Supply

Set CN5 (shunt connector) on the control board to EXT as shown below for a sequence that uses an NPN transistor for an input signal (0-V command and sinking mode) and an external +24-V power supply.



Note:
Set EXT as shown at the right even for a PNP input signal transistor sequence connection (+24-V common/sourcing mode) with a +24-V external power supply.

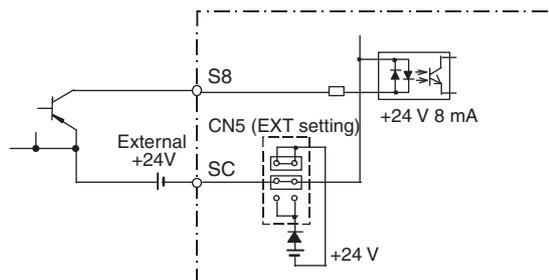


Fig 10.11

◆ Using Contact and Open Collector Outputs

This example shows wiring for contact outputs and open collector outputs.

The following example is for the CIMR-F7A27P5 (200 V Class Inverter for 7.5 kW).

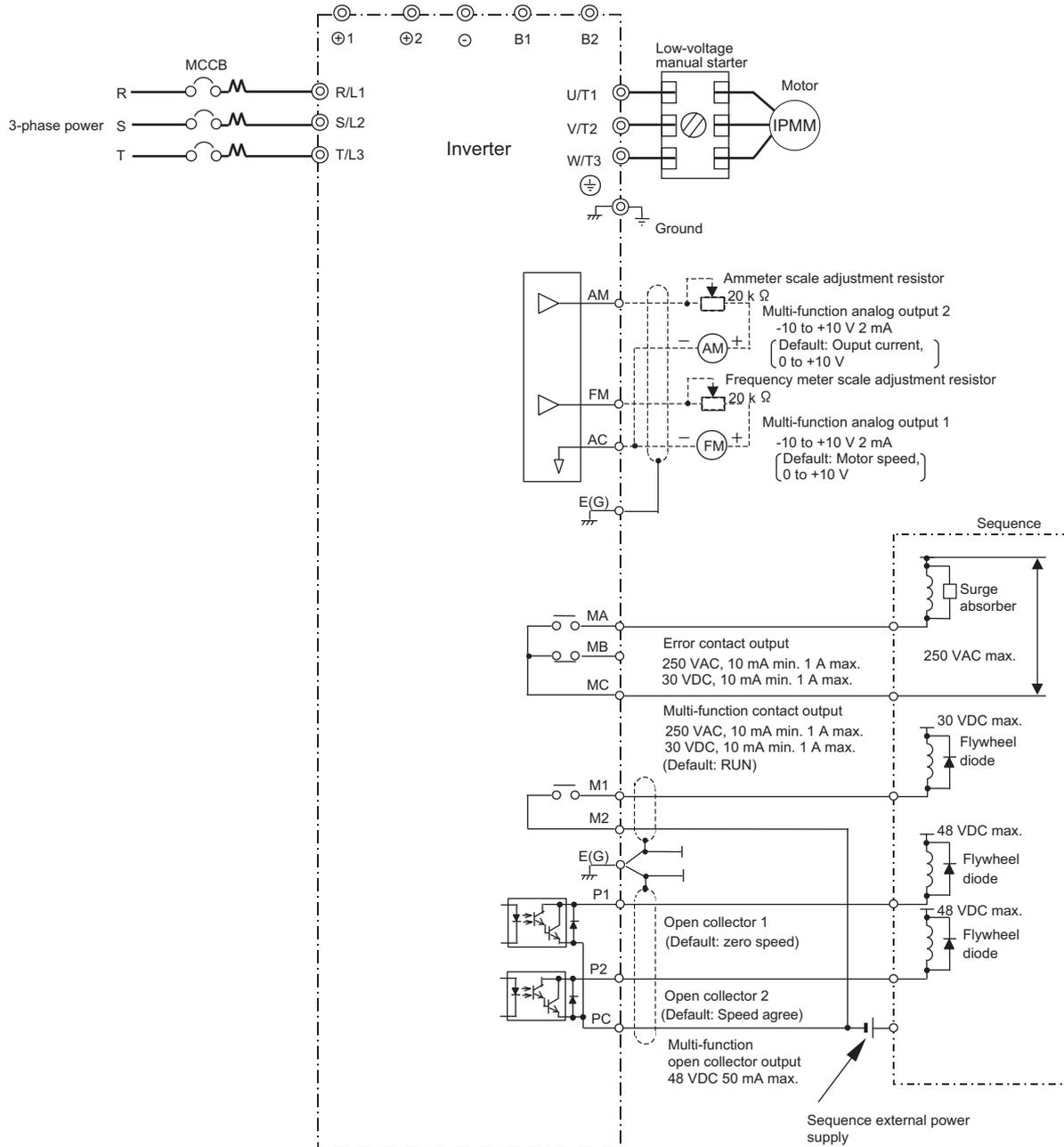


Fig 10.12

User Constants

Factory settings are given in the following table.

Table 10.6 User Constants

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
A1-00	Language selection for Digital Operator display	1*1		b5-04	Integral (I) limit	100.0	
A1-01	Constant access level	2		b5-05	Derivative (D) time	0.00	
A1-02	Control method selection	7*1		b5-06	PID limit	100.0	
A1-03	Initialize	0		b5-07	PID offset adjustment	0.0	
A1-04	Password	0		b5-08	PID primary delay time constant	0.00	
A1-05	Password setting	0		b5-09	PID output characteristics selection	0	
A2-01 to A2-32	User setting constants	-		b5-10	PID output gain	1.0	
b1-01	Reference selection	1		b5-11	PID reverse output selection	0	
b1-02	Operation method selection	1		b5-12	Selection of PID feedback command loss detection	0	
b1-03	Stopping method selection	0		b5-13	PID feedback command loss detection level	0	
b1-04	Prohibition of reverse operation	0		b5-14	PID feedback command loss detection time	1.0	
b1-05	Operation selection for setting E1-09 or less	0		b5-15	PID sleep function operation level	0.0	
b1-06	Read sequence input twice	1		b5-16	PID sleep operation delay time	0.0	
b1-07	Operation selection after switching to remote mode	0		b5-17	Acceleration/deceleration time for PID reference	0.0	
b1-08	Run Command selection in programming modes	1		b6-01	Dwell speed at start	0.0	
b2-01	Zero-speed level (Base block starting speed)	1.0*3		b6-02	Dwell time at start	0.0	
b3-01	Speed search selection	1*3		b6-03	Dwell speed at stop	0.0	
b3-05	Search wait time	1.0		b6-04	Dwell time at stop	0.0	
b4-01	Timer function ON-delay time	0.0		b7-01	Droop control gain	0.0	
b4-02	Timer function OFF-delay time	0.0		b7-02	Droop control delay time	0.05	
b5-01	PID control method selection	0		C1-01	Acceleration time 1	10.0	
b5-02	Proportional gain (P)	1.00		C1-02	Deceleration time 1	10.0	
b5-03	Integral (I) time	1.0		C1-03	Acceleration time 2	10.0	

Table 10.6 User Constants (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
C1-04	Deceleration time 2	10.0		d1-02	Speed reference 2	0.00	
C1-05	Acceleration time 3	10.0		d1-03	Speed reference 3	0.00	
C1-06	Deceleration time 3	10.0		d1-04	Speed reference 4	0.00	
C1-07	Acceleration time 4	10.0		d1-05	Speed reference 5	0.00	
C1-08	Deceleration time 4	10.0		d1-06	Speed reference 6	0.00	
C1-09	Emergency stop time	10.0		d1-07	Speed reference 7	0.00	
C1-10	Accel/decel time setting unit	1		d1-08	Speed reference 8	0.00	
C1-11	Accel/decel time switching speed	0.0		d1-09	Speed reference 9	0.00	
C2-01	S-curve characteristic time at acceleration start	0.00		d1-10	Speed reference 10	0.00	
C2-02	S-curve characteristic time at acceleration end	0.00		d1-11	Speed reference 11	0.00	
C2-03	S-curve characteristic time at deceleration start	0.00		d1-12	Speed reference 12	0.00	
C2-04	S-curve characteristic time at deceleration end	0.00		d1-13	Speed reference 13	0.00	
C5-01	ASR proportional (P) gain 1	10.00 ^{*3}		d1-14	Speed reference 14	0.00	
C5-02	ASR integral (I) time 1	0.500 ^{*3}		d1-15	Speed reference 15	0.00	
C5-03	ASR proportional (P) gain 2	10.00 ^{*3}		d1-16	Speed reference 16	0.00	
C5-04	ASR integral (I) time 2	0.500 ^{*3}		d1-17	Jog speed reference	10.00	
C5-05	ASR limit	5.0		d2-01	Speed reference upper limit	100.0	
C5-06	ASR primary delay time	0.016 ^{*3}		d2-02	Speed reference lower limit	0.0	
C5-07	ASR switching speed	0.0		d2-03	Master speed reference lower limit	0.0	
C5-08	ASR integral (I) limit	400		d3-01	Jump speed 1	0.0	
C5-15	ASR proportional (P) gain at start	5.00 ^{*3}		d3-02	Jump speed 2	0.0	
C6-01	CT/VT selection	1 ^{*8*9}		d3-03	Jump speed 3	0.0	
C6-02	Carrier frequency selection	2 ^{*3*4}		d3-04	Jump speed width	1.0	
d1-01	Speed reference 1	0.00		d4-01	Speed reference hold function selection	0	

Table 10.6 User Constants (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
d4-02	+ - Speed limits	10		E5-02	Motor rated capacity	0.40 *1*5	
d5-01	Torque control selection	0		E5-03	Motor rated current	1.65 *1*5	
d5-02	Torque reference delay time	0 ^{*3}		E5-04	Number of motor poles	6 ^{*1*5}	
d5-03	Speed limit selection	1		E5-05	Motor armature resistance	8.233 *1*5	
d5-04	Speed limit	0		E5-06	Motor d-axis inductance	54.84 *1*5	
d5-05	Speed limit bias	5		E5-07	Motor q-axis inductance	64.10 *1*5	
d5-06	Speed/torque control switching timer	50		E5-09	Motor generated voltage constant	223.0 *1*5	
E1-01	Input voltage setting	200 ^{*2*7}		E5-10	Phase lead compensation	10.0 ^{*1}	
E1-03	V/f pattern selection	F ^{*1}		E5-11	PG home position offset	0.0 ^{*1}	
E1-04	Max. speed	1750 *2*5		F1-02	Operation selection at PG open circuit (PGO)	1	
E1-05	Max. voltage	200.0 ^{*2}		F1-03	Operation selection at overspeed (OS)	1 ^{*3}	
E1-06	Base speed	1750 *2*5		F1-04	Operation selection at deviation	3	
E1-07	Mid. output frequency	3.0		F1-05	PG rotation	1	
E1-08	Mid. output frequency voltage	15.0 *2*9		F1-08	Overspeed detection level	115	
E1-09	Min. speed	1.5 ^{*2}		F1-09	Overspeed detection delay time	0.0	
E1-10	Min. output frequency voltage	175 ^{*2*5}		F1-10	Excessive speed deviation detection level	10	
E1-13	Motor base voltage	190.0 *2*5*7		F1-11	Excessive speed deviation detection delay time	0.5	
E2-01	Motor rated current	1.90 ^{*4}		F1-14	PG open-circuit detection time	2.0	
E2-02	Motor rated slip	2.90 ^{*4}		F1-18	DV3 Detection selection	5	
E2-03	Motor no-load current	1.20 ^{*4}		F1-19	DV4 Detection selection	128	
E2-05	Motor line-to-line resistance	9.842 ^{*4}		F2-01	Bi-polar or uni-polar input selection	0	
E2-10	Motor iron loss for torque compensation	14 ^{*4}		F3-01	Digital input option	0	
E2-11	Motor rated output	0.40 ^{*4}		F4-01	Channel 1 monitor selection	5 ^{*3}	
E5-01	Motor capacity selection	0000 *1*6		F4-02	Channel 1 gain	1.00	

Table 10.6 User Constants (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
F4-03	Channel 2 monitor selection	3 ^{*3}		H1-06	Terminal S8 function selection	F	
F4-04	Channel 2 gain	0.50		H2-01	Terminal M1-M2 function selection (contact)	0	
F4-05	Channel 1 output monitor bias	0.0		H2-02	Terminal P1 function selection (open collector)	1	
F4-06	Channel 2 output monitor bias	0.0		H2-03	Terminal P2 function selection (open collector)	2	
F4-07	Analog output signal level for channel 1	0		H2-06	Integral power output level selection	0	
F4-08	Analog output signal level for channel 2	0		H3-01	Signal level selection (terminal A1)	0	
F5-01	Channel 1 output selection	0		H3-02	Gain (terminal A1)	100.0	
F5-02	Channel 2 output selection	0F		H3-03	Bias (terminal A1)	0.0	
		1					
F5-03	Channel 3 output selection	0F		H3-04	Signal level selection (terminal A3)	0	
		2					
F5-04	Channel 4 output selection	0F		H3-05	Multi-function analog input (terminal A3) function selection	1F	
		4					
F5-05	Channel 5 output selection	0F		H3-06	Gain (terminal A3)	100.0	
		6					
F5-06	Channel 6 output selection	0F		H3-07	Bias (terminal A3)	0.0	
		37					
F5-07	Channel 7 output selection	0F		H3-08	Signal level selection (terminal A2)	2	
F5-08	Channel 8 output selection	0F		H3-09	Multi-function analog input (terminal A2) function selection	0	
F5-09	DO-08 output mode selection	0		H3-10	Gain (terminal A2)	100.0	
F6-01	Operation selection after communications error	1		H3-11	Bias (terminal A2)	0.0	
F6-02	Input level of external fault from Communications Option Card	0		H3-12	Analog input filter time constant	0.03	
F6-03	Stopping method for external fault from Communications Option Card	1		H3-13	Terminal A1/A2 switching	0	
F6-06	Torque reference/torque limit selection from optical option	0		H4-01	Monitor selection (terminal FM)	5 ^{*3}	
H1-01	Terminal S3 function selection	24		H4-02	Gain (terminal FM)	1.00	
H1-02	Terminal S4 function selection	14		H4-03	Bias (terminal FM)	0.0	
H1-03	Terminal S5 function selection	3 (0) ^{*10}		H4-04	Monitor selection (terminal AM)	3 ^{*3}	
H1-04	Terminal S6 function selection	4 (3) ^{*10}		H4-05	Gain (terminal AM)	0.50	
H1-05	Terminal S7 function selection	6 (4) ^{*10}		H4-06	Bias (terminal AM)	0.0	

Table 10.6 User Constants (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
H4-07	Analog output 1 signal level selection	0		L4-01	Speed agreement detection level	0.0	
H4-08	Analog output 2 signal level selection	0		L4-02	Speed agreement detection width	4.0	
H5-01	Slave address	1F		L4-03	Speed agreement detection level (+/-)	0.0	
H5-02	Communication speed selection	3		L4-04	Speed agreement detection width (+/-)	4.0	
H5-03	Communication parity selection	0		L4-05	Operation when speed reference is missing	0	
H5-04	Stopping method after communication error	3		L5-01	Number of auto restart attempts	0	
H5-05	Communication error detection selection	1		L5-02	Auto restart operation selection	0	
H5-06	Send wait time	5		L6-01	Torque detection selection 1	0	
H5-07	RTS control ON/OFF	1		L6-02	Torque detection level 1	150	
H6-01	Pulse train input function selection	0		L6-03	Torque detection time 1	0.1	
H6-02	Pulse train input scaling	1440		L6-04	Torque detection selection 2	0	
H6-03	Pulse train input gain	100.0		L6-05	Torque detection level 2	150	
H6-04	Pulse train input bias	0.0		L6-06	Torque detection time 2	0.1	
H6-05	Pulse train input filter time	0.10		L7-01	Forward drive torque limit	160	
H6-06	Pulse train monitor selection	2		L7-02	Reverse drive torque limit	160	
H6-07	Pulse train monitor scaling	1440		L7-03	Forward regenerative torque limit	160	
L1-01	Motor protection selection	4 ^{*1*3}		L7-04	Reverse regenerative torque limit	160	
L1-02	Motor protection time constant	1.0		L8-01	Protect selection for internal DB resistor (Type ERF)	0	
L2-01	Momentary power loss detection	0 ^{*3}		L8-02	Overheat pre-alarm level	95 ^{*4}	
L2-02	Momentary power loss ridethru time	0.1 ^{*4}		L8-03	Operation selection after overheat pre-alarm	3	
L2-03	Min. baseblock time	0.1 ^{*4}		L8-05	Input open-phase protection selection	0	
L2-05	Undervoltage detection level	190 ^{*7}		L8-07	Output open-phase protection selection	0	
L2-06	KEB deceleration time	30.0		L8-08	Output open-phase detection level	5.0 ^{*3}	
L3-11	Overvoltage inhibit selection	1		L8-09	Ground protection selection	1	

Table 10.6 User Constants (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
L8-10	Cooling fan control selection	0		o2-07	Cumulative operation time setting	0	
L8-11	Cooling fan control delay time	60		o2-08	Cumulative operation time selection	0	
L8-12	Ambient temperature	45		o2-10	Fan operation time setting	0	
L8-15	OL2 characteristics selection at low speeds	1		o2-12	Fault trace/fault history clear function	0	
L8-29	Current imbalance protection selection	1		o2-14	Output power monitor clear selection	0	
L8-32	OH1 detection of Inverter's cooling fan	1		o2-18	Capacitor maintenance setting	0	
N8-01	Current of magnetic pole calculation at start	50		o3-01	Copy function selection	0	
N8-02	Magnetic pole pull-in current	80* ³		o3-02	Read permitted selection	0	
o1-01	Monitor selection	6		T1-01	Autotuning mode selection	2* ³	
o1-02	Monitor selection after power up	1		T2-01	Motor rated capacity (E5-02 correspondence)	0.40* ⁵	
o1-03	Speed units of reference setting and monitor	1		T2-02	Base speed (E1-06 correspondence)	1750* ⁵	
o1-05	LCD brightness adjustment	3		T2-03	Base voltage (E1-13 correspondence)	190.0* ⁵ * ⁷	
o2-01	LOCAL/REMOTE key enable/disable	1		T2-04	Motor rated current (E5-03 correspondence)	1.65* ⁵	
o2-02	STOP key during control circuit terminal operation	1		T2-05	Number of motor poles (E5-04 correspondence)	6* ⁵	
o2-03	User constant initial value	0		T2-06	Motor d axis inductance (E5-06 correspondence)	54.84* ⁵	
o2-04	kVA selection	0* ¹ * ⁴		T2-07	Motor q axis inductance (E5-07 correspondence)	64.10* ⁵	
o2-05	Speed reference setting method selection	0		T2-08	Motor generation voltage constant (E5-09 correspondence)	223.0* ⁵	
o2-06	Operation selection when digital operator is disconnected	0		T2-11	Input voltage setting (E1-01 correspondence)	200* ⁷	

* 1. Not initialized. (Japanese standard specifications: A1-01 = 1, A1-02 = 2)

* 2. This constant is not initialized by the initialize operation if the control method is open-loop vector control for PM or flux vector control for PM.

* 3. The setting will return to be the factory setting if the control method is changed.

* 4. The factory setting varies in accordance with the Inverter capacity.

* 5. The factory settings vary in accordance with the motor capacity selection (E5-01) or the control method selection (A1-02).

* 6. The factory settings vary in accordance with the setting of the inverter capacity selection (o2-04) or the control method selection (A1-02).

* 7. Only 1 (VT) can be set for 400 V Class 220 kW and 300 kW Inverters.

* 8. Setting for 200 V Class Inverters. For 400 V Class Inverters, double the value.

* 9. The factory settings vary in accordance with the setting of C6-01 (CT/VT selection). If C6-01 is set to 0 (CT), the factory setting is 1 (2 kHz).

* 10. The values in parentheses indicate factory settings when initialized in 3-wire sequence.

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The revision dates and numbers of the revised manuals are given on the bottom of the back cover.

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		Chapter 6	Revision: <ul style="list-style-type: none"> • Fig 6.1 Overload Current Reduction Level for Flux Vector Control for PM • Setting Torque Limits Using Constants and an Analog Input
		Chapter 10	Revision: Fig 10.4 Installation Method for Filter and Inverter

Varispeed F7S

INSTRUCTION MANUAL

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