YASKAWA

Matrix Converter for Environmentally Friendly Motor Drives

Varispeed AC
Instruction Manual

Type: CIMR-ACA ☐
Models: 200 V Class: 5.5 to 45 kW (9 to 63 kVA)
400 V Class: 5.5 to 160 kW (10 to 209 kVA)

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MANUAL NO. TOEP C710636 00G

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Preface

This manual is designed to ensure correct and suitable application of the Varispeed AC-Series Matrix Converter (referred to as the “MxC”). Read this manual before attempting to install, operate, maintain, or inspect the MxC. This manual should be kept in a safe, convenient location for future reference. Be sure to have a thorough understanding of all precautions and safety information before attempting to use this product.

General Precautions

- The diagrams and illustrations in this manual may appear without the covers or safety shields that are normally affixed to the actual product. This is to provide the user with a better idea of how the interior of the MxC is designed. Be sure to restore all covers or shields before operating the MxC, and to follow the instructions described in this manual once the application is running.
- Any illustrations, photographs, or examples used in this manual are provided as examples only. Some illustrations may not apply to certain MxC models.
- The products and specifications described in this manual or the content and presentation of the material may be changed without notice to improve the product and/or the manual.
- To order a new copy of this manual, contact your Yaskawa representatives or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- If nameplates become warn or damaged, order new ones from your Yaskawa representatives or the nearest Yaskawa sales office.

Safety Information

The symbols below appear throughout this manual to provide precautions and warnings. Failure to heed the precautions listed in these pages can result in damage to the product or other devices, even serious or fatal injury.

"WARNING" indicates a safety concern that if not heeded, could possibly result in serious injury or loss of life.

"CAUTION" indicates that if the information is not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

Failure to follow information listed as CAUTION can result in serious consequences.

Indicates important information that the user must be aware of while operating the MxC.

Safety Precautions

■ Confirmations upon Delivery

⚠ CAUTION

- Never install an MxC that is damaged or has missing components.
  Failure to do so may result in injury.

■ Installation

⚠ CAUTION

- Always hold the case when carrying the MxC.
  If the MxC is held by the front cover, the main body of the MxC may fall, possibly resulting in injury.
- Attach the MxC to a noncombustible material, such as a metallic surface.
  Attaching the MxC to combustible material may cause a fire.
- Install a cooling fan or other cooling device when installing more than one MxC in the same enclosure so that the temperature of the air entering the MxCs is below 45°C.
  Fire or other damage may result if the MxC overheats.

■ Wiring

⚠ WARNING

- Always turn off the input power supply before wiring terminals.
  Failure to do so may result in electric shock or fire.
- Wiring must be performed by an authorized person qualified in electrical work.
  Electric shock or fire may result if an untrained individual attempts to wire the MxC.
- Be sure that the ground terminal is properly grounded.
  200 V class: Ground to 100 Ω or less 400 V class: Ground to 10 Ω or less
  Failure to do so may result in electric shock or fire.
- Always check emergency stop circuits after they are wired.
  Failure to verify that all emergency stops are working properly may result in serious injury. The user is responsible for properly wiring the product.
- Never touch the output terminals directly with your hands or allow the output lines to come into contact with the MxC case. Never short the output circuits.
  Failure to do so may result in a ground short or electric shock.
- Before turning the power on, make sure that the power LED is off. If the unit is switched on while the power LED is lit, the motor will start automatically.
  Failure to check the power LED may result in injury.
- If the MxC is set up for a 3-wire sequence, then be sure that the multi-function input terminals have been set properly before wiring the control circuit.
  Failure to do so will cause the motor to rotate unexpectedly, and may result in damage or personal injury.

⚠ CAUTION

- Be sure that the ground terminal is properly grounded using a wire of the recommended size.
  200 V class: Ground to 100 Ω or less 400 V class: Ground to 10 Ω or less
  If a wire smaller than the recommended size is used, the MxC may not operate properly.
- Check to be sure that the voltage of the main AC power supply satisfies the rated voltage of the MxC.
  Injury or fire may occur if the voltage is not correct.
- Do not perform voltage tolerance tests on the MxC.
  Such tests may damage semiconductor components and other devices.
- Tighten all terminal screws to the specified tightening torque.
  Failure to do so may result in fire.
- Do not connect AC power to output terminals U, V, and W.
  Circuitry in the MxC will be damaged if voltage is applied to the output terminals.
- Do not wire AC power lines to terminals p1, n1, r2, s2, or t2. These terminals are used for connecting peripheral devices only.
  Applying voltage to these terminals will damage the MxC.
- Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits.
  The MxC may be damaged and circuitry may overheat if these devices are connected.
- Do not connect electromagnetic switches or magnetic contactors to the output circuits.
  If a load is connected while the MxC is operating, a power surge will trigger the overcurrent protection circuit in the MxC.

■ Setting Parameters

⚠ CAUTION

- Disconnect the load (machine, device) from the motor before performing Rotational Auto-Tuning.
  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 during Rotational Auto-Tuning.
  The motor may start operating suddenly when stopped, possibly resulting in injury.

■ Test Run

⚠ WARNING

- Make sure that the front cover is properly attached before turning on the power supply.
  Failure to do so may result in electric shock.
- Leave a reasonable amount of space between yourself and the application when using the fault reset function. The machine may start moving suddenly once the alarm is cleared.
  The application should be designed to ensure safety when the MxC is restarted.
  Failure to do so may result in injury.
- Provide a separate emergency stop switch (the STOP key on the digital operator works only when it has been enabled).
  Failure to do so may result in injury.
- Reset alarms only after confirming that the RUN signal has been switched off.
  Failure to do so may result in injury.

⚠ CAUTION

- Do not touch the cooling fins (heatsink), braking resistor, or Braking Resistor Unit. These components can become extremely hot.
  These components become hot enough to cause serious burns.
- Be sure that the motor and machine is within the applicable ranges before starting operation.
  Failure to do so may result in injury.
- Provide a separate holding brake if necessary.
  The external sequence should be designed to ensure that the holding brake is activated in the event of an emergency, power failure, or fault in the MxC.
  Failure to do so may result in injury.
- If using an MxC with an elevator, take proper steps to ensure safety and to prevent the elevator from falling suddenly.
  Failure to observe to do so may result in injury.
- Refrain from checking relay signals while the MxC is running.
  Failure to do so may result in damage to the application.
- Be careful when changing any settings in the MxC. The default settings when the MxC is first shipped are generally set to optimal values.
  Failure to do so may result in damage to the application.

■ Maintenance and Inspection

⚠ WARNING

- Do not touch the MxC terminals. Some of the terminals carry high voltages and are extremely dangerous.
  Failure to do so may result in electric shock.
- Always have the protective cover in place when power is being supplied to the MxC. When attaching the cover, always turn off power to the MxC through the MCCB.
  Failure to do so may result in electric shock.
- After turning the main circuit power supply off, wait until the CHARGE display light goes out before performing maintenance or inspections.
  The capacitor will remain charged and is dangerous.
- Maintenance, inspection, and replacement of parts must be performed authorized personnel only.
  Remove all metal objects, such as watches and rings, before starting work. Always use grounded tools.
  Failure to heed these warning may result in electric shock.
- Customers must provide the holding brakes.
  Before making any adjustments other than those done in actual operations, be sure to tighten the holding brakes by using an external sequence.
  Failure to do so may result in electric shock.
- If the MxC is used with an elevator, be sure to take safety measures to prevent the car from falling.
  Failure to do so may result in electric shock.

⚠ CAUTION

- A CMOS IC is used in the control board. Handle the control board and CMOS IC carefully.
  The CMOS IC may be destroyed by static electricity if touched directly.
- The control boards designed for MxCs for a motor capacity of 75 kW or less cannot be used for MxCs for a motor capacity of 110/160 kW.
  The control boards are not compatible among all models of MxC. Refer to the model numbers of the applicable control boards below.
  Control board for MxCs with a motor capacity of 110/160 kW: ETC74140X, ETC74141X
  Control board for MxCs with a motor capacity of 75 kW or less: ETC73014X, ETC74015X

⚠ CAUTION

- The control boards designed for MxCs for the motor capacity of 110/160 kW cannot be used for MxCs for the motor capacity of 75 kW or less.
  The control boards are not compatible among all models of MxC. Refer to the model numbers of the applicable control boards below.
  Control board for MxCs with a motor capacity of 110/160 kW: ETC74140X, ETC74141X
  Control board for MxCs with a motor capacity of 75 kW or less: ETC73014X, ETC74015X
- Do not change any wiring and refrain from removing connectors or the digital operator while the MxC is operating.
  Failure to do so may result in injury.

■ Other

⚠ WARNING

- Do not attempt to modify or alter the MxC.
  Failure to do so may result in injury or electric shock.

⚠ CAUTION

- Contact your Yaskawa representative if you intend to use the MxC with a non-Yaskawa motor or any other motor not listed in Yaskawa product literature.
  The MxC can be used with three-phase induction motors with 2, 4, or 6 poles. A multi-pole motor with 8 poles or more, a PM motor, or a motor designed for use with machine tools cannot be used with the MxC.
- Install adequate branch circuit short circuit protection per applicable codes.
  Failure to comply may result in damage to the MxC.
  The MxC is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical Amperes, 220 Vac maximum (200 V Class) and 480 Vac maximum (400 V Class).
- If disinfectants or insecticides must be used to treat packing materials such as wooden frames, pallets, or plywood, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.
  Example: Heat treatment, where materials are kiln-dried to a core temperature of 56°C for 30 minutes or more.
  If the electronic products, which include stand-alone products and products installed in machines, are packed with fumigated wooden materials, the electrical components may be greatly damaged by the gases or fumes resulting from the fumigation process. In particular, disinfectants containing halogen, which includes chlorine, fluorine, bromine, or iodine can contribute to the erosion of the capacitors.

Location of Warning Information

Warning information is printed on the MxC as indicated in the following illustration. Obey all warnings to prevent damage and injury.

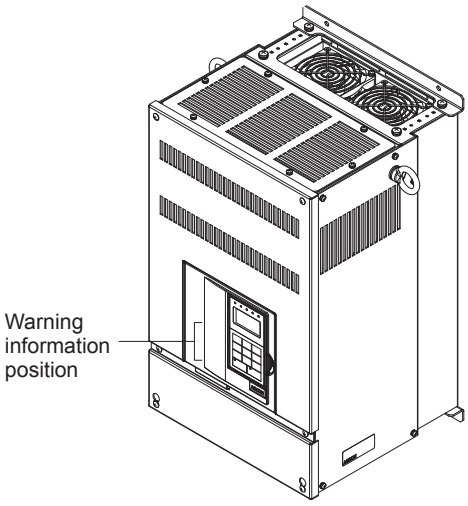

Illustration shows a CIMR-ACA4011

Warning Information

Read this manual before installing the MxC.

⚠WARNING

⚠ Risk of electric shock.

- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.

⚠AVERTISSEMENT

⚠ Risque de décharge électrique.

- Lire le manuel avant l' installation.
- Attendre 5 minutes aprés la coupure de l' allmentation. Pour permettre la décharge des condensateurs.

⚠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分以内はフロントカバーを外さないで下さい。

Warranty Information

■ Free Warranty Period and Scope

Warranty Period

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

Scope of Warranty

Inspections

Periodic inspections must be conducted by the customer. However, upon request, someone from 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 fall outside the scope of this warranty are:

- Problems due to improper maintenance or handling, carelessness, or other reasons where the customer is deemed responsible.
- Problems that result from any additions or modifications made to a Yaskawa product without having consulted Yaskawa first.
- Problems due to the use of a Yaskawa product outside the operation conditions specified in the manual.
- Problems caused by natural disaster or fire.
- Any other problems not due to defects in Yaskawa workmanship or materials.

Warranty service is only applicable within the country where the product was purchased.

However, after-sales service is available for customers outside the country where the product was purchased 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 a defect in a Yaskawa product, are *not* covered by this warranty, whether within or outside the warranty period.

■ Restrictions

- The MxC was not designed or manufactured for use with devices or systems that may directly threaten or harm anyone in any way.
- 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 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:

- CC-Link is a registered trademark of CC-Link Partner Association.
- DeviceNet is a registered trademark of ODVA (Open DeviceNet Vendors Association, Inc.).
- CANopen is a registered trademark of CiA (CAN in Automation).

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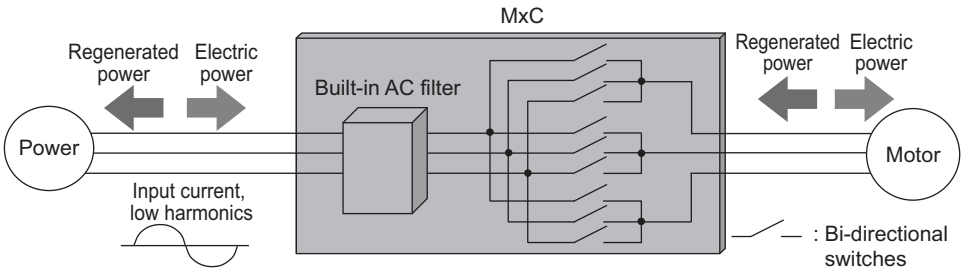
MxC Introduction

◆ Introducing the MxC

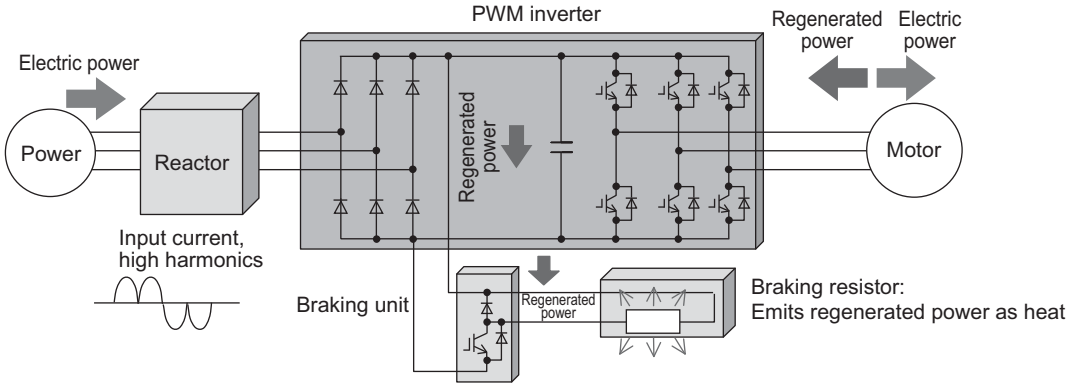
The design of the MxC is simpler and more efficient than a conventional inverter. The MxC uses a different mechanism to generate AC voltage, and relies on nine bi-directional switches to adjust AC output power to the motor directly from an AC line power input.

The MxC has no rectifying diodes and no DC bus capacitors commonly used in inverters.

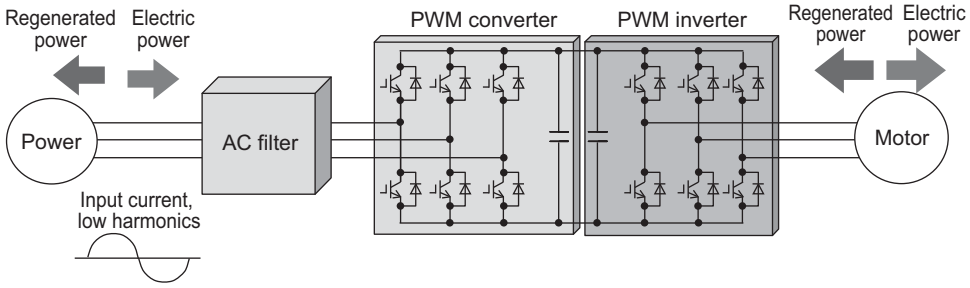
New Type: Varispeed AC (uses the MxC circuit, with no external devices)



Conventional Type: Requires a regenerative resistor discharging system and two external devices



Conventional Type: Harmonic filter and power regeneration system with two external devices



◆ MxC Models

The various models of the MxC are separated into two voltage classes: 200 V and 400 V. Maximum motor capacities vary from 5.5 to 75 kW to create a total of nine different models.

Table 1.1 MxC Models

Voltage Class	Maximum Motor Capacity kW	MxC		Protection Specifications (Always specify the protective design required when placing an order)	
		Output Capacity kVA	Basic Model Number	Open Chassis (IEC IP00) CIMR-ACA□□□□□□	Enclosed Wall-mounted [IEC IP20, NEMA 1 (Type 1)] CIMR-ACA□□□□□□
200 V class	5.5	9	CIMR-ACA25P5	25P50□	25P51□
	11	17	CIMR-ACA2011	20110□	20111□
	22	33	CIMR-ACA2022	20220□	20221□
	45	63	CIMR-ACA2045	20450□	20451□
400 V class	5.5	10	CIMR-ACA45P5	45P50□	45P51□
	11	19	CIMR-ACA4011	40110□	40111□
	22	36	CIMR-ACA4022	40220□	40221□
	45	67	CIMR-ACA4045	40450□	40451□
	75	114	CIMR-ACA4075	40750□	40750□
	110	166	CIMR-ACA4110	41100□	–
	120	209	CIMR-ACA4160	41600□	–

Confirmations upon Delivery

◆ Checks

Check the following items as soon as you have received the MxC.

Table 1.2 Checks

Item	Method
Has the correct model of MxC been delivered?	Check the model number on the nameplate attached to the side of the MxC.
Is the MxC damaged in any way?	Inspect the entire exterior of the MxC to see if there are any scratches or other damage as a result of shipping.
Are any screws or other components loose?	Use a screwdriver to make sure that all screws are properly fastened.

If you find any irregularities with the items listed above, contact the agency from which the MxC was purchased, or your Yaskawa representative immediately.

◆ Nameplate Information

An information nameplate appears on the right side of each MxC. The nameplate shows the model number, specifications, lot number, serial number, and other information on the MxC.

■ Example Nameplate

The following nameplate is an example of a standard MxC: 3-phase, 400 Vac, 11 kW, IEC IP00 design.

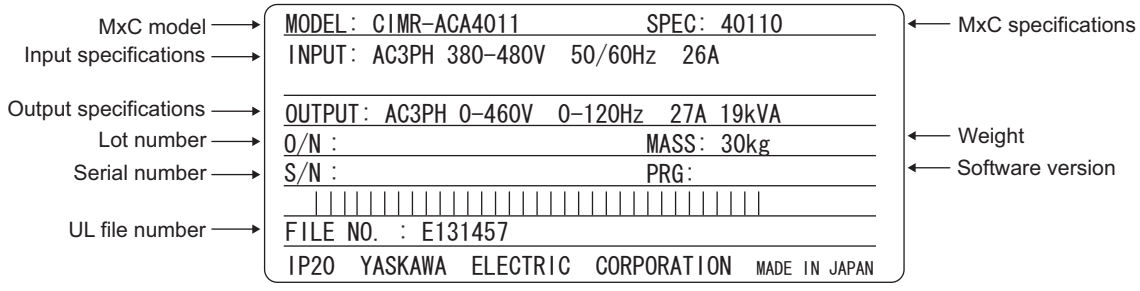
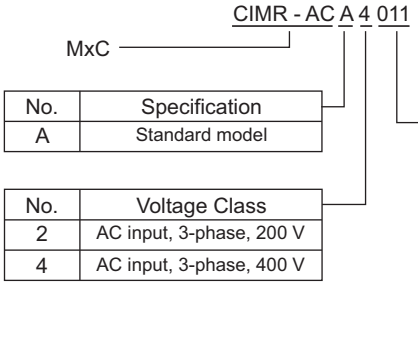


Fig 1.1 Nameplate

■MxC Model Numbers

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



No.	Specification
A	Standard model

No.	Voltage Class
2	AC input, 3-phase, 200 V
4	AC input, 3-phase, 400 V

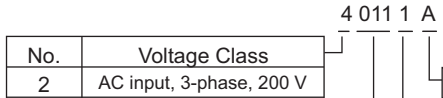
No.	Max. Motor Capacity
5P5	5.5 kW
011	11 kW
022	22 kW
045	45 kW
075	75 kW
110	110 kW
160	160 kW

"P" indicates the decimal point.

Fig 1.2 MxC Model Numbers

■MxC Specifications

The MxC specifications (“SPEC”) on the nameplate indicate the voltage class, maximum motor capacity, the protective structure, and the version of the MxC.



No.	Voltage Class
2	AC input, 3-phase, 200 V
4	AC input, 3-phase, 400 V

No.	Revision
A to Z	Design revision order (A to Z)

No.	Max. Motor Capacity
5P5	5.5 kW
011	11 kW
022	22 kW
045	45 kW
075	75 kW
110	110 kW
160	160 kW

No.	Protective Structure
0	Open chassis (IEC IP00)
1	Enclosed wall-mounted [IEC IP20, NEMA 1 (Type 1)]

"P" indicates the decimal point.

Fig 1.3 MxC Specifications

TERMS

Open Chassis Type (IEC IP00)

Protected so that no one can come in direct contact with electrically charged parts from the front when the MxC is mounted in a control panel.

Enclosed Wall-Mounted Type [IEC IP20, NEMA 1 (Type 1)]

The MxC is structured so that the MxC 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 are required for an IEC IP20 or NEMA 1 (Type 1) protective structure.

◆ Component Names

The exterior of the MxC and its components are shown in *Fig 1.4*. *Fig 1.5* shows the MxC with the terminal cover removed.

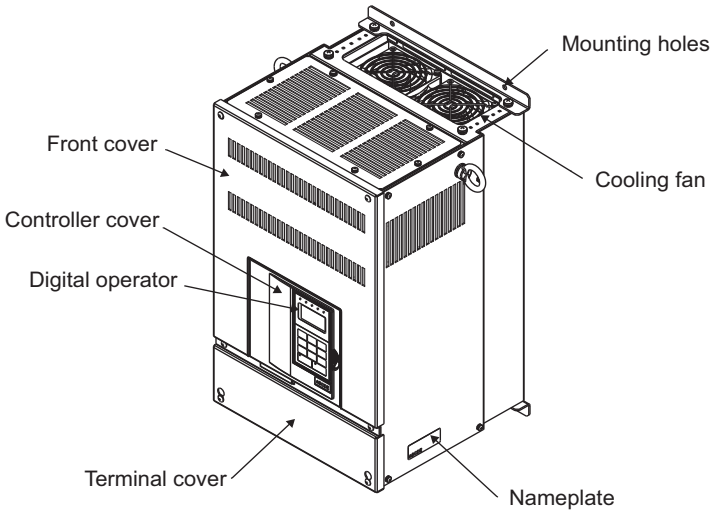


Fig 1.4 MxC Exterior (Model: CIMR-ACA4011)

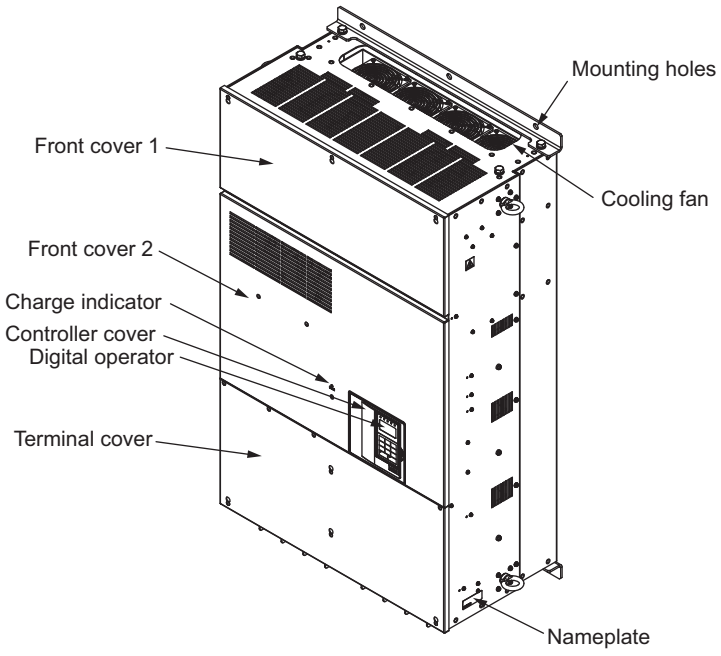


Fig 1.5 MxC Exterior (Model: CIMR-ACA4160)

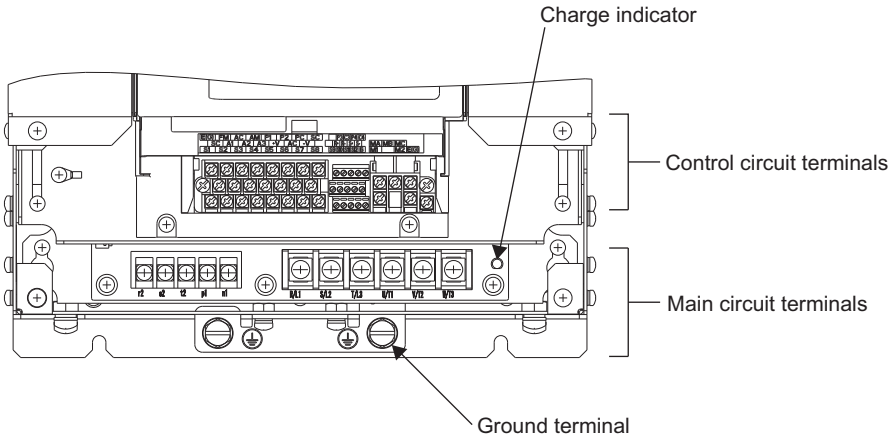


Fig 1.6 Terminal Arrangement (Model: CIMR-ACA4011)

Exterior and Mounting Dimensions

Figure 1.7 and *Figure 1.8* shows the exterior of the open-chassis type (IP00).

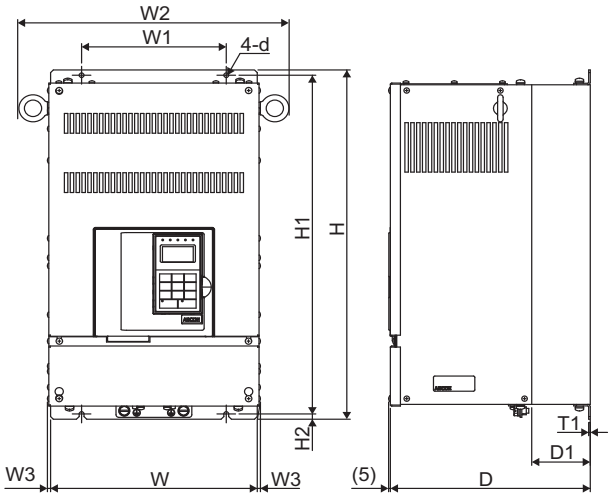


Fig 1.7 Exterior of Open Chassis MxCs (Type 1)

Table 1.3 Dimensions (mm) and Approx Weight (kg) of MxC (Type 1)

Voltage Class	Max Applicable Motor Output (kW)	Dimensions (mm)											Approx. Weight (kg)	Cool-ing Method
		W	H	D	W1	W2	W3	H1	H2	D1	T1	d		
200 V (3-phase)	5.5	300	530	290	210	392	5	514	8	85	2.3	M6	28	Fan
	11	300	530	290	210	392	5	514	8	85	2.3	M6	30	
	22	360	560	300	260	452	5	545	7.5	130	2.3	M6	45	
	45	480	865	403	310	592	6	841	12	170	4.5	M10	130	
400 V (3-phase)	5.5	300	530	290	210	392	5	514	8	85	2.3	M6	32	
	11	300	530	290	210	392	5	514	8	85	2.3	M6	33	
	22	360	560	300	260	452	5	545	7.5	130	2.3	M6	45	
	45	480	865	403	310	592	6	841	12	170	4.5	M10	125	
	75	480	865	403	310	592	6	841	12	170	4.5	M10	145	

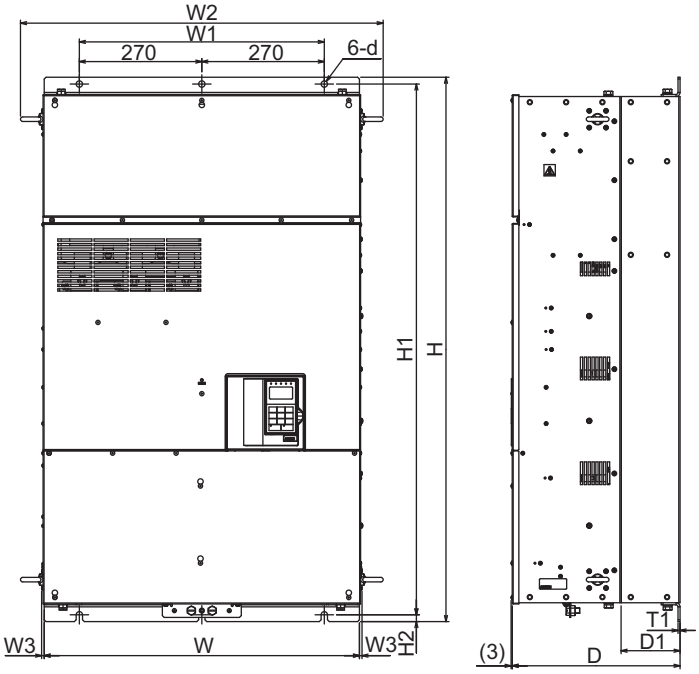


Fig 1.8 Exterior of Open Chassis MxCs (Type 2)

Table 1.4 Dimensions (mm) and Approx Weight (kg) of MxC (Type 2)

Voltage Class	Max Applicable Motor Output (kW)	Dimensions (mm)											Approx. Weight (kg)	Cool-ing Method
		W	H	D	W1	W2	W3	H1	H2	D1	T1	d		
400 V (3-phase)	110	695	1200	370	540	806	6	1170	15	130	4.5	M12	230	Fan
	160	695	1200	370	540	806	6	1170	15	130	4.5	M12	230	

Figure 1.9 shows the exterior of a wall-mounted enclosed MxC [IP20, NEMA1 (Type 1)].

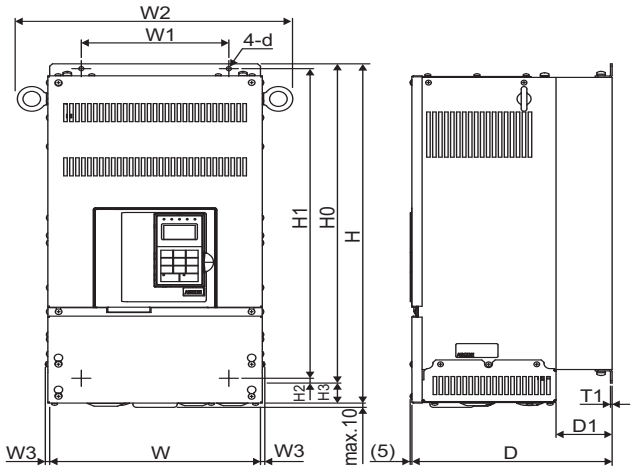


Fig 1.9 Exterior of enclosed, wall-mounted MxCs

Table 1.5 External Dimensions (mm) and Approx Weight (kg) of MxCs

Voltage Class	Max Applicable Motor Output (kW)	External Dimensions (mm)													Approx. Weight (kg)	Cooling Method
		W	H	D	W1	W2	W3	H0	H1	H2	H3	D1	T1	d		
200 V (3-phase)	5.5	300	564	290	210	392	7	530	514	8	34	85	2.3	M6	30	Fan
	11	300	564	290	210	392	7	530	514	8	34	85	2.3	M6	32	
	22	360	725	300	260	452	7	560	545	7.5	165	130	2.3	M6	48	
	45	480	1272	403	310	592	8.5	872	841	12	400	170	4.5	M10	140	
400 V (3-phase)	5.5	300	564	290	210	392	7	530	514	8	34	85	2.3	M6	34	
	11	300	564	290	210	392	7	530	514	8	34	85	2.3	M6	35	
	22	360	725	300	260	452	7	560	545	7.5	165	130	2.3	M6	48	
	45	480	1272	403	310	592	8.5	872	841	12	400	170	4.5	M10	135	
	75	480	1272	403	310	592	8.5	872	841	12	400	170	4.5	M10	155	

Checking and Controlling the Installation Site

The MxC must be installed and used in an area that complies with the conditions listed below. Maintain the conditions of the area for proper performance life.

◆ Installation Site

Install the MxC under the following conditions, making sure that the area complies with Pollution Level 2 or less (as defined by UL standards).

Table 1.6 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)

The MxC should be installed:

- in a clean location free from oil mist and dust.
- in an environment where metal shavings, oil, water, or other foreign materials do not get into the MxC.
- in a location free from radioactive materials and combustible materials (e.g. wood).
- in a location free from harmful gases and liquids.
- in a location free from excessive oscillation.
- in a location free from chlorides.
- in a location away from direct sunlight.

◆ Controlling the Ambient Temperature

To get optimum performance and full product life, the MxC should be installed in an environment free of extreme temperature changes. If the MxC is installed in an enclosed environment such as a box or enclosure panel, use a cooling fan or air conditioner to keep the internal air temperature below 45°C.

◆ Protecting the MxC from Foreign Matter

Place a cover over the MxC during installation to shield it from exposure to metal particles when drilling.

Always remove the cover from the MxC after completing installation. Failing to do so will reduce ventilation and possibly cause the MxC to overheat.

Installation Orientation and Clearance

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

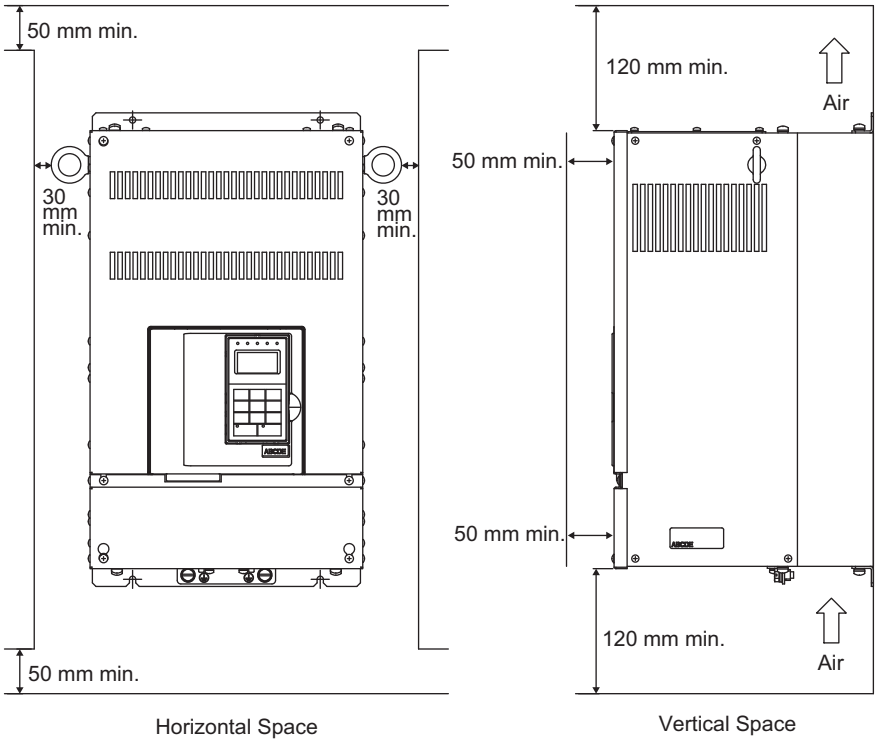


Fig 1.10 MxC Installation Orientation and Clearance

IMPORTANT

1. The same space is required horizontally and vertically for both Open Chassis (IP00) and Enclosed Wall-mounted [IP20, NEMA 1 (Type 1)] designs.
2. Always provide enough space for suspension eye bolts and the main circuit lines when installing a MxC 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

Loosen the screws on the left and right 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.

Note: For 45 kW and 75 kW MxCs, an additional screw is located in position A as indicated below.

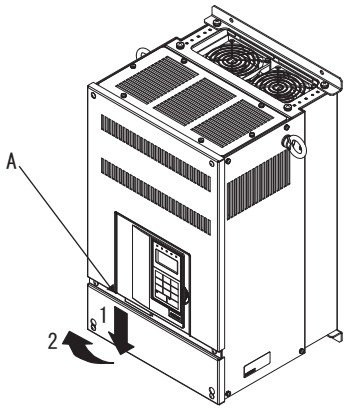


Fig 1.11 Removing the Terminal Cover (Model: CIMR-ACA4011)

■For 400-V Class MxCs with a Motor Capacity of 110 kW or 160 kW

1. Loosen the mounting screws of the terminal cover and slide the terminal cover downward.

Note: Eight mounting screws are used to install 400 V-class MxCs with a motor capacity of 110 kW or 160 kW.
Do not remove the mounting screws.
If the four mounting screws A are removed, the terminal cover might fall out when the other four mounting screws B are loosened, possibly resulting in injury.
The terminal cover of a large-capacity MxC is big and heavy. Be careful when removing or reattaching the cover.

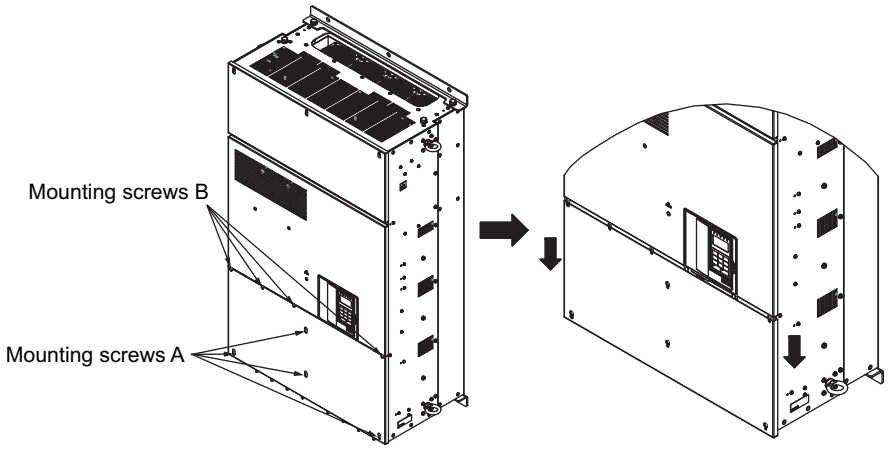


Fig 1.12 Removing the Terminal Cover (Example of CIMR-ACA4160)

2. Pull the terminal cover to remove it.

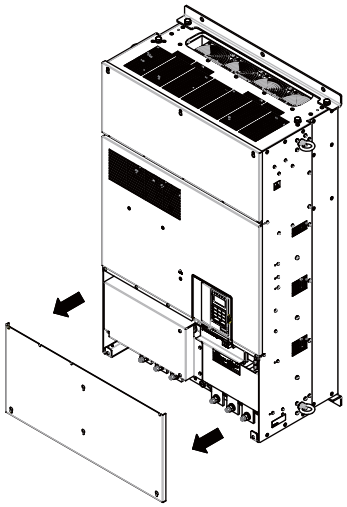


Fig 1.13 Removing the Terminal Cover (Example of CIMR-ACA4160)

◆ Attaching the Terminal Cover

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

Removing/Attaching the Digital Operator and Front Cover

This section demonstrates how the digital operator and front cover are removed.

Remove the terminal cover and then use the following procedures to remove the digital operator and front cover.

■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.

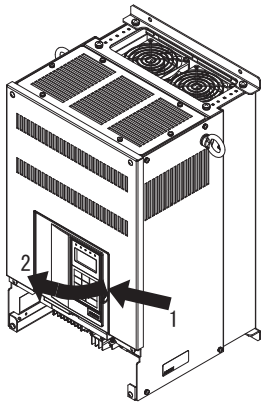


Fig 1.14 Removing the Digital Operator (Model: CIMR-ACA4011)

■Removing the Front Cover

Pull the bottom of the front cover in the direction as shown by arrow 2 while pushing both sides of the cover in the direction shown by arrow 1.

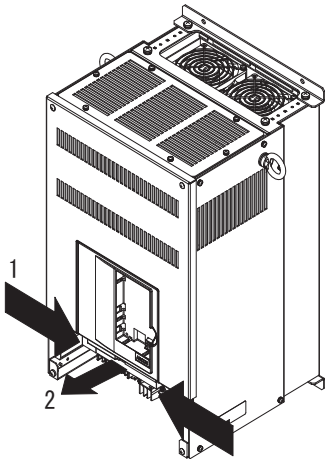


Fig 1.15 Removing the Front Cover (Model: CIMR-ACA4011)

■ Attaching the Front Cover

After completing required work (i.e., installing an option card, setting the control circuit terminal board, etc.), attach the front cover by reversing the procedure to remove it.

1. Make sure 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 still connected.
2. Insert the tab on the top of the front cover into the slot on the MxC and press in on the cover until it clicks into place on the MxC.

■Attaching the Digital Operator

After attaching the front cover, plug the digital operator key pad into the front of the unit as follows:

1. Hook the digital operator at point A (two locations) on the front cover in the direction of arrow 1 as shown in the illustration below.
2. Press the digital operator in the direction of arrow 2 until it snaps in place at B (two locations).

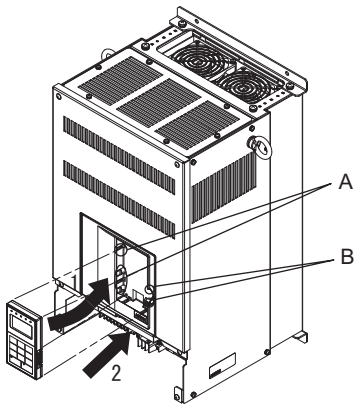


Fig 1.16 Mounting the Digital Operator (Model: CIMR-ACA4011)

2 Wiring

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

Connecting Peripheral Devices 2-2
Connection Diagram 2-3
Terminal Block Configuration 2-5
Wiring Main Circuit Terminals 2-7
Wiring Control Circuit Terminals 2-17
Wiring Check 2-25
Installing and Wiring Option Cards 2-26

Connecting Peripheral Devices

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

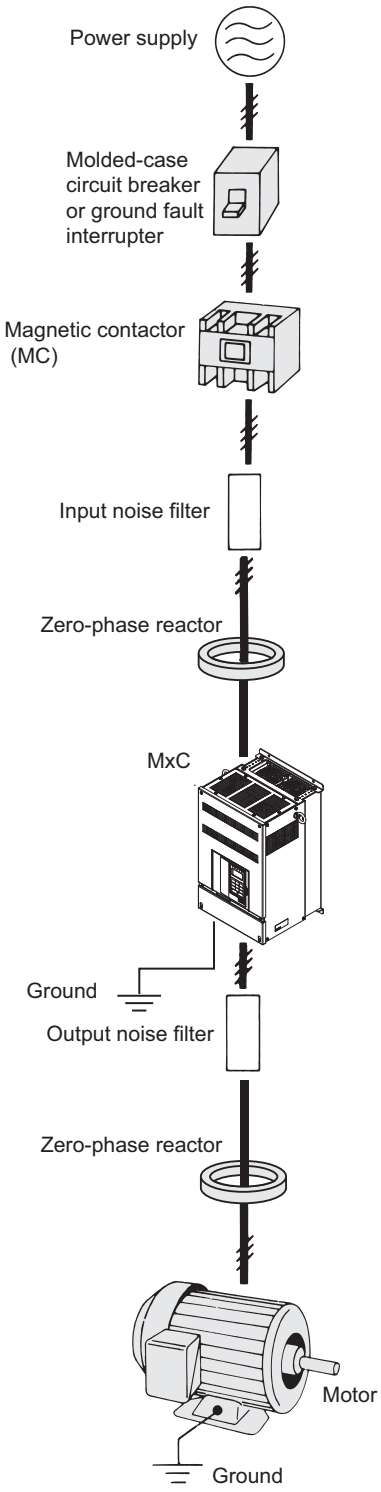
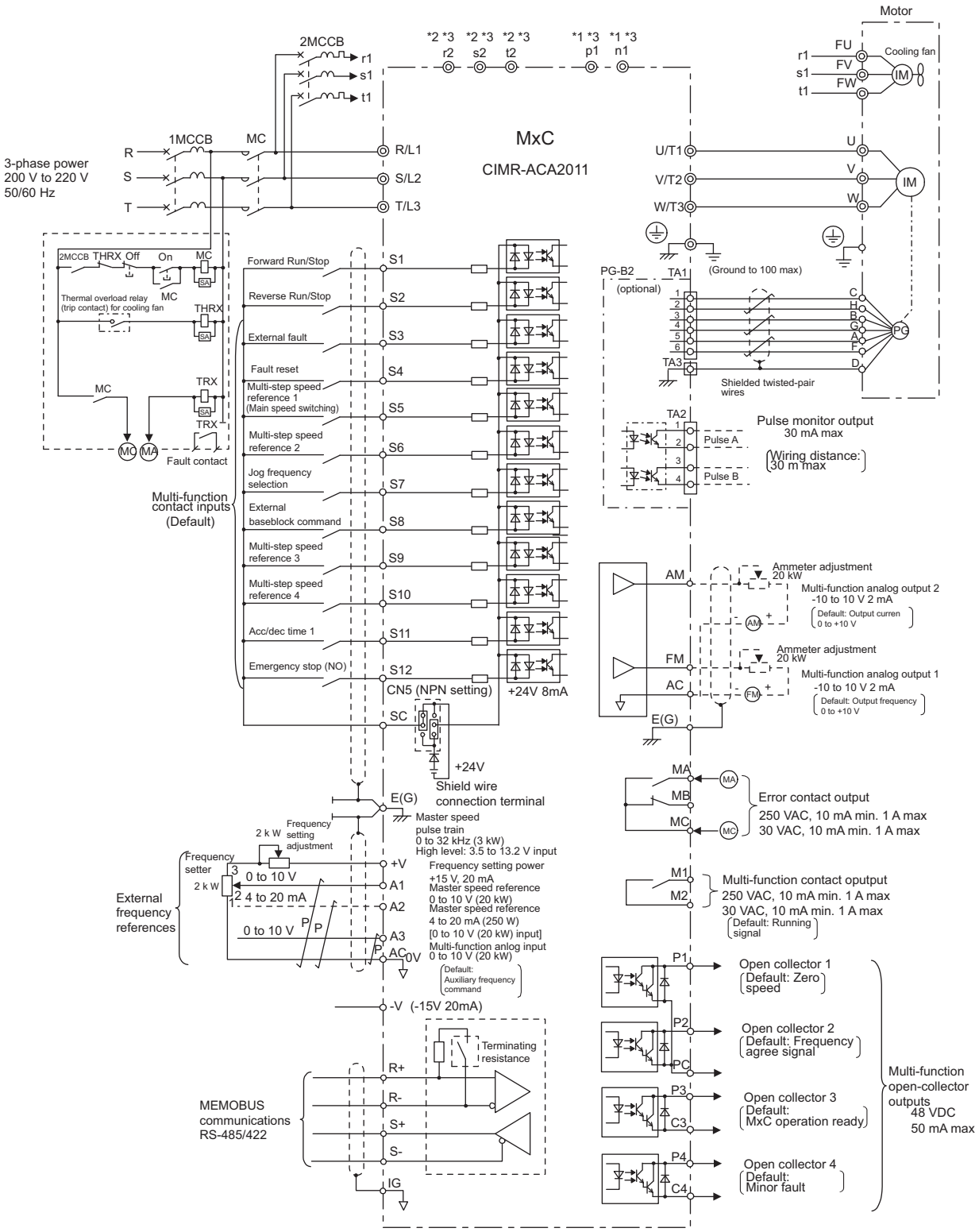


Fig 2.1 Example Connections to Peripheral Devices

Connection Diagram

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

When using the digital operator, the motor can be operated by wiring only the main circuits.



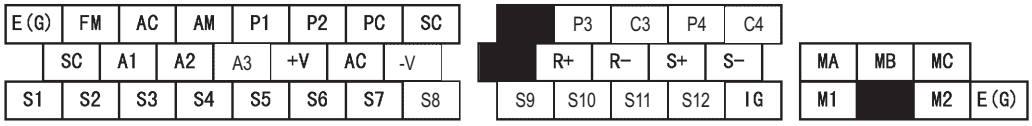
IMPORTANT

* 1. Connect to the momentary power loss compensation unit. Do not connect power lines to these terminals.
* 2. Normally not used. Do not connect power lines to these terminals.
* 3. The MxC models CIMR-ACA4110 and 4160 do not have terminals r2, s2, t2, p1 and n1.

Fig 2.2 Connection Diagram (Model: CIMR-ACA2011)

IMPORTANT

1. Control circuit terminals are arranged as shown below.



2. The output current capacity of the +V terminal is 20 mA. Do not create a short between the +V, -V, and AC control-circuit terminals. This may cause the MxC to fault out or malfunction.
3. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.
4. The wiring for a motor with a cooling fan is not required for self-cooling motors.
5. PG circuit wiring (i.e., wiring to the PG-B2 Card) is not required for control without a PG.
6. Sequence input signals S1 to S12 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 2.10*.
7. The master speed frequency reference can be input from a voltage signal (terminal A1) or current signal (terminal A2) by changing the setting of parameter H3-13. The default setting is for a voltage reference input.
8. 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.
9. The minimum 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.
10. Do not ground the AC terminal of the control circuit. This may cause the MxC to fault out or malfunction.

Terminal Block Configuration

The following figures show the terminal arrangements for MxC. Refer to Fig. 2.3 for 5.5 kW and 11 kW MxCs, Fig.2.4 for a 22 kW MxC, Fig.2.6 for 110 kW and 160 kW, and Fig.2.5 for 45 kW and 75 kW MxCs.

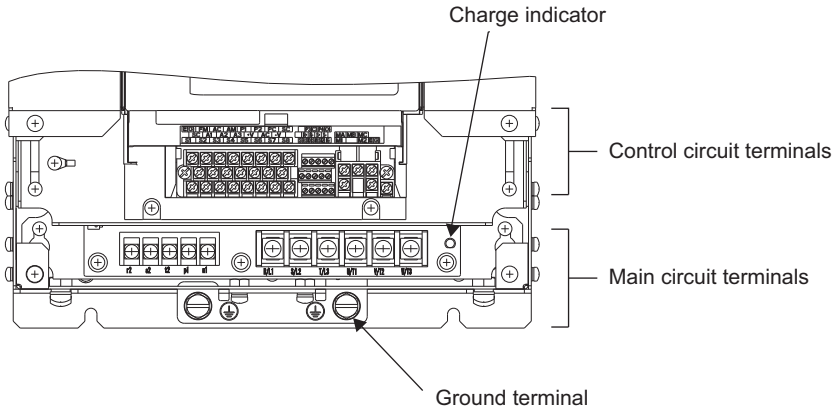


Fig 2.3 Terminal Arrangement (Model: CIMR-ACA4011)

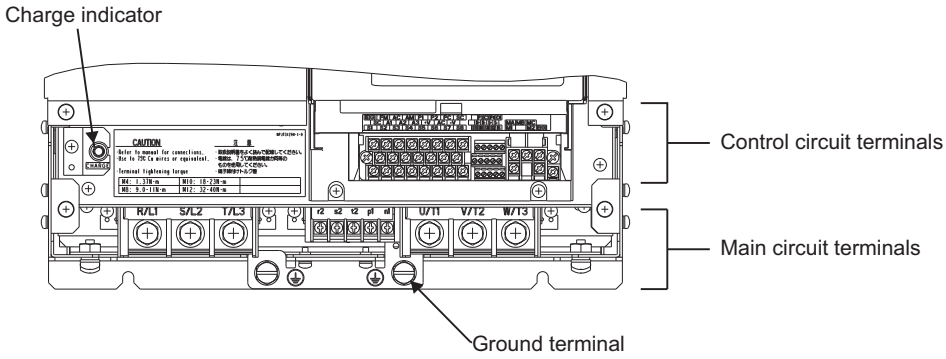


Fig 2.4 Terminal Arrangement (Model: CIMR-ACA4022)

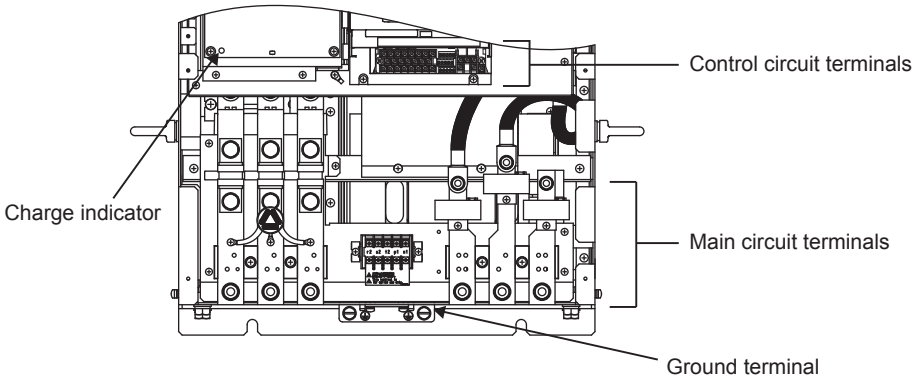


Fig 2.5 Terminal Arrangement (Model: CIMR-ACA2045)

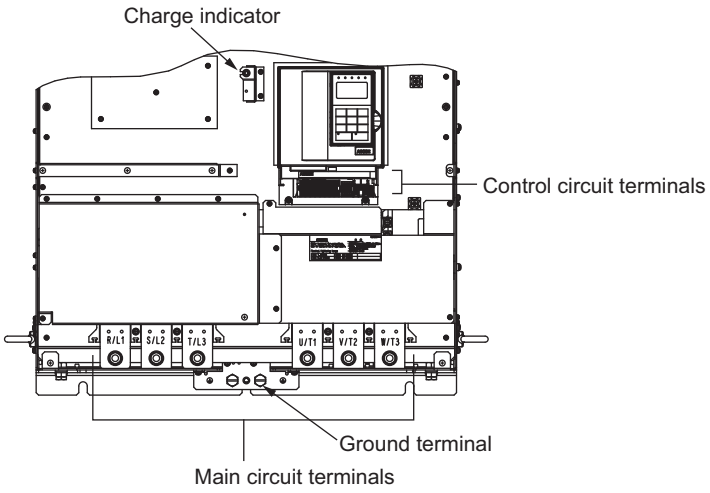


Fig 2.6 Terminal Arrangement (Model: CIMR-ACA4160)

Wiring Main Circuit Terminals

◆ Applicable Wire Gauges and Closed-Loop Connectors

Select the appropriate wires and crimp terminals listed in *Table 2.1* through *Table 2.3*.

Table 2.1 200 V Class Wire Gauges

MxC Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Gauges mm^2(AWG)	Recommended Wire Gauge mm^2 (AWG)	Wire Type
ACA25P5	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M5	2 to 2.4 Nm	8 to 14 (8 to 6)	8 (8)	Power cables, e.g., 600 V vinyl power cables
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	8 to 22 (8 to 4)	8 (8)	
ACA2011	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M5	2 to 2.4 Nm	14 (6)	14 (6)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	14 to 22 (6 to 4)	14 (6)	
ACA2022	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M8	9 to 10 Nm	38 to 60 (1 to 1/0)	38 (1)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	22 to 38 (4 to 2)	22 (4)	
ACA2045	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M10	18 to 23 Nm	100 (4/0)	100 (4/0)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	5 to 60 (1 to 1/0)	50 (1)	

* 1. Connect the momentary power loss compensation unit. Do not connect the power to these terminals.

* 2. Normally not used. Do not connect the power to these terminals.

Note: The wire gauge recommendations for the following conditions: continuous operation at rated current, vinyl-sheathed wire (max: 75°C), and ambient temperature within 30°C.

Table 2.2 400 V Class Wire Gauges

MxC Model CIMR-□	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Gauges mm^2 (AWG)	Recommended Wire Gauge mm^2 (AWG)	Wire Type
ACA45P5	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M5	2 to 2.4 Nm	3.5 to 14 (12 to 6)	3.5 (12)	power cables, e.g., 600 V vinyl power cables
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	3.5 to 22 (12 to 4)	3.5 (12)	
ACA4011	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M5	2 to 2.4 Nm	8 to 14 (8 to 6)	8 (8)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	8 to 22 (8 to 4)	8 (8)	
ACA4022	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M8	9 to 10 Nm	14 to 60 (6 to 1/0)	14 (6)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	14 to 38 (6 to 2)	14 (6)	
ACA4045	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M8	9 to 10 Nm	38 to 60 (1 to 1/0)	38 (2)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	22 to 60 (4 to 1/0)	22 (4)	
ACA4075	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M10	18 to 23 Nm	100 (4/0)	100 (4/0)	
	r2*2, s2*2, t2*2, p1*1, n1*1	M4	1.3 to 1.4 Nm	2 to 3.5 (14 to 12)	2 (14)	
	⏚	M8	9 to 10 Nm	50 to 60 (1 to 1/0)	50 (1)	
ACA4110	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M12	32 to 40 Nm	80 to 325 (3/0 to 600)	200 (400)	
	⏚			30 to 200 (2 to 400)	100 (4/0)	
ACA4160	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3	M12	32 to 40 Nm	80 to 325 (3/0 to 600)	200 (400)	
	⏚			30 to 200 (2 to 400)	100 (4/0)	

* 1. Connect the Momentary Power Loss compensation unit. Do not connect power to these terminals.

* 2. Normally not used. Do not connect power to these terminals.

Note: The wire gauge recommendations for the following conditions: continuous operation at rated current, vinyl-sheathed wire (max: 75°C), and ambient temperature within 30°C.

Table 2.3 Closed-Loop Connector Sizes (JIS C2805) (200 V class and 400 V class)

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

IMPORTANT

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

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

◆ Main Circuit Terminal Functions

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

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

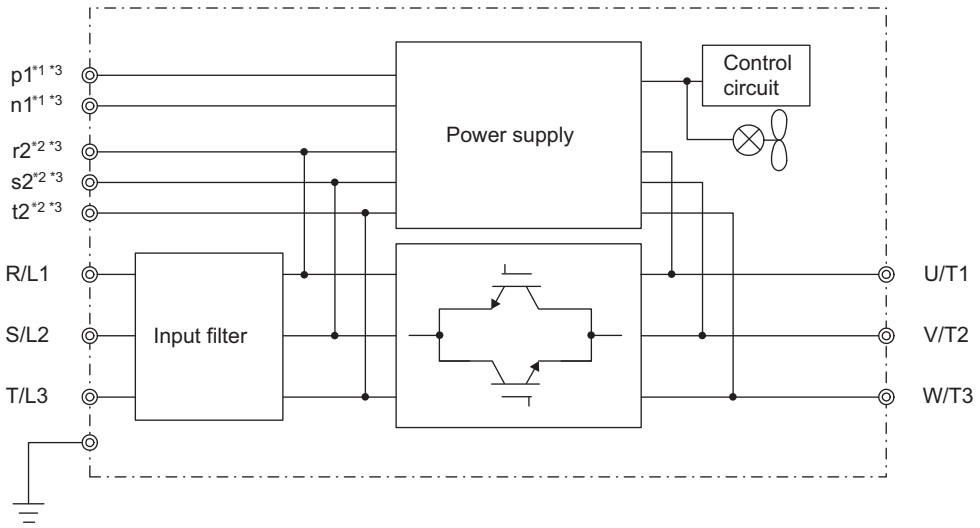
Purpose	Terminal symbols
Main circuit power input	R/L1, S/L2, T/L3
MxC output	U/T1, V/T2, W/T3
Ground	⏚
Connection to optional devices	r2*2 *3, s2*2 *3, t2*2 *3, p1*1 *3, n1*1 *3

* 1. Connect the momentary power loss compensation unit. Do not connect power to these terminals.
* 2. Normally not used. Do not connect power to these terminals.
* 3. The MxC models CIMR-ACA4110 and 4160 do not have terminals r2, s2, t2, p1 and n1.

◆ Main Circuit Configurations

The main circuit configurations of the MxC are shown in *Fig 2.7*.

■CIMR-ACA25P5 to 2045, 45P5 to 4160



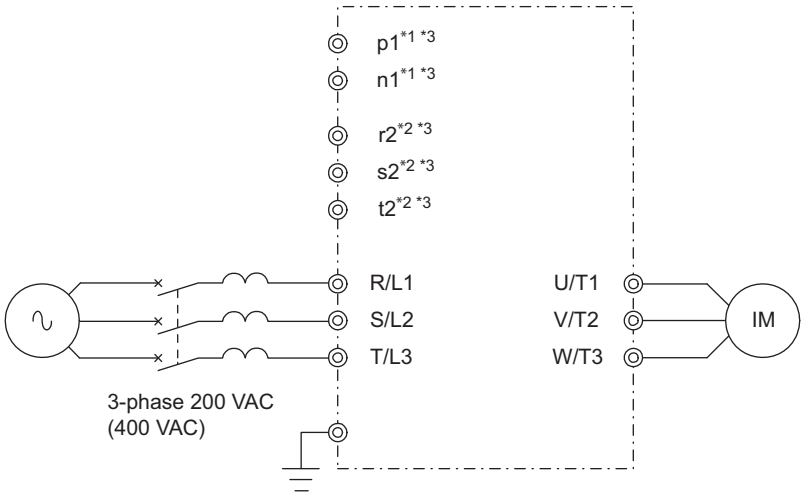
* 1. Connect the momentary power loss compensation unit. Do not connect power to these terminals.
* 2. Normally not used. Do not connect power to these terminals.
* 3. The MxC models CIMR-ACA4110 and 4160 do not have terminals r2, s2, t2, p1 and n1.
Note: Control power is supplied internally from the main circuit power supply for all MxC models.

Fig 2.7 MxC Main Circuit Configurations

◆ Standard Connection Diagrams

Standard MxC connection diagrams are shown in *Fig 2.8.* These are the same for both 200 V class and 400 V class MxCs. The connections depend on the MxC capacity.

■CIMR-ACA25P5 to 2045, 45P5 to 4160



* 1. Connect the Momentary Power Loss Compensation unit. Do not connect power to these terminals.
* 2. Normally not used. Do not connect power to these terminals.
* 3. The MxC models CIMR-ACA4110 and 4160 do not have terminals r2, s2, t2, p1 and n1.
Note: Control power is supplied internally from the main circuit power supply for all MxC models.

Fig 2.8 Main Circuit Terminal Connections

◆ Input and Output Wiring in the Main Circuit

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

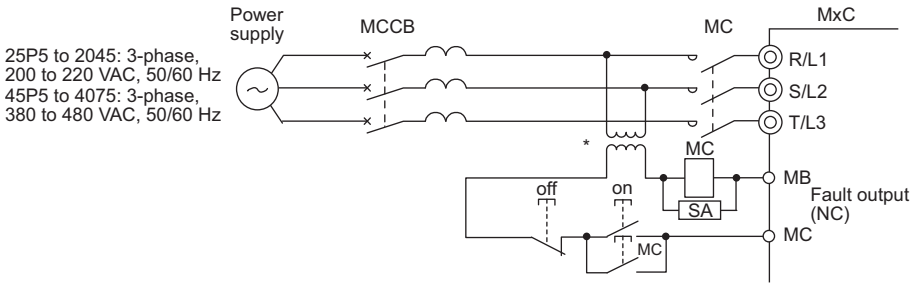
■Wiring Main Circuit Inputs

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

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 MxC.

- Choose an MCCB with a capacity of 1.5 to 2 times larger than the rated current of the MxC.
- The MCCB operation time should reflect the overload protection time of the MxC.
- If the same MCCB is to be used for more than one MxC or in other devices, set up a sequence so that the power supply will be turned off by a fault output, as shown in *Fig 2.9*.



* For 400 V class MxCs, connect a 400/200 V transformer.

Fig 2.9 MCCB Installation

Installing a Ground Fault Interrupter

MxC outputs use high-speed switching, causing high-frequency leakage current to be generated. A ground fault interrupter with countermeasures for high-frequency distortion is therefore needed on the primary side of the MxC in order to detect any hazardous leakage current within the frequency, and to exclude that high-frequency leakage current.

- When deciding to use a ground fault interrupter with countermeasures for high-frequency distortion choose one with a sensitivity amperage of at least 30 mA per MxC.
- A general ground fault interrupter without countermeasures for high-frequency distortion is not recommended. If a general ground fault interrupter malfunctions, replace it with a ground fault interrupter with a sensitivity amperage of 200 mA or more per MxC and with an operating time of 0.1 s or more.

Installing a Magnetic Contactor

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

When a magnetic contactor is installed on the primary side of the main circuit to forcibly stop the MxC, regenerative braking does not work and the MxC will simply coast freely until it stops.

- The MxC 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 MxC to malfunction. The MxC should not be started and stopped more than once every 30 minutes.
- The unit cannot be restarted automatically following an interruption in the power supply when using the digital operator to control the MxC.

Connecting Input Power Supply to the Terminal Block

An input power supply can be connected to terminals R, S, or T on the terminal block. The phase sequence of the input power supply is irrelevant to the phase sequence created by the MxC.

Installing a Surge Absorber

Always use a surge absorber or diode for inductive loads near the MxC. Examples of 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 MxC.

- Correct Noise Filter Installation

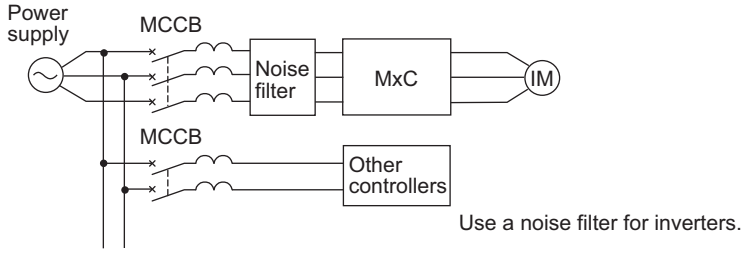


Fig 2.10 Correct Installation of a Power Supply Noise Filter

- Incorrect Noise Filter Installation

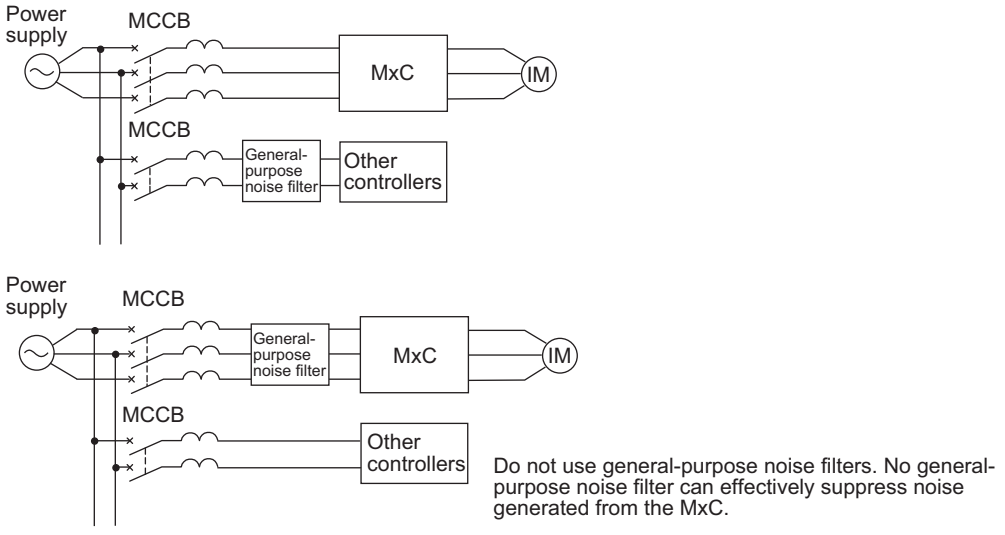


Fig 2.11 Incorrect Installation of a Power Supply Noise Filter

■Wiring the Output Side of the Main Circuit

Observe the following precautions when wiring the main output circuits.

Connecting the MxC and Motor

Connect output terminals U, V, and W to motor lead wires U, V, and W, respectively.

Make sure the motor rotates forward when the Forward Run Command is given. 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. Applying voltage to the output terminals will damage circuitry in the MxC.

Never Short or Ground Output Terminals

If you touch the output wires with your bare hands, or if the output wires come into contact with the MxC 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 general (LC/RC) noise filter to an output circuit. The high-frequency components of the MxC output may result in overheating or damage to these parts, or may result in damage to the MxC or cause other parts to burn.

Do Not Use an Electromagnetic Switch

Never connect an electromagnetic switch (MC) between the MxC and motor and then cycle power while the MxC is running. If the MC is turned on while the MxC is operating, a large current inrush will trigger overcurrent or overvoltage protection.

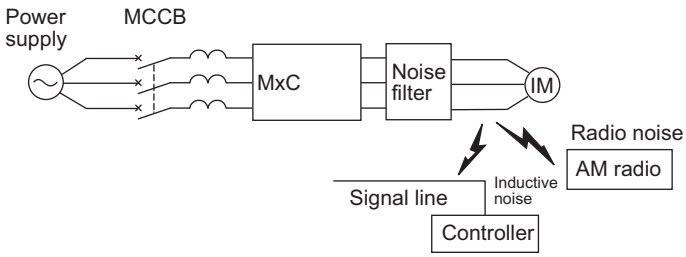
When using an MC to switch over to a commercial power supply, stop the MxC and motor before operating the MC. Use the speed search function if the MC is either open or closed while running. If action must be taken to handle any momentary interruption in power, use a delayed release MC.

Installing a Thermal Overload Relay

This MxC has an electronic thermal protection function to protect the motor from overheating. If a multi-pole motor is used, always install a thermal relay (THR) between the MxC and the motor, then set L1-01 to 0 (no motor protection). The sequence should be designed so that the thermal overload relay contacts turn off the magnetic contactor on the main circuit inputs.

Installing a Noise Filter on Output Side

Connect a noise filter to the output side of the MxC to reduce radio noise and inductive noise. Refer to *Chapter 9 Specifications* for details.



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

Fig 2.12 Installing a Noise Filter on the Output Side

Preventing 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.

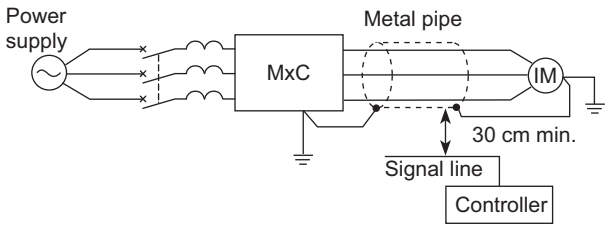


Fig 2.13 Countermeasures Against Inductive Noise

Counteracting RMS

Radio noise is generated from the MxC 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 MxC in a totally enclosed steel box.

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

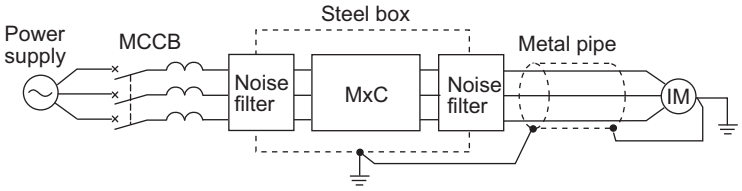


Fig 2.14 Countermeasures Against Radio Interference

Cable Length between the MxC and Motor

If the cable between the MxC and the motor is comparatively long, the high-frequency leakage current will increase, causing the MxC output current to increase as well. This may affect peripheral devices. To prevent this, adjust the carrier frequency (set in C6-01, C6-02) as shown in *Table 2.5* (for details, refer to *Chapter 5 Parameters and Settings*).

Table 2.5 Cable Length between MxC 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

■Ground Wiring

Observe the following precautions when grounding the MxC.

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

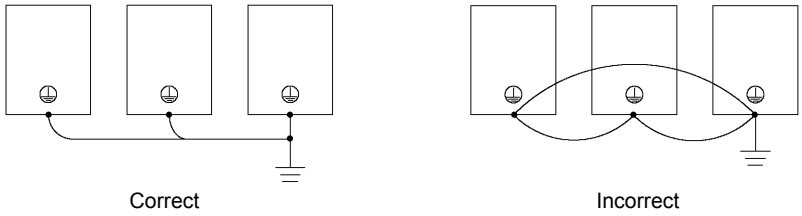


Fig 2.15 Ground Wiring

■Protection between Main Circuit Terminals

Insulation Cap

When using crimp terminals, use them with insulation caps.

Insulation Barriers

Insulation barriers are supplied with 400-V class MxCs with a motor capacity of 110kW or 160kW to reinforce insulation between terminal phases. Yaskawa recommends that insulation barriers be installed in MxCs for better reliability.

Refer to *Fig 2.16* for the procedure for installing the insulation barriers.

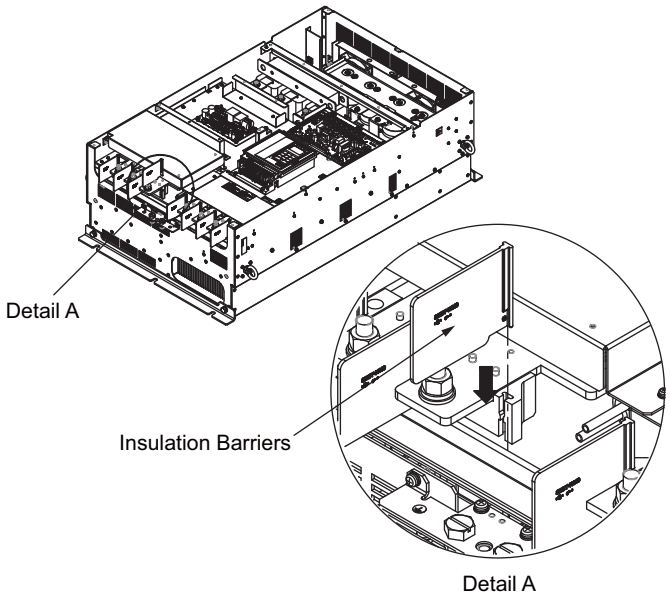


Fig 2.16 Protection between Main Circuit Terminals

Wiring Control Circuit Terminals

◆ Wire Gauges and Closed-Loop Connectors

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

When setting frequencies from an external device (i.e., not from the digital operator), use shielded twisted-pair wires and ground the shield to terminal E (G), as shown in the following diagram.

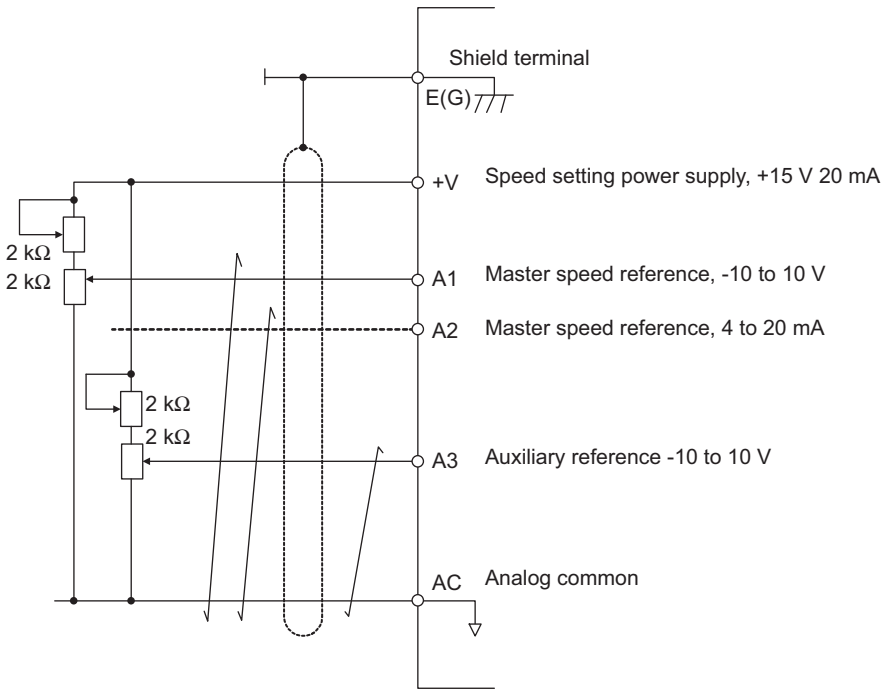


Fig 2.17

Terminal numbers and wire gauges are shown in *Table 2.6*.

Table 2.6 Terminal Numbers and Wire Gauges (Same for all Models)

Terminals	Terminal Screws	Tightening Torque (N•m)	Possible Wire Gauges mm^2(AWG)	Recommended Wire Gauge 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)	• Shielded, twisted-pair wire*1 • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electrical Wire or equivalent)
P3, C3, P4, C4, R+, R-, S9, S10, S11, S12, S+, S-, IG	Phoenix type	0.22 to 0.25	Single wire*3: 0.25 to 1.5 (24 to 16) Stranded wire: 0.25 to 1.0 (24 to 17)	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 frequency reference.

* 2. Refer to *Table 2.3 Closed-Loop Connector Sizes (JIS C2805) (200 V class and 400 V class)* for suitable closed-loop crimp terminal sizes for the wires.

* 3. Yaskawa recommends using a straight solderless terminal on signal lines to simplify wiring and improve reliability.

■ Straight Solderless Terminals for Signal Lines

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

Table 2.7 Straight Solderless Terminal Sizes

Wire Gauge mm^2 (AWG)	Model	d1	d2	L	Manufacturer
0.25 (24)	AI 0.25 - 8YE	0.8	2	12.5	Phoenix Contact K.K.
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	

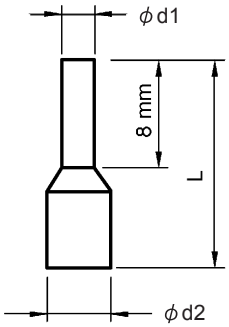


Fig 2.18 Straight Solderless Terminal Sizes

■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. Firmly tighten all terminal screws.

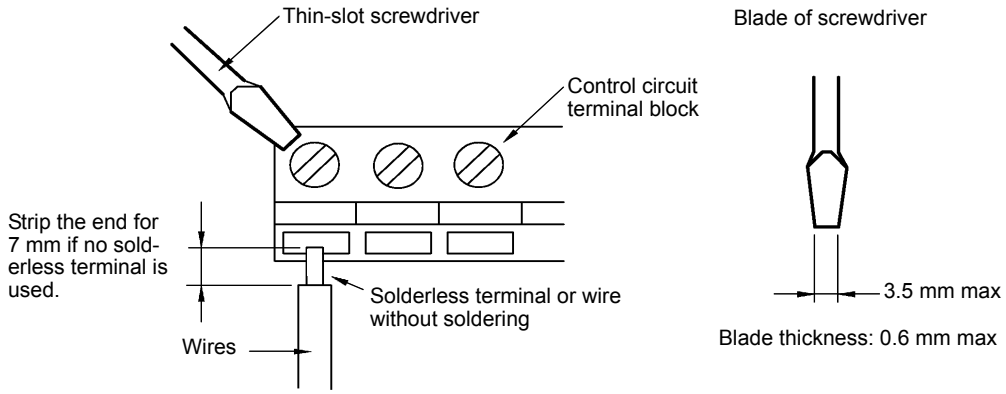


Fig 2.19 Connecting Wires to the Terminal Block

◆ Control Circuit Terminal Functions

The functions available by using the control circuit terminals are shown in *Table 2.8*. Use the appropriate terminals for the correct purposes.

Table 2.8 Control Circuit Terminals

Type	No.	Signal Name	Function	Signal Level
Sequence input signals	S1	Forward Run/Stop Command	Forward run when on, stopped when off.	24 VDC, 8 mA Photocoupler isolation
	S2	Reverse Run/Stop Command	Reverse run when on, stopped when off.	
	S3	Multi-Function Input 1*1	Default: External Fault when on.	
	S4	Multi-Function Input 2*1	Default: Fault Reset when on.	
	S5	Multi-Function Input 3*1	Default: Multi-Speed Reference 1 enabled when on.	
	S6	Multi-Function Input 4*1	Default: Multi-Speed Reference 2 enabled when on.	
	S7	Multi-Function Input 5*1	Default: Jog Frequency selected when on.	
	S8	Multi-Function Input 6*1	Default: External Baseblock when on.	
	S9	Multi-Function Input 7*1	Default: Multi-Speed Reference 3 enabled when on.	
	S10	Multi-Function Input 8*1	Default: Multi-Speed Reference 4 enabled when on.	
	S11	Multi-Function Input 9*1	Default: Accel/Decel Time selected when on.	
	S12	Multi-Function Input 10*1	Default: Emergency Stop (N.O. contact) when on.	
	SC	Sequence input common	-	
Analog input signals	+V	+15 V power output	+15 V power supply for analog references	+15 V (Max current: 20 mA)
	-V	-15 V power output	-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% Default: 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% Default: Analog speed 2 (H3-05 = 2)	-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	-	-

Table 2.8 Control Circuit Terminals (Continued)

Type	No.	Signal Name	Function	Signal Level
Photo-coupler outputs	P1	Multi-Function PHC Output 1	Default: Zero-speed Zero-speed level (b2-01) or below when on.	50 mA max at 48 VDC*2
	P2	Multi-Function PHC Output 2	Default: Frequency agreement detection Frequency within 2 Hz of set frequency when on.	
	PC	Photocoupler output common for P1 and P2	-	
	P3	Multi-Function PHC Output 3	Default: Ready for operation when on.	
	C3			
	P4	Multi-Function PHC output 4	Default: FOUT frequency detected when on.	
	C4			
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*3
	MB	Fault Output Signal (NC contact)		
	MC	Relay contact output common	-	
	M1	Multi-function contact output (NO contact)	Default: Operating Operating when on across M1 and M2.	
	M2			
Analog monitor outputs	FM	Multi-Function Analog Monitor 1	Default: Output frequency 0 to 10 V/100% frequency	0 to +10 VDC ±5% 2 mA max
	AM	Multi-Function Analog Monitor 2	Default: Current monitor 5 V/MxC rated current	
	AC	Analog common	-	
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. Use the photocoupler outputs when the minimum permissible load is 5 VDC or less and 10 mA or less.

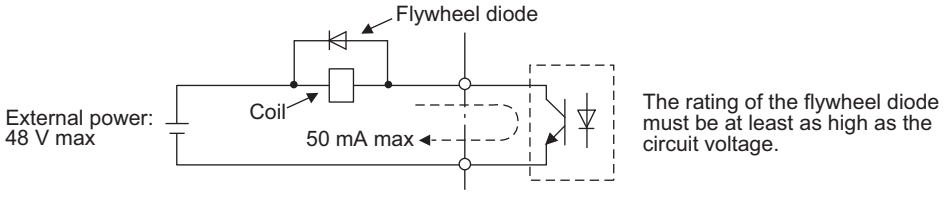


Fig 2.20 Flywheel Diode Connection

■Shunt Connector CN5 and DIP Switch S1

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

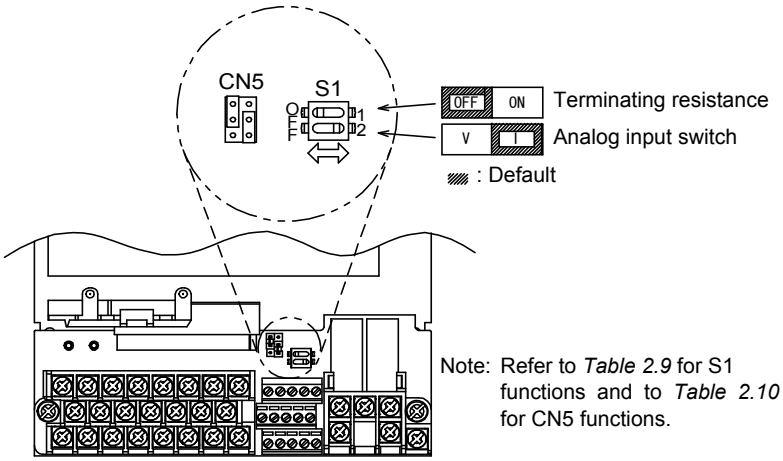


Fig 2.21 Shunt Connector CN5 and DIP Switch S1

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

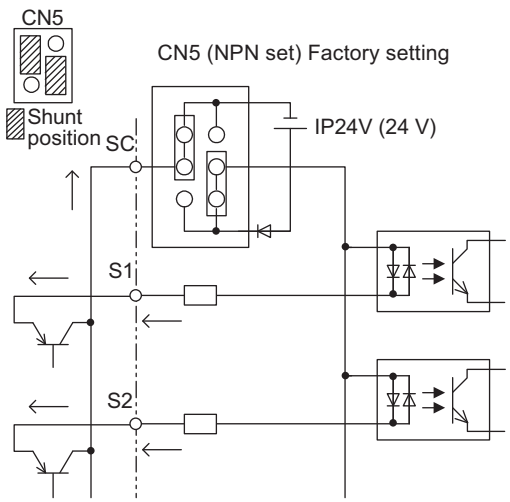
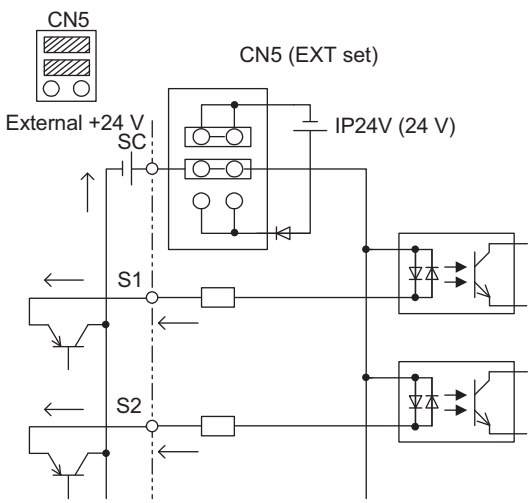
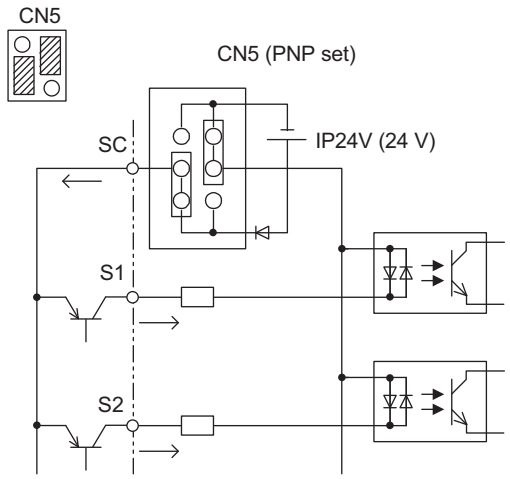
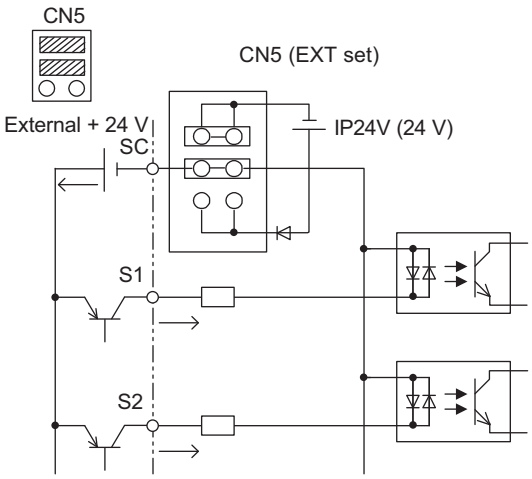
Table 2.9 DIP Switch S1

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

■ Sinking/Sourcing Mode

The input terminal logic can be switched between Sinking Mode (0 V common) and Sourcing Mode (+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 2.10 Sinking/Sourcing Mode and Input Signals

	Internal Power Supply	External Power Supply
Sinking Mode		
Sourcing Mode		

◆ Control Circuit Terminal Connections

Connections to MxC control circuit terminals are shown in *Fig 2.22*.

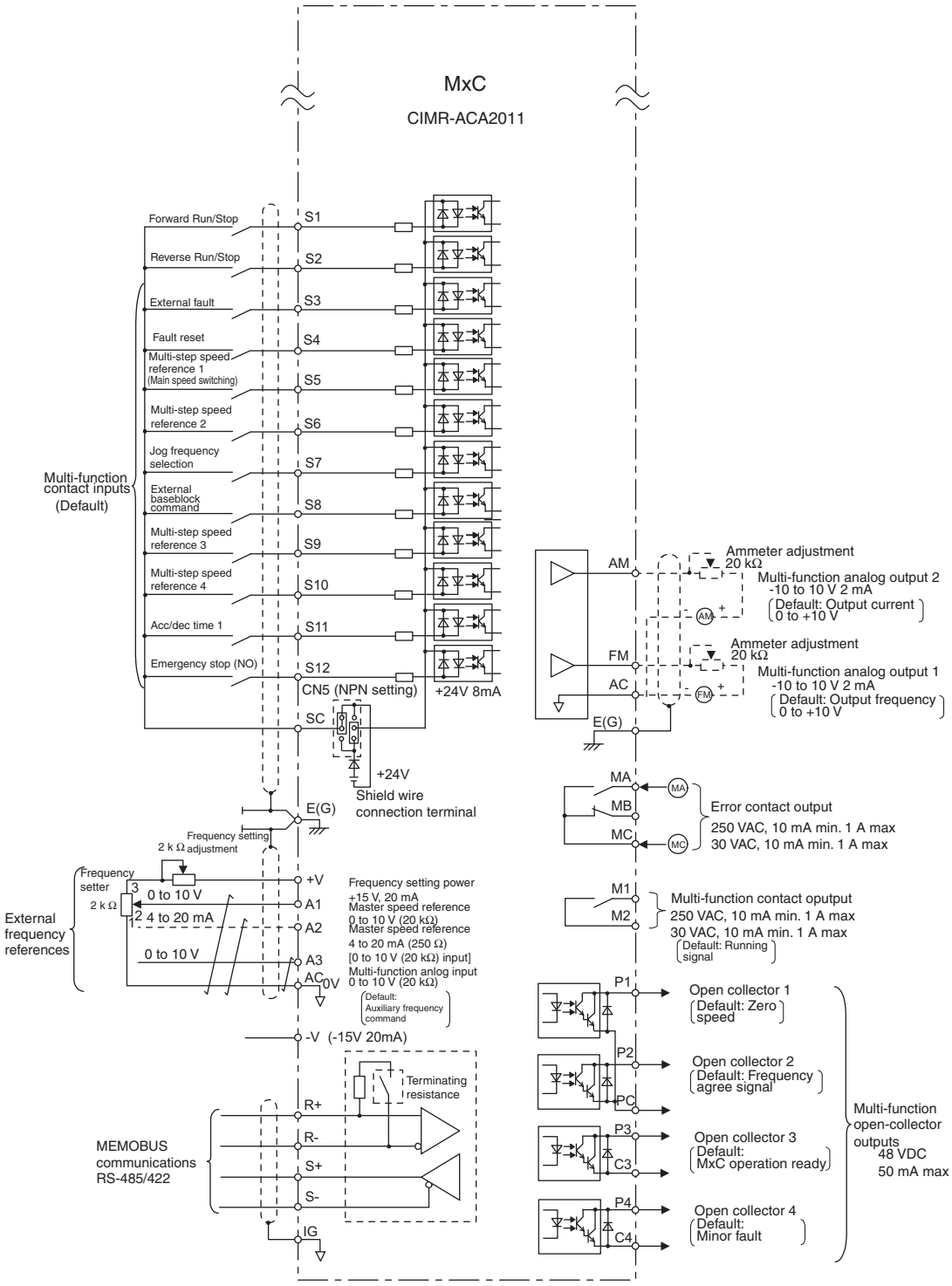


Fig 2.22 Control Circuit Terminal Connections

◆ 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, U/T1, V/T2, W/T3, r2, s2, t2, p1, and n1) 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.

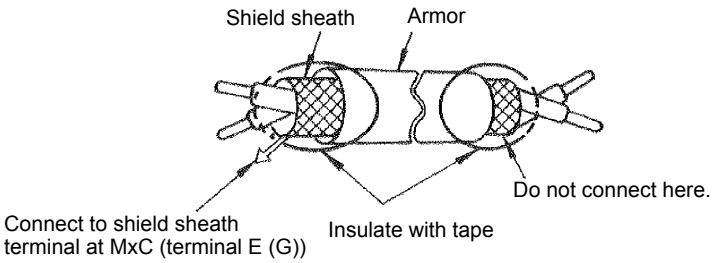


Fig 2.23 Processing the Ends of Shielded Twisted-Pair Cables

Wiring Check

◆ Checks

Check all connections after wiring has been completed. Do not perform a buzzer check on control circuits. Use the following checklist:

- Is all wiring correct?
- Make sure all wire clippings, screws, and other foreign material has been removed from the MxC.
- Have all screws been tightened properly?
- Do any wire ends come into contact with other terminals?

Installing and Wiring Option Cards

◆ Option Card Models and Specifications

Up to three option cards can be mounted in the MxC. An option card can be mounted into each of the three slots available on the control board (A, C, and D) shown in *Fig 2.24*.

Table 2.11 lists the type of option cards available and their specifications.

Table 2.11 Option Card Specifications

Card	Model	Specifications	Mounting Location
PG Speed Control Cards	PG-B2	Phase A/B complimentary inputs	A
	PG-X2	Phase A/B line-driver inputs	A
Speed Reference Cards	AI-14U	Input signal levels 0 to 10 V DC (20 kΩ), 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 kΩ) 4 to 20 mA (250 Ω), 3 channels Input resolution: 13-bit and signed bit	C
	DI-08	8-bit digital speed reference setting	C
	DI-16H2	16-bit digital speed reference setting	C
DeviceNet Interface Card	SI-N1*1	Supports DeviceNet communications.	C
CANopen Interface Card	SI-S1*2	Supports CANopen communications.	C
CC-Link Interface Card	SI-C*3	Supports CC-Link communications.	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

* 1. Applicable for the Varispeed AC with software versions PRG: 1051 or later.
* 2. Under development.
* 3. SI-C card with software versions PRG: 0103 or later is applicable for Varispeed AC.

◆ Installation

Before mounting an option card, remove the terminal cover and be sure that the charge LED inside the MxC has gone out. After confirming that the charge indicator is no longer lit, remove the digital operator and front cover, and then mount the option card.

Refer to documentation provided with the option card for 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 can not be installed completely and may not function properly if it is installed with the option clip attached.

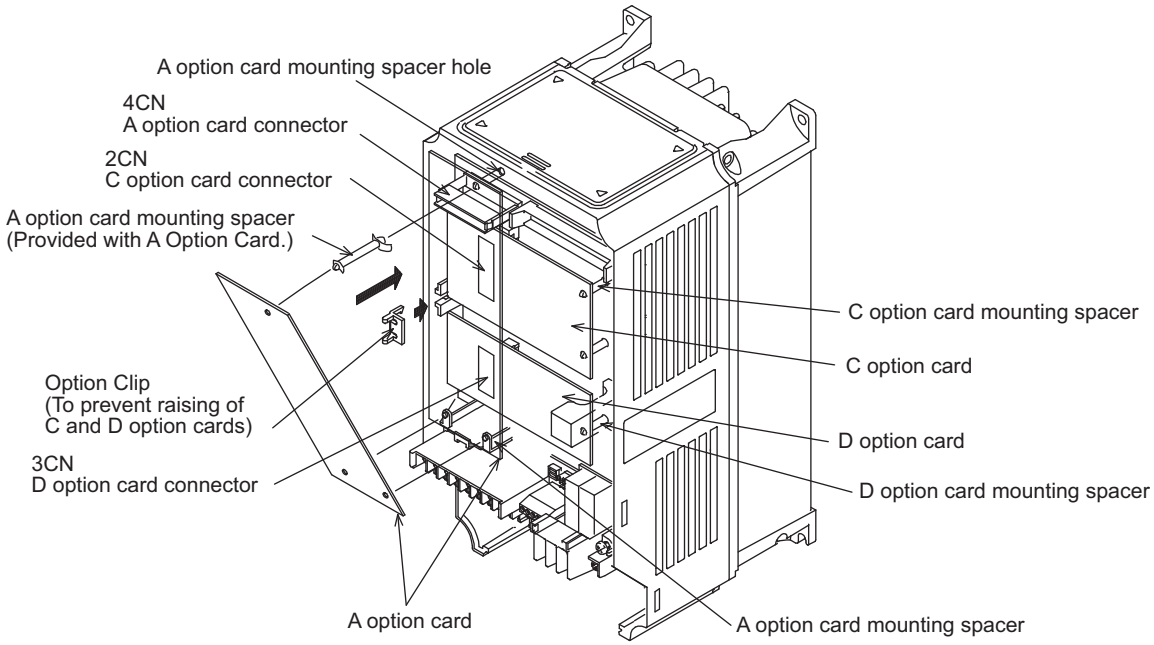


Fig 2.24 Mounting Option Cards

◆ PG Speed Control Card Terminals and Specifications

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

■PG-B2

The terminal specifications for the PG-B2 are given in the following table.

Table 2.12 PG-B2 Terminal Specifications

Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC (±5%), 200 mA max
	2		0 VDC (ground for power supply)
	3	A-phase pulse input terminal	H: +8 to 12 V L: +1 V max Maximum response frequency: 30 kHz
	4		Pulse input common
	5	B-phase pulse input terminal	H: +8 to 12 V L: +1 V max Maximum response frequency: 30 kHz
	6		Pulse input common
TA2	1	A-phase monitor output terminal	Open collector output, 24 VDC, 30 mA max
	2		A-phase monitor output common
	3	B-phase monitor output terminal	Open collector output, 24 VDC, 30 mA max
	4		B-phase monitor output common
TA3	(E)	Shield connection terminal	-

■PG-X2

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

Table 2.13 PG-X2 Terminal Specifications

Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC (±5%), 200 mA max*
	2		0 VDC (ground for power supply)
	3		5 VDC (±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 (Ground 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 ground
TA3	(E)	Shield connection terminal	-

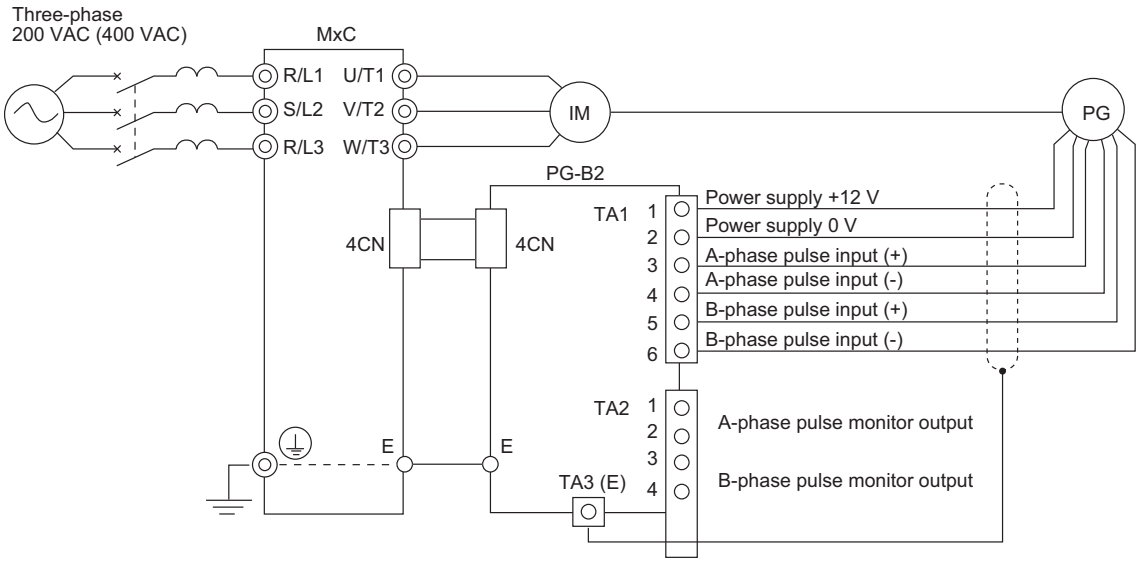
* 5 VDC and 12 VDC cannot be used at the same time.

◆ Wiring

Wiring examples are provided in the following illustrations for the option cards.

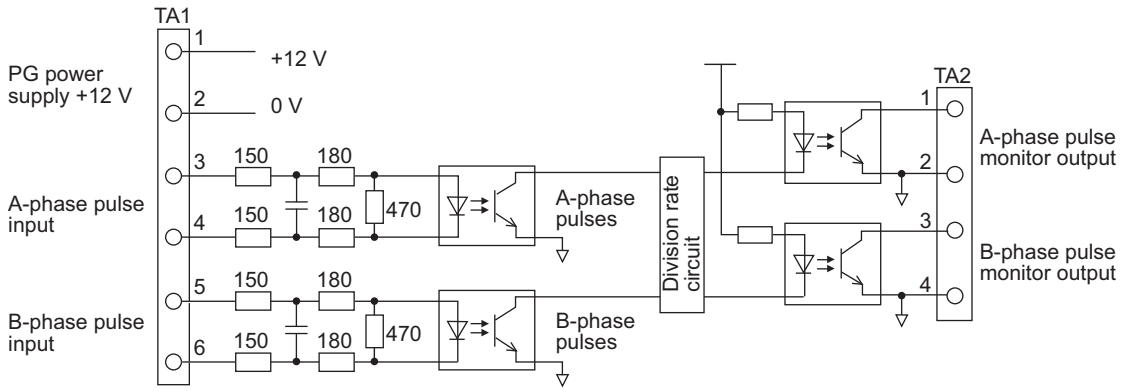
■ Wiring the PG-B2

Wiring examples for the PG-B2 are provided in the following illustrations.

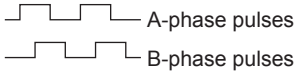


- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator wiring must not be more than 100 meters.
- The direction of rotation of the PG can be set in parameter F1-05. The factory preset is Phase A leads with a forward run command.

Fig 2.25 PG-B2 Wiring



- When connecting to a voltage-output-type PG (encoder), select a PG that has an output impedance with a current of at least 12 mA to the input circuit photocoupler (diode).
- The pulse monitor dividing ratio can be changed using parameter F1-06 (PG division rate).

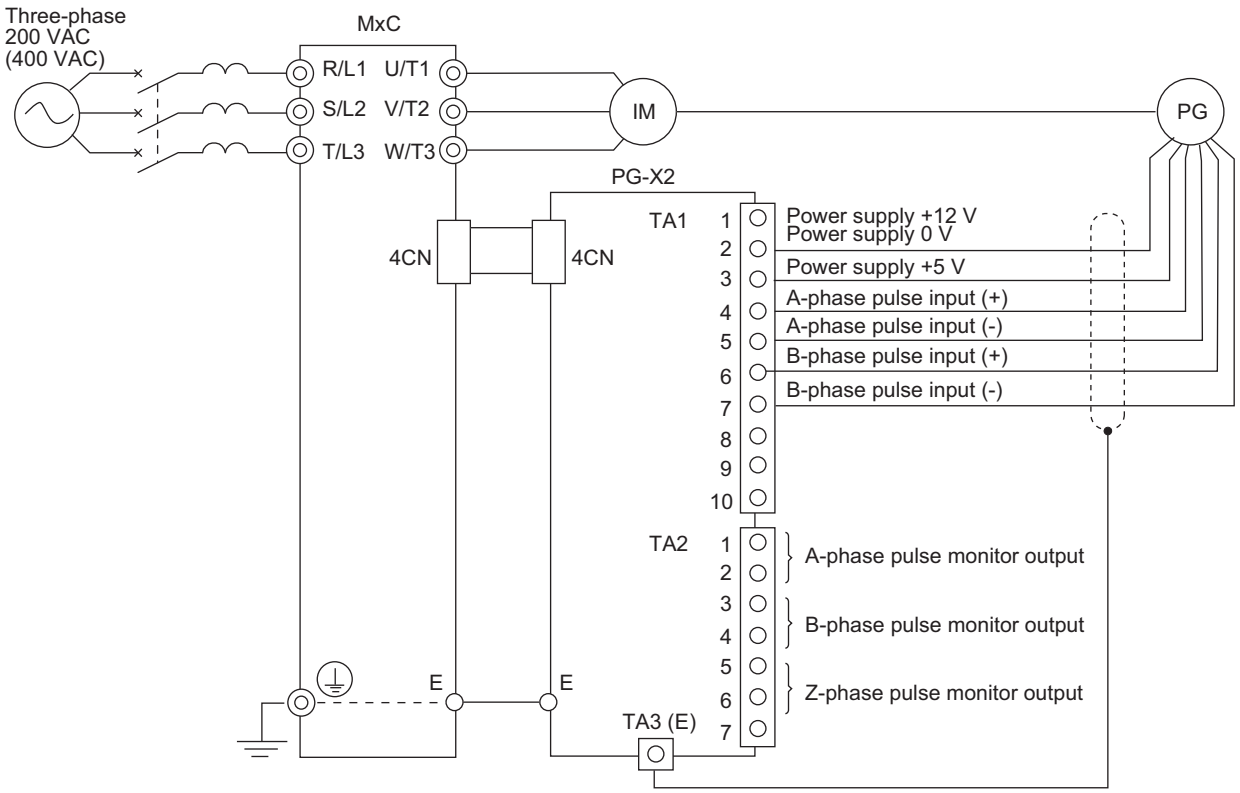


- The pulse monitor emitter is connected to common inside the PG-B2. The emitter common must be used for external circuits.

Fig 2.26 I/O Circuit Configuration of the PG-B2

■Wiring the PG-X2

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



- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator 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 wiring must not be more than 100 meters.
- The direction of rotation of the PG can be set in parameter F1-05 (PG Rotation). The factory preset is Phase A leads with a forward run command.

Fig 2.27 PG-X2 Wiring

IMPORTANT

Be sure that the ground terminal is properly grounded using a wire of the recommended size.
200 V class: Ground to 100 Ω or less 400 V class: Ground to 10 Ω or less

◆ 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 cable for pulse inputs and pulse output monitor wires, and connect the shield to the shield connection terminal.

■Wire Gauges (Same for All Models)

Terminal wire gauges are shown in *Table 2.14*.

Table 2.14 Wire Gauges

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	• 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

Yaskawa recommends using straight solderless terminal on signal lines to simplify wiring and improve reliability.

Refer to *Straight Solderless Terminal Sizes* for specifications.

■Closed-Loop Connector Sizes and Tightening Torque

The closed-loop connectors and tightening torques for various wire gauges are shown in *Table 2.15*.

Table 2.15 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 2-18. Observe the following precautions when wiring:

- Separate the control signal lines for the PG Speed Control Card 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), but only if the MxC is not affected by noise from peripheral devices.
- Do not solder the wire ends. Doing so may cause a contact fault.
- When not using straight solderless terminals, strip the wires to a length of approximately 5.5 mm.

◆ Selecting the Number of PG (Encoder) Pulses

The setting for the number of PG pulses depends on the model of PG Speed Control Card being used. Set the correct number for your model.

■PG-B2

The maximum response frequency is 32,767 Hz.

Use a PG that outputs a maximum frequency of approximately 20 kHz for the rotational speed of the motor.

$$\frac{\text{Motor speed at maximum frequency output (min}^{-1}\text{)}}{60} \times \text{PG rating (p/rev)} = 20{,}000 \text{ Hz}$$

Some examples of PG output frequency (number of pulses) for the maximum frequency output are shown in *Table 2.16*.

Table 2.16 PG Pulse Selection Examples

Motor's Maximum Speed (min^{-1})	PG Rating (p/rev)	PG Output Frequency for Maximum Frequency Output (Hz)
1800	600	18,000
1500	600	15,000
1200	900	18,000
900	1200	18,000

Note: 1. The motor speed at maximum frequency output is expressed as the sync rotation speed.
2. The PG power supply is 12 V.
3. A separate power supply is required if the PG power supply capacity is greater than 200 mA (If momentary power loss must be handled, use a backup capacitor or other method).

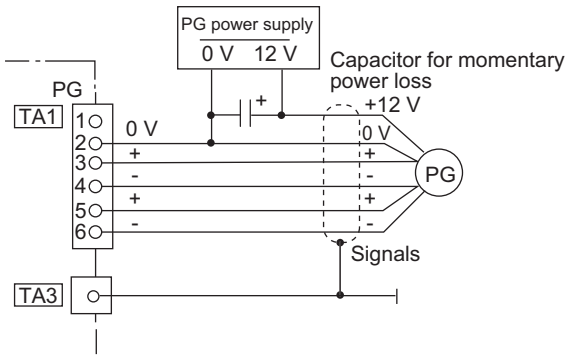


Fig 2.28 PG-B2 Connection Example

■PG-X2

There are 5 V and 12 V PG power supplies.
Check the PG power supply specifications before connecting.

The maximum response frequency is 300 kHz.

Use the following equation to calculate the output frequency of the PG (f_{PG}).

$$f_{PG}\,(\mathrm{Hz}) = \frac{\text{Motor speed at maximum frequency output } (\mathrm{min}^{-1})}{60} \times \text{PG rating (p/rev)}$$

A separate power supply is needed if the PG power supply requirements are greater than 200 mA. Use a backup capacitor or some other type of back up power to handle any concerns with momentary loss of power,

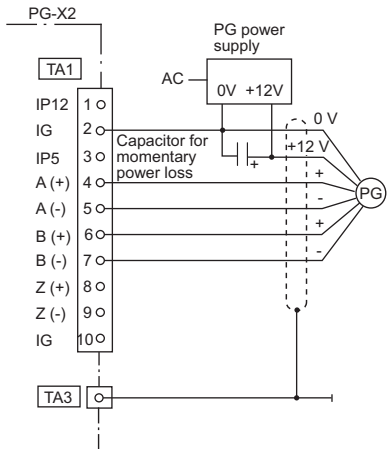


Fig 2.29 PG-X2 Connection Example (for a 12 V PG power supply)

3

Digital Operator and Modes

This chapter describes the various displays screens and functions of the digital operator keypad. An overview of the operating modes is also provided, as well as how to switch between those modes.

Digital Operator.....3-2
Operation Modes 3-5

Digital Operator

This section describes the displays and functions of the digital operator.

◆ Overview of the Digital Operator

The digital operator key names and functions are described below.

Drive Mode Indicators
FWD: Lit when there is a Forward Run Command input.
REV: Lit when there is a Reverse Run Command input.
SEQ: Lit when the Run Command from the control circuit terminal is enabled.
REF: Lit when the frequency reference from control circuit terminals A1 and A2 is enabled.
ALARM: Lit when an error or alarm has occurred.

Data Display
Displays monitor data, parameter numbers, and settings.

Mode Display (Displayed at upper left of data display.)
DRIVE: Lit in Drive Mode.
QUICK: Lit in Quick Programming Mode.
ADV: Lit in Advanced Programming Mode.
VERIFY: Lit in Verify Mode.
A. TUNE: Lit in Auto-Tuning Mode.

Keys

Execute operations such as setting parameters, monitoring, jogging, and Auto-Tuning.

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*.

Note: Except in diagrams, keys are referred to by the key names listed in the following table.

Table 3.1 Key Functions

Key	Name	Function
LOCAL REMOTE	LOCAL/REMOTE key	Switches between operation via the digital operator (LOCAL) and control circuit terminal operation (REMOTE). This key can be enabled or disabled by setting parameter o2-01.
MENU	MENU key	Scrolls through the five main menus: Operation (-DRIVE-), Quick Setting (-QUICK-), Programming (-ADV-), Modified Parameters (-VERIFY-), and Auto-Tuning (-A.TUNE-).
ESC	ESC key	Returns to the current screen to the previous screen display before the DATA/ENTER key was pressed.
JOG	JOG key	Enables jog operation when the MxC is being operated from the digital operator.

Table 3.1 Key Functions (Continued)

Key	Name	Function
FWD / REV	FWD/REV key	Selects the rotation direction of the motor when the MxC is being operated from the digital operator.
RESET	Right arrow/RESET key	Selects the digit to be changed when editing parameter settings. The selected digit will flash. Resets a the MxC after a fault as occurred.
∧	Up arrow key	Used to scroll upwards when selecting from a list of parameters. Increases the setting that appears on the digital operator screen. Used to move to the next item or data value.
∨	Down arrow key	Used to scroll down when selecting from a list of parameters. Increases the setting that appears on the digital operator screen. Used to move to the next item or data value.
DATA / ENTER	DATA/ENTER key	This key is for entering menu items, parameters, and to set values. Also used to switch from one display to another. Parameters cannot be changed when Undervoltage (UV) is detected.
RUN	RUN key	Sends a run command to have the MxC being operating the motor.
STOP	STOP key	Stops MxC operation. This key can be enabled or disabled when operating from the control circuit terminal by setting parameter o2-02.

Note: Except in diagrams, keys are referred to using the key names listed in the above table.

There are indicator LEDs on the upper left of the RUN and STOP keys on the digital operator. These indicators will light and flash to indicate operating status.

An indicator LED on the RUN key will flash and the STOP key LED will light during initial excitation of the dynamic brake. The relationship between the indicators on the RUN and STOP keys and the MxC status is shown in the *Fig 3.2*.

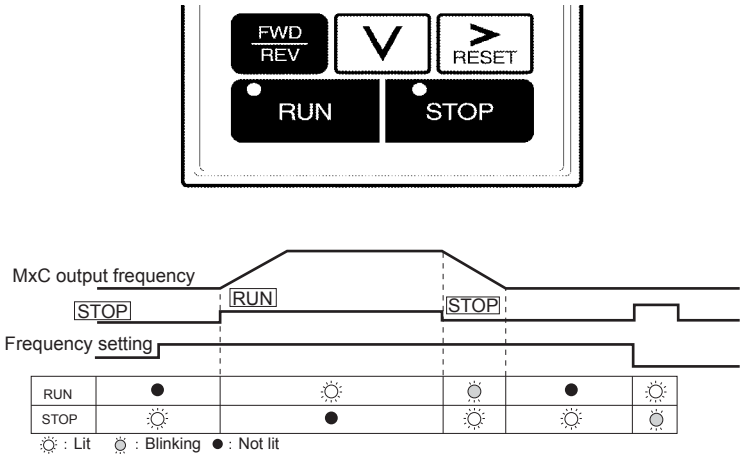


Fig 3.2 RUN and STOP Indicator LEDs

The following table shows the relationship between the indicators on the RUN and STOP keys as well as the MxC operation status.

The LED indicators can be on, off, or flash to indicate the operating status.

Table 3.2 Relation of MxC to RUN and STOP LED Indicators

Priority	RUN Indicator	STOP Indicator	MxC Status	Conditions
1	●	●	Stopped	Power supply has been shut off.
2	●	☼	Stopped*	Emergency stop • A Stop Command is sent from the digital operator when using the control circuit terminals to operate the MxC. • An Emergency Stop Command was sent from the control circuit terminal. The MxC has been switched from LOCAL to REMOTE when the Run Command is still sent from one of the external terminals (LOCAL = operation using the digital operator, REMOTE: operation using the control circuit terminals). Switched from the Quick or Advanced Quick Programming Mode to the Drive Mode while the Run Command is being sent via an external terminal.
3	☀	☼	Stopped	The MxC is trying to run at a frequency below the minimum output frequency. 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	The MxC is decelerating to a stop. During DC injection braking when using the multi-function contact input terminal. During initial excitation of DC injection braking while the MxC is stopped.
6	☼	☼	Running	During emergency deceleration • Stop Command is sent from the digital operator when operating the MxC using the control circuit terminals. • Emergency Stop Command is sent from the control circuit terminal.
7	☀	●	Running	Run Command is issued. During initial excitation of DC injection braking when starting the MxC.

Note: ☀: Lit ☼: Flashing ●: Not lit

* If planning to run the MxC again, first turn off the Run Command and Emergency Stop Command from the control circuit terminal, and then re-send the Run Command.

Operation Modes

This section describes the operation modes available in the MxC, and how to switch between modes.

◆ MxC Modes

Parameters and monitoring functions in the MxC are organized into groups called “modes”. These modes make it easier to read and set parameters. Their are five separate modes available in the MxC.

The five modes and their primary functions are shown in the *Table 3.3*.

Table 3.3 Modes

Mode	Primary functions
Drive Mode	A Run Command may be entered to start the motor when viewing this mode. Use this mode when monitoring values such as frequency references or output current, displaying fault information, or displaying the fault history.
Quick Programming Mode	Use this mode to set and monitor the most commonly used parameters, as well as operate the MxC.
Advanced Programming Mode	Use this mode to reference and set all parameters.
Verify Mode	Use this mode to read/set parameters that have been changed from their original default values.
Auto-Tuning Mode*	Use this mode when running a motor with unknown motor characteristics in Open Loop or Flux Vector Control. In this mode, the MxC automatically calculates the motor characteristics, then enters those values to the motor parameters. Also used to measure the motor line-to-line resistance.

* Always perform Auto-Tuning with the motor before operating in Open Loop or Flux Vector Control. The Auto-Tuning Mode cannot be entered while the MxC is running, or when an error has occurred. The default setting of the MxC is for Open Loop Vector Control (A1-02 = 2).

◆ Switching Between 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.

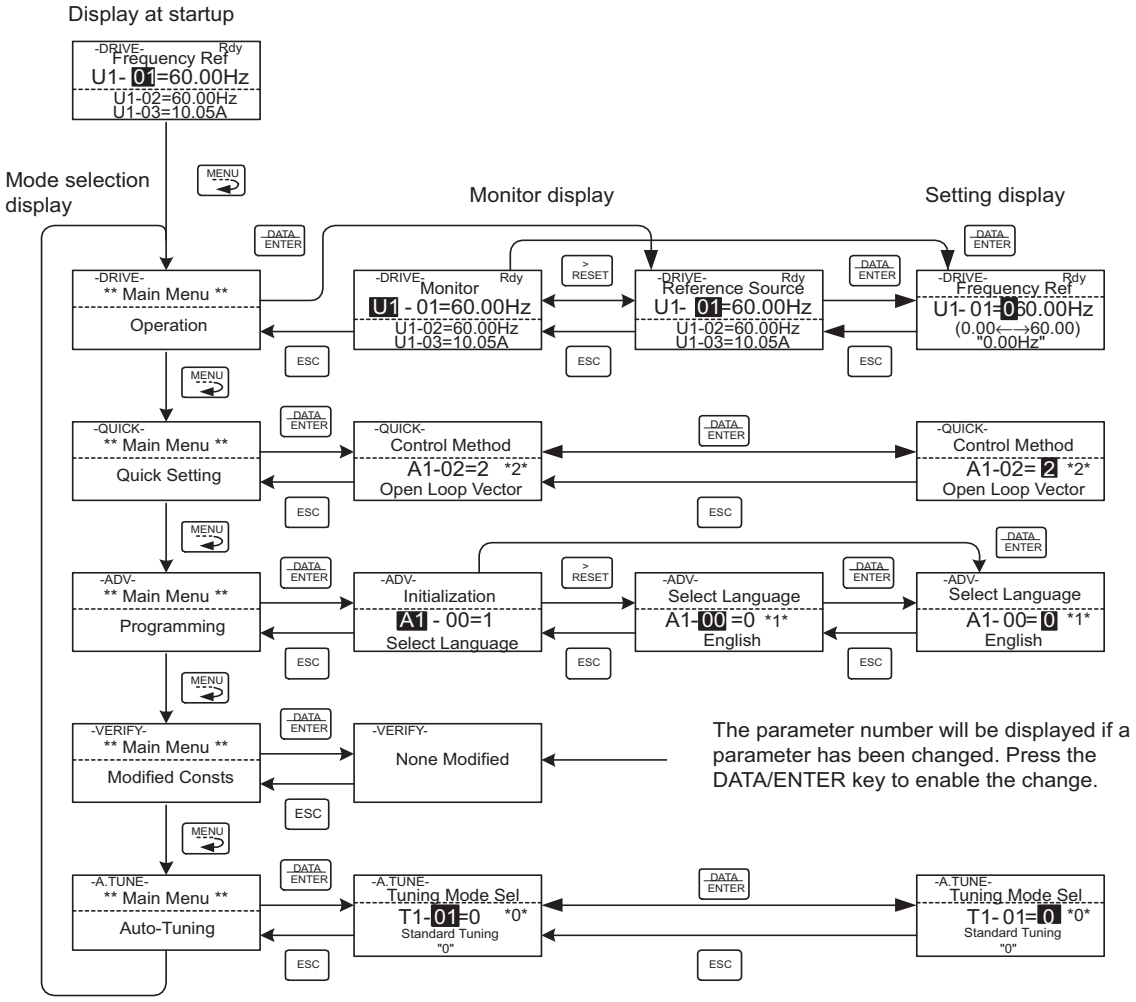


Fig 3.3 Mode Transitions

IMPORTANT

After using the digital operator to issue a Run Command, press the MENU key to select the Drive Mode (the Drive Mode display will appear on the digital operator screen). Next, press the DATA/ENTER key while in the Drive Mode display to bring up the monitor display screen. The MxC will not accept a Run Command if any other screen is displayed. The monitor display screen in the Drive Mode will appear whenever the power is first turned on.

◆ Drive Mode

Once in the Drive Mode, the user can now instruct the MxC to begin operating the motor. The following monitor displays can be viewed while in the Drive Mode: frequency reference, output frequency, output current, output voltage, as well as fault information and the fault history.

When b1-01 (Frequency Reference Selection) is set to 0, the frequency can be changed from the value that appears in the frequency setting display. Use the up arrow and right arrow keys to change parameter settings. Any changes will be saved once the DATA/ENTER key is pushed.

■How to Operate the MxC in the Drive Mode

Key operations in the Drive Mode are shown in the following figure.

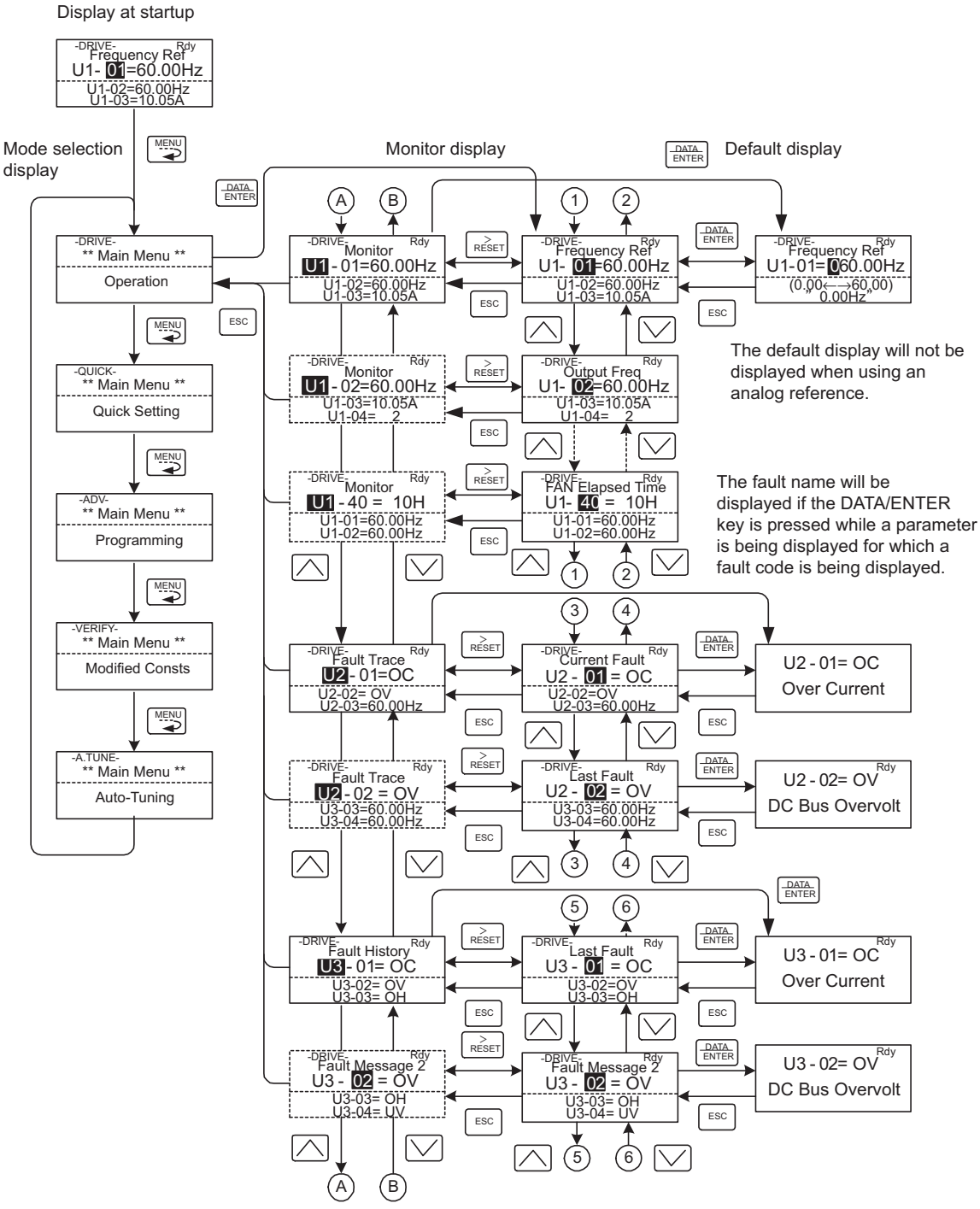


Fig 3.4 Operations in Drive Mode

Note: When changing the display with the up arrow and down arrow keys, the next display after the one for the last parameter number will be the one for the first parameter number. For example, if the up arrow key is pressed when U1-01 is displayed, the last parameter will be displayed instead of U1-02. This is indicated in the figures by the letters A and B and the numbers 1 to 6.

IMPORTANT

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

◆ Quick Programming Mode

In the Quick Programming Mode, the user can set the basic parameters required to test run the MxC.

Parameters can be changed from the setting display screen. Use the up arrow, down arrow, and right arrow keys to change parameter settings. Any changes will be saved once the DATA/ENTER key is pushed.

Refer to *Chapter 5 MxC Parameters* for details on the parameters displayed in Quick Programming Mode.

■Making Changes in the Quick Programming Mode

Key operations in Quick Programming Mode are shown in the following figure.

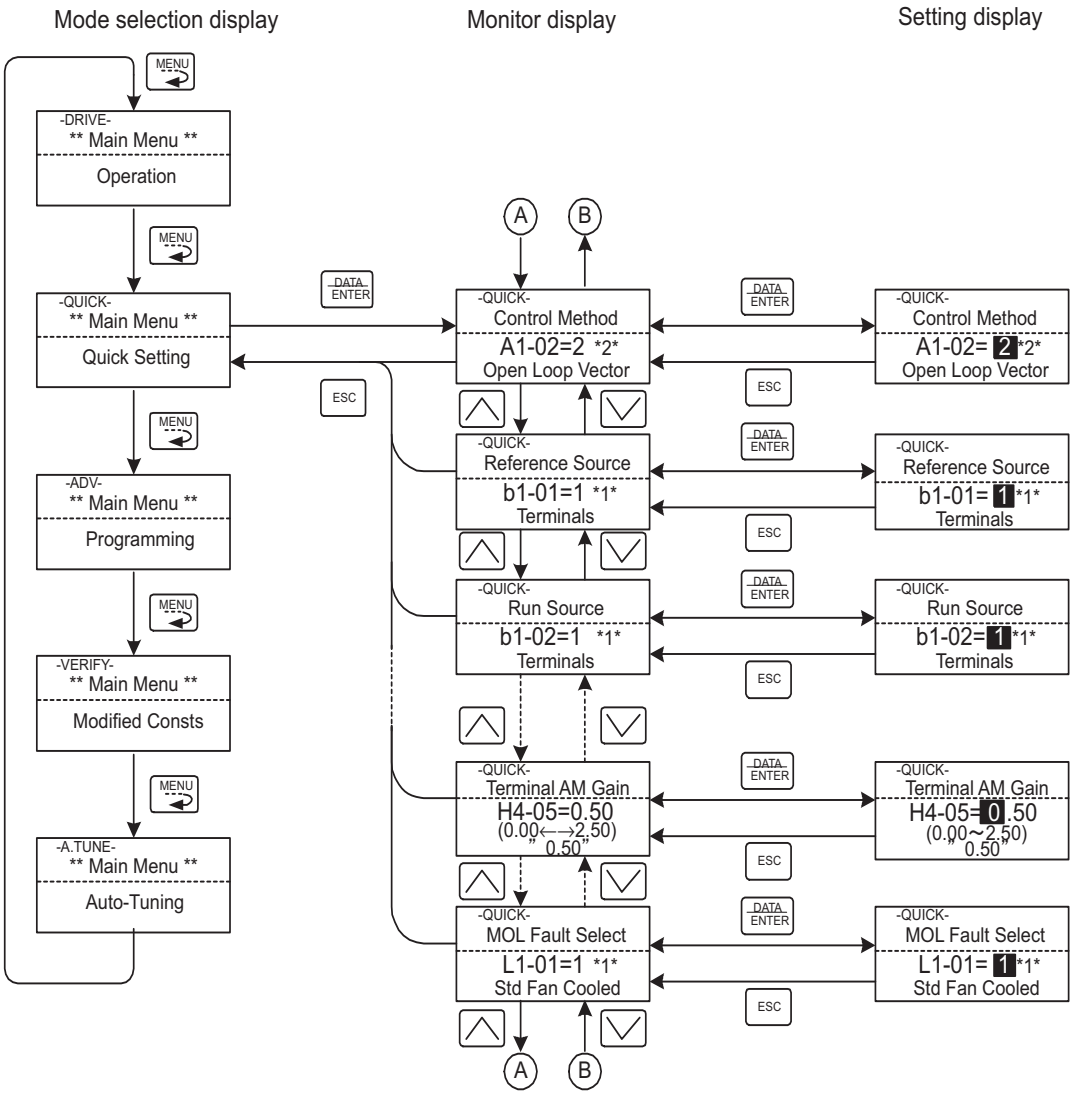


Fig 3.5 Operations in Quick Programming Mode

◆ Advanced Programming Mode

In the Advanced Programming Mode, the user can access all MxC parameters to change settings or simply monitor performance.

The user can change the setting values saved to each parameter. For example, the user can adjust the frequency the motor is running at by using the arrow keys on the keypad. The new value for the parameter will be saved once the DATA/ENTER key is pressed.

Refer to *Chapter 5 Parameters* for a list and description of parameters.

■Making Changes in the Advanced Programming Mode

The following diagram show examples of how to the use the digital operator key pad in the Advanced Programming Mode.

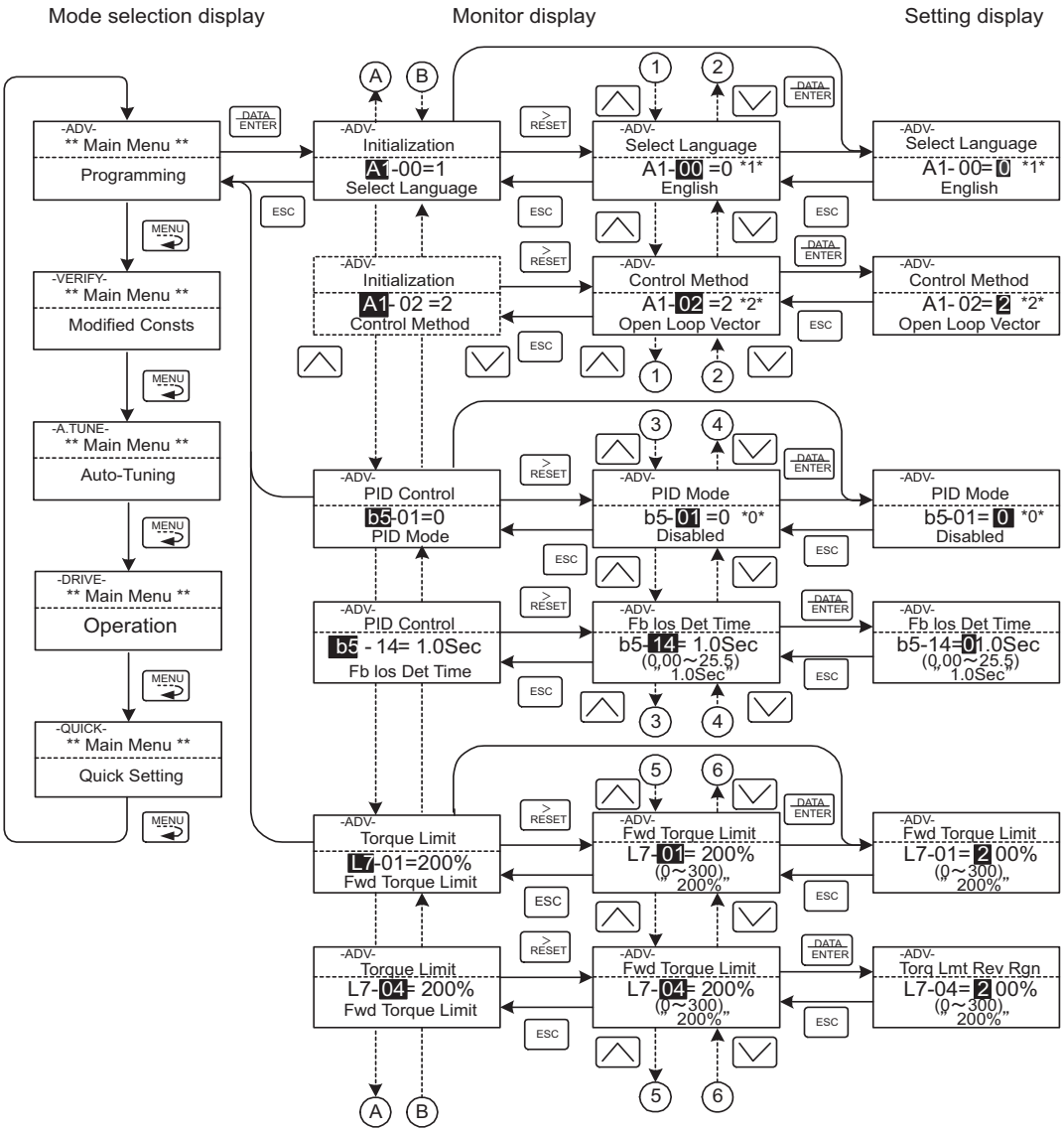


Fig 3.6 Operations in Advanced Programming Mode

■Setting Parameters

The procedure described below explains how to change C1-01 (Acceleration Time 1) from 10 s to 20 s.

Table 3.4 Changing Parameter Settings in the Advanced Programming Mode

Step No.	Digital Operator Display	Description
1	-DRIVE- Rdy Frequency Ref U1- 01=60.00Hz U1-02=60.00Hz U1-03=10.05A	First make sure that the MxC has been powered up.
2	-DRIVE- ** Main Menu ** Operation	Press the MENU key to scroll to “Operation” menu.
3	-QUICK- ** Main Menu ** Quick Setting	Press the MENU key to scroll to “Quick Setting” menu.
4	-ADV- ** Main Menu ** Programming	Press the MENU key to scroll to “Programming” menu.
5	-ADV- Initialization A1-00=1 Select Language	Press the DATA/ENTER key to enter “Programming” menu.
6	-ADV- Accel Time 1 C1-00= 10.0Sec (0.0←→6000.0) ” 10.0Sec”	Press the up arrow key until parameter C1-01 is displayed.
7	-ADV- Accel Time 1 C1-01= 0010.0Sec (0.0←→6000.0) ” 10.0Sec”	Push the DATA/ENTER key to access setting display. The setting of C1-01 (10.00) is displayed.
8	-ADV- Accel Time 1 C1-01= 0010.0Sec (0.0←→6000.0) ” 10.0Sec”	Press the right arrow key to move the flashing digit to the right.
9	-ADV- Accel Time 1 C1-01= 0010.0Sec (0.0←→6000.0) ” 10.0Sec”	Press the up arrow key to increase the value to 20.00 s.
10	-ADV- Accel Time 1 C1-01= 0020.0Sec (0.0←→6000.0) ” 10.0Sec”	Press the DATA/ENTER key to save the change.
11	-ADV- Entry Accepted	“Entry Accepted” is displayed for 1.0 s.
12	-ADV- Accel Time 1 C1- 01= 20.0Sec (0.0←→6000.0) ” 10.0Sec”	The digital operator screen will return to the C1-01 display.

■External Fault Setting Procedure

The following diagram shows how to set one of the multi-function contact inputs to be triggered when an external fault is detected. To make the setting changes, the MxC must be in the Advanced Programming Mode.

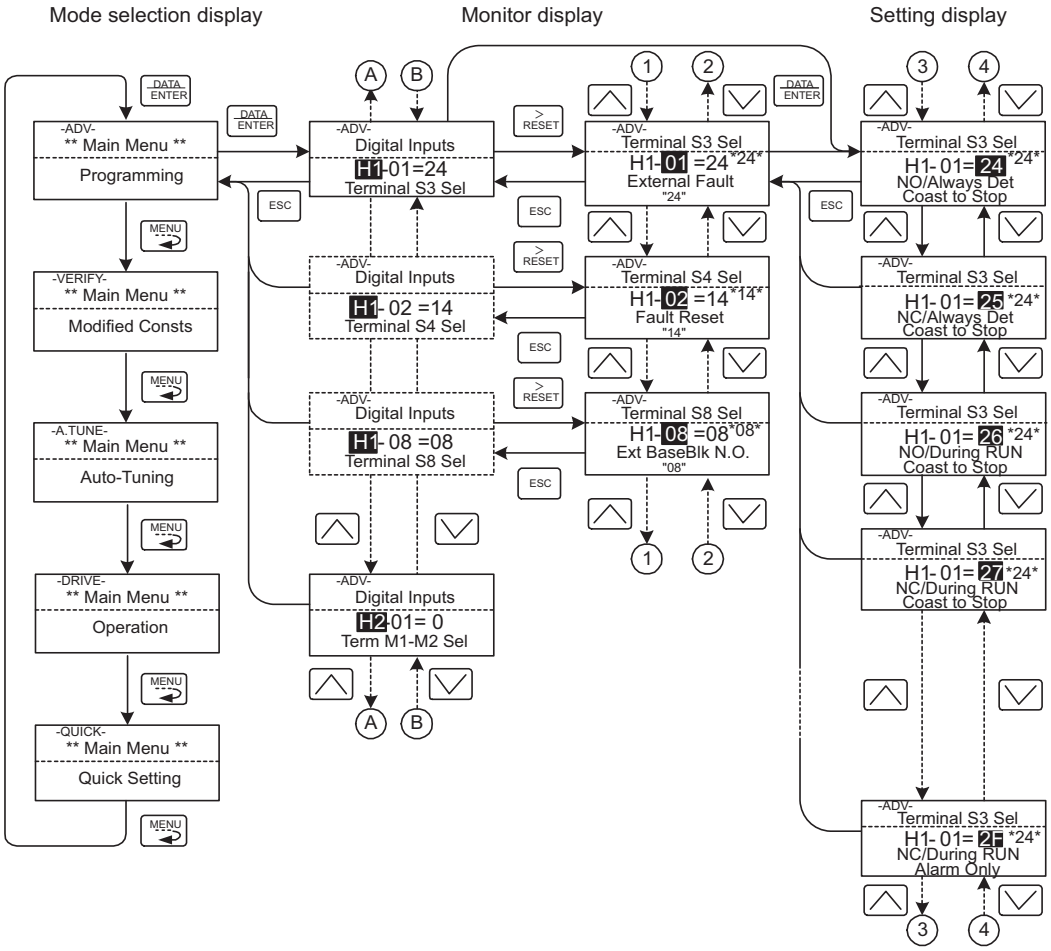


Fig 3.7 External Fault Function Setting Example

◆ Verify Mode

The Verify Mode displays any parameters that have been changed from their default settings. This includes all parameters that were changed by the user in the Programming Mode, and all parameters that were changed when Auto-Tuning was performed. If no parameter settings have been changed, then the Verify Mode display window will read, “None”.

The Verify Mode will not show parameters belonging to the A1: Initialization Settings group (i.e., all parameters that start with A1-□□), even if those parameters have been changed. The exception is A1-02, which will appear if it has been changed from its default value.

The user can also change parameter settings while in the Verify Mode. Just as in the Programming Mode, use the up arrow, down arrow, and SHIFT/RESET keys to adjust any setting values. Save changes by pressing the DATA/ENTER key.

■Using the Verify Mode

The example below demonstrates how to use the Verify Mode to view parameters that have been set to values different from their default settings. In the example, the following parameters have been changed: b1-01 (Reference Selection), C1-01 (Acceleration Time 1), E1-01 (Input Voltage Setting), and E2-01 (Motor Rated Current).

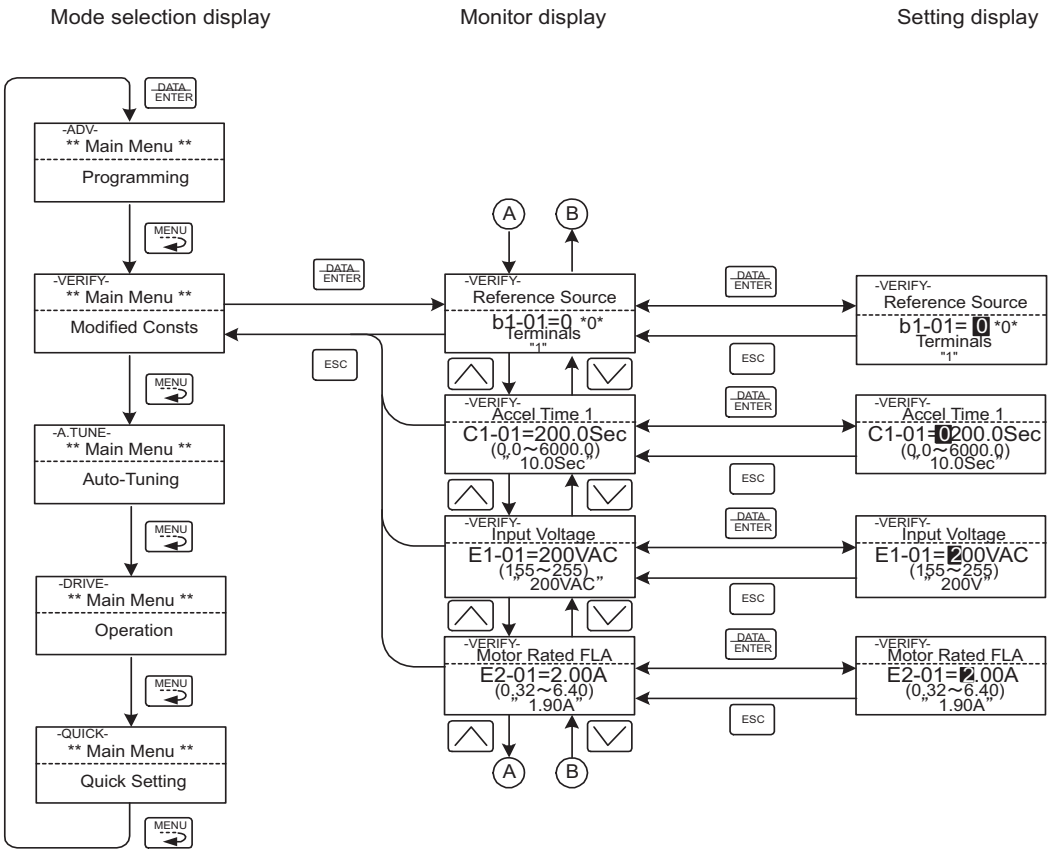


Fig 3.8 Operations in Verify Mode

◆ Auto-Tuning Mode

This menu is used to Auto-Tune the MxC in order to calculate the required motor parameters to optimize motor performance. Ideally, perform Auto-Tuning with the motor uncoupled from the load.

When the motor cannot be disconnected from the load, perform static or terminal resistance Auto-Tuning. To set motor parameters manually, contact your Yaskawa representative. Follow the key operations in Fig 3.9 to access the Auto-Tuning Menu.

The MxC's Auto-Tuning function automatically determines the optimal motor parameters settings. This is fundamentally different from the Auto-Tuning function in a servo system, which instead determines the size of a load. The default setting of the MxC is for Open Loop Vector Control.

■Executing Auto-Tuning

Set the motor output power (kW), rated voltage, rated current, rated frequency, rated speed, and number of poles as specified on the motor nameplate. Next, press RUN. The motor will begin to rotate, and the MxC will automatically set motor parameters based on the information provided from the nameplate and measurements taken during the Auto-Tuning process.

Auto-Tuning requires that motor data be entered from the specifications indicated on the motor nameplate. Auto-Tuning cannot be executed without this information, and cannot be started from the motor rated voltage display.

Set parameter values when they are displayed by using the up, down, and right arrow keys. Changes are saved once DATA/ENTER key is pushed.

The following example shows how to perform Auto-Tuning in the Open Loop Vector Control Method while operating the motor (without switching to motor 2).

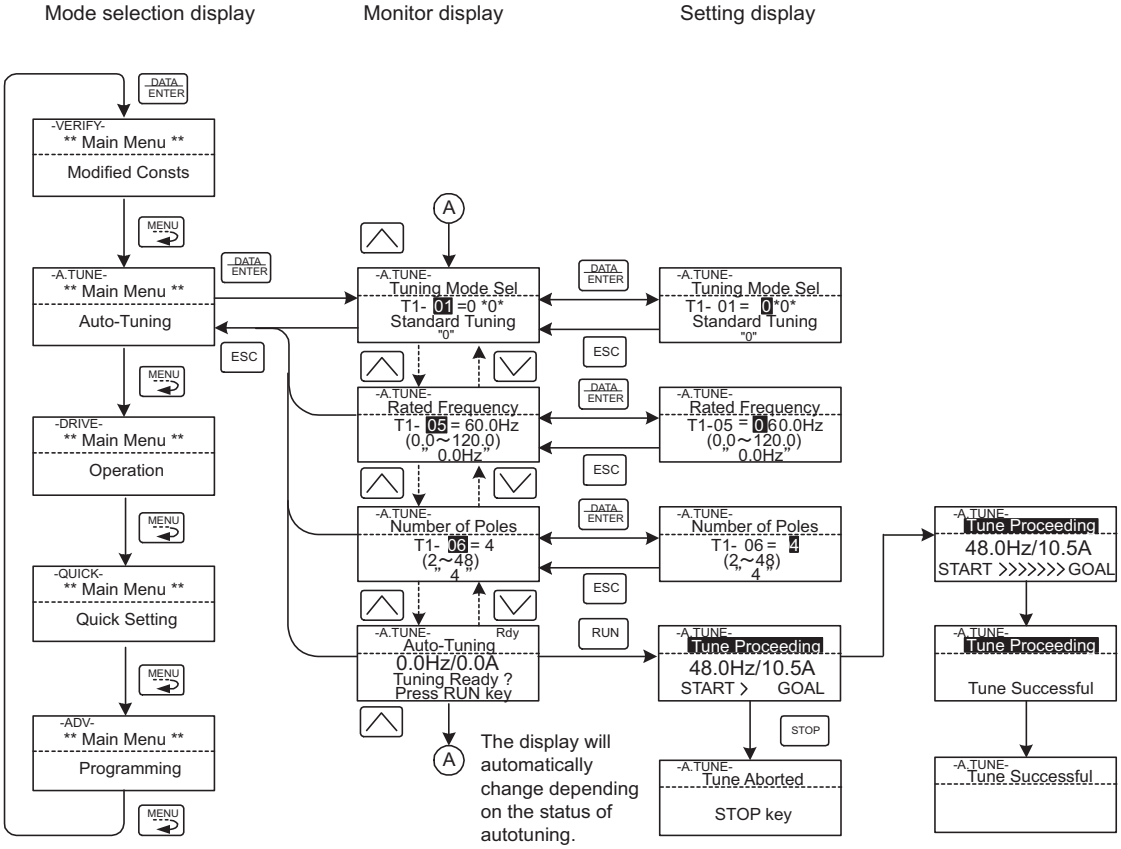


Fig 3.9 Screen Displays in the Auto-Tuning Mode

IMPORTANT

The screen displays in the Auto-Tuning Mode depend on the control method the MxC is operating in (V/f, Open Loop Vector, or Flux Vector). If a fault occurs during Auto-Tuning, refer to *Chapter 7 Troubleshooting.*

4

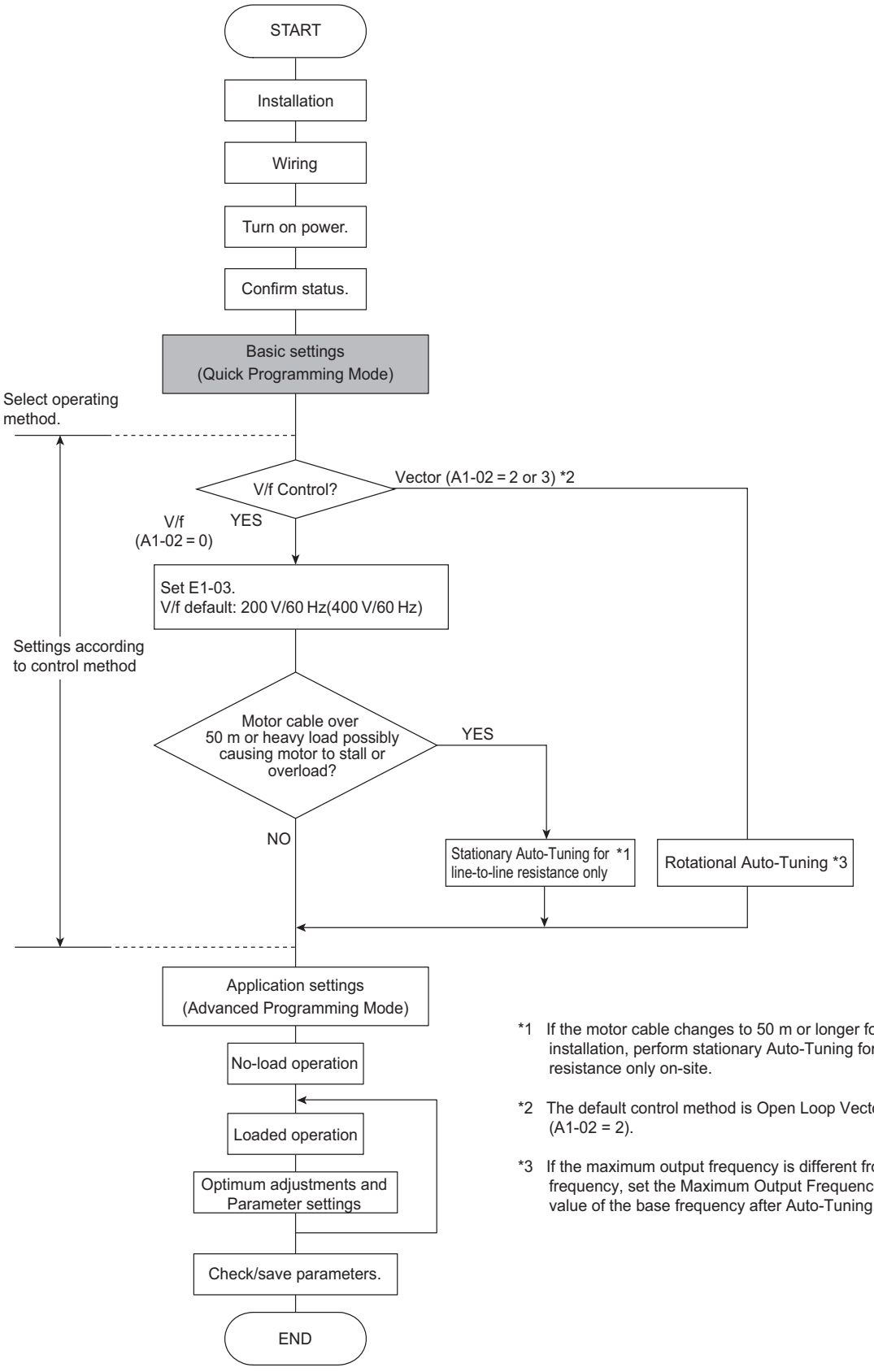
Test Run

This chapter describes the procedures for Test Run of the MxC and provides an example of Test Run.

Test Run Procedure 4-2
Test Run Procedures 4-3
Notes on Tuning the MxC 4-14

Test Run Procedure

Test run the MxC as shown in the flowchart below:



*1 If the motor cable changes to 50 m or longer for the actual installation, perform stationary Auto-Tuning for the line-to-line resistance only on-site.

*2 The default control method is Open Loop Vector Control (A1-02 = 2).

*3 If the maximum output frequency is different from the base frequency, set the Maximum Output Frequency (E1-04) to the value of the base frequency after Auto-Tuning.

Fig 4.1 Test Run Flowchart

Test Run Procedures

This section describes the procedure for performing a test run after the MxC is fully connected.

◆ Switching the Power On

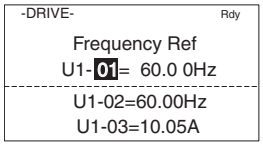
Confirm all of the following items first, and then turn on the power supply.

- Make sure the power supply voltage is correct.
  200 V class: 3-phase 200 to 220 VDC, 50/60 Hz
  400 V class: 3-phase 380 to 480 VDC, 50/60 Hz
  If connecting an MxC to a power supply with high impedance, such as a Slidax, the power-supply voltage may rise during regeneration. Contact your Yaskawa representative for details.
- Use a power supply with a capacity that is the same or greater than the MxC capacity.
- Make sure that the motor output terminals (U, V, W) and the motor are properly connected.
- Make sure that the MxC control circuit terminal and the control device are wired correctly.
- Set all MxC control circuit terminals to off.
- When using a PG Speed Control Card, make sure that it is wired correctly.
- Make sure that the motor is not connected to the mechanical system (no-load status)

◆ Checking the Display Status

Assuming there are no problems, the digital operator will display the following message when the power is switched on:

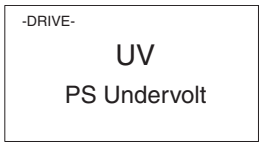
Display during normal operation when the unit is first powered up.



The output frequency reference appears on the digital operator screen.

When a fault has occurred, information concerning the fault will be displayed instead of the message shown above. The user should refer to *Chapter 7 Troubleshooting* for information on how to remedy a fault situation. Below is and example of the digital operator display when a fault occurs.

Operator display when a fault has occurred.



The display will differ depending on the type of fault.
A example on the left shows a low voltage alarm.

◆ Basic Settings

Switch to the Quick Programming Mode ("QUICK" will be displayed on the LCD screen), and then set the following parameters. Refer to *Chapter 3 Digital Operator and Modes* for digital operator operating procedures and to *Chapter 5 Parameters* and *Chapter 6 Parameter Settings by Function* for details on the Parameters.

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

Table 4.1 Parameters that Must Be Set

Parameter Number	Name	Description	Setting Range	Default	Page
A1-02	Control Method Selection	Selects the Control Method. 0: V/f Control Method without a PG encoder 2: Open Loop Vector 3: Flux Vector (Closed Loop Vector)	0, 2, or 3	2	5-7
b1-01	Frequency Reference Selection	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	5-9 6-2 6-67 6-84
b1-02	Run Source	Selects the Run Command input source. 0: Operator - RUN and STOP keys on digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	5-9 6-8 6-67 6-84
b1-03	Stopping Method Selection	Selects the stopping method when the Run Command is removed. 0: Decelerate to stop 1: Coast to Stop 2: DC Injection to Stop 3: Coast with Timer (A new Run Command is ignored if received before the timer expires).	0 to 3 *1	0	5-9 6-11
C1-01	Acceleration Time 1	Sets the time to accelerate from zero to maximum frequency.	0.0 to 6000.0 *2	10.0 s	5-16 6-17
C1-02	Deceleration Time 1	Sets the time to decelerate from maximum frequency to zero.	0.0 to 6000.0 *2	10.0 s	5-16 6-17
C6-02	Carrier Frequency Selection	Select carrier frequency 2: 4.0 kHz 4: 8.0 kHz 6: 12.0 kHz	2, 4, or 6 *3 *4	2	5-19
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 120.00	d1-01 to d1-04: 0.00 Hz d1-17: 6.00 Hz	5-20 5-21

Table 4.1 Parameters that Must Be Set (Continued)

Parameter Number	Name	Description	Setting Range	Default	Page
E2-01	Motor Rated Current	Sets the motor nameplate full load current in amperes (A). This value is automatically set during Auto-Tuning.	10% to 200% of MxC's rated current	Setting for general-purpose motor of same capacity as MxC	5-26 6-51 6-102
F1-01*4 *5	PG Parameter	Sets the number of pulses per revolution (PPM) of the encoder (pulse generator).	0 to 60000	600	5-29
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	5-41
L1-01	Motor Overload Protection Selection	Sets the motor thermal overload protection (OL1) based on the cooling capacity of the motor. 0: Disabled 1: General-purpose motor protection 2: Inverter motor protection 3: Vector motor protection	0 to 3	1	5-43 6-51

* 1. 0 or 1 for Flux Vector Control.

* 2. The setting range for accel/decel times depends on the setting of C1-10 (Accel/Decel Time Setting Unit). If C1-10 is set to 0, the setting range is 0.00 to 600.00 (s).

* 3. Fixed to 2:4 kHz for V/f.
For Open Loop Vector Control, can select from 2:4 kHz or 4:8 kHz (Fixed to 2: 4 kHz for 200 V class MxC for 45 kW and 400 V class MxCs for 22 kW and 45 kW).

* 4. Fixed to 2: 4 kHz for 400 V class MxCs for 110 kW and 160 kW.

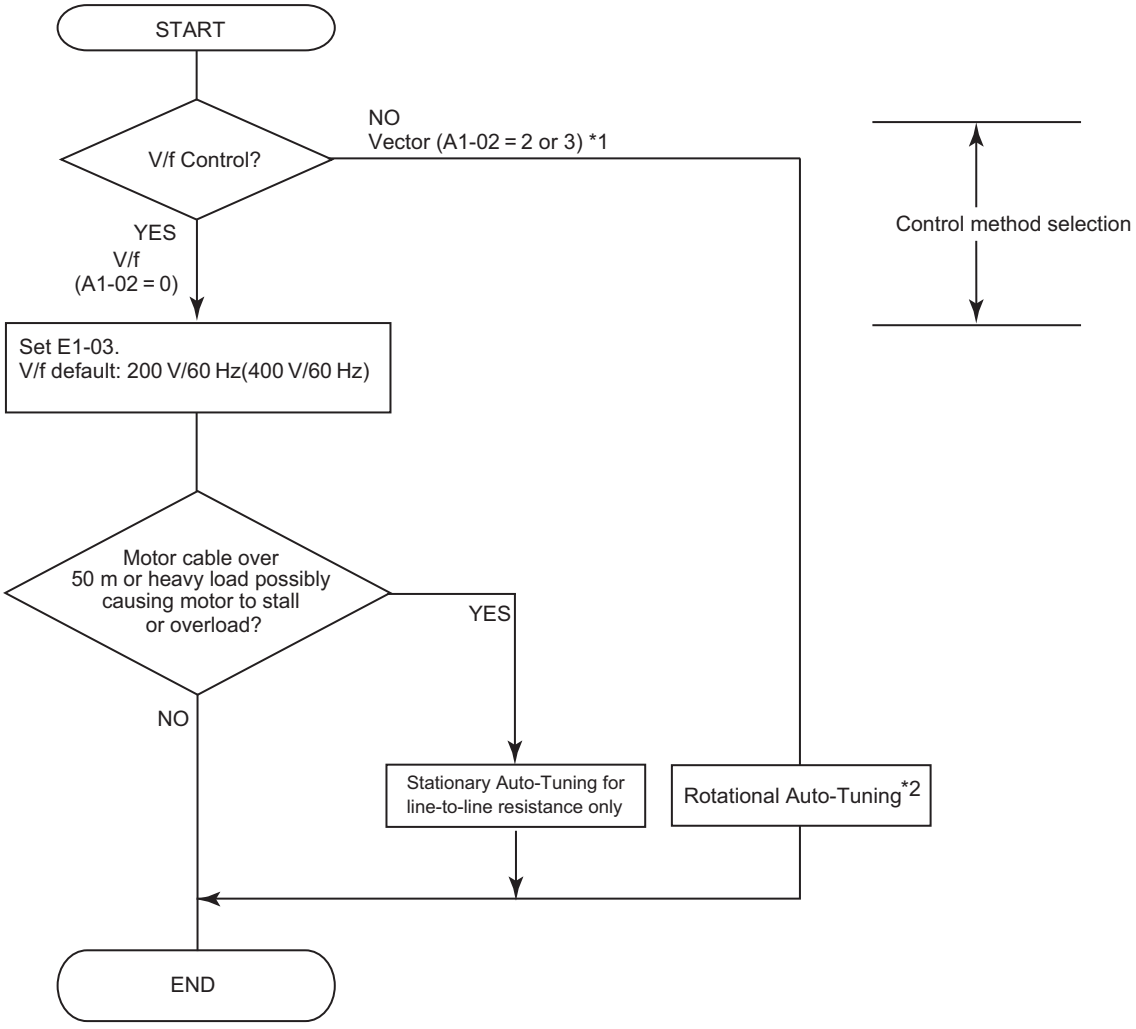
* 5. Displayed only while using Flux Vector Control.

◆ Settings for the Control Methods

Auto-Tuning methods depend on the control method set for the MxC. Make the settings required by the control method.

■Overview of Settings

Make the required settings in the Quick Programming Mode and Auto-Tuning Mode according to the following flowchart.



Note: If the motor cable is 50 m or longer, perform Stationary Auto-Tuning onsite for the line-to-line resistance only.

* 1. The default setting of the MxC is for Open Loop Vector Control (A1-02 = 2).

* 2. If the maximum output frequency is different from the base frequency, set the Maximum Output Frequency (E1-04) to the value of the base frequency after Auto-Tuning the MxC.

Fig 4.2 Settings Parameters in Accordance with the Control Method

■Setting the Control Method

Any of the following three control methods can be set.

Control Method	Parameter Setting	Basic Control	Main Applications
V/f Control	A1-02 = 0	Voltage/frequency ratio fixed control	Variable speed control
Open Loop Vector Control	A1-02 = 2 (default setting)	Current vector control without a PG	Variable speed control, applications requiring speed and torque accuracy using vector control without a PG
Flux Vector Control	A1-02 = 3	Flux Vector Control	High-performance control with a PG

Note: The motor and MxC must be connected 1:1. The MxC is capable of stably operating motors capacities rated at 75% to 100% of the capacity of the MxC.

V/f Control Method (A1-02 = 0)

- Set either one of the fixed patterns (0 to E) to parameter E1-03 (V/f Pattern Selection), or enter "F" to specify a user-set pattern as required for the motor and load characteristics in E1-04 to E1-13 in Advanced Programming Mode.

  Simple operation of a general-purpose motor at 50 Hz: E1-03 = 0

  Simple operation of a general-purpose motor at 60 Hz: E1-03 = F (default) or 1
  If E1-03 = F, the default setting in the user setting from E1-04 to E1-13 are for 60 Hz

- Perform Stationary Auto-Tuning for the line-to-line resistance only if the motor cable is 50 m or longer for the actual installation or the load is heavy enough to produce stalling. Refer to the following section on *Auto-Tuning* for details on Stationary Auto-Tuning for the line-to-line resistance only.

Open Loop Vector Control (A1-02 = 2)

Perform Rotational Auto-Tuning. Refer to the following section on *Auto-Tuning* for details on Rotational Auto-Tuning.

Flux Vector Control (A1-02 = 3)

Perform Rotational Auto-Tuning. Refer to the following section on *Auto-Tuning* for details on Rotational Auto-Tuning.

◆ Auto-Tuning

Use the following procedure to perform Auto-Tuning if using the vector control method or when using a long motor cable. Auto-Tuning calculates the motor characteristics and automatically sets all necessary motor parameters.

If the control method was changed after Auto-Tuning, be sure to perform Auto-Tuning again.

The following types of Auto-Tuning are possible in the MxC:

- Rotational Auto-Tuning
- Stationary Auto-Tuning for line-to-line resistance only
- Stationary Auto-Tuning 2

■ Precautions Before Performing Auto-Tuning

Read the following precautions before Auto-Tuning the MxC.

- Auto-Tuning the MxC is fundamentally different from Auto-Tuning a servo system. The MxC Auto-Tuning automatically adjusts motor parameter settings according to detected motor characteristics, whereas servo system Auto-Tuning adjusts parameters according to the size of the load.
- When speed or torque precision is required at high speeds (i.e., 90% of the rated speed or higher), use a motor with a rated voltage that is 20 V less than the input power supply voltage of the MxC for 200V class MxCs and 40 V less for 400V class MxCs. If the rated voltage of the motor is the same as the input power supply voltage, the voltage output from the MxC will be unstable at high speeds and sufficient performance will not be possible.
- Use Stationary Auto-Tuning 2 whenever performing Auto-Tuning for a motor that is connected to a load.
- Use Rotational Auto-Tuning whenever performing Auto-Tuning for a motor that has fixed output characteristics, when high precision is required, or for a motor that is not connected to a load.
- If Rotational Auto-Tuning is performed on a motor connected to a load, the MxC will be unable to accurately calculate the best motor parameters, which may cause the motor to exhibit operate abnormally. Never perform Rotational Auto-Tuning on a motor connected to a load.
- If the wiring between the MxC and motor changes by 50 m or more between Auto-Tuning and motor installation, perform Stationary Auto-Tuning for line-to-line resistance only.
- If the motor cable is long (50 m or longer), perform Stationary Auto-Tuning for line-to-line resistance only, even when using V/f Control.
- The table below shows the status of the multi-function inputs and multi-function outputs during Auto-Tuning. When performing Auto-Tuning with the motor connected to a load, be sure that the holding brake is not applied during Auto-Tuning, especially when working with conveyor systems or similar equipment.

Tuning Mode	Multi-Function Inputs	Multi-Function Outputs
Rotational Auto-Tuning	Disabled.	Same as during normal operation.
Stationary Auto-Tuning for line-to-line resistance only	Disabled.	All outputs maintain same status as when Auto-Tuning was started.
Stationary Auto-Tuning 2	Disabled.	All outputs maintain same status as when Auto-Tuning was started.

- The STOP key can be used to abort Auto-Tuning.
- Power will be supplied to the motor when Stationary Auto-Tuning is performed even though the motor will not rotate. Do not touch the motor until Auto-Tuning has been completed.

■Selecting the Best Auto-Tuning Mode

Rotational Auto-Tuning (T1-01 = 0)

Rotational Auto-Tuning is used for Open Loop Vector Control and Flux Vector Control. Set T1-01 to 0, input the data from the nameplate, and then press the RUN key on the digital operator. The MxC will stop the motor for approximately one minute and then set the required motor parameters automatically while operating the motor for approximately one minute.

IMPORTANT

1. Always disconnect the motor from the machine and confirm that it is safe to operate the motor before performing Rotational Auto-Tuning.
2. If the motor cannot be operated by itself, perform Stationary Auto-Tuning, but always use Rotational Auto-Tuning whenever it is possible to operate the motor by itself to increase performance.

Stationary Auto-Tuning for Line-to-Line Resistance Only (T1-01 = 2)

Stationary Auto-Tuning for line-to-line resistance only can be used in any control method. This is the only Auto-Tuning possible for V/f Control Method and V/f Control Method with a PG encoder.

Auto-Tuning can be used to prevent control errors when the motor cable is long (50 m or longer) or the cable length has changed since installation or when the motor and MxC have different capacities.

Set T1-01 to 2, and then press the RUN key on the digital operator. The MxC will supply power to the stationary motor for approximately 20 seconds and the Motor Line-to-Line Resistance (E2-05) and cable resistance will be automatically measured.

IMPORTANT

1. Power will be supplied to the motor when Stationary Auto-Tuning for line-to-line resistance is performed even though the motor will not turn. Do not touch the motor until Auto-Tuning has been completed.
2. When performing Stationary Auto-Tuning connected to a conveyor or other machine, ensure that the holding brake is not activated during Auto-Tuning.

Stationary Auto-Tuning 2 (T1-01 = 4)

Stationary Auto-Tuning 2 is used for Open Loop Vector Control and Flux Vector Control. Set T1-04 to 4, and Motor No-Load Current (T1-09) will be added. Input the data written on the motor nameplate. Be sure to input the value or motor no-load current (motor exciting current) from motor examination results to T1-09. After Auto-Tuning, the value of T1-09 will be written in E1-03. When not setting T1-09, the no-load current value of Yaskawa standard motor will be written in E1-03.

IMPORTANT

1. Power will be supplied to the motor when Stationary Auto-Tuning 2 is performed even though the motor will not turn. Do not touch the motor until Auto-Tuning is complete.
2. When performing Stationary Auto-Tuning 2 connected to a conveyor or other machine, ensure that the holding brake is not activated during Auto-Tuning.

■Precautions for Rotational and Stationary Auto-Tuning

Lower the base voltage based on *Fig 4.3* to prevent saturation of the MxC's output voltage when the rated voltage of the motor is higher than the voltage of the power supply to the MxC. Use the following procedure to perform Auto-Tuning.

1. Input the voltage of the input power supply to T1-03 (Motor Rated Voltage).
2. Input the results of the following formula to T1-05 (Motor Base Frequency):
   (Base frequency from the motors nameplate × setting of T1-03)/(Rated voltage from motors nameplate)
3. Perform Auto-Tuning.

After having completed Auto-Tuning, set E1-04 (Motor Maximum Frequency) to the base frequency shown on the motor nameplate.

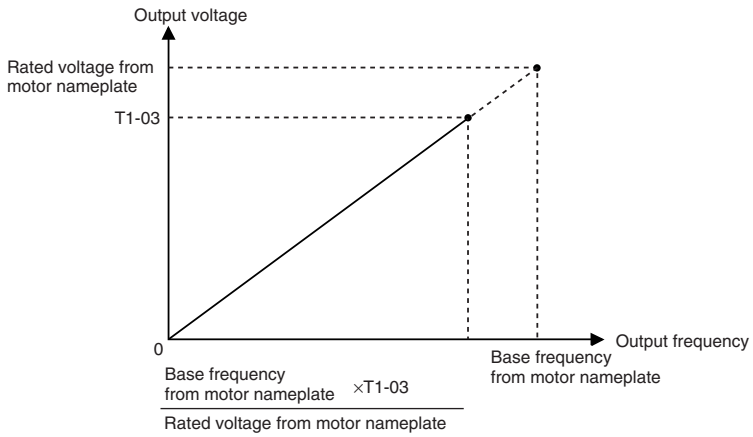


Fig 4.3 Motor Base Frequency and MxC Input Voltage Setting

IMPORTANT

1. When more speed precision is required at high speeds (i.e., 90% of the rated speed or higher), set T1-03 (Motor Rated Voltage) to the input power supply voltage × 0.85.
2. When operating at high speeds (i.e., 90% of the rated speed or higher), the output current will increase as the input power supply voltage is reduced. Be sure to provide sufficient margin in the MxC current.

Operator Display	Easy Setting	Detailed Setting
T1-03	Motor rated output	No-load voltage when motor turns at rated rotation
T1-05	Motor base frequency	No-load frequency when motor turns at rated rotation

■Precautions After Using Rotational and Stationary Auto-Tuning

If the values of the maximum output frequency and the base frequency differ, set E1-04 (Maximum Output Frequency) after Auto-Tuning.

■ Parameter Settings for Auto-Tuning

The following parameters must be set before Auto-Tuning.

Table 4.2 Parameter Settings before Auto-Tuning

Parameter Number	Name	Display	Setting Range	Default	Data Displays during Auto-Tuning		
					V/f	Open Loop Vector	Flux Vector
T1-00	Motor 1/2 Selection*1	Selects which set of motor parameters are to be used and set during Auto-Tuning. If Motor 2 selection (H1-□□=16) is not selected, this parameter will not be displayed. 1: 1st Motor - E1 to E2 2: 2nd Motor - E3 to E4	1 or 2	1	Yes	Yes	Yes
T1-01	Auto-Tuning Mode Selection	Selects the Auto-Tuning Mode. 0: Rotational Auto-Tuning (A1-02 = 2 or 3) 2: Terminal resistance only, (stationary) Auto-Tuning (A1-02 = 0, 1, 2, or 3) 4: Stationary Auto-Tuning 2	0 to 2, 4 *8	0 *2	Yes (only for 2)	Yes	Yes
T1-02	Motor Output Power	Sets the motor rated power in kilowatts (kW). *3 *5	0. 00 to 650.00 kW	5.50 kW *6	Yes	Yes	Yes
T1-03	Motor Rated Voltage	Sets the motor rated voltage in Volts (V). *3 *4	0.0 to 255.0 V (200 V class) 0.0 to 510.0 V (400 V class)	200.0 V (200 V class) 400.0 V (400 V class)	-	Yes	Yes
T1-04	Motor Rated Current	Sets the motor rated current in Amperes (A). *3 *5	2.70 to 54.00 A *9	19.60 A *6	Yes	Yes	Yes
T1-05	Motor Base Frequency	Sets the base frequency of the motor in Hertz (Hz). *3 *4	0.0 to 120.0	60.0 Hz	-	Yes	Yes
T1-06	Number of Motor Poles	Sets the number of motor poles.	2 to 48 poles *10	4 poles	-	Yes	Yes
T1-07	Motor Base Speed	Sets the base speed of the motor in min^{-1} *3 *6	0 to 24000	1750 min^{-1}	-	Yes	Yes
T1-08	Number of PG Pulses when Turning	Sets the number of pulses per revolution (PPR) for the encoder (pulse generator) being used without any multiplication factor.	0 to 60000	600	-	-	Yes
T1-09	Motor No-Load Current	Set the motor no-load current to the value indicated shown in the motor test report or other specification sheets. This parameter is displayed only when Stationary Auto-Tuning 2 (T1-01 = 4) is selected.	0.00 to 19.59 *7	5.10 A *6	No	No	Yes
T1-10	Motor Rated Slip	Set the amount of the motor rated slip in hertz. This parameter is displayed only if Stationary Auto-Tuning 2 (T1-01 = 4) is selected.	0.00 to 20.00	1.50 Hz *6	-	Yes	Yes

* 1. Not normally displayed. Displayed only when a Motor Switch Command is set for a multi-function digital input (one of H1-01 to H1-06 set to 16).
* 2. The default will change when the control method is changed. The V/f Control Method default is given.
* 3. For a constant-output motor, set the value at the base speed.
* 4. For an inverter motor or vector motor, the voltage and frequency may be lower than for a general-purpose motor. Always confirm setting on the nameplate or in test reports. Also, if you know the no-load values, set the no-load voltage in T1-03 and the no-load frequency in T1-05 to obtain better accuracy.
* 5. Stable vector control will be possible when the setting is between 75% and 100% of MxC rating.
* 6. The digital operator shows rpm instead of min^{-1}.

* 7. The default depends on the MxC capacity. The values for a 200 V class MxC for 5.5 kW are given.
* 8. The setting range depends on the MxC capacity. The value for a 200 V class MxC for 5.5 kW is given.
* 9. Set T1-02 and T1-04 when 2 is set for T1-01. Only set value 2 is possible for V/f control.
* 10.The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given.
* 11. For induction motors with two, four, or six poles.

◆ Application Settings

Parameters are set as required in Advanced Programming Mode ("ADV" will be displayed on the LCD screen). All the parameters that can be set in Quick Programming Mode can also be displayed and set in Advanced Programming Mode.

■Setting Examples

The following are examples of settings for applications.

- To prevent the machine from being operated in reverse, set b1-04 to 1 to disable reverse operation.
- To increase the speed of a 60 Hz motor by 10%, set E1-04 to 66.0 Hz.
- To use a 0 V to 10 V analog signal for a 60 Hz motor for variable-speed operation between 0 and 54 Hz (0% to 90% speed deduction), set H3-02 to 90.0%.
- To control speed between 20% and 80% to ensure smooth gear operation and limit the maximum speed of the machine, set d2-01 to 80.0% and set d2-02 to 20.0%.

◆ No-load Operation

To being 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 connected machinery before starting MxC operation from the digital operator. Confirm that the motor works normally and that no errors are displayed.

Jog Frequency Reference (d1-17, default: 6.00 Hz) can be started and stopped by pressing and releasing the JOG key on the digital operator. If the external sequence prevents operation from the digital operator, confirm that emergency stop circuits and machine safety mechanisms are functioning, and then start running the motor in Remote Mode (i.e., with a signal from the control signal terminals). The safety precautions must always be taken before starting the MxC 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 MxC operation.
Input these commands and reference regardless of the operation method (i.e., LOCAL or REMOTE).

◆ 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 run, make sure the STOP key on the digital operator is easily accessible.
- At first, set the frequency reference to a low speed of one tenth the normal operating speed.

■ Checking Operating Status

- Having checked that the operating direction is correct and that the machine is operating smoothly at slow speed, increase the frequency reference.
- After changing the frequency reference or the rotation direction, check that there is no oscillation or abnormal sound from the motor. Check the monitor display to ensure that U1-03 (Output Current) is not too high.
- Refer to *Notes on Tuning the MxC* on page 4-14 if hunting, oscillation, or other problems originating in the control system occur.

◆ Saving Parameters

Use the Verify Mode ("VERIFY" will be displayed on the LCD screen) to check parameters that have been changed for Test Run. Those values are then saved as parameters.

Any parameters that have been change by Auto-Tuning will also be displayed in Verify Mode.

If required, the copy function in parameters o3-01 and o3-02 displayed in Advanced Programming Mode can be used to copy the settings that were changed in the MxC to the memory in the digital operator. If setting changes are saved to the digital operator, they can be easily copied back to the MxC to speed up system recovery if for any reason the MxC has to be replaced.

The following functions can also be used to manage parameters.

- Saving parameters
- Setting access levels for parameters
- Setting a password

■ Initializing the MxC with Parameters (o2-03)

If o2-03 is set to 1 after completing a Test Run, parameters will be saved in the MxC. Later, after MxC settings have been changed further, the MxC can be reset back the parameters values that were saved earlier. All parameters are saved to a separate area of the memory that can be accessed by performing a "user initialization" (A1-03 = 1110).

■Parameter Access Levels (A1-01)

A1-01 can be set to 0 (monitoring-only) to prevent parameters from being changed. A1-01 can also be set to 1 (User-Specified Parameters) and used along with A2 parameters to display only parameters 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 parameters will be displayed only when the correct password is input.

Notes on Tuning the MxC

If hunting, oscillation, or other problems originating in the control system occur during Test Run, adjust the parameters listed in the following table according to the control method. This table lists only the most commonly used parameters.

Table 4.3 Adjusted Parameters

Control Method	Parameters	Performance	Default	Recommended Setting	Adjustment Method
V/f control (A1-02 = 0)	Middle Output Frequency Voltage A (E1-08) Minimum Output Voltage (E1-10)	• Improving torque at low speeds • Controlling shock at startup	Depends on capacity and voltage	Default to Default + 3 to 5 V*1	• Increase the setting if torque is insufficient at low speeds.*2 • Reduce the setting if shock at startup is large.
	Torque Compensation Primary Delay Time (C4-02)	• Increasing torque and speed response • Controlling hunting and oscillation	200 ms	200 to 1000 ms	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or oscillation occurs.
	Torque Compensation Gain (C4-01)	• Improving torque at low speeds (10 Hz or lower) • Controlling hunting and oscillation	1.00	0.50 to 1.50	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if hunting or oscillation occurs for light loads.
	Hunting Prevention Gain Setting (n1-02)	Controlling hunting and oscillation in middle-range speeds (10 to 40 Hz)	1.00	0.10 to 2.00	• Reduce the setting if torque is insufficient for heavy loads. • Increase the setting if hunting or oscillation occurs for light loads.
Open loop vector control (A1-02 = 2)	Middle Output Frequency Voltage A (E1-08) Minimum Output Voltage (E1-10)	• Improving torque at low speeds • Controlling shock at startup	Depends on capacity and voltage	Default to Default + 1 or 2 V*1	• Increase the setting if torque or speed response is slow.*2 • Reduce the setting if shock at startup is large.
	Speed Feedback Detection Control (AFR) Gain (n2-01)	• Increasing torque and speed response • Controlling hunting and oscillation in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or oscillation occurs.
	Speed Feedback Detection Control (AFR) Time Constant 2 (n2-03)	Increasing torque and speed response	750 ms	100 to 750 ms	• Reduce the setting if speed response is slow during sudden load change. • Increase the setting if hunting or oscillation occurs.
	Torque Compensation Primary Delay Time (C4-02)	• Increasing torque and speed response • Controlling hunting and oscillation	20 ms	20 to 100 ms	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or oscillation occurs.
	Slip Compensation Primary Delay Time (C3-02)	• Increasing speed response • Improving speed stability	200 ms	100 to 500 ms	• Reduce the setting if speed response is slow. • Increase the setting if the speed is not stable.

* 1. The setting is given for 200 V class MxCs. Double the voltage for 400 V class MxCs.

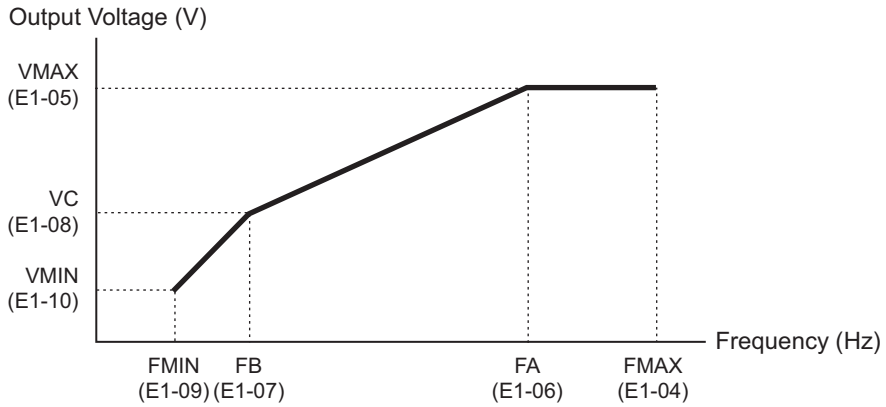
* 2. An example of how to tune the MxC is described on the next page.

Table 4.3 Adjusted Parameters (Continued)

Control Method	Parameters	Performance	Default	Recommended Setting	Adjustment Method
Open loop vector control (A1-02 = 2)	Slip Compensation Gain (C3-01)	• Improving speed accuracy	1.0	0.5 to 1.5	• Increase the setting if speed response is slow. • Reduce the setting if the speed is too fast.
Flux Vector Control (A1-02 = 3)	ASR Proportional Gain 1 (C5-01) and ASR Proportional Gain 2 (C5-03)	• Torque and speed response • Controlling hunting and oscillation	20.00	10.00 to 50.00	• Increase the setting if torque or speed response is slow. • Reduce the setting if hunting or oscillation occurs.
	ASR Integral Time 1 (C5-02) and ASR Integral Time 2 (C5-04)	• Torque and speed response • Controlling hunting and oscillation	0.500 s	0.300 to 1.000 s	• Reduce the setting if the torque or speed response is too slow. • Increase the setting if hunting or oscillation occurs.
	ASR Gain Switching Frequency (C5-07)	Switching the ASR proportional gain and integral time according to the output frequency	0.0 Hz	0.0 to max output frequency	Set the output frequency at which to change the ASR proportional gain and integral time when the same values cannot be used for both high-speed and low-speed operation.
	ASR Primary Delay Time Constant (C5-06)	• Controlling hunting and oscillation	0.004 s	0.004 to 0.020 s	Increase the setting if machine rigidity is low and the system vibrates easily.

■Tuning Procedures

If the torque is approximately 12 Hz and insufficient, tune the MxC as follows.



Assuming that the torque is insufficient in a middle frequency, calculate the middle output voltage using the following formula.

$$VC = \frac{FB}{FA} \times Vmax \times K$$

Settings must be within the following ranges:
VC: Middle frequency (E1-08)
FB: Middle output frequency (E1-07)
FA: Base frequency (E1-06)
Vmax: Maximum output voltage (E1-05)
K: 1.1 to 1.4

Parameter Number	Name Display	Setting Range	Default	Setting example if low torque near 12 Hz
E1-05	Maximum Output Frequency (VMAX) Max Frequency	0.0 to 255.0*1	200.0 VAC*1 *2	200*1
E1-06	Base Frequency (FA) Base Frequency	0.0 to 120.0	60.0 Hz*2	60
E1-07	Mid Output Frequency (FB) Mid Frequency A	0.0 to 120.0	3.0 Hz*2	12
E1-08	Mid Voltage (VC) Mid Voltage A	0.0 to 255.0*1	13.0 VAC*1 *2	If K= 1.1, then set to 44. If K= 1.2, then set to 48. If K= 1.3, then set to 52. If K= 1.4, then set to 56. *1

* 1. Use these values for 200 V class MxCs. For 400 V class MxCs, use a value that is twice as large as that for those in the 200 V class.

* 2. If the control mode is changed, the default settings also change. The values shown in the table are the default settings for Open Loop Vector Control.

IMPORTANT

1. If the value in E1-08 is too large, the excitation current of the motor will be high. A large current also occurs in operations without a load.
2. The level of magnetic saturation depends on the type of motor that is used. If changing the setting of E1-08, first set K to 1.1. If the setting of K is too large, a high current occurs in operations without a load and results in poor efficiency.

■Precautions While Tuning the MxC

- Do not change the Torque Compensation Gain (C4-01) from its default setting of 1.00 when using Open Loop Vector Control.
- If speeds are inaccurate during regeneration in Open Loop Vector Control, enable Slip Compensation During Regeneration (C3-04 = 1).
- Use slip compensation to improve speed control during V/f Control Method (A1-02 = 0).
  Set the Motor Rated Current (E2-01), Motor Rated Slip (E2-02), and Motor No-Load Current (E2-03), and then adjust the Slip Compensation Gain (C3-01) to between 0.5 and 1.5. The default setting for V/f Control Method is C3-01 = 0.0 (slip compensation disabled).

The following parameters will also indirectly affect the control system:

Table 4.4 Parameters Indirectly Affecting Control and Applications

Parameters	Application
Dwell Function (b6-01 to b6-04)	Used for heavy loads or large machine backlashes.
Droop Function (b7-01, b7-02)	Used to soften the torque or to balance the load between two motors. Can be used when the Control Method Selection (A1-02) is set to 3.
Accel/Decel 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 Frequencies (d3-01 to d3-04)	Used to avoid resonance points during run.
Analog Input Filter Time Constant (H3-12)	Used to prevent fluctuations in analog input signals caused by noise.
Stall Prevention (L3-01 to L3-03, L3-05, L3-06)	Used to prevent overvoltage errors and motor stalling for heavy loads or rapid accel/decel. Stall prevention is enabled by default and the setting does not normally need to be changed.
Torque Limits (L7-01 to L7-04, L7-06, L7-07)	Set the maximum torque during vector control. If a setting is increased, use a motor with higher capacity than the MxC. If a setting is reduced, stalling can occur under heavy loads.
Feed Forward Control (n5-01 to n5-03)	Used to increase response for accel/decel or to reduce overshooting when there is low machine rigidity and the gain of the speed controller (ASR) cannot be increased. The inertia ratio between the load and motor and the acceleration time of the motor running alone must be set.

5

Parameters and Settings

This chapter describes all parameters that can be set in the MxC.

Parameter Descriptions 5-2
Digital Operation Display Functions and Levels 5-3
Parameter Tables.....5-7

Parameter Descriptions

This section describes how to read and understand the parameter tables.

◆ Understanding Parameter Tables

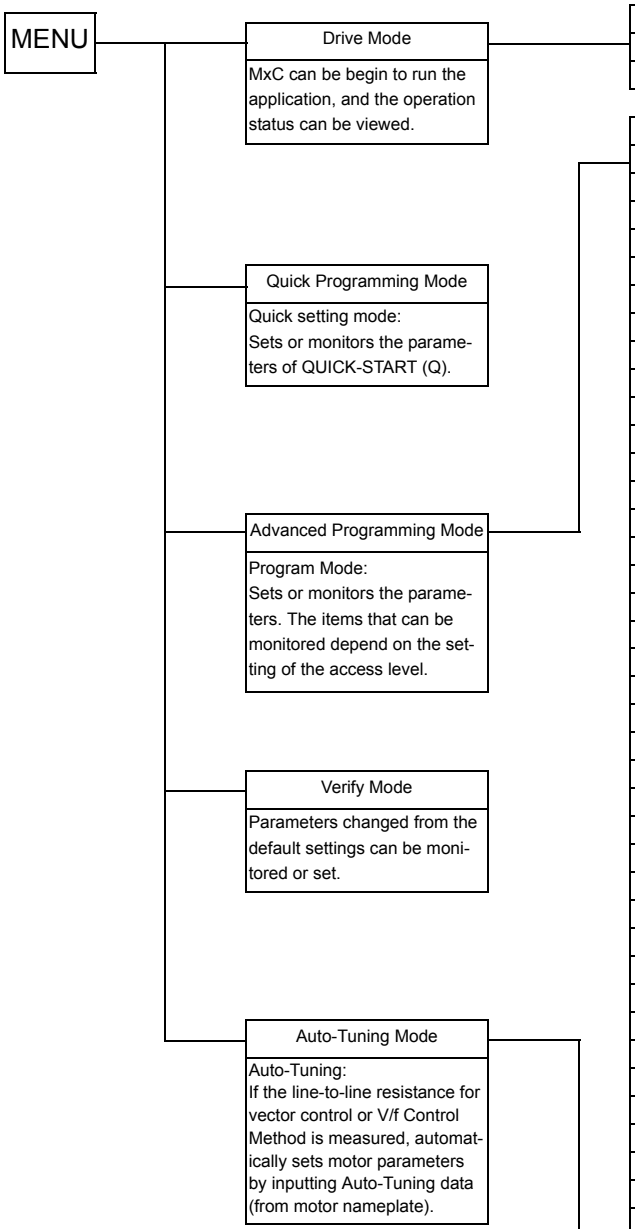
Parameter tables are structured as shown below. Here, b1-01 (Frequency Reference Selection) is used as an example.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMO-BUS Register
						V/f	Open Loop Vector	Flux Vector	
b1-01	Frequency Reference Selection / Reference Source	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q	180H

- Parameter Number: The number of the parameter.
- Name: The name of the parameter.
- Description: Details on the function or settings of the parameter.
- Setting Range: The setting range for the parameter.
- Default: The default (each control method has its own default. Therefore the default changes when the control method is changed).
  Refer to page 5-64 for defaults by control method.
- Changes during Run: Indicates whether or not the parameter can be changed while the MxC is in operation.
  Yes: Parameter settings can be changed while the Run Command is present.
  No: Settings cannot be changed while the Run Command is present.
- Control Methods: Indicates the control methods in which the parameter 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 parameter.

Digital Operation Display Functions and Levels

The following illustration shows the menu screens and display hierarchy of the digital operator.



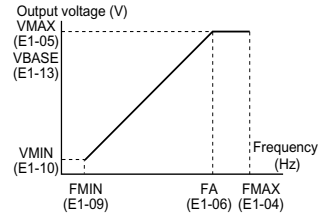
No.	Function	Display	Page
U1	Status Monitor Parameters	Monitor	5-57
U2	Fault Trace	Fault Trace	5-62
U3	Fault History	Fault History	5-63
A1	Initialize Mode	Initialization	5-7
A2	User-Specified Setting Mode	User Parameter	5-8
b1	Operation Mode Selections	Sequence	5-9
b2	DC Injection Braking	DC Braking	5-10
b3	Speed Search	Speed Search	5-11
b4	Timer Function	Delay Timers	5-12
b5	PID Control	PID Control	5-12
b6	Dwell Functions	Reference Hold	5-14
b7	Droop Control	Droop Control	5-14
b9	Zero-Servo	Zero Servo	5-15
C1	Acceleration/Deceleration	Accel/Decel	5-16
C2	S-Curve Acceleration/Deceleration	S-Curve Acc/Dcc	5-17
C3	Motor Slip Compensation	Motor-Slip Comp	5-17
C4	Torque Compensation	Torque Comp	5-18
C5	Speed Control (ASR)	ASR Tuning	5-19
C6	Carrier Frequency	Carrier Freq	5-19
d1	Preset Reference	Preset Reference	5-20
d2	Reference Limits	Reference Limits	5-21
d3	Jump Frequencies	Jump Frequencies	5-22
d4	Reference Frequency Hold	Sequence	5-22
d5	Torque Control	Torque Control	5-23
d6	Field Weakening	Field-weakening	5-24
E1	V/f Pattern	V/f Pattern	5-25
E2	Motor Setup	Motor Setup	5-26
E3	Motor 2 V/f Pattern	V/f Pattern 2	5-27
E4	Motor 2 Setup	Motor Setup 2	5-27
F1	PG Option Setup	PG Option Setup	5-29
F2	Analog Reference Card	AI-14 Setup	5-30
F3	Digital Reference Card	DI-08, 16 Setup	5-31
F4	Analog Monitor Cards	AO-08, 12 Setup	5-31
F5	Digital Output Cards	DO-02,08 Setup	5-32
F6	Communications Option Cards	ComOPT Setup	5-33
H1	Multi-Function Digital Inputs	Digital Inputs	5-34
H2	Multi-Function Digital Outputs	Digital Outputs	5-37
H3	Analog Inputs	Analog Inputs	5-39
H4	Multi-Function Analog Outputs	Analog Outputs	5-41
H5	MEMOBUS Communications	Serial Com Setup	5-42
L1	Motor Overload	Motor Overload	5-43
L2	Power Loss Ridethrough	PwrLoss Ridethru	5-44
L3	Stall Prevention	Stall Prevention	5-45
L4	Reference Detection	Ref Detection	5-46
L5	Fault Restart	Fault Restart	5-47
L6	Torque Detection	Torque Detection	5-47
L7	Torque Limits	Torque Limit	5-48
L8	Hardware Protection	Hdwe Protection	5-49
n1	Hunting Prevention Function	Hunting Prev	5-50
n2	Speed Feedback Protection Control	AFR	5-51
n5	Feed Forward	Feedfoward Cont	5-51
o1	Monitor Select	Monitor Select	5-52
o2	Multi-Function Selections	Key Selections	5-53
o3	Copy Function	COPY Function	5-54
T1	Motor Auto-Tuning	Auto-Tuning	5-55

◆ Quick Programming Mode and Available Parameters

The minimum parameters required for MxC operation can be programmed and monitored in the Quick Programming Mode. The parameters displayed in the Quick Programming Mode are listed in the following table (more parameters are available in the Advanced Programming Mode).

Refer to the illustration of menus and modes on page 3-5 for an overview of Quick Programming Mode.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMOBUS Register
						V/f	Open Loop Vector	Flux Vector	
A1-02	Control Method Selection / Control Method	Selects the Control Method. 0: V/f Control Method without a PG encoder 2: Open Loop Vector 3: Flux Vector (Closed Loop Vector) This parameter is not initialized by the initialize operation.	0, 2, or 3	2	No	Q	Q	Q	102H
b1-01	Frequency Reference Selection / Reference Source	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q	180H
b1-02	Run Command Selection / Run Source	Selects the Run Command input source. 0: Operator - RUN and STOP keys on digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q	181H
b1-03	Stopping Method Selection / Stopping Method	Selects the stopping method when the Run Command is removed. 0: Decelerate to stop 1: Coast to Stop 2: DC Injection to Stop 3: Coast with Timer (A new Run Command is ignored if received before the timer expires).	0 to 3 *1	0	No	Q	Q	Q	182H
C1-01	Acceleration Time 1 / Accel Time 1	Sets the time to accelerate from zero to maximum frequency.	0.0 to 6000.0 *2	10.0 s	Yes	Q	Q	Q	200H
C1-02	Deceleration Time 1 / Decel Time 1	Sets the time to decelerate from maximum frequency to zero.			Yes	Q	Q	Q	201H
C6-02	Carrier Frequency Selection / CarrierFreq Sel	Select carrier frequency 2: 4.0 kHz 4: 8.0 kHz 6: 12.0 kHz	2, 4, or 6 *3	2	No	Q	Q	Q	224H

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register
d1-01	Frequency Reference 1 / Reference 1	Set the frequency reference in the unit specified in o1-03 (Digital Operator Display Selection, unit: Hz)	0.00 to 120.00	0.00 Hz	Yes	Q	Q	Q	280H
d1-02	Frequency Reference 2 / Reference 2	Frequency reference when multi-step speed reference 1 is on for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	Q	Q	281H
d1-03	Frequency Reference 3 / Reference 3	Frequency reference when multi-step speed reference 2 is on for a multi-function input (unit: Set in o1-03).	0.00 to 120.00	0.00 Hz	Yes	Q	Q	Q	282H
d1-04	Frequency Reference 4 / Reference 4	Frequency reference when multi-function input “Multi-step speed reference 1, 2” is on. Setting units are affected by o1-03.		0.00 Hz	Yes	Q	Q	Q	283H
d1-17	Jog Frequency Reference / Jog Reference	Frequency reference when Jog Frequency Selection, FJOG command, or RJOG command is on for a multi-function input (unit: Set in o1-03).		6.00 Hz	Yes	Q	Q	Q	292H
E1-01	Input Voltage Setting / Input Voltage	Set the MxC input voltage in 1 volt. This set value will be the basis for the protection functions.	155 to 255 *5	200 VAC *5	No	Q	Q	Q	300H
E1-03	V/f Pattern Selection / V/F Selection	0 to D: Select from the 14 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10.)	0 to D, F	F	No	Q	Q	No	302H
E1-04	Maximum Output Frequency / Max Frequency		40.0 to 120.0	60.0 Hz *4	No	Q	Q	Q	303H
E1-05	Maximum Output Voltage / Max Voltage		0.0 to 255.0 *5	200.0 VAC *4 *5	No	Q	Q	Q	304H
E1-06	Base Frequency / Base Frequency	To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 120.0	60.0 Hz *4	No	Q	Q	Q	305H
E1-09	Minimum Output Frequency / Min Frequency		0.0 to 120.0	0.5 Hz *4	No	Q	Q	A	308H
E1-13	Base Voltage / Base Voltage	Set only when the V/f pattern is finely adjusted in the constant power area above base speed. Adjustment is not normally required. If E1-13 = 0.0, then value in E1-05 is used for E1-13. Auto-Tuning sets this value.	0.0 to 255.0 *5	0.0 VAC *6	No	A	Q	Q	30CH
E2-01	Motor Rated Current / Motor Rated FLA	Sets the motor nameplate full load current in amperes (A). This value is automatically set during Auto-Tuning.	2.70 to 54.00 *7	19.60 A *8	No	Q	Q	Q	30EH
E2-04	Number of motor poles / Number of Poles	Set the number of motor poles. This value is automatically set during Auto-Tuning.	2 to 48	4 poles	No	No	No	Q	311H

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register
E2-11	Motor Rated Output / Mtr Rated Power	Set the output of the motor in units of 0.01kW. This parameter is automatically set during Auto-Tuning.	5.50 to 650.00	5.50 *8	No	Q	Q	Q	318H
F1-01	PG Parameter / PG Pulses/Rev	Set the number of pulses per rotation for the PG (pulse generator or encoder) being used. (Do not set as a multiple.)	0 to 60000	600	No	No	No	Q	380H
H4-02	Terminal FM Gain Setting / Terminal FM Gain	Set the voltage level gain for multi-function analog output 1. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. Voltage output from the terminals, however, have a 10 V max. meter calibration function.*9	0.00 to 2.50	1.00	Yes	Q	Q	Q	41EH
H4-05	Terminal AM Gain Setting / Terminal AM Gain	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. Voltage output from the terminals, however, have a 10 V max. A meter calibration function is available.*9	0.00 to 2.50	0.50	Yes	Q	Q	Q	421H
L1-01	Motor Overload Protection Selection / MOL Fault Select	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General-purpose motor protection 2: Inverter motor protection 3: Vector motor protection In some applications when the MxC power supply is turned off, the thermal value is reset, so even if this parameter is set to 1, protection may not be effective. When several motors are connected to one MxC, set to 0 and ensure that each motor is installed with a protection device.	0 to 3	1	No	Q	Q	Q	480H

* 1. 0 or 1 for Flux Vector Control.

* 2. The setting range for accel/decel times depends on the setting of C1-10 (Accel/Decel Time Setting Units). If C1-10 is set to 0, the setting range is 0.00 to 600.00 (s).

* 3. Fixed to 2:4 kHz for V/f.
For Open Loop Vector Control, can select from 2:4 kHz or 4:8 kHz (Fixed to 2: 4 kHz for 200 V class MxC for 45 kW and 400 V class MxCs for 22 kW and 45 kW).

* 4. The default will change when the control method is changed. The Open Loop Vector defaults is given.

* 5. These are values for a 200 V class MxC. Values for a 400 V class MxC are double.

* 6. E1-13 is set to the same value as E1-05 by Auto-Tuning.

* 7. The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given.

* 8. The defaults depend on the MxC capacity. The values for a 200 V class MxC for 5.5 kW are given.

* 9. The FM output can be adjusted when the H4-02 or H4-03 setting is displayed in Quick, Advanced, or Verify Mode while the motor is stopped.
The AM output can be adjusted when the H4-05 or H4-06 setting is displayed in Quick, Advanced, or Verify Mode while the motor is stopped.
For analog output, the value equivalent to 100% of output value of monitored item is multiplied by the gain setting and the set bias is added.

Parameter Tables

◆ A: Initialization

The following settings available in the Initialization parameters (all parameters starting with the letter "A"). The parameters determine the language displayed on the digital operator, access level, control method, how parameters settings should be initialized.

■ A1: Initialize Mode

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
A1-00	Language Selection / Select Language	Language selection for the digital operator. This parameter is not reset to the default by A1-03. 0: English 1: Japanese This parameter is not initialized by the initialize operation.	0, 1	1	Yes	A	A	A	100H	-
A1-01	Access Level Selection / Access Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and Initialize mode.) 1: Used to select user parameter (Only parameters set in A2-01 to A2-32 can be read and set.) 2: Advanced (Parameters can be read and set in both quick programming (Q) mode and advanced programming (A) mode.)	0 to 2	2	Yes	A	A	A	101H	4-13 6-133
A1-02	Control Method Selection / Control Method	Selects the Control Method of the MxC. 0: V/f Control 2: Open Loop Vector Control 3: Flux Vector Control This parameter is not initialized by the initialize operation.	0, 2, or 3	2	No	Q	Q	Q	102H	4-4 4-6 4-14
A1-03	Initialize Parameters / Init Parameters	Used to initialize the parameters using the specified method. 0: No initializing 1110: Initializes using the parameters 2220: Initializes using a two-wire sequence. (Initializes to the default.) 3330: Initializes using a three-wire sequence.	0 to 3330	0	No	A	A	A	103H	-
A1-04	Password 1 / Enter Password	Password input when a password has been set in A1-05. This function write-protects some parameters of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 parameters can no longer be changed. (Programming mode parameters can be changed.)	0 to 9999	0	No	A	A	A	104H	4-13 6-133

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
A1-05	Password 2 / Select Password	Used to set a four digit number as the password. This parameter 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	4-13 6-134

■A2: User-specified Setting Mode

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
A2-01 to A2-32	User parameters / User Param 1 to 32	Used to set the parameter numbers that can be set/read. Maximum 32. Effective when the Access Level Selection (A1-01) is set to User Program (1). Parameters set in A2-01 to A2-32 can be set/read in programming mode.	b1-01 to o3-02	-	No	A	A	A	106H to 125H	6-134

◆ b: Application

The following settings are made with the application parameters (B parameters): operation method selection, DC injection braking, speed searching, timer functions, dwell functions, and energy saving functions.

■b1: Operation Mode Selection

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMOBUS Register	Page
						V/f	Open Loop Vector	Flux Vector		
b1-01	Frequency Reference Selection / Reference Source	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q	180H	4-4 6-2 6-67 6-84
b1-02	Run Command Selection / Run Source	Selects the Run Command input source. 0: Operator - RUN and STOP keys on digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q	181H	4-4 6-8 6-67 6-84
b1-03	Stopping Method Selection / Stopping Method	Selects the stopping method when the Run Command is removed. 0: Decelerate to stop 1: Coast to Stop 2: DC Injection to Stop 3: Coast with Timer (A new Run Command is ignored if received before the timer expires).	0 to 3 *1	0	No	Q	Q	Q	182H	4-4 6-11
b1-04	Reverse Operation Selection / Reverse Oper	Determines the forward rotation of the motor, and if reverse operation is disabled. 0: Reverse enabled. 1: Reverse disabled.	0 or 1	0	No	A	A	A	183H	6-55
b1-05	Minimum Output Frequency (E1-09) or Less Operation Selection / Zero-Speed Oper	Operation method when frequency reference is less than minimum output frequency set in E1-09. 0: Operates according to frequency reference (E1-09 is disabled). 1: Output shuts off (coast to stop if less than E1-09). 2: Operates according to E1-09 (frequency reference set to E1-09). 3: Zero speed (frequency reference becomes zero when less than E1-09).	0 to 3	0	No	No	No	A	184H	6-11
b1-06	Digital Input Scan Time / Cntl Input Scans	Sets the scan rate of digital input terminals. 0: 2 ms - 2 scans (for quick response) 1: 5 ms - 2 scans (for noisy environments)	0 or 1	1	No	A	A	A	185H	-

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b1-07	Local/Remote Run Selection / LOC/REM RUN Sel	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 During Program / RUN CMD at PRG	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*2:The MENU key is disabled during run.	0 or 2 *2	0	No	A	A	A	187H	-

* 1. 0 or 1 for Flux Vector Control.

* 2. Applicable for the Varispeed AC with software versions PRG: 1050 or later.

■b2: DC Injection Braking

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b2-01	DC Injection Braking Start Frequency / DCInj Start Freq	Sets the frequency at which DC injection braking starts when decelerate to stop (b1-03 = 0) is selected. If b2-01< E1-09, DC Injection braking starts at E1-09. Note: Zero Speed restrictions are active in Flux Vector Mode.	0.0 to 10.0	0.5 Hz	No	A	A	A	189H	6-11 6-123
b2-02	DC Injection Braking Current / DCInj Current	Sets the DC injection braking current as a percentage of the MxC rated current. Note: The DC excitation current is determined by the setting in E2-03 when operating in Flux Loop Vector Control Method.	0 to 100	50%	No	A	A	No	18AH	6-11 6-15
b2-03	DC Injection Braking Time/DC Excitation Time at Start / DCInj Time @Start	Sets the time of DC injection braking at start in units of 0.01 seconds.	0.00 to 10.00	0.00 s	No	A	A	A	18BH	6-11 6-15
b2-04	DC Injection Braking Time at Stop / DCInj Time @Stop	Sets the time length of DC injection braking at stop in units of 0.01 seconds. 1: When b1-03 = 2, actual DC Injection time is calculated as follows: (b2-04) × 10 × (OutputFreq) / (E1-04) 2: When b1-03 = 0, this parameter determines the amount of time DC Injection is applied to the motor at the end of the decel ramp. 3: This should be set to a minimum of 0.50 seconds when using HSB. This will activate DC injection during the final portion of HSB and help ensure that the motor stops completely.	0.00 to 10.00	0.50 s	No	A	A	A	18CH	6-12

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b2-08	Magnetic Flux Compensation Capacity / Field Comp	Sets the magnetic flux compensation as a percentage of the no-load current value (E2-03).	0 to 1000	0%	No	No	A	No	190H	-

■b3: Speed Search

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b3-01	Speed Search Selection / SpdSrch at Start	Enables/disables the speed search function for the Run Command and sets the speed search method. 0: Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation: When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection: The speed search is started from the frequency when power was momentarily lost and the maximum frequency, and the speed is detected at the search current level.	0 to 3*1	0	No	A	A	No	191H	6-59
b3-02	Speed Search Deactivation Current / SpdSrch Current	Used only when b3-01 = 2 or 3. Sets speed search operating current in units of percent, with MxC rated current as 100%. Note: Normally not necessary to change. If the MxC won't run after a restart, lower this value.	0 to 200	100% *2	No	A	A	No	192H	6-59
b3-03	Speed Search Deceleration Time / SpdSrch Dec Time	Used only when b3-01 = 2 or 3. Sets the deceleration time during speed search.	0.1 to 10.0	2.0 s	No	A	A	No	193H	6-59
b3-04 *4	Current Suppression Gain During Search / SpdSrch I Gain	Sets the gain used to suppress output current during a current detection speed search. If resistor overheat (SOH) occurs, reduce the setting.	10 to 100	100% *3	No	A	A	No	194H	6-59
b3-05	Speed Search Delay Time / Search Delay	Delays the speed search operation after a momentary power loss to allow time for an external output contactor to re-energize.	0.0 to 20.0	0.2 s	No	A	A	A	195H	6-59
b3-10	Speed Search Detection Compensation Gain / Srch Detect Comp	Sets the gain for the frequency at which the MxC starts speed estimation speed search. Use only when b3-01 = 0 or 1.	1.00 to 1.20	1.05	No	A	A	No	19AH	6-59

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b3-14	Bi-directional Speed Search Selection / Bidir Search Sel	This parameter enables the MxC to detect the direction of rotation of the motor during speed search. 0: Disable - MxC uses frequency reference direction. 1: Enable - MxC uses detected direction	0 or 1	0	No	A	A	No	19EH	6-59
b3-19	Number of Speed Search Restarts / Num of SrchRestr	Sets the number of restarts possible for speed search restart operations.	0 to 10	1	No	A	A	A	1F2H	6-60

* 1. Can be set to 1 or 2 only for the MxC models CIMR-ACA4110 and 4160.
* 2. The default will change when the control method is changed. The Open Loop Vector defaults are given.
* 3. The defaults depend on the MxC capacity. The values for a 200 V class MxC for 5.5 kW are given.
* 4. Applicable for the Varispeed AC with software versions PRG: 1052 or later.

■b4: Timer Function

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b4-01	Timer Function ON-Delay Time / Delay-ON Timer	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	A	A	A	1A3H	6-93
b4-02	Timer Function OFF-Delay Time / Delay-OFF Timer	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	A	A	A	1A4H	6-93

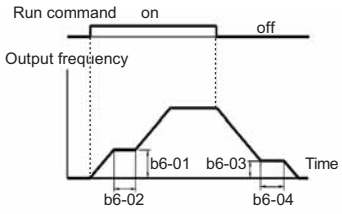
■b5: PID Control

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b5-01	PID Function Setting / PID Mode	0: Disabled 1: Enabled (Deviation is D-controlled.) 2: Enabled (Feedback value is D-controlled.) 3: PID control enabled (frequency reference + PID output, D control of deviation) 4: PID control enabled (frequency reference + PID output, D control of feedback value).	0 to 4	0	No	A	A	A	1A5H	6-95
b5-02	Proportional Gain Setting / PID Gain	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	A	A	1A6H	6-95
b5-03	Integral Time Setting / PID I Time	Sets I-control integral time in 1-second units. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A	A	A	1A7H	6-95

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
b5-04	Integral Limit Setting / PID I Limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0 %	Yes	A	A	A	1A8H	6-95
b5-05	Derivative Time / PID 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	A	A	A	1A9H	6-95
b5-06	PID Output Limit / PID Limit	Sets the upper limit after PID-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0 %	Yes	A	A	A	1AAH	6-95
b5-07	PID Offset Adjustment / PID Offset	Sets the offset after PID-control as a percentage of the maximum output frequency.	-100.0 to +100.0	0.0%	Yes	A	A	A	1ABH	6-95
b5-08	PID Primary Delay Time Constant / PID Delay Time	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	A	A	A	1ACH	6-95
b5-09	PID Output Level Selection / Output Level Sel	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	A	A	A	1ADH	6-95
b5-10	PID Output Gain Setting / Output Gain	Sets output gain.	0.0 to 25.0	1.0	No	A	A	A	1AEH	6-95
b5-11	PID Output Reverse Selection / Output Rev Sel	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	A	A	A	1AFH	6-95
b5-12	PID Feedback Reference Missing Detection Selection / Fb los Det Sel	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	A	A	A	1B0H	6-96
b5-13	PID Feedback Loss Detection Level / Fb los Det Lvl	Sets the PID feedback loss detection level as a percent units, with the maximum output frequency at 100%.	0 to 100	0%	No	A	A	A	1B1H	6-96
b5-14	PID Feedback Loss Detection Time / Fb los Det Time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A	A	A	1B2H	6-96
b5-15	PID Sleep Function Start Level / PID Sleep Level	Set the PID sleep function start level as a frequency.	0.0 to 120.0	0.0 Hz	No	A	A	A	1B3H	6-96
b5-16	PID Sleep Delay Time / PID Sleep Time	Set the delay time until the PID sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	A	A	A	1B4H	6-96

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b5-17	PID Accel/Decel Time / PID Acc/Dec Time	Set the accel/decel time for PID reference in seconds.	0.0 to 25.5	0.0 s	No	A	A	A	1B5H	6-96

■b6: Dwell Functions

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b6-01	Dwell Reference at Start / Dwell Ref @Start	 The dwell function is used to temporarily hold the frequency when driving a motor with heavy load.	0.0 to 120.0	0.0 Hz	No	A	A	A	1B6H	4-17 6-151
b6-02	Dwell Time at Start / Dwell Time @Start		0.0 to 10.0	0.0 s	No	A	A	A	1B7H	4-17 6-151
b6-03	Dwell Frequency at Stop / Dwell Ref @Stop		0.0 to 120.0	0.0 Hz	No	A	A	A	1B8H	4-17 6-152
b6-04	Dwell Time at Stop / Dwell Time @Stop		0.0 to 10.0	0.0 s	No	A	A	A	1B9H	4-17 6-152

■b7: Droop Control

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
b7-01	Droop Control Level / Droop Quantity	Sets the speed decrease as a percentage of motor base speed (E1-06) when the motor is at 100% load torque. Setting of 0.0 disables droop control.	0.0 to 100.0	0.0	Yes	No	No	A	1CAH	4-17 6-122
b7-02	Droop Control Delay Time / Droop Delay Time	Determines the droop control delay time in response to a load change.	0.03 to 2.00	0.05 s	Yes	No	No	A	1CBH	4-17 6-122

■b9: Zero-servo

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
b9-01	Zero Servo Gain / Zero Servo Gain	Adjust the strength of the zero-servo lock. Enabled when the "zero-servo command" is set for the multi-function input. When the zero-servo command has been input and the frequency reference drop below excitation level (b2-01), a position control loop is created and the motor stops. Increasing the zero-servo gain in turn increases the strength of the lock. Increasing it by too much will cause oscillation.	0 to 100	5	No	No	No	A	1DAH	6-123
b9-02	Zero Servo Completion Width / Zero Servo Count	Sets the output width of the P-lock completion signal. Enabled when the "zero-servo completion (end)" is set for a multi-function input. The zero-servo completion signal is on when the current position is within the range (the zero-servo position ± zero-servo completion width.) Set the allowable position displacement from the zero-servo position to 4 times the pulse rate of the PG (pulse generator, encoder) in use.	0 to 16383	10	No	No	No	A	1DBH	6-123

◆ C: Auto-Tuning

The following settings are made with the Auto-Tuning parameters (C parameters): Accel/decel times, S-curve characteristics, slip compensation, torque compensation, speed control, and carrier frequency functions.

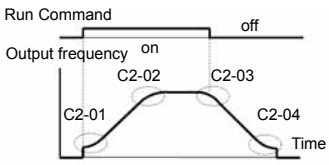
■C1: Acceleration/Deceleration

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
C1-01	Acceleration Time 1 / Accel Time 1	Sets the time to accelerate from zero to maximum frequency.	0.0 to 6000.0*	10.0 s	Yes	Q	Q	Q	200H	4-4, 4-17, 6-17
C1-02	Deceleration Time 1 / Decel Time 1	Sets the time to decelerate from maximum frequency to zero.			Yes	Q	Q	Q	201H	4-4, 4-17, 6-17
C1-03	Acceleration Time 2 / Accel Time 2	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.			Yes	A	A	A	202H	4-17, 6-17
C1-04	Deceleration Time 2 / Decel Time 2	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.			Yes	A	A	A	203H	4-17, 6-17
C1-05	Acceleration Time 3 / Accel Time 3	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.			No	A	A	A	204H	4-17, 6-17
C1-06	Deceleration Time 3 / Decel Time 3	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.			No	A	A	A	205H	4-17, 6-17
C1-07	Acceleration Time 4 / Accel Time 4	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.			No	A	A	A	206H	4-17, 6-17
C1-08	Deceleration Time 4 / Decel Time 4	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.			No	A	A	A	207H	4-17, 6-17
C1-09	Fast Stop Time / Fast Stop Time	Sets the time to decelerate from maximum frequency to zero for the multi-function input "Fast Stop" function. Note: This parameter is also used by selecting "Fast Stop" as a Stop Method when a fault is detected.			No	A	A	A	208H	4-17, 6-16
C1-10	Accel/Decel Time Setting Units / Acc/Dec Units	Sets the setting resolution of C1-01 to C1-09. 0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	0 or 1	1	No	A	A	A	209H	4-17, 6-17

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
C1-11	Accel/Decel Switch Frequency / Acc/Dec SW Freq	Sets the frequency for automatic switching of accel/decel times. Fout < C1-11: Accel/Decel Time 4 Fout≥C1-11: Accel/Decel Time 1 Multi-function inputs "Multi-Acc/Dec 1" and "Multi-Acc/Dec 2" have priority over C1-11. Note: With Multi-Function Input, Accel/Decel Time 1 and 2 will take precedence.	0.0 to 120.0	0.0 Hz	No	A	A	A	20AH	4-17 6-17

* The setting range for accel/decel times depends on the setting of C1-10 (Accel/Decel Time Setting Units). If C1-10 is set to 0, the setting range is 0.00 to 600.00 (s).

■C2: S-Curve Acceleration/Deceleration

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
C2-01	S-Curve Characteristic at Accel Start / SCrv Acc @ 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	0.20 s	No	A	A	A	20BH	4-17 6-18
C2-02	S-Curve Characteristic at Accel End / SCrv Acc @ End		0.00 to 2.50	0.20 s	No	A	A	A	20CH	4-17 6-18
C2-03	S-Curve Characteristic at Decel Start / SCrv Dec @ Start		0.00 to 2.50	0.20 s	No	A	A	A	20DH	4-17 6-18
C2-04	S-Curve Characteristic at Decel End / SCrv Dec @ End		0.00 to 2.50	0.00 s	No	A	A	A	20EH	4-17 6-18

■C3: Motor Slip Compensation

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
C3-01	Slip Compensation Gain / Slip Comp Gain	This parameter is used to increase motor speed to account for motor slip by boosting the output frequency. If the speed is lower than the frequency reference, increase C3-01. If the speed is higher than the frequency reference, decrease C3-01. Note: Adjustment is not normally required. When operating in Open Loop Vector, this parameter works as a function to set the proper amount of gain.	0.0 to 2.5	1.0*	Yes	A	A	A	20FH	4-15 6-32

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
C3-02	Slip Compensation Primary Delay Time / Slip Comp Time	This parameter adjusts the filter on the output of the slip compensation function. Increase to add stability, decrease to improve response.	0 to 10000	200 ms *	No	A	A	No	210H	4-14 6-32
C3-03	Slip Compensation Limit / Slip Comp Limit	This parameter sets the upper limit for the slip compensation function. It is set as a percentage of motor rated slip (E2-02).	0 to 250	200%	No	A	A	No	211H	6-32
C3-04	Slip Compensation Selection During Regeneration / Slip Comp Regen	Determines whether slip compensation is enabled or disabled during regenerative operation. 0: Disabled. 1: Enabled.	0 or 1	0	No	A	A	No	212H	6-32
C3-05	Output Voltage Limit Operation Selection / Output V Lim Sel	Determines if the motor magnetic flux is automatically decreased when output voltage saturation occurs. 0: Disabled. 1: Enabled.	0 or 1	0	No	No	A	A	213H	6-32

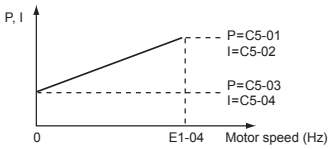
* The default will change when the control method is changed. The Open Loop Vector defaults are given.

■C4: Torque Compensation

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
C4-01	Torque Compensation Gain / Torq Comp Gain	This parameter sets the gain for the MxC's automatic torque boost function to match the MxC's output voltage to the motor load. This parameter helps to produce better starting torque. It determines the amount of torque or voltage boost based upon motor current, motor resistance, and output frequency. Adjustment is not normally required.	0.00 to 2.50	1.00	Yes	A	A	No	215H	4-14 6-35
C4-02	Torque Compensation Primary Delay Time / Torq Comp Time	This parameter adjusts the filter on the output of the torque compensation function. Increase to add stability, decrease to improve response. Adjustment is not normally required.	0 to 10000	100 ms *	No	A	A	No	216H	4-14 6-35
C4-03	Torque Compensation at Forward Start / F TorqComp @ start	Sets torque compensation at forward start as a percentage of motor torque.	0.0 to 200.0	0.0%	No	No	A	No	217H	-
C4-04	Torque Compensation at Reverse Start / R TorqCmp @ start	Sets torque compensation at reverse start as a percentage of motor torque.	-200.0 to 0.0	0.0%	No	No	A	No	218H	-
C4-05	Torque Compensation Time Constant / TorqCmp Delay T	Sets the time constant for torque compensation at forward start and reverse start (C4-03 and C4-04). The filter is disabled if the time is set to 4 ms or less.	0 to 200	10 ms	No	No	A	No	219H	-

* The default will change when the control method is changed. The Open Loop Vector defaults are given.

■C5: Speed Control (ASR)

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
C5-01	ASR Proportional Gain 1 / ASR P Gain 1	Sets the proportional gain of the speed control loop (ASR).	0.00 to 300.00	20.00 *	Yes	No	No	A	21BH	4-15 6-116
C5-02	ASR Integral Time 1 / ASR I Time 1	Sets the integral time of the speed control loop (ASR).	0.000 to 10.000	0.500 s *	Yes	No	No	A	21CH	4-15 6-116
C5-03	ASR Proportional Gain 2 / ASR P Gain 2	Sets the speed control gain 2 and integral time 2 of the speed control loop (ASR). Note: Adjustment is not normally required.	0.00 to 300.00	20.00 *	Yes	No	No	A	21DH	4-15 6-116
C5-04	ASR Integral Time 2 / ASR I Time 2		0.000 to 10.000	0.500 s *	Yes	No	No	A	21EH	4-15 6-116
C5-06	ASR Primary Delay Time Constant / ASR Delay Time	Sets the filter time constant for the time from the speed loop to the Torque Command output.	0.000 to 0.500	0.004 s *	No	No	No	A	220H	4-15 6-116
C5-07	ASR Gain Switching Frequency / ASR Gain SW Freq	Sets the frequency for switching between Proportional Gain 1, 2 and Integral Time 1, 2.	0.0 to 120.0	0.0 Hz	No	No	No	A	221H	4-15 6-116
C5-08	ASR Integral Limit / ASR I Limit	Sets the ASR integral upper limit and rated load as a percentage of maximum output frequency (E1-04).	0 to 400	400%	No	No	No	A	222H	6-116

* The default will change when the control method is changed. These values are the defaults for the Flux Vector Control.

■C6: Carrier Frequency

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
C6-02	Carrier Frequency Selection / CarrierFreq Sel	Select carrier frequency pattern. 2: 4 kHz 4: 8 kHz 6: 12 kHz	2, 4, or 6 *1 *2	2	No	Q	Q	Q	224H	4-4 6-38

* 1. Fixed to 2:4 kHz for V/f.
For Open Loop Vector Control, can select from 2:4 kHz or 4:8 kHz (Fixed to 2: 4 kHz for 200 V class MxC for 45 kW and 400 V class MxCs for 22 kW and 45 kW).

* 2. Fixed to 2: 4 kHz for 400 V class MxCs for 110 kW and 160 kW.

◆ d: Reference

The following settings are made with the reference parameters (d parameters): Frequency references.

■d1: Preset Reference

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
d1-01	Frequency Reference 1 / Reference 1	Sets the frequency reference in the units used in o1-03.	0.00 to 120.00 *	0.00 Hz	Yes	Q	Q	Q	280H	4-4 6-5
d1-02	Frequency Reference 2 / Reference 2	The frequency reference when multi-step speed reference 1 is on for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	Q	Q	281H	4-4 6-5
d1-03	Frequency Reference 3 / Reference 3	The frequency reference when multi-step speed reference 2 is on for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	Q	Q	282H	4-4 6-5
d1-04	Frequency Reference 4 / Reference 4	The frequency reference when multi-step speed references 1 and 2 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	Q	Q	Q	283H	4-4 6-5
d1-05	Frequency Reference 5 / Reference 5	The frequency when multi-step speed reference 3 is on for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	284H	6-5
d1-06	Frequency Reference 6 / Reference 6	The frequency reference when multi-step speed references 1 and 3 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	285H	6-5
d1-07	Frequency Reference 7 / Reference 7	The frequency reference when multi-step speed references 2 and 3 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	286H	6-5
d1-08	Frequency Reference 8 / Reference 8	The frequency reference when multi-step speed references 1, 2, and 3 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	287H	6-5
d1-09	Frequency Reference 9 / Reference 9	The frequency reference when multi-step speed reference 4 is on for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	288H	-
d1-10	Frequency Reference 10 / Reference 10	The frequency reference when multi-step speed references 1 and 4 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	28BH	-
d1-11	Frequency Reference 11 / Reference 11	The frequency reference when multi-step speed references 2 and 4 are on for a multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	28CH	-
d1-12	Frequency Reference 12 / Reference 12	The frequency reference when multi-step speed references 1, 2, and 4 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	28DH	-

* The upper limit of the setting range depends on the upper limit set at E1-04. The maximum allowable setting is 120.00.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
d1-13	Frequency Reference 13 / Reference 13	The frequency reference when multi-step speed references 3 and 4 are on for multi-function inputs (unit: Set in o1-03).	0.00 to 120.00 *	0.00 Hz	Yes	A	A	A	28EH	-
d1-14	Frequency Reference 14 / Reference 14	The frequency reference when multi-step speed references 1, 3, and 4 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	28FH	-
d1-15	Frequency Reference 15 / Reference 15	The frequency reference when multi-step speed references 2, 3, and 4 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	290H	-
d1-16	Frequency Reference 16 / Reference 16	The frequency reference when multi-step speed references 1, 2, 3, and 4 are on for multi-function inputs (unit: Set in o1-03).		0.00 Hz	Yes	A	A	A	291H	-
d1-17	Jog Frequency Reference / Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is on (unit: Set in o1-03).		6.00 Hz	Yes	Q	Q	Q	292H	4-4 6-5 6-75

* The upper limit of the setting range depends on the upper limit set at E1-04. The maximum allowable setting is 120.00.

■d2: Reference Limits

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
d2-01	Frequency Reference Upper Limit / Ref Upper Limit	Set the output frequency upper limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0 %	No	A	A	A	289H	6-30 6-70
d2-02	Frequency Reference Lower Limit / Ref Lower Limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	A	A	28AH	6-30 6-70
d2-03	Master Speed Reference Lower Limit / Ref1 Lower Limit	Set the master speed reference lower limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A	A	A	293H	6-30 6-70

■d3: Jump Frequencies

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
d3-01	Jump Frequency 1 / Jump Freq 1	Set the center values of the jump frequencies in Hz. This function is disabled by setting the jump frequency to 0 Hz. Always ensure that the following applies: d3-01 ≥ d3-02 ≥ d3-03 Operation in the jump frequency range is prohibited but during acceleration and deceleration, speed changes smoothly without jump.	0.0 to 120.0	0.0 Hz	No	A	A	A	294H	4-17 6-28
d3-02	Jump Frequency 2 / Jump Freq 2			0.0 Hz	No	A	A	A	295H	4-17 6-28
d3-03	Jump Frequency 3 / Jump Freq 3			0.0 Hz	No	A	A	A	296H	4-17 6-28
d3-04	Jump Frequency Width / Jump Bandwidth	Sets the jump frequency bandwidth in Hz. The jump frequency will be the jump frequency ± d3-04.	0.0 to 20.0	1.0 Hz	No	A	A	A	297H	4-17 6-28

■d4: Reference Frequency Hold

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
d4-01	Frequency Reference Hold Function Selection / MOP Ref Memory	Sets whether or not frequencies 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 frequency.) This function is available when the multi-function inputs “accel/decel Ramp Hold” or “up/down” commands are set.	0 or 1	0	No	A	A	A	298H	6-69
d4-02	Trim Control Level / Trim Control Lvl	Set the frequency to be added to or subtracted from the analog frequency reference as a percent, taking the maximum output frequency to be 100%. Enabled when the increase (+) speed command or decrease (-) speed command is set for a multi-function input.	0 to 100	10%	No	A	A	A	299H	6-73

■d5: Torque Control

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
d5-01	Torque Control Selection / Torq Control Sel	0: Speed control (C5-01 to C5-07) 1: Torque control This function is only available in Flux Vector Control method. 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	No	A	29AH	6-108
d5-02	Torque Reference Delay Time / Torq Ref Filter	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	No	A	29BH	6-108
d5-03	Speed Limit Selection / Speed Limit Sel	Set the speed limit command method for the torque control method. 1: The analog input limit from a frequency reference 2: Limited by d5-04 setting values.	1 or 2	1	No	No	No	A	29CH	6-108
d5-04	Speed Limit / Speed Lmt Value	Set the speed limit during torque control as a percentage of the maximum output frequency. 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	No	A	29DH	6-108
d5-05	Speed Limit Bias / Speed Lmt Bias	Set the speed limit bias as a percentage of the maximum output frequency. Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 to 120	10%	No	No	No	A	29EH	6-108
d5-06	Speed/Torque Control Switchover Timer / Ref Hold Time	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	0 ms	No	No	No	A	29FH	6-108

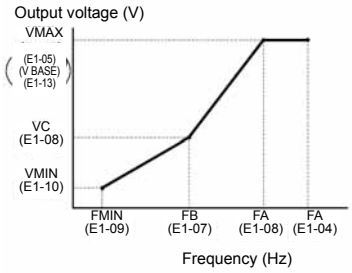
■d6: Field Weakening

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
d6-01	Magnetic Field Weakening Level / Field-Weak Lvl	Set the MxC output voltage when the field weakening command is input. It is enabled when the field weakening command is set for a multi-function input. Set the level as a percentage taking the voltage set in the V/f pattern as 100%.	0 to 100	80%	No	A	No	No	2A0H	-
d6-02	Magnetic Field Frequency / Field-Weak Freq	Set the lower limit in hertz of the frequency range where field control is valid. The field weakening command is valid only at frequencies above this setting and only when the speed is in agreement with the current speed reference.	0.0 to 120.0	0.0 Hz	No	A	No	No	2A1H	-
d6-03	Magnetic Field Forcing Function Selection / Field Force Sel	Set the field forcing function. 0: Disabled 1: Enabled	0 or 1	0	No	No	A	A	2A2H	-
d6-06	Magnetic Field Forcing Limit / FieldForce Limit	Set the excitation current reference's upper limit for field forcing. Set the limit as a percentage, taking the motor's no-load current as 100%. Enabled for operation other than DC excitation. Usually, there is no need to change this setting.	100 to 400	400%	No	No	No	A	2A5H	-

◆ E: Motor Parameter

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

■E1: V/f Pattern

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
E1-01	Input Voltage Setting / Input Voltage	Set the MxC input voltage in 1 volt. This setting is used as a reference value in protection functions.	155 to 255 *1	200 VAC *1	No	Q	Q	Q	300H	6-104
E1-03	V/F Pattern Selection / V/F Selection	0 to D: Select from the 14 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10).	0 to D, and F	F	No	Q	Q	No	302H	6-104
E1-04	Maximum Output Frequency / Max Frequency		40.0 to 120.0	60.0 Hz *2	No	Q	Q	Q	303H	6-104
E1-05	Maximum Output Voltage / Max Voltage		0.0 to 255.0 *1	200.0 VAC *1 *2	No	Q	Q	Q	304H	6-104
E1-06	Base Frequency / Base Frequency		0.0 to 120.0	60.0 Hz *2	No	Q	Q	Q	305H	6-104
E1-07	Mid Output Frequency A / Mid Frequency A		0.0 to 120.0	3.0 Hz *2	No	A	A	No	306H	6-104
E1-08	Mid Output Voltage A / Mid Voltage A	To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 255.0 *1	13.0 VAC *1 *2	No	A	A	No	307H	4-14 6-104
E1-09	Minimum Output Frequency / Min Frequency		0.0 to 120.0	0.5 Hz *2	No	Q	Q	A	308H	6-104
E1-10	Minimum Output Voltage / Min Voltage		0.0 to 255.0 *1	2.5 VAC *1 *2	No	A	A	No	309H	4-14 6-104
E1-11	Mid Output Frequency B / Mid Frequency B	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 120.0	0.0 Hz *3	No	A	A	A	30AH	6-104
E1-12	Mid Output Voltage B / Mid Voltage B		0.0 to 255.0 *1	0.0 VAC *3	No	A	A	A	30BH	6-104
E1-13	Base Voltage / Base Voltage		0.0 to 255.0 *1	0.0 VAC *4	No	A	Q	Q	30CH	6-104

* 1. These are values for a 200 V class MxC. Double the value for a 400 V class MxC.
* 2. The default will change when the control method is changed. The Open Loop Vector defaults are given.
* 3. E1-11 and E1-12 are disregarded when set to 0.0.
* 4. E1-13 is set to the same value as E1-05 by Auto-Tuning.

■E2: Motor Setup

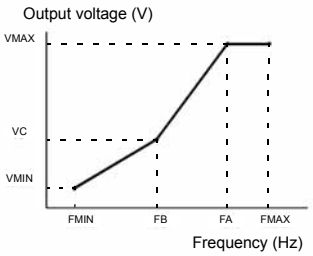
Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
E2-01	Motor Rated Current / Motor Rated FLA	Sets the motor nameplate full load current in amperes (A). This value is automatically set during Auto-Tuning.	2.70 to 54.00 *2	19.60 A *1	No	Q	Q	Q	30EH	4-5 6-51 6-102
E2-02	Motor Rated Slip / Motor Rated Slip	Sets the motor rated slip in hertz (Hz). This value is automatically set during Rotational Auto-Tuning.	0.00 to 20.00	1.50 Hz *1	No	A	A	A	30FH	6-100 6-102
E2-03	Motor No-Load Current / No-Load Current	Sets the magnetizing current of the motor as a percentage of full load amps (E2-01). This value is automatically set during Rotational Auto-Tuning.	0.00 to 19.59 *3	5.10 A *1	No	A	A	A	310H	6-102
E2-04	Number of Motor Poles / Number of Poles	Sets the number of motor poles. This value is automatically set during Auto-Tuning.	2 to 48	4 poles	No	No	No	Q	311H	6-102
E2-05	Motor Line-to-Line Resistance / Term Resistance	Sets the phase-to-phase motor resistance in ohms. This value is automatically set by Auto-Tuning.	0.000 to 65.000	0.399 Ω *1	No	A	A	A	312H	6-102
E2-06	Motor Leakage Inductance / Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. This value is automatically set during Auto-Tuning.	0.0 to 40.0	18.2% *1	No	No	A	A	313H	6-102
E2-07	Motor Iron-core Saturation Coefficient 1 / Saturation Comp1	Sets the motor iron saturation coefficient at 50% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.	0.00 to 0.50	0.50	No	No	A	A	314H	6-102
E2-08	Motor Iron-core Saturation Coefficient 2 / Saturation Comp2	Sets the motor iron saturation coefficient at 75% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.	0.50 to 0.75	0.75	No	No	A	A	315H	6-102
E2-09	Motor Mechanical Loss / Mechanical Loss	Sets the motor mechanical loss as a percentage of motor rated power (kW) capacity. Adjust in the following circumstances: • When torque loss is large due to motor bearing friction. • When the torque loss in the load is large.	0.0 to 10.0	0.0%	No	No	A	A	316H	-
E2-10	Motor Iron Loss for Torque Compensation / Tcomp Iron Loss	Sets the motor iron loss in watts (W).	0 to 65535	172 W *1	No	A	No	No	317H	6-102
E2-11	Motor Rated Output / Mtr Rated Power	Sets the motor rated power in kilowatts (kW). This value is automatically set during Auto-Tuning.	5.50 to 650.00	5.50 kW *1	No	Q	Q	Q	318H	-
E2-12	Motor Iron-Core Saturation Coefficient 3 / Saturation Comp3	Set to the motor iron saturation coefficient at 130% of magnetic flux.	1.30 to 1.60	1.30	No	No	A	A	328H	6-102

* 1. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

* 2. The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given. The upper limit of the Motor No-Load Current (E2-03) must be less than the Motor Rated Current (E2-01).

* 3. The setting range depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

■ E3: Motor 2 V/f Pattern

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
E3-01	Motor 2 Control Method Selection / Control Method	0: V/f Control 2: Open Loop Vector Control 3: Flux Vector Control	0, 2, or 3	2	No	A	A	A	319H	-
E3-02	Motor 2 Maximum Output Frequency / Max Frequency	 To set V/f characteristics in a straight line, set the same values for E3-05 and E3-07. In this case, the setting for E3-06 will be disregarded. Be sure that the four frequencies are set in the following manner or else an OPE10 fault will occur: E3-02 ≥ E3-04 ≥ E3-05 ≥ E3-07	40.0 to 120.0	60.0 Hz *2	No	A	A	A	31AH	-
E3-03	Motor 2 Maximum Output Voltage / Max Voltage		0.0 to 255.0 *1	200.0 VAC *1 *2	No	A	A	A	31BH	-
E3-04	Motor 2 Base Frequency / Base Frequency		0.0 to 120.0	60.0 Hz *2	No	A	A	A	31CH	-
E3-05	Motor 2 Mid Output Frequency / Mid Frequency		0.0 to 120.0	3.0 Hz *2	No	A	A	No	31DH	-
E3-06	Motor 2 Mid Output Voltage VA / Mid Voltage		0.0 to 255.0 *1	13.0 VAC *1 *2	No	A	A	No	31EH	-
E3-07	Motor 2 Minimum Output Frequency / Min Frequency		0.0 to 120.0	0.5 Hz *2	No	A	A	A	31FH	-
E3-08	Motor 2 Minimum Output Voltage / Min Voltage		0.0 to 255.0 *1	2.5 VAC *1 *2	No	A	A	No	320H	-

* 1. These are values for a 200 V class MxC. Double the value for a 400 V class MxC.

* 2. The default will change when the control method is changed. The Open Loop Vector defaults are given.

■E4: Motor 2 Setup

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
E4-01	Motor 2 Rated Current / Motor Rated FLA	Sets the motor 2 name plate full load current in amperes (A). This value is automatically set during Auto-Tuning.	2.70 to 54.00 *2	19.60 A *1	No	A	A	A	321H	6-51
E4-02	Motor 2 Rated Slip / Motor Rated Slip	Sets the rated slip of motor 2 in hertz (Hz). This value is automatically set during Rotational Auto-Tuning.	0.00 to 20.00	1.50 Hz *1	No	A	A	A	322H	-
E4-03	Motor 2 No-Load Current / No-Load Current	Sets the magnetizing current of motor 2 in percentage of full load current (E4-01). This value is automatically set during Rotational Auto-Tuning.	0.00 to 19.59 *3	5.10 A *1	No	A	A	A	323H	-

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
E4-04	Motor 2 Number of Poles / Number of Poles	Sets the number of poles of motor 2. This value is automatically set during Auto-Tuning.	2 to 48	4 poles	No	No	No	A	324H	-
E4-05	Motor 2 Line-to-Line Resistance / Term Resistance	Sets the phase-to-phase resistance of motor 2 in ohms. This value is automatically set by the Auto-Tuning.	0.000 to 65.000	0.399 Ω *1	No	A	A	A	325H	-
E4-06	Motor 2 Leakage Inductance / Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of rated voltage of motor 2. This value is automatically set during Auto-Tuning.	0.0 to 40.0	18.2% *1	No	No	A	A	326H	-
E4-07	Motor 2 Rated Output / Mtr Rated Power	Sets the rated power of motor 2 in kilowatts (kW). This value is automatically set during Auto-Tuning.	5.50 to 650.00	5.50 kW *1	No	A	A	A	327H	-

* 1. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

* 2. The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given.

* 3. If a multi-function input is set for motor 2 (H1-□□ = 16), the setting range will depend upon the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

◆ F: Option

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

■F1: PG Option Setup

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
F1-01	PG Parameter / PG Pulses/Rev	Sets the number of PG (pulse generator or encoder) pulses. Sets the number of min^{-1}.*	0 to 60000	600	No	No	No	Q	380H	6-135
F1-02	Operation Selection at PG Open Circuit (PGO) / PG Fdbk Loss Sel	Sets stopping method when a PG open circuit fault (PGO) occurs. See parameter F1-14. 0: Decelerate to Stop. Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - MxC continues operation.	0 to 3	1	No	No	No	A	381H	6-135
F1-03	Operation Selection at Overspeed (OS) / PG Overspeed Sel	Sets the stopping method when an overspeed (OS) fault occurs. See F1-08 and F1-09. 0: Decelerate to Stop. Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - MxC continues operation.	0 to 3	1	No	No	No	A	382H	6-135
F1-04	Operation Selection at Deviation / PG Deviation Sel	Sets the stopping method when a speed deviation (DEV) fault occurs. See F1-10 and F1-11. 0: Decelerate to Stop. Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - MxC continues operation.	0 to 3	3	No	No	No	A	383H	6-135
F1-05	PG Rotation Selection / PG Rotation Sel	0: Fwd = C.C.W. - Phase A leads with Forward Run Command (Phase B leads with Reverse Run Command). 1: Fwd = C.W. - Phase B leads with Forward Run Command (Phase A leads with Reverse Run Command).	0 or 1	0	No	No	No	A	384H	6-135
F1-06	PG Division Rate (PG Pulse Monitor) / PG Output Ratio	Sets the division ratio for the pulse monitor of the PG-B2 encoder feedback option card. This function is not available with the PG-X2 option card. Division ratio = [(1 + n) / m] (n = 0 to 1, m =1 to 32) F1-06 = □ (n) □□ (m) The possible division ratio settings are: 1/32 ≤ F1-06 ≤ 1	1 to 132	1	No	No	No	A	385H	6-135

* The digital operator shows rpm instead of min^{-1}.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
F1-08	Overspeed Detection Level / PG Overspd Level	Configures the overspeed fault (OS) detection. OS fault will occur, if the motor speed feedback is greater than the F1-08 setting for a time longer than F1-09. F1-08 is set as a percentage of the maximum output frequency (E1-04). See F1-03.	0 to 120	115%	No	No	No	A	387H	6-136
F1-09	Overspeed Detection Delay Time / PG Overspd Time		0.0 to 2.0	0.0 s *	No	No	No	A	388H	6-136
F1-10	Excessive Speed Deviation Detection Level / PG Deviate Level	Configures the speed deviation fault (DEV) detection. DEV fault will occur if the speed deviation is greater than the F1-10 setting for a time longer than F1-11. F1-10 is set as a percentage of the maximum output frequency (E1-04). Speed deviation is the difference between actual motor speed and the Frequency Reference Command. See F1-04.	0 to 50	10%	No	No	No	A	389H	6-136
F1-11	Excessive Speed Deviation Detection Delay Time / PG Deviate Time		0.0 to 10.0	0.5 s	No	No	No	A	38AH	6-136
F1-14	PG Open-Circuit Detection Time / PGO Detect Time	Configures the PG open (PGO) function. PGO will be detected if no PG pulses are detected for a time longer than F1-14. See F1-02.	0.0 to 10.0	2.0 s	No	No	No	A	38DH	6-136

* The default will automatically change if the control method is changed. The defaults for the Flux Vector Control is given.

■F2: Analog Reference Card

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
F2-01	AI-14 Input Selection / AI-14 Input Sel	Sets the function for channel 1 to 3 of the AI-14B analog input reference option card. 0: 3-channel individual (Channel 1: terminal A1, Channel 2: terminal A2, Channel 3: terminal A3) 1: 3-channel addition (Summed values of channels 1 to 3 is the frequency reference) When set to 0, select 1 for b1-01. In this case, the multi-function input "Option/MxC selection" cannot be used.	0 or 1	0	No	A	A	A	38FH	6-141

■F3: Digital Reference Card

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
F3-01	DI-08 / DI-16H2 Input Selection DI Input	Sets the function of the DI-08 or the DI-16H2 digital input option card. 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 (5-digit) 0.01 Hz unit (enabled only when DI-16H2 is used). 7: Binary input 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	6-142

■F4: Analog Monitor Cards

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
F4-01	AO-08/AO-12 Channel 1 Monitor Selection AO Ch1 Select	Effective when the Analog Monitor Card is used. Monitor selection: Set the number of the monitor item to be output. (U1-□□) Items that can be set differ in accordance with the selected control modes. Gain: Set the multiple of 10 V for outputting monitor items. For information on the parameters for which analog output is possible, refer to *U: Monitors*. When the AO-12 Analog Monitor Card is used, outputs of ± 10 V are possible. To output ± 10 V, set F4-07 or F4-08 to 1. When the AO-08 Analog Monitor Card is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.*	1 to 99	2	No	A	A	A	391H	6-80
F4-02	AO-08/AO-12 Channel 1 Gain AO Ch1 Gain		0.00 to 2.50	1.00	Yes	A	A	A	392H	6-80
F4-03	AO-08/AO-12 Channel 2 Monitor Selection AO Ch2 Select		1 to 99	3	No	A	A	A	393H	6-80
F4-04	AO-08/AO-12 Channel 2 Gain AO Ch2 Gain		0.00 to 2.50	0.50	Yes	A	A	A	394H	6-80
F4-05	AO-08/AO-12 Channel 1 Output Bias AO Ch1 Bias	Sets the channel 1 item bias to 100%/10 V when the Analog Monitor Card is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	395H	6-80
F4-06	AO-08/AO-12 Channel 2 Output Bias AO Ch2 Bias	Sets the channel 2 item bias to 100%/10 V when the Analog Monitor Card is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	396H	6-80
F4-07	AO-12 Channel 1 Signal Level AO Opt Level Ch1	0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A	397H	6-80

* The CH1 output can be adjusted when the F4-02 or F4-05 setting is displayed in Quick, Advanced, or Verify Mode while the motor is stopped.
The CH2 output can be adjusted when the F4-04 or F4-06 setting is displayed in Quick, Advanced, or Verify Mode while the motor is stopped.
For analog output, the value equivalent to 100% of output value of monitored item is multiplied by the gain setting and the set bias is added.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
F4-08	AO-12 Channel 2 Signal Level / AO Opt Level Ch2	0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A	398H	6-80

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

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
F5-01	DO-02/DO-08 Channel 1 Output Selection / DO Ch1 Select	Sets the digital output function number for channel 1. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	0	No	A	A	A	399H	6-138
F5-02	DO-02/DO-08 Channel 2 Output Selection / DO Ch2 Select	Sets the digital output function number for channel 2. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	1	No	A	A	A	39AH	6-138
F5-03	DO-08 Channel 3 Output Selection / DO Ch3 Select	Sets the digital output function number for channel 3. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	2	No	A	A	A	39BH	6-138
F5-04	DO-08 Channel 4 Output Selection / DO Ch4 Select	Sets the digital output function number for channel 4. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	4	No	A	A	A	39CH	6-138
F5-05	DO-08 Channel 5 Output Selection / DO Ch5 Select	Sets the digital output function number for channel 5. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	6	No	A	A	A	39DH	6-139
F5-06	DO-08 Channel 6 Output Selection / DO Ch6 Select	Sets the digital output function number for channel 6. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	37	No	A	A	A	39EH	6-139
F5-07	DO-08 Channel 7 Output Selection / DO Ch7 Select	Sets the digital output function number for channel 7. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	0F	No	A	A	A	39FH	6-139
F5-08	DO-08 Channel 8 Output Selection / DO Ch8 Select	Sets the digital output function number for channel 8. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	0F	No	A	A	A	3A0H	6-139

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
F5-09	DO-08 Output Mode Selection / DO-08 Selection	Sets the function of the DO-08 digital output option card. 0: 8-channel individual outputs. 1: Binary code output. 2: 8-channel Selected - Output according to F5-01 to F5-08 settings.	0 to 2	0	No	A	A	A	3A1H	6-139

■F6: Communications Option Cards

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
F6-01	Operation Selection after Communication Error / Comm Bus Flt Sel	Selects the stopping method for a communication option card fault (BUS). Active only when a communication option card is installed and b1-01 or b1-02 = 3. 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	1	No	A	A	A	3A2H	-
F6-02	Selection of External Fault from Communication Option Card / EF0 Detection	Selects the condition in which an EF0 fault is detected from a communication option card. Active only when a communication option card is installed and b1-01 or b1-02 = 3. 0: Always detected. 1: Detected only during run.	0 or 1	0	No	A	A	A	3A3H	-
F6-03	Stopping Method for External Fault from Communication Option Card / EF0 Fault Action	Selects the stopping method for an external fault from a communication option card (EF0). Active only when a communication option card is installed and b1-01 or b1-02 = 3. 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	1	No	A	A	A	3A4H	-
F6-04	Trace Sampling from Communications Option Card / Trace Sample Tim	–	0 to 60000	0	No	A	A	A	3A5H	-
F6-06	Torque Reference/ Torque Limit Selection from Communications Option / Torq Ref/Lmt Sel	Selects torque reference/limit when using communications option card. 0: Disabled. - Torque reference/limit from option card disabled 1: Enabled.- Torque reference/limit from option card enabled.	0 or 1	0	No	No	No	A	3A7H	-

◆ H: Terminal Function

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

■H1: Multi-Function Contact Inputs

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMOBUS Register	Page
						V/f	Open Loop Vector	Flux Vector		
H1-01	Multi-Function Digital Input Terminal S3 Function Selection / Terminal S3 Sel	Multi-function contact input 1	0 to 78	24	No	A	A	A	400H	-
H1-02	Multi-Function Digital Input Terminal S4 Function Selection / Terminal S4 Sel	Multi-function contact input 2	0 to 78	14	No	A	A	A	401H	-
H1-03	Multi-Function Digital Input Terminal S5 Function Selection / Terminal S5 Sel	Multi-function contact input 3	0 to 78	3 (0)*	No	A	A	A	402H	-
H1-04	Multi-Function Digital Input Terminal S6 Function Selection / Terminal S6 Sel	Multi-function contact input 4	0 to 78	4 (3)*	No	A	A	A	403H	-
H1-05	Multi-Function Digital Input Terminal S7 Function Selection / Terminal S7 Sel	Multi-function contact input 5	0 to 78	6 (4)*	No	A	A	A	404H	-
H1-06	Multi-Function Digital Input Terminal S8 Function Selection / Terminal S8 Sel	Multi-function contact input 6	0 to 78	8	No	A	A	A	405H	-
H1-07	Multi-Function Digital Input Terminal S9 Function Selection / Terminal S9 Sel	Multi-function contact input 7	0 to 78	5	No	A	A	A	406H	-
H1-08	Multi-Function Digital Input Terminal S10 Function Selection / Terminal S10 Sel	Multi-function contact input 8	0 to 78	32	No	A	A	A	407H	-

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
H1-09	Multi-Function Digital Input Terminal S11 Function Selection / Terminal S11 Sel	Multi-function contact input 9	0 to 78	7	No	A	A	A	408H	-
H1-10	Multi-Function Digital Input Terminal S12 Function Selection / Terminal S12 Sel	Multi-function contact input 10	0 to 78	15	No	A	A	A	409H	-

* The defaults in the parentheses are for 3-wire sequence.

Multi-Function Contact Input Functions

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Page
0	3-wire sequence (Forward/Reverse Run Command)	Yes	Yes	Yes	6-9
1	Local/Remote selection (ON: Operator, off: Parameter setting)	Yes	Yes	Yes	6-67
2	Option/MxC selection (ON: Option card)	Yes	Yes	Yes	6-74 6-141
3	Multi-step speed reference 1 When H3-09 (Multi-function analog input (terminal A2) function selection) is set to 0 (Auxiliary frequency reference), this function can be used with the master/auxiliary speed switch.	Yes	Yes	Yes	6-5
4	Multi-step speed reference 2	Yes	Yes	Yes	6-5
5	Multi-step speed reference 3	Yes	Yes	Yes	6-5
6	Jog Frequency Command (higher priority than multi-step speed reference)	Yes	Yes	Yes	6-5
7	Accel/decel time 1	Yes	Yes	Yes	6-18
8	External baseblock NO (NO contact: Baseblock at on)	Yes	Yes	Yes	6-68
9	External baseblock NC (NC contact: Baseblock at off)	Yes	Yes	Yes	6-68
A	Accel/decel ramp hold (ON: Accel/decel stopped, frequency on hold)	Yes	Yes	Yes	6-69
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	No	Yes	6-116
F	Not used (Set when a terminal is not used)	-	-	-	-
10	Up Command (Always set with the Down Command)	Yes	Yes	Yes	6-70
11	Down Command (Always set with the Up Command)	Yes	Yes	Yes	6-70
12	FJOG Command (ON: Forward run at jog frequency d1-17)	Yes	Yes	Yes	6-75
13	RJOG Command (ON: Reverse run at jog frequency d1-17)	Yes	Yes	Yes	6-75
14	Fault reset (Reset when turned on)	Yes	Yes	Yes	7-2
15	Emergency stop (Normally open condition: Decelerate to stop in deceleration time set in C1-09 when on).	Yes	Yes	Yes	6-16
16	Motor Switch Command (Motor 2 selection)	Yes	Yes	Yes	-
17	Emergency stop (Normally closed condition: Decelerate to stop in deceleration time set in C1-09 when off)	Yes	Yes	Yes	6-16

Set Value	Function	Control Methods			Page
		V/f	Open Loop Vector	Flux Vector	
18	Timer function input (Functions are set in b4-01 and b4-02 and the timer function outputs are set in H1-□□ and H2-□□).	Yes	Yes	Yes	6-93
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes	6-97
1A	Accel/Decel time 2	Yes	Yes	Yes	6-18
1B	Parameters write enable (ON: All parameters can be written-in. off: All parameters other than frequency monitor are write protected).	Yes	Yes	Yes	6-133 7-18
1C	Trim control increase (ON: d4-02 frequency is added to analog frequency reference).	Yes	Yes	Yes	6-73
1D	Trim control decrease (ON: d4-02 frequency is subtracted from analog frequency reference).	Yes	Yes	Yes	6-73
1E	Analog frequency reference sample/hold	Yes	Yes	Yes	6-74
20 to 2F	External fault (Desired settings possible) Input Mode: NO contact/NC contact, Detection Mode: Normal/during run	Yes	Yes	Yes	6-76
30	PID control integral reset (reset when Reset Command is input or when stopped during PID control)	Yes	Yes	Yes	6-97
31	PID control integral hold (ON: Hold)	Yes	Yes	Yes	6-97
32	Multi-step speed reference 4	Yes	Yes	Yes	-
34	PID soft starter	Yes	Yes	Yes	6-97
35	PID input characteristics switch	Yes	Yes	Yes	6-97
60	DC Injection Braking Command (ON: Performs DC injection braking)	Yes	Yes	Yes	6-15
61	External Search Command 1 (ON: Speed search from maximum output frequency)	Yes	Yes	No	6-60
62	External Search Command 2 (ON: Speed search from set frequency)	Yes	Yes	No	6-60
63	Field Weakening Command (ON: Field weakening control set for d6-01 and d6-02)	Yes	No	No	-
64	External Speed Search Command 3	Yes	Yes	Yes	-
67	Communications Test Mode (“Pass” is displayed when the communications test is passed).	Yes	Yes	Yes	6-93
71	Speed/torque control change (ON: Torque control)	No	No	Yes	6-109 6-114
72	Zero-Servo Command (ON: Zero-servo)	No	No	Yes	6-123
77	Speed control (ASR) proportional gain switch (ON: C5-03)	No	No	Yes	6-116
78	Polarity Reversing Command for external torque reference	No	No	Yes	6-109

■ H2: Multi-Function Contact Outputs

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
H2-01	Terminal M1 thru M2 Function Selection (Relay) / Term M1-M2 Sel	Multi-function contact output	0 to 37	0	No	A	A	A	40BH	-
H2-02	Terminal M3-M4 Function Selection (Relay) / Term P1 Sel	Multi-function contact output 1	0 to 37	1	No	A	A	A	40CH	-
H2-03	Terminal M5-M6 Function Selection (Relay) / Term P2 Sel	Multi-function contact output 2	0 to 37	2	No	A	A	A	40DH	-
H2-04	Terminal P3 Function Selection (Open Collector) / Term P3 Sel	Multi-function contact output 3	0 to 37	6	No	A	A	A	40EH	-
H2-05	Terminal P4 Function Selection (Open Collector) / Term P4 Sel	Multi-function contact output 4	0 to 37	10	No	A	A	A	40FH	-

Multi-Function Contact Output Functions

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Page
0	During Run (ON: Run Command is on or voltage is being output)	Yes	Yes	Yes	6-77
1	Zero-speed	Yes	Yes	Yes	6-77
2	Frequency agree 1 (L4-02 used).	Yes	Yes	Yes	6-45
3	Desired frequency agree 1 (ON: Output frequency = ±L4-01, L4-02 used and during frequency agree)	Yes	Yes	Yes	6-45
4	Frequency (FOUT) detection 1 (ON: +L4-01 ≥ output frequency ≥ -L4-01, L4-02 used)	Yes	Yes	Yes	6-45
5	Frequency (FOUT) detection 2 (ON: Output frequency ≥ +L4-01 or output frequency ≤ -L4-01, L4-02 used)	Yes	Yes	Yes	6-45
6	MxC operation ready READY: After initialization, no faults	Yes	Yes	Yes	-
7	During detection of power voltage fault (FDV, AUV, or UV)	Yes	Yes	Yes	-
8	During baseblock (ON: during baseblock)	Yes	Yes	Yes	-
9	Frequency 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	6-49
C	Loss of frequency reference (Enabled when 1 is set for L4-05)	Yes	Yes	Yes	6-64

Set Value	Function	Control Methods			Page
		V/f	Open Loop Vector	Flux Vector	
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).	-	-	-	-
10	Minor fault (ON: Alarm displayed)	Yes	Yes	Yes	-
11	Fault Reset Command active	Yes	Yes	Yes	-
12	Timer function output	Yes	Yes	Yes	6-93
13	Frequency agree 2 (L4-04 used)	Yes	Yes	Yes	6-45
14	Desired frequency agree 2 (ON: Output frequency = L4-03, L4-04 used, and during frequency agree)	Yes	Yes	Yes	6-45
15	Frequency detection 3 (ON: Output frequency ≤ -L4-03, L4-04 used)	Yes	Yes	Yes	6-45
16	Frequency detection 4 (ON: Output frequency ≥ -L4-03, L4-04 used)	Yes	Yes	Yes	6-45
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at off)	Yes	Yes	Yes	6-49
18	Overtorque/undertorque detection 2 NO (NO Contact: Torque detection at on)	Yes	Yes	Yes	6-49
19	Overtorque/undertorque detection 2 NC (NC Contact: Torque detection at off)	Yes	Yes	Yes	6-49
1A	During reverse run (ON: During reverse run)	Yes	Yes	Yes	-
1B	During baseblock 2 (OFF: During baseblock)	Yes	Yes	Yes	-
1C	Motor selection (Motor 2 selected)	Yes	Yes	Yes	-
1D	During regeneration (ON: During regeneration)	No	No	Yes	-
1E	Restart enabled (ON: Restart enabled.)	Yes	Yes	Yes	6-65
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	Yes	Yes	Yes	6-51 6-78
20	MxC overheat (OH) pre-alarm (ON: Temperature exceeds L8-02 setting)	Yes	Yes	Yes	6-78
2F *	Maintenance Time ON: The operation time of either the capacitors on the PCB board or the cooling fan have reached the specified maintenance time.	Yes	Yes	Yes	6-155
30	During torque limit (current limit) (ON: During torque limit)	No	Yes	Yes	-
31	During speed limit (ON: During speed limit)	No	No	Yes	6-78
32	Speed control circuit operating for torque control (except when stopped). The external torque reference will be limited if torque control is selected (internal torque reference < external torque reference). Output when the motor is rotating at the speed limit.	No	No	Yes	6-109
33	Zero-Servo Complete (ON: Zero-servo function completed)	No	No	Yes	6-78 6-123
36	Frequency (FOUT) detection 5 (ON: Output frequency is equal to or greater than the set value of +L4-01 or equal to or less than the set value of –L4-01 and L4-02 is used, off during base blocked)	Yes	Yes	Yes	6-44
37	During Run 2 (ON: Frequency output, off: Baseblock, DC Injection Braking, initial excitation, operation stop)	Yes	Yes	Yes	6-77

* Applicable for the Varispeed AC with software versions PRG:1050 or later.

■H3: Analog Inputs

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
H3-01	Terminal A1 Signal Level Selection / Term A1 Lvl Sel	Sets the signal level of terminal A1. 0: 0 to 10VDC 1: -10 to +10VDC [11-bit plus polarity sign]	0 or 1	0	No	A	A	A	410H	6-25
H3-02	Terminal A1 Gain Setting / Terminal A1 Gain	Sets the output level when 10 V is input, as a percentage of the maximum output frequency (E1-04).	0.0 to 1000.0	100.0 %	Yes	A	A	A	411H	6-25
H3-03	Terminal A1 Bias Setting / Terminal A1 Bias	Sets the output level when 0 V is input, as a percentage of the maximum output frequency (E1-04).	-100.0 to +100.0	0.0%	Yes	A	A	A	412H	6-25
H3-04	Terminal A3 Signal Level Selection / Term A3 Signal	Sets the signal level of terminal A3. 0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A	413H	6-25 6-108
H3-05	Terminal A3 Function Selection / Terminal A3 Sel	Select multi-function analog input function for terminal A3. Refer to the next page.	0 to 1F	2	No	A	A	A	414H	6-25 6-108
H3-06	Terminal A3 Gain Setting / Terminal A3 Gain	Sets the output level when 10 V is input.	0.0 to 1000.0	100.0 %	Yes	A	A	A	415H	6-25 6-109
H3-07	Terminal A3 Bias Setting / Terminal A3 Bias	Sets the frequency reference when 0 V is input.	-100.0 to +100.0	0.0%	Yes	A	A	A	416H	6-25 6-109
H3-08	Terminal A2 Signal Level Selection / Term A2 Signal	Selects the signal level of terminal A2. 0: 0 to 10 VDC (switch S1-2 must be in the off position). 1: -10 to +10 VDC (switch S1-2 must be in the off position). 2: 4 to 20 mA (switch S1-2 must be in the on position) Note: Switch between current or voltage inputs by using (S1-2) switch on the terminal board.	0 to 2	2	No	A	A	A	417H	6-25 6-109
H3-09	Terminal A2 Function Selection / Terminal A2 Sel	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A	418H	6-25 6-109
H3-10	Terminal A2 Gain Setting / Terminal A2 Gain	Sets the output level when 10V is input.	0.0 to 1000.0	100.0 %	Yes	A	A	A	419H	6-25 6-109
H3-11	Terminal A2 Bias Setting / Terminal A2 Bias	Sets the output level when 0V is input.	-100.0 to +100.0	0.0%	Yes	A	A	A	41AH	6-25 6-109
H3-12	Analog Input Filter Time Constant / Filter Avg Time	This parameter adjusts the filter on all 3 analog inputs. Increase to add stability, decrease to improve response.	0.00 to 2.00	0.03 s	No	A	A	A	41BH	4-17 6-26

H3-05, H3-09 Settings

Set Value	Function	Contents (100%)	Control Methods			Page
			V/f	Open Loop Vector	Flux Vector	
0	Add to terminal A1	Maximum output frequency	Yes	Yes	Yes	6-27 6-109
1	Frequency gain	Frequency Reference (voltage) Command value	Yes	Yes	Yes	6-26
2	Auxiliary Frequency Reference 1 (2nd step analog)	Maximum output frequency	Yes	Yes	Yes	6-5
3	Auxiliary Frequency Reference 2 (3rd step analog)	Maximum output frequency	Yes	Yes	Yes	6-5
4	Voltage bias	200 V (200 V class), 400 V (400 V class)	Yes	No	No	-
5	Accel/decel change (reduction coefficient)	Set acceleration and deceleration times (C1-01 to C1-08)	Yes	Yes	Yes	6-17
6	DC injection braking current	MxC rated output current	Yes	Yes	No	6-16
7	Overtorque/undertorque detection level	Motor rated torque for vector control MxC rated output current for V/f control	Yes	Yes	Yes	6-50
8	Stall prevention level during run	MxC rated output current	Yes	No	No	6-44
9	Frequency reference lower limit level	Maximum output frequency	Yes	Yes	Yes	6-31
A	Jump frequency	Maximum output frequency	Yes	Yes	Yes	6-29
B	PID feedback	Maximum output frequency	Yes	Yes	Yes	6-97
C	PID target value	Maximum output frequency	Yes	Yes	Yes	6-97
D	Frequency bias 2	Maximum output frequency	Yes	Yes	Yes	6-27
E	Motor temperature input	10 V = 100%	Yes	Yes	Yes	6-55
10	Positive torque limit	Motor rated torque	No	Yes	Yes	6-41
11	Negative torque limit	Motor rated torque	No	Yes	Yes	6-41
12	Regenerative torque limit	Motor rated torque	No	Yes	Yes	6-41
13	Torque reference/torque limit at speed control	Motor rated torque	No	No	Yes	6-109
14	Torque compensation	Motor rated torque	No	No	Yes	6-109
15	Positive/negative torque limit	Motor rated torque	No	Yes	Yes	6-41
1F	Analog input not used.	-	Yes	Yes	Yes	6-6
16 to 1E	Not used	-	-	-	-	-

■H4: Multi-Function Analog Outputs

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
H4-01	Terminal FM Monitor Selection / Terminal FM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal FM. Items that can be set differ in accordance with the selected control modes. For information on the parameters for which analog output is possible, refer to *U: Monitors*.	1 to 99	2	No	A	A	A	41DH	6-79
H4-02	Terminal FM Gain Setting / Terminal FM Gain	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.*	0.00 to 2.50	1.00	Yes	Q	Q	Q	41EH	4-5 6-79
H4-03	Terminal FM Bias Setting / Terminal FM Bias	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.*	-10.0 to +10.0	0.0%	Yes	A	A	A	41FH	6-79
H4-04	Terminal AM Monitor Selection / Terminal AM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal AM. Items that can be set differ in accordance with the selected control modes. For information on the parameters for which analog output is possible, refer to *U: Monitors*.	1 to 99	3	No	A	A	A	420H	6-79
H4-05	Terminal AM Gain Setting / Terminal AM Gain	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.*	0.00 to 2.50	0.50	Yes	Q	Q	Q	421H	4-5 6-79
H4-06	Terminal AM Bias Setting / Terminal AM Bias	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.*	-10.0 to +10.0	0.0%	Yes	A	A	A	422H	6-79
H4-07	Terminal FM Signal Level Selection / AO Level Select 1	Sets the signal output level for multi-function output 1 (terminal FM) 0: -10 to 10 VDC output 1: -10 to 10 VDC output	0 or 1	0	No	A	A	A	423H	6-79
H4-08	Terminal AM Signal Level Selection / AO Level Select 2	Sets the signal output level for multi-function output 2 (terminal AM) 0: 0 to +10 VDC output 1: 0 to ±10 VDC output	0 or 1	0	No	A	A	A	424H	-

* The FM output can be adjusted when the H4-02 or H4-03 setting is displayed in Quick, Advanced, or Verify Mode while the motor is stopped. The AM output can be adjusted when the H4-05 or H4-06 setting is displayed in Quick, Advanced, or Verify Mode while the motor is stopped. For analog output, the value equivalent to 100% of output value of monitored item is multiplied by the gain setting and the set bias is added.

■H5: MEMOBUS Communications

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
H5-01	MxC Node Address / Serial Comm Adr	Set the MxC's station address.	0 to 20 *	1F	No	A	A	A	425H	6-84
H5-02	Communication Speed Selection / Serial Baud Rate	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	6-84
H5-03	Communication Parity Selection / Serial Com Sel	Set the parity for MEMOBUS communications of CN6. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	A	A	427H	6-84
H5-04	Stopping Method After Communication Error / Serial Fault Sel	Set the stopping method for communications errors. 0: Deceleration to stop 1: Coast to stop 2: Emergency stop 3: Continue operation	0 to 3	3	No	A	A	A	428H	6-84
H5-05	Communication Fault Detection Selection / Serial Flt Dtct	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	6-84
H5-06	MxC Transmit Wait Time / Transmit Wait-TIM	Set the time from the MxC receiving data to when the MxC starts to send.	5 to 65	5 ms	No	A	A	A	42AH	6-84
H5-07	RTS Control Selection / RTS Control Sel	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
H5-10	Unit Selection for Memobus Register 0025H / MEMOBUS 25H UNIT	Selects the units used for MEMOBUS registry 0025H (monitors the output voltage reference). 0: 0.1 V units 1: 1 V units	0 or 1	0	No	A	A	A	436H	6-84

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

◆ L: Protection Function

The following settings are made with the protection function parameters (L parameters): Motor selection function, power loss ridethrough function, stall prevention function, frequency detection, torque limits, and hardware protection.

■L1: Motor Overload

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMOBUS Register	Page
						V/f	Open Loop Vector	Flux Vector		
L1-01	Motor Overload Protection Selection / MOL Fault Select	Sets the motor thermal overload protection (OL1) based on the cooling capacity of the motor. 0: Disabled. 1: Standard Fan Cooled (< 10:1 motor) 2: Standard Blower Cooled (10:1 motor) 3: Vector Motor (≤1000:1 motor)	0 to 3	1	No	Q	Q	Q	480H	4-5 6-51
L1-02	Motor Overload Protection Time / MOL Time Const	Sets the motor thermal overload protection (OL1) time. A larger L1-02 time will increase the time before an OL1 fault will occur.	0.1 to 5.0	1.0 min	No	A	A	A	481H	6-51
L1-03	Motor Overheat Alarm Operation Selection / Mtr OH Alarm Sel	Sets operation selection when the motor temperature analog input (H3-09 = E) exceeds the OH3 alarm level (1.17V) 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	No	A	A	A	482H	6-54
L1-04	Motor Overheat Fault Operation Selection / Mtr OH Fault Sel	Sets stopping method when the motor temperature analog input (H3-09 = E) exceeds the OH4 fault level. 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop	0 to 2	1	No	A	A	A	483H	6-54
L1-05	Motor Temperature Input Filter Time / Mtr Temp Filter	This parameter adjusts the filter on the motor temperature analog input (H3-09 = E). Increase to add stability, decrease to improve response.	0.00 to 10.00	0.20 s	No	A	A	A	484H	6-54

■L2: Power Loss Ridethrough

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
L2-01	Momentary Power Loss Detection Selection / PwrL Selection	Enables and disables the momentary power loss function. 0: Disabled. - MxC trips on (FDV) fault when power is lost. 1: Power Loss Ridethrough Time - MxC will restart if power returns within the time set in L2-02. 2: CPU Power Active - MxC will restart if power returns prior to control power supply shut down.	0 to 2	0	No	A	A	A	485H	6-56
L2-02	Momentary Power Loss Ridethrough Time / PwrL Ridethru t	Sets the power loss ridethrough time. This value is dependent on the capacity of the MxC. Enabled only when L2-01 = 1.	0.0 to 2.5	0.5 s	No	A	A	A	486H	6-56
L2-03	Momentary Power Loss Minimum Base Block Time / PwrL Baseblock t	Sets the minimum time to wait to allow the residual motor voltage to decay before the MxC output turns back on during power loss ridethrough. After a power loss, if L2-03 is greater than L2-02, operation resumes after the time set in L2-03.	0.1 to 5.0	0.7 s *1	No	A	A	A	487H	6-56 6-60
L2-04	Momentary Power Loss Voltage Recovery Ramp Time / PwrL V/F Ramp t	Sets the time it takes the output voltage to return to the preset V/f pattern after speed search (Current Detection Mode) is complete.	0.0 to 5.0	1.5 s	No	A	A	A	488H	6-56 6-60
L2-05	Undervoltage Detection Level / PUV Det Level	Sets the PS undervoltage trip level of the MxC. If this is set lower than the default, additional AC input reactance or PS voltage may be necessary. Consult the factory before changing this parameter setting.	150 to 210 *2	190 VDC *2	No	A	A	A	489H	6-56
L2-13	Power Frequency Fault Detection gain / FDV Gain	Set the gain to detect a power frequency fault (FDV). If an FDV is detected when no momentary power loss occurred, decrease the set value in units of 0.1.	0.1 to 2.0	1.0	No	A	A	A	4CDH	6-56
L2-21	Undervoltage-Detection Level / Power UV Level	Set the undervoltage-detection level for the input power voltage in volts.	100 to 200 *2	150 VAC *2	No	A	A	A	4D5H	6-56
L2-27 *3	Detection Width of Input Power Frequency Error / FDV Level	Sets the frequency width in hertz that detects the input power frequency error (FDV). The customer needs not to set or modify.	3.0 to 20.0	6.0 Hz	No	A	A	A	4F7H	6-57

* 1. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

* 2. These are values for a 200 V class MxC. Double the value for a 400 V class MxC.

* 3. Applicable for the Varispeed AC with software versions PRG:1050 or later.

■L3: Stall Prevention

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
L3-01*	Stall Prevention Selection During Accel / StallP Accel Sel	Selects the stall prevention method used to prevent excessive current during acceleration. 0: Disabled. - Motor accelerates at active acceleration rate. The motor may stall if load is too heavy or accel time is too short. 1: General Purpose - When output current exceeds L3-02 level, acceleration stops. Acceleration will continue when the output current level falls below the L3-02 level. 2: Intelligent - The active acceleration rate is ignored. Acceleration is completed in the shortest amount of time without exceeding the current value set in L3-02.	0 to 2	1	No	A	A	No	48FH	4-17 6-21
L3-02	Stall Prevention Level During Acceleration / StallP Accel Lvl	This function is enabled when L3-01 is "1" or "2". MxC rated current is 100%. Decrease the set value if stalling or excessive current occurs with default.	0 to 200	150%	No	A	A	No	490H	4-17 6-21
L3-03	Stall Prevention Limit During Acceleration / StallP CHP Lvl	Sets the lower limit for stall prevention during acceleration, as a percentage of the rated current of the MxC, when operation is in the frequency range above E1-06 (constant power region).	0 to 100	50%	No	A	A	No	491H	4-17 6-21
L3-04*	Stall Prevention Selection During Deceleration / StallP Decel Sel	0: Disabled. - Motor decelerates at active deceleration rate. The motor may stall if load is too heavy or decel time is too short. 1: General Purpose - When output current exceeds L3-14 level, deceleration stops. Deceleration will continue when the output current level falls below the L3-14 level.	0 or 1	1	No	A	A	A	492H	6-23
L3-05	Stall Prevention Selection During Run / StallP Run Sel	Selects the stall prevention method to use to prevent MxC faults during run. 0: Disabled.- MxC runs a set frequency. A heavy load may cause the MxC to trip on an OC or OL fault. 1: Decel Time 1 - In order to avoid stalling during heavy loading, the MxC will decelerate at Decel time 1 (C1-02) if the output current exceeds the level set by L3-06. Once the current level drops below the L3-06 level, the MxC will accelerate back to its frequency reference at the active acceleration rate. 2: Decel Time 2 - Same as setting 1 except the MxC decelerates at Decel Time 2 (C1-04). When output frequency is 6 Hz or less, Stall Prevention during Run is disabled regardless of the setting in L3-05.	0 to 2	1	No	A	No	No	493H	4-17 6-43

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
L3-06	Stall Prevention Level During Run / StallP Run Level	This parameter is enabled when L3-05 is set to "1" or "2". MxC rated current is set as 100%. Decrease the set value if stalling or excessive current occurs with the defaults.	30 to 200	160%	No	A	No	No	494H	4-17 6-43
L3-14	Stall prevention level during decel / StallP Decel Lvl	Enabled if L3-04 is set to 1. Set the level as a percentage of the MxC rated current. Usually setting is not necessary. Lower the value if the motor stalls at the default.	100 to 200	150%	No	A	A	A	4E9H	6-23

* Not available for the MxC models CIMR-ACA4110 and 4160 for V/f Control.

■L4: Reference Detection

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
L4-01	Speed Agreement Detection Level / Spd Agree Level	Effective when "Desired frequency (speed) agree 1," "Frequency (FOUT) detection 1," or "Frequency (FOUT) detection 2" is set for a multi-function output. Frequencies to be detected are set in Hz units.	0.0 to 120.0	0.0 Hz	No	A	A	A	499H	6-44
L4-02	Speed Agreement Detection Width / Spd Agree Width	Effective when "Frequency (speed) agree 1," "Frequency (FOUT) agree 1," or "Frequency (FOUT) detection 2" is set for a multi-function output. Sets the frequency detection width in Hz units.	0.0 to 20.0	2.0 Hz	No	A	A	A	49AH	6-44
L4-03	Speed Agreement Detection Level(+/-) / Spd Agree Lvl +-	Effective when "Desired frequency (speed) agree 2," "Frequency (FOUT) detection 3," or "Frequency (FOUT) detection 4" is set for a multi-function output. Frequency that should be detected is set in Hz units.	-120.0 to +120.0	0.0 Hz	No	A	A	A	49BH	6-44
L4-04	Speed Agreement Detection Width (+/-) / Spd Agree Wdth +-	Effective when "Frequency (speed) agree 2," "Frequency (FOUT) detection 3," or "Frequency detection 4" is set for a multi-function output. Frequency detection width is set in Hz units.	0.0 to 20.0	2.0 Hz	No	A	A	A	49CH	6-44
L4-05	Frequency Reference Loss Detection Selection / Ref Loss Sel	0: Stop (Operation follows the frequency reference.) 1: Operation at 80% speed continues. (At 80% of speed before the frequency reference was lost) Frequency reference is lost: Frequency reference dropped over 90% in 400 ms.	0 or 1	0	No	A	A	A	49DH	6-64

■L5: Fault Restart

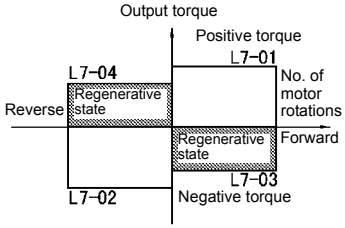
Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
L5-01	Number of Auto Restart Attempts / Num of Restarts	Sets the number of auto restart attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A	A	A	49EH	6-65
L5-02	Auto Restart Operation Selection / Restart Sel	Sets whether a fault contact output is activated during fault restart. 0: Not output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A	A	A	49FH	6-65

■L6: Torque Detection

The following table shows the parameters for the torque detection function.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
L6-01	Torque Detection Selection 1 / Torq Det 1 Sel	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A	A	A	4A1H	6-48
L6-02	Torque Detection Level 1 / Torq Det 1 Lvl	Open Loop Vector Control: Motor rated torque is set as 100%. V/f Control: MxC rated current is set as 100%.	0 to 300	150%	No	A	A	A	4A2H	6-48
L6-03	Torque Detection Time 1 / Torq Det 1 Time	Sets the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	A	A	A	4A3H	6-48
L6-04	Torque Detection Selection 2 / Torq Det 2 Sel	Multi-function output for overtorque detection 1 is output to multi-function contact output when overtorque detection 1 NO or overtorque detection 1 NC is selected. Multi-function output for overtorque detection 2 is output to multi-function contact output when overtorque detection 2 NO or overtorque detection 2 NC is selected.	0 to 8	0	No	A	A	A	4A4H	6-48
L6-05	Torque Detection Level 2 / Torq Det 2 Lvl		0 to 300	150%	No	A	A	A	4A5H	6-48
L6-06	Torque Detection Time 2 / Torq Det 2 Time		0.0 to 10.0	0.1 s	No	A	A	A	4A6H	6-48

■L7: Torque Limits

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
L7-01	Forward Torque Limit / Torq Limit Fwd	Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set. 	0 to 300	200%	No	No	A	A	4A7H	4-17 6-40
L7-02	Reverse Torque Limit / Torq Limit Rev		0 to 300	200%	No	No	A	A	4A8H	4-17 6-40
L7-03	Forward Regenerative Torque Limit / Torq Lmt Fwd Rgn		0 to 300	200%	No	No	A	A	4A9H	4-17 6-40
L7-04	Reverse Regenerative Torque Limit / Torq Lmt Rev Rgn		0 to 300	200%	No	No	A	A	4AAH	4-17 6-40
L7-06	Torque Limit Integral Time Constant / Torq Limit Time	Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set.	5 to 10,000	200 ms	No	No	A	No	4ACH	4-17 6-40
L7-07	Torque Limit Control Method Selection During Accel/Decel / Torque Limit Sel	Selects the method of torque limit controls during accel/decel 0: Proportional Controls (uses integral controls at fixed speeds). 1: Integral Controls Adjustment is not normally required. With applications that require torque limits during accel/decel, integral controls (setting value = 1) are used when torque controls take precedence. When torque limit is applied to the motor, accel/decel time may increase and motor speed may not run at the indicated speed reference.	0, 1	0	No	No	A	No	4C9H	4-17 6-40

■L8: Hardware Protection

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
L8-02	Overheat Alarm Level / OH Pre-Alarm Lvl	When the cooling fin temperature exceeds the value set in this parameter, an Overheat Alarm (OH) will occur.	50 to 130	90 °C *	No	A	A	A	4AEH	6-66
L8-03	Overheat Pre-Alarm Operation Selection / OH Pre-Alarm Sel	Selects the MxC operation upon an OH pre-alarm detection. 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	No	A	A	A	4AFH	6-66
L8-07	Output Phase Loss Protection / Ph Loss Out Sel	Selects the detection method for output phase loss. When applied motor capacity is too small for MxC capacity, output phase loss may be detected inadvertently. In this case, set to 0. 0: Disabled. 1: Single Phase Loss Detection 2: 2/3-phase Loss Detection	0 to 2	0	No	A	A	A	4B3H	-
L8-09	Output Ground Fault Detection Selection / Ground Fault Sel	Enables and disables the MxC's output ground fault detection. 0: Disabled. 1: Enabled.	0 or 1	1	No	A	A	A	4B5H	-
L8-10	Heatsink Cooling Fan Operation Selection / Fan On/Off Sel	Controls the heatsink cooling fan operation. 0: Fan On-Run Mode - Fan will operate only when the MxC is running and for L8-11 seconds after RUN is removed. 1: Fan always on - Cooling fan operates whenever the MxC is powered up.	0 or 1	0	No	A	A	A	4B6H	-
L8-11	Heatsink Cooling Fan Operation Delay Time / Fan Delay Time	This parameter sets the delay time for the cooling fan turn off after the Run Command is removed when L8-10 = 0.	0 to 300	60 s	No	A	A	A	4B7H	-
L8-12	Ambient Temperature Setting / Ambient Temp	When the MxC is installed in an ambient temperature exceeding its rating, the MxC overload (OL2) protection level is adjusted.	45 to 60	45 °C	No	A	A	A	4B8H	-
L8-15	OL2 Characteristic Selection at Low Speeds / OL2 Sel @ L-Spd	This parameter assists in protecting the output transistors from overheating when output current is high and output frequency is low (6 Hz and less). 0: Disabled. - L8-16 and L8-17 are disabled. 1: Enabled. - L8-16 and L8-17 are active.	0 or 1	1	No	A	A	A	4BBH	-
L8-42	Factory adjustment 1 / Voltage Offset	For factory adjustment Do not change the setting. 0: Not adjusted 1: Being adjusted 2: Adjusted	0 to 2	2	No	A	A	A	4F3H	8-3

* The default depends upon the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

◆ n: Special Adjustments

The following settings are made with the special adjustments parameters (N parameters): Hunting prevention, speed feedback detection control, and feed forward control.

■n1: Hunting Prevention Function

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMOBUS Register	Page
						V/f	Open Loop Vector	Flux Vector		
n1-01	Hunting Prevention Selection / Hunt Prev Select	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. This function is enabled in V/f Control method only. If high response is to be given priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A	No	No	580H	6-36
n1-02	Hunting Prevention Gain Setting / Hunt Prev Gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to make this setting. Adjust this parameter as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A	No	No	581H	4-14 6-36
n1-03	Hunting Prevention Time Constant / Hunt Prev Time	Set the hunting-prevention primary delay time in units of ms.	0 to 500	10 ms	No	A	No	No	582H	6-36

■n2: Speed Feedback Protection Control Functions

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
n2-01	Speed Feedback Detection Control (AFR) Gain / AFR Gain	Set the internal speed feedback detection control gain using the multiplication function. Normally, there is no need to make this setting. Adjust this parameter as follows: • If hunting occurs, increase the set value. • If response is low, decrease the set value. Adjust the setting by 0.05 at a time, while checking the response.	0.00 to 10.00	1.00	No	No	A	No	584H	4-14 6-37
n2-02	Speed Feedback Detection Control (AFR) Time Constant / AFR Time	Set the time constant to decide the rate of change in the speed feedback detection control.	0 to 2000	100 ms	No	No	A	No	585H	6-37
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2 / AFR Time 2	Increase the setting if overvoltage (OV) failures occur at the completion of acceleration or when the load changes radically.	0 to 2000	750 ms	No	No	A	No	586H	6-37

■n5: Feed Forward

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
n5-01	Feed Forward Control Selection / Feedfoward Sel	Selects the feed forward controls. 0: Disabled. 1: Enabled.	0 or 1	0	No	No	No	A	5B0H	4-17 6-120
n5-02	Motor Acceleration Time / Motor Accel Time	Sets the time required to accelerate the motor at the rated torque (T100) to the rated speed (Nr). J: $(GD^2) / 4$, P: Motor rated output $ta = \frac{2\pi \cdot J[kgm^2] \cdot Nr[min^{-1}]}{60 \cdot T_{100}[N \cdot m]}$ [sec] And $T_{100} = \frac{60}{2\pi} \cdot \frac{P[kW]}{Nr[min^{-1}]} \times 10^3 [N \cdot m]$	0.001 to 10.000	0.168 s *	No	No	No	A	5B1H	4-17 6-120
n5-03	Feed Forward Control Ratio Gain / Feedfoward Gain	Sets the proportional gain for feed forward controls. Response to the speed reference will increase as the setting of n5-03 is increased.	0.00 to 100.00	1.0	No	No	No	A	5B2H	4-17 6-120

* The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

◆ o: Digital Operator

The following settings are made with the digital operator parameters (o parameters): Selection of items displayed on the digital operator, multi-function selections and the copy function.

■o1: Monitor Select

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
o1-01	User Monitor Selection / User Monitor Sel	Set the number of the monitor item to be displayed (U1-□□). Items that can be set differ in accordance with the selected control modes. The output monitor voltage (default) can be changed. For information on the parameters for which analog output is possible, refer to *U: Monitors*.	4 to 99	6	Yes	A	A	A	500H	-
o1-02	User Monitor Selection After Power-Up / Power-On Monitor	Sets the monitor item to be displayed when the power is turned on. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	A	A	501H	6-125
o1-03	Digital Operator Display Selection / Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: 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. □□□□□ Set 4-digit number excluding the decimal point. Set the number of digits below the decimal point to display. Example: When the max. output frequency value is 200.0, set 12000.	0 to 39999	0	No	A	A	A	502H	6-125 6-142
o1-04	Setting unit for frequency parameters related to V/f characteristics / Display Units	Set the setting unit for frequency reference-related parameters. 0: Hz 1: min^{-1} *	0 or 1	0	No	No	No	A	503H	6-125
o1-05	LCD Brightness Adjustment / LCD Contrast	Adjust the brightness of the LCD. Set a smaller value to lighten the LCD and a larger value to darken the LCD (standard: 3).	0 to 5	3	No	A	A	A	504H	-

* The digital operator shows rpm instead of min^{-1}.

■o2: Multi-function Selections

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
o2-01	Local/Remote Key Function Selection / Local/Remote Key	Determines if the digital operator LOCAL/REMOTE key is functional. 0: Disabled. 1: Enabled.	0 or 1	1	No	A	A	A	505H	6-125
o2-02	STOP Key Function Selection / Oper STOP Key	Determines if the STOP key on the digital operator will stop the MxC when MxC is operating from external terminals or serial communication. 0: Disabled. 1: Enabled.	0 or 1	1	No	A	A	A	506H	6-125
o2-03	User Parameter Default Value / User Defaults	Allows storing of parameter settings as a User Initialization Selection. 0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. A1-03 now allows selecting <1110> for user initialization and returns o2-03 to zero. 2: Clear All - Clears the currently saved user initialization. A1-03 no longer allows selecting <1110> and returns o2-03 to zero.	0 to 2	0	No	A	A	A	507H	4-13 6-126
o2-04	MxC/kVA Selection / MxC Model #	This parameter only needs to be set when installing a new control board. Do not change for any other reason.	0 to FF	5*1	No	A	A	A	508H	-
o2-05	Frequency Reference Setting Method Selection / Operator M.O.P.	Determines if the DATA/ENTER key must be used to input a frequency reference from the digital operator. 0: Disabled. - DATA/ENTER key must be pressed to enter a frequency reference. 1: Enabled. - DATA/ENTER key is not required. The frequency reference is adjusted by the up and down arrow keys on the digital operator without having to press the DATA/ENTER key.	0 or 1	0	No	A	A	A	509H	6-126
o2-06	Operation Selection when Digital Operator is Disconnected / Oper Detection	Determines if the MxC will stop when the digital operator is removed when in Local Mode or b1-02 = 0. 0: Disabled. - The MxC will not stop when the digital operator is removed. 1: Enabled. - The MxC will fault (OPR) and coast to stop when the digital operator is removed.	0 or 1	0	No	A	A	A	50AH	-
o2-07	Cumulative Operation Time Setting / Elapsed Time Set	Sets the initial value of the elapsed operation timer U1-13.	0 to 65535	0 hr	No	A	A	A	50BH	6-126
o2-08	Cumulative Operation Time Selection / Elapsed Time Run	Sets how time is accumulated for the elapsed operation timer U1-13. 0: Power-On Time. Time accumulates when the MxC is powered. 1: Running Time. Time accumulates only when the MxC is running.	0 or 1	0	No	A	A	A	50CH	-

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
o2-09	Initialization Specification Selection / Init Mode Sel	Determines parameter default values after a full initialization (A1-03) is executed. This should always be set to "1" for North American installations. 0: Japanese spec 1: American spec 2: European spec	0 to 2	0	No	A	A	A	50DH	-
o2-10 *2	Fan operation time setting / Fan ON Time Set	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0	No	A	A	A	50EH	6-126 6-156
o2-12	Fault Trace/Fault History Clear Function / FLT Trace Init	Clears the fault memory contained in the U2 and U3 monitors. 0: Disabled. - no effect 1: Enabled. - resets U2 and U3 monitors, and returns o2-12 to zero.	0 or 1	0	No	A	A	A	510H	-
o2-14	kWh User Monitor Initialization / kWh Monitor Init	Used to reset the kilowatt-hour monitor U1-29 to zero. 0: Disabled. - no change 1: Enabled. - Resets U1-29 to zero and returns o2-14 to zero.	0 or 1	0	No	A	A	A	512H	5-60
o2-18 *2	Capacitor maintenance setting / C MaintenanceSet	Allows the user to set the maintenance time for the capacitors on the PCB board (U1-61). The user can reset the accumulated operation time back to zero, or to some other desired value.	0 to 150	0%	No	A	A	A	51DH	6-156

* 1. The default depends upon the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

* 2. Applicable for the Varispeed AC with software versions PRG: 1050 or later.

■ o3: Copy Function

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMO-BUS Register	Page
o3-01	Copy Function Selection / Copy Function Sel	This parameter controls the copying of parameters to and from the digital operator. 0: COPY SELECT (no function) 1: INV→ OP READ: All parameters are copied from the MxC to the digital operator. 2: OP → INV WRITE: All parameters are copied from the digital operator to the MxC. 3: OP ⇔ INV VERIFY: Parameter settings in the MxC are compared to those in the digital operator. Note: When using the copy function, the MxC model number (o2-04), software number (U1-14), and control method (A1-02) must match or an error will occur.	0 to 3	0	No	A	A	A	515H	6-128
o3-02	Copy Allowed Selection / Read Allowable	Enables and disables the digital operator copy functions. 0: Disabled. - No digital operator copy functions are allowed. 1: Enabled. - Copying allowed.	0 or 1	0	No	A	A	A	516H	6-128

◆ T: Motor Auto-Tuning

The following settings are made with the motor Auto-Tuning parameters (T parameters): Settings for Auto-Tuning.

The parameters cannot be displayed in the Quick, Advance, or Verify Mode.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
T1-00	Motor Selection 1/2 *1 / Select Motor	Selects which set of motor parameters are to be used and set during Auto-Tuning. If Motor 2 selection (H1-□□=16) is not selected, this parameter will not be displayed. 1: 1st Motor - E1 to E2 2: 2nd Motor - E3 to E4	1 or 2	1	No	Yes	Yes	Yes	700H	4-11
T1-01	Auto-Tuning Mode Selection / Tuning Mode Sel	Selects the Auto-Tuning Mode. 0: Rotational Auto-Tuning (A1-02 = 2 or 3) 2: Terminal resistance only, (stationary) Auto-Tuning (A1-02 = 0, 1, 2, or 3) 4: Stationary Auto-Tuning 2	0, 2, or 4 *8	0 *2	No	Yes for 2 only	Yes	Yes	701H	4-9 4-11
T1-02	Motor Rated Power / Mtr Rated Power	Sets the motor rated power in kilowatts (kW). *3 *5	0.00 to 650.00 kW	5.50 kW *6	No	Yes	Yes	Yes	702H	4-11
T1-03	Motor rated voltage / Rated Voltage	Sets the motor rated voltage in Volts (V). *3 *4	0.0 to 255.0 for 200 V class, 0.0 to 510.0 for 400 V class	200.0 VAC for 200 V class, 400.0 for 400 V class	No	No	Yes	Yes	703H	4-11
T1-04	Motor Rated Current / Rated Current	Sets the motor rated current in Amperes (A). *3 *5	2.70 to 54.00 A *9	19.60 A *6	No	Yes	Yes	Yes	704H	4-11
T1-05	Motor Base Frequency / Rated Frequency	Sets the base frequency of the motor in Hertz (Hz). *3 *4	0.0 to 120.0	60.0 Hz	No	No	Yes	Yes	705H	4-11
T1-06	Number of Motor Poles / Number of Poles	Sets the number of motor poles.	2 to 48 poles *10	4 poles	No	No	Yes	Yes	706H	4-11
T1-07	Motor Base Speed / Rated Speed	Sets the base speed of the motor in min^{-1} *. *3	0 to 24000	1750 min^{-1} *11	No	No	Yes	Yes	707H	4-11
T1-08	Number of PG Pulses / PG Pulses / Rev	Sets the number of pulses per revolution (PPR) for the encoder (pulse generator) being used without any multiplication factor.	0 to 60000	600	No	No	No	Yes	708H	4-11
T1-09	Motor no-load current / No-Load Current	Set the motor no-load current to the value indicated shown in the motor test report or other specification sheets. This parameter is displayed only when Stationary Auto-Tuning 2 (T1-01 = 4) is selected.	0.00 to 19.59 *7	5.10 A *6	No	No	Yes	Yes	709H	4-11

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register	Page
T1-10	Motor rated slip / Motor Rated Slip	Set the amount of the motor rated slip in hertz. This parameter is displayed only if Stationary Auto-Tuning 2 (T1-01 = 4) is selected.	0.00 to 20.00	1.50 Hz *6	No	No	Yes	Yes	70AH	4-11

* 1. Displayed only when the Motor Switch Command is set to a multi-function digital input and one of the parameters H1-01 to H1-10 is set to 16.

* 2. The default depends on the control method. The default for Open Loop Vector Control is given.

* 3. For constant torque motors, set the value at the base speed.

* 4. The voltage or frequency of the Inverter motor or the motor for vector control may be lower than that of a general-purpose motor. Always check the nameplate or test report before changing the settings. If the values for a motor without load are known, set the no-load voltage at T1-03 and no-load frequency at T1-05 to ensure accuracy.

* 5. For stable vector control, set the parameter to a value between 75% and 100% of the MxC rating.

* 6. The default depends on the MxC capacity. The value for a 200 V class MxC for 5.5 kW is given.

* 7. The setting range depends on the MxC capacity. The value for a 200 V class MxC for 5.5 kW is given.

* 8. Set T1-02 and T1-04 when 2 is set for T1-01. Only set value 2 is possible for V/f Control.

* 9. The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given.

* 10. For driving an induction motor with 2, 4, or 6 poles.

* 11. The digital operator shows rpm instead of min^{-1}.

◆ U: Monitors

The following settings are made with the monitor parameters (U parameters): Setting parameters for monitoring in Drive Mode.

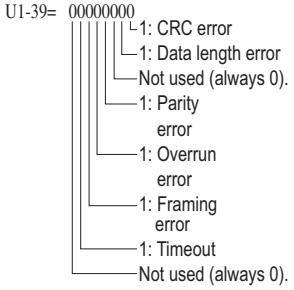
■ U1: Status Monitors

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods			MEMOBUS Register
					V/f	Open Loop Vector	Flux Vector	
U1-01	Frequency reference / Frequency Ref	Monitors/sets the frequency reference value.*	10 V: Max frequency (−10 V to + 10 V possible)	0.01 Hz	A	A	A	40H
U1-02	Output frequency / Output Freq	Monitors the output frequency.*	10 V: Max frequency (−10 V to + 10 V possible)	0.01 Hz	A	A	A	41H
U1-03	Output current / Output Current	Monitors the output current.	10 V: MxC rated output current (0 V to +10 V, absolute value output)	0.1 A	A	A	A	42H
U1-04	Control method / Control Method	Checks the current control method.	No output available	-	A	A	A	43H
U1-05	Motor speed / Motor Speed	Monitors the detected motor speed.*	10 V: Max frequency (−10 V to + 10 V possible)	0.01 Hz	No	A	A	44H
U1-06	Output voltage / Output Voltage	Monitors the output voltage reference value in the MxC.	10 V: 200 VAC (400 VAC) (0 V to +10 V output)	0.1 VAC	A	A	A	45H
U1-07	Control circuit voltage / PS Voltage	Monitors the control circuit voltage in the MxC.	10 V: 400 VDC (800 VDC) (0 V to +10 V output)	1 VDC	A	A	A	46H
U1-08	Output power / Output kWatts	Monitors the output power (internally detected value).	10 V: MxC capacity (max applicable motor capacity) (−10 V to + 10 V possible)	0.1 kW	A	A	A	47H
U1-09	Torque reference / Torque Reference	Monitors internal torque reference value for vector control.	10 V: Motor rated torque (−10 V to + 10 V possible)	0.1%	No	A	A	48H

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

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods			MEMO-BUS Register
					V/f	Open Loop Vector	Flux Vector	
U1-10	Input terminal status / Input Term Sts	Shows input on/off status. U1-10= 00000000 1: FWD command (S1) is on. 1: REV command (S2) is on. 1: Multi input 1 (S3) is on. 1: Multi input 2 (S4) is on. 1: Multi input 3 (S5) is on. 1: Multi input 4 (S6) is on. 1: Multi input 5 (S7) is on. 1:Multi input 6 (S8) is on. The on/off status of the following input terminals can be checked by displaying U1-10 and pressing the ENTER key. (Press the ENTER key again to return to the original display.) Upper 4 bits. U1-10= 0000 1: Multi input 7 (S9) is on. 1: Multi input 8 (S10) is on. 1: Multi input 9 (S11) is on. 1: Multi input 10 (S12) is on.	*No output available*	-	A	A	A	49H
U1-11	Output terminal status / Output Term Sts	Shows output on/off status. U1-11= 00000000 1: Multi-function contact output (M1-M2) is on. 1: Multi-funtion contact output 1 (P1) is on. 1: Multi-funtion contact output 2 (P2) is on. 1: Multi-function contact output 3 (P3) is on. 1: Multi-function contact output 4 (P4) is on. Not used (always 0). 1: Error output (MA/AB-MC) is on.	*No output available*	-	A	A	A	4AH
U1-12	Operation status / Int Ctl Sts 1	MxC operating status. U1-12= 00000000 1: Run 1: Zero speed 1: Reverse 1: Reset signal input 1: Speed agree 1: MxC ready 1: Minor fault 1: Major fault	*No output available*	-	A	A	A	4BH

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register
U1-13	Cumulative operation time / Elapsed Time	Monitors the total operating time of the MxC. The initial value and the operating time/power on time selection can be set in o2-07 and o2-08.	*No output available*	1 hr	A	A	A	4CH
U1-14	Software No. (flash memory) / FLASH ID	(Manufacturer's ID number)	*No output available*	-	A	A	A	4DH
U1-15	Terminal A1 input voltage / Term A1 Level	Monitors the input voltage of the voltage frequency reference. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (–10 V to + 10 V possible)	0.1%	A	A	A	4EH
U1-16	Terminal A2 input voltage / Term A2 Level	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (–10 V to + 10 V possible)	0.1%	A	A	A	4FH
U1-17	Terminal A3 input voltage / Term A3 Level	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (–10 V to + 10 V possible)	0.1%	A	A	A	50H
U1-18	Motor secondary current (Iq) / Mot SEC Current	Monitors the calculated value of the motor secondary current. The motor rated secondary current corresponds to 100%.	10 V: Motor rated secondary current) (–10 V to + 10 V possible)	0.1%	A	A	A	51H
U1-19	Motor exciting current (Id) / Mot EXC Current	Monitors the calculated value of the motor excitation current. The motor rated secondary current corresponds to 100%.	10 V: Motor rated secondary current) (–10 V to + 10 V possible)	0.1%	No	A	A	52H
U1-20	Output frequency after soft-start / SFS Output	Monitors the output frequency after a soft start. The frequency given does not include compensations, such as slip compensation. The unit is set in o1-03.	10 V: Max frequency (–10 V to + 10 V possible)	0.01 Hz	A	A	A	53H
U1-21	ASR input / ASR Input	Monitors the input to the speed control loop. The maximum frequency corresponds to 100%.	10 V: Max frequency (–10 V to + 10 V possible)	0.01 %	No	No	A	54H
U1-22	ASR output / ASR Output	Monitors the output from the speed control loop. The motor rated secondary current corresponds to 100%.	10 V: Motor rated secondary current) (–10 V to + 10 V possible)	0.01 %	No	No	A	55H
U1-24	PID feedback value / PID Feedback	Monitors the feedback value when PID control is used. The input for the max frequency corresponds to 100%.	10 V: Max frequency (–10 V to + 10 V possible)	0.01 %	A	A	A	57H
U1-25	DI-16H2 input status / DI-16 Reference	Monitors the reference value from a DI-16H2 digital reference card. The value will be displayed in binary or BCD depending on parameter F3-01.	*No output available*	-	A	A	A	58H
U1-26	Output voltage reference (Vq) / Voltage Ref (Vq)	Monitors the MxC internal voltage reference for motor secondary current control.	10 V: 200 VAC (400 VAC) (–10 V to + 10 V possible)	0.1 VAC	No	A	A	59H

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods			MEMO-BUS Register
					V/f	Open Loop Vector	Flux Vector	
U1-27	Output voltage reference (Vd) Voltage Ref (Vd)	Monitors the MxC internal voltage reference for motor excitation current control.	10 V: 200 VAC (400 VAC) (−10 V to + 10 V possible)	0.1 VAC	No	A	A	5AH
U1-28	Software No. (CPU) CPU ID	(Manufacturer's CPU software No.)	*No output available*	-	A	A	A	5BH
U1-29	Output power lower 4 digits kWh Lower 4 dig	Monitors the MxC's output power. The display is split into upper digits and lower digits in the following way. □□□□□ (U1-30) □□□□□ (U1-29) kWH Example: If the output power is 12345678.9 kWh, the display will be as follows: U1-29: 678.9 kWH U1-30: 12345 MWH (Analog monitor: No output)	0.0 to 32767999.9	0.1 kWH	A	A	A	5CH
U1-30	Output power upper 5 digits kWh Upper 5 dig			MWH	A	A	A	5DH
U1-32	ACR output of q axis ACR(q) Output	Monitors the current control output value for the motor secondary current.	10 V: 100% (−10 V to + 10 V possible)	0.1 %	No	A	A	5FH
U1-33	ACR output of d axis ACR(d) Output	Monitors the current control output value for the motor excitation current.	10 V: 100% (−10 V to + 10 V possible)	0.1 %	No	A	A	60H
U1-34	OPE fault parameter OPE Detected	Shows the first parameter number where an OPE fault was detected.	*No output available*	-	A	A	A	61H
U1-35	Zero-servo movement pulses Zero Servo Pulse	Shows the number of PG pulses times 4 for the movement range when stopped at zero.		1	No	No	A	62H
U1-36	PID input volume PID Input	PID feedback volume Given as maximum frequency/ 100%	10 V: Max frequency (−10 V to + 10 V possible)	0.01 %	A	A	A	63H
U1-37	PID output volume PID Output	PID control output Given as maximum frequency/ 100%	10 V: Max frequency (−10 V to + 10 V possible)	0.01 %	A	A	A	64H
U1-38	PID target value PID Setpoint	PID target value Given as maximum frequency/ 100%	10 V: Max frequency	0.01 %	A	A	A	65H
U1-39	MEMOBUS communications error code Transmit Err	Shows MEMOBUS errors. 	*No output available*	-	A	A	A	66H

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register
U1-40	Cooling fan operating time / FAN Elapsed Time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	*No output available*	1 hr	A	A	A	67H
U1-44	ASR output without filter / ASR Out W/O Fil	Monitors the output from the speed control loop (i.e., the primary filter input value). 100% is displayed for rated secondary current of the motor.	10 V: Rated secondary current of motor (-10 V to +10 V)	0.01 %	No	No	A	6BH
U1-45	Feed forward control output / FF Cout Output	Monitors the output from feed forward control. 100% is displayed for rated secondary current of the motor.	10 V: Rated secondary current of motor (-10 V to +10 V)	0.01 %	No	No	A	6CH
U1-54	Power voltage / Power Voltage	Monitors the input power supply voltage in the MxC.	10 V: 400 VAC (200 V class) 800 VAC (400 V class) (0 V to 10V possible)	1V	A	A	A	075H
U1-55	Power frequency / Power Frequency	Monitors the input power supply frequency in the MxC.	10 V: 60 Hz (0 V to +10V possible)	0.1 Hz	A	A	A	076H
U1-56	Input Power Info / Power Status	Information on the input power supply U2-25= 00000000 bit0: Power detect 0: Not 1: Detect bit1: Phase Direction 0: For 1: Rev bit2: Rated Power Frequency 0: 60 Hz 1: 50 Hz bit3: SRC Detect 0: Not 1: Detect (SRC) bit4: FDEV Detect 0: Not 1: Detect (FDEV) bit5: AUV Detect 0: Not 1: Detect (AUV) bit6: FSTABLED detect 0: Not 1: End (FSTABLE) bit7: RFINI_FLAG detect 0: Not 1: End (RFINI_FLAG)	*No output available*	-	A	A	A	077H
U1-61 *	DC bus capacitor maintenance / C Maintenance	For maintenance purposes, this timer shows the amount of time the capacitors on the PCB board have been operating. Capacitors should be replaced when the monitor reaches 100%.	*No output available*	1%	A	A	A	7CH
U1-63 *	Cooling fan maintenance / Fan Maintenance	This monitor displays the amount of time the cooling fan has been operating. Replace the cooling fan when the display reads 100%.	*No output available*	1%	A	A	A	7EH

* Applicable for the Varispeed AC with software versions PRG: 1050 or later.

■ U2: Fault Trace

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods			MEMO-BUS Register
					V/f	Open Loop Vector	Flux Vector	
U2-01	Current fault / Current Fault	The contents of the current fault.	*No output available*	-	A	A	A	80H
U2-02	Previous fault / Last Fault	The contents of the error that occurred just prior to the current fault.		-	A	A	A	81H
U2-03	Reference frequency at fault / Frequency Ref	The reference frequency when the previous fault occurred.		0.01Hz	A	A	A	82H
U2-04	Output frequency at fault / Output Freq	The output frequency when the previous fault occurred.		0.01Hz	A	A	A	83H
U2-05	Output current at fault / Output Current	The output current when the previous fault occurred.		0.1 A	A	A	A	84H
U2-06	Motor speed at fault / Motor Speed	The motor speed when the previous fault occurred.		0.01 Hz	No	A	A	85H
U2-07	Output voltage reference at fault / Output Voltage	The output reference voltage when the previous fault occurred.		0.1 VAC	A	A	A	86H
U2-08	Control circuit voltage at fault / PS Voltage	The control circuit voltage when the previous fault occurred.		1 VDC	A	A	A	87H
U2-09	Output power at fault / Output kWatts	The output power when the previous fault occurred.		0.1 kW	A	A	A	88H
U2-10	Torque reference at fault / Torque Reference	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 / Input Term Sts	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 / Output Term Sts	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 / MxC Status	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 / Elapsed time	The operating time when the previous fault occurred.		1 hr	A	A	A	8DH
U2-23 *	Power voltage / Power Voltage	Monitors the input power supply voltage in the MxC.	10 V: 400 VAC (200 V class) 800 VAC (400 V class) (0 V to 10V possible)	1VAC	A	A	A	7E8H

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register
U2-24 *	Power frequency / Power Frequency	Monitors the input power supply frequency in the MxC.	10 V: 60 Hz (0 V to +10V possible)	0.1 Hz	A	A	A	7E9H
U2-25 *	Input Power Info / Power Status	Information on the input power supply U2-25= 00000000 bit0: Power detect 0: Not 1: Detect bit1: Phase Direction 0: For 1: Rev bit2: Rated Power Frequency 0: 60 Hz 1: 50 Hz bit3: SRC Detect 0: Not 1: Detect (SRC) bit4: FDEV Detect 0: Not 1: Detect (FDEV) bit5: AUV Detect 0: Not 1: Detect (AUV) bit6: FSTABLED detect 0: Not 1: End (FSTABLE) bit7: RFINI_FLAG detect 0: Not 1: End (RFINI_FLAG)	*No output available*	-	A	A	A	7EAH

* Applicable for the Varispeed AC with software versions PRG: 1050 or later.

Note: The error trace does not include the following errors: CPF00, 01, 02, 03, and power faults.

■U3: Fault History

Parameter Number	Name / Display	Description	Output Signal Level during Multi-Function Analog Output	Min. Unit	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector	MEMOBUS Register
U3-01	Most recent fault / Last Fault	The error contents of 1st previous fault.	*No output available*	-	A	A	A	90H
U3-02	Second most recent fault / Fault Message 2	The error contents of 2nd previous fault.		-	A	A	A	91H
U3-03	Third most recent fault / Fault Message 3	The error contents of 3rd previous fault.		-	A	A	A	92H
U3-04	Fourth/oldest fault / Fault Message 4	The error contents of 4th previous fault.		-	A	A	A	93H
U3-05	Cumulative operation time at fault / Elapsed Time 1	The total operating time when the 1st previous fault occurred.		1 hr	A	A	A	94H
U3-06	Accumulated time of second fault / Elapsed Time 2	The total operating time when the 2nd previous fault occurred.		1 hr	A	A	A	95H
U3-07	Accumulated time of third fault / Elapsed Time 3	The total operating time when the 3rd previous fault occurred.		1 hr	A	A	A	96H
U3-08	Accumulated time of fourth/oldest fault / Elapsed Time 4	The total operating time when the 4th previous fault occurred.		1 hr	A	A	A	97H

* Applicable for the Varispeed AC with software versions PRG: 1050 or later.

Note: The error log does not include the following errors: CPF00, 01, 02, 03, and power faults.

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

The defaults of the following parameters will change if the control method (A1-02) is changed.

Parameter Number	Name / Display	Setting Range	Unit	Default		
				V/f Control	Open loop Vector	Flux Vector
b3-01	Speed Search Selection SpdSrch at Start	0 to 3	1	0	0	-
b3-02	Speed Search Deactivation Current SpdSrch Current	0 to 200	1%	120	100	-
C3-01	Slip Compensation Gain Slip Comp Gain	0.0 to 2.5	0.1	0.0	1.0	1.0
C3-02	Slip Compensation Primary Delay Time Slip Comp Time	0 to 10000	1 ms	2000	200	-
C4-02	Torque Compensation Primary Delay Time Torq Comp Time	0 to 10000	1 ms	200	100	-
C5-01	ASR Proportional Gain 1 ASR P Gain 1	0.00 to 300.00	0.01	-	-	20.00
C5-02	ASR Integral Time 1 ASR I Time 1	0.000 to 10.000	0.001sec	-	-	0.500
C5-03	ASR Proportional Gain 2 ASR P Gain 2	0.00 to 300.00	0.01	-	-	20.00
C5-04	ASR Integral Time 2 ASR I Time 2	0.000 to 10.000	0.001 s	-	-	0.500
C5-06	ASR Primary Delay Time Constant ASR Delay Time	0.000 to 0.500	0.001 s	-	-	0.004
d5-02	Torque Reference Delay Time Torq Ref Filter	0 to 1000	1 ms	-	-	0
n5-01	Feed Forward Control Selection Feedfoward Sel	0 or 1	-	-	-	0
E1-04 E3-02	Maximum Output Frequency Max Frequency	0.0 to 120.0	0.1 Hz	60.0 *2	60.0	60.0
E1-05 E3-03	Maximum Output Voltage Max Voltage	0.0 to 255.0 (0.0 to 510.0)	0.1 V	200.0 *2	200.0	200.0
E1-06 E3-04	Base Frequency Base Frequency	0.0 to 120.0	0.1 Hz	60.0 *2	60.0	60.0
E1-07 E3-05	Mid Output Frequency A Mid Frequency A	0.0 to 120.0	0.1 Hz	3.0 *2	3.0	0.0
E1-08 E3-06	Mid Output Voltage A Mid Voltage A	0.0 to 255.0 (0.0 to 510.0)	0.1 V	14.0 *2	13.0	0.0
E1-09 E3-07	Minimum Output Frequency Min Frequency	0.0 to 120.0	0.1 Hz	1.5 *2	0.5	0.0
E1-10 E3-08	Minimum Output Voltage Min Voltage	0.0 to 255.0 (0.0 to 510.0)	0.1 V	7.0 *2	2.5	0.0

Parameter Number	Name Display	Setting Range	Unit	Default V/f Control	Default Open loop Vector	Default Flux Vector
F1-09	Overspeed Detection Delay Time PG Overspd Time	0.0 to 2.0	0.1 s	-	-	0.0

* 1. These are setting range and default value for a 200 V class MxC. Values for a 400 V class MxC are double.

* 2. Settings vary as shown in the following tables depending on the MxC capacity and E1-03.

■200 V and 400 V Class MxCs of 5.5 to 75 kW

Parameter Number	Unit	Default															Open Loop Vector Control	Flux Vector Control
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F		
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0	60.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	0.0
E1-08 *	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0	13.0	0.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	0.5	0.0
E1-10 *	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0	2.5	0.0

* The setting shown are for 200 V class MxCs. The values will double for 400 V class MxCs.

◆ Defaults for Various MxC Capacities (o2-04)

If the MxC capacity (o2-04) is changed, the defaults of the following parameters will change.

Parameter Number	Name	Unit	Default 200 V class				Default 400 V class						
-	MxC Capacity	kW	5.5	11	22	45	5.5	11	22	45	75	110	160
E2-11	Motor Rated Output												
E4-07	Motor 2 Rated Output												
o2-04	MxC/kVA Selection	-	5	7	A	D	26	28	2B	2E	30	32	34
E2-01 (E4-01)	Motor Rated Current	A	19.60	39.7	77.2	160.0	9.80	19.9	38.6	79.7	130.0	190.0	270.0
E2-02 (E4-02)	Motor Rated Slip	Hz	1.50	1.70	1.70	1.60	1.50	1.70	1.70	1.60	1.39	1.40	1.35
E2-03 (E4-03)	Motor No-Load Current	A	5.10	11.2	18.5	44.0	2.60	5.6	9.2	22.0	36.0	49.0	70.0
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	0.399	0.230	0.079	0.030	1.595	0.922	0.316	0.122	0.092	0.046	0.029
E2-06 (E4-06)	Motor Leakage Inductance	%	18.2	19.5	19.5	20.2	18.2	19.6	23.5	19.9	20.0	20.0	20.0
E2-10	Motor Iron Loss for Torque Compensation	W	172	245	538	852	193	385	586	1125	1600	2150	2850
n5-02	Motor Acceleration Time	s	0.168	0.265	0.355	0.387	0.168	0.265	0.355	0.387	0.533	0.646	0.777
L8-02	Overheat Alarm Level	°C	90	90	85	90	85	85	85	90	90	1.7	1.9
L2-03	Momentary Power Loss Minimum Base Block Time	s	0.7	0.9	1.1	0.7	0.7	0.9	1.1	1.2	1.5	115	115

6

Parameter Settings by Function

Frequency Reference 6-2
Run Command 6-7
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Frequency Reference

This section explains how to input and set the frequency reference to the MxC.

◆ Selecting the Frequency Reference Source

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

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b1-01	Frequency Reference Selection / Reference Source	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q

■Entering the Frequency Reference from the Digital Operator

The frequency reference can be entered from the digital operator when b1-01 is set to 0.

Input the frequency reference from the frequency reference setting screen display.

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

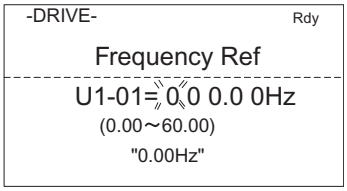


Fig 6.1 Frequency Setting Display

■Inputting the Frequency Reference Using a Voltage Signal (Analog Setting)

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

Inputting Master Speed Frequency Reference Only

When using a voltage signal to send the master speed frequency reference, use control circuit terminal A1.

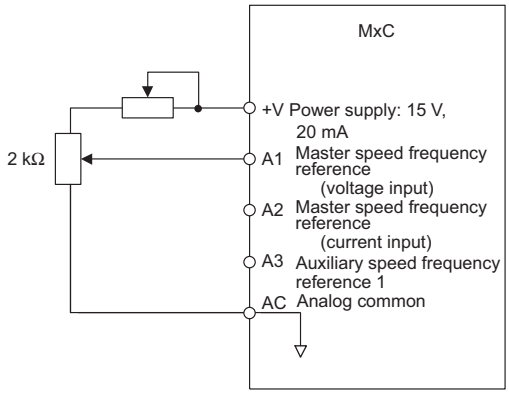


Fig 6.2 Voltage Input for the Master Speed Frequency Reference

When using a current signal to provide the master speed frequency reference, use control circuit terminal A2. Connect the 0 V lead to terminal A1, set H3-08 to 2 (allows current input for the multi-function analog input terminal A2 signal level selection), and set H3-09 (Terminal A2 Function Selection) to 0 (add to terminal A1).

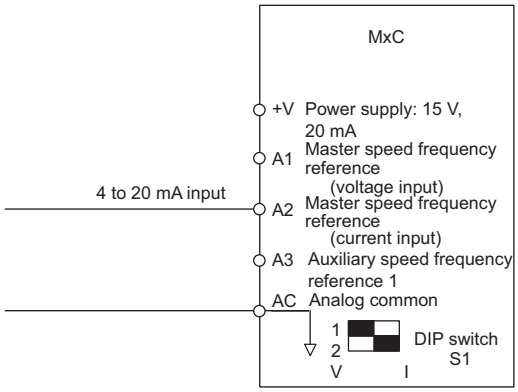


Fig 6.3 Current Input for Master Speed Frequency Reference

IMPORTANT

Set pin 2 of DIP switch S1 to the “on” position (towards I) when using current input to terminal A2 (pin 2 determines the voltage/current). Pin 2 of DIP switch S1 should be set to the “off” position (toward V) 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, connect the master speed frequency reference to control circuit terminal A1 or A2 and connect the auxiliary speed frequency reference to terminal A3. The reference on terminal A1 or A2 will be used for the MxC frequency reference when the multi-function input allocated to Multi-Speed Command 1 is off, and the reference on terminal A3 will be used when it is on.

When switching between the master and auxiliary speeds, set H3-05 (Terminal A3 Function Selection) to 2 (auxiliary frequency reference, 2nd step analog) and set on of the multi-function input terminals to Multi-Step Speed Reference 1.

When using a current input to terminal A2 for the master speed frequency reference, set H3-08 (Terminal A2 Signal Level Selection) to 2 (current input), and set H3-09 (Terminal A2 Function Selection) to 0 (add to terminal A1).

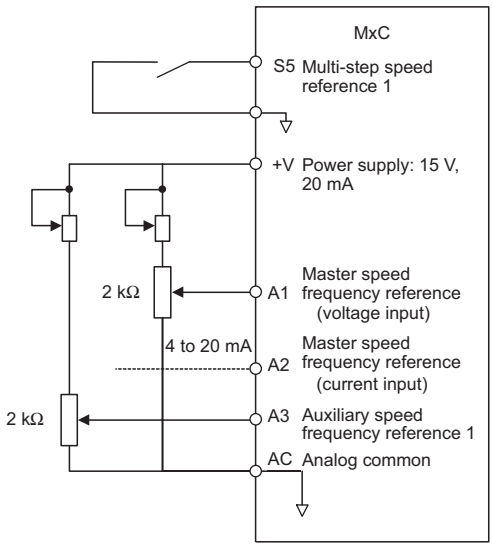


Fig 6.4 Switching between Master and Auxiliary Frequencies

◆ Using Multi-Step Speed Operation

The MxC can be programmed to change the speed of the motor over a 17-step process, using 16 frequency references and one jog frequency reference.

The following example of a multi-function input terminal function shows a 9-step operation using Multi-Step References 1 to 3 and the Jog Frequency Selection functions.

■Related Parameters

To switch frequency references, set Multi-Step Speed References 1 to 3 and the Jog Reference Selection to the multi-function digital inputs. Setting examples are shown below.

Multi-Function Digital Inputs (H1-01 to H1-10)

Terminal	Parameter Number	Set Value (Default)	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 is set to 2 (auxiliary frequency reference)).
S6	H1-04	4	Multi-Step Speed Reference 2
S9	H1-07	5	Multi-Step Speed Reference 3
S7	H1-05	6	Jog Frequency Selection (given priority over multi-step speed reference)

Combination of Multi-Function References and Multi-Function Digital Inputs

Change the selected frequency reference by combining the on/off status of S5 to S9 (multi-function digital input terminals) to set Multi-Step Speed References 1 to 3 and the Jog Frequency Selection. The following table shows the possible combinations.

Speed	Terminal S5	Terminal S6	Terminal S9	Terminal S7	Selected Frequency
	Multi-Step Speed Reference 1	Multi-Step Speed Reference 2	Multi-Step Speed Reference 3	Jog Frequency Selection	
1	off	off	off	off	Frequency Reference 1 d1-01, Master Speed Frequency
2	on	off	off	off	Frequency Reference 2 d1-02, Auxiliary Frequency 1
3	off	on	off	off	Frequency Reference 3 d1-03, Auxiliary Frequency 2
4	on	on	off	off	Frequency Reference 4 d1-04
5	off	off	on	off	Frequency Reference 5 d1-05
6	on	off	on	off	Frequency Reference 6 d1-06
7	off	on	on	off	Frequency Reference 7 d1-07
8	on	on	on	off	Frequency Reference 8 d1-08
9	-	-	-	on*	Jog Frequency d1-17

* The Jog Frequency Selection for terminal S7 is given priority over the other multi-step speed references.

■Connection Example and Time Chart

The following diagram and time chart show how to set up the control circuit terminal for a 9-step speed sequence.

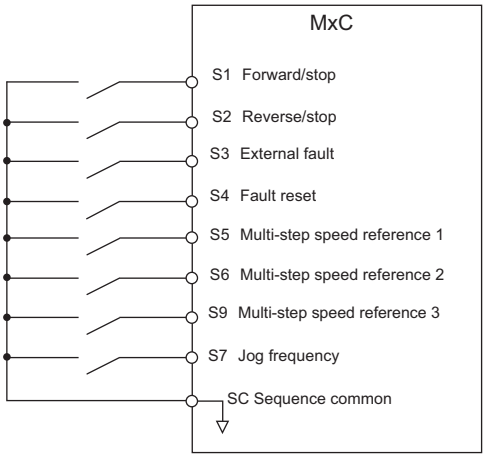


Fig 6.5 Control Circuit Terminal during 9-Step Operation

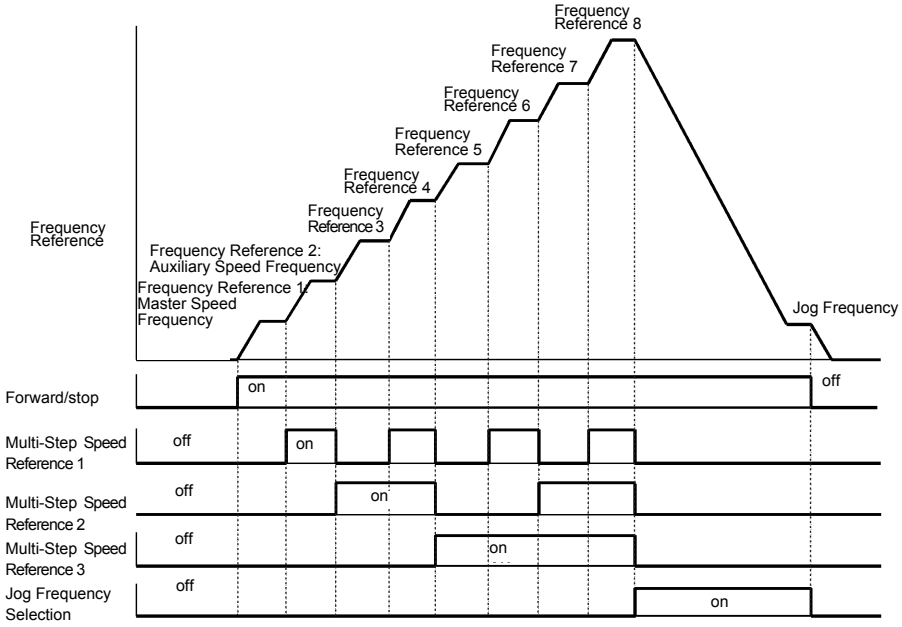


Fig 6.6 Multi-Step Speed Reference/Jog Frequency Selection Time Chart

Setting Precautions

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

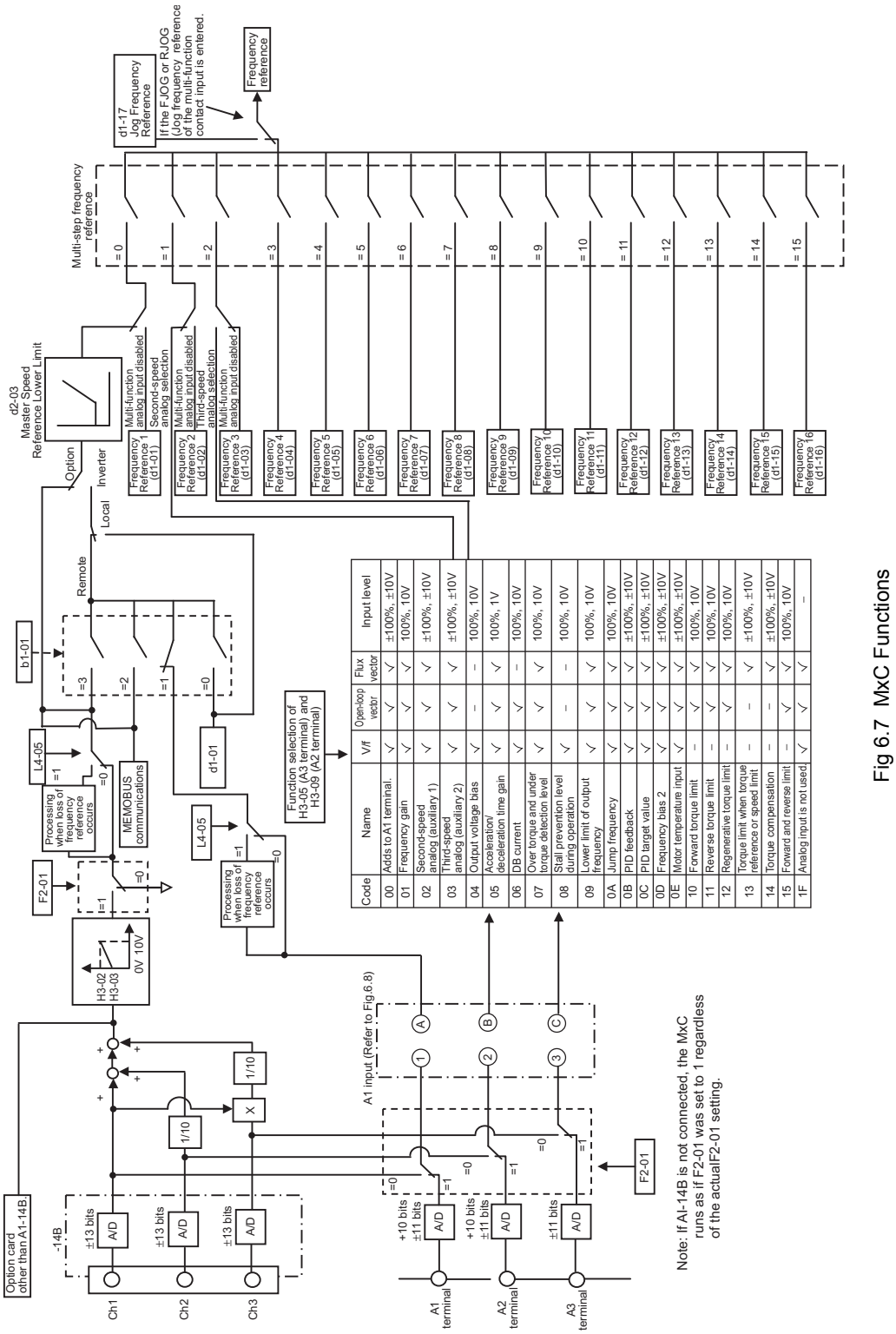
- **Step 1**
  When setting terminal A1's analog input to step 2, set b1-01 to 1, and when setting d1-01 (Frequency Reference 1) to step 1, set b1-01 to 0.
- **Step 2**
  When setting the analog input for terminal A2 to step 2, also set H3-09 to 2 (Auxiliary Frequency Reference 1). When setting d1-02 (Frequency Reference 2) to step 2, set H3-05 to 1F (do not use analog inputs).
- **Step 3**
  When setting terminal A3's analog input to step 3, set H3-05 to 3 (Auxiliary Frequency Reference 2). When setting d1-03 (Frequency Reference 3) to step 3, set H3-05 to 1F (analog input not used).

Run Command

This section explains how to input the Run Command.

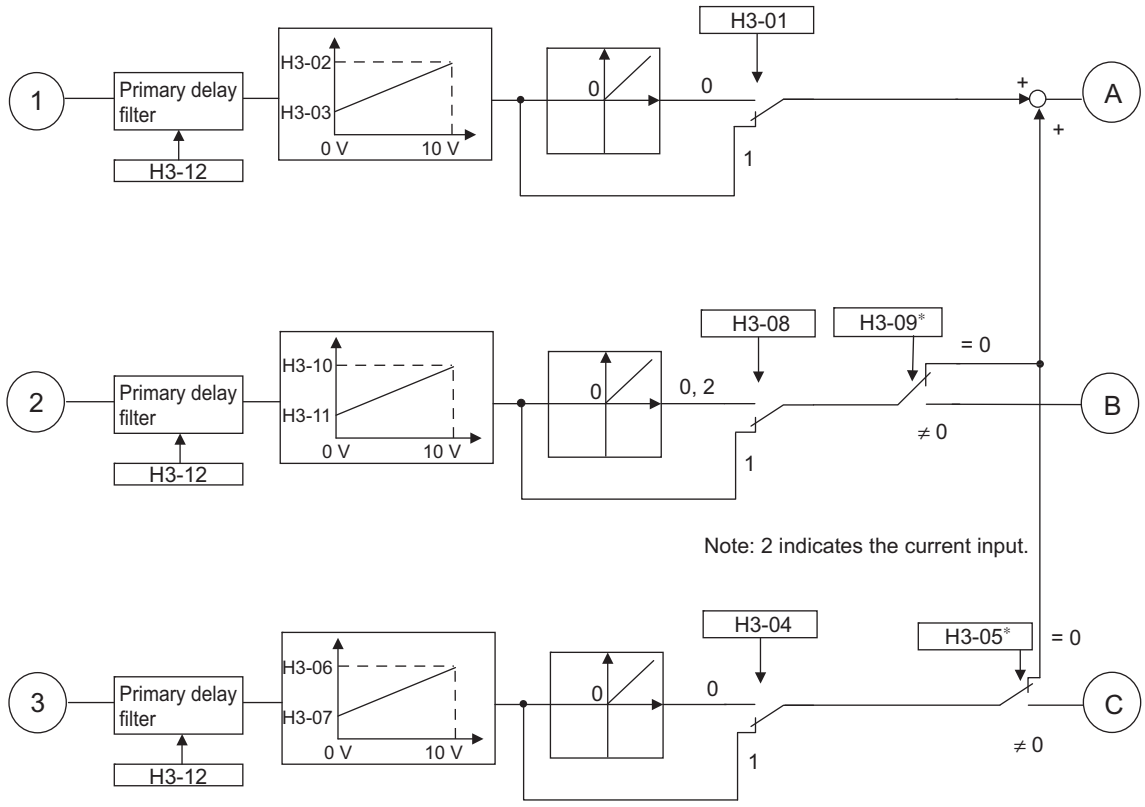
◆ MxC Functions

The following block diagram shows the functions available in the MxC.



Code	Name	V/f	Open-loop vector	Flux vector	Input level
00	Adds to A1 terminal.	√	√	√	±100%, ±10V
01	Frequency gain	√	√	√	100%, 10V
02	Second-speed analog (auxiliary 1)	√	√	√	±100%, ±10V
03	Third-speed analog (auxiliary 2)	√	√	√	±100%, ±10V
04	Output voltage bias	√	–	–	100%, 10V
05	Acceleration/ deceleration time gain	√	√	√	100%, 1V
06	DB current	√	√	–	100%, 10V
07	Over torque and under torque detection level	√	√	√	100%, 10V
08	Stall prevention level during operation	√	–	–	100%, 10V
09	Lower limit of output frequency	√	√	√	100%, 10V
0A	Jump frequency	√	√	√	100%, 10V
0B	PID feedback	√	√	√	±100%, ±10V
0C	PID target value	√	√	√	±100%, ±10V
0D	Frequency bias 2	√	√	√	±100%, ±10V
0E	Motor temperature input	√	√	√	±100%, ±10V
10	Forward torque limit	–	√	√	100%, 10V
11	Reverse torque limit	–	√	√	100%, 10V
12	Regenerative torque limit	–	√	√	100%, 10V
13	Torque limit when torque reference or speed limit	–	–	√	±100%, ±10V
14	Torque compensation	–	–	√	±100%, ±10V
15	Forward and reverse limit	–	√	√	100%, 10V
1F	Analog input is not used.	√	√	√	–

Fig 6.7 MxC Functions



* H3-05 and H3-09 cannot be set to the same value.

Fig 6.8 AI Input

◆ Selecting the Run Command Source

Set parameter b1-02 to select the source of the Run Command.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b1-02	Run Command Selection / Run Source	Selects the Run Command input source. 0: Operator - RUN and STOP keys on digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q

■Running the MxC via the Digital Operator Keypad

When b1-02 is set to 0, the MxC can operate the motor by 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, MxC can be operated using the control circuit terminals.

Performing Operations Using a 2-Wire Sequence

The default setting is for a 2-wire sequence. When control circuit terminal S1 is switched on, the MxC will start to run the motor in the forward direction. When S1 is turned off, the MxC will stop. In the same way, when control circuit terminal S2 is switched on, reverse operation will be performed, and when S2 is turned off, the MxC will stop.

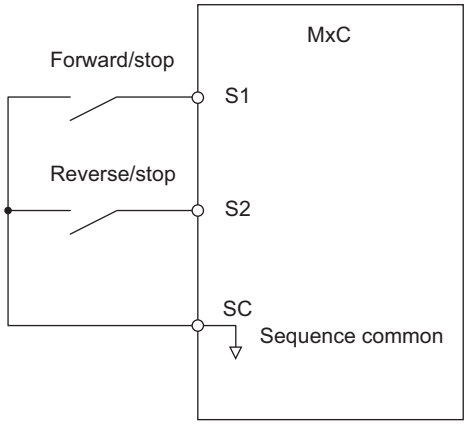


Fig 6.9 2-wire Sequence Wiring Example

Performing Operations Using a 3-Wire Sequence

When any one of the H1 parameters (multi-function digital input terminals S3 to S12) 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 will function as a Forward/Reverse Run Command terminal.

When the MxC is initialized for 3-wire sequence control with A1-03, Multi-Function Input 3 becomes the input terminal for the Forward/Reverse Run Command.

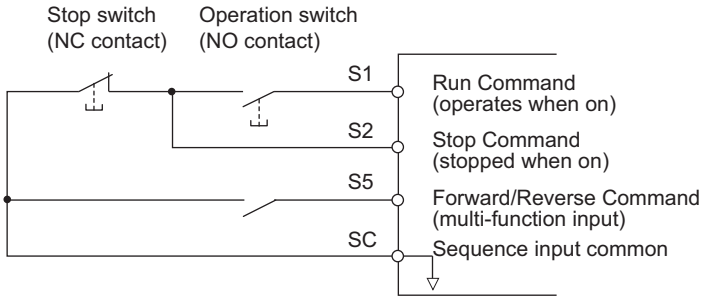


Fig 6.10 3-Wire Sequence Wiring Example

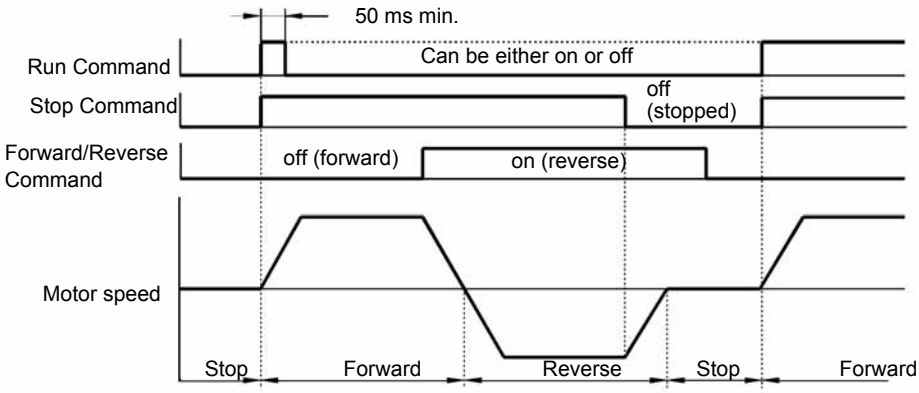


Fig 6.11 3-Wire Sequence Time Chart

INFO

1. Use a sequence that switches terminal S1 on for 50 ms or longer for the Run Command. This will make the Run Command self-holding in the MxC.
2. Before setting the 3-wire sequence, set the parameters for the multi-function input terminals, and then wire the control circuit. If not, the motor might rotate unexpectedly and could cause injury or damage.

Stopping Methods

This section explains the parameter settings and functions to have the MxC stop the motor.

◆ Selecting the Stopping Method when a Stop Command is Sent

There are four methods of stopping the MxC when a Stop Command is sent:

- Decelerate to Stop (also referred to as, “Ramp to Stop”)
- Coast to Stop
- DC Injection Braking Stop
- Coast to Stop (with or without a timer)

Set parameter b1-03 to indicate how the MxC should stop the motor. The MxC is unable to coast to stop or use DC braking when operating in Flux Vector Control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
b1-03	Stopping Method Selection / Stopping Method	Selects the stopping method when the Run Command is removed. 0: Decelerate to stop 1: Coast to Stop 2: DC Injection to Stop 3: Coast with Timer (A new Run Command is ignored if received before the timer expires).	0 to 3 *	0	No	Q	Q	Q
b1-05	Minimum Output Frequency (E1-09) or Less Operation Selection / Zero-Speed Oper	Operation method when frequency reference is less than minimum output frequency set in E1-09. 0: Operates according to frequency reference (E1-09 is disabled). 1: Output shuts off (coast to stop if less than E1-09). 2: Operates according to E1-09 (frequency reference set to E1-09). 3: Zero speed (frequency reference becomes zero when less than E1-09).	0 to 3	0	No	No	No	A
b2-01	DC Injection Braking Start Frequency / DCInj Start Freq	Sets the frequency at which DC injection braking starts when decelerate to stop (b1-03 = 0) is selected. If b2-01< E1-09, DC Injection braking starts at E1-09. Note: Zero Speed restrictions are active in Flux Vector Mode.	0.0 to 10.0	0.5 Hz	No	A	A	A
b2-02	DC Injection Braking Current / DCInj Current	Sets the DC injection braking current as a percentage of the MxC rated current. Note: The DC excitation current is determined by the setting in E2-03 when operating in Flux Loop Vector Control Method.	0 to 100	50%	No	A	A	No
b2-03	DC Injection Braking Time/DC Excitation Time at Start / DCInj Time @Start	Sets the time of DC injection braking at start in units of 0.01 seconds.	0.00 to 10.00	0.00 s	No	A	A	A

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Control Methods Open Loop Vector	Control Methods Flux Vector
b2-04	DC Injection Braking Time at Stop DCInj Time @Stop	Sets the time length of DC injection braking at stop in units of 0.01 seconds. 1: When b1-03 = 2, actual DC Injection time is calculated as follows: (b2-04) × 10 × (OutputFreq) / (E1-04) 2: When b1-03 = 0, this parameter determines the amount of time DC Injection is applied to the motor at the end of the decel ramp. 3: This should be set to a minimum of 0.50 seconds when using HSB. This will activate DC injection during the final portion of HSB and help ensure that the motor stops completely.	0.00 to 10.00	0.50 s	No	A	A	A

* 0 or 1 for Flux Vector Control.

■Decelerate 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 (default: C1-02 (Deceleration Time 1)).

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

For deceleration time settings, refer to page 6-17, *Setting Acceleration and Deceleration Times*.

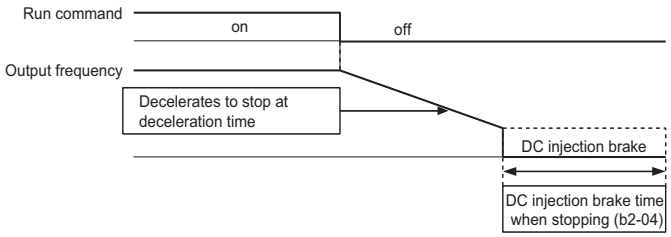


Fig 6.12 Decelerate to Stop

The operation after the MxC has brought the motor to stop depends on the setting of b1-05 when using Flux Vector Control (A1-02 = 3).

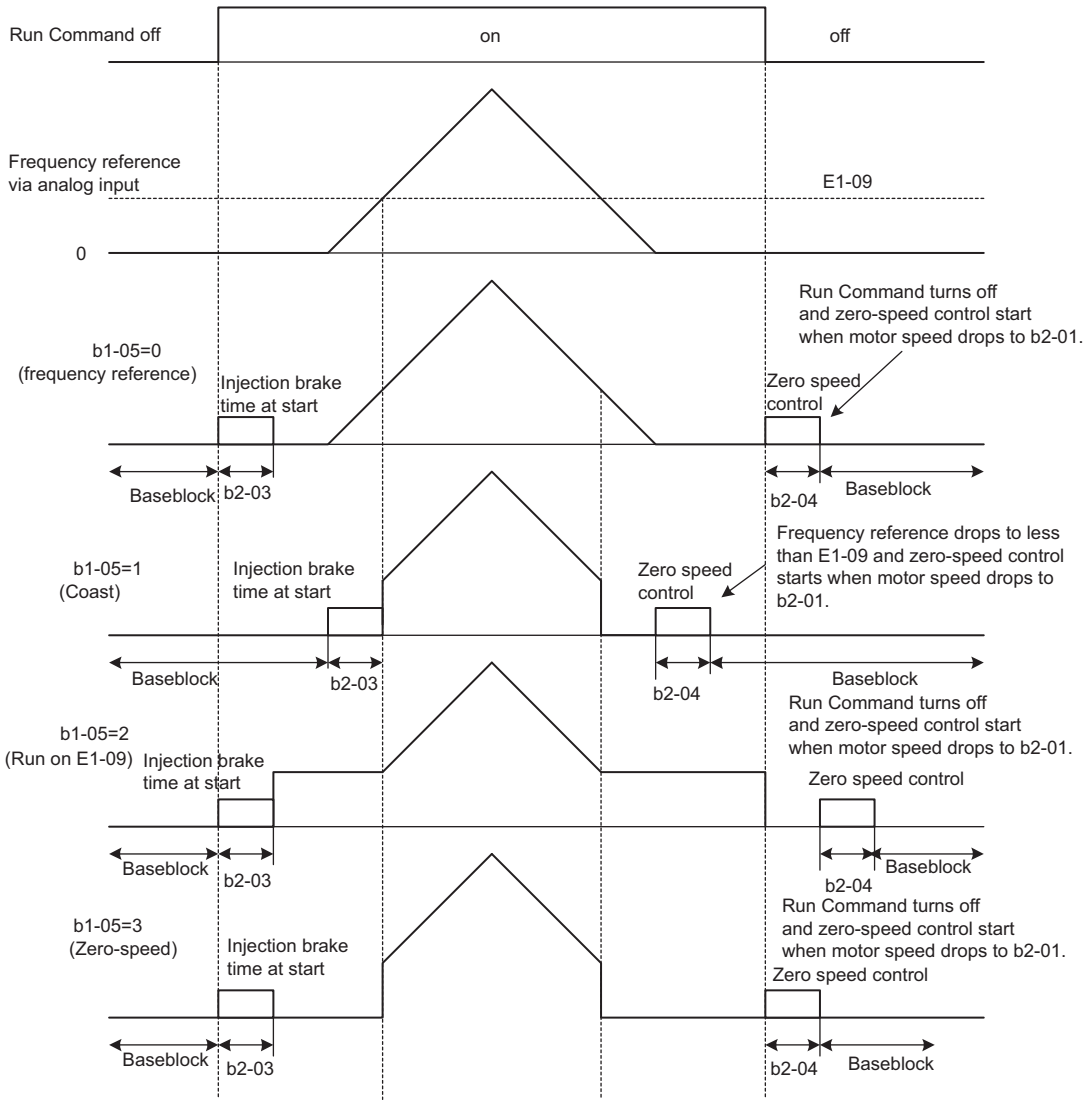


Fig 6.13 Decelerate to Stop (for Flux Vector Control)

Setting Precautions

- When using Flux Vector Control, the zero-speed control starts when motor speed drops to b2-01 during deceleration. Also, the setting b2-01 < E1-09 is possible.
- The current level during injection brake time at start is the value of E2-03 (Motor No-Load Current). Accordingly, b2-02 is invalid in Flux Vector Control.

■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 MxC output voltage will be interrupted. The motor coasts to a stop at the deceleration rate that counterbalances load inertia and prevents damage to the application.

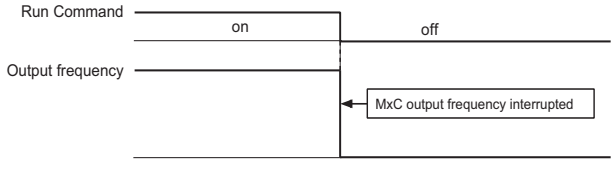


Fig 6.14 Coast to Stop

INFO

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

■DC Braking Stop

If the Stop Command is input (i.e., the Run Command is turned off) when b1-03 is set to 2, then the MxC will wait for the duration set to L2-03 (Momentary Power Loss Minimum Baseblock Time) before applying DC Injection Braking current (set in b2-02) to the motor. DC Injection Brake time is determined by the set value in b2-04 and the output frequency.

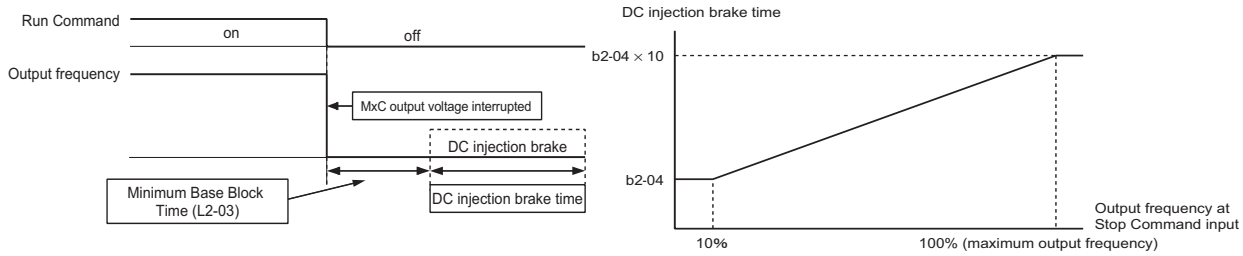


Fig 6.15 DC Injection Braking (DB) Stop

INFO

Lengthen the Momentary Power Loss Minimum Base Block Time (L2-03) when overcurrent (OC) occurs while stopping.

■Coast to Stop with Timer

If the Stop Command is input (i.e., the Run Command is turned off) when b1-03 is set to 3, the MxC output will be shut off to allow the motor to coast to stop. After the Stop Command is input, Run Commands are ignored until time T has elapsed. The length of T depends upon the output frequency when the Stop Command is input as well as the deceleration time.

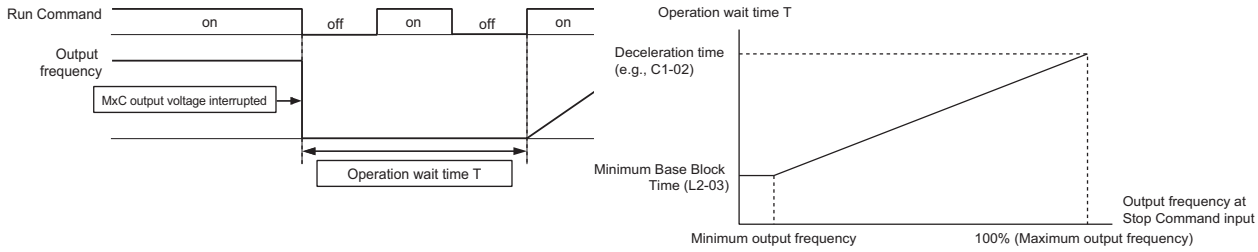


Fig 6.16 Coast to Stop with Timer

◆ Using DC Injection Braking

Set parameter b2-03 to apply DC Injection Braking current to the motor while it is coasting to stop. This allows the MxC to stop the motor more quickly than simply allowing it to coast, and also to restart the motor again.

Set b2-03 to 0 to disable DC Injection Braking at start.

Set the DC injection braking current using b2-02. DC injection braking is used at start up in Flux Vector Control with the current set in E2-03 (Motor No-Load Current).

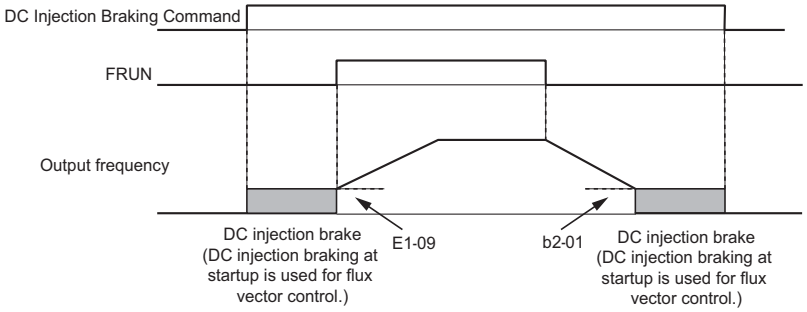
■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b2-02	DC Injection Braking Current / DCInj Current	Sets the DC Injection Braking current as a percentage of the MxC rated current. Note: The DC excitation current is determined by the setting in E2-03 when operating in Flux Loop Vector Control Method.	0 to 100	50%	No	A	A	No
b2-03	DC Injection Braking Time/DC Excitation Time at Start / DCInj Time @Start	Sets the time of DC Injection Braking at start in units of 0.01 seconds.	0.00 to 10.00	0.00 s	No	A	A	A

■Inputting DC Injection Braking Command from Control Circuit Terminals

If a multi-function digital input terminal (H1-□□) is set to 60 (DC Injection Braking Command), DC Injection Braking can be applied to the motor is applied by enabling the terminal for which DC Injection Braking Command has been set when the MxC is being stopped. DC Injection Braking is used at startup in Flux Vector Control.

The time chart for DC Injection Braking is shown below.



If you input DC Injection Braking Command from an external terminal, or if the Run Command and Jog Command are input, DC Injection Brake will be disabled, and operation will resume.

Fig 6.17 DC Injection Brake Time Chart

■Changing the DC Injection Braking Current Using an Analog Input

If H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) is set to 6 (DC Injection Braking Current), the DC Injection Braking Current level can be changed using the analog input is changed.

At 10 V input (voltage) or 20 mA input (current), 100% of the MxC rated current will be applied.

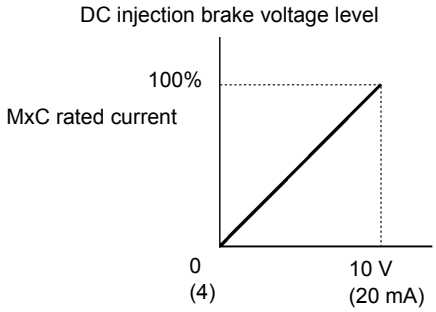


Fig 6.18 DC Injection Brake Current Using an Analog Input

◆ Using an Emergency Stop ("Fast Stop")

To have the MxC stop the machinery immediately as is done with an emergency stop, use the Fast Stop feature. Set a multi-function input terminal (H1-□□) to 15 or 17 (Fast Stop) to decelerate to a stop at the deceleration time set in C1-09. If inputting the emergency stop with an N.O. contact, set the multi-function input terminal (H1-□□) to 15, and if inputting the emergency stop with an N.C. contact, set the multi-function input terminal (H1-□□) to 17.

After the Fast Stop Command has been input, operation cannot be restarted until the MxC has stopped. To cancel the Fast Stop, turn off the Run Command and Emergency Stop Command.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
C1-09	Fast Stop Time / Fast Stop Time	Sets the time to decelerate from maximum frequency to zero for the multi-function input "Fast Stop" function. Note: This parameter is also used by selecting "Fast Stop" as a Stop Method when a fault is detected.	0.0 to 6000.0*	10.0 s	No	A	A	A

* The setting range for accel/decel times depends on the setting of C1-10 (Accel/Decel Time Setting Unit). If C1-10 is set to 0, the setting range is 0.00 to 600.00 (s).

Acceleration and Deceleration Characteristics

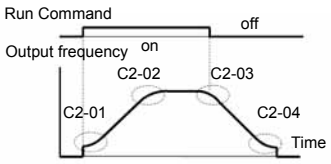
This section explains the acceleration and deceleration characteristics of the MxC.

◆ Setting Acceleration and Deceleration Times

The “acceleration time” refers to the time it takes for the output frequency to climb from 0% to 100%, while “deceleration time” refers the time taken for the output frequency drop down to 0%. The default acceleration time is C1-01, and the default of the deceleration time is C1-02.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
C1-01	Acceleration Time 1 Accel Time 1	Sets the time to accelerate from zero to maximum frequency.	0.0 to 6000.0*	10.0 s	Yes	Q	Q	Q
C1-02	Deceleration Time 1 Decel Time 1	Sets the time to decelerate from maximum frequency to zero.			Yes	Q	Q	Q
C1-03	Acceleration Time 2 Accel Time 2	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.			Yes	A	A	A
C1-04	Deceleration Time 2 Decel Time 2	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.			Yes	A	A	A
C1-05	Acceleration Time 3 Accel Time 3	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.			No	A	A	A
C1-06	Deceleration Time 3 Decel Time 3	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.			No	A	A	A
C1-07	Acceleration Time 4 Accel Time 4	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.			No	A	A	A
C1-08	Deceleration Time 4 Decel Time 4	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.			No	A	A	A
C1-10	Accel/Decel Time Setting Units Acc/Dec Units	Sets the setting resolution of C1-01 to C1-09. 0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	0 or 1	1	No	A	A	A
C1-11	Accel/Decel Switch Frequency Acc/Dec SW Freq	Sets the frequency for automatic switching of accel/decel times. Fout < C1-11: Accel/Decel Time 4 Fout≥C1-11: Accel/Decel Time 1 Multi-function inputs “Multi-Acc/Dec 1” and “Multi-Acc/Dec 2” have priority over C1-11. Note: With Multi-Function Input, Accel/Decel Time 1 and 2 will take precedence.	0.0 to 120.0	0.0 Hz	No	A	A	A

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Control Methods Open Loop Vector	Control Methods Flux Vector
C2-01	S-Curve Characteristic at Accel 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	0.20 s	No	A	A	A
	SCrv Acc @ Start							
C2-02	S-Curve Characteristic at Accel End		0.00 to 2.50	0.20 s	No	A	A	A
	SCrv Acc @ End							
C2-03	S-Curve Characteristic at Decel Start		0.00 to 2.50	0.20 s	No	A	A	A
	SCrv Dec @ Start							
C2-04	S-Curve Characteristic at Decel End		0.00 to 2.50	0.00 s	No	A	A	A
	SCrv Dec @ End							

* The setting range for accel/decel times depends on the setting of C1-10 (Accel/Decel Time Setting Units). If C1-10 is set to 0, the setting range is 0.00 to 600.00 (s).

■Setting the Units to Express the Acceleration and Deceleration Time

Set the accel/decel time units using C1-10. The default setting for C1-10 is 1.

Set value	Details
0	The accel/decel time settings range is 0.00 to 600.00 in units of 0.01 s.
1	The accel/decel time settings range is 0.0 to 6000.0 in units of 0.1 s.

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

The MxC allows for four separate acceleration times and four separate deceleration times. When the multi-function input terminals (H1-□□) are set to 7 (Accel/Decel Time Selection 1) and 1A (Accel/Decel Time Selection 2), the accel/decel time of the MxC can be changed even while the application is running based on the terminal switch status.

The following table shows the possible accel/decel time switching combinations.

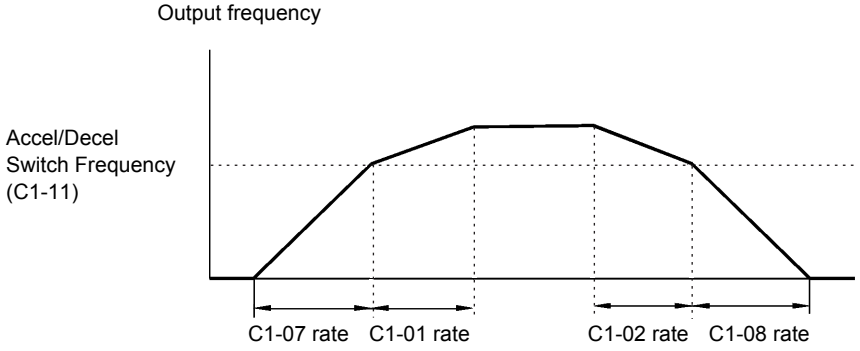
Accel/Decel Time Selection 1 Terminal	Accel/Decel Time Selection 2 Terminal	Acceleration Time	Deceleration Time
off	off	C1-01	C1-02
on	off	C1-03	C1-04
off	on	C1-05	C1-06
on	on	C1-07	C1-08

■Switching Acceleration and Deceleration Time Automatically

Use this setting to switch between accel/decel times automatically based on the output frequency of the MxC.

When the output frequency reaches the value set to parameter C1-11, the MxC switches the accel/decel time automatically as shown in the diagram below.

To use this function, C1-11 must be set to a value other than 0.0 Hz. If C1-11 is set to 0.0 Hz, then the function will be disabled.



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

When output frequency < C1-11, acceleration and deceleration are performed using Accel/Decel Time 4 (C1-07, C1-08).

Fig 6.19 Accel/Decel Time Switching Frequency

■Adjusting Acceleration and Deceleration Time Using an Analog Input

If either H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) is set to 5 (accel/decel time gain), then the accel/decel time can be adjusted using an input voltage signal to terminal A2.

The acceleration time will change as follows when set to parameter C1-01:

acceleration time = C1-01 set value × accel/decel time gain

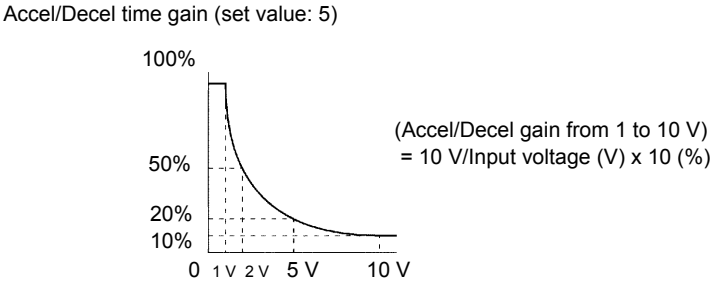


Fig 6.20 Accel/Decel Time Gain Using an Analog Input

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

The MxC minimizes any sudden jerking or shock when starting and stopping the application by using the S-curve pattern to smooth out acceleration and deceleration.

Set an S-curve characteristic time for the acceleration start time, deceleration start time, acceleration end time, and deceleration end time.

INFO

Set the S-curve characteristic time to lengthen accel/decel time as follows:

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

Deceleration time = selected deceleration time + (deceleration start time S-curve characteristic time + deceleration end time S-curve characteristic time) / 2

Setting Example

The diagram below shows how S-curve characteristics work when changing between forward and reverse.

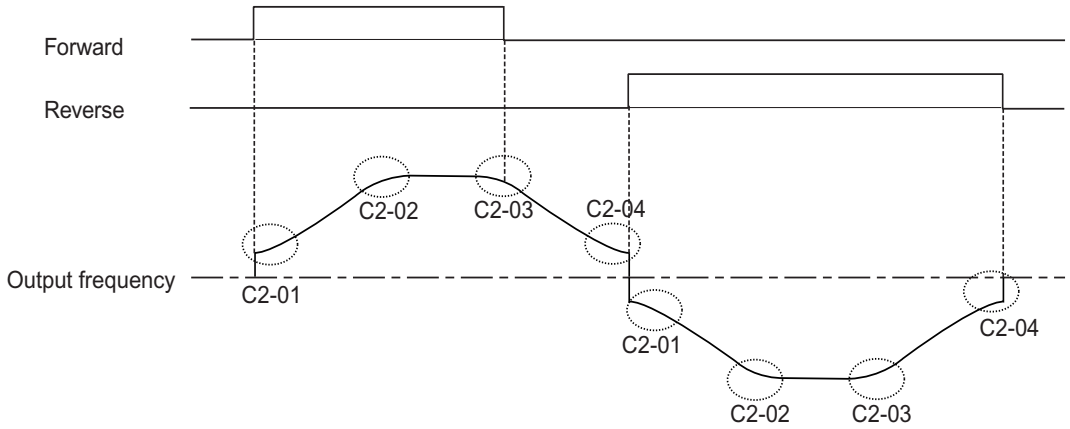


Fig 6.21 S-Curve Characteristic when Changing Motor Direction

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

The Stall Prevention during Acceleration function prevents the motor from stalling if a heavy load is placed on the motor and also during sudden rapid acceleration.

If L3-01 is set to 1 (enabled) and the MxC output current exceeds the -15% level of L3-02, then the acceleration rate will begin to slow down. Acceleration will stop if the output current rises above L3-02.

When L3-01 is set to 2, then the motor will accelerate to the value set in L3-02 as the MxC automatically adjusts the rate of acceleration to prevent stalling. Here, the acceleration time setting is disregarded.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L3-01*	Stall Prevention Selection During Accel / StallP Accel Sel	Selects the stall prevention method used to prevent excessive current during acceleration. 0: Disabled. - Motor accelerates at active acceleration rate. The motor may stall if load is too heavy or accel time is too short. 1: General Purpose - When output current exceeds L3-02 level, acceleration stops. Acceleration will continue when the output current level falls below the L3-02 level. 2: Intelligent - The active acceleration rate is ignored. Acceleration is completed in the shortest amount of time without exceeding the current value set in L3-02.	0 to 2	1	No	A	A	No
L3-02	Stall Prevention Level During Acceleration / StallP Accel Lvl	This function is enabled when L3-01 is "1" or "2". MxC rated current is 100%. Decrease the set value if stalling or excessive current occurs with default.	0 to 200	150%	No	A	A	No
L3-03	Stall Prevention Limit During Acceleration / StallP CHP Lvl	Sets the lower limit for stall prevention during acceleration as a percentage of the rated current of the MxC when operation is in the frequency range above E1-06 (constant power region).	0 to 100	50%	No	A	A	No

* Not available for the MxC models CIMR-ACA4110 and 4160 for V/f Control.

■Time Chart

The frequency characteristics when L3-01 is set to 1 appear in the time chart below.

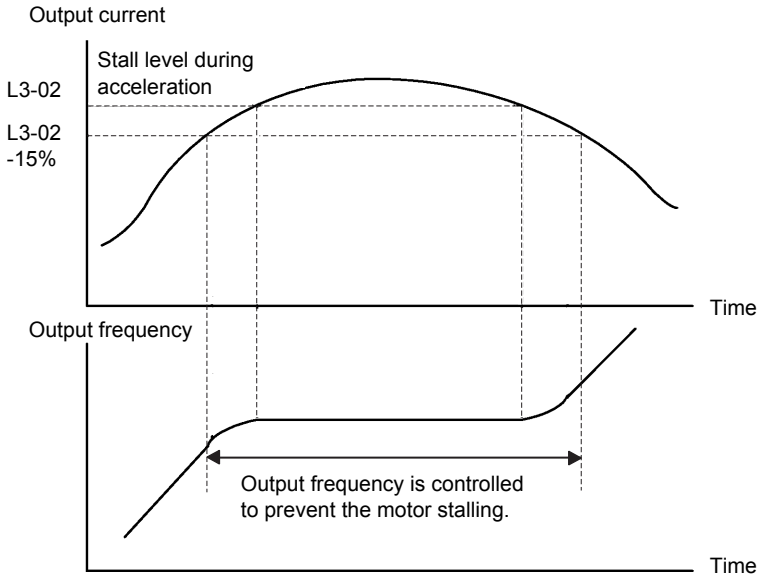


Fig 6.22 Time Chart for Stall Prevention During Acceleration

■Setting Precautions

- If the motor capacity is relatively small compared to the capacity of the MxC, or if the motor is operated using default settings, the motor may stall. To prevent this, lower the value set to L3-02.
- If using the motor in the constant output range, L3-02 will be automatically lowered to prevent stalling. L3-03 is the limit value to prevent the stall prevention level in the constant output range from being reduced more than necessary.
- Set the parameters as a percent taking the MxC rated voltage to be 100%.

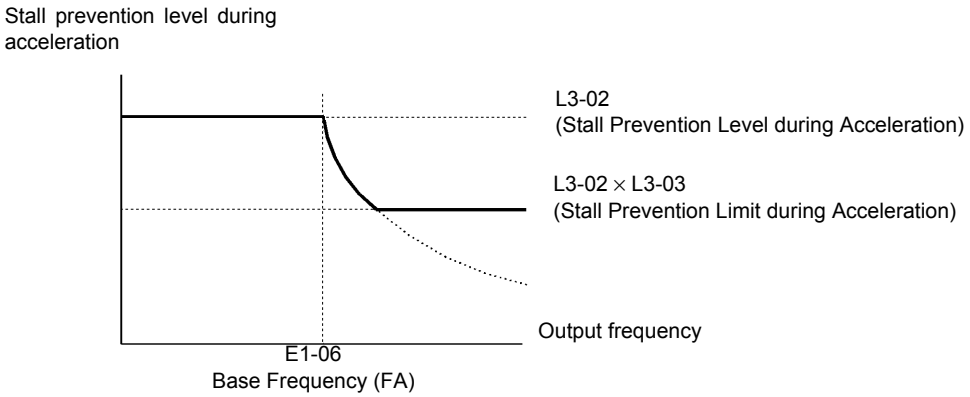


Fig 6.23 Stall Prevention Level and Limit during Acceleration

◆ Preventing Motor Stall during Deceleration (Stall Prevention during Deceleration Function)

The Stall Prevention during Deceleration function prevents the motor from stalling if a heavy load is placed on the motor, or sudden rapid deceleration is performed.

If L3-04 is set to 1 (enabled) and the MxC output current exceeds the -15% level of the set value in L3-14, the deceleration rate will begin to slow down. When L3-14 is exceeded, deceleration will stop.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
L3-04*	Stall Prevention Selection During Deceleration / StallP Decel Sel	0: Disabled. - Motor decelerates at active deceleration rate. The motor may stall if load is too heavy or decel time is too short. 1: General Purpose - When output current exceeds L3-14 level, deceleration stops. Deceleration will continue when the output current level falls below the L3-14 level.	0 or 1	1	No	A	A	A
L3-14	Stall prevention level during decel / StallP Decel Lvl	Enabled if L3-04 is set to 1. Set the level as a percentage of the MxC rated current. Usually setting is not necessary. Lower the value if the motor stalls at the default.	100 to 200	150%	No	A	A	A

* Not available for the MxC models CIMR-ACA4110 and 4160 for Flux Vector Control.

■Time Chart

The following figure shows the frequency characteristics when L3-04 is set to 1.

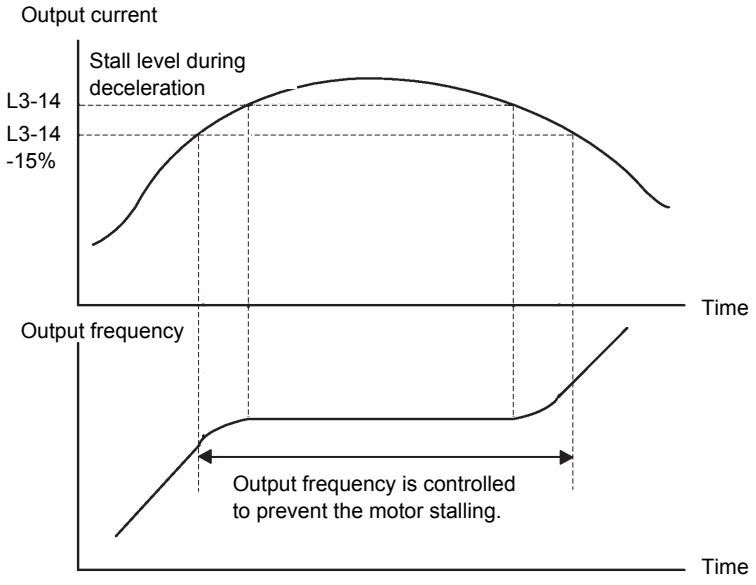


Fig 6.24 Time Chart for Stall Prevention during Deceleration

■Setting Precautions

- The motor may stall if the motor capacity is relatively small compared to capacity of the MxC, or if the motor is operated with its defaults settings. Here, lower the value set to parameter L3-14.
- If using the motor in the constant torque range, L3-14 will be automatically lowered to prevent stalling. L3-03 is the limit value to prevent the stall prevention level in the constant torque range from being reduced more than necessary.
- Set L3-14 as a percent with the MxC rated voltage as 100%.

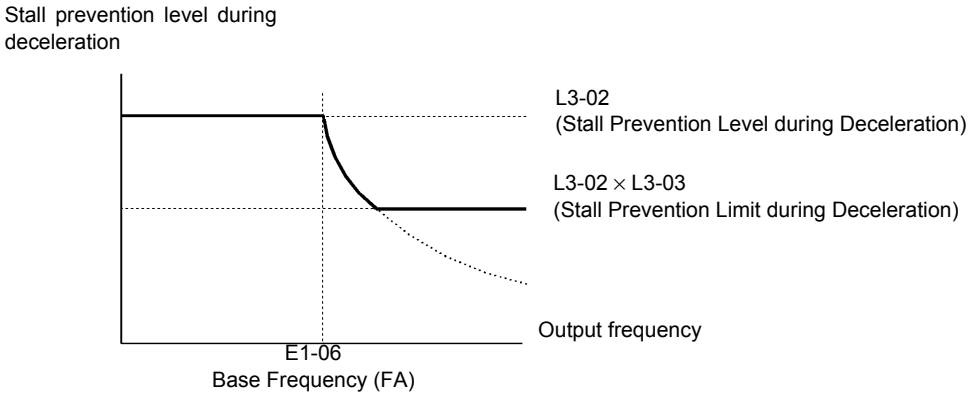


Fig 6.25 Stall Prevention Level and Limit during Deceleration

Adjusting Frequency References

This section explains methods of adjusting frequency references.

◆ Adjusting Analog Frequency References

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

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
H3-01	Terminal A1 Signal Level Selection / Term A1 Lv1 Signal	Sets the signal level of terminal A1. 0: 0 to 10VDC 1: -10 to +10VDC [11-bit plus polarity sign]	0 or 1	0	No	A	A	A
H3-02	Terminal A1 Gain Setting / Terminal A1 Gain	Sets the output level when 10 V is input, as a percentage of the maximum output frequency (E1-04).	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-03	Terminal A1 Bias Setting / Terminal A1 Bias	Sets the output level when 0 V is input as a percentage of the maximum output frequency (E1-04).	-100.0 to +100.0	0.0%	Yes	A	A	A
H3-04	Terminal A3 Signal Level Selection / Term A3 Signal	Sets the signal level of terminal A3. 0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A
H3-05	Terminal A3 Function Selection / Terminal A3 Sel	Select multi-function analog input function for terminal A3. Refer to the next page.	0 to 1F	2	No	A	A	A
H3-06	Terminal A3 Gain Setting / Terminal A3 Gain	Sets the output level when 10 V is input.	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-07	Terminal A3 Bias Setting / Terminal A3 Bias	Sets the frequency reference when 0 V is input.	-100.0 to +100.0	0.0%	Yes	A	A	A
H3-08	Terminal A2 Signal Level Selection / Term A2 Signal	Selects the signal level of terminal A2. 0: 0 to 10 VDC (switch S1-2 must be in the off position). 1: -10 to +10 VDC (switch S1-2 must be in the off position). 2: 4 to 20 mA (switch S1-2 must be in the on position) Note: Switch between current or voltage inputs by using (S1-2) switch on the terminal board.	0 to 2	2	No	A	A	A
H3-09	Terminal A2 Function Selection / Terminal A2 Sel	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A
H3-10	Terminal A2 Gain Setting / Terminal A2 Gain	Sets the output level when 10V is input.	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-11	Terminal A2 Bias Setting / Terminal A2 Bias	Sets the output level when 0V is input.	-100.0 to +100.0	0.0%	Yes	A	A	A

Parameter Number	Name	Description	Setting Range	Default	Change during Run	Control Methods		
	Display					V/f	Open Loop Vector	Flux Vector
H3-12	Analog Input Filter Time Constant Filter Avg Time	This parameter adjusts the filter on all 3 analog inputs. Increase to add stability, decrease to improve response.	0.00 to 2.00	0.03 s	No	A	A	A

■Adjusting Analog Frequency Reference Using Parameters

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

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

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

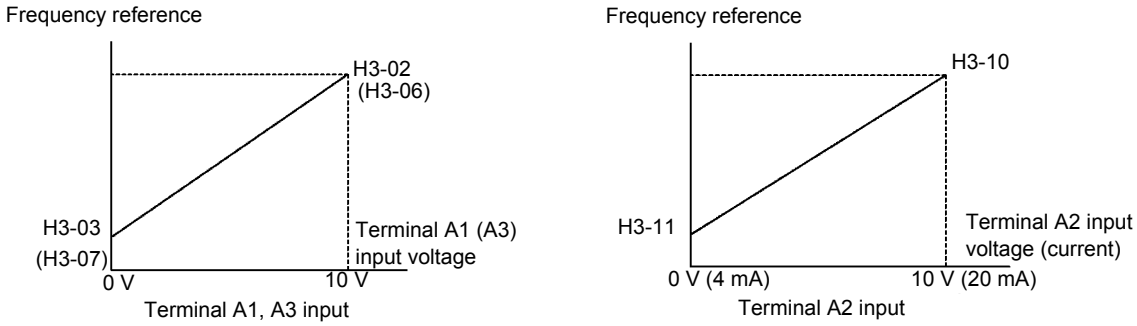


Fig 6.26 Terminals A1 and A2 Inputs

■Adjusting Frequency Gain Using an Analog Input

When H3-09 or H3-05 is set to 1 (frequency gain), the frequency gain can be adjusted using the analog input terminal A2 or A3.

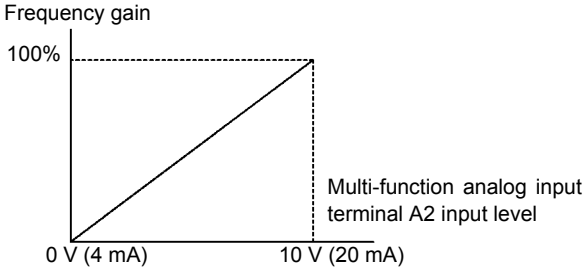


Fig 6.27 Frequency Gain Adjustment (Terminal A2 Input)

The frequency 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 frequency reference will be 50%.

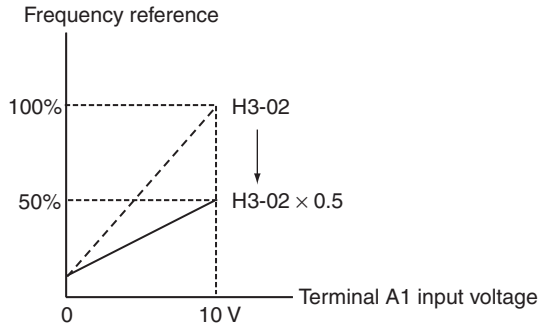


Fig 6.28 Example of Frequency Gain Adjustment

Setting Precautions

The frequency gain cannot be added to the terminal A1 input voltage and so H3-05 cannot be set to 0.

■Adjusting Frequency Bias Using an Analog Input

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

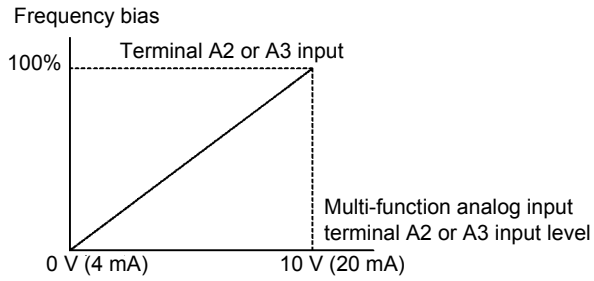


Fig 6.29 Frequency Bias Adjustment (Terminal A2 or A3 Input)

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

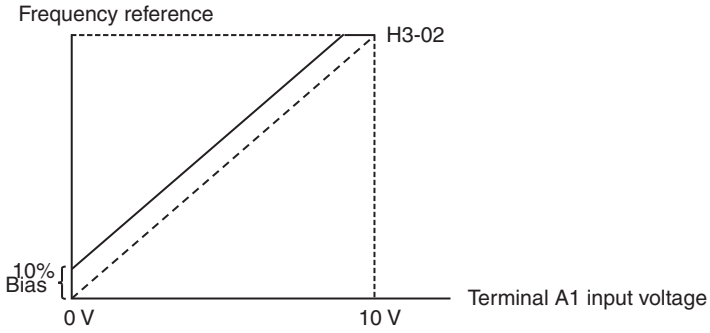


Fig 6.30 Example of Frequency Bias Adjustment

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

◆ Operation Avoiding Resonance (Jump Frequency Function)

The jump frequency function operates the motor while avoiding resonance caused by characteristic frequencies in the machinery.

This function creates a deadband frequency range, and restricts the MxC from operating at those frequencies.

Although the MxC is prohibited from the jump frequency range while operating at a constant speed, it will still sweep through that range during acceleration and deceleration.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d3-01	Jump Frequency 1 Jump Freq 1	Set the center values of the jump frequencies in Hz. This function is disabled by setting the jump frequency to 0 Hz. Always ensure that the following applies: d3-01 ≥ d3-02 ≥ d3-03 Operation in the jump frequency range is prohibited but during acceleration and deceleration, speed changes smoothly without jump.	0.0 to 120.0	0.0 Hz	No	A	A	A
d3-02	Jump Frequency 2 Jump Freq 2			0.0 Hz	No	A	A	A
d3-03	Jump Frequency 3 Jump Freq 3			0.0 Hz	No	A	A	A
d3-04	Jump Frequency Width Jump Bandwidth	Sets the jump frequency bandwidth in Hz. The jump frequency will be the jump frequency ± d3-04.	0.0 to 20.0	1.0 Hz	No	A	A	A

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

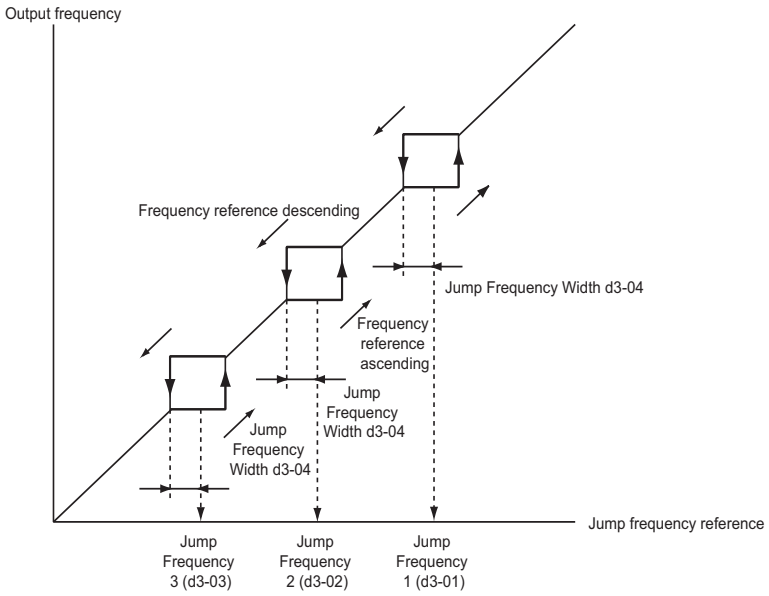


Fig 6.31 Jump Frequency

■Setting Jump Frequency Reference Using an Analog Input

When parameter H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) is set to A (jump frequency), the jump frequency can be changed using the terminal A2 input level.

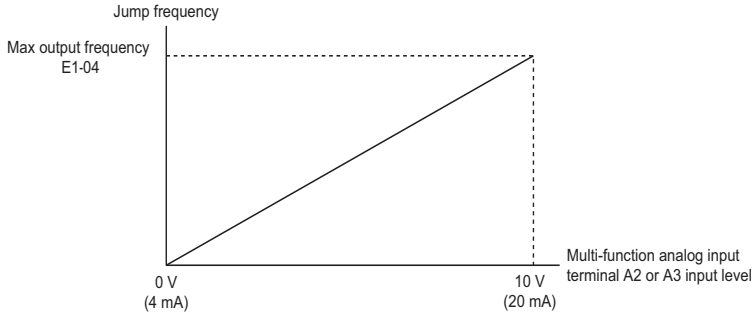


Fig 6.32 Jump Frequency Setting Using an Analog Input

■Setting Precautions

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

Speed Limit (Frequency Reference Limit Function)

This section explains how to limit the motor speed.

◆ Limiting Maximum Output Frequency

Use parameter d2-01 to set the maximum speed of the motor.

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

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d2-01	Frequency Reference Upper Limit Ref Upper Limit	Set the output frequency upper limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0%	No	A	A	A

◆ Limiting Minimum Frequency

Use parameters d2-02 or d2-03 not to rotate the motor at a given frequency or less.

There are two ways to set the minimum frequency:

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

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d2-02	Frequency Reference Lower Limit Ref Lower Limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	A	A
d2-03	Master Speed Reference Lower Limit Ref1 Lower Limit	Set the master speed reference lower limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A	A	A

■Adjusting Frequency Lower Limit Using an Analog Input

If H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) is set to 9 (output frequency lower level), the frequency lower level can be adjusted using the terminal A2 input level.

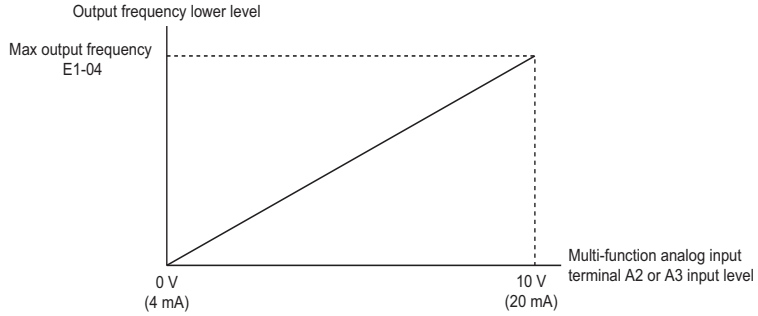


Fig 6.33 Output Frequency Lower Level for Multi-function Analog Input

INFO

If parameter d2-02 and the terminal A2 output frequency lower level have been set at the same time, the larger value will become the frequency lower limit.

Improved Operating Efficiency

This section explains functions for improving motor operating efficiency.

◆ Reducing Motor Speed Fluctuation (Slip Compensation Function)

With larger loads, the amount of motor slip increases while to motor speed decreases. The slip compensation function controls the motor at a constant speed, regardless of changes in load. When the motor is operating at the rated load, parameter E2-02 (Motor Rated Slip) × the frequency in parameter C3-01 is added to the output frequency.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
C3-01	Slip Compensation Gain / Slip Comp Gain	This parameter is used to increase motor speed to account for motor slip by boosting the output frequency. If the speed is lower than the frequency reference, increase C3-01. If the speed is higher than the frequency reference, decrease C3-01. Note: Adjustment is not normally required. When operating in Open Loop Vector, this parameter works as a function to set the proper amount of gain.	0.0 to 2.5	1.0*	Yes	A	A	A
C3-02	Slip Compensation Primary Delay Time / Slip Comp Time	This parameter adjusts the filter on the output of the slip compensation function. Increase to add stability, decrease to improve response.	0 to 10000	200 ms *	No	A	A	No
C3-03	Slip Compensation Limit / Slip Comp Limit	This parameter sets the upper limit for the slip compensation function. It is set as a percentage of motor rated slip (E2-02).	0 to 250	200%	No	A	A	No
C3-04	Slip Compensation Selection During Regeneration / Slip Comp Regen	Determines whether slip compensation is enabled or disabled during regenerative operation. 0: Disabled. 1: Enabled.	0 or 1	0	No	A	A	No
C3-05	Output Voltage Limit Operation Selection / V/f Slip Cmp Sel	Determines if the motor magnetic flux is automatically decreased when output voltage saturation occurs. 0: Disabled. 1: Enabled.	0 or 1	0	No	No	A	A

* The default will change when the control method is changed. The values in the table above are the defaults when using Open Loop Vector Control.

■Adjusting Slip Compensation Gain

Switch the C3-01 parameter settings as shown below by changing the control method.

- V/f Control: 0.0
- Open Loop Vector Control: 1.0
- Flux Vector Control: 1.0

Set C3-01 to 1.0 to compensate the rated slip set using the rated torque output status.

Adjust the slip compensation gain using the following procedure.

1. Set E2-02 (Motor Rated Slip) and E2-03 (Motor No-Load Current) correctly.
   Use the following formula to calculate the motor rated slip from the values on the motor nameplate.
   amount of motor rated slip (Hz) =
   motor rated frequency (Hz) - no. of rated rotations (min^{-1}) × no. of motor poles / 120
   Set the values for rated voltage, rated frequency, and no-load current in the motor unladen current. The motor rated slip is set automatically in the vector control using Auto-Tuning.
2. In V/f control, set C3-01 to 1.0. Setting this parameter to 0.0 disables slip compensation.
3. Apply a load, and measure the speed to adjust the slip compensation gain. Adjust the slip compensation gain by 0.1 at a time. If the speed is less than the target value, increase the slip compensation gain, and if the speed is greater than the target value, reduce the slip compensation gain.

For Flux Vector Control, the slip compensation gain is used as the motor temperature compensation gain. When the motor temperature increases, the motor's internal parameter increases, resulting in an increase in slip. If C3-01 is set, the amount of slip is adjusted as the temperature rises. Set C3-01 if the amount of torque varies with the temperature when using torque control or a torque limit. The larger the value of C3-01, the larger the compensation.

■Adjusting Slip Compensation Primary Delay Time Constant

Set the slip compensation primary delay time constant in ms.

Switch the default settings as follows by changing the control method.

- V/f Control: 2000 ms
- Open Loop Vector Control: 200 ms

Normally, there is no need to change these settings from their original values. Lower the set value only when the slip compensation response is low. When the speed is unstable, increase the set value.

■Adjusting Slip Compensation Limit

Set the upper limit for the slip compensation amount as a percent, taking the motor rated slip amount as 100%.

If the speed is lower than the target value but does not change even after adjusting the slip compensation gain, the motor may have reached the slip compensation limit. Increase the limit, and check the speed again. Make sure that the value of the slip compensation limit and reference frequency does not exceed what the application can handle.

The following diagram shows the slip compensation limit for the constant torque range and fixed output range.

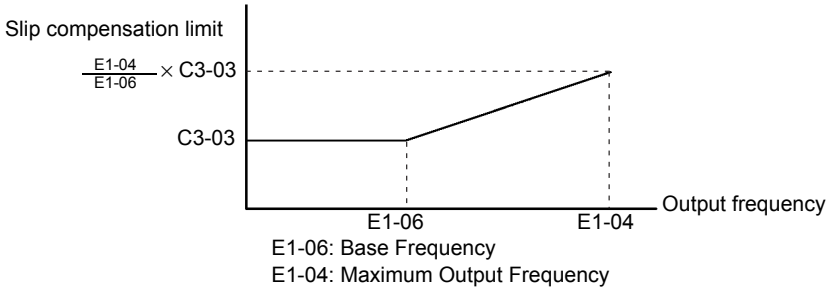


Fig 6.34 Slip Compensation Limit

■Selecting Slip Compensation Function during Regeneration

Set the MxC to enable or disable the slip compensation function during regeneration.

Activating slip compensation during regeneration will help improve speed control.

■Selecting Output Voltage Limit Operation

If output voltage saturation occurs while the output voltage limit operation is disabled, the output current will not change, but torque control accuracy will be lost. If torque control accuracy is required, change the settings to enable the output voltage limit operation.

If the output voltage limit operation is enabled, motor magnetic flux current is controlled automatically, and torque control accuracy is maintained to limit the output voltage references. Consequently, the output current will increase by approximately 10% maximum (with rated load) compared with when the output voltage limit operation is disabled, so check the margin of the MxC rated current.

Setting Precautions

- It is not necessary to change the output voltage limit operation if using the device at medium to low speed only, if the power supply voltage is 10% or more higher than the motor rated voltage, or if the torque control accuracy at high speeds is insufficient.
- If the power supply voltage is too low compared with the motor rated voltage, torque control accuracy may be lost even if the output voltage limit operation is enabled.

◆ Compensating for Insufficient Torque at Startup and Low-Speed Operation (Torque Compensation)

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

V/f Control Method calculates and adjusts the motor primary loss voltage according to the output voltage (V), and compensates for insufficient torque at start up and during low-speed operation. Calculate the compensation voltage as follows: motor primary voltage loss × parameter C4-01.

Vector control separates the motor excitation current and the torque current by calculating the motor primary current, and controlling each of the two separately.

Calculate the torque current as follows: Calculated torque reference × C4-01

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
C4-01	Torque Compensation Gain / Torq Comp Gain	This parameter sets the gain for the MxC's automatic torque boost function to match the MxC's output voltage to the motor load. This parameter helps to produce better starting torque. It determines the amount of torque or voltage boost based upon motor current, motor resistance, and output frequency. Adjustment is not normally required.	0.00 to 2.50	1.00	Yes	A	A	No
C4-02	Torque Compensation Primary Delay Time / Torq Comp Time	This parameter adjusts the filter on the output of the torque compensation function. Increase to add stability, decrease to improve response. Adjustment is not normally required.	0 to 10000	20 ms *	No	A	A	No

* The default will change when the control method is changed. The open loop vector defaults are given.

■Adjusting Torque Compensation Gain

Normally, there is no need to change this setting. Do not adjust the torque compensation gain when using Open Loop Vector Control.

Adjust the torque compensation gain using V/f Control Method in the following circumstances:

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

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

■Adjusting the Torque Compensation Primary Delay Time Constant

Set the primary delay for the torque compensation function in milliseconds.

Switch the defaults as follows by changing the control method settings:

- V/f Control: 200 ms
- Open Loop Vector Control: 100 ms

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

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

◆ Hunting-Prevention Function

The Hunting-Prevention Function suppresses hunting when the motor is operating with a light load. This function can be set in V/f Control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
n1-01	Hunting Prevention Selection / Hunt Prev Select	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. This function is enabled in V/f Control method only. If high response is to be given priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A	No	No
n1-02	Hunting Prevention Gain Setting / Hunt Prev Gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to make this setting. Adjust this parameter as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A	No	No
n1-03	Hunting Prevention Time Constant / Hunt Prev Time	Set the hunting-prevention primary delay time in units of ms.	0 to 500	10 ms	No	A	No	No

◆ Stabilizing Speed (Speed Feedback Detection Function)

The speed feedback detection control (AFR) function measures the stability of the speed when a load is suddenly applied by calculating the amount of fluctuation of the torque current feedback value, and compensating the output frequency with the amount of fluctuation.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
n2-01	Speed Feedback Detection Control (AFR) Gain / AFR Gain	Set the internal speed feedback detection control gain using the multiplication function. Normally, there is no need to make this setting. Adjust this parameter as follows: • If hunting occurs, increase the set value. • If response is low, decrease the set value. Adjust the setting by 0.05 at a time, while checking the response.	0.00 to 10.00	1.00	No	No	A	No
n2-02	Speed Feedback Detection Control (AFR) Time Constant / AFR Time	Set the time constant to decide the rate of change in the speed feedback detection control.	0 to 2000	100 ms	No	No	A	No
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2 / AFR Time 2	Increase the setting if overvoltage (OV) failures occur at the completion of acceleration or when the load changes radically.	0 to 2000	750 ms	No	No	A	No

Machine Protection

This section explains functions for protecting the machine.

◆ Reducing Noise and Leakage Current

The switching frequency of the output transistors in the MxC can be changed to reduce carrier noise and leakage current from the motor.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
C6-02	Carrier Frequency Selection / CarrierFreq Sel	Select carrier frequency pattern. 2: 4 kHz 4: 8 kHz 6: 12 kHz	2, 4, or 6 *1 *2	2	No	Q	Q	Q

* 1. Fixed to 2:4 kHz for V/f.
For Open Loop Vector Control, can select from 2:4 kHz or 4:8 kHz (Fixed to 2: 4 kHz for a 200 V class MxC for 45 kW and a 400 V class MxCs for 22 kW and 45 kW).

* 2. Fixed to 2: 4 kHz for 400 V class MxCs for 110 kW and 160 kW.

■Control Method and Carrier Frequency Settings

Carrier frequency settings are restricted as listed in the following table according to the control method selection.

Control Method	Carrier Frequency
V/f Control	2: 4.0 kHz
Open Loop Vector Control	2: 4.0 kHz 4: 8.0 kHz*
Flux Vector Control	2: 4.0 kHz 4: 8.0 kHz 6: 12.0 kHz

* Fixed to 2: 4 kHz for 200 V class MxC for 45 kW and 400 V class MxCs for 22 kW and 45 kW

Note: 1. Fixed to 2: 4 kHz for 400 V class MxCs for 110 kW and 160 kW.
2. The upper limit of the carrier frequency depends on the MxC capacity.

■Carrier Frequency Setting Precautions

When selecting the carrier frequency, observe the following precautions.

- Adjust the carrier frequency according to the cases shown below.
  If the wiring distance between MxC 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 Selection) setting	2, 4, or 6 (4, 8, or 12 kHz)	2 or 4 (4 or 8 kHz)	2 (4 kHz)

  If speed and torque are inconsistent at low speeds: Lower the carrier frequency.
  If there is too much leakage current from the MxC: Lower the carrier frequency.
  If the metallic noise from the motor is too loud: Raise the carrier frequency.

■Reduction Ratio of Carrier Frequency and Rated Current

The following table shows the reduction ratio of the carrier frequency and rated current.

Model: CIMR-ACA25P5, 2011, 2022, 2045, 45P5, 4011, 4045, and 4075

Carrier Frequency (kHz)	Continuous Rating	60-second Rating
4	100%	150%
8	90%	135%
12	80%	120%

Model: CIMR-ACA4022

Carrier Frequency (kHz)	Continuous Rating	60-second Rating
4	100%	150%
8	80%	120%
12	60%	90%

Models: CIMR-ACA4110 and 4160

Carrier Frequency (kHz)	Continuous Rating	60-second Rating
4	100%	150%

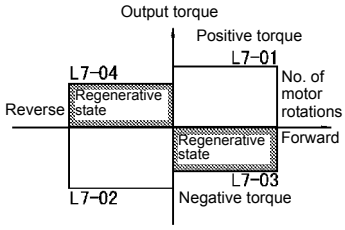
Note: 100% means the rated output current value of the MxC.

◆ Limiting Motor Torque (Torque Limit Function)

The motor torque limit function is enabled with Flux Vector Control and Open Loop Vector Control.

In the Open Loop Vector Control and Flux Vector Control, the user-set value is applied to the torque limit by internally calculating the torque output by the motor. Enable this function to keep the MxC from applying torque above a specified amount, or to limit the amount a regenerative energy created by the motor.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
L7-01	Forward Torque Limit / Torq Limit Fwd	Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set. 	0 to 300	200%	No	No	A	A
L7-02	Reverse Torque Limit / Torq Limit Rev		0 to 300	200%	No	No	A	A
L7-03	Forward Regenerative Torque Limit / Torq Lmt Fwd Rgn		0 to 300	200%	No	No	A	A
L7-04	Reverse Regenerative Torque Limit / Torq Lmt Rev Rgn		0 to 300	200%	No	No	A	A
L7-06	Torque Limit Integral Time Constant / Torq Det 2 Tim	Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set.	5 to 10,000	200 ms	No	No	A	No
L7-07	Torque Limit Control Method Selection During Accel/Decel / Torq Lmt Sel	Selects the method of torque limit controls during accel/decel 0: Proportional Controls (uses integral controls at fixed speeds). 1: Integral Controls Adjustment is not normally required. With applications that require torque limits during accel/decel, integral controls (setting value = 1) are used when torque controls take precedence. When torque limit is applied to the motor, accel/decel time may increase and motor speed may not run at the indicated speed reference.	0, 1	0	No	No	A	No

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

Set Value	Function	Contents (100%)	Control Methods		
			V/f	Open Loop Vector	Flux Vector
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

Note: The forward torque limit is the limit value when the analog input signal generates forward torque. This torque limit setting is enabled even when the analog input signal generates forward torque while the motor is operating (regeneration).

■Setting the Torque Limit in Parameters

Set individually four torque limits using L7-01 to L7-04 in the following directions: forward drive, reverse drive, forward regeneration, and reverse regeneration.

■Set the Torque Limit Value Using an Analog Input

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 levels are set up as shown when shipped from the factory:

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.

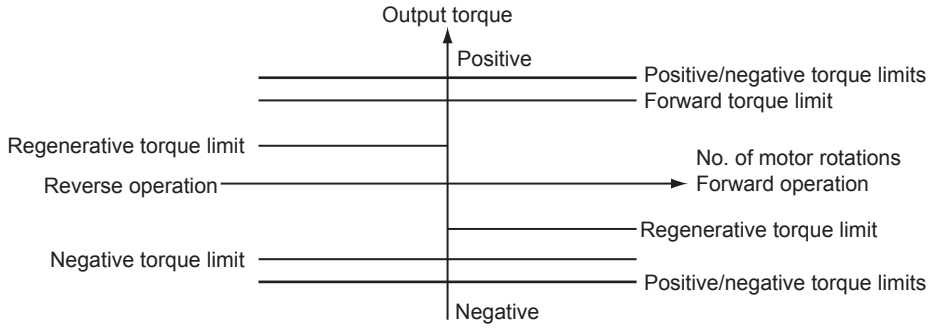


Fig 6.35 Torque Limit by Analog Input

■Setting Torque Limits Using Parameters and an Analog Input

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

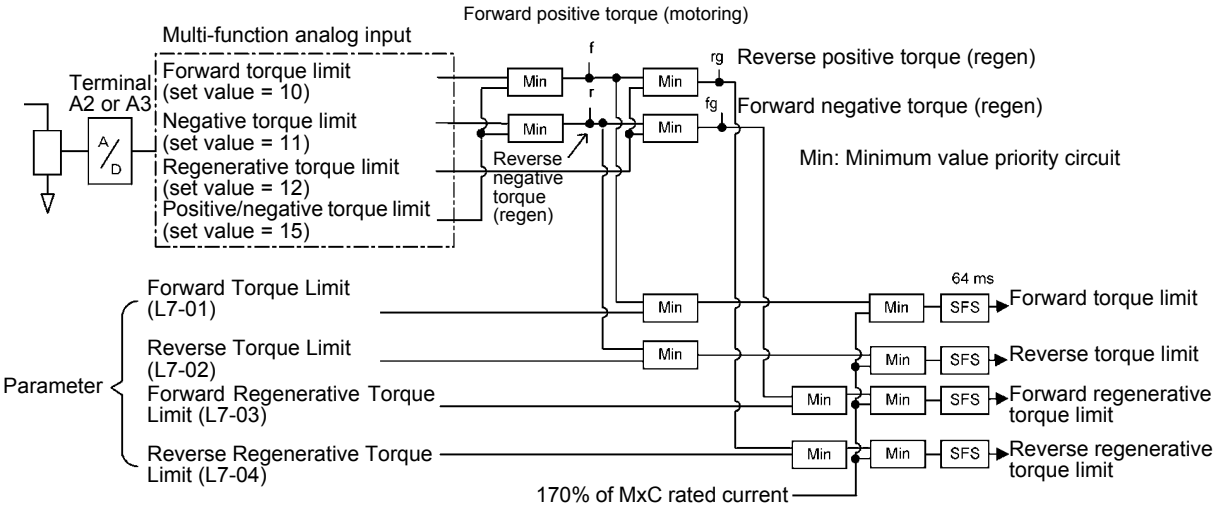


Fig 6.36 Torque Limit Using Parameters and an Analog Input

■Selecting the Control Method for Torque Limit during Acceleration and Deceleration

L7-07 is used to select the control method for the torque limit during acceleration and deceleration. The selections are proportional control and integral control. For applications such as presses, in which the torque limit will be reached during acceleration and deceleration, torque control can be given priority by selecting integral control. To increase the change in frequency for the torque limit when integral control is selected, decrease the value set for L7-06 (Torque Limit Integral Time Constant).

■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 cause the load to slip or fall.
- 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 ±5% at the output frequency of 10 Hz or above. When output frequency is less than 10 Hz, 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.

◆ Stall Prevention during Run

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

Stall Prevention during Run is enabled only during V/f Control. If the MxC output current continues to exceed the setting in parameter L3-06 for 100 ms or longer, the motor speed is reduced. Set whether to enable or disable deceleration time using parameter L3-05. Set the deceleration time using C1-02 (Deceleration Time 1) or C1-04 (Deceleration Time 2).

If the MxC output current reaches the set value in L3-06 - 2% (MxC Rated Output Current), the motor will accelerate again at the frequency set or the acceleration time set.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L3-05	Stall Prevention Selection During Running / StallP Run Sel	Selects the stall prevention method to use to prevent MxC faults during run. 0: Disabled.- MxC runs a set frequency. A heavy load may cause the MxC to trip on an OC or OL fault. 1: Decel Time 1 - In order to avoid stalling during heavy loading, the MxC will decelerate at Decel time 1 (C1-02) if the output current exceeds the level set by L3-06. Once the current level drops below the L3-06 level, the MxC will accelerate back to its frequency reference at the active acceleration rate. 2: Decel Time 2 - Same as setting 1 except the MxC decelerates at Decel Time 2 (C1-04). When output frequency is 6 Hz or less, Stall Prevention during Run is disabled regardless of the setting in L3-05.	0 to 2	1	No	A	No	No
L3-06	Stall Prevention Level During Running / StallP Run Level	This parameter is enabled when L3-05 is set to "1" or "2". MxC rated current is set as 100%. Decrease the set value if stalling or excessive current occurs with the defaults.	30 to 200	160%	No	A	No	No

◆ Changing Stall Prevention Level during Run Using an Analog Input

If H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) is set to 8 (stall prevention level during run), the stall level during run by setting H3-10 (Terminal A2 Gain Setting) and H3-11 (Terminal A2 Bias Setting) or H3-06 (Terminal A3 Gain Setting) and H3-07 (Terminal A3 Bias Setting) can be changed.

The stall prevention level enabled while the motor is running is either the multi-function analog input terminal A2 or A3 input level, or the value set to parameter L3-06, whichever is smaller.

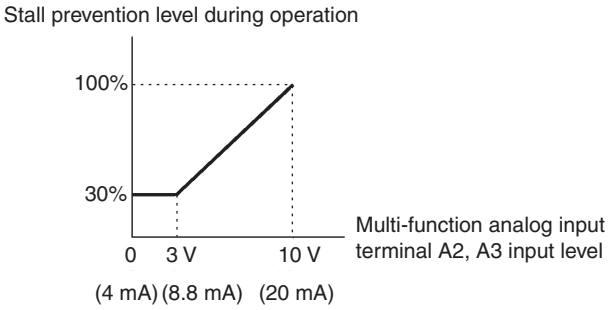


Fig 6.37 Stall Prevention Level during Run Using an Analog Input

INFO

If the motor capacity is smaller than the MxC capacity or the motor stalls when operating at the defaults, lower the stall prevention level during run.

◆ Using Frequency Detection: L4-01 to L4-05

Set these parameters when outputting one of the frequency agree or frequency detection signals from a multi-function output. When using Flux Vector Control, the motor speed is detected.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L4-01	Speed Agreement Detection Level / Spd Agree Level	Effective when "Desired frequency (speed) agree 1," "Frequency (FOUT) detection 1," or "Frequency (FOUT) detection 2" is set for a multi-function output. Frequencies to be detected are set in Hz units.	0.0 to 120.0	0.0 Hz	No	A	A	A
L4-02	Speed Agreement Detection Width / Spd Agree Width	Effective when "Frequency (speed) agree 1," "Frequency (FOUT) agree 1," or "Frequency (FOUT) detection 2" is set for a multi-function output. Sets the frequency detection width in Hz units.	0.0 to 20.0	2.0 Hz	No	A	A	A
L4-03	Speed Agreement Detection Level (+/-) / Spd Agree Lvl +-	Effective when "Desired frequency (speed) agree 2," "Frequency (FOUT) detection 3," or "Frequency (FOUT) detection 4" is set for a multi-function output. Frequency that should be detected is set in Hz units.	-120.0 to +120.0	0.0 Hz	No	A	A	A

Parameter Number	Name	Description	Setting Range	Default	Change during Run	Control Methods		
	Display					V/f	Open Loop Vector	Flux Vector
L4-04	Speed Agreement Detection Width (+/-) Spd Agree Wdth +-	Effective when "Frequency (speed) agree 2," "Frequency (FOUT) detection 3," or "Frequency detection 4" is set for a multi-function output. Frequency detection width is set in Hz units.	0.0 to 20.0	2.0 Hz	No	A	A	A

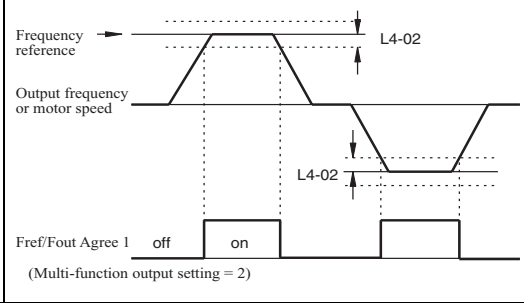
■Parameters and Output Signals

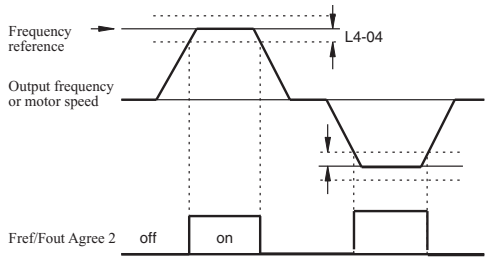
Parameter Number	Name	Function
L4-01	Speed Agree Detection Level	Fref/Set Agree 1 Frequency Detection 1 Frequency Detection 2
L4-02	Speed Agree Detection Width	Fref/Fout Agree 1 Fref/Set Agree 1 Frequency Detection 1 Frequency Detection 2
L4-03	Speed Agree Detection Level (+/-)	Fref/Set Agree 2 Frequency Detection 3 Frequency Detection 4
L4-04	Speed Agree Detection Width (+/-)	Fref/Fout Agree 2 Fref/Set Agree 2 Frequency Detection 3 Frequency Detection 4

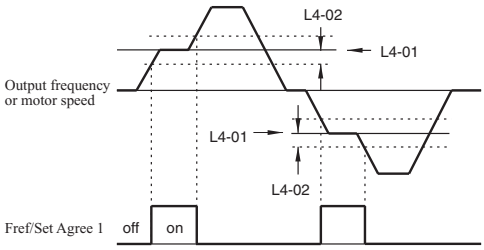
Set the corresponding setting in the multi-function output (H2-01 to H2-05) to output the desired Fref/Fout Agree signal, Fref/Set Agree signal, or Frequency Detection signal.

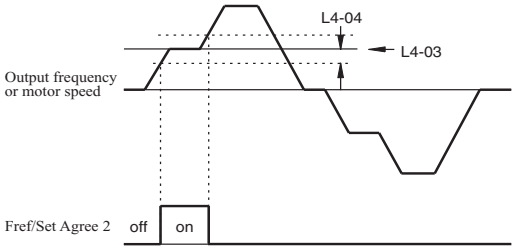
Function	Setting
Fref/Fout Agree 1	2
Fref/Set Agree 1	3
Frequency Detection 1	4
Frequency Detection 2	5
Fref/Fout Agree 2	13
Fref/Set Agree 2	14
Frequency Detection 3	15
Frequency Detection 4	16

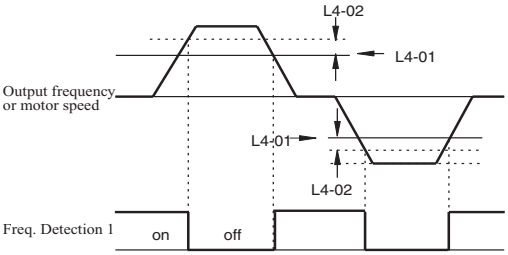
Timing Chart for Frequency Detection Operation

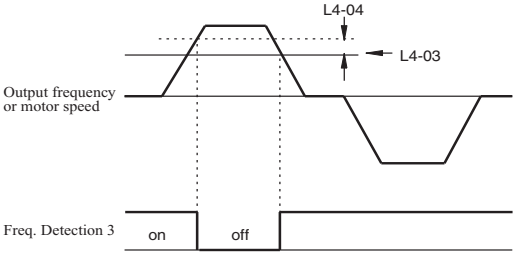
<table>
<tr><th>Related Parameter</th><th>L4-01: Speed Agree Level
L4-02: Speed Agree Width</th><th>L4-03: Speed Agree Level +/–
L4-04: Speed Agree Width +/–</th></tr>
<tr><td rowspan="2">Fref/Fout Agree</td><td>Fref/Fout Agree 1</td><td>Fref/Fout Agree 2</td></tr>
<tr><td> 

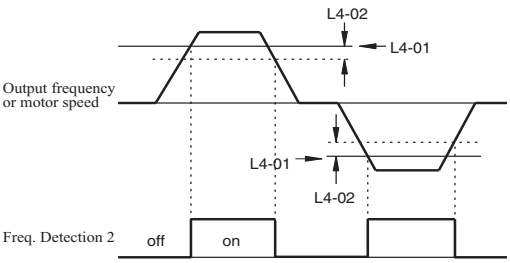
(Multi-function output setting = 2)</td><td> 

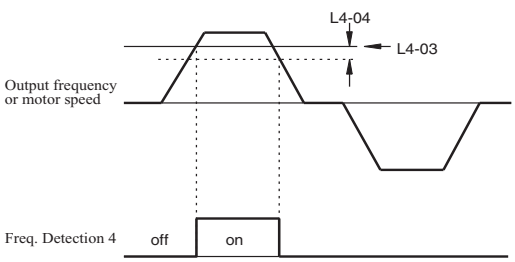
(Multi-function output setting = 13)</td></tr>
<tr><td rowspan="2">Fref/Set Agree</td><td>Fref/Set Agree 1
Switches on under the following conditions during Frequency Agree.</td><td>Fref/Set Agree 2
Switches on under the following conditions during Frequency Agree.</td></tr>
<tr><td> 

(Multi-function output setting = 3)</td><td> 

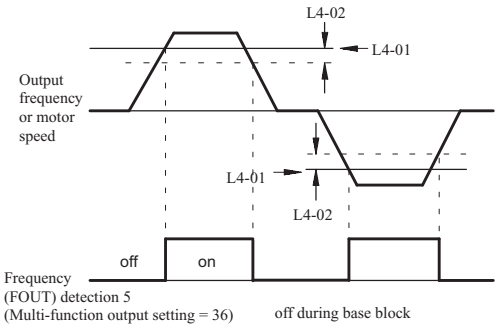
(Multi-function output setting = 14)</td></tr>
<tr><td rowspan="4">Frequency Detection</td><td>Frequency (FOUT) Detection 1
(L4-01 > | output frequency |)</td><td>Frequency (FOUT) Detection 3
(L4-03 > output frequency)</td></tr>
<tr><td> 

(Multi-function output setting = 4)</td><td> 

(Multi-function output setting = 15)</td></tr>
<tr><td>Frequency (FOUT) Detection 2
(L4-01 < | output frequency |)</td><td>Frequency (FOUT) Detection 4
(L4-01 < output frequency)</td></tr>
<tr><td> 

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

(Multi-function output setting = 16)</td></tr>
</table>

Related Parameter	L4-01: Speed Agree Level L4-02: Speed Agree Width	L4-03: Speed Agree Level +/– L4-04: Speed Agree Width +/–
Frequency (FOUT) Detection	Frequency (FOUT) Detection 5 (L4-01< | output frequency |)	
		

◆ Detecting Motor Torque

If an excessive load is placed on the machinery (overtorque) or the load is suddenly lightened (undertorque), an alarm signal is output to multi-function output terminal M1-M2, P1-PC, P2-PC, P3-C3, or P4-C4.

To use the overtorque/undertorque detection function, set B, 17, 18, 19 (overtorque/undertorque detection NO/NC) in one of the following parameters: H2-01 to H2-05 (Terminals M1-M2, P1-PC, P2-PC, P3-C3, and P4-C4 Function Selection).

The overtorque/undertorque detection level is the current level (MxC rated output current 100%) in V/f control, and the motor torque (motor rated torque 100%) in vector control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L6-01	Torque Detection Selection 1 / Torq Det 1 Sel	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A	A	A
L6-02	Torque Detection Level 1 / Torq Det 1 Lvl	Open Loop Vector Control: Motor rated torque is set as 100%. V/f Control: MxC rated current is set as 100%.	0 to 300	150%	No	A	A	A
L6-03	Torque Detection Time 1 / Torq Det 1 Time	Sets the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	A	A	A
L6-04	Torque Detection Selection 2 / Torq Det 2 Sel	Multi-function output for overtorque detection 1 is output to multi-function contact output when overtorque detection 1 NO or overtorque detection 1 NC is selected. Multi-function output for overtorque detection 2 is output to multi-function contact output when overtorque detection 2 NO or overtorque detection 2 NC is selected.	0 to 8	0	No	A	A	A
L6-05	Torque Detection Level 2 / Torq Det 2 Lvl		0 to 300	150%	No	A	A	A
L6-06	Torque Detection Time 2 / Torq Det 2 Time		0.0 to 10.0	0.1 s	No	A	A	A

Multi-function Digital Outputs (H2-01 to H2-05)

Set Value	Function	Control Methods		
		V/f	Open Loop Vector	Flux Vector
B	Overtorque/undertorque detection 1 N.O. (N.O. contact: Overtorque/undertorque detection when on)	Yes	Yes	Yes
17	Overtorque/undertorque detection 1 N.C. (N.C. Contact: Overtorque/undertorque detection when off)	Yes	Yes	Yes
18	Overtorque/undertorque detection 2 N.O. (N.O. Contact: Overtorque/undertorque detection when on)	Yes	Yes	Yes
19	Overtorque/undertorque detection 2 N.C. (N.C. Contact: Overtorque/undertorque detection when off)	Yes	Yes	Yes

■L6-01 and L6-04 Set Values and LCD Indicator Lights

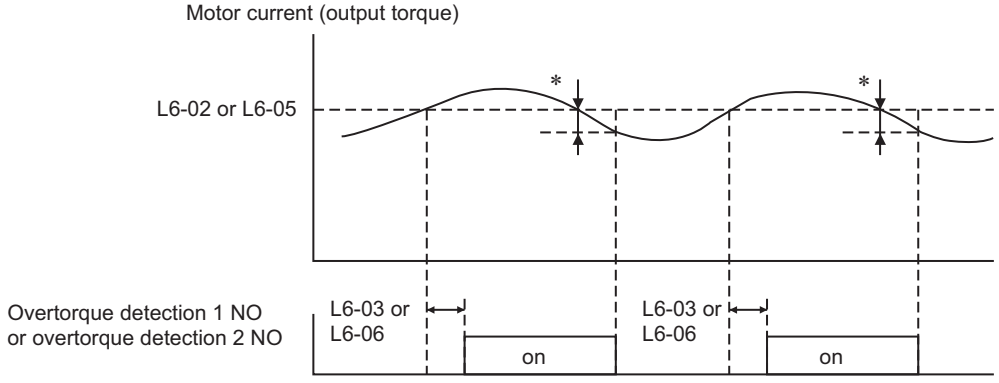
The relationship between alarms displayed by the digital operator when overtorque or undertorque is detected and the set values in L6-01 and L6-04 is shown in the following table.

Set Value	Function	LCD 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 run: 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 run: 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 run: 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 run: Output stopped upon detection (protected operation).	UL3 lit	UL4 lit

■Setting Example

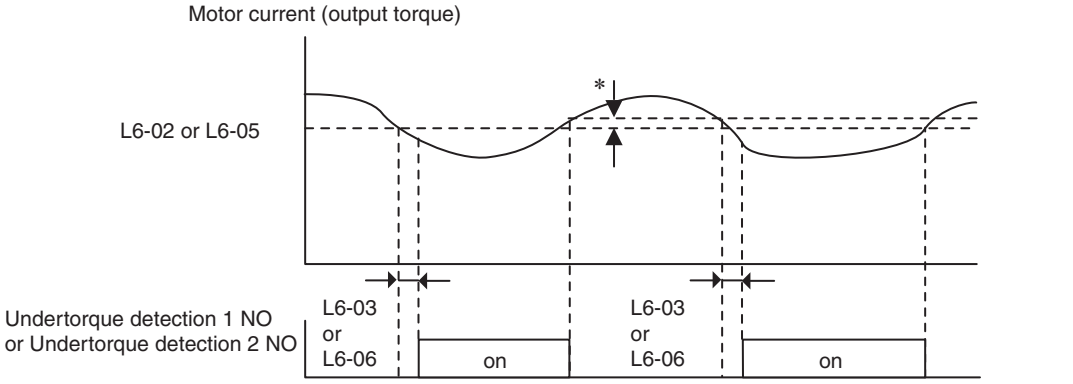
The following diagram shows the time chart for overtorque and undertorque detection.

- Overtorque Detection



* Overtorque detection disabled bandwidth is approximately 10% of the MxC rated output current (or motor rated torque).

• Undertorque Detection



* The undertorque detection disabled margin is approximately 10% of the MxC rated output current (or motor rated torque)

◆ Changing Overtorque and Undertorque Detection Levels Using an Analog Input

If parameter H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) is set to 7 (overtorque/undertorque detection level), the overtorque/undertorque detection level can be changed.

If the overtorque/undertorque detection level is changed 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.

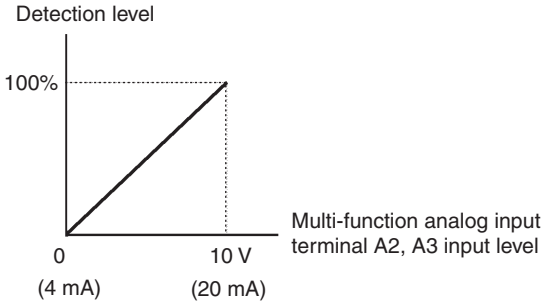


Fig 6.38 Overtorque/Undertorque Detection Level Using an Analog Input

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

Set Value	Function	Contents (100%)	Control Methods		
			V/f	Open Loop Vector	Flux Vector
7	Overtorque/undertorque detection level	Motor rated torque for vector control MxC rated output current for V/f control	Yes	Yes	Yes

◆ Motor Overload Protection

The MxC's built-in electronic thermal overload relay protects the motor from overload.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
E2-01	Motor Rated Current / Motor Rated FLA	Sets the motor nameplate full load current in amperes (A). This value is automatically set during Auto-Tuning.	2.70 to 54.00 *2	19.60 A *1	No	Q	Q	Q
E4-01	Motor 2 Rated Current / Motor Rated FLA	Sets the motor 2 name plate full load current in amperes (A). This value is automatically set during Auto-Tuning.	2.70 to 54.00 *2	19.60 A *1	No	A	A	A
L1-01	Motor Overload Protection Selection / MOL Fault Select	Sets the motor thermal overload protection (OL1) based on the cooling capacity of the motor. 0: Disabled. 1: Standard Fan Cooled (< 10:1 motor) 2: Standard Blower Cooled (10:1 motor) 3: Vector Motor (≤1000:1 motor)	0 to 3	1	No	Q	Q	Q
L1-02	Motor Overload Protection Time / MOL Time Const	Sets the motor thermal overload protection (OL1) time. A larger L1-02 time will increase the time before an OL1 fault will occur.	0.1 to 5.0	1.0 min	No	A	A	A

* 1. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.
* 2. The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given.

Multi-Function Outputs (H2-01 to H2-05)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
1F	Motor overload (OL1, including OH3) pre-alarm (on: 90% or more of the detection level)	Yes	Yes	Yes

■Setting Motor Rated Current

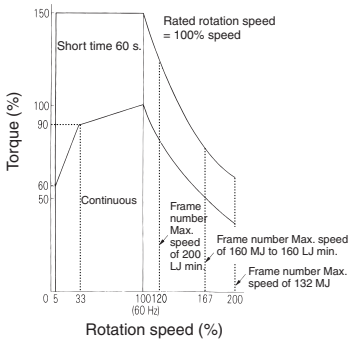
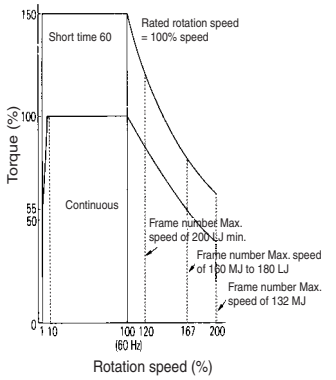
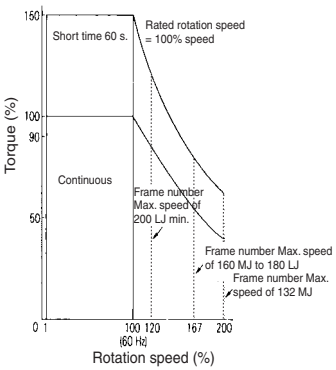
Set the rated current value on the motor nameplate in parameters E2-01 (Motor Rated Current) and E4-01 (Motor 2 Rated Current). This set value is the electronic thermal base current.

■Setting Motor Overload Protection Characteristics

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

The induction motor's cooling abilities differ according to the speed control range. Consequently, be sure to select the electronic thermal protection characteristics to match the applicable motor's tolerance load characteristics.

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

L1-01 Set Value	Motor Type	Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
1	General-purpose motor (standard motor)		Use this motor for operations using a commercial power supply. This motor construction yields best cooling effect when operating at 50/60 Hz.	When operating continuously at 50/60 Hz or less, motor overload detection (OL1) is detected. The MxC outputs the error contact, and the motor coasts to a stop.
2	Inverter motor (constant torque) (1:10)		This motor yields a cooling effect even when operating at low speeds (approx. 6 Hz).	Operates continuously at 6 to 50/60 Hz.
3	Vector motor (1:100)		This motor yields a cooling effect even when operating at extremely low speeds (approx. 0.6 Hz).	Operates continuously at 0.6 to 60 Hz.

◆ 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 default is resistance to 150% for 60 seconds.

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

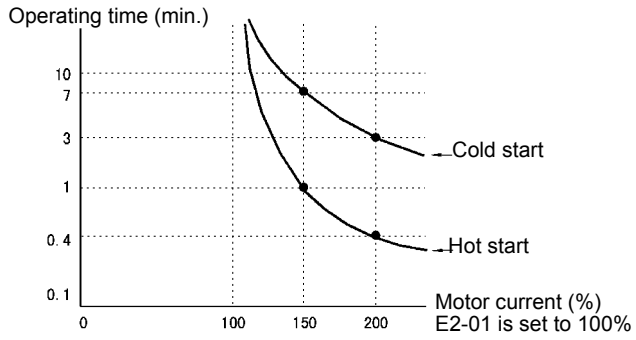


Fig 6.39 Motor Protection Operation Time

■Setting Precautions

- Do not connect more than one motor per MxC.
- 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 parameter has been set to 1 (enabled), because the thermal value will be reset.
- To detect overload quickly, set the set value in parameter L1-02 to a low setting.
- When using a general-purpose motor (standard motor), the cooling ability will be lowered by $f^{1/4}$ (frequency). Consequently, the frequency may cause motor overload protection (OL1) to occur, even below the rated current. If operating using the rated current at a low frequency, use a special motor.

■Setting the Motor Overload Pre-Alarm

If the motor overload protection function is enabled (i.e., L1-01 is set to other than 0) and H2-01 to H2-05 (Terminals M1-M2, P1-PC, P2-PC, P3-C3, and P4-C4 Function Selection) are set to 1F (motor overload OL1 pre-alarm), the motor overload pre-alarm will be enabled. If the electronic thermal value reaches minimum 90% of the overload detection level, the output terminal that has been set will be turned on.

◆ Motor Overheating Protection Using PTC Thermistor Inputs

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

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
L1-03	Motor Overheat Alarm Operation Selection / Mtr OH Alarm Sel	Sets operation selection when the motor temperature analog input (H3-09 = E) exceeds the OH3 alarm level (1.17V) 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	No	A	A	A
L1-04	Motor Overheat Fault Operation Selection / Mtr OH Fault Sel	Sets stopping method when the motor temperature analog input (H3-09 = E) exceeds the OH4 fault level. 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop	0 to 2	1	No	A	A	A
L1-05	Motor Temperature Input Filter Time / Mtr Temp Filter	This parameter adjusts the filter on the motor temperature analog input (H3-09 = E). Increase to add stability, decrease to improve response.	0.00 to 10.00	0.20 s	No	A	A	A

■PTC Thermistor Characteristics

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

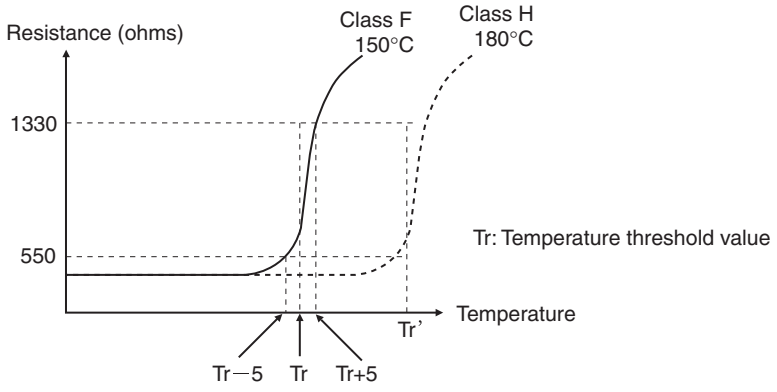


Fig 6.40 PTC Thermistor Temperature-Resistance Value Characteristics

■Operation during Motor Overheat

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

Error Codes If the Motor Overheats

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

By setting H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) to E (Motor temperature input), alarm OH3 or OH4 will occur using the PTC temperature-resistance characteristics, and protect the motor. The terminal connections are shown in the following diagram.

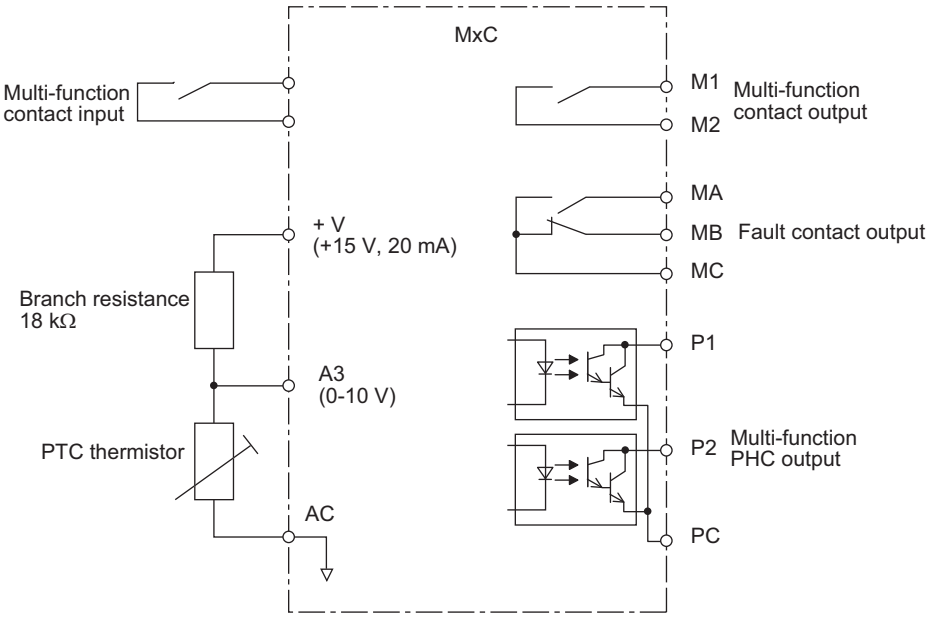


Fig 6.41 Mutual Connections During Motor Overheating Protection

◆ Limiting Motor Rotation Direction

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

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
b1-04	Reverse Operation Selection / Reverse Oper	Determines the forward rotation of the motor, and if reverse operation is disabled. 0: Reverse enabled. 1: Reverse disabled.	0 or 1	0	No	A	A	A

Continuing Operation

This section explains functions for continuing or automatically restarting MxC operation even if an error occurs.

◆ Restarting Automatically after Power is Restored

Even if a temporary power loss occurs, the MxC can restart automatically after power is restored to continue motor operation.

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

If L2-01 is set to 1, when power is restored within the time set in L2-02, the MxC will restart. If the time set in L2-02 is exceeded, alarm UV1 (main circuit undervoltage) will be detected.

If L2-01 is set to 2, when the main power supply is restored while the control power supply (i.e., power supply to the control panel) is backed up, the MxC will restart. Consequently, alarm FDEV (power supply frequency fault) will not be detected.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L2-01	Momentary Power Loss Detection Selection / PwrL Selection	Enables and disables the momentary power loss function. 0: Disabled. - MxC trips on (FDV) fault when power is lost. 1: Power Loss Ridethrough Time - MxC will restart if power returns within the time set in L2-02. 2: CPU Power Active - MxC will restart if power returns prior to control power supply shut down.	0 to 2	0	No	A	A	A
L2-02	Momentary Power Loss Ride-thru Time / PwrL Ridethru t	Sets the power loss ridethrough time. This value is dependent on the capacity of the MxC. Enabled only when L2-01 = 1.	0 to 2.5	0.5 s *1	No	A	A	A
L2-03	Momentary Power Loss Minimum Base Block Time / PwrL Baseblock t	Sets the minimum time to wait to allow the residual motor voltage to decay before the MxC output turns back on during power loss ridethrough. After a power loss, if L2-03 is greater than L2-02, operation resumes after the time set in L2-03.	0.1 to 5.0	0.7 s *1	No	A	A	A
L2-04	Momentary Power Loss Voltage Recovery Ramp Time / PwrL V/f Ramp t	Sets the time it takes the output voltage to return to the preset V/f pattern after speed search (Current Detection Mode) is complete.	0.0 to 5.0	1.5 s *1	No	A	A	A
L2-05	Undervoltage Detection Level / PUV Det Level	Sets the PS undervoltage trip level of the MxC. If this is set lower than the default, additional AC input reactance or PS voltage may be necessary. Consult the factory before changing this parameter setting.	150 to 210 *2	190 VDC *2	No	A	A	A
L2-13	Power frequency fault detection gain / FDV Gain	Set the gain to detect a power frequency fault (FDV). If an FDV is detected when no momentary power loss occurred, decrease the set value in units of 0.1.	0.1 to 2.0	1.0	No	A	A	A

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L2-21	Undervoltage-detection level / Power UV Level	Set the undervoltage-detection level for the input power voltage in volts.	100 to 200	150 VAC *2	No	A	A	A
L2-27*3	Detection width of input power frequency error / FDV	Sets the frequency width in hertz that detects the input power frequency error (FDV). The customer needs not to set or modify.	3.0 to 20.0	6.0 Hz	No	A	A	A

* 1. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.
* 2. These are values for a 200 V class MxC. Value for a 400 V class MxC is double.
* 3. Applicable for the Varispeed AC with software versions PRG:1050 or later.

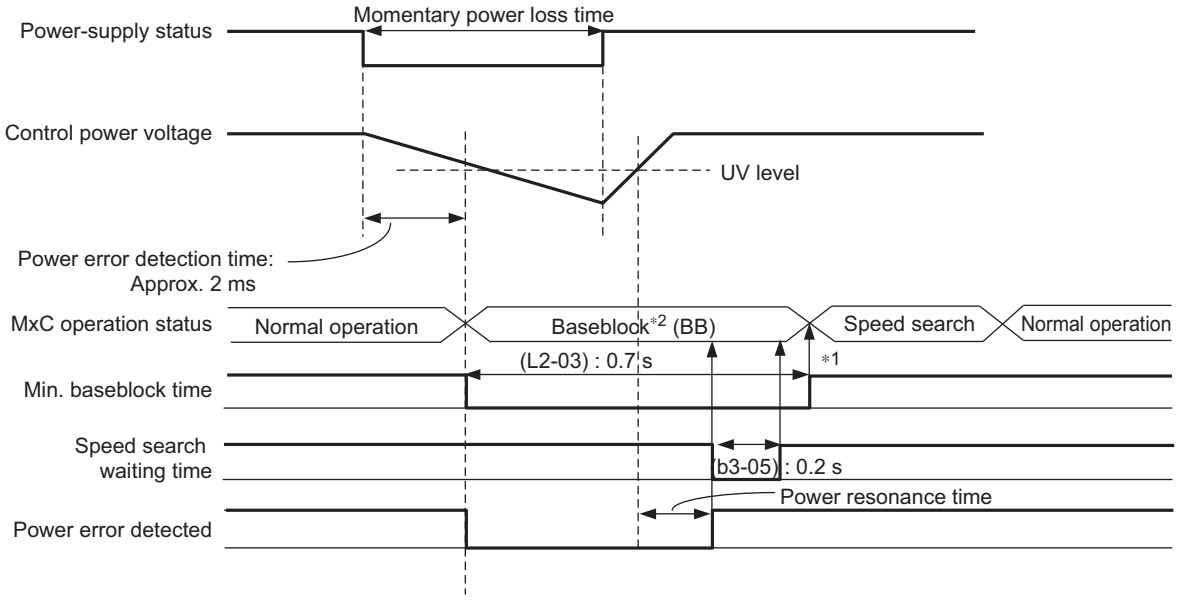
■Setting Precautions

- Error output signals are not output during momentary power loss recovery.
- To continue MxC operation after power has been restored, make settings so that Run Commands from the control circuit terminal are stored even while power is suspended.
- If the momentary power loss operation selection is set to 0 (Disabled), if the momentary power loss occurs, alarm FDV (Power supply frequency fault) will be detected.
- If the CIMR-ACA45P5, 4011, 25P5, 2011, or 2022 needs two seconds or more for the momentary power loss ridethrough time, a separate momentary-power-loss compensation unit is required. Even if the Momentary Power Loss Detection function (L2-01) is enabled, the MxC will run for 2 ms and then stop if a momentary power loss occurs. Take note of this delay when the MxC is used in various applications.
- A time lag of about 0.3 s can occur between the actual momentary power loss time and the momentary power loss ridethrough time.

■Example of Momentary Power Loss

Figure 6.42 shows an example of what happens in the MxC if a momentary power loss occurs when: L2-01 is set to 1, L2-02 to 0.5, L2-03 to 0.7, or b3-05 to 0.2.

If the power is restored within the momentary power loss ridethrough time, MxC will carry out speed search and normal operation will automatically restart after completing the power resonance.



* 1. The baseblock will be released after completing L2-03, UV time, b3-05, and the power resonance time.

* 2. The motor will be in coasting to a stop during baseblock. Take measures if there is possibility that the coasting to a stop cause the problem.

Fig 6.42 Example when Momentary Power Loss Occurs

If the momentary power loss time is longer than the momentary power loss ridethrough time, an FDV alarm (Power Supply Frequency Fault) will occur and the MxC will stop the operation.

◆ Speed Search

The speed search function finds the actual speed of the motor that is rotating using inertia, and then starts smoothly from that speed. When restoring power after a temporary power loss, the speed search function switches connection from the commercial power supply, and then restarts the fan that is rotating using inertia.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b3-01	Speed Search Selection / SpdSrch at Start	Enables/disables the speed search function for the Run Command and sets the speed search method. 0: Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation: When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection: The speed search is started from the frequency when power was momentarily lost and the maximum frequency, and the speed is detected at the search current level.	0 to 3*1	0	No	A	A	No
b3-02	Speed Search Deactivation Current / SpdSrch Current	Used only when b3-01 = 2 or 3. Sets speed search operating current in units of percent, with MxC rated current as 100%. Note: Normally not necessary to change. If the MxC won't run after a restart, lower this value.	0 to 200	100%*2	No	A	A	No
b3-03	Speed Search Deceleration Time / SpdSrch Dec Time	Used only when b3-01 = 2 or 3. Sets the deceleration time during speed search.	0.1 to 10.0	2.0 s	No	A	A	No
b3-04 *4	Current Suppression Gain During Search / SpdSrch I Gain	Sets the gain used to suppress output current during a current detection speed search. If resistor overheat (SOH) occurs, reduce the setting.	10 to 100	100% *3	No	A	A	No
b3-05	Speed Search Delay Time / Search Delay	Delays the speed search operation after a momentary power loss to allow time for an external output contactor to re-energize.	0.0 to 20.0	0.2 s	No	A	A	A
b3-10	Speed Search Detection Compensation Gain / Srch Detect Comp	Sets the gain for the frequency at which the MxC starts speed estimation speed search. Use only when b3-01 = 0 or 1.	1.00 to 1.20	1.15	No	A	A	No
b3-14	Bi-directional Speed Search Selection / Bidir Search Sel	This parameter enables the MxC to detect the direction of rotation of the motor during speed search. 0: Disable - MxC uses frequency reference direction. 1: Enable - MxC uses detected direction	0 or 1	0	No	A	A	No

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Control Methods Open Loop Vector	Control Methods Flux Vector
b3-19	Number of Speed Search Restarts Num of SrchRestr	Sets the number of restarts possible for speed search restart operations.	0 to 10	1	No	A	A	No
L2-03	Momentary Power Loss Minimum Base Block Time PwrL Baseblock t	Sets the minimum time to wait to allow the residual motor voltage to decay before the MxC output turns back on during power loss ridethrough. After a power loss, if L2-03 is greater than L2-02, operation resumes after the time set in L2-03.	0.1 to 5.0	0.7 s *3	No	A	A	A
L2-04	Momentary Power Loss Voltage Recovery Ramp Time PwrL V/f Ramp t	Sets the time it takes the output voltage to return to the preset V/f pattern after speed search (Current Detection Mode) is complete.	0.0 to 5.0	1.5 s *3	No	A	A	A

* 1. Can be set to 1 or 2 only for the MxC models CIMR-ACA4110 and 4160.
* 2. The default will change when the control method is changed. The Open Loop Vector defaults are given.
* 3. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.
* 4. Applicable for the Varispeed AC with software versions PRG: 1052 or later.

Multi-Function Digital Inputs (H1-01 to H1-10)

Set Value	Function	Control Methods V/f	Control Methods Open Loop Vector	Control Methods Flux Vector
61	External Search Command 1 (ON: Speed search from maximum output frequency)	Yes	Yes	No
62	External Search Command 2 (ON: Speed search from set frequency)	Yes	Yes	No

■Setting Precautions

- When both External Search Commands 1 and 2 are set for the multi-function digital 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 Momentary Power Loss Minimum Baseblock Time (L2-03).
- If the MxC output is equipped with a contact, set the contact operation delay time in the Speed Search Delay Time (b3-05). The default is 0.2 s. When not using the contact, the search time can be reduced by making the setting 0.0 s. After waiting for the speed search wait time, the MxC starts the speed search.
- Parameter b3-02 is a current detection speed search (current detection level for search completion). When the current falls below the detection level, the speed search is viewed as completed, and the motor accelerates or decelerates to the set frequency. If the motor cannot restart, lower the set value.
- If an overcurrent (OC) is detected when using speed search after recovery following a power loss, lengthen the Momentary Power Loss Minimum Baseblock Time (L2-03).
- If a resistor overheat (SOH) is detected when using a current detection speed search, reduce the Current Suppression Gain During Search (b3-04)

■Application Precautions for Speed Estimation Speed Search

- When using V/f Control Method always perform Stationary Auto-Tuning for line-to-line resistance only before using speed searches based on estimated speeds.
- When using vector control, always perform Rotational Auto-Tuning before using speed search based on estimated speeds.
- If the cable length between the motor and MxC is changed after Auto-Tuning has been performed, perform Stationary Auto-Tuning for line-to-line resistance only again.

IMPORTANT

The motor will not operate when Stationary Auto-Tuning for line-to-line resistance only is performed.

■Speed Search Selection

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

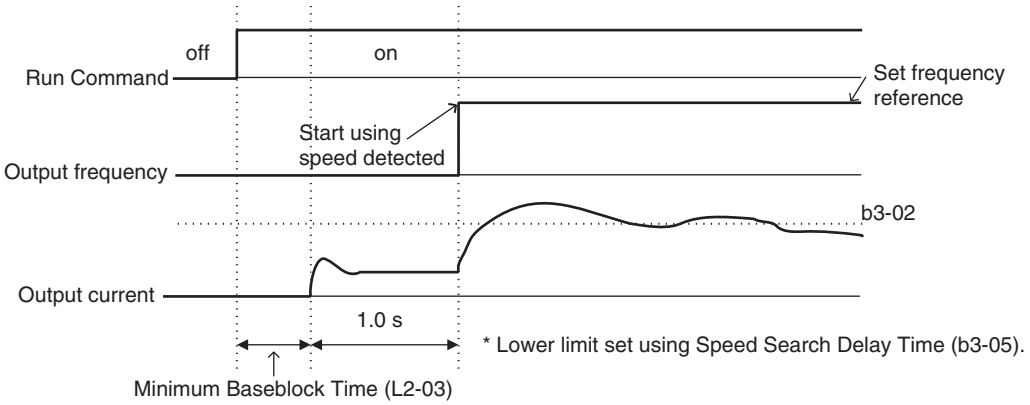
Search Name	Estimated Speed	Current Detection
Search Method	If the b3-14 (Bi-Directional Speed Search Selection) is set to 1 (enable), estimates the motor speed when the search starts, and accelerates and decelerates from the estimated speed to the set frequency. Also, the direction of motor rotation can be searched.	Starts speed search from the frequency when the temporary power loss was detected, or from the highest frequency, and performs speed detection at the current level during the search.
External Speed Search Command	External Search Command 1 and External Search Command 2 become the same operation, estimating the motor speed and starting the search from the estimated speed.	External Speed Search Command 1: Starts speed search from the maximum output frequency. External Speed Search Command 2: Starts speed search from the frequency reference set before the search command.
Application Precautions	Cannot be used multi-motor MxCs, motors two or more frames smaller than the MxC capacity, and high-speed motors (120 Hz min.)	In control method without a PG encoder, the motor may accelerate suddenly with light loads.

■Estimated Speed Search

The time chart for estimated speed searches is shown below.

Search at Startup

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



Note: If the stopping method is set to coast to stop, and the Run Command turns on in a short time, the operation may be the same as the search in External Speed Search Command 2.

Fig 6.43 Speed Search at Startup (Estimated Speed)

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

- Loss Time Shorter Than the Momentary Power Loss Minimum Baseblock Time (L2-03)

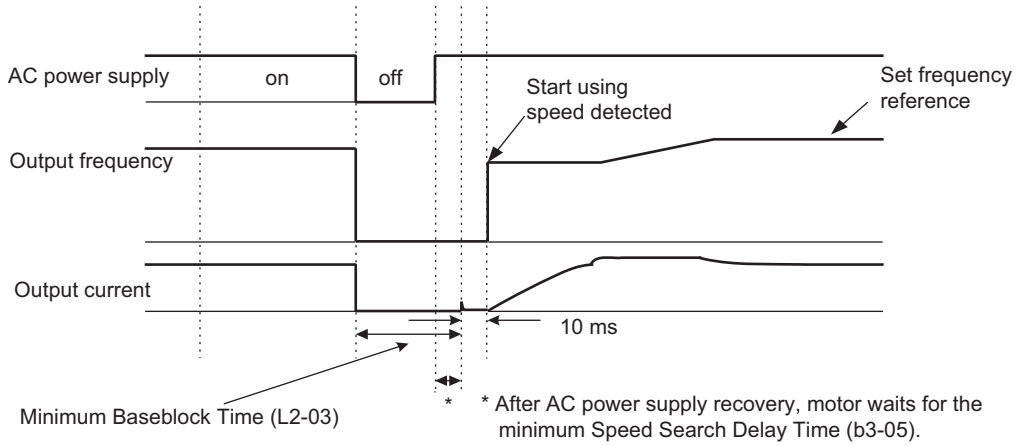
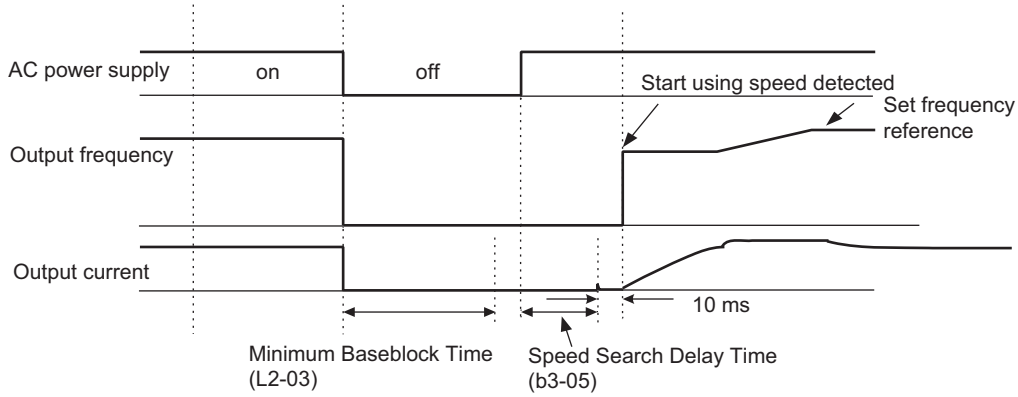


Fig 6.44 Speed Search after Baseblock (When Estimated Speed: Loss Time Is Set in L2-03)

• Power Loss Time Longer than the Momentary Power Loss Minimum Baseblock Time (L2-03)



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

Fig 6.45 Speed Search After Baseblock (Estimated Speed: Loss Time > L2-03)

■Current Detection Speed Search

The time charts for current detection speed search are shown below.

Speed Search at Startup

The time chart when speed search at startup or External Speed Search Command is selected is shown below.

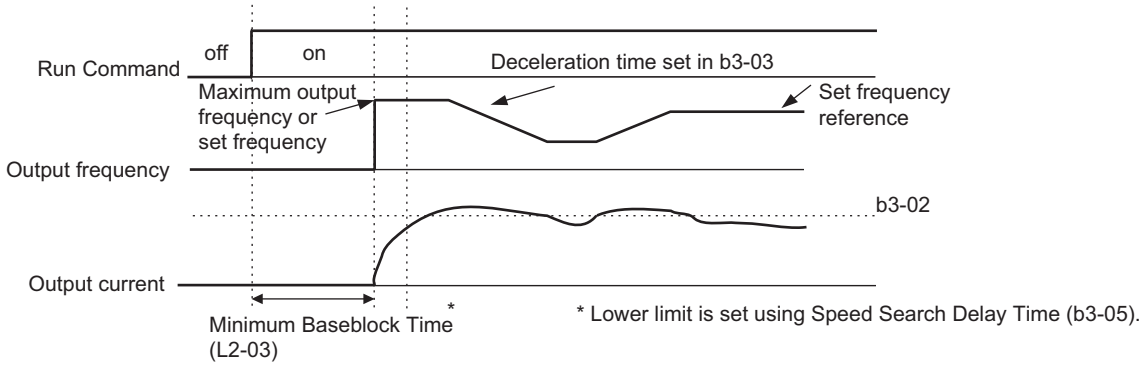


Fig 6.46 Speed Search at Startup (Using Current Detection)

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

• Loss Time Shorter Than Minimum Baseblock Time

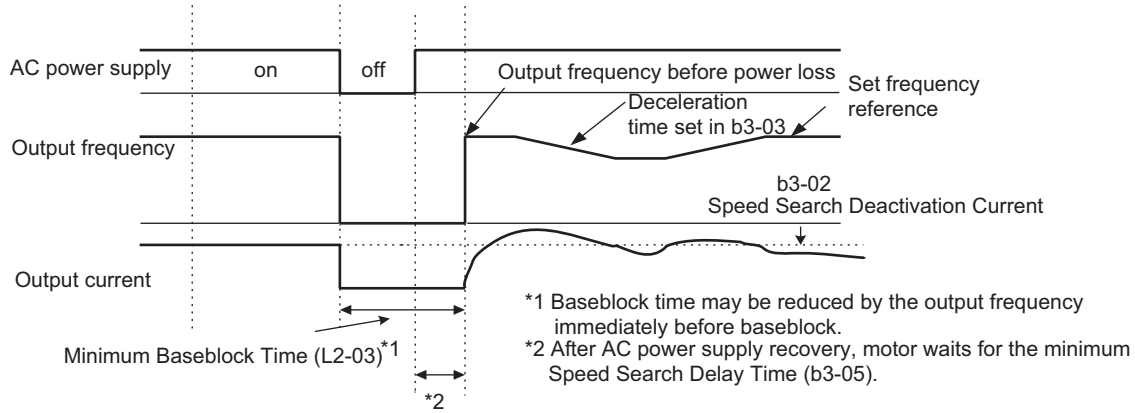


Fig 6.47 Speed Search after Baseblock (Current Detection: Loss Time < L2-03)

• Power Loss Time Longer than Minimum Baseblock Time

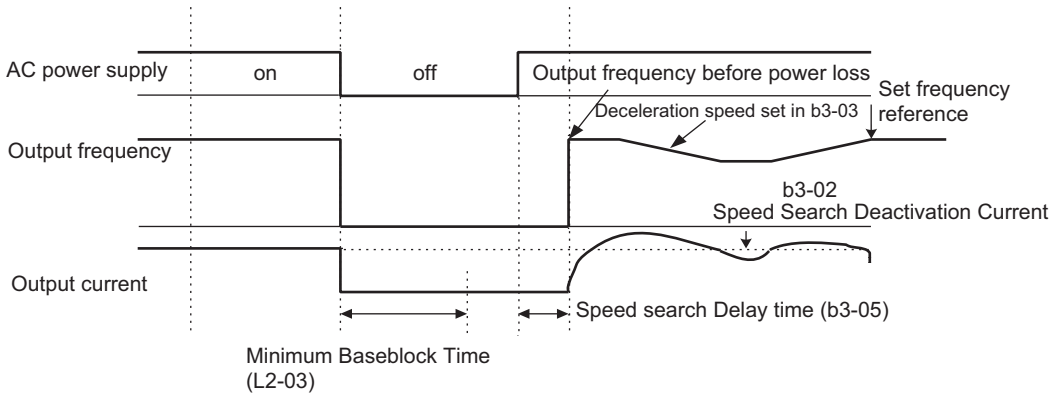


Fig 6.48 Speed Search After Baseblock (Current Detection: Loss Time > L2-03)

◆ Continue Running after Frequency Reference Loss

The frequency reference loss detection function continues operation using 80% speed of the frequency reference before loss when the frequency reference using an analog input is reduced 90% or more in 400 ms.

When the error signal during frequency reference loss is output externally, set H2-01 to H2-05 (Terminals M1-M2, P1-PC, P2-PC, P3-C3, and P4-C4 Function Selection) to C (frequency reference lost).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L4-05	Frequency Reference Loss Detection Selection / Ref Loss Sel	0: Stop (Operation follows the frequency reference.) 1: Operation at 80% speed continues. (At 80% of speed before the frequency reference was lost) Frequency reference is lost: Frequency reference dropped over 90% in 400 ms.	0 or 1	0	No	A	A	A

◆ Restarting Operation after Transient Fault (Auto-Restart Function)

If an MxC fault occurs during run, the MxC will perform a self-diagnosis. If no fault is detected, the MxC will automatically restart. This is called the auto restart function.

Set the number of auto restarts in parameter L5-01. A fault reset is carried out every 5 ms after the minimum baseblock time has passed. The counter counts the number of times that the operation is restarted after the fault is reset. If the fault is not reset after executing the number of auto restarts set in L5-01, the protection function will be activated.

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)
- OV (Main circuit overvoltage)
- AOV (Main circuit overvoltage)
- LF (Output phase failure)
- OL1 (Motor overload)
- OH1 (Motor overheat)
- OL3 (Overtorque)
- OL4 (Overtorque)

■Auto Restart External Outputs

To output auto restart signals externally, set H2-01 to H2-05 (Terminals M1-M2, P1-PC, P2-PC, P3-C3, and P4-C4 Function Selection) to 1E (auto restart).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L5-01	Number of Auto Restart Attempts / Num of Restarts	Sets the number of auto restart attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A	A	A
L5-02	Auto Restart Operation Selection / Restart Sel	Sets whether a fault contact output is activated during fault restart. 0: Not output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A	A	A

■ 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 with variable loads.

MxC Protection

This section explains the functions for protecting the MxC.

◆ Reducing MxC Overheating Pre-Alarm Warning Levels

The MxC detects the temperature of the heatsink using the thermistor, and protects the MxC from overheating. The MxC overheating pre-alarms will occur in units of 1°C.

The following overheating pre-alarm warnings are available: Stopping the MxC as error protection, and continuing operation with the alarm OH (Radiation fins overheating) on the digital operator flashing.

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
L8-02	Overheat Alarm Level OH Pre-Alarm Lvl	When the cooling fin temperature exceeds the value set in this parameter, an Overheat Alarm (OH) will occur.	50 to 130	90 °C*	No	A	A	A
L8-03	Overheat Pre-Alarm Operation Selection OH Pre-Alarm Sel	Selects the MxC operation upon an OH pre-alarm detection. 0: Decelerate to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	No	A	A	A

* The default depends upon the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

Input Terminal Functions

This section explains input terminal functions, which set operating methods by switching functions for the multi-function digital input terminals (S3 to S12).

◆ Temporarily Switching Operation between Digital Operator and Control Circuit Terminals

Switch the MxC Run Command inputs and frequency reference inputs between local (i.e., digital operator) and remote (input method using b1-01 and b1-02).

Switch between local and remote by turning on and off the terminals if an output from H1-01 to H1-10 (Terminal S3 to S12 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 Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b1-01	Frequency Reference Selection / Reference Source	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q
b1-02	Run Command Selection / Run Source	Selects the Run Command input source. 0: Operator - RUN and STOP keys on digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q

INFO

Switch local or remote 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 MxC Outputs (Baseblock Commands)

Set 8 or 9 (Baseblock Command NO/NC) in one of the parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection) to perform Baseblock Commands using the terminal's on/off operation, and prohibit MxC output using the Baseblock Commands.

Clear the Baseblock Command to restart the operation using speed search from frequency references from the previous Baseblock Command input.

Multi-Function Digital Inputs (H1-01 to H1-10)

Set Value	Function	Control Methods		
		V/f	Open Loop Vector	Flux Vector
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.

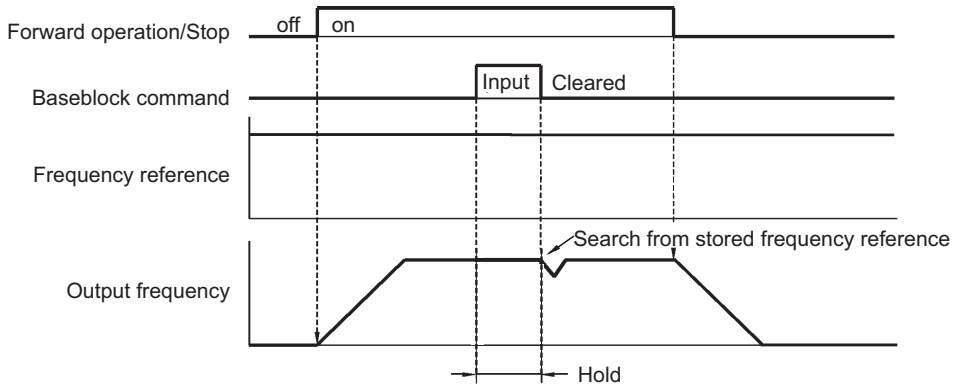


Fig 6.49 Baseblock Commands

IMPORTANT

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

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

The accel/decel ramp hold function stops acceleration and deceleration, stores the output frequency at that point in time, and then continues operation.

Set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection) to A (accel/decel ramp hold) to stop acceleration and deceleration when the terminal is turned on and to store the 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 Accel/Decel Ramp Hold Command is input, the output frequency is still stored even after the power supply is turned off.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d4-01	Frequency Reference Hold Function Selection / MOP Ref Memory	Sets whether or not frequencies 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 frequency.) This function is available when the multi-function inputs "accel/decel Ramp Hold" or "up/down" commands are set.	0 or 1	0	No	A	A	A

■Time Chart

A time chart for the Accel/Decel Ramp Hold Commands appears below.

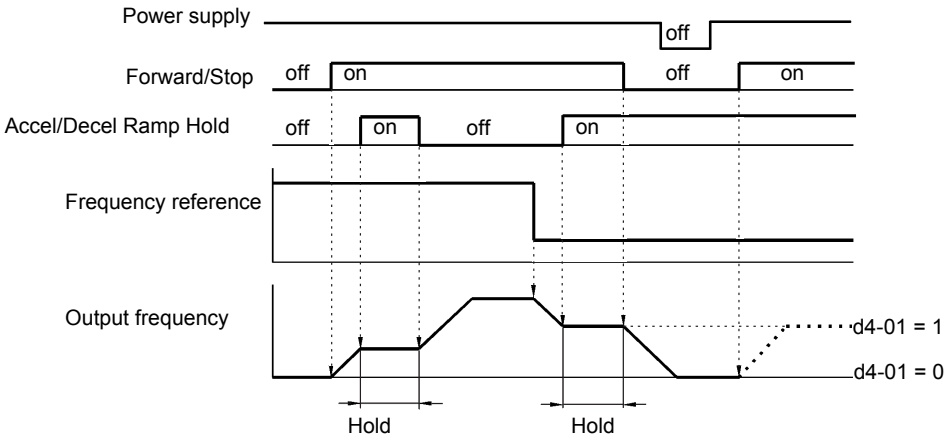


Fig 6.50 Accel/Decel Ramp Hold

■Application Precautions

- When d4-01 is set to 1, the output frequency on hold is stored even after the power supply is turned off. If performing operations using this frequency after the MxC has also been turned off, input the Run Command with the Accel/Decel Ramp Hold turned on.
- When d4-01 is set to 0 and a Run Command is input while the Accel/Decel Ramp Hold is turned on, the output frequency will be set to zero.
- If an Accel/Decel Ramp Hold Command is entered by mistake when decelerating during positioning, deceleration may be canceled.

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

The UP and DOWN Commands raise and lower MxC frequency references by turning on and off multi-function digital input terminal S3 to S7.

To use this function, set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 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 output frequency depends on the acceleration and deceleration time. Be sure to set b1-02 (Run Command selection) to 1 (Control circuit terminal).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d2-01	Frequency Reference Upper Limit / Ref Upper Limit	Set the output frequency upper limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0%	No	A	A	A
d2-02	Frequency Reference Lower Limit / Ref Lower Limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	A	A
d2-03	Master Speed Reference Lower Limit / Ref1 Lower Limit	Set the master speed reference lower limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A	A	A

■Precautions

When setting and using UP and DOWN Commands, observe the following precautions.

Setting Precautions

If multi-function input terminals S3 to S12 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 Accel/Decel Ramp Hold have been allocated at the same time.

Application Precautions

- Frequency outputs using UP/DOWN Commands are limited by the frequency reference upper and lower limits set in parameters d2-01 to d2-03. Here, frequency references from analog frequency reference terminal A1 becomes the frequency reference lower limit. If using a combination of the frequency reference from terminal A1 and the frequency reference lower limit set in either parameter d2-02 or d2-03, the larger lower limit will become the frequency reference lower limit.
- If inputting the Run Command when using Up/Down Commands, the output frequency accelerates to the frequency reference lower limit.
- When using Up/Down Commands, multi-step operations are disabled.
- When d4-01 (Frequency Reference Hold Function Selection) is set to 1, the frequency reference 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 frequency reference that has been stored. To reset (i.e., to 0 Hz) the stored frequency reference, turn on the UP or DOWN Command while the Run Command is on.

■Connection Example and Time Chart

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

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

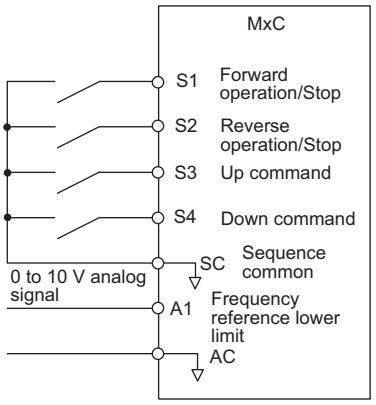
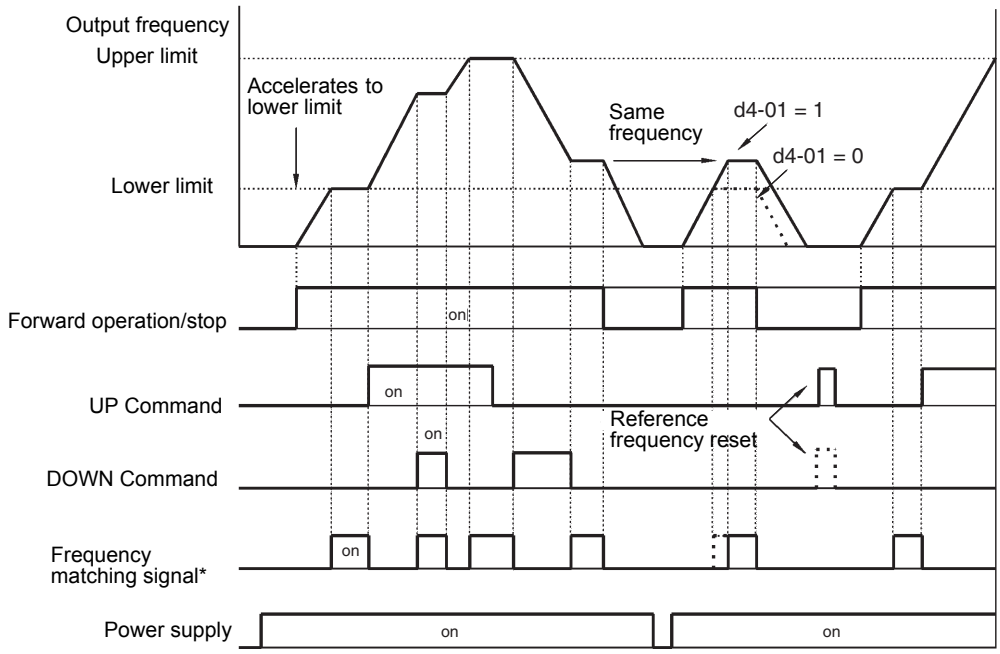


Fig 6.51 Connection Example when UP/DOWN Commands Are Allocated



* The frequency matching signal turn on when the motor is not accelerating/ decelerating while the Run Command is on.

Fig 6.52 UP/DOWN Commands Time Chart

◆ Accelerating and Decelerating Parameter Frequencies in the Analog References (+/- Speed)

The +/- speed function increments or decrements the frequency set in analog frequency reference d4-02 (Trim Control Level) using two contact signal inputs.

To use this function, set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 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 Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d4-02	Trim Control Level Trim Control Lvl	Set the frequency to be added to or subtracted from the analog frequency reference as a percent, taking the maximum output frequency to be 100%. Enabled when the increase (+) speed command or decrease (-) speed command is set for a multi-function input.	0 to 100	10%	No	A	A	A

■Trim Control Increase/Decrease Command and Frequency Reference

The frequency references using Trim Control Increase/Decrease Command on/off operations are shown below.

Frequency Reference	Set Frequency Reference + d4-02	Set Frequency Reference - d4-02	Set Frequency 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 frequency reference value - d4-02 < 0, the frequency reference is set to 0.
- If only the Trim Control Increase Command or Trim Control Decrease Command has been set for a multi-function digital input terminal S3 to S12, operation error OPE03 (invalid multi-function input selected) will occur.

◆ Hold Analog Frequency Using User-set Timing

When one of H1-01 to H1-10 (Terminal S3 to S12 Function Selection) is set to 1E (Sample/Hold Analog Frequency Command), the analog frequency reference will be held from 100 ms after the terminal is turned on, and operation will continue thereafter at that frequency.

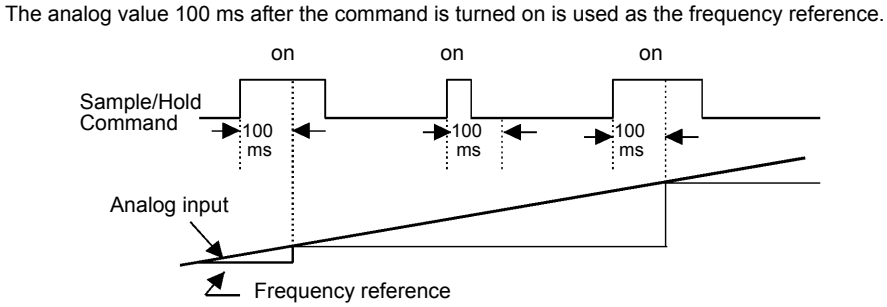


Fig 6.53 Sample/Hold Analog Frequency

■Precautions

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

Setting Precautions

When using sample/hold of analog frequency reference, the following commands cannot be used at the same time. If these commands are used at the same time, operation error OPE03 (invalid multi-function input selection) will occur.

- Accel/Decel Ramp Hold Command
- UP/DOWN Command
- Trim Control Increase/Decrease Command

Application Precautions

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

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

Switch reference input between the Communications Option Card and the control circuit terminals. Set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection) to 2 (Option/MxC selection) to enable switching reference input using the terminal on/off status when the MxC is stopped.

■Setting Precautions

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

- Set b1-01 (Frequency Reference Selection) to 1 [Control circuit terminal (analog input)]
- Set b1-02 (Run Command Selection to 1 [Control circuit terminal (sequence inputs)]
- Set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection) to 2 (Option/MxC selection).

Terminal Status	Frequency Reference and Run Command Selection
off	MxC (Can be operated from frequency reference or control circuit terminal from analog input terminal).
on	Communications Option Card (Frequency reference and Run Command are enabled from Communications Option Card).

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

The FJOG/RJOG Command functions operate the MxC using jog frequencies by using the terminal on/off operation. When using the FJOG/RJOG Commands, there is no need to input the Run Command.

To use this function, set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection) to 12 (FJOG Command) or 13 (RJOG Command).

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Open Loop Vector	Flux Vector
d1-17	Jog Frequency Reference Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is on (unit: Set in o1-03).	0 to 120.00	6.00 Hz	Yes	Q	Q	Q

Note: The unit is set in o1-03 (Digital Operator Display Selection). The default for o1-03 is 0 (increments of 0.01 Hz).

multi-function digital Inputs (H1-01 to H1-10)

Set Value	Function	Control Methods V/f	Open Loop Vector	Flux Vector
12	FJOG Command (ON: Forward run at jog frequency d1-17)	Yes	Yes	Yes
13	RJOG Command (ON: Reverse run at jog frequency d1-17)	Yes	Yes	Yes

■Application Precautions

- Jog frequencies using FJOG and RJOG Commands are given priority over other frequency references.
- When both FJOG Command and RJOG Commands are on for 500 ms or longer at the same time, the MxC stops according to the setting in b1-03 (Stopping Method Selection).

◆ Stopping the MxC by Notifying Programming Device Errors to the MxC (External Fault Function)

The external fault function performs the error contact output, and stops the MxC operation if the MxC 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 parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection).

Select the value to be set in H1-01 to H1-10 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	Parameter Detection	Detection during Run	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 parameter detection or detection during run.
Parameter detection: Detects while power is supplied to the MxC.
Detection during run: Detects only during MxC operation.

Output Terminal Functions

The output terminal function, which sets the output methods by switching the functions of the multi-function output terminals (M1-M2, P1-PC, P2-PC, P3-C3, and P4-C4), is described here.

During Run (Setting: 0)

off	The Run Command is off and there is no output voltage.
on	The Run Command is on or a voltage is being output.

During Run 2 (Setting: 37)

off	The MxC is not outputting a frequency. (Baseblock, DC injection braking, initial excitation, or stopped)
off	The MxC is outputting a frequency.

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

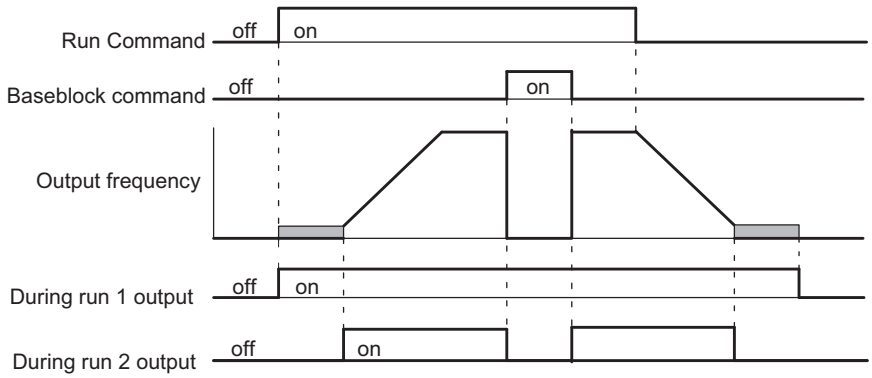


Fig 6.54 Timing Chart for “During Run” Output

Zero-speed (Setting: 1)

off	The output frequency is greater than the Minimum Output Frequency (E1-09). (With Flux Vector Control motor speed is greater than the DC Injection Braking Start Frequency (b2-01).)
on	The output frequency is less than the Minimum Output Frequency (E1-09). (With Flux Vector Control motor speed is less than the zero-speed level DC Injection Braking Start Frequency (b2-01).)

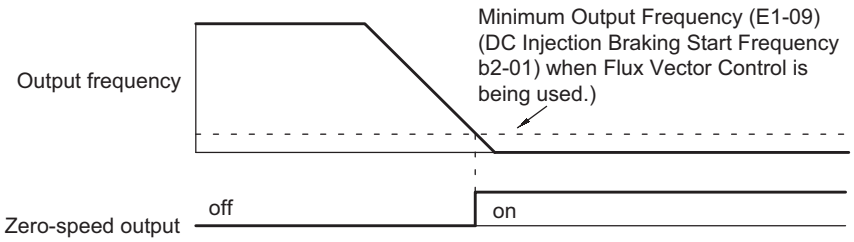


Fig 6.55 Timing Chart for Zero-Speed

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.

MxC 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 (Overheating Alarm Level).

Speed Reference Limit (Setting: 31)

off	Any time this switch in not on.
on	Enables the speed reference limit in the following conditions (in Flux Vector Control): 1. Frequency reference ≥ Frequency Reference Upper Limit (d2-01) Frequency reference ≤ Frequency Reference Lower Limit (d2-02) Frequency reference ≥ Output frequency lower limit of the multi-function analog input (Setting: 9) 2. The frequency reference is less than the Min. Output Frequency (E1-09), and b1-05 is set to 1, 2, or 3.

Zero-Servo End (Setting: 33)

off	The Zero-Servo Command isn’t being input or zero-servo position control hasn’t been completed.
on	The position has been brought within the Zero Servo Completion Width (b9-02) after the Zero-Servo Command was input.

- This output function indicates that zero-servo position control has been completed.
- The output is turned on after the Zero-Servo Command is input and the difference between the zero-servo operation starting position and the current position is within the Zero Servo Completion Width (b9-02).

Monitor Parameters

This section explains the analog monitor and pulse monitor parameters.

◆ Using the Analog Monitor Parameters

This section explains the analog monitor parameters.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
H4-01	Terminal FM Monitor Selection / Terminal FM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal FM. Items that can be set differ in accordance with the selected control modes. For information on the parameters for which analog output is possible, refer to *U: Monitors*.	1 to 99	2	No	A	A	A
H4-02	Terminal FM Gain Setting / Terminal FM Gain	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.*	0.00 to 2.50	1.00	Yes	Q	Q	Q
H4-03	Terminal FM Bias Setting / Terminal FM Bias	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.*	-10.0 to +10.0	0.0%	Yes	A	A	A
H4-04	Terminal AM Monitor Selection / Terminal AM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal AM. Items that can be set differ in accordance with the selected control modes. For information on the parameters for which analog output is possible, refer to *U: Monitors*.	1 to 99	3	No	A	A	A
H4-05	Terminal AM Gain Setting / Terminal AM Gain	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.*	0.00 to 2.50	0.50	Yes	Q	Q	Q
H4-06	Terminal AM Bias Setting / Terminal AM Bias	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.*	-10.0 to +10.0	0.0%	Yes	A	A	A
H4-07	Terminal FM Signal Level Selection / AO Level Select 1	Sets the signal output level for multi-function output 1 (terminal FM) 0: -10 to 10 VDC output 1: -10 to 10 VDC output	0 or 1	0	No	A	A	A

* If the setting display of H4-02 or H4-03 appear when the motor is not rotating in the Quick, Advanced, or Verify Mode, the FM output can be adjusted. If the setting display of H4-05 or H4-06 appear when the motor is not rotating in the Quick, Advanced, or Verify Mode, the AM output can be adjusted. For analog output, multiple gain 100% of the output the items that can be monitored.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
F4-01	AO-08/AO-12 Channel 1 Monitor Selection AO Ch1 Select	Effective when the Analog Monitor Card is used. Monitor selection: Set the number of the monitor item to be output. (U1-□□) Items that can be set differ in accordance with the selected control modes. Gain: Set the multiple of 10 V for outputting monitor items. For information on the parameters for which analog output is possible, refer to *U: Monitors*. When the AO-12 Analog Monitor Card is used, outputs of ± 10 V are possible. To output ± 10 V, set F4-07 or F4-08 to 1. When the AO-08 Analog Monitor Card is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.*	1 to 99	2	No	A	A	A
F4-02	AO-08/AO-12 Channel 1 Gain AO Ch1 Gain		0.00 to 2.50	1.00	Yes	A	A	A
F4-03	AO-08/AO-12 Channel 2 Monitor Selection AO Ch2 Select		1 to 99	3	No	A	A	A
F4-04	AO-08/AO-12 Channel 2 Gain AO Ch2 Gain		0.00 to 2.50	0.50	Yes	A	A	A
F4-05	AO-08/AO-12 Channel 1 Output Bias AO Ch1 Bias	Sets the channel 1 item bias to 100%/10 V when the Analog Monitor Card is used.	-10.0 to 10.0	0.0	Yes	A	A	A
F4-06	AO-08/AO-12 Channel 2 Output Bias AO Ch2 Bias	Sets the channel 2 item bias to 100%/10 V when the Analog Monitor Card is used.	-10.0 to 10.0	0.0	Yes	A	A	A
F4-07	AO-12 Channel 1 Signal Level AO Opt Level Sel	0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A
F4-08	AO-12 Channel 2 Signal Level AO Opt Level Sel	0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A

* If the setting display of F4-02 or F4-05 appears when the motor is not rotating in the Quick, Advanced, or Verify Mode, the CH1 output can be adjusted. If the setting display of F4-04 or F4-06 appear when the motor is not rotating in the Quick, Advanced, or Verify Mode, the CH2 output can be adjusted. For analog output, multiple gain 100% of the output the items that can be monitored.

■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 Parameters and Settings*, and set the values for the □□ part of U1-□□ (status monitor).

Alternatively, monitor items (U1-□□ [status monitor]) will be outputted from analog output option terminal channels 1 and 2 on analog monitor cards AO-08 and AO-12. Refer to the table of parameters, 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 MxC 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 V/100% monitor output × output gain (H4-02) + 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 V/100% monitor output × output gain (F4-02) + output bias (F4-05)

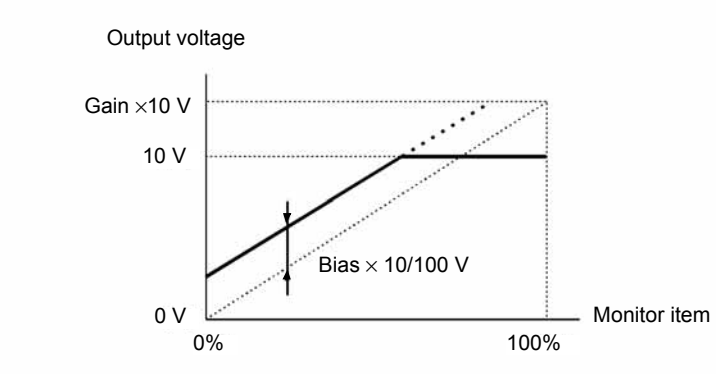


Fig 6.56 Monitor Output Adjustment

■Switching Analog Monitor Signal Levels

Monitor items corresponding to -10 V 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 V to +10 V, refer to *Chapter 5 Parameters and Settings*.

INFO

Select the signal levels separately for multi-function analog output terminals and analog output option terminals.

Individual Functions

This section explains the individual functions used in special applications.

◆ Using MEMOBUS Communications

The serial communications with MEMOCON-series Programmable Controllers (PLCs) or similar devices can be performed 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, be sure to 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.

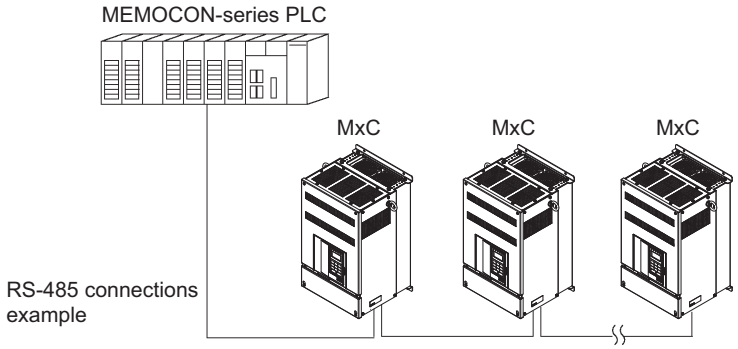


Fig 6.57 Example of Connections between PLC and MxC

■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 1200, 2400, 4800, 9600, and 19200 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 MxC only, as seen from the PLC.

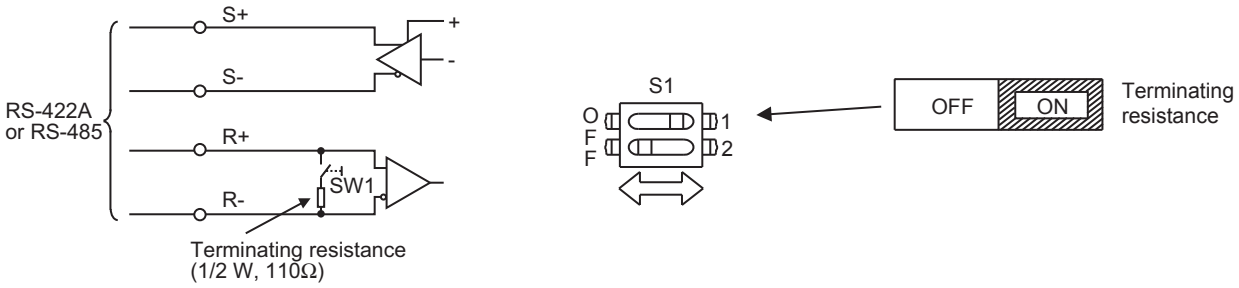
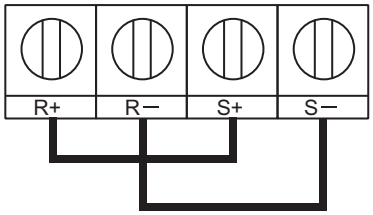


Fig 6.58 Communications Connection Terminal

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 MxC 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 MxC exterior.



■Procedure for Communicating with the PLC

Use the following procedure to perform communications with the PLC.

1. Turn off the power supply and connect the communication cable between the PLC and the MxC.
2. Turn on the power supply.
3. Set the required communications parameters (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 Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
b1-01	Frequency Reference Selection / Reference Source	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q
b1-02	Run Command Selection / Run Source	Selects the Run Command input source. 0: Operator - RUN and STOP keys on digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+, and S-. 3: Option PCB - Option card connected on 2CN.	0 to 3	1	No	Q	Q	Q
H5-01	MxC Node Address / Serial Comm Adr	Set the MxC's station address.	0 to 20 *	1F	No	A	A	A
H5-02	Communication Speed Selection / Serial Baud Rate	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
H5-03	Communication Parity Selection / Serial Com Sel	Set the parity for MEMOBUS communications of CN6. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	A	A
H5-04	Stopping Method After Communication Error / Serial Fault Sel	Set the stopping method for communications errors. 0: Deceleration to stop 1: Coast to stop 2: Emergency stop 3: Continue operation	0 to 3	3	No	A	A	A
H5-05	Communication Fault Detection Selection / Serial Flt Dtct	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
H5-06	MxC Transmit Wait Time / Transmit Wait-TIM	Set the time from the MxC receiving data to when the MxC starts to send.	5 to 65	5 ms	No	A	A	A
H5-07	RTS Control Selection / RTS Control Sel	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

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
H5-10	Unit Selection for Memobus Register 0025H / MEMOBUS 25H UNIT	Selects the units used for MEMOBUS registry 0025H (monitors the output voltage reference). 0: 0.1 V units 1: 1 V units	0 or 1	0	No	A	A	A

* Set H5-01 to 0 to disable MxC 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 parameters
- 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 digital input terminals S3 to S12.

■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.

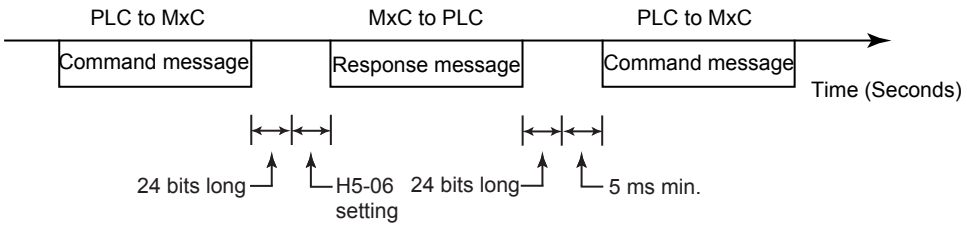


Fig 6.59 Message Spacing

Slave Address

Set the MxC address from 0 to 32 Hex. If the address is set 0, commands from the master will be broadcast (i.e., the MxC 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 default for CRC-16 communications is usually 0, but when using the MEMOBUS system, set the default 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 upper 8 bits and lower 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 MxC.

Command Message

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

Response Message (During Normal Operation)

Slave Address		02H
Function Code		03H
Data quantity		08H
Lead storage register	Upper bit	00H
	Lower bit	65H
Next storage register	Upper bit	00H
	Lower bit	00H
Next storage register	Upper bit	00H
	Lower bit	00H
Next storage register	Upper bit	01H
	Lower bit	F4H
CRC-16	Upper bit	AFH
	Lower bit	82H

Response Message (During Error)

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

Loopback Test

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

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

Command Message

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

Response Message (During Normal Operation)

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

Response Message (During Error)

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

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: upper 8 bits, then lower 8 bits, in storage register address order.

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

Command Message

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

Response Message (During Normal Operation)

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

Response Message (During Error)

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

INFO

Set the number of data specified using command messages as quantity of specified messages × 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	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	Multi-Function Input Command 9
	Bit D	Multi-Function Input Command 10
	Bit E	Multi-Function Input Command 11
	Bit F	Multi-Function Input Command 12
0002H	Frequency reference (Set units using parameter o1-03)	
0003H	Not used	
0004H	Not used	
0005H	Not used	
0006H	PID target value	
0007H	Analog output 1 setting (-11 V/-1540 to 10 V/1540)	
0008H	Analog output 2 setting (-11 V/-1540 to 11 V/1540)	
0009H	Multi-function digital 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	PHC3 (Contact P3-C3) 1: on 0: off
	Bit 4	PHC4 (Contact P4-C4) 1: on 0: off
	Bit 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
	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	MxC status	
	Bit 0	Operation 1: Operating 0: Stopped
	Bit 1	Reverse operation 1: Reverse operation 0: Forward operation
	Bit 2	MxC startup complete 1: Completed 2: Not completed
	Bit 3	Error 1: Error
	Bit 4	Data setting error 1: Error
	Bit 5	Multi-function digital 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
	Bit 8	Multi-function PHC output 3 (terminal P3 - C3) 1: on 0: off
	Bit 9	Multi-function PHC output 4 (terminal P4 - C4) 1: on 0: off
	Bits A and B	Not used
0021H	Error details	
	Bit 0	Overcurrent (OC) Ground fault (GF)
	Bit 1	Control circuit overvoltage (OV), or input power overvoltage (AOV)
	Bit 2	MxC overload (OL2)
	Bit 3	MxC overheat (OH1, OH2)
	Bit 4	Built-in resistor overheat (SOH, DOH)
	Bit 5	Not used
	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 disconnect (PGO), Overspeed (OS), Speed deviation (DEV)
	Bit B	Control circuit undervoltage (UV) detected, input voltage undervoltage (AUV) detected, power frequency error (FDV) detected
	Bit C	Control circuit undervoltage (UV1), control power supply error (UV2), input power frequency error (FDV), input power undervoltage (AUV), or input power rotation variation error (SRC)
	Bit D	Output phase loss (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	Frequency reference (U1-01)	
0024H	Output frequency (U1-02)	
0025H	Output voltage reference (U1-06)	
0026H	Output current (U1-03)	
0027H	Output power (U1-08)	
0028H	Torque reference (U1-09)	
0029H	Not used	
002AH	Not used	

Register No.	Contents		
002BH	Sequence input status		
	Bit 0	1: Control circuit terminal S1 on	
	Bit 1	1: Control circuit terminal S2 on	
	Bit 2	1: Control circuit terminal S3 on	
	Bit 3	1: Control circuit terminal S4 on	
	Bit 4	1: Control circuit terminal S5 on	
	Bit 5	1: Control circuit terminal S6 on	
	Bit 6	1: Control circuit terminal S7 on	
	Bit 7	1: Control circuit terminal S8 on	
	Bit 8	1: Control circuit terminal S9 on	
	Bit 9	1: Control circuit terminal S10 on	
	Bit A	1: Control circuit terminal S11 on	
	Bit B	1: Control circuit terminal S12 on	
	Bits C to F	Not used	
002CH	MxC status		
	Bit 0	Operation	1: Operating
	Bit 1	Zero-speed	1: Zero-speed
	Bit 2	Frequency matching	1: Matched
	Bit 3	User-defined speed matching	1: Matched
	Bit 4	Frequency detection 1	
	Bit 5	Frequency detection 2	
	Bit 6	MxC startup completed	1: Startup completed
	Bit 7	Low voltage detection	1: Detected
	Bit 8	Baseblock	1: MxC output baseblock
	Bit 9	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	Frequency reference lost	1: Lost
	Bit D	Restarting error	1: Restarting
	Bit E	Error (including MEMOBUS communications time-out) 1:Error occurred	
	Bit F	MEMOBUS communications timeout 1: Timed out	
002DH	Multi-function digital output status		
	Bit 0	Multi-function digital 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	
	Bit 3	Multi-function PHC output 3 (terminal P3 - C3) 1: on 0: off	
	Bit 4	Multi-function PHC output 4 (terminal P4 - C4) 1: on 0: off	
	Bits 5 to F	Not used	
002EH - 0030H	Not used		
0031H	Main circuit DC voltage		
0032H	Torque monitor		
0033H	Output power (U1-08)		
0034H - 0037H	Not used		
0038H	PID feedback quantity (Input equivalent to 100%/Max output frequency, 10/1%, without sign)		
0039H	PID input quantity (±100%/±Max output frequency, 10/1%, signed)		
003AH	PID output quantity (±100%/±Max output frequency, 10/1%, signed)		
003BH	CPU software number		
003CH	Flash software number		

Register No.	Contents	
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 an 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 digital input terminal S5 input
	Bit D	Multi-function digital input terminal S6 input
	Bit E	Multi-function digital input terminal S7 input
	Bit F	Multi-function digital 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 parameters to the MxC from the PLC using MEMOBUS communications, the parameters are temporarily stored in the parameter data area in the MxC. To enable these parameters in the parameter data area, use the ENTER Command.

There are two types of ENTER Commands: ENTER Commands that enable parameter data in RAM, and ENTER Commands that write data to EEPROM (non-volatile memory) in the MxC 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 parameter data to EEPROM
0910H	Parameter data is not written to EEPROM, but refreshed in RAM only.

INFO

EEPROM can be written to from MxC a maximum of 100,000 times. Refrain from writing excessively to the EEPROM using the Enter Commands (0900H).
The ENTER Command registers are write-only. Consequently, if reading these registers, the register address will become invalid (Error code: 02H).

■Error Codes

The following table shows MEMOBUS communications error codes.

Error Code	Contents
01H	Function code error A function code other than 03H, 08H, or 10H has been set by the PLC.
02H	Invalid register number error • The register address is not recorded anywhere. • With broadcast sending, a start address other than 0000H, 0001H, or 0002H has been set.
03H	Invalid quantity error • The number of data packets being read or written is outside the range 1 to 16. • In Write Mode, the number of data packets in the message is not number of packets × 2.
21H	Data setting error • A simple upper limit or lower limit error has occurred in the control data or when writing parameters. • When writing parameters, the parameter setting is invalid.
22H	Write Mode error • Attempting to write parameters from the PLC during run. • Attempting to write via ENTER Commands from the PLC during run. • Attempting to write parameters 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 control circuit undervoltage (UV) error • Writing parameters from the PLC during UV (control circuit undervoltage) alarm. • Writing via ENTER Commands from the PLC during UV (control circuit undervoltage) alarm.
24H	Writing error during parameters processing Attempting to write parameters from the PLC while processing parameters in the MxC.

■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 MxC 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 slave devices. 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 MxC has a built-in function for analyzing any problems in the 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 MxC, 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 MxC, and set 67 (Communications Test Mode) in parameter H1-05 (Multi-Function Digital Input Terminal S7 Function Selection).
2. Turn off the power supply to the MxC.
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 MxC again.

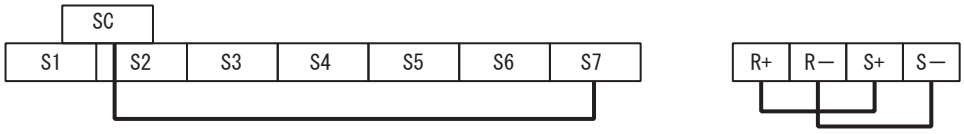


Fig 6.60 Details of Communications Terminals

"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 MxC operation ready signal will be turned off.

◆ Using the Timer Function

Multi-function digital input terminals S3 to S12 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, chattering from the sensors and switches can be erased.

- Set one of the parameters H1-01 to H1-10 (Terminal S3 to S12 Function Selection) to 18 (timer function input).
- Set H2-01 to H2-03 (Terminals M1-M2, P1-PC, P2-PC, P3-C3, and P4-C4 Function Selection) to 12 (timer function output).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b4-01	Timer Function ON-Delay Time / Delay-ON Timer	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	A	A	A
b4-02	Timer Function OFF-Delay Time / Delay-OFF Timer	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	A	A	A

■Setting Example

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

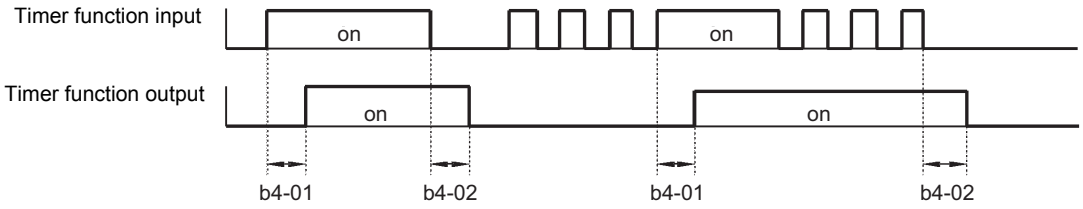


Fig 6.61 Timer Function Operation Example

◆ 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), targets (machinery) with play time can be controlled.

The characteristics of the PID control operations are given below.

- P control: Outputs the amount of operation proportional to the deviation. The deviation can not be set 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.

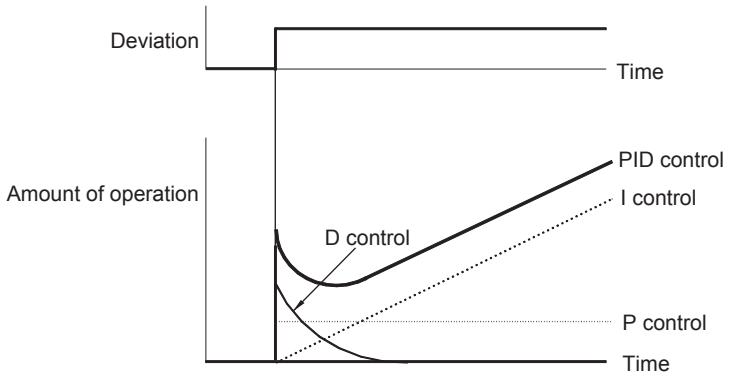


Fig 6.62 PID Control Operation

■PID Control Applications

The following table shows examples of PID control applications using the MxC.

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

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
b5-01	PID Function Setting / PID Mode	0: Disabled 1: Enabled (Deviation is D-controlled.) 2: Enabled (Feedback value is D-controlled.) 3: PID control enabled (frequency reference + PID output, D control of deviation) 4: PID control enabled (frequency reference + PID output, D control of feedback value).	0 to 4	0	No	A	A	A
b5-02	Proportional Gain Setting / PID Gain	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	A	A
b5-03	Integral Time Setting / PID I Time	Sets I-control integral time in 1-second units. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A	A	A
b5-04	Integral Limit Setting / PID I Limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	A	A
b5-05	Derivative Time / PID 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	A	A	A
b5-06	PID Output Limit / PID Limit	Sets the upper limit after PID-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	A	A
b5-07	PID Offset Adjustment / PID Offset	Sets the offset after PID-control as a percentage of the maximum output frequency.	-100.0 to +100.0	0.0%	Yes	A	A	A
b5-08	PID Primary Delay Time Constant / PID Delay Time	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	A	A	A
b5-09	PID Output Level Selection / Output Level Sel	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	A	A	A

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
b5-10	PID Output Gain Setting / Output Gain	Sets output gain.	0.0 to 25.0	1.0	No	A	A	A
b5-11	PID Output Reverse Selection / Output Rev Sel	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	A	A	A
b5-12	PID Feedback Reference Missing Detection Selection / Fb los Det Sel	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	A	A	A
b5-13	PID Feedback Loss Detection Level / Fb los Det Lvl	Sets the PID feedback loss detection level as a percent units, with the maximum output frequency at 100%.	0 to 100	0%	No	A	A	A
b5-14	PID Feedback Loss Detection Time / Fb los Det Time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A	A	A
b5-15	PID Sleep Function Start Level / PID Sleep Level	Set the PID sleep function start level as a frequency.	0.0 to 120.0	0.0 Hz	No	A	A	A
b5-16	PID Sleep Delay Time / PID Sleep Time	Set the delay time until the PID sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	A	A	A
b5-17	PID Accel/Decel Time / PID Acc/Dec Time	Set the accel/decel time for PID reference in seconds.	0.0 to 25.5	0.0 s	No	A	A	A

Monitor Functions

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
U1-24	PID feedback value / PID Feedback	Monitors the feedback value when PID control is used. The input for the max frequency corresponds to 100%.	10 V: Max frequency (-10 V to +10 V possible)	0.01 %	A	A	A
U1-36	PID input volume / PID Input	PID feedback volume Given as maximum frequency/100%	10 V: Max frequency (-10 V to +10 V possible)	0.01 %	A	A	A
U1-37	PID output volume / PID Output	PID control output Given as maximum frequency/100%	10 V: Max frequency (-10 V to +10 V possible)	0.01 %	A	A	A
U1-38	PID target value / PID Setpoint	PID target value Given as maximum frequency/100%	10 V: Max frequency	0.01 %	A	A	A

Multi-Function Digital Inputs (H1-01 to H1-10)

Set Value	Function	Control Methods		
		V/f	Open Loop Vector	Flux Vector
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	Yes	Yes	Yes
35	PID input characteristics switch	Yes	Yes	Yes

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

Set Value	Function	Contents (100%)	Control Methods		
			V/f	Open Loop Vector	Flux Vector
B	PID feedback	Maximum output frequency	Yes	Yes	Yes
C	PID target value	Maximum output frequency	Yes	Yes	Yes

■PID Control Methods

There are four PID control methods. Select the method by setting parameter b5-01.

Set Value	Control Method
1	PID output becomes the MxC output frequency, and D control is used in the difference between PID target value and feedback value.
2	PID output becomes the MxC output frequency, and D control is used in the PID feedback value.
3	PID output is added as compensation value of the MxC 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 MxC output frequency, and D control is used in the PID feedback value.

■PID Input Methods

Enable PID control using parameter 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 (Frequency Reference Selection).

Normally, the frequency reference selected in b1-01 is the PID target value, but the PID target value can be changed as shown in the following table.

PID Target Input Method	Setting Conditions
Multi-Function Analog Terminal A2 Input	Set H3-05 or H3-09 to C (PID target value). Also, be sure to set H6-01 (Terminal RP 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 to be able to use register number 0006H as the 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 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection) to B (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.

■Adjusting PID Settings

Use the following procedure to adjust PID while performing PID control and measuring the response waveform.

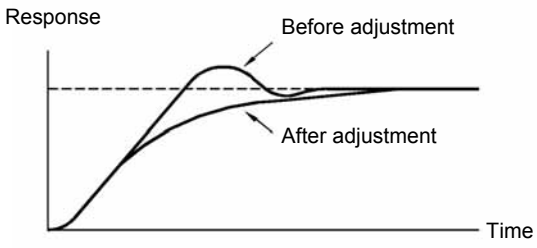
1. Set b5-01 (PID Function Setting) to 1 or 2 (PID control enabled).
2. Increase b5-02 (Proportional Gain Setting) to within a range that does not vibrate.
3. Reduce b5-03 (Integral Time Setting) to within a range that does not vibrate.
4. Increase b5-05 (Derivative Time) to within a range that does not vibrate.

■Fine Tuning PID

This section explains the fine adjustment of PID after setting the PID control parameters.

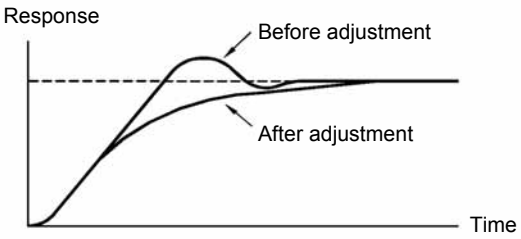
Suppressing Overshoot

If overshoot occurs, reduce derivative time (D), and increase integral time (I).



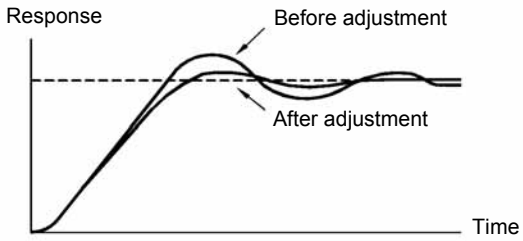
Set a Rapidly Stabilizing Control Condition

Reduce integral time (I), and lengthen derivative time (D) to quickly stabilize control even when overshoot occurs.



Suppressing Long-Cycle Oscillation

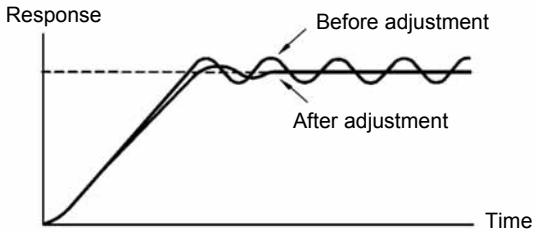
If oscillation occurs with a longer cycle than the integral time (I) set value, the integral operation is set too high. Lengthen the integral time (I) to suppress the oscillation.



Suppressing Short Cycle Oscillation

The differential operation is probably set too high if oscillation still occurs when the oscillation cycle is both relatively short and almost identical to the derivative time (D). Shorten the derivative time (D) to suppress any mechanical oscillation.

If oscillation 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, parameter b5-04 is used to prevent the calculated integral control value from exceeding the specified amount. When the load varies rapidly, the machine may be damaged or the motor may stall in based on the response of the MxC. In this case, reduce the set value to speed up MxC response.
- The b5-06 parameter is used to prevent the arithmetic operation following the PID control calculations from exceeding the specified amount. Set this parameter as a percent of the maximum output frequency.
- The b5-07 parameter is used to adjust PID control offset. Set in increments of 0.1% with the maximum output frequency as 100%.
- Set the low pass filter time constant for the PID control output in b5-08. Enable this parameter to prevent machinery resonance from occurring when machinery adhesive abrasion is great, or rigidity is poor. In this case, set the parameter to be greater than the resonance frequency cycle. Increase this time constant to reduce MxC responsiveness.
- Using b5-09, the PID output polarity can be inverted. Consequently, if the PID target value is increased, this parameter can be applied to applications to lower the MxC output frequency.
- Using b5-10, gain can be applied to the PID control output. Enable this parameter to adjust the amount of compensation if adding PID control output to the frequency reference as compensation.
- When PID control output is negative, use parameter b5-11 to invert the MxC. When b1-04 (Reverse Operation Selection) is set to 1 (enabled), however, PID output limit is 0.
- With the MxC, by setting an independent accel/decel time in parameter b5-17, the PID target value can be increased or decreased using the accel/decel time. The accel/decel function (parameter 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 parameter C1 until hunting does not occur, and maintain the accel/decel time using b5-17. Also, the set value can be disabled in b5-17 from the external terminals during run using multi-function input set value 34 (PID soft starter).

■PID Control Block

The following diagram shows the PID control block in the MxC.

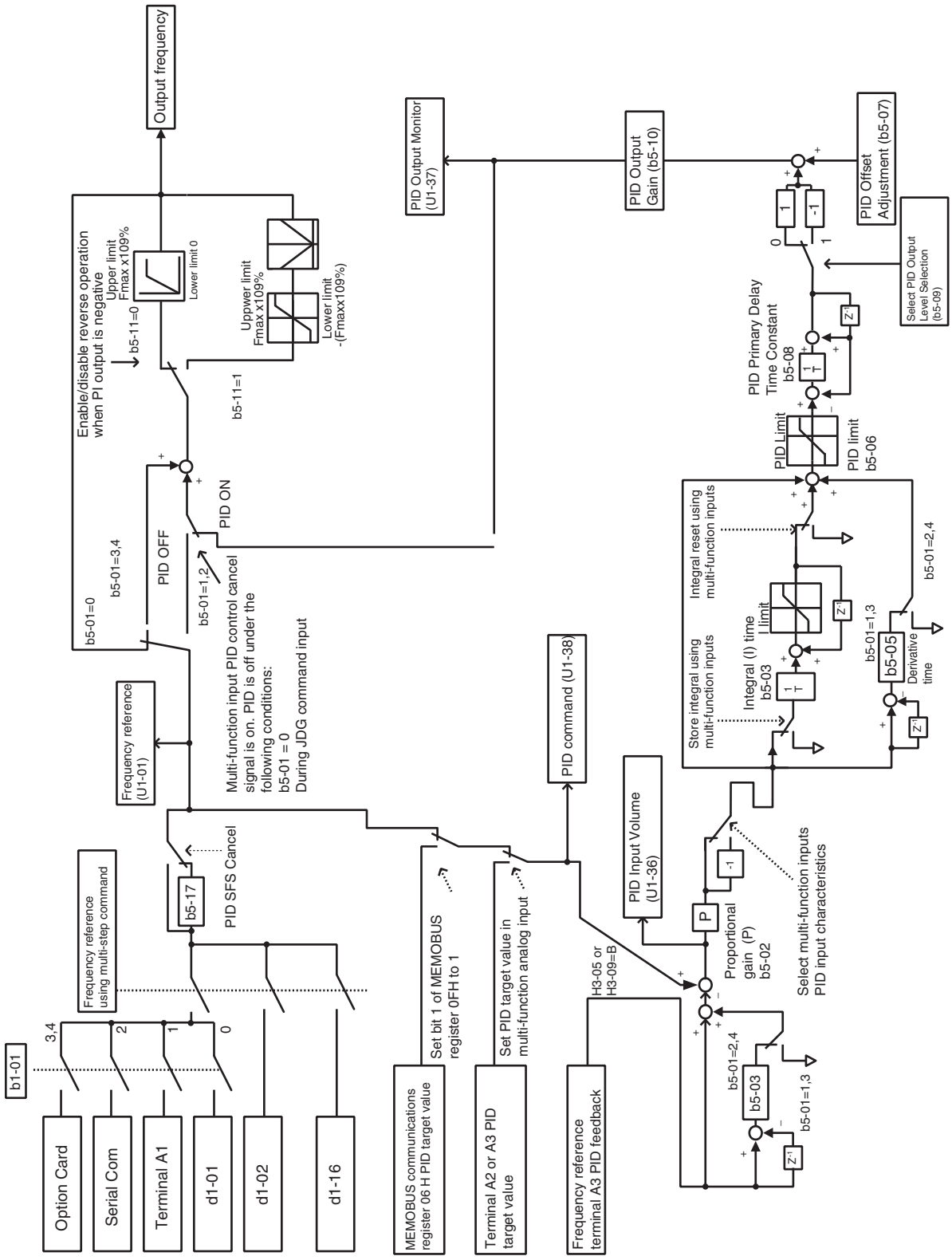


Fig 6.63 PID Control Block

■PID Feedback Loss Detection

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

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 MxC 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 MxC operation will be stopped.

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

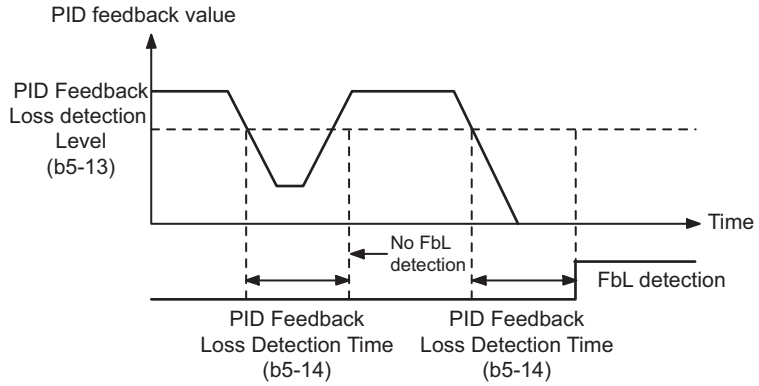


Fig 6.64 PID Feedback Loss Detection Time Chart

■PID Sleep

The PID sleep function stops the MxC 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, MxC 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.

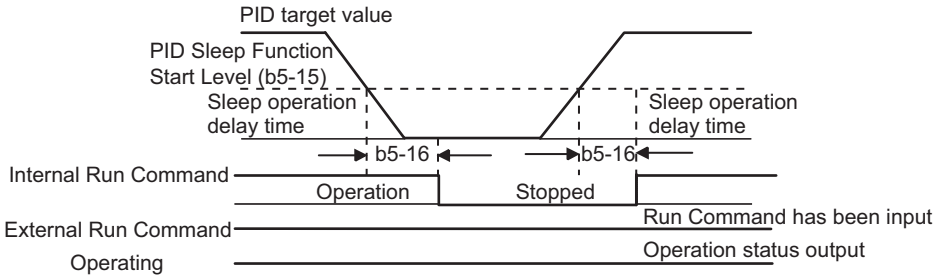


Fig 6.65 PID Sleep Time Chart

◆ Setting Motor Parameters

In vector control method, the motor parameters are set automatically using Auto-Tuning. If Auto-Tuning does not complete normally, set them manually.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
E2-01	Motor Rated Current / Motor Rated FLA	Sets the motor nameplate full load current in amperes (A). This value is automatically set during Auto-Tuning.	2.70 to 54.00 *2	19.60 A *1	No	Q	Q	Q
E2-02	Motor Rated Slip / Motor Rated Slip	Sets the motor rated slip in hertz (Hz). This value is automatically set during Rotational Auto-Tuning.	0.00 to 20.00	1.50 Hz *1	No	A	A	A
E2-03	Motor No-Load Current / No-Load Current	Sets the magnetizing current of the motor as a percentage of full load amps (E2-01). This value is automatically set during Rotational Auto-Tuning.	0.00 to 19.59 *3	5.10 A *1	No	A	A	A
E2-04	Number of Motor Poles / Number of Poles	Sets the number of motor poles. This value is automatically set during Auto-Tuning.	2 to 48	4 poles	No	No	No	Q
E2-05	Motor Line-to-Line Resistance / Term Resistance	Sets the phase-to-phase motor resistance in ohms. This value is automatically set by Auto-Tuning.	0.000 to 65.000	0.399 Ω *1	No	A	A	A
E2-06	Motor Leakage Inductance / Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. This value is automatically set during Auto-Tuning.	0.0 to 40.0	18.2% *1	No	No	A	A
E2-07	Motor Iron-core Saturation Coefficient 1 / Saturation Comp1	Sets the motor iron saturation coefficient at 50% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.	0.00 to 0.50	0.50	No	No	A	A
E2-08	Motor Iron-core Saturation Coefficient 2 / Saturation Comp2	Sets the motor iron saturation coefficient at 75% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.	0.50 to 0.75	0.75	No	No	A	A
E2-10	Motor Iron Loss for Torque Compensation / Tcomp Iron Loss	Sets the motor iron loss in watts (W).	0 to 65535	172 W *1	No	A	No	No
E2-11	Motor Rated Output / Mtr Rated Power	Sets the motor rated power in kilowatts (kW). This value is automatically set during Auto-Tuning.	5.50 to 650.00	5.50 kW *1	No	Q	Q	Q
E2-12	Motor Iron-Core Saturation Coefficient 3 / Saturation Comp3	Set to the motor iron saturation coefficient at 130% of magnetic flux.	1.30 to 1.60	1.30	No	No	A	A

* 1. The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

* 2. The setting range is from 10% to 200% of the MxC rated output current. The value for a 200 V class MxC for 5.5 kW is given. The maximum value of the Motor No-Load Current (E2-03) must be less than that of the Motor Rated Current (E2-01).

* 3. The setting range depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

■Setting Motor Parameters Manually

A description of how to set the motor parameters manually appears below. Enter all parameter settings while referring to the motor test report.

Motor Rated Voltage Setting

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

Motor Rated Slip

Set E2-02 to the motor rated slip calculated from the number of rated rotations on the motor nameplate.

amount of motor rated slip =

motor rated frequency (Hz) - no. of rated rotations (min^{-1}) × no. of motor poles/120.

Motor No-Load Current

Set E2-03 to the motor no-load current using the rated voltage and rated frequency. The motor no-load current is not normally written on the motor nameplate. Consult the motor manufacturer.

Default is the no-load current value for a standard Yaskawa 4-pole motor.

Motor Line-to-Line Resistance

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

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

Motor Leak Inductance

Set the amount of voltage drop due to motor leak inductance in E2-06 using the percentage over the motor rated voltage. Make this setting when the high-speed motor inductance is small. If the inductance is not written on the motor nameplate, consult the motor manufacturer.

Motor Iron Saturation Coefficients 1 and 2

E2-07 and E2-08 are set automatically using Rotational Auto-Tuning.

Motor Iron Loss for Torque Compensation

E2-10 is displayed only when in V/f Control Method. To increase the torque compensation accuracy when in V/f Control, set the motor iron loss in watts.

Motor Mechanical Loss

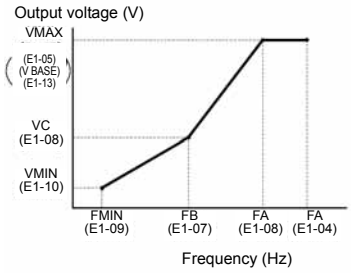
When using Flux Vector Control, adjust mechanical loss in the following cases (normally this setting does not need to be changed). The mechanical loss setting is used to compensate the torque.

- There is excessive torque loss from the motor bearings.
- There is excessive torque loss from a fan, pump, etc.

◆ Setting the V/f Pattern

In V/f Control Method, the MxC input voltage and the V/f pattern can be set as the need arises.

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Open Loop Vector	Flux Vector
E1-01	Input Voltage Setting Input Voltage	Set the MxC input voltage in 1 volt. This setting is used as a reference value in protection functions.	155 to 255 *1	200 VAC *1	No	Q	Q	Q
E1-03	V/f Pattern Selection V/f Selection	0 to D: Select from the 14 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10).	0 to D, F	F	No	Q	Q	No
E1-04	Maximum Output Frequency Max Frequency		40.0 to 120.0	60.0 Hz *2	No	Q	Q	Q
E1-05	Maximum Output Voltage Max Voltage		0.0 to 255.0 *1	200.0 VAC *1 *2	No	Q	Q	Q
E1-06	Base Frequency Base Frequency		0.0 to 120.0	60.0 Hz *2	No	Q	Q	Q
E1-07	Mid Output Frequency A Mid Frequency A		0.0 to 120.0	3.0 Hz *2	No	A	A	No
E1-08	Mid Output Voltage A Mid Voltage A	To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded.	0.0 to 255.0 *1	13.0 VAC *1 *2	No	A	A	No
E1-09	Minimum Output Frequency Min Frequency	Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 120.0	0.5 Hz *2	No	Q	Q	A
E1-10	Minimum Output Voltage Min Voltage		0.0 to 255.0 *1	2.5 VAC *1 *2	No	A	A	No
E1-11	Mid Output Frequency B Mid Frequency B	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 120.0	0.0 Hz *3	No	A	A	A
E1-12	Mid Output Voltage B Mid Voltage B		0.0 to 255.0 *1	0.0 VAC *3	No	A	A	A
E1-13	Base Voltage Base Voltage		0.0 to 255.0 *1	0.0 VAC *4	No	A	Q	Q

* 1. Values appearing in this table are for a 200 V class MxC. Double values when using a 400 V class MxC.
* 2. The default will change when the control method is changed. The Open Loop Vector defaults are given.
* 3. E1-11 and E1-12 are disregarded when set to 0.0.
* 4. E1-13 is set to the same value as E1-05 by Auto-Tuning.

■Setting V/f Pattern

When using V/f Control, set the V/f pattern in E1-03. There are two methods of setting the V/f pattern: Select one of the 14 pattern presets (set value: 0 to D), or set a user-defined V/f pattern (set value: F).

The default for E1-03 is F. The contents of E1-03 when factory-set to F are the same as when E1-03 is set to 1.

Use the table below when selecting one of the preset V/f patterns.

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

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

When selecting one of the patterns shown above, the value set to parameters E1-04 to E1-10 will automatically change to fit the V/f pattern selection.

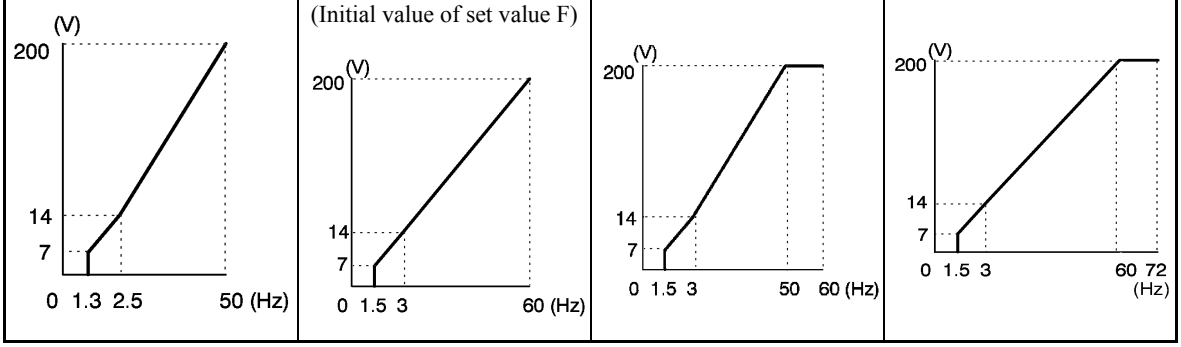
The following pages contain graphs of the V/f characteristics for the preset V/f patterns.

V/f Pattern

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

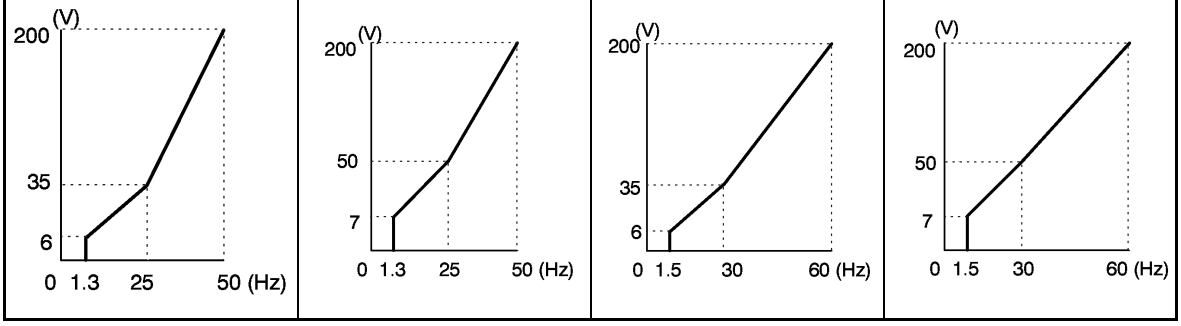
- Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0	Set Value 1	Set Value 2	Set Value 3
50 Hz	60 Hz (Initial value of set value F)	60 Hz	72 Hz



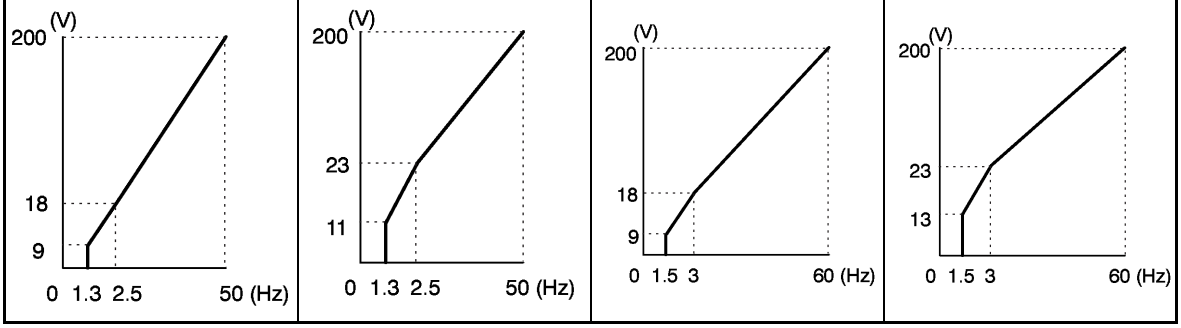
- Decrement Torque Characteristics (Set Value: 4 to 7)

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



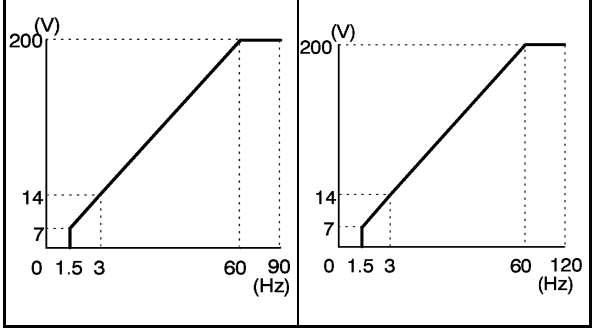
- High Startup Torque (Set Value: 8 to B)

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



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

Set Value C	Set Value D
90 Hz	120 Hz



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

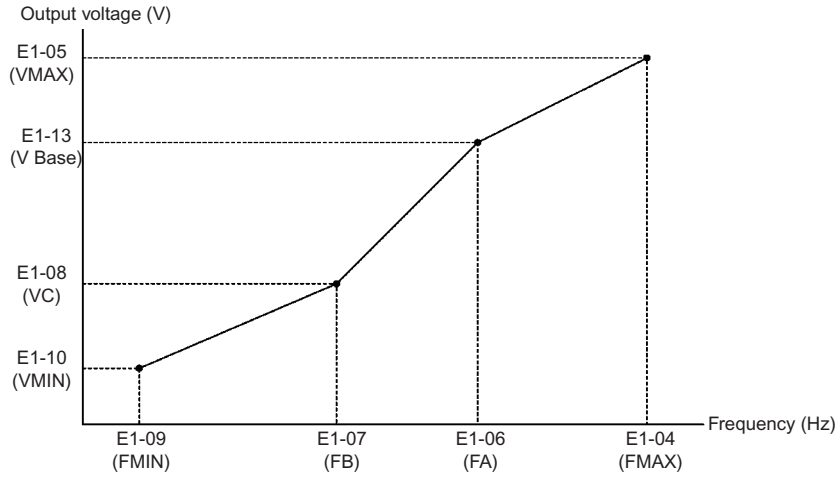


Fig 6.66 User-Set V/f Pattern

■Setting Precautions

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

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

◆ Torque Control

With Flux Vector Control, the motor's output torque can be controlled by a torque reference from an analog input. To carry out the torque control, set d5-01 to 1 or H1-□□ (Multi-function digital input) to 71 for speed or torque control, and then turn on the contact.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
d5-01	Torque Control Selection / Torq Control Sel	0: Speed control (C5-01 to C5-07) 1: Torque control This function is only available in Flux Vector Control method. 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	No	A
d5-02	Torque Reference Delay Time / Torq Ref Filter	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	No	A
d5-03	Speed Limit Selection / Speed Limit Sel	Set the speed limit command method for the torque control method. 1: The analog input limit from a frequency reference 2: Limited by d5-04 setting values.	1 or 2	1	No	No	No	A
d5-04	Speed Limit / Speed Lmt Value	Set the speed limit during torque control as a percentage of the maximum output frequency. 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	No	A
d5-05	Speed Limit Bias / Speed Lmt Bias	Set the speed limit bias as a percentage of the maximum output frequency. Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 to 120	10%	No	No	No	A
d5-06	PID Output Limit / PID Limit	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	0 ms	No	No	No	A
H3-04	Terminal A3 Signal Level Selection / Term A3 Signal	Sets the signal level of terminal A3. 0: 0 to 10 VDC 1: -10 to +10 VDC	0 or 1	0	No	A	A	A
H3-05	Terminal A3 Function Selection / Terminal A3 Sel	Select multi-function analog input function for terminal A3. Refer to the next page.	0 to 1F	2	No	A	A	A

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
H3-06	Terminal A3 Gain Setting / Terminal A3 Gain	Sets the output level when 10 V is input.	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-07	Terminal A3 Bias Setting / Terminal A3 Bias	Sets the frequency reference when 0 V is input.	-100.0 to +100.0	0.0%	Yes	A	A	A
H3-08	Terminal A2 Signal Level Selection / Term A2 Signal	Selects the signal level of terminal A2. 0: 0 to 10 VDC (switch S1-2 must be in the off position). 1: -10 to +10 VDC (switch S1-2 must be in the off position). 2: 4 to 20 mA (switch S1-2 must be in the on position) Note: Switch between current or voltage inputs by using (S1-2) switch on the terminal board.	0 to 2	2	No	A	A	A
H3-09	Terminal A2 Function Selection / Terminal A2 Sel	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A
H3-10	Terminal A2 Gain Setting / Terminal A2 Gain	Sets the output level when 10V is input.	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-11	Terminal A2 Bias Setting / Terminal A2 Bias	Sets the output level when 0V is input.	-100.0 to +100.0	0.0%	Yes	A	A	A

Multi-Function Digital Input Functions (H1-01 to H1-10)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
71	Speed/torque control change (closed: torque control)	No	No	Yes
78	Polarity Reverse Command for external torque reference	No	No	Yes

Multi-Function Digital Output Functions (H2-01 to H2-05)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
32	Speed control circuit operating for torque control (except when stopped). The external torque reference will be limited if torque control is selected. Output when the motor is rotating at the speed limit.	No	No	Yes

Multi-Function Analog Inputs (H3-05, H3-09)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
0	Add to terminal A1	Yes	Yes	Yes
13	Torque reference/torque limit at speed control	No	No	Yes
14	Torque compensation	No	No	Yes

Monitor Function

Parameter Number	Name Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods		
					V/f	Open Loop Vector	Flux Vector
U1-09	Torque reference Torque Reference	Monitors internal torque reference value for vector control.	10 V: Motor rated torque (-10 V to +10 V possible)	0.1 %	No	A	A

■Inputting Torque References and Torque Reference Directions

The torque reference can be changed according to an analog input by setting H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function 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 (0 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) (0 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).

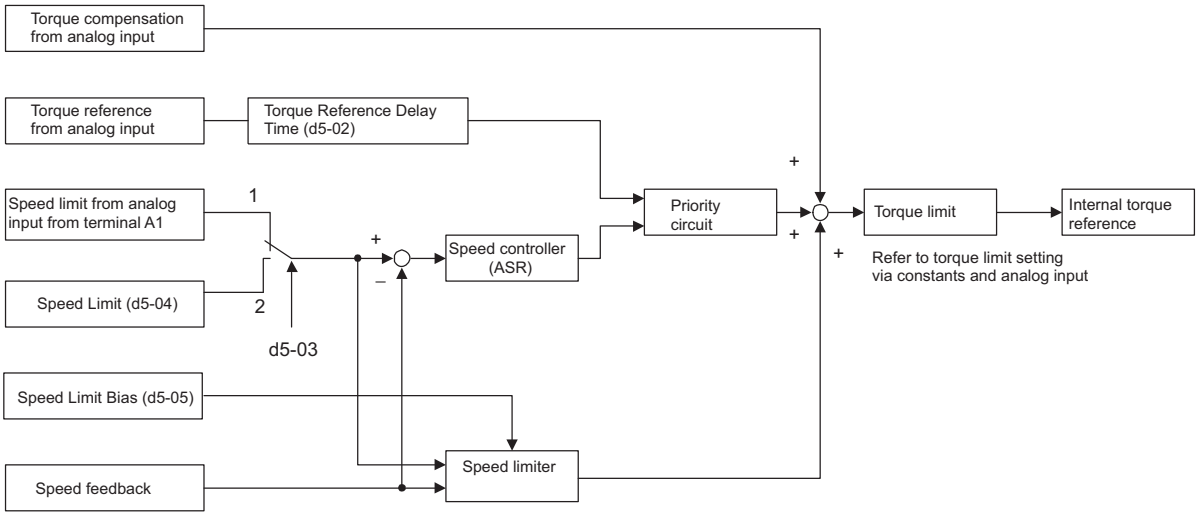


Fig 6.67 Torque Control Block Diagram

■Speed Limiter and Priority Circuit (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 and priority 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. The priority circuit switches the internal torque reference to ASR output so that the motor speed does not exceed the speed limit value.

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	Parameter Settings	Remarks
Voltage input (0 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.

Speed Limit Input Method	Location of Reference	Parameter Settings	Remarks
Option card (AI-14B) (0 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.

■Speed Limit Bias Setting

The speed limit bias can be set to limit both the forward and reverse speed to the same value. This differs from the operation of the speed limit setting. To use the speed limit bias, set d5-04 to 0 and set the bias in d5-05 as a percentage of the maximum output frequency.

To set 50% forward and reverse speed limits, set the speed limit setting to 0 (d5-03 = 2, d5-04 = 0, and d5-05 = 50). The range of torque control will be from -50% to 50% of the maximum output speed.

When using both the speed limit and the speed limit bias, the range of torque control will be positive and negative speed limits with the speed limit bias added to each.

The range of torque control when the forward speed limit is 50% and the speed limit bias is 10% is shown in the following figure. This figure does not take the priority circuit into account.

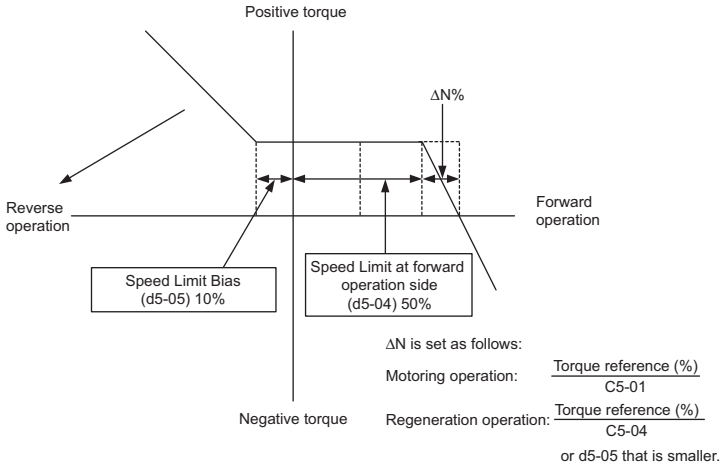


Fig 6.68 Speed Limit Bias Setting

■Torque Limit Operation Examples

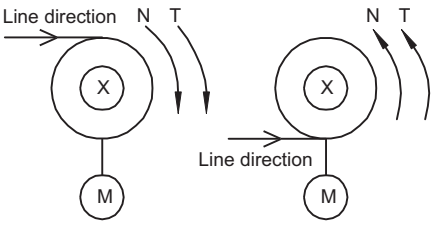
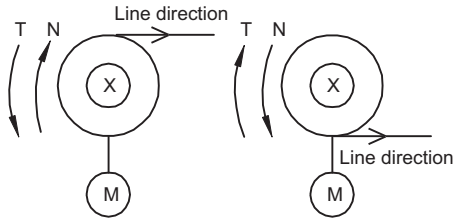
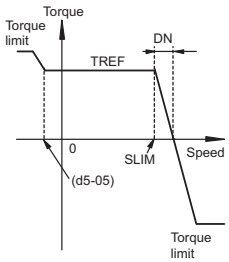
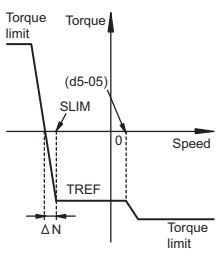
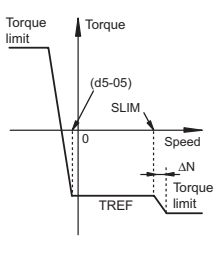
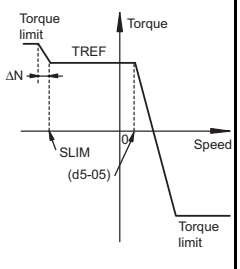
Operation examples will be described separately for winding operation, in which the speed and motor torque are in the same directions, and unwinding operation, in which the speed and motor torque are in opposite directions.

Winding Applications

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 speed limit, 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.

Unwinding Applications

In an unwinding 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 unwinding 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 speed limit, 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 Applications		Unwinding Applications	
Configuration				
Normal Rotation Direction	Forward	Reverse	Forward	Reverse
Torque Reference Polarity (TREF)	⊕	⊖	⊖	⊕
Speed Limit Polarity (SLIM)	⊕	⊖	⊕	⊖
Generated Torque	 $\Delta N(\%)=\frac{TREF(\%)}{C5\text{-}01}$	 $\Delta N(\%)=\frac{TREF(\%)}{C5\text{-}01}$	 $\Delta N(\%)=\frac{TREF(\%)}{C5\text{-}01}$ or d5-05(%) that is smaller.	 $\Delta N(\%)=\frac{TREF(\%)}{C5\text{-}01}$ or d5-05(%) that is smaller.

■Adjusting the Torque Reference

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 parameter 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 Torque Compensation

Set multi-function analog input A2 or A3 to torque compensation (setting 14). When the amount of torque loss (such as mechanical loss, etc.) 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 shaft).
- Negative voltage: Torque compensation reference for reverse motor rotation (clockwise as viewed from the motor output shaft).

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. To input reverse torque compensation, select the 0 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 H1-10) 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 frequency 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 H1-10) to switch between speed and torque control during run. An example is shown below.

Terminal No.	Parameter No.	Default	Setting	Function
8	H1-06	8	71	Speed/torque control change
A1	b1-01	1	1	Frequency reference selection (terminals A1, A2)
	C5-03	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.

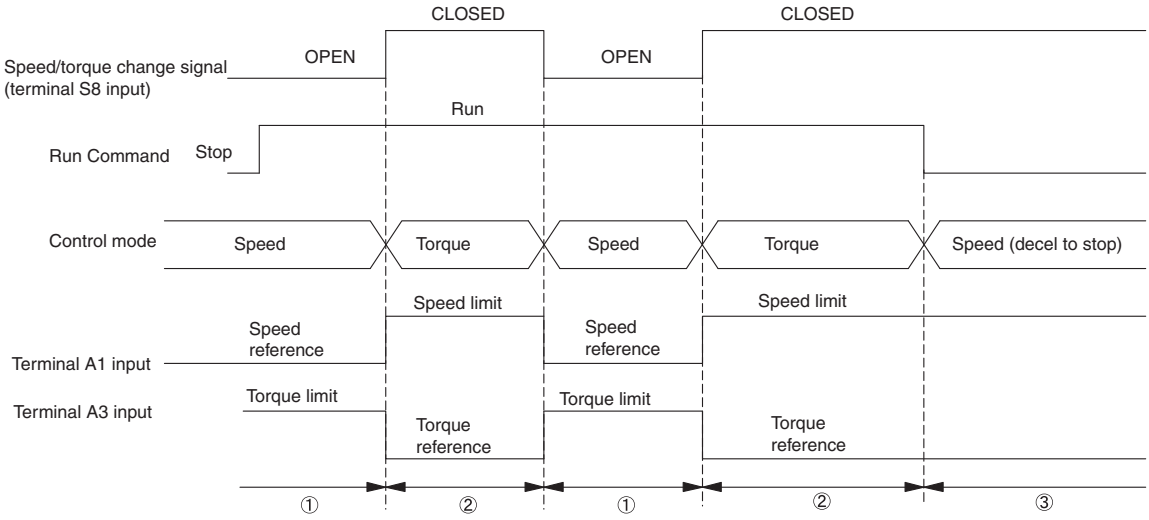
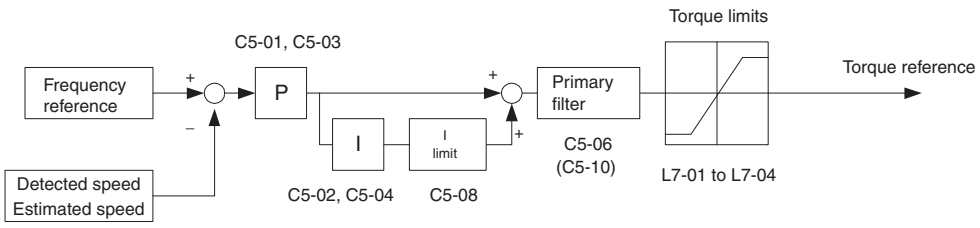


Fig 6.69 Speed/Torque Control Switching Time Chart.

◆ Speed Control (ASR) Structure

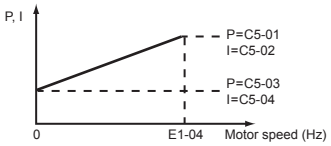
Speed control (ASR) during vector control adjusts the torque reference so that the deviation between the speed reference and the estimated speed (PG feedback or speed estimator) is 0. The following block diagram shows the structure of the speed control for vector control.



Speed Control Block Diagram for Vector Control

Fig 6.70 Speed Control Block Diagrams

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
C5-01	ASR Proportional Gain 1 ASR P Gain 1	Sets the proportional gain of the speed control loop (ASR).	0.00 to 300.00	20.00 *	Yes	No	No	A
C5-02	ASR Integral Time 1 ASR I Time 1	Sets the integral time of the speed control loop (ASR).	0.000 to 10.000	0.500 s *	Yes	No	No	A
C5-03	ASR Proportional Gain 2 ASR P Gain 2	Sets the speed control gain 2 and integral time 2 of the speed control loop (ASR). Note: Adjustment is not normally required. 	0.00 to 300.00*	20.00 *	Yes	No	No	A
C5-04	ASR Integral Time 2 ASR I Time 2		0.000 to 10.000	0.500 s *	Yes	No	No	A
C5-06	ASR Primary Delay Time Constant ASR Delay Time	Sets the filter time constant for the time from the speed loop to the Torque Command output.	0.000 to 0.500	0.004 s *	No	No	No	A
C5-07	ASR Gain Switching Frequency ASR Gain SW Freq	Sets the frequency for switching between Proportional Gain 1, 2 and Integral Time 1, 2.	0.0 to 120.0	0.0 Hz	No	No	No	A
C5-08	ASR Integral Limit ASR I Limit	Sets the ASR integral upper limit and rated load as a percentage of maximum output frequency (E1-04).	0 to 400	400%	No	No	No	A

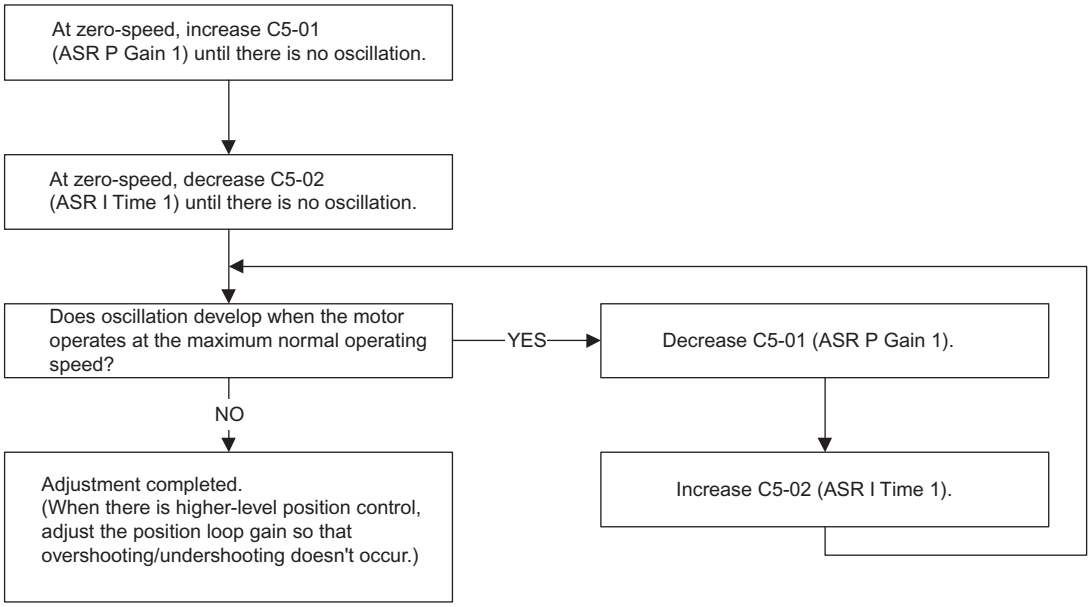
* The default changes if the control method is changed. The values shown in this table are the defaults for Flux Vector Control.

Multi-Function Digital Input Functions (H1-01 to H1-10)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
E	Speed control integral reset Enables switching between PI and P control for the speed control loop.	No	No	Yes
77	Speed control (ASR) proportional gain switch (switching between C5-01 and C5-03) off: Use proportional gain in C5-01 ON: Use proportional gain in C5-03	No	No	Yes

■Speed Control (ASR) Gain Adjustment in Flux Vector Control

Use the following procedure to adjust C5-01 and C5-03 with the mechanical system and actual load connected.



Fine-Tuning

To make even finer adjustments to the gain setting, adjust the gain while observing the speed waveform. Parameter settings like those shown in the following table will be necessary to monitor the speed waveform.

Parameter No.	Name	Setting	Explanation
H4-01	Terminal FM Monitor Selection	2	Settings that allow multi-function analog output 1 to be used to monitor the output frequency.
H4-02	Terminal FM Gain Setting	1.00	
H4-03	Terminal FM Bias Setting	0.0	
H4-04	Terminal AM Monitor Selection	5	Settings that allow multi-function analog output 2 to be used to monitor the motor speed.
H4-05	Terminal AM Gain Setting	1.00	
H4-06	Terminal AM Bias Setting	0.00	
H4-07	Terminal FM Signal Level Selection	1	Settings that allow a 0 to ±10 V signal range to be monitored.
H4-08	Terminal AM Signal Level Selection	1	

The multi-function analog outputs have the following functions with these parameter settings.

- Multi-function analog output 1 (terminal FM): Outputs MxC's output frequency (0 to ±10 V).
- Multi-function analog output 2 (terminal AM): Outputs actual motor speed (0 to ±10 V).

Terminal AC is the multi-function analog output common.
We recommend monitoring both the output frequency 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.

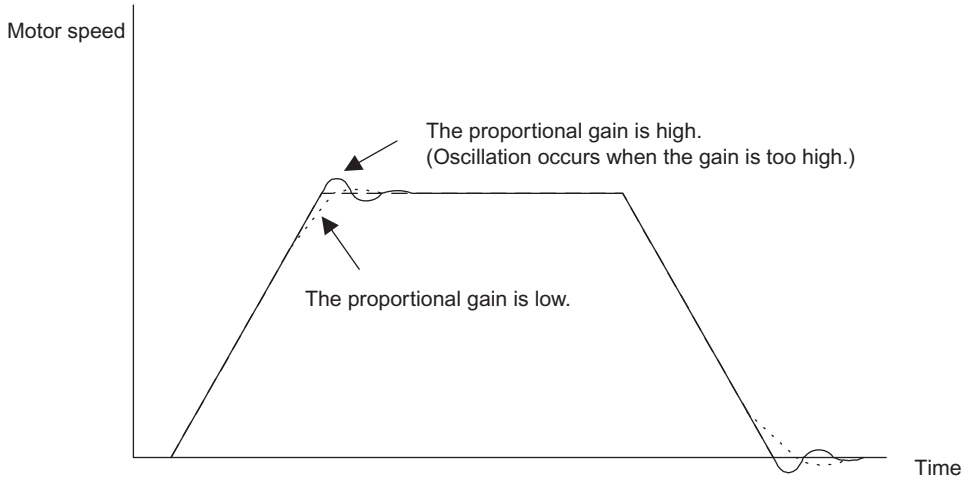


Fig 6.71 Responsiveness for Proportional Gain

Adjusting ASR Integral Time 1 (C5-02)

This parameter 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.

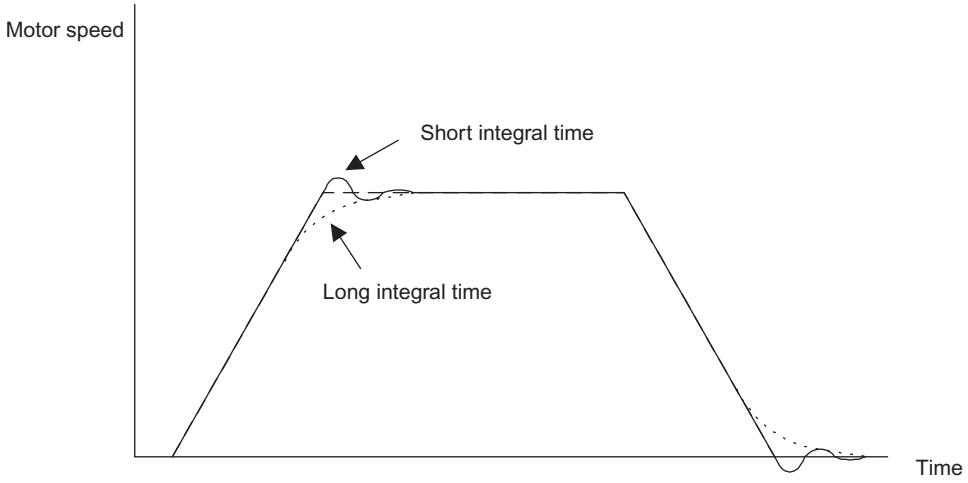


Fig 6.72 Responsiveness for Integral Time

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.

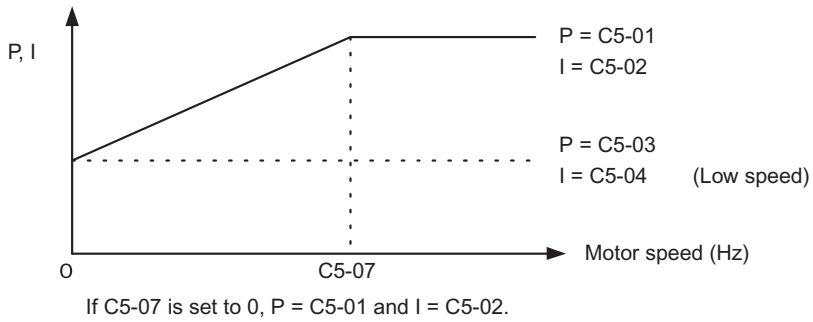


Fig 6.73 Low-Speed and High-Speed Gain Settings

Setting the Gain Switching Frequency (C5-07)

Set the switching frequency to about 80% of the motor operating frequency or the frequency at which oscillation occurs.

Low-Speed Gain Adjustments (C5-03, C5-04)

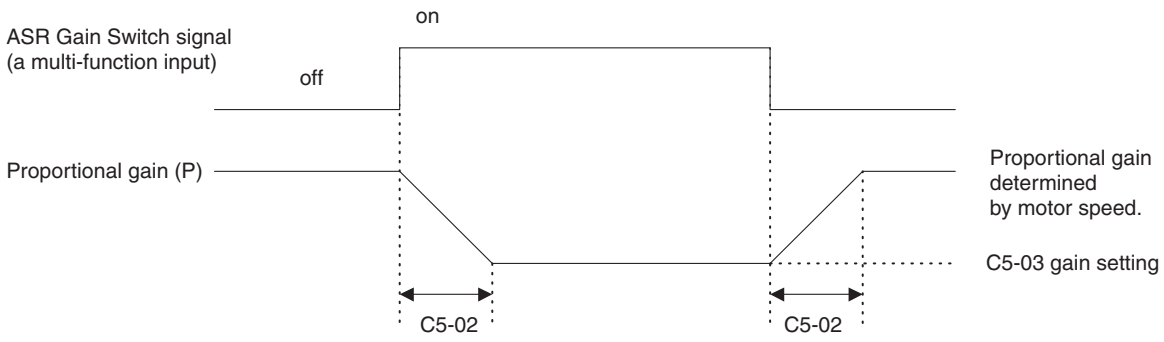
Connect the actual load and adjust these parameters at zero-speed. Increase C5-03 (ASR Proportional Gain 2) until there is no oscillation. Decrease C5-04 (ASR Integral Time 2) until there is no oscillation.

High-Speed Gain Adjustments (C5-01, C5-02)

Adjust these parameters 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-Tuning* on page 6-117 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 H1-10) is set to 77, the input can be used to switch between C5-01 (ASR Proportional Gain 1) and C5-03 (ASR 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 6.74 ASR Proportional Gain Switch

◆ Increasing the Speed Reference Response (Feed Forward Control)

Use feed forward control to increase the responsiveness to speed references. This function is enabled for machines for which the ASR gain cannot be increased to a large value because doing so would result in oscillations. There is also the additional effect of making the system less prone to overshoot. This function is valid only in Flux Vector Control.

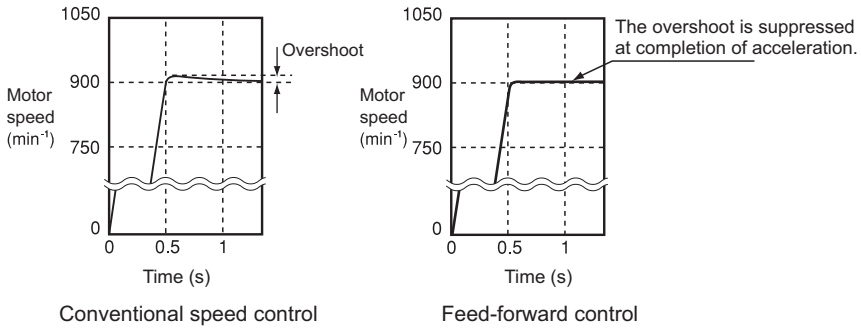


Fig 6.75 Overshoot Suppression

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
n5-01	Feed Forward Control Selection / Feedfoward Sel	Selects the feed forward controls. 0: Disabled. 1: Enabled.	0 or 1	0	No	No	No	A
n5-02	Motor Acceleration Time / Motor Accel Time	Sets the time required to accelerate the motor at the rated torque (T100) to the rated speed (Nr). J: $(GD^2) / 4$, P: Motor rated output $ta = \frac{2\pi \cdot J[kgm^2] \cdot Nr[min^{-1}]}{60 \cdot T_{100}[N \cdot m]}$ [sec] And $T_{100} = \frac{60}{2\pi} \cdot \frac{P[kW]}{Nr[min^{-1}]} \times 10^3 [N \cdot m]$	0.001 to 10.000	0.168 s *	No	No	No	A
n5-03	Feed Forward Control Ratio Gain / Feedfoward Gain	Sets the proportional gain for feed forward controls. Response to the speed reference will increase as the setting of n5-03 is increased.	0.00 to 100.00	1.0	No	No	No	A

* The default depends on the MxC capacity. The value for a 200 V class MxC of 5.5 kW is given.

■Feed Forward Control Structure

- The following block diagram shows the speed controller (ASR) and the feed forward control structure.

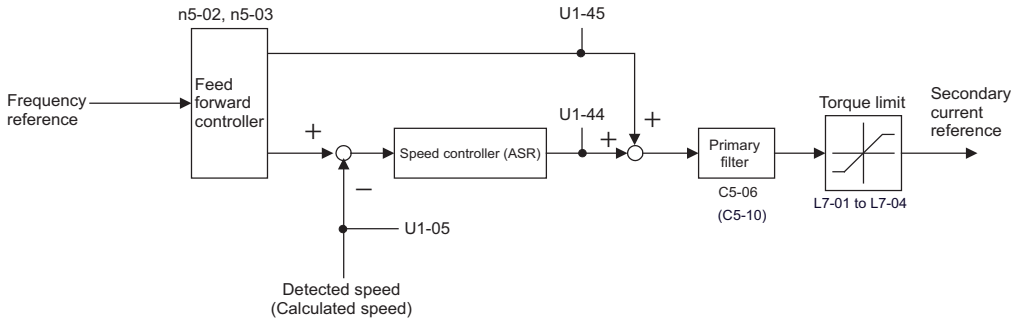


Fig 6.76 Structure of Speed Controller (ASR) and Feed Forward Control

■Setting Precautions

- When n5-02 (Motor Acceleration Time) is not properly set, the acceleration time may not increase. The default of n5-02 depends on the MxC capacity. When the MxC capacity is different from the motor capacity, calculate an appropriate acceleration time using the equation given in n5-02 of *Chapter 5 Parameters and Settings* or set the time that corresponds to the motor capacity by referring to *Defaults for Various MxC Capacities (o2-04)* (Page 5-65)
- When setting the Feed Forward Proportional Gain (n5-03), take the inertia of the motor to be equivalent to 1. If the speed reference response is slow, increase the Feed Forward Control Ratio Gain (n5-03). If overshoot occurs with the actual speed, or if a negative torque reference is output when acceleration is completed, reduce the Feed Forward Control Gain (n5-03).
- When using the Droop Control function (i.e., if b7-01 is not set to 0.0), then disable feed forward control (set n5-01 to 0).

◆ Droop Control Function

Droop Control is a function that allows the user to set the amount of motor slip.
When a single load is operated with two motors (such as in a crane conveyor), a high-resistance motor is normally used. This set up takes advantage of torque characteristics that exhibit proportional changes due to changes in the secondary resistance, thus maintaining both the overall speed and torque balance with the load. If Droop Control is used, high-resistance motor characteristics can be set for a general-purpose motor.

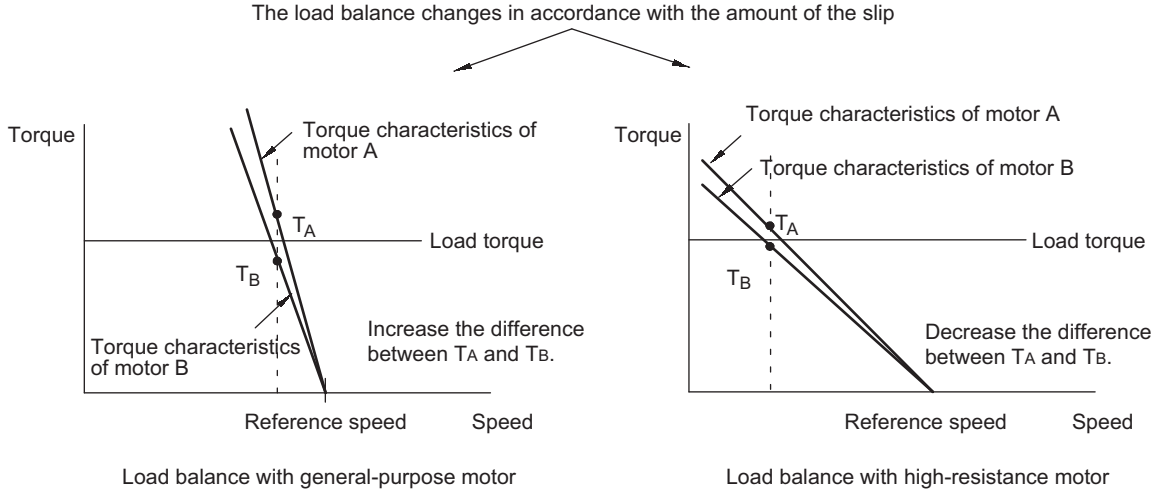


Fig 6.77 Droop Control Function

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
b7-01	Droop Control Level / Droop Quantity	Sets the speed decrease as a percentage of motor base speed (E1-06) when the motor is at 100% load torque. Setting of 0.0 disables droop control.	0.0 to 100.0	0.0	Yes	No	No	A
b7-02	Droop Control Delay Time / Droop Delay Time	Determines the droop control delay time in response to a load change.	0.03 to 2.00	0.05 s	Yes	No	No	A

■Setting Precautions

- Droop Control is disabled if b7-01 is set to 0.0.
- Set b7-01 to the amount of slip as the percentage of slip when the maximum output frequency is input and the rated torque is generated.
- Parameter b7-02 is used to adjust the responsiveness of Droop Control. Increase this setting if oscillation or hunting occur.
- Disable the feed forward control (n5-01 = 0) when using the droop control function.

■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 output frequency.

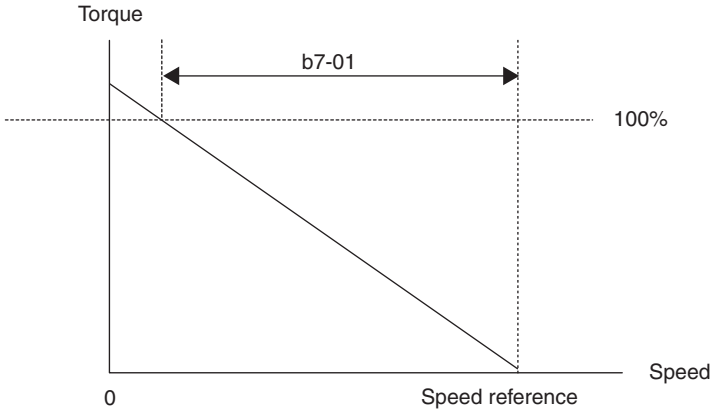


Fig 6.78 Droop Control Gain

◆ Zero-Servo Function

The Zero-Servo function holds the motor when the motor is stopped in what is call a Zero-Servo status. This function can be used to stop the motor even with an external force acts on the motor or the analog reference input is offset.

The Zero-Servo function is enabled when one of the multi-function inputs (H1-01 to H1-10) is set to 72 (Zero-Servo Command). If the Zero-Servo Command is on when the frequency (speed) reference falls below the Zero-Speed level, then the Zero-Servo function is triggered.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
b2-01	DC Injection Braking Start Frequency / DCInj Start Freq	Sets the frequency at which DC injection braking starts when decelerate to stop (b1-03 = 0) is selected. If b2-01< E1-09, DC Injection braking starts at E1-09. Note: Zero Speed restrictions are active in Flux Vector Mode.	0.0 to 10.0	0.5 Hz	No	A	A	A
b9-01	Zero Servo Gain / Zero Servo Gain	Adjust the strength of the zero-servo lock. Enabled when the "zero-servo command" is set for the multi-function input. When the zero-servo command has been input and the frequency reference drop below excitation level (b2-01), a position control loop is created and the motor stops. Increasing the zero-servo gain in turn increases the strength of the lock. Increasing it by too much will cause oscillation.	0 to 100	5%	No	No	No	A
b9-02	Zero Servo Completion Width / Zero Servo Count	Sets the output width of the P-lock completion signal. Enabled when the "zero-servo completion (end)" is set for a multi-function input. The zero-servo completion signal is on when the current position is within the range (the zero-servo position ± zero-servo completion width.) Set the allowable position displacement from the zero-servo position to 4 times the pulse rate of the PG (pulse generator, encoder) in use.	0 to 16383	10	No	No	No	A

Multi-function Digital Input Functions (H1-01 to H1-10)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
72	Zero-Servo Command (ON: Zero-servo)	No	No	Yes

Multi-Function Digital Output Functions (H2-01 to H2-03)

Set Value	Function	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
33	Zero-Servo Complete ON: Current position is within zero-servo start position ± the Zero-Servo Complete width.	No	No	Yes

To output the Zero-Servo status externally, assign the Zero-Servo Complete signal (setting 33) to one of the multi-function outputs (H2-01 to H2-03).

Monitor Function

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods		
					V/f	Open Loop Vector	Flux Vector
U1-35	Zero-Servo movement pulses / Zero Servo Pulse	Shows the number of PG pulses times 4 for the movement range when stopped at zero.	*No output available*	1	No	No	A

■Time Chart

A time chart for the zero-servo function is given in *Time Chart for Zero-Servo*.

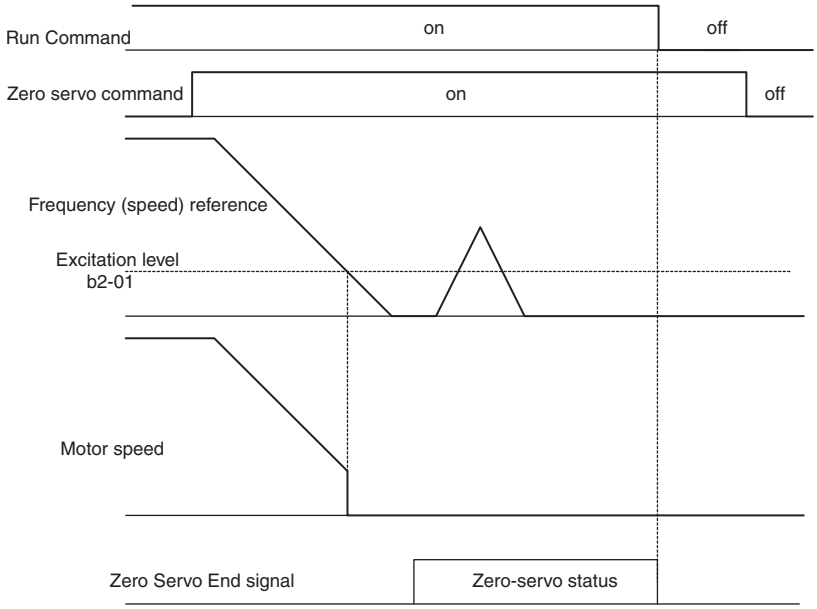


Fig 6.79 Time Chart for Zero-Servo

■Application Precautions

- Be sure to leave the Run Command input on. If the Run Command is turned off, the output will be interrupted and the zero-servo function will be disabled.
- The holding force of the zero-servo is adjusted in b9-01. The holding force will increase if the value of the setting is increased, but oscillation and hunting will occur if the setting is too large. Adjust b9-01 after adjusting the speed control gain.
- The zero-servo detection width is set as the allowable position offset from the zero-servo start position. Set 4 times the number of pulses from the PG.
- The Zero-servo End signal will go off when the Zero-Servo Command is turned off.

IMPORTANT

Do not lock the servo for extended periods of time at 100% when using the zero-servo function. MxC errors may result. Extended periods of servo lock can be achieved by ensuring that the current during the servolock is 70% or less or by increasing the MxC output capacity.

Digital Operator Functions

This section explains the digital operator functions.

◆ Setting Digital Operator Functions

The user can set digital operator-related parameters such as selecting the digital operator display, multi-function selections, and copy functions.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
o1-02	User Monitor Selection After Power-Up / Power-On Monitor	Sets the monitor item to be displayed when the power is turned on. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	A	A
o1-03	Digital Operator Display Selection / Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: 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. □□□□□ Set 4-digit number excluding the decimal point. Set the number of digits below the decimal point to display. Example: When the max. output frequency value is 200.0, set 12000.	0 to 39999	0	No	A	A	A
o1-04	Setting unit for frequency parameters related to V/f characteristics / Display Units	Set the setting unit for frequency reference-related parameters. 0: Hz 1: min^{-1} *	0 or 1	0	No	No	No	A
o2-01	Local/Remote Key Function Selection / Local/Remote Key	Determines if the digital operator LOCAL/REMOTE key is functional. 0: Disabled. 1: Enabled.	0 or 1	1	No	A	A	A
o2-02	STOP Key Function Selection / Oper STOP Key	Determines if the STOP key on the digital operator will stop the MxC when MxC is operating from external terminals or serial communication. 0: Disabled. 1: Enabled.	0 or 1	1	No	A	A	A

* The digital operator shows rpm instead of min^{-1}.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
o2-03	User Parameter Default Value / User Defaults	Allows storing of parameter settings as a User Initialization Selection. 0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. A1-03 now allows selecting <1110> for user initialization and returns o2-03 to zero. 2: Clear All - Clears the currently saved user initialization. A1-03 no longer allows selecting <1110> and returns o2-03 to zero.	0 to 2	0	No	A	A	A
o2-05	Frequency Reference Setting Method Selection / Operator M.O.P.	Determines if the DATA/ENTER key must be used to input a frequency reference from the digital operator. 0: Disabled. - DATA/ENTER key must be pressed to enter a frequency reference. 1: Enabled. - DATA/ENTER key is not required. The frequency reference is adjusted by the up and down arrow keys on the digital operator without having to press the DATA/ENTER key.	0 or 1	0	No	A	A	A
o2-07	Cumulative Operation Time Setting / Elapsed Time Set	Sets the initial value of the elapsed operation timer U1-13.	0 to 65535	0 hr	No	A	A	A
o2-10	Cumulative Cooling Fan Operation Time Setting / Fan ON Time Set	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

■Changing Frequency Reference and Display Units

Set the digital operator frequency reference and display units using parameter o1-03. You can change the units for the following parameters using o1-03.

- U1-01 (shows the frequency reference)
- U1-02 (shows the output frequency)
- U1-05 (shows the motor speed)
- U1-20 (shows the output frequency after Soft Start)
- d1-01 to d1-17 (frequency reference parameters)

■Switching between Monitors when the Power Supply is On

Using parameter o1-02, select the monitor item (U1-□□ [status monitor]) to be displayed on the digital operator when the power supply is turned on. For information on monitors that may be displayed, refer to U1-□□ in *Chapter 5 Parameters and Settings*.

Setting Precautions

If selecting monitor parameters other than U1-01 (shows the frequency reference), U1-02 (shows the output frequency), and U1-03 (shows the 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 MxC reference inputs set using reference inputs from the digital operator, b1-01 (Frequency Reference Selection), or b1-02 (Run Command Selection).

■Initializing Parameters Back to Default Values

You can save the MxC parameter set values that you have changed as parameter initial values. Change the set values from the MxC defaults, and then set o2-03 to 1.

If, however, "Out of Memory MAX Param Change" is displayed on the operator when changes in the settings of the parameters are saved as initial values, do not attempt to register any further changes as initial values.

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

■Setting the Frequency Reference using the UP and DOWN Keys without Using the ENTER Key

Use this function when inputting frequency references from the digital operator. When o2-05 is set to 1, you can increase and decrease the frequency reference using the up and down arrow keys without using the ENTER key.

For example, enter the Run Command using a 0 Hz reference, and then continuously press the UP key to increase the frequency reference by 0.01 Hz only for the first 0.5 s, and then by 0.01 Hz every 80 ms for 3 s thereafter. Press and hold down the up arrow key for 3 s minimum to reach the maximum output frequency 10 s after that. The frequency reference that has been set will be stored in memory 5 s after the up or down arrow keys are released.

■Clearing Cumulative Operation Time

Set the cumulative operation time initial value in time units in parameter o2-07. Set o2-07 to 0 to clear U1-13 (MxC Operating Time).

■Clearing MxC Cooling Fan Operation Time

Set the fan operation time initial value in time units in parameter o2-10. Set o2-10 to 0 to clear U1-40 (Cooling Fan Operating Time).

◆ Copying Parameters

The digital operator can perform the following three functions using the built-in EEPROM (non-volatile memory).

- Store MxC parameter set values in the digital operator (READ)
- Write parameter set values stored in the digital operator to the MxC (COPY)
- Compare parameter set values stored in the digital operator with MxC parameters (VERIFY)

The Matrix Converter is displayed as MxC, and the digital operator is displayed as OP while executing the COPY function.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
o3-01	Copy Function Selection / Copy Function Sel	This parameter controls the copying of parameters to and from the digital operator. 0: COPY SELECT (no function) 1: INV → OP READ: All parameters are copied from the MxC to the digital operator. 2: OP → INV WRITE: All parameters are copied from the digital operator to the MxC. 3: OP⇔INV VERIFY: Parameter settings in the MxC are compared to those in the digital operator. Note: When using the copy function, the MxC model number (o2-04), software number (U1-14), and control method (A1-02) must match or an error will occur.	0 to 3	0	No	A	A	A
o3-02	Copy Allowed Selection / Read Allowable	Enables and disables the digital operator copy functions. 0: Disabled. - No digital operator copy functions are allowed. 1: Enabled. - Copying allowed.	0 or 1	0	No	A	A	A

■Storing MxC Set Values in the Digital Operator (READ)

To store MxC set values in the digital operator, follow the directions below.

Table 6.1 READ Function Procedure

Step No.	Digital Operator Display	Explanation
1	-ADV- ** Main Menu ** Programming	Press the MENU key, and select Advanced Programming Mode.
2	-ADV- Initialization A1 - 00=1 Select Language	Press the DATA/ENTER key, and select the parameters monitor display.
3	-ADV- COPY Function o3 - 01=0 Copy Funtion Sel	Display o3-01 (Copy Function Selection) using the up arrow key and down arrow key.
4	-ADV- Copy Funtion Sel o3-01= 0 *0* COPY SELECT	Press the DATA/ENTER key, and select the parameters setting display.
5	-ADV- Copy Funtion Sel o3-01= 1 *0* MxC→OP READ	Change the set value to 1 using the up arrow key.
6	-ADV- READ MxC→OP READING	Set the changed data using the DATA/ENTER key. The READ function will start.
7	-ADV- READ READ COMPLETE	If the Read function ends normally, “READ COMPLETE” appears on the digital operator screen.
8	-ADV- Copy Funtion Sel o3 - 01=0 *0* COPY SELECT	The display returns to o3-01 when a key is pressed.

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 o3-01 display.

Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using the Digital Operator Copy Function*.)

Error Display	Meaning
PRE READ IMPOSSIBLE	You are attempting to set o3-01 to 1 while o3-02 is set to 0.
IFE READ DATA ERROR	Read data length mismatch or read data error.

Error Display	Meaning
RDE DATA ERROR	Tried to write parameters to EEPROM on the digital operator, but unable to perform write operation.

Select READ Permitted

Avoid overwriting the data stored in EEPROM in the digital operator by mistake. With o3-02 set to 0, if you set o3-01 to 1, and perform the write operation, PrE will be displayed on the digital operator, and the write operation will be stopped.

■Writing Parameter Set Values Stored in the Digital Operator to the MxC (COPY)

Follow the instructions below to write parameter setting stored in the digital operator to the MxC.

Table 6.2 COPY Function Procedure

Step No.	Digital Operator Display	Explanation
1	-ADV- ** Main Menu ** Programming	Press the MENU key, and select Advanced Programming Mode.
2	-ADV- Initialization A1 - 00=1 Select Language	Press the DATA/ENTER key, and select the parameters monitor display.
3	-ADV- COPY Function o3 - 01=0 Copy Funtion Sel	Display o3-01 (Copy Function Selection) using the up and down arrow keys.
4	-ADV- Copy Funtion Sel o3-01= 0 *0* COPY SELECT	Press the DATA/ENTER key, and select the parameters setting display.
5	-ADV- Copy Funtion Sel o3-01= 2 *0* OP→MxC WRITE	Change the set value to 2 using the up arrow key.
6	-ADV- COPY OP→MxC COPYING	Set the changed data using the DATA/ENTER key. The COPY function will start.
7	-ADV- COPY COPY COMPLETE	If the COPY function ends normally, “COPY COMPLETE” is displayed on the digital operator.
8	-ADV- Copy Funtion Sel o3 - 01=0 *0* COPY SELECT	The display returns to o3-01 when a key is pressed.

During the copy operation, errors may occur. 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
CPE ID UNMATCH	MxC product code and MxC software number do not match.
VAE MxC KVA UNMATC	MxC capacity with which you are trying to copy, and the MxC capacity stored in the digital operator are different.
CRE CONTROL UNMATCH	The MxC control method in which you are trying to copy, and the MxC control method stored in the digital operator are different.
CYE COPY ERROR	Comparison between the parameter written to the MxC and the parameter in the digital operator shows they are different.
CSE SUM CHECK ERROR	After the copying process has ended, comparison between the sum value of the MxC parameter area and the sum value of the digital operator parameter area shows they are different.

■Comparing MxC Parameters and Digital Operator Parameter Set Values (VERIFY)

To compare MxC parameters and digital operator parameter set values, follow the directions below.

Table 6.3 VERIFY Function Procedure

Step No.	Digital Operator Display	Explanation
1	-ADV- ** Main Menu ** Programming	Press the MENU key and select Advanced Programming Mode.
2	-ADV- Initialization A1 - 00=1 Select Language	Press the DATA/ENTER key, and select the parameters monitor display.
3	-ADV- COPY Function o3 - 01=0 Copy Funtion Sel	Display o3-01 (Copy Function Selection) using the up and down arrow keys.
4	-ADV- Copy Funtion Sel o3-01= 0 *0* COPY SELECT	Press the DATA/ENTER key, and select the function setting display.
5	-ADV- Copy Funtion Sel o3-01= 3 *0* OP←→MxC VERIFY	Change the set value to 3 using the up arrow key.

Table 6.3 VERIFY Function Procedure (Continued)

Step No.	Digital Operator Display	Explanation
6	-ADV- VERIFY DATA VERIFYING	Set the changed data using the DATA/ENTER key. The VERIFY function will start.
7	-ADV- VERIFY VERIFY COMPLETE	If the VERIFY function ends normally, “VERIFY COMPLETE” appears on the digital operator.
8	-ADV- Copy Funtion Sel o3 - 01=0 *0* COPY SELECT	The display returns to o3-01 after any key is pressed.

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
VYE VERIFY ERROR	Verify error (Settings in the digital operator and the MxC do not match).

■Application Precautions

When using the copy function, check that the following settings are the same between the MxC and the digital operator.

- MxC product and type
- MxC capacity and voltage
- Software number
- Control method
- If using the copy function, make sure communications are off-line or the option card has been removed.
- If the power supply of the MxC is turned off while executing the copy function, a CPF03 fault (EEPROM error) will occur.

◆ Writing Parameters from the Digital Operator

If A1-01 is set to 0, the user can use the digital operator to view and set the A1 and A2 parameter groups.

If one of parameters H1-01 to H1-05 is set to 1B (meaning that "write to parameters permitted" is set one of the multi-function digital input terminals S3 to S7), then parameter settings can be saved from the digital operator to the MxC (provided that the terminal set to 1B is switched on). When the terminal is off, writing parameters other than the frequency reference is prohibited. You can, however, reference other parameters.

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
A1-01	Access Level Selection / Access Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and Initialize mode.) 1: Used to select user parameter (Only parameters set in A2-01 to A2-32 can be read and set.) 2: Advanced (Parameters can be read and set in both quick programming (Q) mode and advanced programming (A) mode.)	0 to 2	2	Yes	A	A	A

◆ Setting a Password

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

You can prohibit the setting and referencing of all parameters except A1-00 by using the password function in combination with setting A1-01 to 0 (Monitor only).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
A1-01	Access Level Selection / Access Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and Initialize mode.) 1: Used to select user parameter (Only parameters set in A2-01 to A2-32 can be read and set.) 2: Advanced (Parameters can be read and set in both quick programming (Q) mode and advanced programming (A) mode.)	0 to 2	2	Yes	A	A	A
A1-04	Password 1 / Enter Password	Password input when a password has been set in A1-05. This function write-protects some parameters of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 parameters can no longer be changed. (Programming mode parameters can be changed.)	0 to 9999	0	No	A	A	A

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Open Loop Vector	Flux Vector
A1-05	Password 2 Select Password	Used to set a four digit number as the password. This parameter 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

■Setting Precautions

Parameter A1-05 is hidden and cannot be accessed normally. To access A1-05, hold down the RESET key and press the MENU key while A1-04 is displayed.

◆ Displaying User-Set Parameters Only

To set and refer to a specific list of parameters use the A2 parameters (User-Set parameter group) and A1-01 (Language Selection).

Enter the parameter numbers between A2-01 to A2-32 that you wish to use, and then set A1-01 to 1. Now the user can set and refer only to A1-01 through A1-03 and A2-01 through A2-32 only, using Advanced Programming Mode.

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Open Loop Vector	Flux Vector
A2-01 to A2-32	User parameters User Param 1 to 32	Used to set the parameter numbers that can be set/read. Maximum 32. Effective when the Access Level Selection (A1-01) is set to User Program (1). Parameters set in A2-01 to A2-32 can be set/read in programming mode.	b1-01 to o3-02	-	No	A	A	A

Options

This section explains the MxC option functions.

◆ Performing Speed Control with a PG Encoder

This section explains functions with V/f Control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
F1-01	PG Parameter / PG Pulses/Rev	Sets the number of PG (pulse generator or encoder) pulses. Sets the number of min^{-1}.*	0 to 60000	600	No	No	No	Q
F1-02	Operation Selection at PG Open Circuit (PGO) / PG Fdbk Loss Sel	Sets stopping method when a PG open circuit fault (PGO) occurs. See parameter F1-14. 0: Decelerate to Stop. Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - MxC continues operation.	0 to 3	1	No	No	No	A
F1-03	Operation Selection at Overspeed (OS) / PG Overspeed Sel	Sets the stopping method when an overspeed (OS) fault occurs. See F1-08 and F1-09. 0: Decelerate to Stop. Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - MxC continues operation.	0 to 3	1	No	No	No	A
F1-04	Operation Selection at Deviation / PG Deviation Sel	Sets the stopping method when a speed deviation (DEV) fault occurs. See F1-10 and F1-11. 0: Decelerate to Stop. Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - MxC continues operation.	0 to 3	3	No	No	No	A
F1-05	PG Rotation Selection / PG Rotation Sel	0: Fwd = C.C.W. - Phase A leads with Forward Run Command (Phase B leads with Reverse Run Command). 1: Fwd = C.W. - Phase B leads with Forward Run Command (Phase A leads with Reverse Run Command).	0 or 1	0	No	No	No	A
F1-06	PG Division Rate (PG Pulse Monitor) / PG Output Ratio	Sets the division ratio for the pulse monitor of the PG-B2 encoder feedback option card. This function is not available with the PG-X2 option card. Division ratio = [(1 + n) / m] (n = 0 to 1, m =1 to 32) F1-06 = □ (n) □□ (m) The possible division ratio settings are: 1/32 ≤ F1-06 ≤ 1	1 to 132	1	No	No	No	A

Parameter Number	Name Display	Description	Setting Range	Default	Change during Run	Control Methods V/f	Control Methods Open Loop Vector	Control Methods Flux Vector
F1-08	Overspeed Detection Level PG Overspd Level	Configures the overspeed fault (OS) detection. OS fault will occur, if the motor speed feedback is greater than the F1-08 setting for a time longer than F1-09. F1-08 is set as a percentage of the maximum output frequency (E1-04). See F1-03.	0 to 120	115%	No	No	No	A
F1-09	Overspeed Detection Delay Time PG Overspd Time		0.0 to 2.0	0.0 s	No	No	No	A
F1-10	Excessive Speed Deviation Detection Level PG Deviate Level	Configures the speed deviation fault (DEV) detection. DEV fault will occur if the speed deviation is greater than the F1-10 setting for a time longer than F1-11. F1-10 is set as a percentage of the maximum output frequency (E1-04). Speed deviation is the difference between actual motor speed and the Frequency Reference Command. See F1-04.	0 to 50	10%	No	No	No	A
F1-11	Excessive Speed Deviation Detection Delay Time PG Deviate Time		0.0 to 10.0	0.5 s	No	No	No	A
F1-14	PG Open-Circuit Detection Time PGO Detect Time	Configures the PG open (PGO) function. PGO will be detected if no PG pulses are detected for a time longer than F1-14. See F1-02.	0.0 to 10.0	2.0 s	No	No	No	A

■Using PG Speed Control Card

There are two types of PG Speed Control Cards that can be used for Flux Vector Control.

- PG-B2: A/B phase pulse inputs, complementary outputs
- PG-X2: A/B/Z phase pulse inputs, line driver outputs

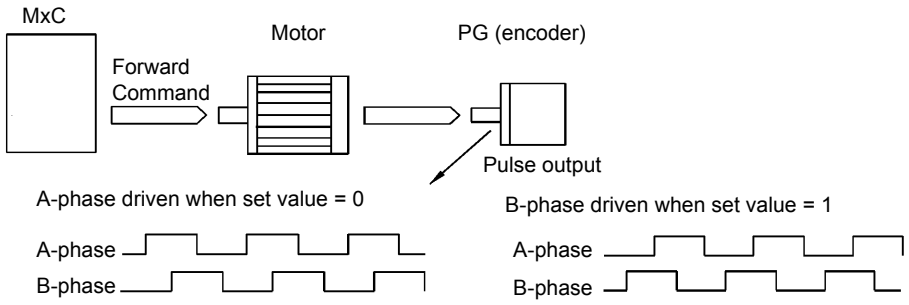
For the connection diagram, refer to page 2-30 to 2-31.

■Setting Number of PG Pulses

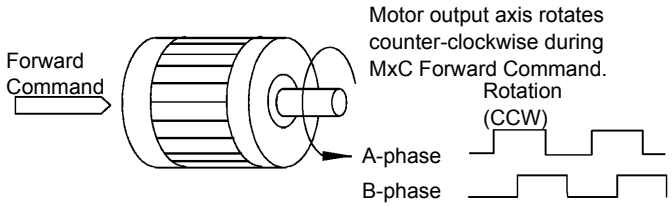
Set the number of PG (pulse generator/encoder) pulses in pulses per motor revolution. Set the number of A-phase or B-phase pulses per 1 motor rotation in F1-01.

■Matching PG Rotation Direction and Motor Rotation Direction

Parameter F1-05 matches the rotation direction of both the PG encoder and the motor. If the motor is rotating forwards, then indicate whether it is A-phase driven or B-phase driven by setting F1-05 accordingly. F1-05 must be set when using the PG-B2 or PG-X2 option cards.



Example: Forward rotation of standard Yaskawa motor (PG used: Samtack (KK))



Yaskawa standard PG used is A-phase driven (CCW) when motor rotation is forward.

Fig 6.80 PG Rotation Direction Setting

Generally, a PG encoder is A-phase driven when rotation is clockwise (CW) from the input axis. In the same way, motor rotation is counter-clockwise (CCW) from the output side when Forward Commands are output. Consequently, when motor rotation is forward, PG is normally A-phase driven when a load is applied, and B-phase driven when a load is not applied.

■Setting PG Pulse Monitor Output Ratio

This function is enabled only when using PG speed control card PG-B2, and sets the ratio for the PG pulse monitor output. The set value is expressed as *n* for the upper digit, and *m* for the lower 2 digits. The ratio of pulses for monitor output is calculated as follows:

Dividing ratio = (1 + n)/m (Setting range) n: 0 or 1, m: 1 to 32

F1-06 = $\frac{\square}{n}$ $\frac{\square\square}{m}$

The ratio can be set within the following range: 1/32 ≤ F1-06 ≤ 1. For example, if the ratio is 1/2 (set value 2), half of the number of pulses from the PG are monitor output.

■Detecting PG Disconnect

Select the stopping method when the PG cable disconnect is detected and the PG open circuit (PGO) detection time.

When the MxC is operating with the frequency reference set to 1% minimum (except when operating on direct current), PGO is detected if the speed feedback from PG is greater than the time setting in F1-14.

■Detecting Motor Overspeed

An error is detected when the number of motor rotations exceeds the regulated limit. An overspeed (OS) is detected when a frequency that exceeds the set value in F1-08 continues for longer than the time set in F1-09. After detecting an overspeed (OS), the MxC stops according to the setting in F1-03.

■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) situation occurs after speed agree. The difference between the speed reference and actual workpiece speed is becomes greater than F1-10 and continues for longer than the time set in F1-11. After a speed deviation situation is detected, the MxC stops according to the setting in F1-04.

◆ Using Digital Output Cards

There are two types of MxC digital output cards:

- DO-02C
  Relay contact output (DPDT contact)
- DO-08
  6 photocoupler output channels (shared commons)
  2 (independent) relay contact output channels (NC contact)

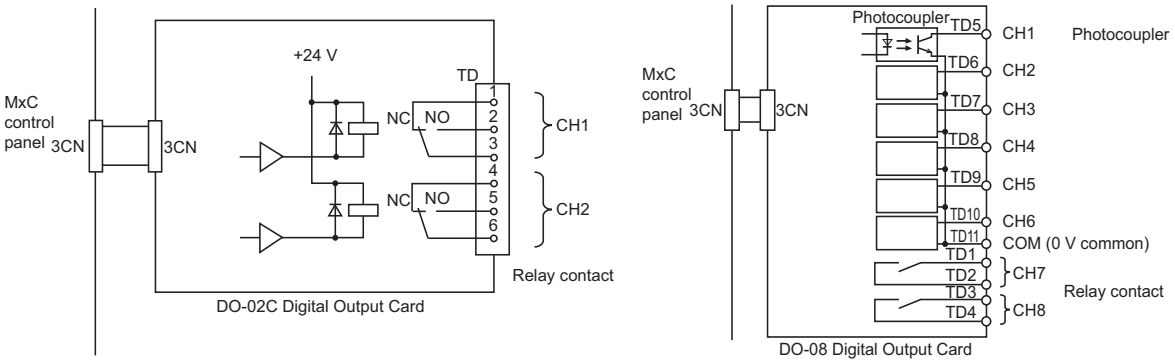


Fig 6.81 Digital Output Cards

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods: V/f	Control Methods: Open Loop Vector	Control Methods: Flux Vector
F5-01	DO-02/DO-08 Channel 1 Output Selection / DO Ch1 Select	Sets the digital output function number for channel 1. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	0	No	A	A	A
F5-02	DO-02/DO-08 Channel 2 Output Selection / DO Ch2 Select	Sets the digital output function number for channel 2. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	1	No	A	A	A
F5-03	DO-08 Channel 3 Output Selection / DO Ch3 Select	Sets the digital output function number for channel 3. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	2	No	A	A	A
F5-04	DO-08 Channel 4 Output Selection / DO Ch4 Select	Sets the digital output function number for channel 4. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	4	No	A	A	A
F5-05	DO-08 Channel 5 Output Selection / DO Ch5 Select	Sets the digital output function number for channel 5. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	6	No	A	A	A
F5-06	DO-08 Channel 6 Output Selection / DO Ch6 Select	Sets the digital output function number for channel 6. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	37	No	A	A	A
F5-07	DO-08 Channel 7 Output Selection / DO Ch7 Select	Sets the digital output function number for channel 7. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	0F	No	A	A	A
F5-08	DO-08 Channel 8 Output Selection / DO Ch8 Select	Sets the digital output function number for channel 8. See the H2 parameter group for possible selections. Enabled when digital output card DO-02 or DO-08 is used.	0 to 37	0F	No	A	A	A
F5-09	DO-08 Output Mode Selection / DO-08 Selection	Sets the function of the DO-08 digital output option card. 0: 8-channel individual outputs. 1: Binary code output. 2: 8-channel Selected - Output according to F5-01 to F5-08 settings.	0 to 2	0	No	A	A	A

■Setting Output Items for the DO-02C Digital Output Card

If using DO-02C Digital Output Card, set the output items using F5-01 and F5-02.

■Setting Output Items for the DO-08 Digital Output Card

If using DO-08 Digital Output Card, 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 (OC, GF)
	TD6-TD11	Overvoltage (OV, AOV)
	TD7-TD11	MxC overload (OL2, OH2)
	TD8-TD11	Not used
	TD9-TD11	Overspeed (OS)
	TD10-TD11	MxC overheated (OH1) or motor overload (OL1)
	TD1-TD2	Zero-speed detected
	TD3-TD4	Speed Agree

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 Agree	
	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 (EF□□)
0001	Overcurrent (OC, GF)	1001	Controller error (CPF□□)
0010	Overvoltage (OV, AOV)	1010	Motor overload (OL1)
0011	MxC overload (OL2, OH2)	1011	Not used
0100	MxC overheated (OH, OH1)	1100	Power loss (UV1, UV2, FDV, AUV, or SRC)
0101	Overspeed (OS)	1101	Speed deviation (DEV)
0110	Not used	1110	PG Disconnect (PGO)
0111	Built-in resistor overheated (SOH, DOH)	1111	Not used

F5-09 Set to 2

Output depends on the settings in F5-01 to F5-08.

◆ Using an Analog Reference Card

AI-14B provides 3 channels of bi-polar inputs with 14-bit A/D conversion accuracy (signed 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 option card.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
F2-01	AI-14 Input Selection / AI-14 Input Sel	Sets the function for channel 1 to 3 of the AI-14B analog input reference option card. 0: 3-channel individual (Channel 1: terminal A1, Channel 2: terminal A2, Channel 3: terminal A3) 1: 3-channel addition (Summed values of channels 1 to 3 is the frequency reference) When set to 0, select 1 for b1-01. In this case, the multi-function input "Option/MxC selection" cannot be used.	0 or 1	0	No	A	A	A

■Setting Precautions

Always set b1-01 (Frequency 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 H1-10 (parameters for multi-function digital input terminals S3 to S12) cannot be set to 2 (Option/MxC).

◆ Using a Digital Speed Reference Card

When using a DI-08 or DI-16H2 Digital Speed Reference Card, set b1-01 (Frequency Reference Selection) to 3 (Option card).

The DI-16H2 can be used to set a frequency using a 16-bit digital reference. The DI-08 can be used to set a frequency using a 8-bit digital reference.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods		
						V/f	Open Loop Vector	Flux Vector
F3-01	DI-08 / DI-16H2 Input Selection DI Input	Sets the function of the DI-08 or the DI-16H2 digital input option card. 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 (5-digit) 0.01 Hz unit (enabled only when DI-16H2 is used). 7: Binary input 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
o1-03	Digital Operator Display Selection Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: 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. □□□□□ Set 4-digit number excluding the decimal point. Set the number of digits below the decimal point to display. Example: When the max. output frequency value is 200.0, set 12000.	0 to 39999	0	No	A	A	A

* The digital operator shows rpm instead of min^{-1}.

■Selecting Input Terminal Functions for the DI-16H2 Digital Speed Reference Card

The frequency reference from the DI-16H2 option card 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 Signed	16-bit Binary Signed	3-digit BCD Signed		4-digit BCD Signed		4-digit BCD Not signed	
		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	BDC digit 1 (0 to 9)	1	BDC digit 1 (0 to 9)	2	BDC digit 1 (2 to 9)
	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	BDC digit 2 (0 to 9)
	5	Bit 1 (2^4)	Bit 1 (2^4)	1	BDC digit 2 (0 to 9)	1	BDC digit 2 (0 to 9)	2	
	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	BDC digit 3 (0 to 9)
	9	Bit 1 (2^8)	Bit 1 (2^8)	1	BDC digit 3 (0 to 9)	1	BDC digit 3 (0 to 9)	2	
	10	Bit 1 (2^9)	Bit 1 (2^9)	2		2		4	
TC2	1	Bit 1 (2^{10})	Bit 1 (2^{10})	4		4		8	
	2	Bit 1 (2^{11})	Bit 1 (2^{11})	8		8		1	BDC digit 4 (0 to 9)
	3	-	Bit 1 (2^{12})		-	1	BDC digit 4 (0 to 9)	2	
	4	-	Bit 1 (2^{13})		-	2		4	
	5	-	Bit 1 (2^{14})		-	4		8	
	6	-	Bit 1 (2^{15})		-	8		1	BDC 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 frequency (100% speed) reference will be used when the binary input is set (setting: 6 or 7) and all bits equal 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. Signed bits are used as data bits, so only positive (plus) data can be set. Also, the first digit starts from 0, so the minimum setting is 0.02 Hz.

■Selecting the Input Terminal Function for a DI-08 Digital Speed Reference Card

The frequency reference from a DI-08 Card is determined by the setting of F3-01, as shown in the following table.

Terminal	Pin No.	8-bit Binary Signed	2-digit BCD Signed	
		F3-01 = 7	F3-01 = 0 to 5	
TC	1	Bit 1 (2^0)	1	BDC 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	BDC 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 (Frequency 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 parameters.

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-bit	3-digit BCD signed, 1%	-110 to 110%	0.01 Hz	0.01%
		16-bit	4-digit BCD signed, 1%	-110 to 110%		
	1	12-bit	3-digit BCD signed, 0.1%	-110.0 to 110.0%		
		16-bit	4-digit BCD signed, 0.1%	-110.0 to 110.0%		
	2	12-bit	3-digit BCD signed, 0.01%	-15.99 to 15.99%		
		16-bit	4-digit BCD signed, 0.01%	-110.0 to 110.0%		
	3	12-bit	3-digit BCD signed, 1 Hz	-120 to 120 Hz		
		16-bit	4-digit BCD signed, 1 Hz	-120 to 120 Hz		
	4	12-bit	3-digit BCD signed, 0.1 Hz	-120.0 to 120.0 Hz		
		16-bit	4-digit BCD signed, 0.1 Hz	-120.0 to 120.0 Hz		
	5	12-bit	3-digit BCD signed, 0.01 Hz	-15.99 to 15.99 Hz		
		16-bit	4-digit BCD signed, 0.01 Hz	-120.00 to 120.00 Hz		
	6	16-bit	5-digit BCD not signed, 0.01 Hz	000.00 to 120.00 Hz		

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	7	12-bit	12-bit binary signed, 100%/4095	-4095 to 4095	0.01 Hz	0.01%
		16-bit	16-bit binary signed, 100%/30000	-33000 to 33000		
2 to 39	-	12-bit	3-digit BCD signed, 1 rpm	-1599 to 1599 rpm	1 rpm	
		16-bit	4-digit BCD signed, 1 rpm	-15999 to 15999 rpm	1 rpm	
40 to 39999	-	12-bit	3-digit BCD signed, 100%/ (1- to 4-digit setting of o1-03)	-4095 to 4095	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-bit	4-digit BCD signed, 100%/ (1- to 4-digit setting of o1-03)	-10999 to 10999 (when o1-03 = 9999)		
10000 x = 1 to 3	-	16-bit	4-digit BCD signed, 100%/10000	-11000 to 11000		

DI-08 Reference Ranges

When using the DI-08, the following ranges can be set depending on the settings of the parameters.

F3-01	Reference Input Mode	Reference Setting Range	U1-01 Monitor Unit	
			o1-03 = 0	o1-03 = 1
0	2-digit BCD signed, 1%	-110 to 110%	0.01 Hz	0.01%
1	2-digit BCD signed, 0.1%	-15.9 to 15.9%		
2	2-digit BCD signed, 0.01%	-1.59 to 1.59%		
3	2-digit BCD signed, 1 Hz	-120 to 120 Hz		
4	2-digit BCD signed, 0.1 Hz	-15.9 to 15.9 Hz		
5	2-digit BCD signed, 0.01 Hz	-1.59 to 1.59 Hz		
6	-			
7	12-bit binary signed, 100%/4095	-255 to 255		

Elevator and Hoist Type Applications

This section describes precautions when using the MxC for elevating machines such as elevators and cranes.

◆ Brake On/Off Sequence

■Brake On/Off Sequence

For the holding brake's on/off sequence, use the following MxC output signals according to the control method.

Control Method	Brake On/Off Signal		Brake On/Off Level Adjustment	
	Signal Name	Parameter *1	Signal Name	Parameter
V/f (A1-02 = 0) Open Loop Vector (A1-02 = 2, default)	Frequency Detection 2	H2-01 = 05 *4	Frequency detection level and detection width	L4-01 = 1.0 to 3.0 Hz *2, L4-02 = 0.1 to 0.5 Hz *3
	Frequency Detection 5	H2-01 = 36 *4		
Flux Vector (A1-02 = 3)	During Run 2	H2-01 = 37	Zero-speed level (off timing only)	b2-01 = 0.1 to 0.5 Hz

* 1. This example shows multi-function output terminals M1-M2 used for the holding brake on/off signal.
Do not set H2-01 to 0 (During run).

* 2. This is the standard setting range for Open Loop Vector Control. For V/f control, set to approximately the motor rated slip frequency +0.5 Hz.
If the set value is too low, the motor torque is insufficient and the load may slip when the brake is applied. Be sure to set L4-01 to a value larger than that of E1-09 (Min. Output Frequency) and larger than that of L4-02 shown in Figure 6.82. If the set value is too large, the motor may not run smoothly when it starts running.

* 3. The hysteresis in Frequency Detection 2 can be adjusted (from 0.1 to 0.5 Hz) by L4-02 (Speed Agree Detection Width). Change the setting to approximately 0.1 Hz if there are drops while stopping.

* 4. If using the Frequency Detection 2, set L4-01 before setting the H2-01. Otherwise, the holding brake will open when the motor stops. Also, use the Frequency Detection 5 to close the holding brake when the MxC is in Baseblock.

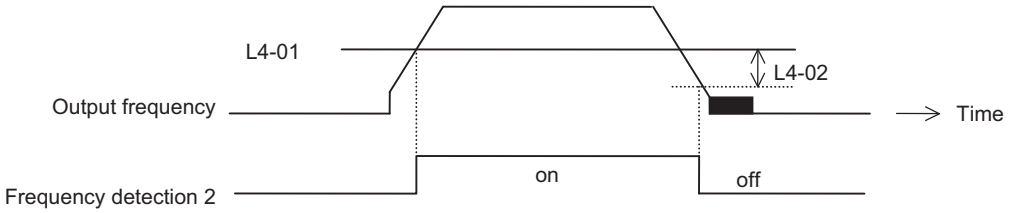
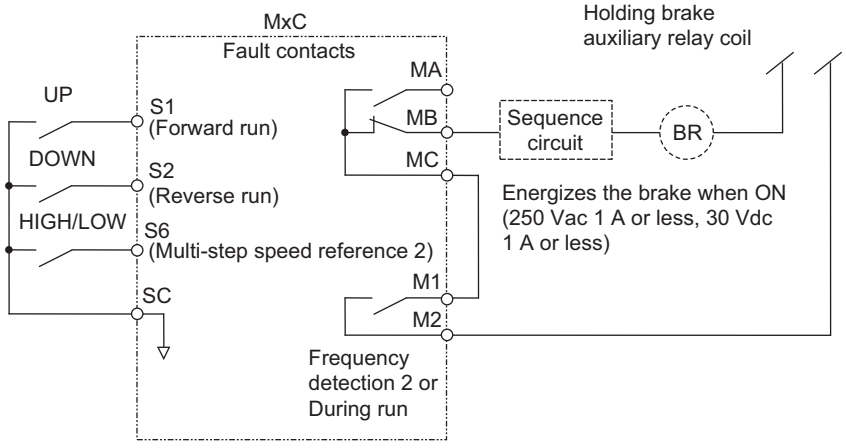


Fig 6.82

■Sequence Circuit Configuration

The brake on/off sequence circuit configuration is shown below.

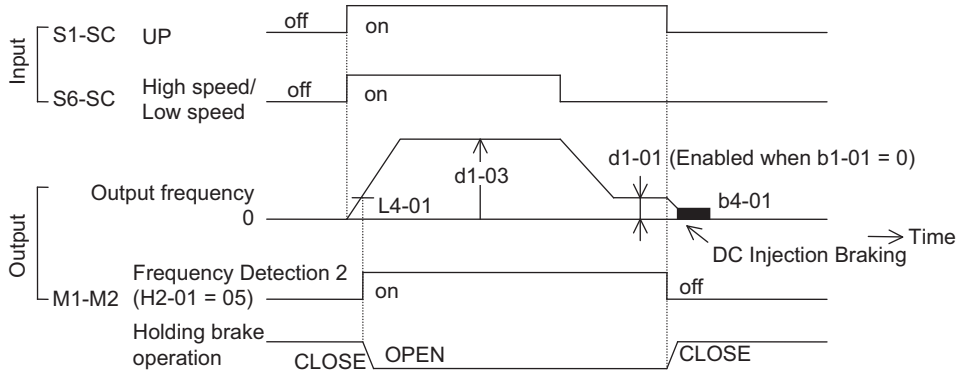


Note: Design the sequence so that the holding brake contact is open when the sequence operation conditions are satisfied and the contact between M1 and M2 is closed (on).
Make sure that the holding brake contact is closed when the emergency stop signal or MxC fault contact output signal is on.

Fig 6.83 Brake On/Off Sequence Circuit Configuration

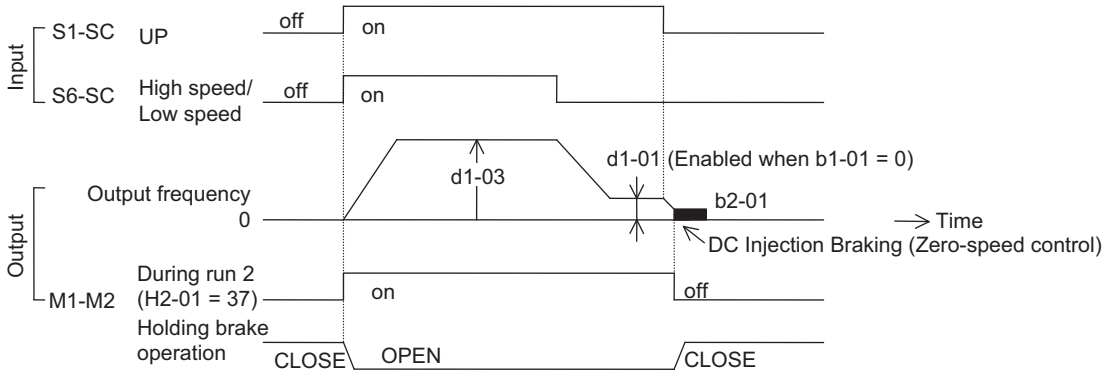
■Time Chart

The brake on/off sequence time charts are shown in Figs. 6.84 and 6.85.



Note: For variable speed operation by an analog signal, set to b1-01 = 1.

Fig 6.84 Brake On/Off Sequence Time Chart (V/f, Open Loop Vector)



Note: For variable speed operation by an analog signal, set to b1-01 = 1.

Fig 6.85 Brake On/Off Sequence Time Chart (Flux Vector)

◆ Auto-Tuning

Always perform Auto-Tuning with the motor before operating using vector control. Be sure to disconnect the motor from the load before conducting Auto-Tuning. Conducting Auto-Tuning while the motor is connected to an elevator or hoist type of application is dangerous because Auto-Tuning automatically runs the motor for approximately one minute.

IMPORTANT

1. If the machine cannot be removed from the motor, carry out Stationary Auto-Tuning (T1-01 = 4). If Stationary Auto-Tuning is complete, the MxC will turn on the motor without rotating it, and automatically measures the motor data.
2. To improve low-speed torque characteristics using V/f control, conduct Stationary Auto-Tuning for line to line resistance only (T1-01 = 2).
3. When conducting Auto-Tuning on a wound motor or other special types of motors, obtain a test report for the motor in advance and confirm that the E2 motor parameters after Auto-Tuning do not vary greatly from those of the test report.

◆ Momentary Power Loss Ridethrough

Do not use the Momentary Power Loss Restart and Fault Restart functions in elevator-type applications. Make sure that L2-01=0 and L5-01=0. If these functions are used, the motor coasts to a stop with the brake contact open when a momentary power loss or fault occurs during run, possibly resulting in serious accidents.

◆ Torque Limit

The torque limit values (L7-01 to L7-04) are the motor's rated torque. When there is a possibility of insufficient torque at start up or other times, increase the MxC capacity and set the torque limit value between 200% and 300% (default is 200%).

◆ I/O Phase Loss Protection and Overtorque Detection

To prevent the load from falling when phase loss or a similar situation occurs, enable L8-07 (Output Phase Loss Protection) and L6-01 to L6-06 (Torque Detection Selection). This setting is disabled as a default.

Falling detection or a similar safety measure should also be provided on the load side.

◆ External Baseblock Signal

If the External Baseblock Command (settings 8 and 9 of H1-01 to H1-10) is input while the motor is running, the motor will immediately coast to a stop. Do not input the External Baseblock Command while the motor is running unless necessary.

Make sure that the holding brake operates when using the External Baseblock Command for a Fast Stop or interlock to start the MxC.

If the External Baseblock Command is input and immediately reset, the MxC does not output voltage for the time set to L2-03 (Momentary Power Loss Minimum Baseblock Time). The default for L2-03 is 0.5 to 2.0 seconds, depending on the MxC capacity. Do not use the External Baseblock Command in an application where the motor is frequently started and stopped.

◆ Acceleration/Deceleration Time

If the delay time for the holding brake's mechanical operation is not properly calculated and the accel/decel time on the MxC side is too short, overcurrent or wear on the brakes may occur at start. This can also cause the load to slip at stop because the holding brake won't be triggered in time. If these situations arise, adjust the timing for the holding brake by using the Dwell function at start or the Dwell function at stop. See page 6-152 for more information.

◆ Output Side Magnetic Contactor

Do not install a magnetic contactor between the MxC and the motor. Other than an emergency situation, if a magnetic contactor must be installed because of local electrical codes or regulations, or in order to operate cer-

tain motors with an MxC, open or close the magnetic contactor only when the holding brake is fully closed and the MxC is in baseblock status with the baseblock signal on.

If the magnetic contactor is opened or closed while the MxC is controlling the motor or during DC Injection Braking (Zero-speed control), surge voltage or current from the motor by a full-voltage start may cause an MxC fault.

When a magnetic contactor is installed between the MxC and the motor, set L8-07 (Output Phase Loss Protection) to 1 or 2 (Enabled).

◆ Control Related Adjustments

The MxC is designed to provide sufficient performance for elevator and hoist type applications. However, if problems related to controllability should occur such as oscillation or slipping, adjust the following parameters in accordance with the control method. Only parameters that frequently require adjustment are listed in this table.

Table 6.4 Control-Related Adjustments

Control Method	Parameter Number	Name	Performance	Factory Setting	Recommended Setting	Adjustment Method
Open Loop Vector Control (A1-02 = 2)	E1-08	Mid Output Frequency Voltage (VC)	• Improves torque and speed response at low speeds • Controls shock at start up	13.0 VAC*	12.0 to 15.0 VAC*	• Torque or speed response is insufficient: Increase the setting • Shock at startup is large: Reduce the setting
	E1-10	Min. Output Frequency Voltage (VMIN)		2.5 VAC*	2.0 to 3.0 VAC*	
	n2-01	Speed Feedback Detection Control (AFR) Gain	• Increases torque and speed response • Controls hunting and oscillation in mid-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Torque or speed response is insufficient: Reduce the setting • Hunting or oscillation occurs: Increase the setting
	n2-03	Speed Feedback Detection Control (AFR) Time Constant 2	Increases torque and speed response	750 ms	100 to 750 ms	• Speed response is slow during sudden load change: Reduce the setting • Hunting or oscillation occurs: Increase the setting
	C4-02	Torque Compensation Primary Delay Time Constant	• Increases torque and speed response • Controls hunting and oscillation	100 ms	20 to 200 ms	• Torque or speed response is insufficient: Reduce the setting • Hunting or oscillation occurs: Increase the setting
	C3-02	Slip Compensation Primary Delay Time	• Increases speed response • Improves speed stability	200 ms	100 to 500 ms	• Speed response is slow: Reduce the setting • Speed is not stable: Increase the setting
	C3-01	Slip Compensation Gain	Improves speed accuracy	1.0	0.5 to 1.5	• Speed is slow: Increase the setting • Speed is too fast: Reduce the setting

Table 6.4 Control-Related Adjustments (Continued)

Control Method	Parameter Number	Name	Performance	Factory Setting	Recommended Setting	Adjustment Method
Flux Vector Control (A1-02 = 3)	C5-01	ASR Proportional (P) Gain 1	• Increases torque and speed response • Controls hunting and oscillation	20.00	10.00 to 50.00	• Torque or speed response is insufficient: Increase the setting • Hunting or oscillation occurs: Reduce the setting
	C5-03	ASR Proportional (P) Gain 2				
	C5-02	ASR Integral (I) Time 1	• Increases torque and speed response • Controls hunting and oscillation	0.500 s	0.300 to 1.000 s	• Torque or speed response is insufficient: Reduce the setting • Hunting or oscillation occurs: Increase the setting
	C5-04	ASR Integral (I) Time 2				
	C5-07	ASR Switching Frequency	Switches the ASR proportional gain and integral time according to the output frequency.	0.0 Hz (no switching)	0.0 to max output frequency	Set the output frequency at which to change the ASR proportional gain and integral time when the same values cannot be used for both high-speed and low-speed operation.
	C5-06	ASR Primary Delay time	Controls hunting and oscillation	0.004 s	0.004 to 0.020 s	Machine rigidity is low and the system vibrates easily: Increase the setting
V/f Control Method (A1-02 = 0)	E1-08	Mid Output Frequency Voltage (VC)	• Improves torque at low speeds • Controlling shock at startup	14.0 VAC*	13.0 to 16.0 VAC *	• Torque is insufficient at low speeds: Increase the setting • Shock at startup is large: Reduce the setting
	E1-10	Min. Output Frequency Voltage (VMIN)		7.0 VAC*	7.0 to 10.0 VAC *	
	C4-01	Torque Compensation Gain	• Improves torque at low speeds (10 Hz or lower) • Controlling hunting and oscillation for light loads	1.00	0.50 to 1.50	• Torque is insufficient at low speeds: Increase the setting • Hunting or oscillation occurs for light loads: Reduce the setting
	n1-02	Hunting-Prevention gain	Controls hunting and oscillation in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Torque is insufficient for heavy loads: Reduce the setting • Hunting or oscillation occurs for light loads: Increase the setting

* The setting is given for 200 V class MxCs. Double the voltage for 400 V class MxCs.

Note: 1. Do not change C4-01 (Torque Compensation Gain) from its default of 1.00 when using Open Loop Vector Control.

2. If speeds are inaccurate during regeneration in Open Loop Vector Control, enable Slip Compensation Selection during Regeneration (C3-04 = 1). If speeds are inaccurate in the high-speed range, enable Output Voltage Limit Operation Selection (C3-05 = 1).

3. Do not use Slip Compensation Gain (C3-01) during V/f Control Method (A1-02 = 0). C3-01 is disabled as a default during V/f Control.

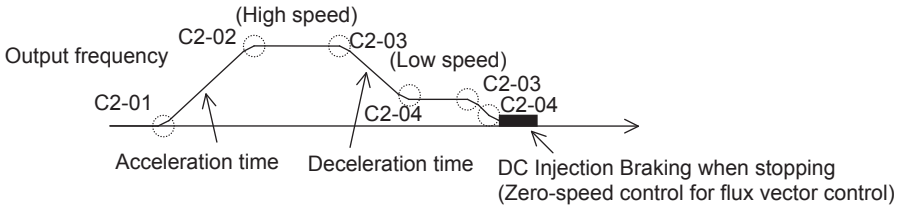
4. The torque and speed response of high-resistance (high-slip) motors are insufficient. Make appropriate adjustments to improve them. Low-resistance (low-slip) motors are easily subject to hunting and oscillation.

5. The current at start may rise when C4-02 (Torque Compensation Primary Delay Time) is increased. Check the current during startup while adjusting this parameter.

◆ Reducing Shock at Start/Stop and during Acceleration/Deceleration

Adjust the following parameters when riding comfort is highly important during start, stop, acceleration, and deceleration. These settings are often used for passenger elevators.

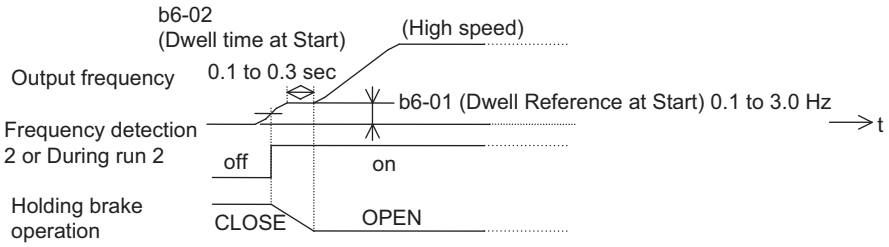
■S-Curve Characteristics, Acceleration/Deceleration Times



IMPORTANT

1. The default for C2-04 (S-Curve characteristic at decel end) is 0.00 second, while the default for all other S-curve characteristic times is 0.20 seconds. Make appropriate settings for the accel/decel times and S-curve characteristic times at each point. (S-curve characteristic time = Approximately 0.2 to 1.0 second)
2. The accel/Decel rate can be automatically switched during acceleration and deceleration by using C1-11 (Accel/Decel Switch Frequency). (Default: Disabled.)
   Output frequency ≥ set frequency: C1-01, C1-02 accel/decel times
   Output frequency < set frequency: C1-07, C1-08 accel/decel times
3. If the output frequency during the S-curve characteristic time for deceleration falls below the value set for E1-09 (Min. output frequency), the S-curve characteristic will be cancelled, and the DC injection braking (Zero-speed control) will be applied.
4. Do not use the S-curve characteristic for applications where a short run time is desired, such as in cranes and hoists. (S-curve characteristic time = Approximately 0.0 to 0.2 seconds)

■Dwell Function at Start

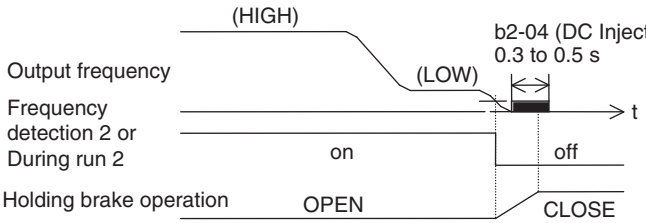


If the mechanical operation of the holding brake is slow, use the Dwell function at start to prevent brake wear, and accelerate after the brake is completely open.

IMPORTANT

1. When using Open Loop Vector Control or V/f Control, set b6-01 (Dwell frequency at start) higher than Frequency Detection 2 (frequency when brakes open).
2. If the motor tends to have insufficient torque when started, use the DC Injection Braking function to allow sufficient motor current (torque) before starting.
   - b2-03 (DC Injection Braking Time/DC Excitation Time at Start): 0.2 to 0.5 s
   - b2-02 (DC Injection Braking Current): 50% to 80% (Open Loop Vector Control, V/f Control Method only)

■Stopping with DC Injection Braking and Zero-Speed Control



- b2-01 (DC Injection Braking Start Frequency)]: 0.1 to 3.0 Hz
- b2-02 (DC Injection Braking Current): 50% to 80%
  (open loop vector control, V/f control only)

When the holding brake's mechanical operation is slow, use DC Injection Braking (zero-speed control for Flux Vector Control) until the brakes are fully closed to prevent the brakes from slipping when stopping.

IMPORTANT

1. When the load cannot be maintained sufficiently using DC Injection Braking with Open Loop Vector Control and V/f control, use the Dwell functions at stop.
   - b6-03 (Dwell Frequency at Stop): Min. output frequency to 3.0 Hz.
     The value must be less than the frequency when frequency detection 2 is off (L4-01 − L4-02).
   - b6-04 (Dwell Time at Stop): 0.3 to 0.5 s
     [b2-04 (DC Injection Braking Time at Stop): 0.0 s]
2. If the MxC and motor must be isolated while stopping using a magnetic contactor, for example in an elevator, fully close the holding brakes and isolate the MxC during baseblock (during baseblock signal: on) as stipulated by law in the EU.
   During motor control or DC Injection Braking (zero-speed control), an MxC error may occur due to surge voltage. When a magnetic contactor is used between the MxC and motor, set L8-07 (Output Phase Loss Protection) to 1 (enabled).

■Torque Compensation (Flux Vector Control Only)

When Flux Vector Control is used, the torque compensation signals corresponding to the load can be input from the multi-function analog input terminals in advance to reduce shock, such as that caused by opening and closing holding brakes. The load size and motoring/regenerating status must be detected at the machine side in advance. Check that polarity is correct. Incorrect polarity will increase the shock.

Sequence Circuit Configuration

The following diagram shows the sequence circuit configuration for torque compensation.

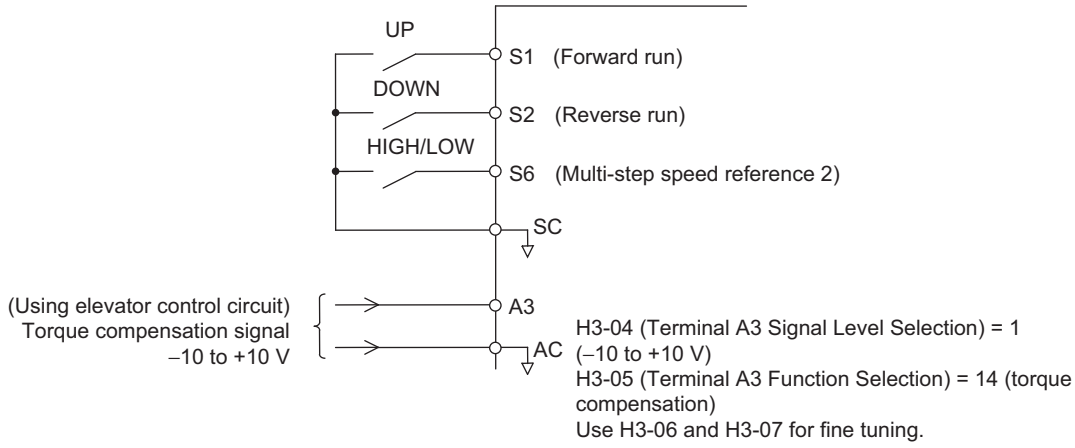


Fig 6.86 Torque Compensation Sequence Circuit Configuration

Time Chart

• Lifting

The analog signals corresponding to the load size are input as torque compensation signals from before the MxC starts until operation stops (default: 10 V/100% torque).
Positive polarity is input for motor loads and negative polarity is input for regenerative loads.
The following diagram shows the time chart for lifting the load.

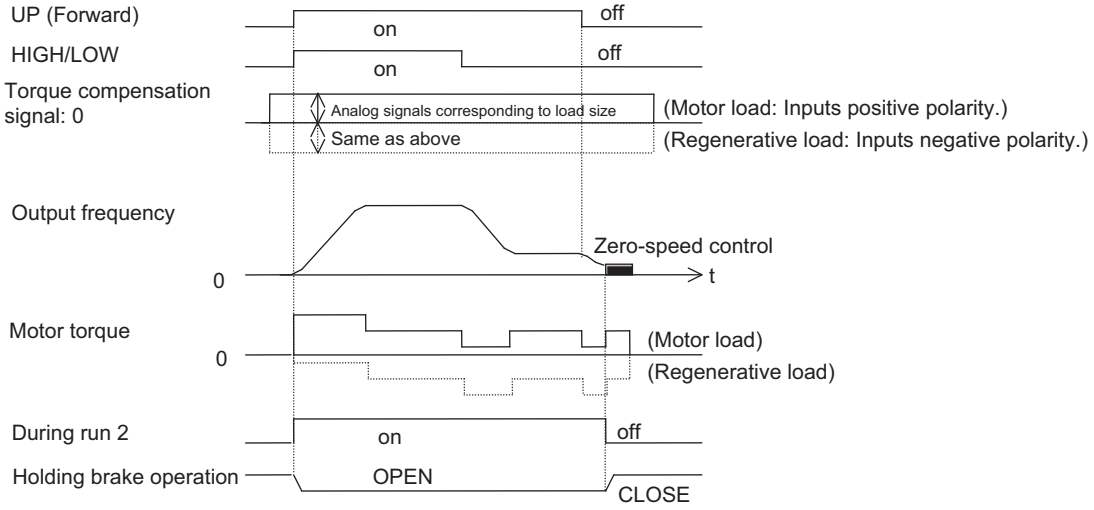


Fig 6.87 Torque Compensation Time Chart (Lifting)

• Lowering

In the same way as for lifting, when the torque decreases, the analog signals corresponding to the load size are input as torque compensation signals from before the MxC starts until operation stops (default: 10 V/100% torque).
Negative polarity is input for motor loads and positive polarity is input for regenerative loads.

The following diagram shows the time chart for lowering.

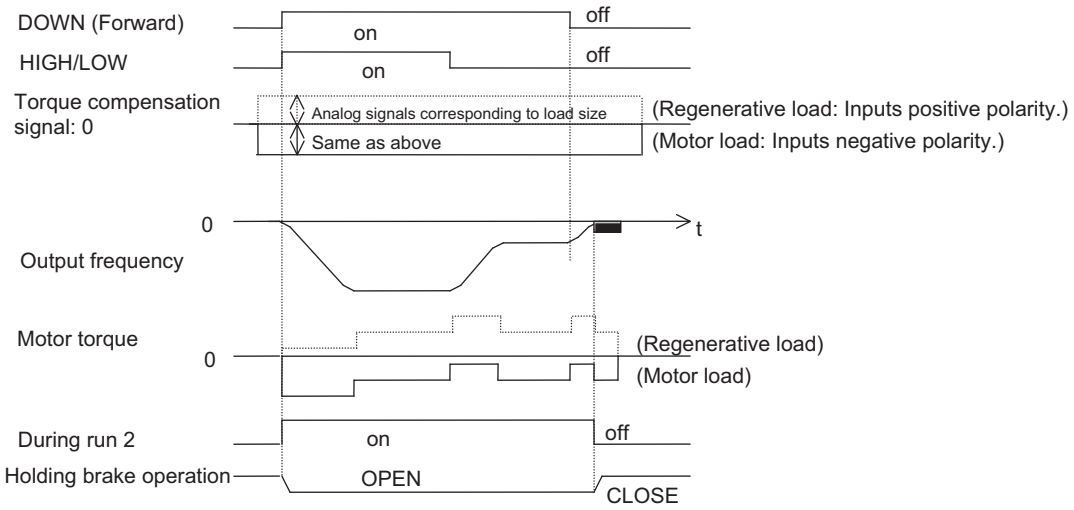


Fig 6.88 Torque Compensation Time Chart (Lowering)

IMPORTANT

1. For either increasing or decreasing torque, externally maintain the torque compensation signals during run to prevent them from fluctuating. Fluctuation in compensation signals during run may result in oscillation.
2. If reverse run is used for lifting and forward run is used for lowering, the torque compensation signal polarity must be reversed.

■Analog Input Filter Time Constant

If noise enters the analog frequency reference during run using analog frequency reference (b1-01 = 1), and operation becomes rough, implement noise countermeasures and also set H3-12 (Analog Input Filter Time Constant) to between 0.01 and 0.10 s.

◆ Confirming Start Up Current and Reducing Carrier Frequency

When performing test run, check the motor current using the digital operator or a clamp ammeter with and without the load. An extremely high current will flow if the motor torque at start is insufficient, or if timing is not correct and the motor locks with the holding brake.

If the current at start is 150%, the IGBT in the MxC will be subject to heat stress, resulting in a shortened performance life. Refer to the previous precautions and take steps to reduce the current, such as re-tuning and reducing the load until the current drops to less than 150%. If using Flux Vector Control and particularly low noise is not required, reduce the influence of heat stress by decreasing the MxC's carrier frequency to 4 kHz.

Maintenance Timer Display Function

This function indicates that the estimated performance life of the cooling fan and the capacitors on the PCB board has 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 Enable the 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 parameters U1-61 and U1-63).

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

The maintenance time period for the cooling fan or DC bus 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		
		V/f	Open Loop Vector	Flux Vector
2F*	Maintenance Time ON: The operation time of either the capacitors on the PCB board or the cooling fan have reached the specified maintenance time.	Yes	Yes	Yes

* Applicable for Varispeed AC with software versions PRG:1050 or later.

Refer to *H2: Multi-Function Contact Outputs* in *Chapter 5 Parameters and Settings* for information on multi-function contact outputs.

■Related Status Monitoring Parameters

Parameter Number	Name Display	Description	Setting Range	Min.Unit	Control Methods			MEMO-BUS Register
					V/f	Open Loop Vector	Flux Vector	
U1-40	Cooling fan operating time FAN Elapsed Time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	*No output available*	1 hr	A	A	A	67H
U1-61*	DC bus capacitor maintenance C Maintenance	For maintenance purposes, this timer shows the amount of time the capacitors on the PCB board have been operating. Capacitors should be replaced when the monitor reaches 100%.	*No output available*	1%	A	A	A	7CH
U1-63*	Cooling fan maintenance Fan Maintenance	This monitor displays the amount of time the cooling fan has been operating. Replace the cooling fan when the display reads 100%.	*No output available*	1%	A	A	A	7EH

* Applicable for Varispeed AC with software versions PRG: 1050 or later.

■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
LT-C* (flashing) Maintenance	Monitor U1-61 has reached 100%.	The capacitors on the PCB board have reached their estimated maintenance time period.	Reset parameter o2-18 to "0%" after replacing the capacitors on the PCB board.
LT-F* (flashing) Fan Maintenance	Monitor U1-63 has reached 100%.	The cooling fan has reached its estimated maintenance time period.	Replace the cooling fan and set parameter o2-10 to "0H".

* Applicable for the Varispeed AC with software versions PRG: 1050 or later.

◆ Settings Required After Replacement of Cooling Fan or Capacitors on PCB Board

- Set o2-10 to 0 after replacing the cooling fan.
- Set o2-18 to 0 after replacing the PCB board.

Refer to *Chapter 8 Maintenance and Inspection* for the replacement procedure.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Default	Change during Run	Control Methods			MEMO-BUS Register
						V/f	Open Loop Vector	Flux Vector	
o2-10*	Fan operation time setting / Fan ON Time Set	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
o2-18*	Capacitor maintenance setting / C MaintenanceSet	Allows the user to set the maintenance time for the capacitors on the PCB board (U1-61). The user can reset the accumulated operation time back to zero, or to some other desired value.	0 to 150	0%	No	A	A	A	51DH

* Applicable for Varispeed AC with software versions PRG: 1050 or later.

7

Troubleshooting

This chapter describes diagnostics and troubleshooting for the MxC.

Protective and Diagnostic Functions 7-2
Troubleshooting 7-18

Protective and Diagnostic Functions

This section describes alarm features available in the MxC. The alarm functions include fault detection, alarm detection, operation error detection, and Auto-Tuning error detection.

◆ Fault Detection

When the MxC detects a fault, a fault contact output is triggered and the operator screen will display the appropriate fault code. The MxC output is shut off, which causes the motor to coast to a stop. The user may select how the MxC should stop the motor for some faults, and MxC will obey the specified stop method when those faults occur. A fault code is displayed on the digital operator.

If a fault occurs, refer to the following table to identify and correct the problem that caused the fault.

Use one of the following methods to reset the fault before restarting the MxC:

- Set a multi-function digital input (H1-01 to H1-05) to 14 (Fault Reset) and turn on the fault reset signal.
- Press the RESET key on the digital operator.
- Cycle power to the MxC (i.e., turn the main circuit power supply off and back on again).

A fault may occur if there is a short between the +V, -V, and AC terminals. Be sure the terminals have been wired properly.

Table 7.1 Fault Displays and Processing

Display	Meaning	Probable Causes	Corrective Actions
No display	The display of the digital operator shows nothing.	The wiring is incorrect.	Check and correct the wiring on the MxC input end.
		The digital operator is not connected properly.	• Reconnect the digital operator. • Replace the digital operator.
		A short circuit occurred in the main circuit or control fuse.	Replace the MxC.
OC Overcurrent	Overcurrent The MxC output current exceeded the overcurrent detection level. (200% of rated current)	• A short-circuit or ground fault occurred at the MxC output. A short or ground fault may be due to a damaged motor, worn insulation, or a bad cable. • The load is too large or the accel/decel time is too short. • A special-purpose motor or motor with a capacity too large for the MxC is being used. • A magnetic contactor for the MxC output was opened or closed.	Clear the fault after cycling power or removing the cause of the problem. Note: Before turning the power back on again, make sure that there is no short-circuit or ground fault for the MxC output.
		The PG wiring is broken or doesn't have a good connection.	Fix any broken or loose wiring.
		The PG is wired incorrectly.	Properly rewire the PG.
		The PG is not receiving enough power.	Supply the required amount of power to the PG.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
GF Ground Fault	Ground Fault* The ground fault current at the MxC output exceeded approximately 50% of the MxC rated output current.	A ground fault occurred at the MxC output. A ground fault may be due to a damaged motor, worn insulation, or a bad cable.	Clear the fault after cycling power or removing the cause of the problem. Note: Before turning the power back on again, make sure that there is no short-circuit or ground fault for the MxC output.
AUV Power UV	Power Supply Undervoltage The power supplied to the MxC is below the minimum amount set to L2-21. 200 V class: Approx. 150 VAC 400 V class: Approx. 300 VAC	• The power capacity is too small. • The power distortion is too large.	• Increase the power capacity. • Decrease the impedance of the input power wiring. For details, refer to *MxC Application Precautions* in Chapter 10.
		An open phase occurred in the input power supply.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.
		Check whether there is short-circuit between the following terminals. R/L1 ← → r2, S/L2 ← → s2, T/L3 ← → t2 If no short-circuit is found, then the problem may be a damaged fuse.	Replace the MxC.
OV PS Overvolt	Control Circuit Overvoltage The control circuit voltage exceeded the overvoltage detection level. 200 V class: Approx. 410 V 400 V class: Approx. 870 V	The power supply voltage is too high.	Decrease the voltage to be within specifications.
		• The terminal of the input power is loosened. • The magnetic contactor is turned on or off at the MxC output side.	Clear the fault after correcting the problem or removing its cause.
		The power supply has an open phase.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.
AOV Power OV	Power Supply Overvoltage The control-circuit voltage exceeded the overvoltage detection level. 200 V class: Approx. 250 V 400 V class: Approx. 550 V	• The power-supply voltage is too high. • The power capacity is too small. • The power distortion is too large.	• Decrease the voltage to be within specifications. • Increase the power capacity. • Decrease the impedance of the input power wiring. For details, refer to *MxC Application Precautions* in Chapter 10.
		An open phase occurred in the input power supply.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.

* 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
UV1 Undervolt-age	Control Circuit Undervoltage The control circuit DC voltage is below the Undervoltage Detection Level (L2-05). 200 V class: Approx. 190 V 400 V class: Approx. 380 V	• There was a momentary loss in power. • The wiring terminals for the input power supply are loose. • Too much voltage fluctuation in the input power supply.	Clear the fault after correcting the power or removing its cause.
		An open-phase occurred with the input power supply.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.
UV2 CTL PS Undervolt	Control Power Fault Not enough voltage is being produced by the power supply.	-	• Cycle power to the MxC. • Replace the MxC if the fault continues to occur.
FDV Freq DEV	Power Supply Frequency Fault The fluctuation in the power frequency exceeded the allowable amount.	• 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 phase is bad.	Clear the fault after correcting the power supply or removing its cause.
		An open phase occurred in the input power supply.	Check and correct the open-phase condition or the imbalance of the input power.
SRC Power Phase Err	Power Phase Rotation Variation After control power supply is on, the direction of the phase rotation changes.	• The phase sequence changed during run. • 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 phase is bad.	Clear the fault after correcting the power or removing its cause.
LF Output Pha Loss	Output Open-Phase An open-phase occurred at the MxC output. This fault is detected when L8-07 is set to “Enabled.”	• There is a broken wire in the output cable. • There is a broken wire in the motor-winding. • The output terminals are loose.	Clear the fault after correcting the problem or removing its cause.
		The motor being used has a capacity less than 5% of the rated output current of the MxC.	Check the motor and MxC capacity.

Table 7.1 Fault Displays and Processing (Continued)

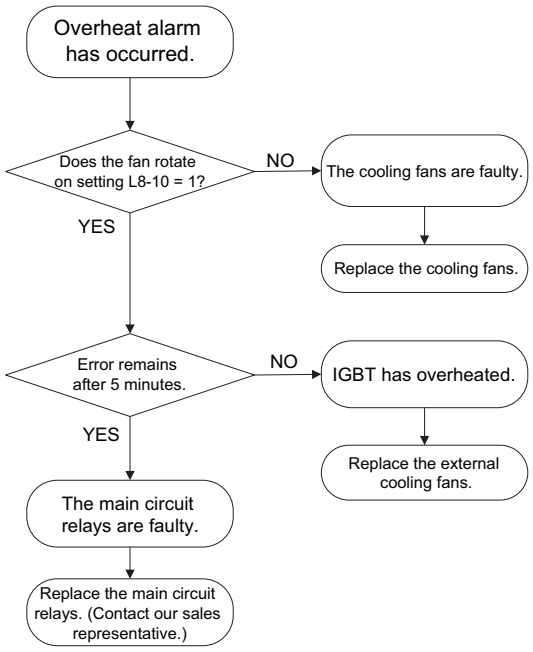
<table>
<tr><th>Display</th><th>Meaning</th><th>Probable Causes</th><th>Corrective Actions</th></tr>
<tr><td rowspan="4">OH
(OH1)
Heatsnk
Overtemp
(Heatsnk
MAX
Temp)</td><td rowspan="4">Cooling Fin Overheating
The temperature of the MxC's cooling fins exceeded the setting in L8-02 or 105°C.</td><td>The ambient temperature is too high.</td><td>Install a cooling unit.</td></tr>
<tr><td>There is a heat source nearby.</td><td>Remove the heat source.</td></tr>
<tr><td>The MxC's cooling fan has stopped.</td><td>Replace the cooling fan. (Contact our sales representative.)</td></tr>
<tr><td colspan="2">Note Check the flowchart below for appropriate corrective actions for CIMR-ACA4110 and CIMR-ACA4160.
 
</td></tr>
<tr><td>OH3
Motor
Overheat 1</td><td>Motor Overheating Alarm
The MxC will stop or will continue to operate according to the setting of L1-03.</td><td rowspan="3">The motor has overheated.</td><td>Check the size of the load and the length of the acceleration, deceleration, and cycle times.
Check the V/f characteristics.
Check the Motor Rated Current (E2-01).</td></tr>
<tr><td>OH4
Motor
Overheat 2</td><td>Motor Overheating Fault
The MxC will stop according to the setting of L1-04.</td><td>Check the size of the load and the length of the acceleration, deceleration, and cycle times.
Check the V/f characteristics.
Check the Motor Rated Current (E2-01).</td></tr>
</table>

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
SOH Dischrg Res. Flt	Resistor Overheat The temperature of the resistor exceeded tolerance.	• The input power supply voltage is too high. • The power capacity is too small. • The power distortion is too large.	• Decrease the voltage to be within specifications. • Increase the power capacity. • Decrease the impedance of the input power wiring. For details, refer to *MxC Application Precautions* in Chapter 10.
		The load conditions were too heavy during repetitive operation.	• Decrease the load. • Lengthen the acceleration and deceleration times.
		An open phase occurred in the input power supply.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.
		Current overflow during a current detection speed search.	Reduce the Current Suppression Gain During Search (b3-04).
DOH Dumping OH	Internal Resistance Overheat The temperature of the built-in resistor exceeded the set value.	• The power capacity is too small. • The power distortion is too large.	• Increase the power capacity. • Decrease the impedance of the input power wiring. For details, refer to *MxC Application Precautions* in Chapter 10.
		An open phase occurred in the input power supply.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.
		An operation command was input while this warning was displayed.	Set L8-10 (Heatsink Cooling Fan Operation Selection) to 1 so that the cooling fan will always turn on when the power is turned on. After changing the setting, wait for a while and then clear the fault.
OL1 Motor Overloaded	Motor Overload The motor overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time, and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high.	Check the V/f characteristics.
		The Motor Rated Current (E2-01) is incorrect.	Check the Motor Rated Current (E2-01).
OL2 MxC Overloaded	MxC Overload The MxC overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high.	Check the V/f characteristics.
		The MxC capacity is too low.	Replace the MxC with one that has a larger capacity.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
OL3 Overtorque Det 1	Overtorque Detection 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
OL4 Overtorque Det 2	Overtorque Detection 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	-	• 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 Undertorq Det 1	Undertorque Detection 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
UL4 Undertorq Det 2	Undertorque Detection 2 There has been a current less than the setting in L6-05 for longer than the setting in L6-06.	-	• 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 Det	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.
PGO PG Open	PG Disconnect Detected No PG pulse were input when the MxC was outputting a frequency.	The PG wiring is broken or disconnected.	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.
		-	Check for open circuit when using brake (motor).
DEV Speed Deviation	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.
		-	Check for open circuit when using brake (motor).
CF Ctl Fault	Control Fault The torque limit was continuously reached for three seconds or longer during a decelerate to stop with Open Loop Vector Control.	Motor parameter settings are not correct.	• Check the motor parameters. • Perform Auto-Tuning.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
FBL Feedback Loss	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).	-	-
EF0 Opt External Flt	External Fault Input from Communications Option Card	-	Check the Communications Option Card and communications signals.
EF3 Ext Fault S3	External Fault (Input Terminal S3)	An "external fault" was input from a multi-function input terminal.	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 Ext Fault S4	External Fault (Input Terminal S4)		
EF5 Ext Fault S5	External Fault (Input Terminal S5)		
EF6 Ext Fault S6	External Fault (Input Terminal S6)		
EF7 Ext Fault S7	External Fault (Input Terminal S7)		
EF8 Ext Fault S8	External Fault (Input Terminal S8)		
EF9 Ext Fault S9	External Fault (Input Terminal S9)		
EF10 Ext Fault S10	External Fault (Input Terminal S10)	An "external fault" was input from a multi-function input terminal.	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF11 Ext Fault S11	External Fault (Input Terminal S11)		
EF12 Ext Fault S12	External Fault (Input Terminal S12)		
SVE Zero Servo Fault	Zero-servo Fault The rotation position moved during zero-servo operation.	The torque limit is too small.	Increase the limit.
		The load torque is too large.	Reduce the load torque.
		-	Check for signal noise.
OPR Oper Disconnect	Digital Operator Connection Fault The connection to the digital operator was broken during run for a Run Command from the digital operator.	-	Check the connection to the digital operator.
CE Memobus Com Err	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.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
BUS Option Com Err	Option Communications Error A communications error was detected during a Run Command or while setting a frequency reference from a Communications Option Card.	-	Check the communications devices and communications signals.
CPF00 CPF	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 MxC's control circuits are faulty.	Replace the MxC.
	CPU External RAM Fault	-	Try turning the power supply off and on again.
		The control circuits were destroyed.	Replace the MxC.
CPF01 CPF01	Digital Operator Communications Error 2 After communications were established, there was a communications error with the digital operator for more than 2 seconds.	The digital operator isn't connected properly.	Disconnect the digital operator and then connect it again.
		The MxC's control circuits are faulty.	Replace the MxC.
CPF03 EEPROM Error	EEPROM Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the MxC.
CPF04 Internal A/D Err	CPU Internal A/D Converter Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the MxC.
CPF05 External A/D Err	CPU External A/D Converter Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the MxC.
CPF06 Option error	Option Card Connection Error	The option card is not connected properly.	Turn off the power and insert the card again.
		The MxC or option card is faulty.	Replace the option card or the MxC.
CPF07 RAM-Err	ASIC Internal RAM Fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the MxC.
CPF08 WAT-Err	Watchdog Timer Fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the MxC.
CPF09 CPU-Err	CPU-ASIC Mutual Diagnosis Fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the MxC.
CPF10 ASIC-Err	ASIC Version Fault	The MxC control circuit is faulty	Replace the MxC.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
CPF20 Option A/D error	Communications Option Card A/D Converter Error	The option card is not connected properly.	Turn off the power and insert the card again.
		The option card's A/D converter is faulty.	Replace the Communications Option Card.
CPF21 Option CPU down	Communications Option Card Self Diagnostic Error	Communications Option Card fault.	Replace the option card.
CPF22 Option Type Err	Communications Option Card Model Code Error		
CPF23 Option DPRAM Err	Communications Option Card DPRAM Error		

◆ Alarm Detection

Alarms are detected as a type of MxC protection function that do not operate the fault contact output. The system will automatically returned to its original status once the cause of the alarm has been removed.

The digital operator display flashes and the alarm is output from the multi-function outputs (H2-01 to H2-03).

When an alarm occurs, take appropriate countermeasures according to the table below.

Table 7.2 Alarm Displays and Processing

Display	Meaning	Probable causes	Corrective Actions
EF (flashing) External Fault	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. The motor will stop by the stopping method that is set in b1-03 when this fault occurs.
UV (flashing) PS Undervolt	Control Circuit Undervoltage The following conditions occurred when there was no run signal. • The control circuit voltage was below the Undervoltage Detection Level Setting (L2-05). • The control power supply voltage was below the CUV level.	See causes for UV1 and UV2 faults in the previous table.	See corrective actions for UV1 and UV2 faults in the previous table.
AUV (flashing) Power UV	Power Supply Undervoltage The power supply is below the undervoltage detection level (L2-21). 200 V class: Approx. 150 VAC 400 V class: Approx. 300 VAC	• The power voltage is too high. • The power capacity is too small. • The power distortion is too large.	• Decrease the voltage to be within specifications. • Increase the power capacity. • Decrease the impedance of the input power wiring. For details, refer to *MxC Application Precautions* in Chapter 10.
		An open phase occurred in the input power supply.	Check and correct the open-phase condition or the imbalance of the input power. Clear the fault after correcting the problem or removing its cause.
		Check if a short circuit occurred between the following terminals. R/L1 ← → r2, S/L2 ← → s2, T/L3 ← → t2	Replace the MxC.
FDV (flashing) Freq DEV	Power Supply Frequency Fault The fluctuation in the power frequency exceeded the allowable amount.	• 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 not equal.	• Increase the power capacity. • Decrease the impedance of the input power wiring. Clear the fault after correcting the problem or removing its cause. For details, refer to *MxC Application Precautions* in Chapter 10.
	Power Supply Undervoltage The power supply is below the undervoltage detection level (L2-21). 200 V class: Approx. 150 VAC 400 V class: Approx. 300 VAC	• 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 not equal.	• Increase the power capacity. • Decrease the impedance of the input power wiring. Clear the fault after correcting the problem or removing its cause. For details, refer to *MxC Application Precautions* in Chapter 10.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
SRC (flashing) Power Phase Err	Power Phase Rotation Variation After control power supply is on, the direction of the phase rotation changes.	• The phase sequence changed during run. • 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. • The voltage balance between phase is bad.	Clear the fault after correcting the problem or removing its cause.
OV (flashing) PS Overvolt	Control Circuit Overvoltage The control circuit voltage exceeded the overvoltage detection level. 200 V class: Approx. 410 V 400 V class: Approx. 870 V	The power supply voltage is too high.	Decrease the voltage to be within specifications.
OH (flashing) Heatsink Overtemp	Cooling Fin Overheat The temperature of the MxC'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 MxC cooling fan has stopped.	Replace the cooling fan. Contact your Yaskawa representative.
OH2 (flashing) Over Heat 2	MxC Overheating Pre-alarm An OH2 alarm signal (MxC overheating alarm signal) was input from a multi-function input terminal (S3 to S12).	-	Clear the multi-function input terminal's overheating alarm input.
OH3 (flashing) Motor Overheat 1	Motor Overheat The MxC continues or stops the operation according to the setting of L1-03.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the setting in E2-01 (Motor Rated Current).
DOH (flashing) Dumping OH	Internal Resistance Overheat The temperature of the built-in resistor exceeded the set value.	• The power capacity is too small. • The power distortion is too large.	• Increase the power capacity. • Decrease the impedance of the input power wiring. For details, refer to *MxC Application Precautions* in Chapter 10.
		An open phase occurred in the input power supply.	• Check and correct the open-phase condition or the imbalance of the input power. • If DOH flashes when the MxC is not running operating, Set L8-10 (Heatsink Cooling Fan Operation Selection) to 1. So that the cooling fan will always turn on when the power is turned on. Clear the fault after correcting the problem or removing its cause.
OL3 (flashing) Overtorque Det 1	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
OL4 (flashing) Over-torque Det 2	Overtorque 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	-	• 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 (flashing) Under-torq Det 1	Undertorque 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
UL4 (flashing) Under-torq Det 2	Undertorque 2 There has been a current less than the setting in L6-05 for longer than the setting in L6-06.	-	• 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 (flashing) Over-speed Det	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/undershooting are occurring.	Readjust the gain.
		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.
PGO (flashing) PG Open	PG Disconnect The MxC is outputting a frequency, but PG pulses aren't being input.	There is a break in the PG wiring.	Fix the broken or disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power isn't being supplied to the PG.	Supply power to the PG properly.
DEV (flashing) Speed Deviation	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.
EF0 (flashing) Opt External Flt	External Fault Detected for Communications 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.
EF3 (flashing) Ext Fault S3	External Fault (Input Terminal S3)	An external fault was input from a multi-function input terminal (S3 to S12).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 (flashing) Ext Fault S4	External Fault (Input Terminal S4)		
EF5 (flashing) Ext Fault S5	External Fault (Input Terminal S5)		
EF6 (flashing) Ext Fault S6	External Fault (Input Terminal S6)		

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
EF7 (flashing) Ext Fault S7	External Fault (Input Terminal S7)	An external fault was input from a multi-function input terminal (S3 to S12).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF8 (flashing) Ext Fault S8	External Fault (Input Terminal S8)		
EF9 (flashing) Ext Fault S9	External Fault (Input Terminal S9)		
EF10 (flashing) Ext Fault S10	External Fault (Input Terminal S10)		
EF11 (flashing) Ext Fault S11	External Fault (Input Terminal S11)		
EF12 (flashing) Ext Fault S12	External Fault (Input Terminal S12)		
FBL (flashing) Feed-back Loss	PID Feedback Reference Lost A PID feedback reference loss was detected (b5-12 = 2) and the PID feed-back 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).	-	-
CE (flashing) MEMO-BUS Com Err	MEMOBUS Communications Error Normal reception was not possible for 2 s or longer after received control data.	-	Check the communications devices and signals.
BUS (flashing) Option Com Err	Option Card Communications Error A communications error occurred in a mode where the Run Command or a frequency reference is set from an Communications Option Card.	-	Check the communications devices and signals.
CALL (flashing) Com Call	Communications on Standby Control data was not normally received when power was turned on.	-	Check the communications devices and signals.
LT-C*1 (flashing) Mainte-nance	Electrolytic Capacitor Maintenance Timer Monitor U1-61 has reached 100%.	The electrolytic capacitors have reached their estimated maintenance time period.	Reset constant o2-18 to “0%” after replacing*2 the PCB board.
LT-F*1 (flashing) Fan Mainte-nance	Cooling Fan Maintenance Timer Monitor U1-63 has reached 100%.	The cooling fan has reached its esti-mated maintenance time period.	Replace the cooling fan*2 and set con-stant o2-10 to “0H”.

* 1. Available for Varispeed AC with software versions PRG: 1050 or higher.

* 2. For details on replacement, refer to *Chapter 8 Maintenance and Inspection*.

◆ Operation Errors

An operation error will occur if there is an invalid setting or a contradiction between two parameter settings. The MxC cannot be started until the parameters 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 error.

Table 7.3 Operation Error Displays and Possible Incorrect Settings

Display	Meaning	Possible Incorrect Settings
OPE01 kVA Selection	Incorrect MxC Capacity Setting	The MxC capacity setting doesn't match the MxC being used. Contact your Yaskawa representative.
OPE02 Limit	Parameter Setting Range Error	The parameter setting is outside of the valid setting range. Press the ENTER key on the digital operator to display OPE fault parameter (U1-34).
OPE03 Terminal	Multi-Function Input Selection Error	One of the following errors has been made when setting the Multi-Function Digital Input Terminal Function Selection (H1-01 to H1-10). • The same setting has been selected for two or more multi-function inputs. • 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 Function Setting (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 Sequence Select	Option Card Selection Error	The option card was selected as the frequency reference source by setting b1-01 to 3, but an option card isn't connected (C option).
OPE06 PG Opt Missing	Control Method Selection Error	Flux Vector Control was selected by setting A1-02 to 3, but a PG Speed Control Card isn't connected.
OPE07 Analog Selection	Multi-Function Analog Input Selection Error	The same setting has been selected for the analog input selection and the PID function selection. • H3-09 = B and H6-01 = 1 • H3-09 = C and H6-01 = 2 b1-01 (Frequency Reference Selection) is set to 4 (pulse input) and H6-01 (Terminal RP Pulse Train Input Function Selection) is set to a value other than 0 (frequency reference).
OPE08 Ctrl Func Error	Parameter Selection Error	A setting has been made that is not required in the current control method. Example: A function used only with Open Loop Vector Control was selected for V/f control. Press the ENTER key on the digital operator to display OPE fault parameter (U1-34).
OPE09 PID Select Error	PID Control Selection Error	The following settings have been made at the same time. • b5-01 (PID Function Setting) has been set to a value other than 0. • b5-15 (PID Sleep Function Start Level) has been set to a value other than 0. • b1-03 (Stopping Method Selection) has been set to 2 or 3.
OPE10 V/f Ptrn Setting	V/f Data Setting Error	Parameters E1-04, E1-06, E1-07, and E1-09 do not satisfy the following conditions: • E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN) • E3-02 (FMAX) ≥ E3-04 (FA) > E3-05 (FB) ≥ E3-07 (FMIN)
OPE20 Factory Setting Err	Default Error	The defaults were not done. • *Precautions on Control Board Replacement* on page 8-3.
ERR EEPROM R/W Err	EEPROM Write Error	A verification error occurred when writing EEPROM. • Try turning the power supply off and then on again. • Try setting the parameters again.

◆ Errors During Auto-Tuning

The errors that can occur during Auto-Tuning are given in the following table. If an error is detected, the motor will coast to a stop and an error code will be displayed on the digital operator. The error contact output and alarm output will not function.

Table 7.4 Errors During Auto-Tuning

Display	Meaning	Probable Causes	Corrective Actions
Data Invalid	Motor data error	There is an error in the data input for Auto-Tuning. There is an error in the relationship between the motor output and the motor rated current. The is an error between the no-load current setting and the input motor rated current (when Auto-Tuning for only line-to-line resistance is performed for vector control).	• Check the input data. • Check the capacity of the MxC and motor. • Check the motor rated current and no-load current.
Minor Fault	Alarm	A minor fault occurred during Auto-Tuning (□□□).	• Check the input data. • Check wiring and the machine. • Check the load.
STOP key	STOP key input	The STOP key was pressed to cancel Auto-Tuning.	
Resistance	Line-to-line resistance error	Auto-Tuning was not completed in the specified time. The results of Auto-Tuning has exceeded the setting range for a parameter.	• Check the input data. • Check motor wiring. • If the motor is connected to the machine, disconnect it.
No-Load Current	No-load current error		
Rated Slip	Rated slip error		
Accelerate	Acceleration error (detected only for rotational Auto-Tuning)	The motor did not accelerate in the specified time.	• Increase C1-01 (Acceleration Time 1). • Increase L7-01 and L7-02 (Forward and Reverse Torque Limits) if they are low. • If the motor is connected to the machine, disconnect it.
PG Direction	Motor direction error	The connection between the MxC and the PG (A or B phase) or the MxC and Motor (U,V, or W) is faulty.	• Check the PG wiring. • Check the motor wiring. • Compare the rotational direction of the PG with the setting of F1-05 (PG Rotation Selection).
Motor Speed	Motor speed error (detected only for Rotational Auto-Tuning)	The torque reference was too high (100%) during acceleration (for Open Loop Vector Control only).	• If the motor is connected to the machine, disconnect it. • Increase C1-01 (Acceleration Time 1). • Check the input data (particularly the number of PG pulses and the number of motor poles).
I-det. Circuit	Current detection error	The current flow exceeded the motor rated current.	Check the current detection circuit, motor wiring, current detector, and installation methods.
		The detected current sign was the opposite of what it should be.	
		There is a phase fault for U, V, or W.	
Leak Inductance	Leakage inductance error	Auto-Tuning was not completed in the specified time.	Check motor wiring.
PG Open	PG Disconnection Detected	No pulse from the PG although power was being generated.	Check motor wiring, and correct the disconnected parts.

Table 7.4 Errors During Auto-Tuning (Continued)

Display	Meaning	Probable Causes	Corrective Actions
V/f Over Setting	V/f settings excessive*	The torque reference exceeded 100% and the no-load torque exceeded 70% during Auto-Tuning.	• Check and correct the settings. • Disconnect the load from the motor.
Saturation	Motor core saturation error (detected only for Rotational Auto-Tuning)*	The results of Auto-Tuning has exceeded the setting range for a parameter so a temporary setting was made for the motor core saturation coefficient.	• Check the input data. • Check motor wiring. • If the motor is connected to the machine, disconnect it.
Rated FLA Alm	Rated current setting alarm*	The rated current is set high.	Check the input data (particularly the motor output current and motor rated current).

* Displayed after Auto-Tuning has been completed.

◆ Errors when Using the Digital Operator Copy Function

The errors that can occur when using the copy function from the digital operator are given in the following table. An error code will be displayed on the digital operator. If a digital operator key is pressed when an error code is being displayed, the display will be cleared and o3-01 will appear on the screen. Neither the error contact output nor the alarm output will function.

Table 7.5 Errors during Copy Function

Function	Display	Meaning	Probable causes	Corrective Actions
Read	PRE READ IMPOSSIBLE	Digital operator write-protected	o3-01 was set to 1 to write a parameter when the digital operator was write-protected (o3-02 = 0).	Set o3-02 to 1 to enable writing parameters with the digital operator.
	IFE READ DATA ERROR	Illegal read data	The read data length does not agree.	Try reading the data again. Check the digital operator cable. Replace the digital operator.
			The write data is incorrect.	
	RDE DATA ERROR	Illegal write status	An attempted write of a parameter to EEPROM on the Digital Writer failed.	A low MxC voltage has been detected. Try reading the data again. Replace the digital operator.
Copy	CPE ID UNMATCH	ID not matched	The MxC product code or software number is different.	Use the copy function for the same product code and software number.
	VAE MxC. KVA UNMATCH	MxC capacity matched	The capacity of the MxC being copied and the capacity in the digital operator are different.	Use the copy function for the same MxC capacity.
	CRE CONTROL UNMATCH	Control method mismatch	The control method of the MxC and the control method of the stored data in the digital operator were different.	Use the copy function for the same control method.
	CYE COPY ERROR	Verify error	A parameter setting written to the MxC was different than the setting stored in the digital operator.	Restart the copy procedure.
	CSE SUM CHECK ERROR	Checksum error	Upon completion of the COPY function, the data checksum for the MxC was different than the digital operator's data checksum.	Restart the copy procedure.
Verify	VYE VERIFY ERROR	Verify error	The setting in the digital operator and the setting in the MxC settings do not agree.	Restart the copy procedure and verify the data again.

Troubleshooting

Due to parameter setting errors, faulty wiring, and so on, the MxC and motor may not operate as expected when the system is started up. Use this section as a reference to take the appropriate action if such problems occur.

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

◆ Trouble Setting Parameters

Use the following information if any MxC parameters cannot be set.

■The display does not change when the up and down arrow keys are pressed.

The following causes are possible.

The MxC is operating (Drive Mode).

There are some parameters that cannot be set during while the motor is running. Stop the MxC to change the setting values in such parameters, and then re-enter the Run Command.

"Parameter write enable" is input.

This occurs when "parameter write enable" (set value: 1B) is set for a multi-function digital input terminal (H1-01 to H1-10). If the parameter write enable input is off, the parameters cannot be changed. Turn it on and then set the parameters.

Passwords do not match.

Occurs only when the password is set. If the parameter A1-04 (Password 1) and A1-05 (Password 2) numbers are different, the parameters for the Initialize Mode cannot be changed. Reset the password.

If you cannot remember the password, display A1-05 (Password 2) 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 parameter A1-04.

■OPE01 through OPE11 is displayed.

The set value for the parameter 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 MxC 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.

If the MxC is not in Drive Mode (the DRIVE LED on the JVOP-161 operator is not lit), it will remain in ready status and will not start. Press the MENU key to display the Drive Mode, and enter the Drive Mode by pressing the DATA/ENTER key. “-Rdy-” will be displayed when Drive Mode is entered.

The operation method setting is wrong.

If parameter b1-02 (Run Command 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).

The LOCAL/REMOTE key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the Drive Mode is entered.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the MxC will not operate.

Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog input H3-09 is set to 1 (frequency gain), and if no voltage (current) has been entered, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor does not operate when an external operation signal is input.

The following causes are possible.

The MxC is not in Drive Mode (the “DRIVE” LED on the JVOP-161 operator is not lit).

If the MxC is not in Drive Mode, it will remain in ready status and will not start. Press the MENU key to flash the Drive Mode, and enter the Drive Mode by pressing the DATA/ENTER key. “-Rdy-” will be displayed when Drive Mode is entered.

The operation method selection is wrong.

If parameter b1-02 (Run Command 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 digital operator is in the Drive Mode.

A 3-wire sequence is in effect.

The input method for a 3-wire sequence is different than when operating by forward/stop and reverse/stop (2-wire sequence). When 3-wire sequence is set, the motor will not operate even when an input terminal suitable for forward run/stop and reverse run/stop is turned on.

When using a 3-wire sequence, refer to the timing chart and input the proper signals.

When using a 2-wire sequence, set the multi-function input terminal (H1-01 through H1-10, terminals S3 to S11) to a value other than 0.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the MxC will not operate. Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog inputs H3-05 (Terminal A3 Function Selection) and H3-09 (Terminal A2 Function Selection) are set to 1 (frequency gain), and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor stops during acceleration or when a load is connected.

The load may be too heavy. The MxC has a stall prevention function and an automatic torque boost function, but the motor responsiveness limit may be exceeded if acceleration is too rapid or if the load is too heavy. Lengthen the acceleration time or reduce the load. Also consider increasing the motor capacity.

■The motor 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 (Reverse Operation Selection) is set to 1 (reverse run prohibited), the MxC will not receive Reverse Run Commands. To use both forward and reverse operation, set b1-04 to 0.

◆ Direction of the Motor Rotation is Reversed

If the motor operates in the wrong direction, the motor output wiring is faulty. When the MxC 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).

◆ Motor Does Not Produce Torque or 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 parameters 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 (H3-05 or H3-09 = 10 to 12 or 15), check to be sure that the analog input value is suitable.

■The stall prevention level during acceleration is too low.

If the value set for L3-02 (Stall Prevention Level during Acceleration) is too low, the acceleration time will be too long. Check to be sure that the set value is suitable.

■The stall prevention level during run is too low.

If the value set for L3-06 (Stall Prevention Level during run) is too low, the speed will drop before outputting torque. Check to be sure that the set value is suitable.

■Auto-Tuning has not been performed for vector control

Open Loop Vector and Flux Vector controls will not work if Auto-Tuning has not been performed first. Perform Auto-Tuning separately for the motor, or set the motor parameters through calculations. Alternatively, change the Control Method Selection (A1-02) to V/f control (0).

◆ Motor Operates Faster than the Frequency Reference

Use the following information if the motor operates faster than the frequency reference.

■The analog frequency reference bias setting is wrong (the gain setting is wrong).

The frequency reference bias set in parameter H3-03 is added to the frequency reference. Check to be sure that the set value is suitable.

■A signal is being input to the frequency reference (current) terminal A1.

When 0 (added to terminal A1) is set for parameter H3-09 (Terminal A2 Function Selection) or H3-05 (Terminal A3 Function Selection), a frequency corresponding to the terminal A2 or A3 input voltage (current) is added to the frequency reference. Check to be sure that the set value and analog input value are suitable.

◆ Slip Compensation Function has Low Speed Precision

If speed control accuracy is too low for the slip compensation function, the slip compensation limit has been reached. With the slip compensation function, compensation cannot be carried out beyond the slip compensation limit set in parameter C3-03. Check to be sure that the set value is suitable.

◆ Low Speed Control Accuracy at High-Speed Rotation in Open Loop Vector Control Method

The motor rated voltage is high.

The maximum output voltage for the MxC is determined by its input voltage. For example, if 200 VAC is input, then the maximum output voltage will be 190 (200 × 0.95) VAC. The speed control accuracy will decrease if the output voltage reference value exceeds the MxC maximum output voltage as a result of Open Loop Vector Control. Use a motor with a low rated voltage (i.e., a special motor for use with Open Loop Vector), or change to Flux Vector Control.

◆ Insufficient torque during Rotational Auto-Tuning in Flux Loop Vector

Take the following action if there isn't enough torque when using Flux Loop Vector to control the motor.

1. Gradually increase the amount of slip compensation set in C3-01 in increments of 0.1.
2. If step 1 is unsuccessful, next try lowering the carrier frequency set in C6-02.

◆ Speed fluctuation during Rotational Auto-Tuning in Flux Loop Vector

The power supply voltage might be below the acceptable range for the motor.
Take the following action if the speed fluctuates excessively in Flux Loop Vector.

1. Gradually increase the accel/decel rates in increments of 1 second. If this solves the problem, then do not proceed to the following steps.
2. Lower the carrier frequency set in C6-02.
3. Gradually increase the amount of slip compensation set in C3-01 in increments of 0.1.
4. Enable Field Forcing (d6-01 = 1).

◆ Motor Deceleration is Too Slow

Use the following information when the motor deceleration is slow.

The deceleration time is too long.

Check the deceleration time setting (parameters C1-02, C1-04, C1-06, and C1-08).

Motor torque is insufficient.

If the parameters 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 parameters 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 (Terminal A2 Function Selection) or H3-05 (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.

■Vertical-Axis Load Drops when Brake is Applied

The sequence is incorrect. The MxC goes into DC injection braking status for 0.5 seconds after deceleration is completed (this is the factory-set default).

To ensure that the brake holds, set Frequency Detection 2 (H2-01 = 5) for the multi-function digital output terminals (M1 and M2) so that the relays will switch off when the output frequency is greater than L4-01 (3.0 to 5.0 Hz). The contacts will switch on again when the output frequency falls below L4-01.

There is hysteresis in Frequency Detection 2 (i.e., a frequency detection width, L4-02 = 2.0 Hz). Change the setting to approximately 0.5 Hz if there are drops during stop. Do not use the multi-function digital output run signal (H2-01 = 0) for the brake on/OFF signal.

◆ Motor Overheat

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 enabled torque exceeding the motor's rated torque, the motor will overheat. Some motor rating are given for short period performance and are not continuous ratings. Reduce the load amount by either lightening the load or lengthening the accel/decel time. Also consider increasing the motor capacity.

■The ambient temperature is too high.

The motor rating is determined within a particular ambient operating temperature range. The motor will burn out if it is run continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded. Lower the motor's ambient temperature to within the acceptable ambient operating temperature range.

■The voltage tolerance between motor phases is insufficient.

When the motor is connected to the MxC output, a surge is generated between the MxC switching and the motor coil. Normally the maximum surge voltage is three times the MxC's input power supply voltage (i.e., 1,200 V for 400 V class). Be sure to use a motor with a voltage tolerance between motor phases that is greater than the maximum surge voltage. In particular, when using a 400 V class MxC, use a special motor for inverters.

■Auto-Tuning has not been performed for Open Loop Vector Control.

Open Loop Vector Control will not operate the motor if Auto-Tuning has not yet been performed. Perform Auto-Tuning, or calculate and set the motor parameters manually. Alternatively, change the Control Method Selection to the V/f Control Method (A1-02 = 0).

◆ Noise is Produced from an AM Radio or when the MxC is Started

If noise is generated by MxC switching, then take the following action:

- Change the MxC'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 MxC's power supply input area.
- Install an Output Noise Filter at the MxC's power supply output area.
- Use metal tubing. Electric waves can be shielded by metal, so encase the MxC with metal (steel).
- Ground the MxC and motor.
- Separate main circuit wiring from control wiring.

◆ Ground Fault Interrupter Operates while the MxC is Running

The MxC 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 inverter). It will also help to some extent to change the MxC's Carrier Frequency Selection (C6-02) to lower the carrier frequency. In addition, remember that the leakage current increases as the cable is lengthened.

◆ Mechanical Oscillation

Use the following information when there is mechanical oscillation.

■The machinery produces an irregular sound.

The following causes are possible.

There may be resonance between the mechanical system's characteristic frequency and the carrier frequency.

The motor is running with no problems and the machinery is oscillating with a high-pitched whine. To prevent this type of resonance, adjust the carrier frequency with parameters C6-02 (Carrier Frequency Selection).

There may be resonance between a machine's characteristic frequency and the output frequency of the MxC.

Either use the jump frequency functions in parameters d3-01 to d3-04 or install rubber padding on the motor base to reduce oscillation.

■Oscillation and hunting occur in Open Loop Vector Control.

The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting parameters C4-02 (Torque Compensation Primary Delay time), n2-01 (Speed Feedback Detection Control (AFR) Gain), and C3-02 (Slip Compensation Primary Delay Time) in order. Lower the gain setting and raise the primary delay time setting.

Open Loop Vector Control will not operate the motor if Auto-Tuning has not yet been performed. Perform Auto-Tuning, or calculate and set the motor parameters manually. Alternatively, change the Control Method Selection to the V/f Control Method (A1-02 = 0).

■Oscillation and hunting are occurring in V/f control.

The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting parameters C4-02 (Torque Compensation Primary Delay Time), C3-02 (Slip Compensation Primary Delay Time), and n1-02 (Hunting-Prevention Gain) in order. Lower the gain setting and raise the primary delay time setting.

■Oscillation and hunting are occurring in Flux Vector Control.

The gain adjustment is insufficient. Adjust the various gains for speed control (ASR). If the oscillation points overlap with those of the machine and cannot be eliminated, increase the primary delay time constant for speed control (ASR) in C5-06 and then readjust the gains.

If Auto-Tuning is not performed, proper performance cannot be achieved for vector control. Perform Auto-Tuning or set the motor parameters according to calculations.

■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 parameters. (Refer to page 6-98.)

■Auto-Tuning has not been performed for Open Loop Vector Control.

Open Loop Vector Control will not operate the motor if Auto-Tuning has not yet been performed. Perform Auto-Tuning, or calculate and set the motor parameters manually. Alternatively, change the Control Method Selection to the V/f Control Method (A1-02 = 0).

◆ Torque Generated for the Motor is Insufficient (Insufficient Power)

If Auto-Tuning has not yet been performed or the control method has been changed since the last time Auto-Tuning was performed, then perform Auto-Tuning again. If the problem occurs after Stationary Auto-Tuning is performed, perform Rotational Auto-Tuning.

◆ Motor Rotates Even When MxC Output is Stopped

If the motor rotates even when the MxC output is stopped, the DC injection braking is insufficient. If the motor continues operating at low speed, without completely stopping, and after a deceleration stop has been executed, it means that the DC Injection Braking is not decelerating enough. Adjust DC Injection Braking as follows:

- Increase the parameter b2-02 (DC Injection Braking Current) setting.
- Increase the parameter b2-04 (DC Injection Braking Time at Stop) setting.

◆ OV or OC is Detected when the Fan is Started or Stalls

Generation of OV (control circuit overvoltage) or OC (overcurrent) and stalling can occur if the fan is turning when it is started. The DC injection braking is insufficient when starting.

This can be prevented by slowing fan rotation by DC injection braking before starting the fan. Increase the parameter b2-03 (DC Injection Braking Time /DC Excitation Time at Start) setting.

Or, validate the settings of b3-01 (Speed Search Selection).

◆ Output Frequency does not Reach the Specified Frequency Reference

Use the following information if the output frequency does not reach to the frequency reference.

■The frequency reference is within the jump frequency range.

When the jump frequency function is used, the output frequency does not change within the jump frequency range. Check to be sure that the Jump Frequency (d3-01 to d3-03) and Jump Frequency Width (d3-04) settings are suitable.

■The frequency reference upper limit has been reached.

The output frequency upper limit is determined by the following formula:
Maximum Output Frequency (E1-04) × Frequency Reference Upper Limit (d2-01) / 100
Check to be sure that the parameter E1-04 and d2-01 settings are suitable.

8

Maintenance and Inspection

This chapter describes basic maintenance and inspection for the MxC.

Maintenance and Inspection 8-2

Maintenance and Inspection

◆ Limited Warranty

This product is warranted for twelve months after delivery to the customer or for up to eighteen months from the date of shipment, whichever comes first.

◆ Daily Inspection

Check the following items after the MxC has been installed.

- The motor should not vibrate or make unusual noise.
- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The output current value shown on the monitor display should not be higher than normal.
- The cooling fan of the MxC should be operating normally.

◆ Periodic Inspection

Check the following items during periodic maintenance.

Always turn off the power supply before beginning inspection. Confirm that the LCD and LED indicators on the front cover have all been turned off, and then wait until at least five minutes has elapsed before inspecting the MxC. 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?	Firmly tighten loose screws and bolts.
	Are connectors tight?	Re-affix any loose connectors.
Heatsink	Is the heatsink dirty or full of dust?	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 oscillation? 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 power components?	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).

◆ Periodic Maintenance of Parts

The MxC is configured of various components, all of which must be operating properly in order to take full advantage of the MxC functions.

Some electrical components will require maintenance depending on storage conditions and how the MxC is used. In order to keep the MxC 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 will vary depending the installation environment and usage conditions. Recommended maintenance periods are noted below. Keep them as reference.

To replace the cooling fan, follow the *Cooling Fan Replacement* on page 8-4. To replace other parts, contact your Yaskawa representatives for technical maintenance.

Table 8.2 Part Replacement Guidelines

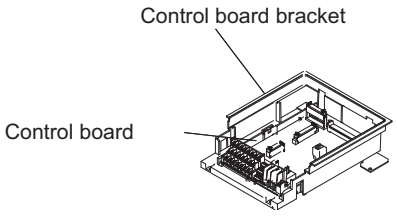
Part	Standard Replacement Period	Replacement Method
Cooling fan	2 to 3 years	Replace with new part.
Breaker relays	-	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

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

◆ Precautions when Replacing the Control Board (1PCB)

IMPORTANT

- The control board is under the bracket.



- For more information on the replacing the control board (PCB), contact your Yaskawa representative.
- For details on the how to replace the board, refer to *Varispeed AC Control Board Replacement Procedure* (Manual no.: EZZ020345).
- After replacing the control board, all settings must be returned to their original default values when the product was first shipped from Yaskawa. If the board is not reset to the defaults, the control board will fail to perform at optimum levels.

◆ Types and Number of Cooling Fans Used in the MxC

Cooling fans used for the MxC has two types; External cooling fan and circulation fan. External cooling fan blows air to the MxC cooling fin. Circulation fan stirs up the air inside the MxC unit.

Table 8.3 shows the number of cooling fans used in the MxC. Refer to the spare parts list (Manual no. EZZ020357) for the specifications of cooling fans.

Be sure to use the specified type of fan when replacing the cooling fan. If the wrong fan is used, the MxC may fail to perform at optimum levels.

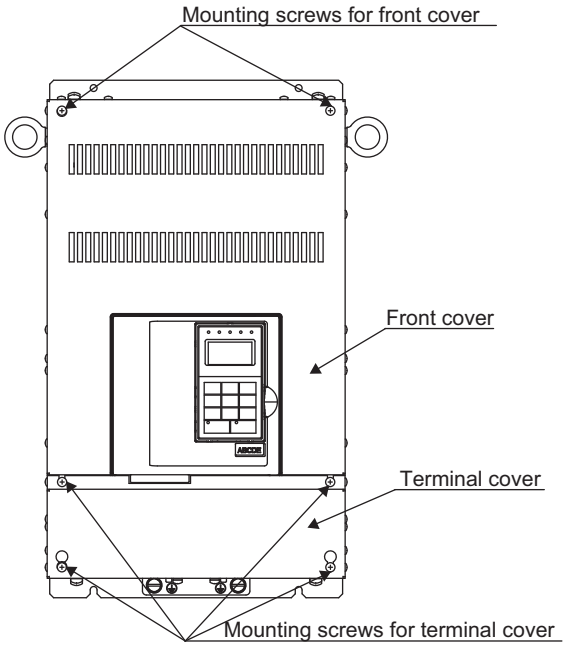
Table 8.3 Number of Cooling Fans to be Used

Maximum Motor Capacity (kW)	200 V class		400 V class	
	External Cooling Fan	Circulation Fan	External Cooling Fan	Circulation Fan
5.5	2	0	2	0
11	2	0	2	0
22	2	0	2	0
45	2	1	2	1
75	–	–	2	1
110	–	–	4	2
160	–	–	4	2

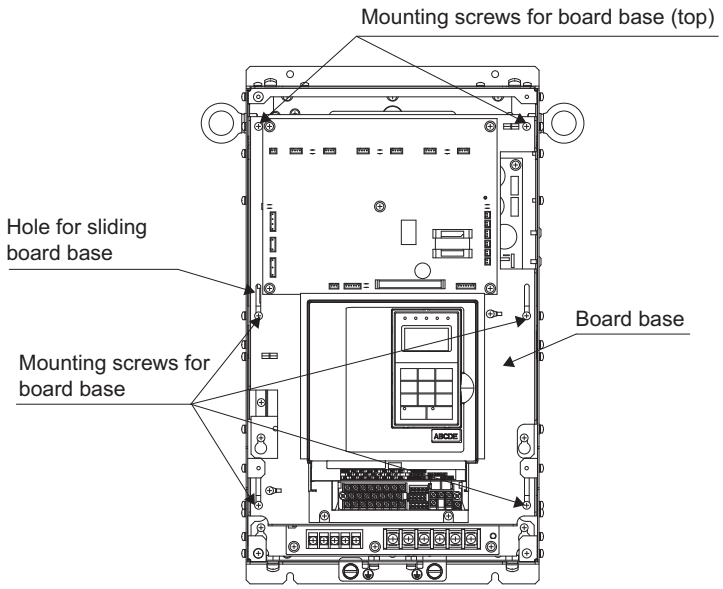
◆ How to Replace the External Cooling Fan

■200 V and 400 V classes, 5.5 kW or 11kW

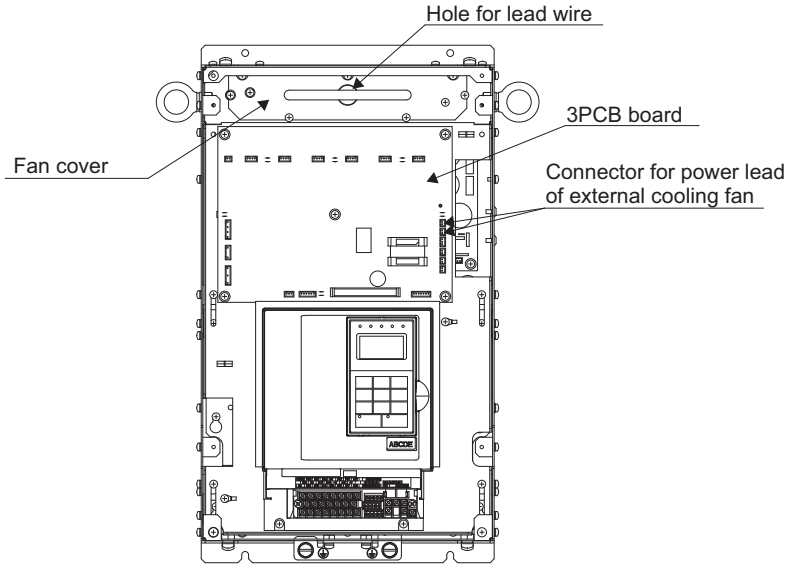
1. Remove the terminal cover and the front cover.



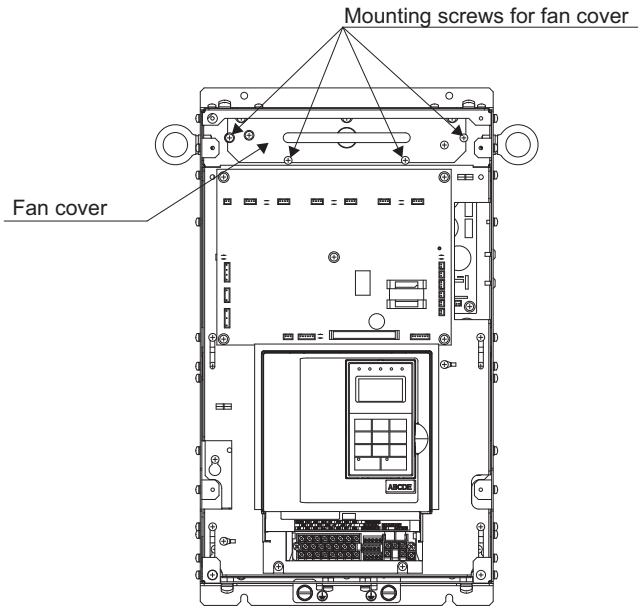
2. Unscrew the mounting screws on the base board. Next loosen the other four screws, and push the base board so that it slides down approximately 30 mm.



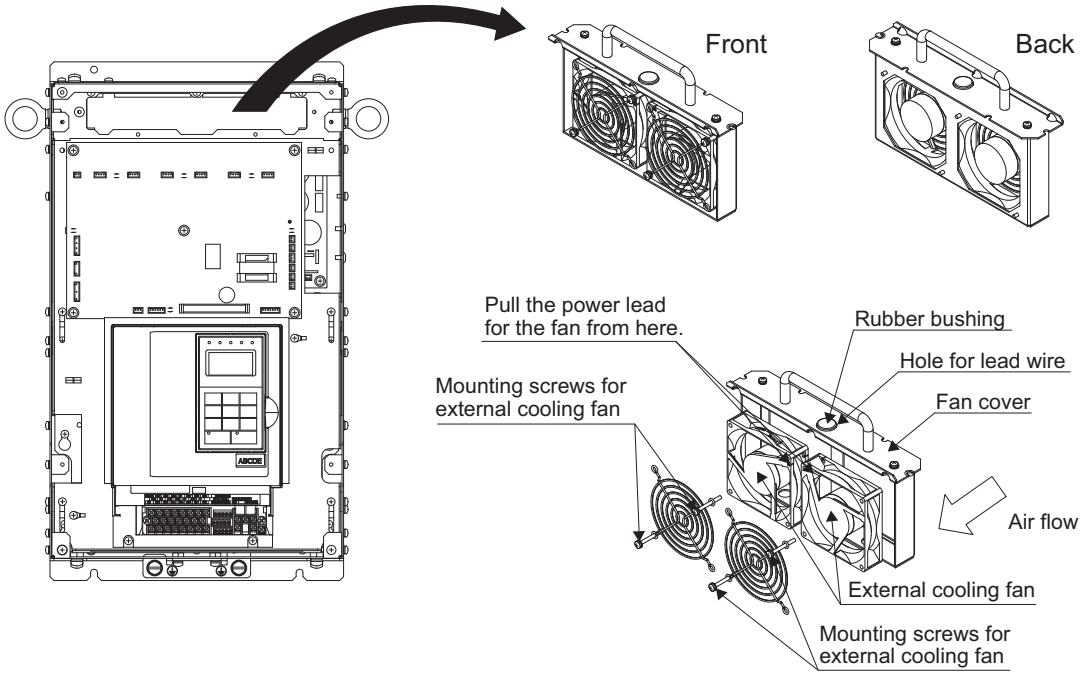
3. Pull the connector for the external cooling fan power cable out of the relay board. (board no. 3PCB, connector no. CN26 and CN27)



4. Unscrew the four screws on the fan cover, and remove the fan cover from the MxC.



5. Remove the external cooling fan and replace it with a new one.



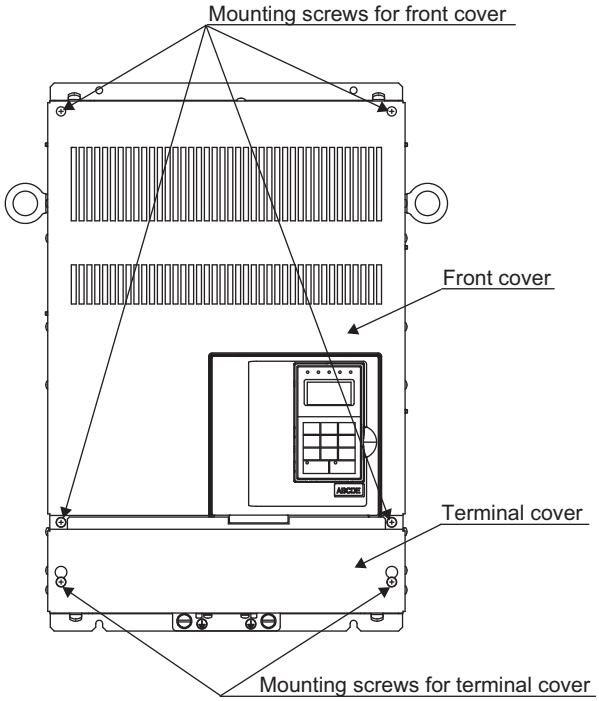
6. Reverse the procedure to install the new external cooling fan.

External Cooling Fan Installation Precautions

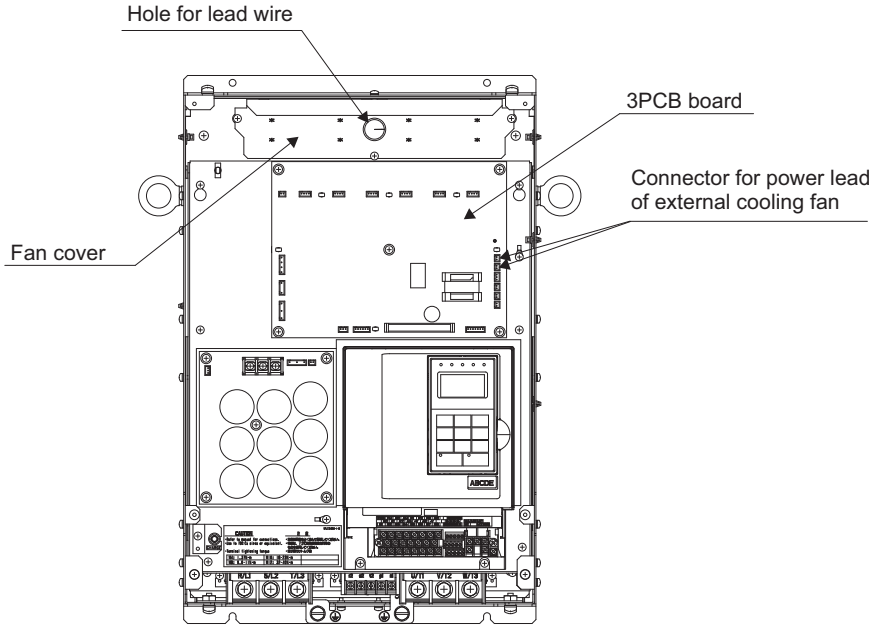
- When installing the new external cooling fan, note that the air intake for the external cooling fan's ventilation is on the top of the MxC.
- When reconnecting the power lead for the external cooling fan, place it near to the hole for the lead wire on the fan cover. This will prevent the wire from getting pinched.
- After the power lead of the external cooling fan is passed through the hole on the fan cover, attach the rubber bushing.
- There shouldn't be an problems if connectors CN26 and CN27 are accidentally reversed when reconnecting components. This is because CN26 and CN27 have the same electrical specifications.

■200 V and 400 V classes, 22kW

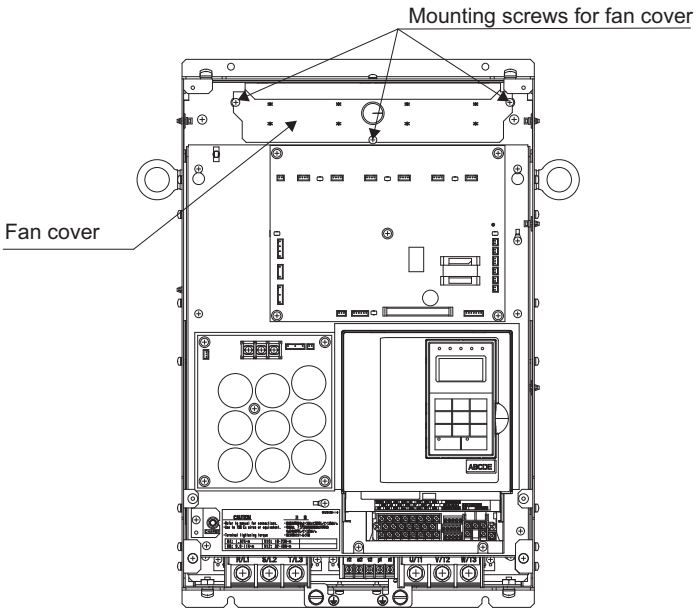
1. Remove the terminal cover and the front cover.



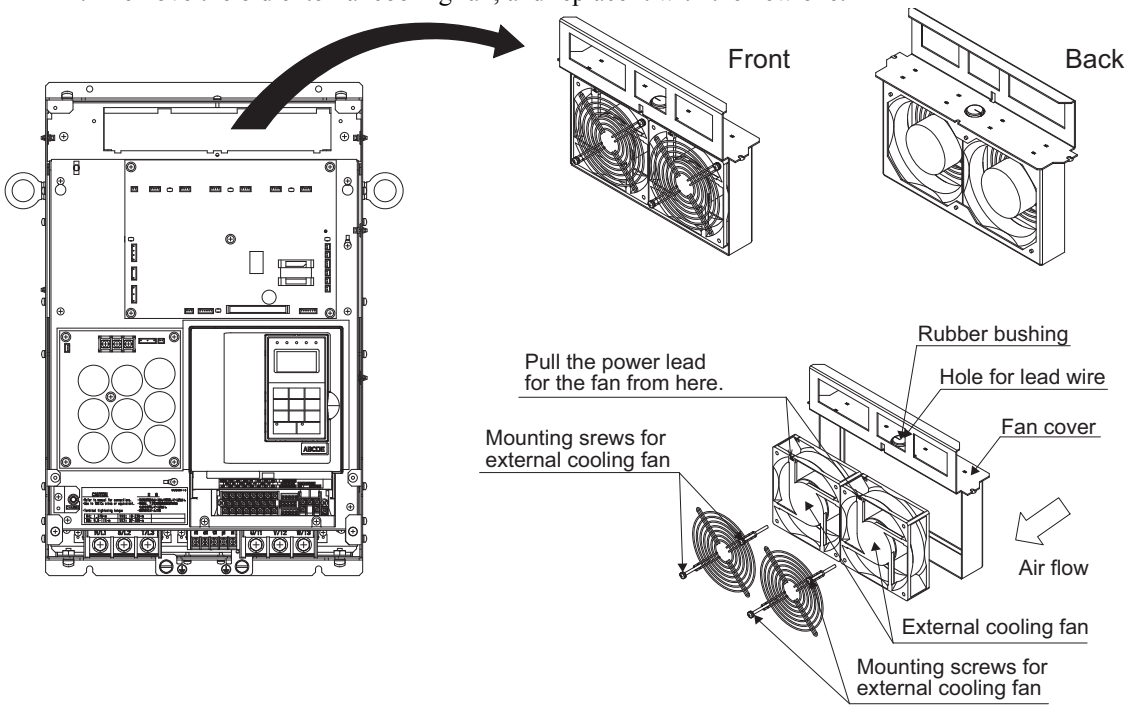
2. Pull the connector for the external cooling fan power cable out of the relay board for the external cooling fan power. (board no. 3PCB, connector no. CN26 and CN27)



3. Unscrew the three screws of fan cover, and remove the fan cover from MxC.



4. Remove the old external cooling fan, and replace it with the new one.



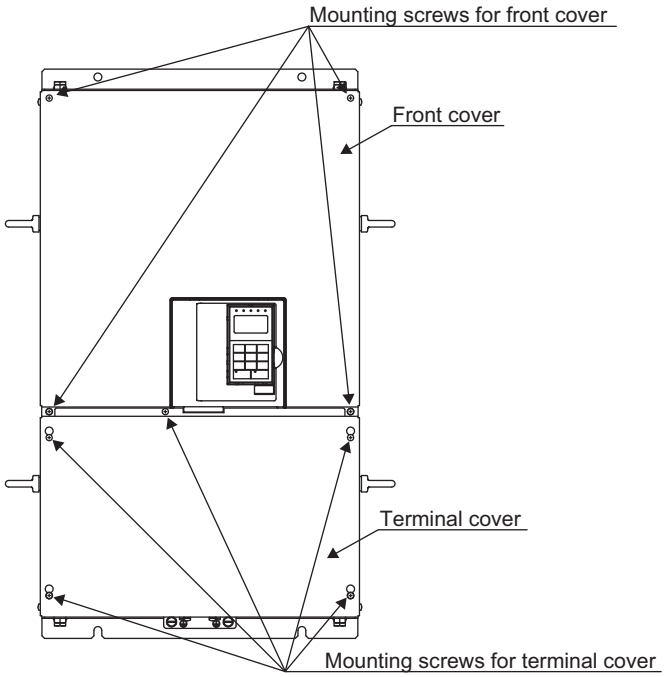
5. Reverse the procedure to install the new external cooling fan.

External Cooling Fan Installation Precautions

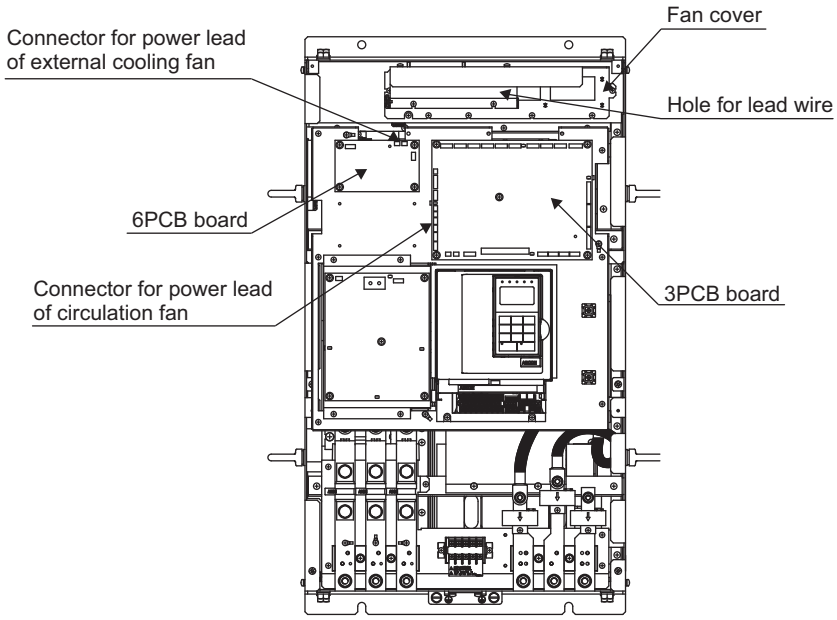
- When installing the new external cooling fan, note that the air intake for the external cooling fan's ventilation is on the top of the MxC.
- When reconnecting the power lead for the external cooling fan, place it near to the hole for the lead wire on the fan cover so the wire does not get pinched.
- After the power lead of the external cooling fan is passed through the hole on the fan cover, attach the rubber bushing.
- There shouldn't be an problems if connectors CN26 and CN27 are accidentally reversed when reconnecting components. This is because CN26 and CN27 have the same electrical specifications.

■45 kW 200 V and 400 V classes and 75 kW 400 V class

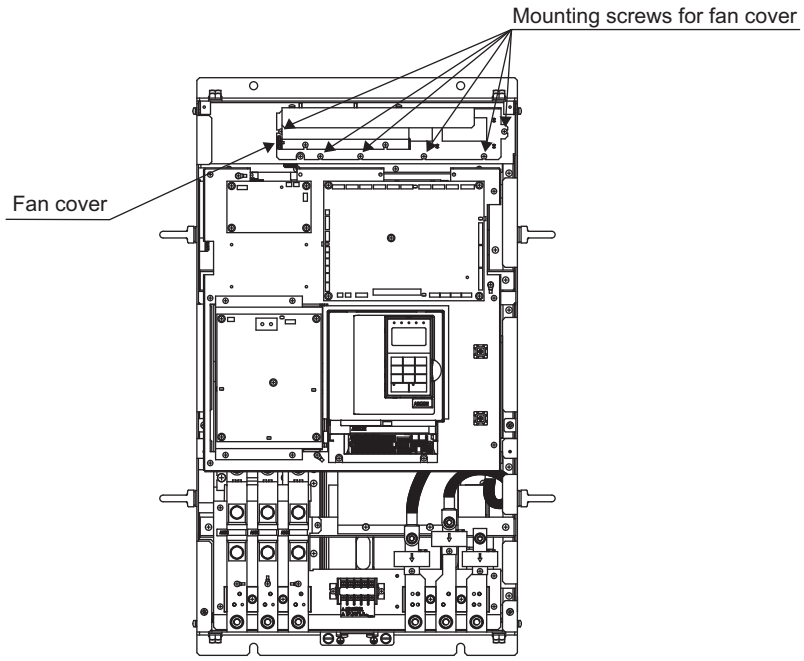
1. Remove the terminal cover and the front cover.



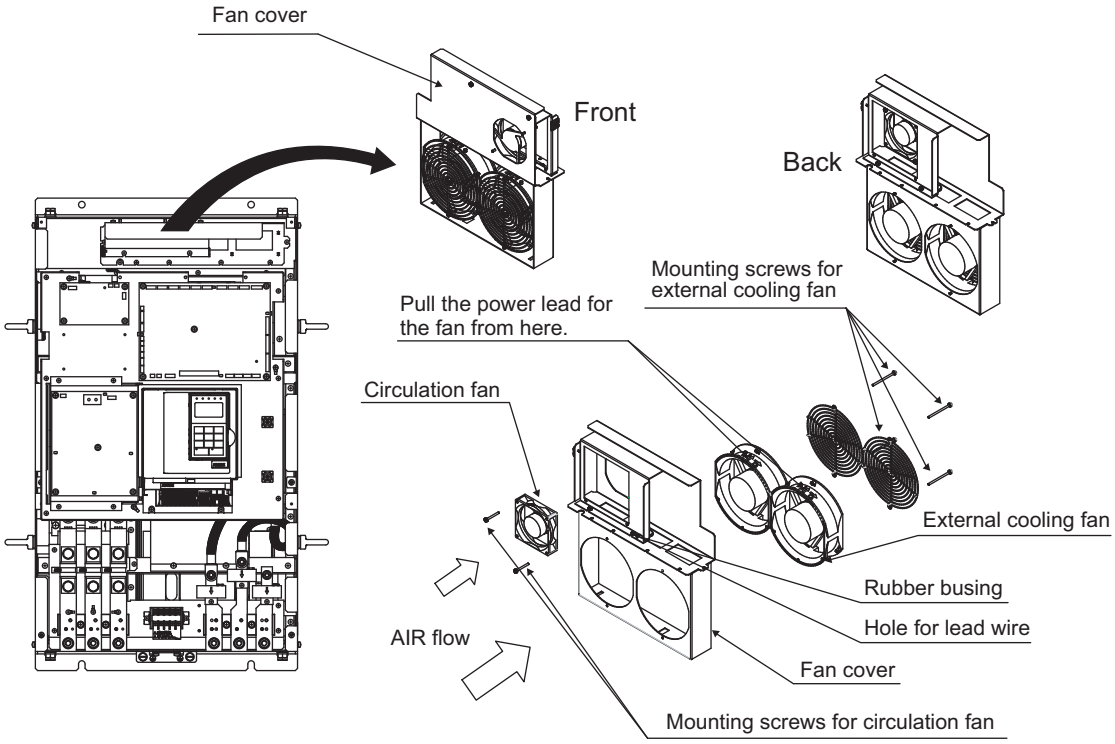
2. Pull the connectors for the external cooling fan and the circulation fan power cables out of the relay board for the external cooling fan and the circulation fan power.
   Circulation fan: board no.3PCB, connector no. CN28
   External cooling fan: board no. 6PCB, connector no. CN26 and CN27



3. Unscrew the six screws of fan cover, and remove the fan cover from MxC.



4. Remove the old external cooling fan and circulation fan, and replace them with the new ones.



5. Reverse the procedure to install the new external cooling fan and circulation fan.

External cooling Fan and Circulation Fan Installation Precautions

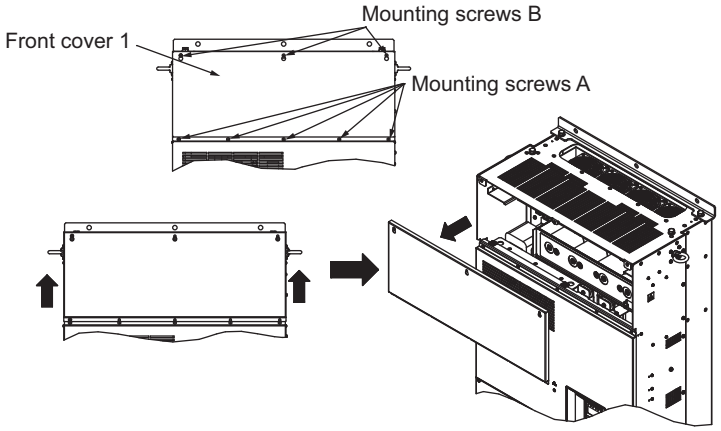
- When installing the new external cooling fan and circulation fan, note that the air intake for their ventilation is on the top of the MxC.
- When reconnecting the power lead for the external cooling fan, place it near to the hole for the lead wire on the fan cover so the wire does not get pinched.
- After the power lead of the external cooling fan is passed through the hole on the fan cover, attach the rubber bushing.
- There shouldn't be an problems if connectors CN26 and CN27 are accidentally reversed when reconnecting components. This is because CN26 and CN27 have the same electrical specifications.
- The external cooling fan is heavy. Handle it with care.

■For 400 V Class MxCs with a Motor Capacity of 110kW or 160kW

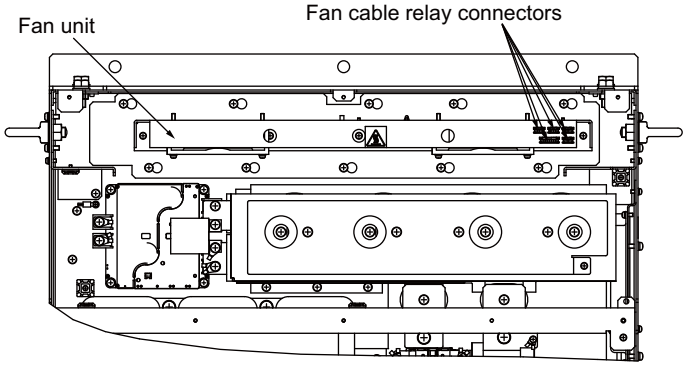
Fan Unit Replacement

1. Loosen the mounting screws securing front cover 1 of the MxC, then slide and remove the front cover 1.

Note: Eight mounting screws are installed in 400 V class MxCs with a motor capacity of 110kW or 160kW.
Do not remove the mounting screws.
If the five mounting screws A are removed, the front cover 1 may fall when the three mounting screws B are loosened, possibly resulting in injury.
The front cover 1 of a large capacity MxC is large and heavy. Take care when removing and installing it.

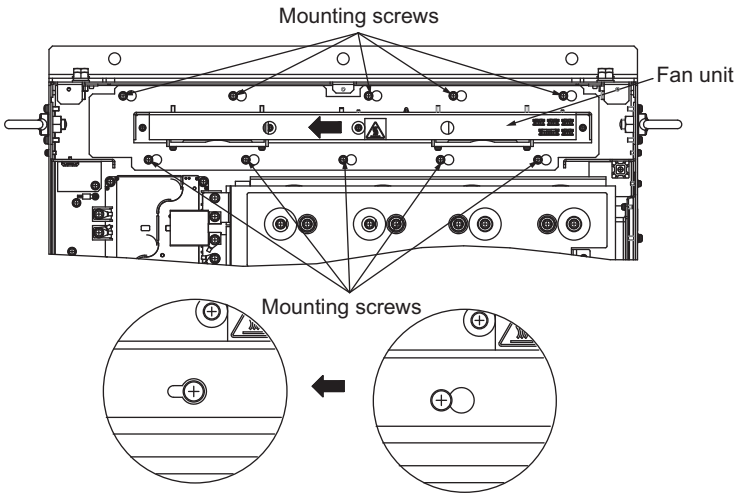


2. Disconnect the relay connector of the fan cable from the fan unit.

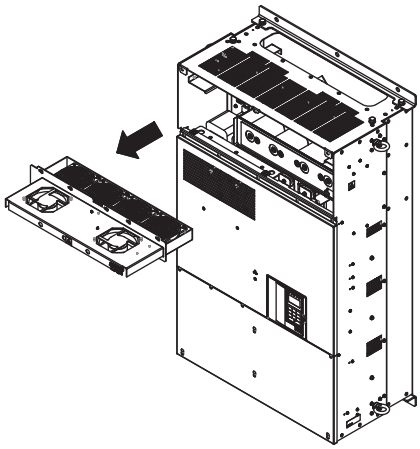


3. Loosen the mounting screws of the fan unit and slide the fan unit to the left.

Note: The fan unit can be removed by just loosening the mounting screws, without removing them.



4. Remove the fan unit and replace the fans with new ones.
   For the details of the procedure for replacing the fans, refer to Fan Replacement.

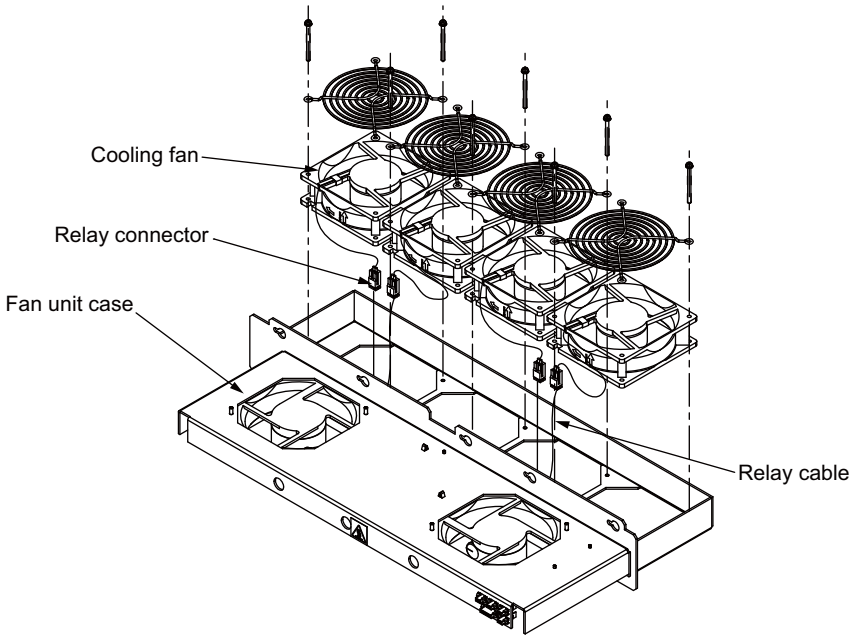


5. To install all of the component parts, reverse the removal procedure.

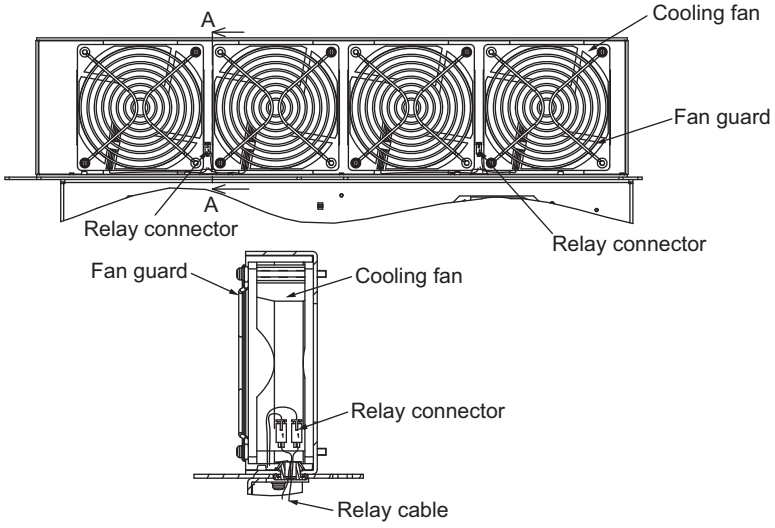
Fan Replacement

1. Remove the screws securing relay connectors and cooling fans, and replace the cooling fans.

Note: When installing cooling fans, be careful not to trap relay cables.

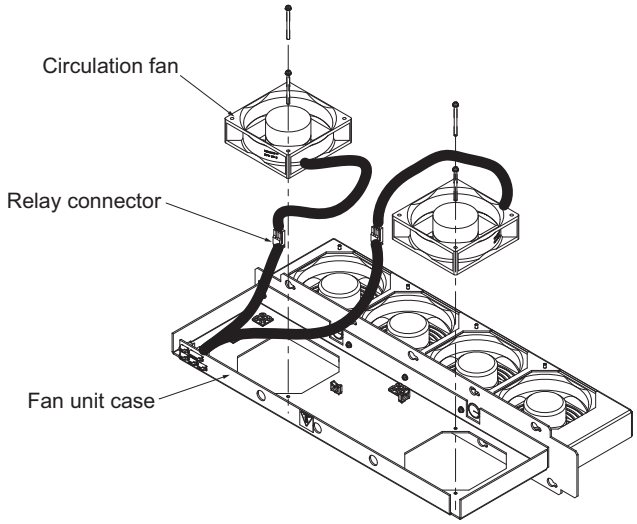


2. Connect the relay connectors and place the relay cables into the cooling fans.
   Push the relay connectors in between the cooling fans as shown in Sectional View A.

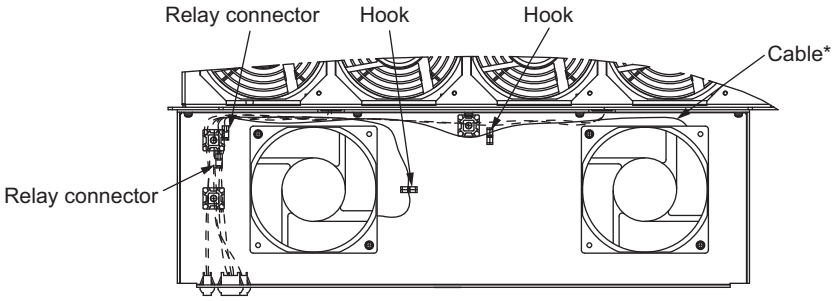


Sectional View A

3. Reverse the fan unit.
   Remove the screws securing relay connectors and circulation fans, and replace the circulation fans.



4. Connect the relay connectors, fit the cables in the hooks (at two locations), and place the relay cables into the fan unit case.



* The cables indicated with dotted lines are already fixed in place.
Fit the cables indicated with solid lines in the hooks to fix them.

◆ How to Remove or Install the Control-Circuit Terminal Board

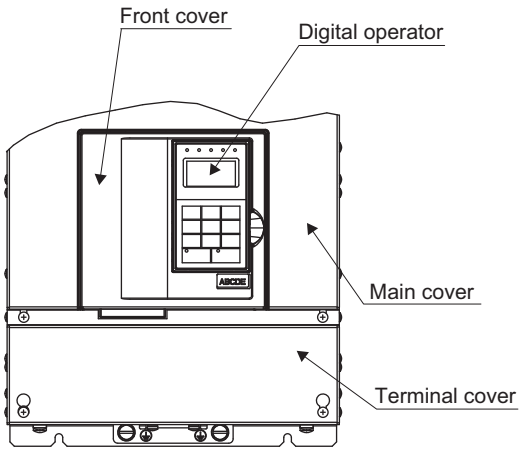
The control-circuit terminal board can be removed and installed without disconnecting the cables.

IMPORTANT

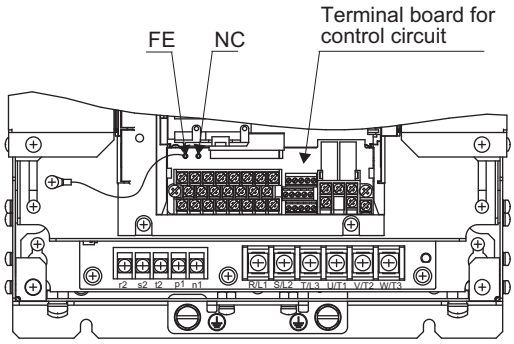
Always make sure that the charge indicator LED is completely out before removing or installing the control-circuit terminal board.

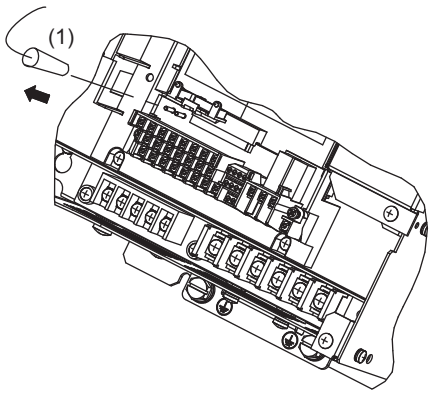
■Removal

1. Remove the digital operator and the front cover. The main cover does not need to be removed.

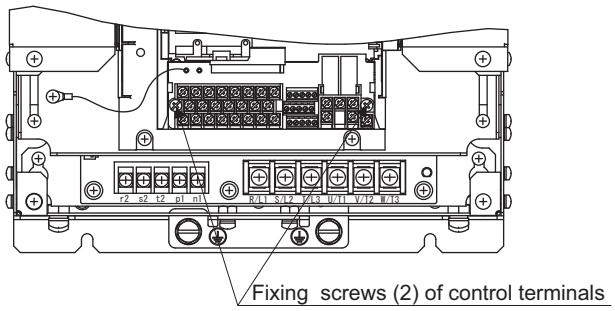


2. Remove the connectors and the lines connected to the FE and NC pins on the control-circuit terminal board.

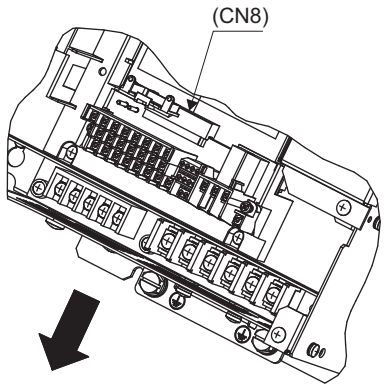




3. Loosen the mounting screws (1) on the left and right sides of the control terminals until the terminals are free. These screws do not have to be completely removed. They are self-rising.



4. Pull out the terminal board sideways (as indicated by the large arrow) with the screws sticking out from the board.



■Installation

Follow the steps used to remove the terminal board but in reverse order.

Before inserting the board, make sure that the pin for the CN8 connector on the control board is correctly positioned with the terminal board.

The connector pins may be bent if the board is forced into place, and possibly prevent the MxC from operating correctly.

9

Specifications

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

Standard MxC Specifications 9-2
Specifications for Options and Peripheral Devices 9-5

Standard MxC Specifications

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

◆ Specifications by Model

Specifications are given by model in the following tables.

■200 V class

Table 9.1 200 V Class MxCs

Model Number CIMR-ACA□		25P5	2011	2022	2045
Max applicable motor output (kW)*		5.5	11	22	45
Output ratings	Rated output capacity (kVA)	9	17	33	63
	Rated output current (A)	27	49	96	183
	Max output voltage (V)	Ratio of input voltage (Input voltage × 0.95)			
	Max output frequency (Hz)	Frequencies supported up to 120 Hz using parameter setting			
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)	3-phase, 200/208/220 VAC, 50/60 Hz			
	Allowable voltage fluctuation	+ 10%, - 15%			
	Allowable frequency fluctuation	±3% frequency fluctuation rate, 1 Hz/100 ms or less			

* The maximum applicable motor output is given for a standard 4-pole Yaskawa motor. When selecting the actual motor and MxC, be sure that the MxC's rated current is applicable for the motor's rated current.

■400 V class

Table 9.2 400 V Class MxCs

Model Number CIMR-ACA□		45P5	4011	4022	4045	4075	4110	4160
Max applicable motor output (kW) *		5.5	11	22	45	75	110	160
Output ratings	Rated output capacity (kVA)	10	19	36	67	114	166	209
	Rated output current (A)	15	27	52	97	165	240	302
	Max output voltage (V)	Ratio of input voltage (Input voltage × 0.95)						
	Max output frequency (Hz)	Frequencies supported up to 120 Hz using parameter setting						
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)	3-phase, 380, 400, 415, 440, 460 or 480 VAC, 50/60 Hz						
	Allowable voltage fluctuation	+ 10%, - 15%						
	Allowable frequency fluctuation	±3% frequency fluctuation rate, 1 Hz/100 ms or less						

* The maximum applicable motor output is given for a standard 4-pole Yaskawa motor. When selecting the actual motor and MxC, be sure that the MxC's rated current is applicable for the motor's rated current.

◆ Common Specifications

The following specifications apply to MxCs in both 200 V and 400 V classes.

Table 9.3 Common Specifications

Voltage Class (V)		200				400						
Model: CIMR-ACAA□		25P5	2011	2022	2045	45P5	4011	4022	4045	4075	4110	4160
Maximum motor capacity (kW) *1		5.5	11	22	45	5.5	11	22	45	75	110	160
Rated input current*2 A		26	47	91	174	14	26	49	92	157	228	287
Rated output	Output capacity (kVA)	9	17	33	63	10	19	36	67	114	166	209
	Rated output current (A)*3	27	49	96	183	15	27	52	97	165	240	302
	Max output voltage	Ratio of input voltage (Input voltage × 0.95)										
	Max output frequency	Applicable for 120 Hz depending on parameter settings.										
Power	Rated voltage and rated frequency	3-phase: 200 V, 208 V, and 220 V, 50 Hz or 60 Hz				3-phase: 380 V, 400 V, 415 V, 440 V, 460 V, and 480 V, 50 Hz or 60 Hz						
	Allowable voltage fluctuation	+10% to -15%										
	Allowable frequency fluctuation	± 3%, fluctuation ratio: 1 Hz/100 ms or less										
	Allowable power voltage imbalance between phases	Within 2%										
	Input power factor	0.95 or more (When the rated load is applied.)										
Control characteristics	Control method	Sine wave pulse-width modulation (PWM) Use parameter settings to select from three methods: Flux Vector Control, Open Loop Vector Control, or V/f Control.										
	Torque characteristics	150%/0 Hz with Flux Vector Control *4										
	Speed control range	1:1000 with Flux Vector Control *4										
	Speed control accuracy*5	± 0.2% with Open Loop Vector Control at -10°C to +40°C,*4 ± 0.05% with Flux Vector Control at 25°C ± 10°C *4										
	Speed control response	30 Hz with Flux Vector Control *4										
	Torque limits	For vector control only. Use parameter settings to change 4 quadrant control.										
	Torque accuracy	± 10% (Flux vector control: 25 °C ±10 °C with a vector motor, carrier frequency of 4kHz)*4										
	Frequency control range	0.01 Hz to 120 Hz										
	Frequency accuracy (temperature characteristics)	Digital references: ± 0.01% (-10 °C to +40 °C), Analog references: ± 0.1% (25 °C ±10 °C)										
	Frequency setting resolution	Digital references: 0.01 Hz Analog references: 0.03 Hz/ 60 Hz (11 bit signed)										
	Output frequency resolution	0.001 Hz										
	Overload capacity and maximum current*6	150% of rated output current per one minute (for carrier frequency of 4 kHz).										
	Acceleration/ Deceleration time	0.00 s to 6000.0 s Select from four combinations of independent acceleration and deceleration settings.										
	Braking torque	Same overload capacity for motoring and regeneration										

Table 9.3 Common Specifications (Continued)

Voltage Class (V)		200				400						
Model: CIMR-ACAA□		25P5	2011	2022	2045	45P5	4011	4022	4045	4075	4110	4160
Control characteristics	Main control functions	Restarting for momentary power loss, speed search, overtorque detection, torque limits, 17-speed control (maximum), accel/decel time changes, S-curve accel/decel, 3-wire sequence, Auto-Tuning (rotational or stationary), dwell functions, cooling fan on/OFF control, slip compensation, torque compensation, jump frequencies, upper and lower limits for frequency references, DC braking for starting and stopping, PID control with sleep function, MEMOBUS communications (RS-485/422, 19.2 kbps maximum), fault reset, function copying, droop control, torque control, speed/torque control switching, etc.										
	Regenerative function	Provided										
Protective functions	Motor protection	Protection by electronic thermal overload relay.										
	Instantaneous overcurrent protection	Stops at approx. 200% of rated output current.										
	Blown fuse protection	Stops if fuse blows.										
	Overload protection	150% of rated output current per one minute (for carrier frequency of 4 kHz)										
	Overvoltage protection	Input voltage: Stops if input power supply voltage is greater than approx. 250 VAC.				Input voltage: Stops if input power supply voltage is greater than approx. 550 VAC.						
	Undervoltage protection	Input voltage: Stops if control power supply voltage is less than approx. 150 VAC.				Input voltage: Stops if control power supply voltage is less than approx. 300 VAC.						
	Momentary power loss ridethrough	Stops for 2 ms or more during power loss (default). Parameter settings allow the unit to continue running if power is restored within 2s.*7										
	Cooling fin overheating	Protection by thermistor.										
	Stall prevention	Stall prevention during acceleration or deceleration while running.										
	Grounding protection*8	Protection by electronic circuits. (Overcurrent level)										
	Charge indicator	Lit until the control-power voltage is approx. 50 V or more.										
Environment	Ambient operating temperature	Enclosed, wall-mounted type: -10°C to + 40°C Open chassis type: -10°C to + 45°C										
	Ambient operating humidity	95% RH max (with no condensation)										
	Storage temperature	- 20°C to + 60°C (short-term temperature during transportation)										
	Application site	Indoor (no corrosive gas, dust, etc.)										
	Altitude	1000 m max										
	Oscillation	200 V Class Inverters of 5.5 to 22 kW and 400 V Class Inverters of 5.5 to 22 kW 10 to 20 Hz: 9.8 m/s2 20 to 55 Hz: 5.9 m/s2 200 V Class Inverters of 45 kW and 400 V Class Inverters of 45 to 160 kW 10 to 20 Hz: 9.8 m/s2 20 to 55 Hz: 2.0 m/s2										
Protective structure		Open chassis type (IP00) and enclosed wall-mounted type [NEMA1 (Type 1)]*9										

* 1. The maximum applicable motor capacity is given for a standard, four-pole Yaskawa motor. When selecting the actual motor and MxC, be sure that the MxC's rated current is greater than the motor's rated current.

* 2. The rated current will vary in accordance with the values of the voltage or impedance of the power supply (including the power transformer, the input reactor, and wires).

* 3. Required to reduce the rated output current in accordance with the values of the carrier frequencies or control mode.

* 4. Rotational Auto-Tuning is required for the open loop vector or Flux Vector Control.

* 5. The speed control accuracy varies in accordance with the installation condition and motor type. For more details, contact your Yaskawa representative.

* 6. Derating is required for applications that use repetitive loads. To decrease the carrier frequency or to gradually decrease the current, use an MxC with a greater capacity. For more details, contact your Yaskawa representative.

* 7. If the CIMR-ACA45P5, 4011, 25P5, 2011, or 2022 needs two seconds or more for the momentary power loss ridethrough time, a separate momentary-power-loss compensation unit is required. Even if the Momentary Power Loss Detection function (L2-01) is enabled, the MxC will run for 2 ms and then stop if a momentary power loss occurs. Take note of this delay when the MxC is used in various applications.

* 8. 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.

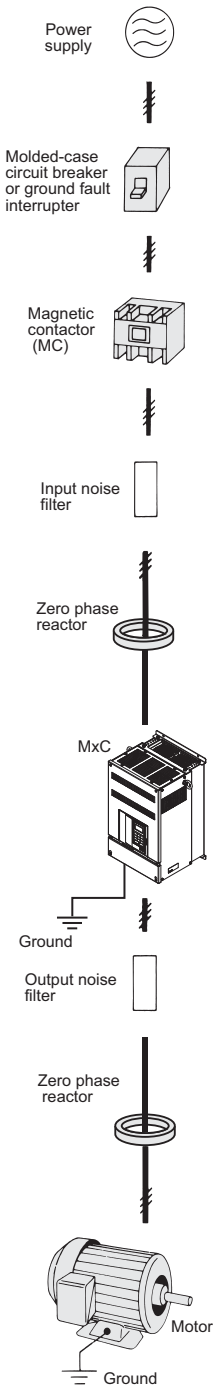
* 9. The open chassis is the only type of protective structure available for the MxC models CIMR-ACA4110 and 4160.

Specifications for Options and Peripheral Devices

The following options and peripheral devices can be used for the MxC. Select them according to the application.

Table 9.4 Options and Peripheral Devices

Purpose	Name	Model (Code)	Descriptions
Protect MxC wiring	MCCB or Ground Fault Interrupter*1	NF□	Always connect a breaker to the power supply line to protect MxC wiring. Use a ground fault interrupter suitable for high frequencies.
Prevents burning of the MxC.	Magnetic Contactor	SC series	Install to prevent the MxC from burning out when faults occur at the input terminal side of the MxC. 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 MxC.
Isolates I/O signals	Isolator	DGP□	Isolates the I/O signals of the MxC and is enabled against inductive noise.
Reduces the affects of radio and control device noise	Input Noise Filter	LNFD-□ FN-□	Reduces noise coming into the MxC from the power supply line and to reduce noise flowing from the MxC into the power supply line. Connect as close to the MxC 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 MxC input power system. Insert as close to the MxC as possible. Can be use on both the input side and output side.
	Output Noise Filter	LF-□	Reduces noise generated by the MxC. Connect as close to the MxC as possible.
Operates the MxC externally	VS Operator (small plastic Operator)	JVOP-95•□ (73041-0905X-□)	Allows frequency reference settings and on/OFF operation control to be performed by analog references from a remote location (50 m max). Frequency counter specifications: 60/120 Hz, 90/180Hz
	VS Operator (Standard steel-plate Operator)	JVOP-96•□ (73041-0906X-□)	Allows frequency reference settings and on/OFF operation control to be performed by analog references from a remote location (50 m max). Frequency counter specifications: 75 Hz, 150 Hz, 220 Hz
	Digital Operator Connection Cable	1 m cable: (72606-WV001) 3 m cable: (72606-WV003)	Extension cable to use a digital operator remotely. Cable length: 1 m or 3 m
Controls an MxC system	VS System Module	JGSM-□	A system controller that can be match to the automatic control system to produce an optimum system configuration.
Saves the momentary power loss compensation time of MxC	Momentary power loss compensation unit	P00□0 (73600-P00□0)	Safety measure taken to protect against momentary power loss of the control power supply.
Set/monitor frequencies and voltages externally.	Frequency Meter	DCF-6A	Devices to set or monitor frequencies externally.
	Frequency Setter	RV30YN20S (2 kΩ)	
	Frequency Setter Knob	CM-3S	
	Output Voltmeter	SCF-12NH	Measures the output voltage externally and designed for use with a PWM MxC.
Correct frequency reference input, frequency meter, ammeter scales	Variable Resistor Board for Frequency Reference	2 kΩ (ETX003270) 20 kΩ (ETX003120)	Connected to the control circuit terminals to input a frequency reference.
	Frequency Meter Scale Correction Resistor	(RH000850)	Calibrates the scale of frequency meters and ammeters.



* 1. Use an earth leakage breaker that has harmonics protection and a minimum current of 30 mA per MxC. Otherwise, the harmonic leakage current may cause a malfunction. If a malfunction occurs in an earth leakage breaker without harmonic protection, lower the carrier frequency of MxC, replace the earth leakage breaker with one that has harmonic protection, or raise the current of the earth leakage breaker to 200 mA or more per MxC.

* 2. The FINEMET zero-phase reactor is manufactured by Hitachi Metals.

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 Card AI-14U	73600-C001X	Enables high-precision, high-resolution setting of analog speed references. • 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 Card AI-14B	73600-C002X	Enables high-precision, high-resolution setting of analog speed references. • Input signal ranges: 0 to ±10 V (20 kΩ) 4 to 20 mA (500 Ω), 3 channels • Input resolution: 13-bit + sign (1/8192)	TOBPC7306 0015
		Digital Speed Reference Card DI-08	73600-C003X	Enables 8-bit digital setting of speed references. • 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 Speed Reference Card DI-16H2	73600-C016X	Enables 16-bit digital setting of speed references. • 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 Card AO-08	73600-D001X	Converts analog signals to monitor the MxC's output status (output frequency, output current, etc.) to absolute values and outputs them. • Output resolution: 8-bit (1/256) • Output voltage: 0 to +10 V (not insulated) • Output channels: 2 channels	TOE-C736-30.21
		Analog Monitor Card AO-12	73600-D002X	Output analog signals to monitor the MxC's output status (output frequency, output current, etc.). • 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 Card DO-08	73600-D004X	Outputs isolated digital signals to monitor the MxCs 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 Card DO-02C	73600-D007X	Provides two multi-function outputs (DPDT relay contacts) in addition to those provided by the MxC.	TOE-C736-40.8
Built-in (connect to connector)	PG Speed Control Cards	PG-B2	73600-A013X	• Used for Flux Vector Control. • A-, B-phase input (complimentary input) • Maximum input frequency: 32767 Hz • Pulse monitor output: Open-collector (PG power supply output: +12 V, 200 mA max)	TOBPC7306 0009
		PG-X2	73600-A015X	• 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)	TOBPC7306 0010

Table 9.5 Option Cards (Continued)

Type		Name	Code Number	Function	Document Number
Built-in (connected to connector)	Communications Option Cards	DeviceNet Communications Interface Card SI-N1*1	73600-C021X	Used to communicate with an MxC from a host computer using DeviceNet communications to start/stop MxC operation, read/set parameters, and read/set monitor parameters (output frequencies, output currents, etc.).	SIBPC7306 0001
		CANopen Communications Interface Card SI-S1	*2	Used to communicate with an MxC from a host computer using CANopen communications to start/stop MxC operation, read/set parameters, and read/set monitor parameters (output frequencies, output currents, etc.).	-
		CC-Link Communications Interface Card SI-C*3	73600-C032X	Used to communicate with an MxC from a host computer using CC-Link communications to start/stop MxC operation, read/set parameters, and read/set monitor parameters (output frequencies, output currents, etc.).	TOB-C736-70.6

* 1. Applicable for the Varispeed AC with software versions PRG: 1051 or later.
* 2. Under development.
* 3. SI-C card with software versions PRG: 0103 or later is applicable for Varispeed AC.

10

Appendix

This chapter includes precautions for the MxC, motor, and peripheral devices, as well as a list of parameters.

MxC Control Methods 10-2
MxC Application Precautions 10-5
Motor Application Precautions 10-10
Wiring Examples 10-12
Parameters 10-17

MxC Control Methods

Details of the MxC control methods and their features are provided in this section.

◆ Control Methods and Features

The MxC offers three control methods, allowing the selection of a control method to suit the required purpose. *Table 10.1* provides an overview of the control methods and their features.

Table 10.1 Overview of Control Methods and Features

Control Method		V/f Control	Open Loop Vector Control	Flux Vector Control
Parameter Setting		A1-02 = 0	A1-02 = 2 (default)	A1-02 = 3
Basic Control		Voltage/frequency fixed ratio control	Current vector control without a PG	Current vector control with a PG
Main Applications		Variable speed control	Variable speed control	High-performance control with a PG on the motor side
PG Speed Control Card (Option)		Not required.	Not required.	Required
Basic Performance	Speed Control Range*1	1:10	1:10	1:1000
	Speed Control Accuracy*2	±2 to 3%	±0.2%	±0.05%
	Speed Response*3	-	5 Hz	30 Hz
	Maximum Output Frequency	120 Hz	120 Hz	120 Hz
	Starting Torque*4	150%/6 Hz	150%/6 Hz	150%/0 min^{-1}
Application Functions	Auto-Tuning	Line-to-line resistance (normally not required)	Rotational Auto-Tuning, Stationary Auto-Tuning, Stationary Auto-Tuning for line-to-line resistance only	Rotational Auto-Tuning, Stationary Auto-Tuning, Stationary Auto-Tuning for line-to-line resistance only
	Torque Limiting*5	No	Yes (except during accel/decel, below minimum frequency, or during reverse rotation)	Yes
	Torque Control*6	No	No	Yes
	Droop Control*7	No	No	Yes (except for 0 min^{-1} and during reverse rotation)
	Zero-Servo Control*8	No	No	Yes

Table 10.1 Overview of Control Methods and Features

Control Method		V/f Control	Open Loop Vector Control	Flux Vector Control
Application Functions	Speed Estimation (Detection) Instantaneous Speed Search*9	Yes (speed and rotation direction estimation)	Yes (speed and rotation direction estimation)	Yes (speed and rotation direction detection)
	Feed Forward Control*10	No	No	Yes

* 1. The variable speed control range. For continuous operation, the motor's temperature rise must be considered.
* 2. The speed deviation in relation to the maximum speed with a rated load and when the load is stable. For Open Loop Vector Control, the motor temperature must be 25 °C ± 10 °C.
* 3. The speed response guidelines indicating the extent of the motor's actual speed gain in proportion to the speed reference, which changes in a sinusoidal wave form, within a range where motor torque does not become saturated.
* 4. A guideline for the motor torque that can be generated when started at a low speed and its output frequency (rotations) at that time.
* 5. This function limits the maximum motor torque to protect the machine and the load.
* 6. This function directly controls the amount of torque being generated at the motor and its rotation direction, e.g., to control force.
* 7. This function controls the amount of motor slip that occurs to prevent mechanical shock, when replacing a torque motor, etc.
* 8. This function performs simple positioning control (servo lock), without using an external positioning control device.
* 9. This function instantaneously estimates or detects the speed and rotation direction of a coasting motor, and quickly starts it without subjecting it to shock.
* 10.This function enables proportional gain in relation to changes in the speed reference, even for low rigidity (corresponds to the servo's model gain control).

■Application Function Precautions

Observe the following precautions when using the application functions.

- Perform Rotational Auto-Tuning during a test run whenever it is possible to separate the motor and machine. To achieve the characteristics of Open Loop Vector Control described in *Table 10.1*, the control must be adjusted within a range that the machine will not vibrate after Rotational Auto-Tuning has been performed.
- With vector control, the motor and MxC must be connected 1:1. Vector control is not possible when multiple motors are connected to a single MxC. Select an MxC capacity so the rated motor current is 75% of the rated MxC current.
- For estimated speed searching, the motor and MxC must be connected 1:1. The speed search must be performed at a frequency of 120 Hz or less and with a motor with the same number of frames as or one frame less than the MxC capacity.
- Feed Forward Control is a function that improves the proportional gain of the motor speed in relation to the change in the speed reference. Adjust the response to interference loads using the speed controller (ASR) parameters.
- The torque limit function will not operate during acceleration or deceleration (during soft start transition) when using a control method such as Open Loop Vector Control. Even if the motor speed drops due to torque limiting while set to a fixed speed, the speed will not fall below the minimum frequency and the motor will not slip into reverse rotation. These conditions also apply to other application functions.

◆ Control Methods and Applications

Application examples for the MxC control methods are provided below.

■V/f Control (A1-02 = 0)

V/f Control is suitable for applications that require the motors to operate at variable speeds.

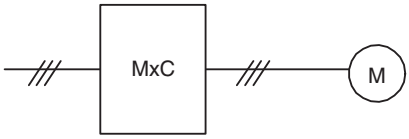


Fig 10.1

■Open Loop Vector Control (A1-02 = 2)

Open Loop Vector Control enables high-performance functions without a motor encoder. PG (pulse generator) wiring is therefore not required.

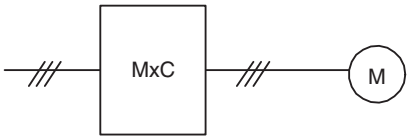


Fig 10.2

■Flux Vector Control (A1-02 = 3)

Flux Vector Control is suitable for applications high-precision functions that require PG feedback. High-precision positioning, zero-speed control, and torque control are possible with this mode.

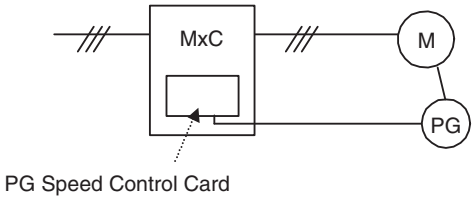


Fig 10.3

MxC Application Precautions

This section provides precautions for selecting, installing, setting, and handling MxCs.

◆ Selection

Observe the following precautions in selecting an MxC.

■Reduction Ratio of Carrier Frequency, Control Method, and Rated Current

The following table shows the reduction ratio of the carrier frequency, control methods, and rated current.

Model: CIMR-ACA25P5, 2011, 2022, 45P5, and 4011

Carrier Frequency (kHz)	Control Method	Continuous Rating	60-second Rating
4	V/f Open Loop Vector Flux Vector	100%	150%
8	Flux Vector	90%	135%
12	Flux Vector	80%	120%

Model: CIMR-ACA2045, 4045, and 4075

Carrier Frequency (kHz)	Control Method	Continuous Rating	60-second Rating
4	V/f Open Loop Vector Flux Vector	100%	150%
8	Open Loop Vector Flux Vector	90%	135%
12	Flux Vector	80%	120%

Model: CIMR-ACA4022

Carrier Frequency (kHz)	Control Method	Continuous Rating	60-second Rating
4	V/f Open Loop Vector Flux Vector	100%	150%
8	Flux Vector	80%	120%
12	Flux Vector	60%	90%

Models: CIMR-ACA4110 and 4160

Carrier Frequency (kHz)	Control Method	Continuous Rating	60-second Rating
4	V/f Open Loop Vector Flux Vector	100%	150%

Note: 100% indicates the rated current value when the carrier frequency is 4 kHz.

■When Momentary Power Loss Ridethrough Time Needs 2 Seconds or More

If the CIMR-ACA45P5, 4011, 25P5, 2011, or 2022 needs two seconds or more for the momentary power loss ridethrough time, a momentary-power-loss compensation unit is necessary. If L2-01 (Momentary Power Loss Detection Selection) is enabled, the MxC will stop 2 ms after the momentary power loss occurs. Be aware of these differences and select appropriately for your application needs.

- 200 V class momentary power loss compensation unit: Code no. 73600-P0010
- 400 V class momentary power loss compensation unit: Code no. 73600-P0020

■Required Time to be Ready

The MxC needs one second more than general-purpose inverters to prepare for operation. Be careful of this delay if using an external reference input.

Model	Required Time to be Ready After Power is Turned On
Varispeed AC (MxC)	Approx. 1.5 seconds*
Varispeed G7/F7	Approx. 0.5 seconds*

* This time is required if no optional device is used with the MxC. If an optional transmission device is used, the time required for the MxC to be ready for operation will vary in accordance with the start up time of the optional transmission card.

■Number of Motors

An MxC is capable of operating only one motor. Do not use a single MxC to operate several motors.

■Improving the Power Factor

No AC reactor or DC reactor is required to improve the power factor.

■Selection of Power Capacity

Use a power supply that is greater than the rated input capacity (kVA) of the MxC. If the power is lower than the rated capacity of the MxC, the device will be unable to run the application properly and a fault will occur.

The input capacity of the MxC, S_{CONV} (kVA), can be calculated by the following formula.

$S_{CONV} = \sqrt{3} \times I_{in} \times V_{in} \div 1000$

(I_{in}: MxC Rated input current [A], V_{in}: Applicable power line-to-line voltage [V])

■Connection to Power Supply

The total impedance of the power supply and wiring for the rated current of the MxC is %Z = 10% or more. If the impedance of the power supply is too large, then power voltage distortion may occur. If the wiring is too long, then be sure that proper preventative measures such as thick cables or series wiring have been taken to lower the impedance of wiring.

■Grounding the power supply

Observe the following precautions when grounding the MxC.

- Because Mxc is designed to run with a 1:1 ratio relative ratio relative to the power supply, it is highly recommended that the power supply has its own dedicated ground.
- Other devices should be grounded as directed in the specifications for those device.
- Particular care needs to be taken when connecting sensitive electronic equipment (such as OA devices). Separate ground lines to prevent problems from noise, and install a noise filter.

■Precaution on Using Peripheral Devices

If installing a noise filter on the power-supply side of the MxC, use a specified noise filter such as a FINEMET zero-phase reactor.

■When Using a Generator as a Power Supply

- Select the generator capacity approximately twice as large as the MxC input power supply capacity. For further information, contact your Yaskawa representative.
- Set the deceleration time or load so that the regenerative power from the motor will be 10% or less of the generator capacity.

■When a Phase Advance Capacitor or Thyristor Controller is Provided for the Power Supply

No phase advance capacitor is needed for the MxC. Installing a phase advance capacitor to the VS-656DC5 will weaken the power factor.

For the phase advance capacitor that has already been installed on the same power supply system as the MxC, attach a phase-advance capacitor with a series reactor to prevent oscillation with the MxC.

Contact your Yaskawa representative, if any device generating voltage surge or voltage distortion such as DC motor drive thyristor controller or magnetic agitator is installed on the same power supply system.

■Prevention Against EMC (Radio Noise) or Harmonic Leakage Current

Preventive actions against EMC (radio noise) or harmonic leakage current are necessary for the MxC as well as for general inverter drives.

If a device that will be affected by noise is near the MxC, use a zero-phase reactor as a noise filter.

Use a leakage relay or an ground leakage breaker designed for inverters (products provided with prevention from harmonics leak current), when necessary.

■Guidelines for Harmonic Reduction

A guideline for handling problems with harmonics is available for users who receive 6.6 kVA or more from the power supply system.

■Affects of Power Supply Distortion

When the power supply voltage is distorted, or when several devices are connected in parallel to the same power supply, the harmonics contents increase because the harmonics of the power supply system enter the Varispeed AC.

■Applications Requiring Frequent Stops and Starts

Applications with repetitive loads such as cranes, elevators, presses, and washing machines must be derated to handle the load. Derating refers to a reduction of the carrier frequency and current, and involves a change to accel/decel timing and increasing the frame size of the MxC.
Contact your Yaskawa representative for more information.

■Initial Torque

The startup and acceleration characteristics of the motor are restricted by the overload current ratings of the MxC that is driving the motor. The torque characteristics are generally less than those required when starting the motor with a normal commercial power supply. If a large initial torque is required, select an MxC with a somewhat larger capacity or increase the capacity of both the motor and the MxC.

■Emergency Stop

Although the protective functions in the MxC will trigger a Stop Command 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 p1, n1, r2, s2, and t2 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 MxC.

■Using Enclosures

Either install the MxC in a clean location free of oil mist, air-bourne matter, dust, and other contaminants, or install the MxC in a completely enclosed panel. Provide cooling measures and sufficient panel space so that the temperature surrounding the MxC does not rise above allowable limits. Do not install the MxC on a wood surface or to any other combustible materials.

■Installation Directions

Mount the MxC so that it sits upright.

◆ Settings

Observe the following precautions when making settings for an MxC.

■Upper Limits

The digital operator can be used to set high-speed operation up to a maximum of 120 Hz. Incorrect settings can be dangerous. Use the maximum frequency setting functions to set upper limits. The maximum output frequency is factory-set to 60 Hz.

■DC Injection Braking

The motor can overheat if the DC Injection Braking voltage or braking time is set too high.

■Acceleration/Deceleration Times

The acceleration and deceleration times for the motor are determined by the motor generated torque, the load torque, and the inertial moment of the load ($GD^2/4$). If the stall prevention functions are activated during acceleration or deceleration, increase the acceleration or deceleration time. The stall prevention functions will increase the acceleration or deceleration time by the amount of time the stall prevention function is active.

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

◆ Handling

Observe the following precautions when wiring or performing maintenance on the MxC.

■Wiring Check

Internal damage will occur if the power supply voltage is applied to output terminal U, V, or W or to optional connection terminal r2, s2, t2, p1, and n1. Check wiring for any mistakes before supplying power. Be sure to check all wiring and sequences carefully.

■Magnetic Contactor Installation

Do not start and stop the motor frequently when using a magnetic contactor installed on the power supply line. Doing so can cause the MxC to malfunction. The MxC should not be switched on and off more than once every 30 minutes when using a magnetic contactor.

■Maintenance and Inspections

After shutting off the main circuit power supply, always confirm that the CHARGE light has gone out before performing any maintenance or inspecting the MxC. Remaining voltage in the capacitor may cause electric shock.

Motor Application Precautions

This section provides precautions for motor application.

◆ Using the MxC to Run an Existing Standard Motor

When a standard motor is operated with the MxC, power loss is slightly higher than when operated with a commercial power supply. Observe the following precautions when using the MxC to operate an existing standard motor.

■Low Speed Ranges

Cooling effects diminish in the low-speed range, resulting in higher motor temperatures. The motor torque should be reduced in the low-speed range whenever using a non-Yaskawa motor. If 100% torque is required continuously at low speeds, consider using a special inverter or vector motor.

■Installation and Voltage Tolerance

Considerations must be made for the motor insulation voltage when the input voltage is high (440 V or higher) or the motor wiring is too long. Contact your Yaskawa representative for more details.

■Operating at High Speeds

When using the motor at a high speed (60 Hz or more), problems may arise in dynamic balance and bearing durability. Contact your Yaskawa representative for more details.

■Torque Characteristics

The motor may require more acceleration torque when the motor is operated with the MxC than when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor to set a proper V/f pattern.

■Resonance with the Natural Frequency of the Mechanical System

Take special care when a machine that has been operated at a constant speed is to be operated in Variable Speed Mode. If there are any problems with resonance, then install oscillation-proof rubber on the motor base or use the frequency jump function to skip any resonant frequencies in the application.

■Imbalanced Rotor

Take special care when the motor is operated at a high speeds (60 Hz or more).

■Noise

Noise varies with the carrier frequency. At high carrier frequencies, the noise is almost the same when the motor is operated with a commercial power supply. Motor noise, however, becomes louder when the motor is operated at a speed higher than the rated speed (60 Hz).

◆ Using the MxC for Motors other than Standard Yaskawa Motors

The MxC can drive three-phase induction motors with two, four, or six poles. The MxC cannot run PM motors, motors for machine tools, or multi-pole motors with eight poles or more.

If using the MxC with a motor not made by Yaskawa, contact your Yaskawa representative.

◆ 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 60 Hz.

Wiring Examples

This section provides wiring examples to connect peripheral devices to the main circuits, examples of wiring a transformer to MxC I/O, and other aspects of MxC wiring.

◆ Using a VS Operator

This example shows wiring for using a VS Operator. The VS Operator model number is JVOP-95•☐ or JVOP-96 •☐.

CIMR-ACA25P5 (200 V class 5.5 kW)

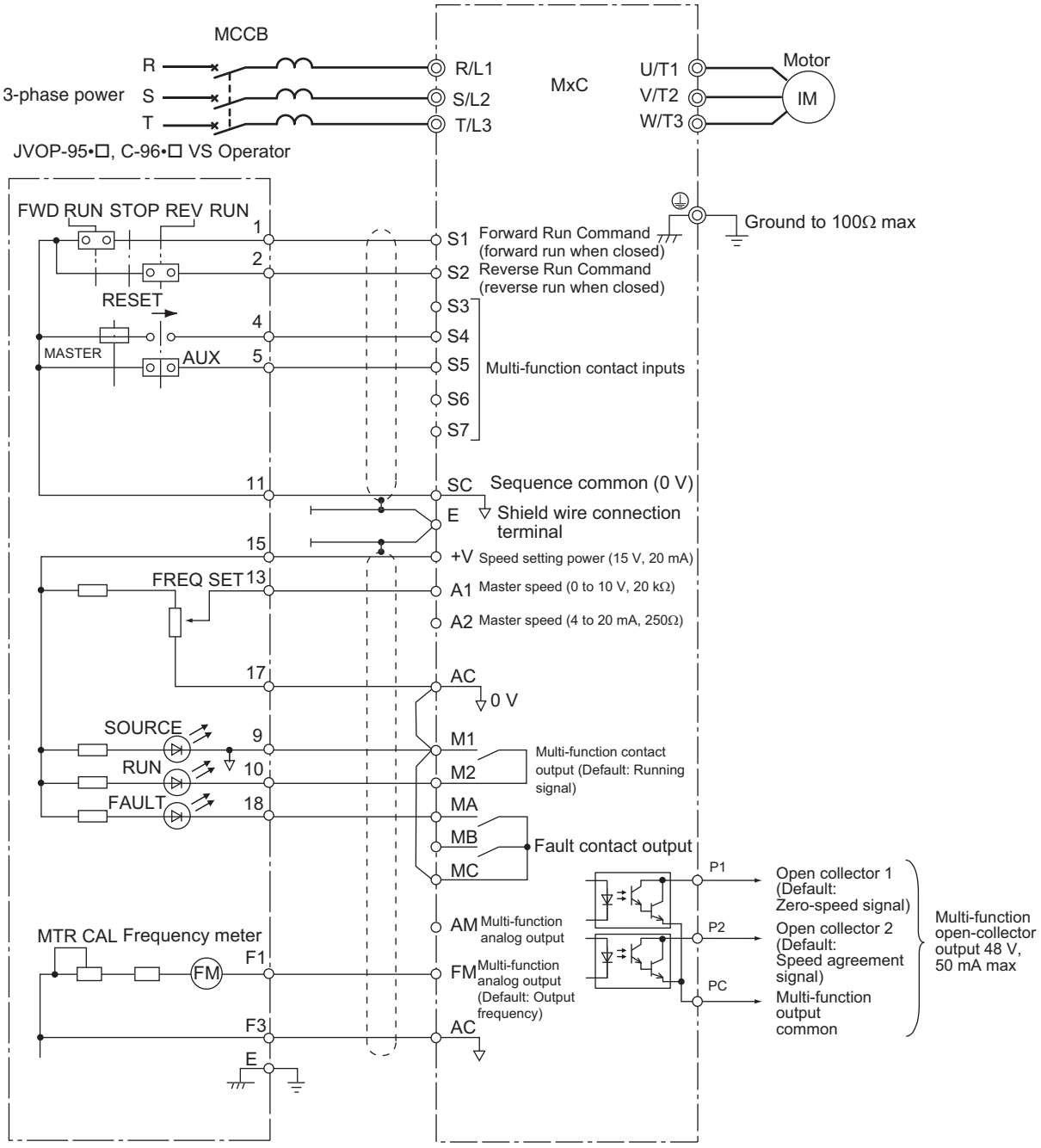


Fig 10.4

◆ 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.

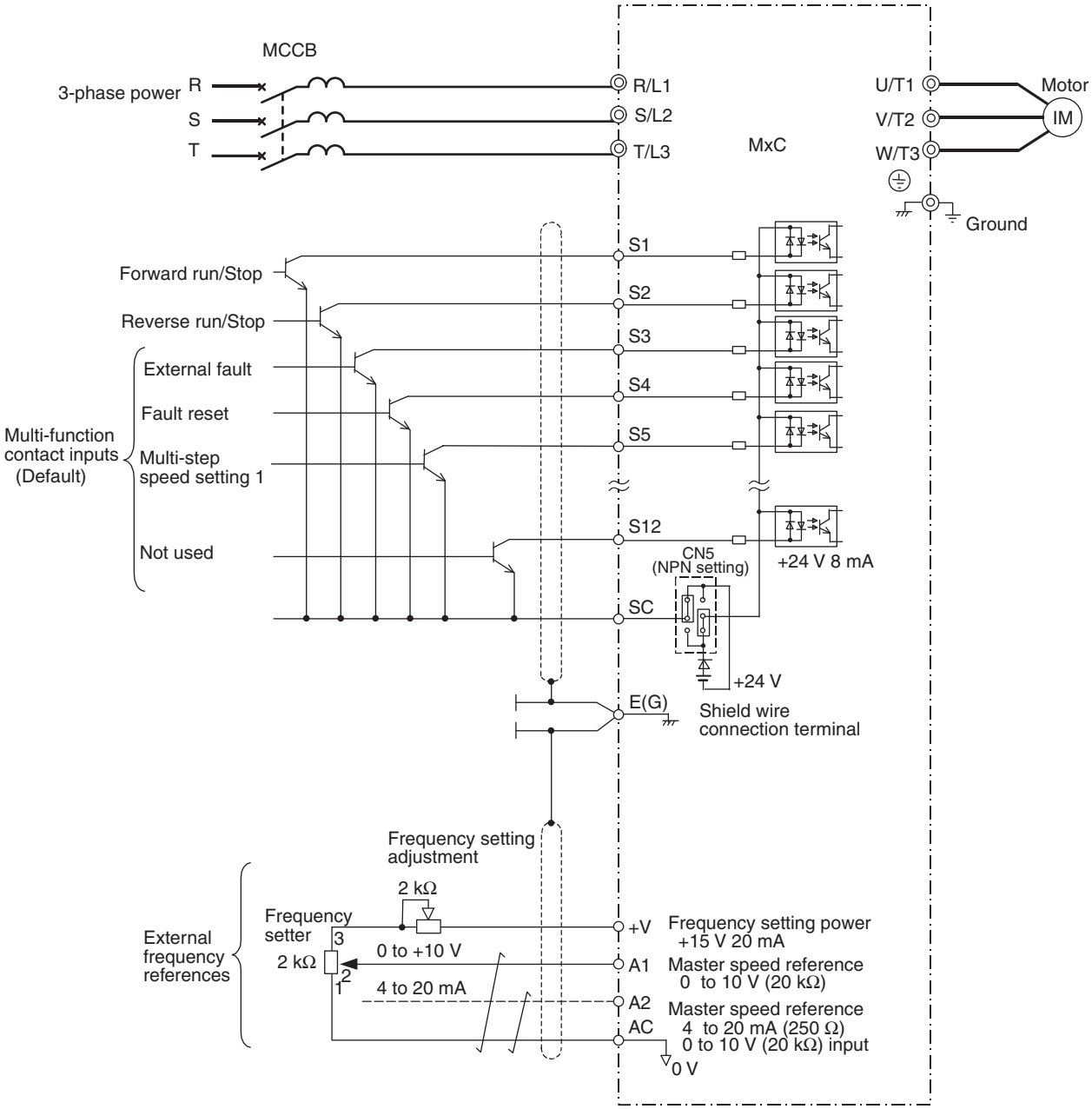


Fig 10.5

◆ 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.

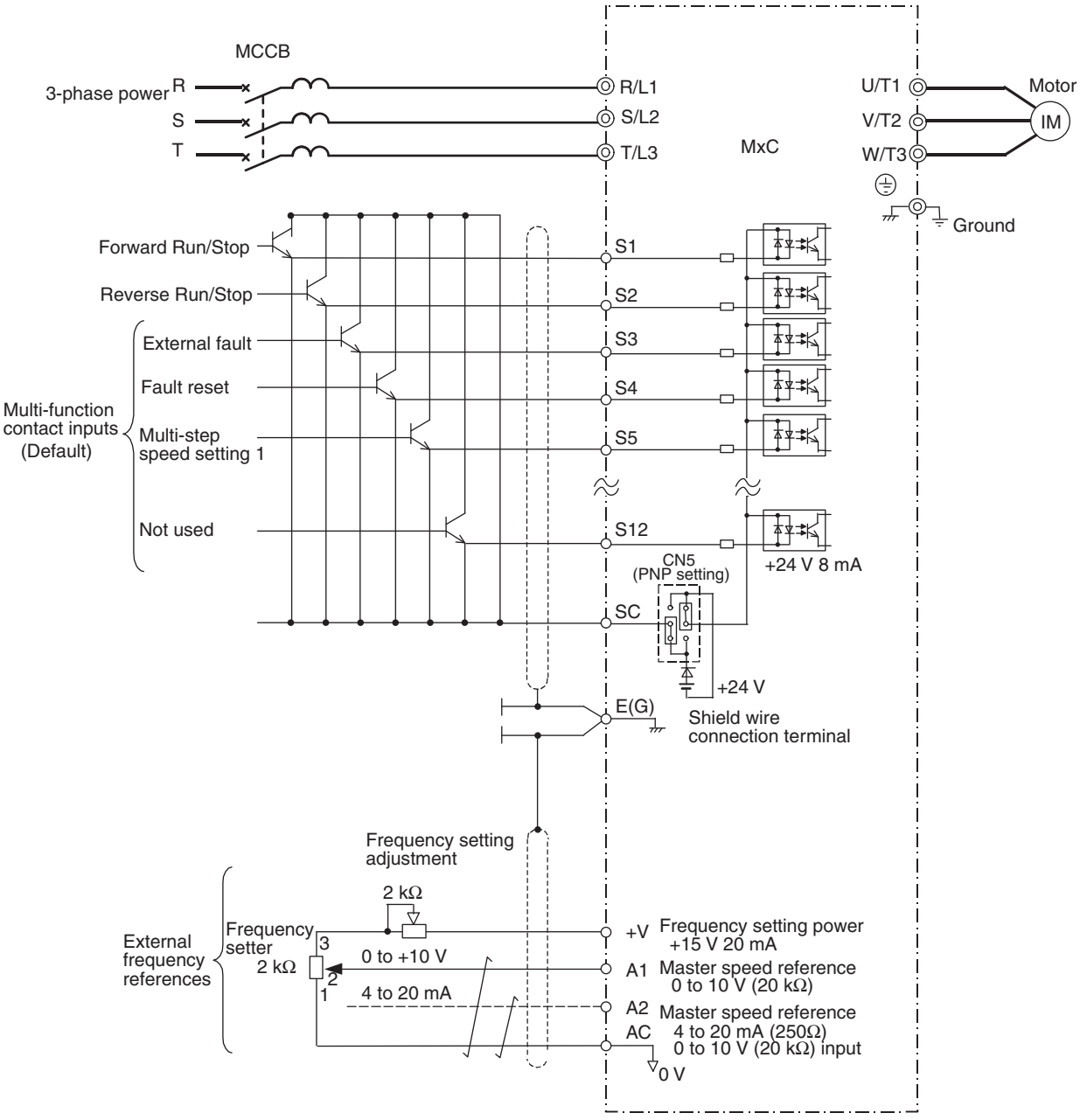
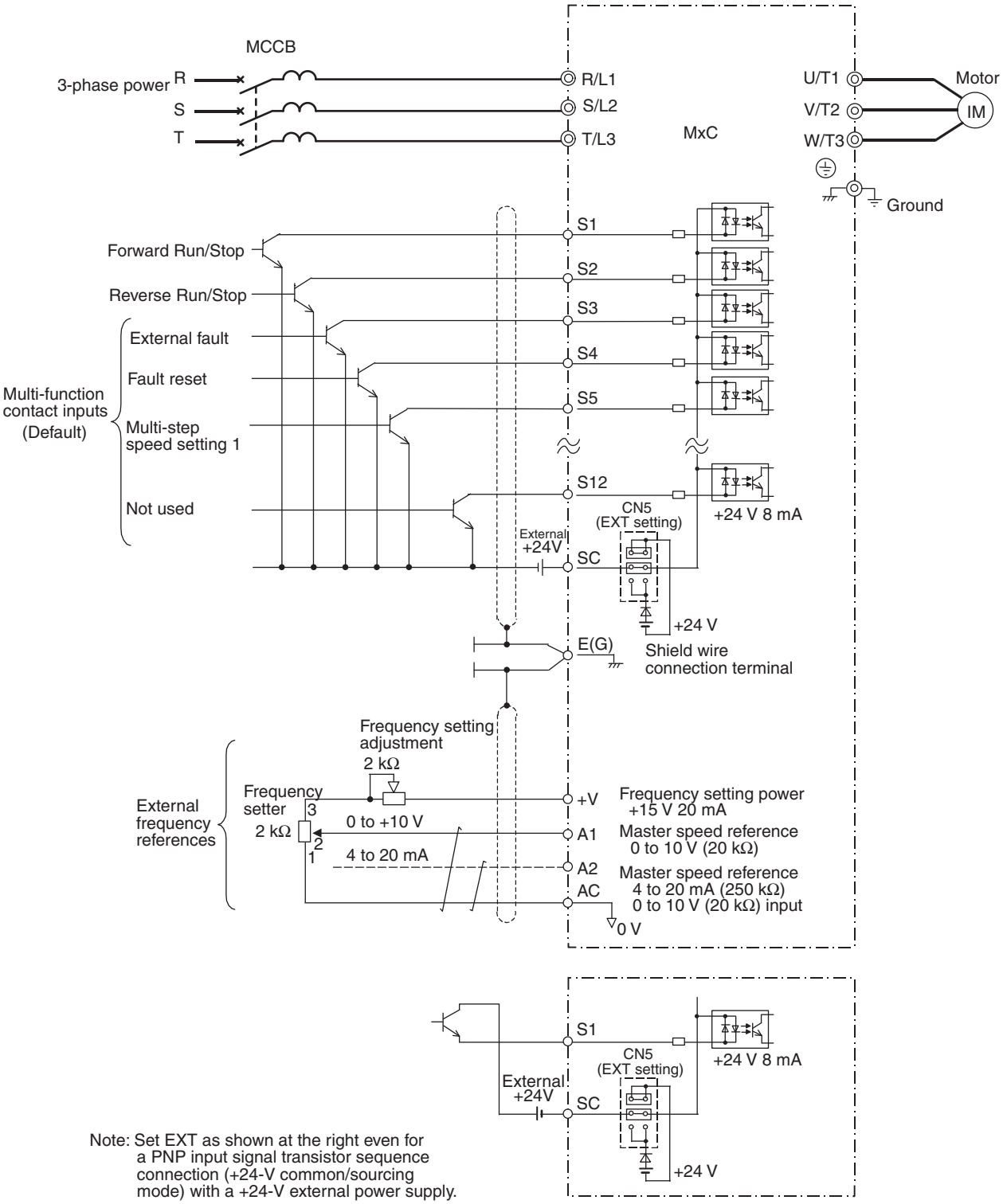


Fig 10.6

◆ Using Transistors for Input Signals and a 0 V Common in Sink 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 common 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 10.7

◆ Using Contact and Open Collector Outputs

This example shows wiring for digital outputs and open collector outputs.

The following example is for the CIMR-ACA25P5 (200 V class MxC for 5.5 kW).

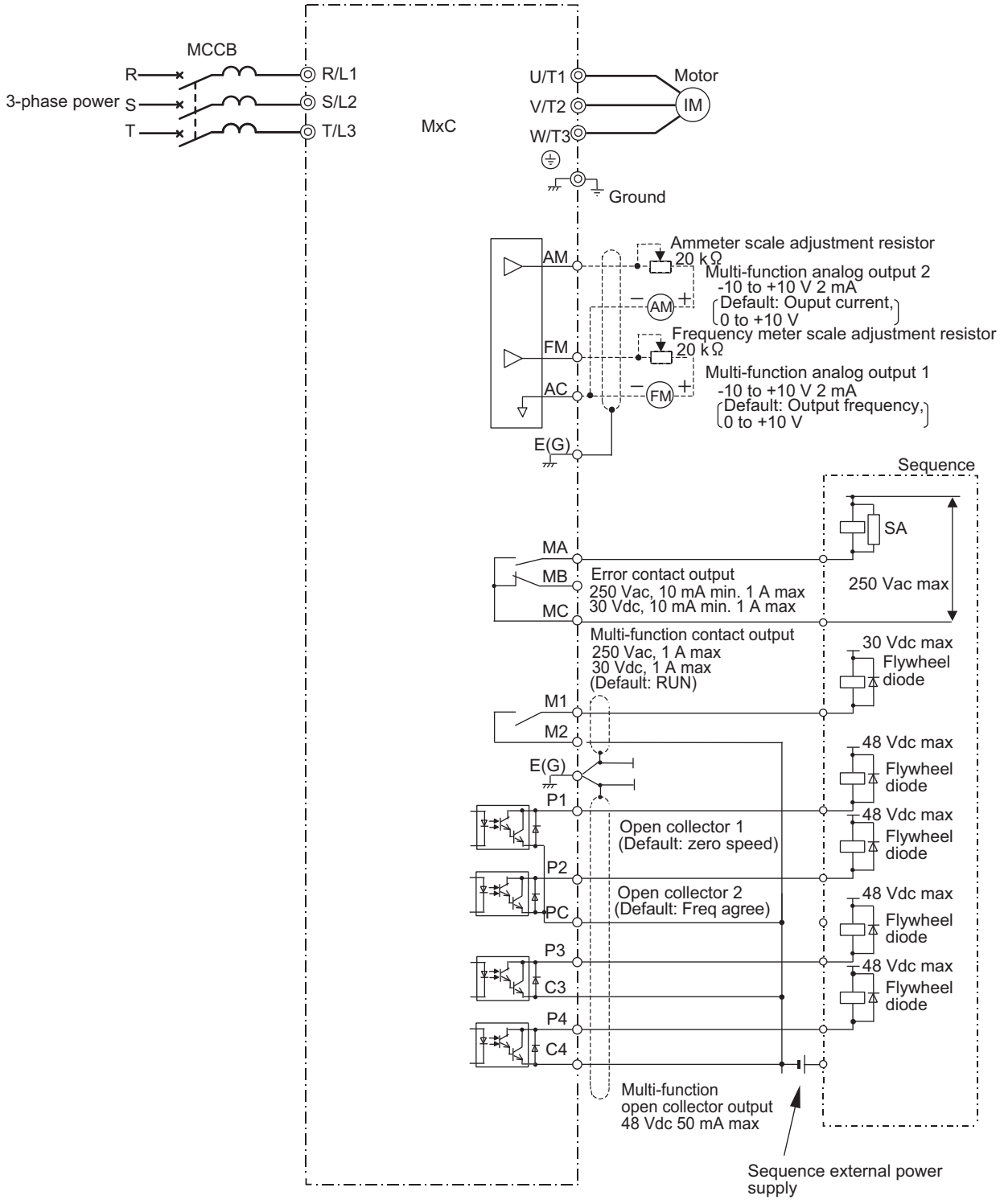


Fig 10.8

Parameters

Defaults in the MxC are listed below. These settings are for a 200 V class 5.5 kW MxC set to Open Loop Vector Control (the factory default control method).

Table 10.2 Parameters

No.	Name	Default	Set-ting	No.	Name	Default	Set-ting
A1-00	Language Selection	1		b3-04*8	Current Suppression Gain During Search	100*2	
A1-01	Access Level Selection	2		b3-05	Speed Search Delay Time	0.2	
A1-02	Control Method Selection	2		b3-10	Speed Search Detection Compen-sation Gain	1.05	
A1-03	Initialize Parameters	0		b3-14	Bi-Directional Speed Search Selection	0	
A1-04	Password 1	0		b3-19	Number of Speed Search Restarts	1	
A1-05	Password 2	0		b4-01	Timer Function ON-Delay Time	0.0	
A2-01 to A2-32	User Parameters	-		b4-02	Timer Function OFF-Delay Time	0.0	
b1-01	Frequency Reference Selection	1		b5-01	PID Function Setting	0	
b1-02	Run Command Selection	1		b5-02	Proportional Gain Setting	1.00	
b1-03	Stopping Method Selection	0		b5-03	Integral Time Setting	1.0	
b1-04	Reverse Operation Selection	0		b5-04	Integral Limit Setting	100.0	
b1-05	Minimum Output Frequency (E1-09) or Less Operation Selection	0		b5-05	Derivative Time	0.00	
b1-06	Digital Input Scan Time	1		b5-06	PID Output Limit	100.0	
b1-07	Local/Remote Run Selection	0		b5-07	PID Offset Adjustment	0.0	
b1-08	Run Command Selection During Program	0		b5-08	PID Primary Delay Time Constant	0.00	
b2-01	DC Injection Braking Start Fre-quency	0.5		b5-09	PID Output Level Selection	0	
b2-02	DC Injection Braking Current	50		b5-10	PID Output Gain Setting	1.0	
b2-03	DC Injection Braking Time/DC Excitation Time at Start	0.00		b5-11	PID Output Reverse Selection	0	
b2-04	DC Injection Braking Time at Stop	0.50		b5-12	PID Feedback Reference Missing Detection Selection	0	
b2-08	Magnetic Flux Compensation Capacity	0		b5-13	PID Feedback Loss Detection Level	0	
b3-01	Speed Search Selection	0		b5-14	PID Feedback Loss Detection Time	1.0	
b3-02	Speed Search Deactivation Current	100*1		b5-15	PID Sleep Function Start Level	0.0	
b3-03	Speed Search Deceleration Time	2.0		b5-16	PID Sleep Delay Time	0.0	

Table 10.2 Parameters (Continued)

No.	Name	Default	Set-ting	No.	Name	Default	Set-ting
b5-17	PID Accel/Decel Time	0.0		C3-01	Slip Compensation Gain	1.0*1	
b6-01	Dwell Reference at Start	0.0		C3-02	Slip Compensation Primary Delay Time	200*1	
b6-02	Dwell Time at Start	0.0		C3-03	Slip Compensation Limit	200	
b6-03	Dwell Frequency at Stop	0.0		C3-04	Slip Compensation Selection during Regeneration	0	
b6-04	Dwell Time at Stop	0.0		C3-05	Output Voltage Limit Operation Selection	0	
b7-01	Droop Control Level	0.0		C4-01	Torque Compensation Gain	1.00	
b7-02	Droop Control Delay Time	0.05		C4-02	Torque Compensation Primary Delay Time	100*1	
b9-01	Zero Servo Gain	5		C4-03	Torque Compensation at Forward Start	0.0	
b9-02	Zero Servo Completion Width	10		C4-04	Torque Compensation at Reverse Start	0.0	
C1-01	Acceleration Time 1	10.0		C4-05	Torque Compensation Time Constant	10	
C1-02	Deceleration Time 1	10.0		C5-01	ASR Proportional Gain 1	20.00*1	
C1-03	Acceleration Time 2	10.0		C5-02	ASR Integral Time 1	0.500*1	
C1-04	Deceleration Time 2	10.0		C5-03	ASR Proportional Gain 2	20.00*1	
C1-05	Acceleration Time 3	10.0		C5-04	ASR Integral Time 2	0.500*1	
C1-06	Deceleration Time 3	10.0		C5-06	ASR Primary Delay Time Constant	0.004*1	
C1-07	Acceleration Time 4	10.0		C5-07	ASR Gain Switching Frequency	0.0	
C1-08	Deceleration Time 4	10.0		C5-08	ASR Integral Limit	400	
C1-09	Fast Stop Time	10.0		C6-02	Carrier Frequency Selection	2	
C1-10	Accel/Decel Time Setting Units	1		d1-01	Frequency Reference 1	0.00	
C1-11	Accel/Decel Switch Frequency	0.0		d1-02	Frequency Reference 2	0.00	
C2-01	S-Curve Characteristic at Accel Start	0.20		d1-03	Frequency Reference 3	0.00	
C2-02	S-Curve Characteristic at Accel End	0.20		d1-04	Frequency Reference 4	0.00	
C2-03	S-Curve Characteristic at Decel Start	0.20		d1-05	Frequency Reference 5	0.00	
C2-04	S-Curve Characteristic at Decel End	0.00		d1-06	Frequency Reference 6	0.00	

Table 10.2 Parameters (Continued)

No.	Name	Default	Set-ting	No.	Name	Default	Set-ting
d1-07	Frequency Reference 7	0.00		d5-05	Speed Limit Bias	10	
d1-08	Frequency Reference 8	0.00		d5-06	Speed/Torque Control Switchover Timer	0	
d1-09	Frequency Reference 9	0.00		d6-01	Magnetic Field Weakening Level	80	
d1-10	Frequency Reference 10	0.00		d6-02	Magnetic Field Frequency	0.0	
d1-11	Frequency Reference 11	0.00		d6-03	Magnetic Field Forcing Function Selection	0	
d1-12	Frequency Reference 12	0.00		d6-06	Magnetic Field Forcing Limit	400	
d1-13	Frequency Reference 13	0.00		E1-01	Input Voltage Setting	200*3	
d1-14	Frequency Reference 14	0.00		E1-03	V/f Pattern Selection	F	
d1-15	Frequency Reference 15	0.00		E1-04	Maximum Output Frequency	60.0*1	
d1-16	Frequency Reference 16	0.00		E1-05	Maximum Output Voltage	200.0 *1 *3	
d1-17	Jog Frequency Reference	6.00		E1-06	Base Frequency	60.0*1	
d2-01	Frequency Reference Upper Limit	100.0		E1-07	Mid Output Frequency A	3.0*1	
d2-02	Frequency Reference Lower Limit	0.0		E1-08	Mid Output Voltage A	13.0 *1 *3	
d2-03	Master Speed Reference Lower Limit	0.0		E1-09	Minimum Output Frequency	0.5*1	
d3-01	Jump Frequency 1	0.0		E1-10	Minimum Output Voltage	2.5*1 *3	
d3-02	Jump Frequency 2	0.0		E1-11	Mid Output Frequency B	0.0*4	
d3-03	Jump Frequency 3	0.0		E1-12	Mid Output Voltage B	0.0*4	
d3-04	Jump Frequency Width	1.0		E1-13	Base Voltage	0.0*5	
d4-01	Frequency Reference Hold Function Selection	0		E2-01	Motor Rated Current	19.60*2	
d4-02	Trim Control Level	10		E2-02	Motor Rated Slip	1.50*2	
d5-01	Torque Control Selection	0		E2-03	Motor No-Load Current	5.10*2	
d5-02	Torque Reference Delay Time	0		E2-04	Number of Motor Poles	4	
d5-03	Speed Limit Selection	1		E2-05	Motor Line-to-Line Resistance	0.399*2	
d5-04	Speed Limit	0		E2-06	Motor Leakage Inductance	18.2*2	

Table 10.2 Parameters (Continued)

No.	Name	Default	Setting	No.	Name	Default	Setting
E2-07	Motor Iron-Core Saturation Coefficient 1	0.50		F1-04	Operation Selection at Deviation	3	
E2-08	Motor Iron-Core Saturation Coefficient 2	0.75		F1-05	PG Rotation Selection	0	
E2-09	Motor Mechanical Loss	0.0		F1-06	PG Division Rate (PG Pulse Monitor)	1	
E2-10	Motor Iron Loss for Torque Compensation	172*2		F1-08	Overspeed Detection Level	115	
E2-11	Motor Rated Output	5.50*2		F1-09	Overspeed Detection Delay Time	0.0	
E2-12	Motor Iron-Core Saturation Coefficient 3	1.30		F1-10	Excessive Speed Deviation Detection Level	10	
E3-01	Motor 2 Control Method Selection	2		F1-11	Excessive Speed Deviation Detection Delay Time	0.5	
E3-02	Motor 2 Maximum Output Frequency	60.0*1		F1-14	PG Open-Circuit Detection Time	2.0	
E3-03	Motor 2 Maximum Output Voltage	200.0 *1 *3		F2-01	AI-14 Input Selection	0	
E3-04	Motor 2 Base Frequency	60.0*1		F3-01	DI-08 / DI-16H2 Input Selection	0	
E3-05	Motor 2 Mid Output Frequency	3.0 *1		F4-01	AO-08/AO-12 Channel 1 Monitor Selection	2	
E3-06	Motor 2 Mid Output Voltage VA	13.0 *1 *3		F4-02	AO-08/AO-12 Channel 1 Gain	1.00	
E3-07	Motor 2 Minimum Output Frequency	0.5 *1		F4-03	AO-08/AO-12 Channel 2 Monitor Selection	3	
E3-08	Motor 2 Minimum Output Voltage	2.5 *1 *3		F4-04	AO-08/AO-12 Channel 2 Gain	0.50	
E4-01	Motor 2 Rated Current	19.60 *2		F4-05	AO-08/AO-12 Channel 1 Output Bias	0.0	
E4-02	Motor 2 Rated Slip	1.50 *2		F4-06	AO-08/AO-12 Channel 2 Output Bias	0.0	
E4-03	Motor 2 No-Load Current	5.10 *2		F4-07	AO-12 Channel 1 Signal Level	0	
E4-04	Motor 2 Number of Poles	4		F4-08	AO-12 Channel 2 Signal Level	0	
E4-05	Motor 2 Line-to-Line Resistance	0.399*2		F5-01	DO-02/DO-08 Channel 1 Output Selection	0	
E4-06	Motor 2 Leakage Inductance	18.2*2		F5-02	DO-02/DO-08 Channel 2 Output Selection	1	
E4-07	Motor 2 Rated Output	5.50*2		F5-03	DO-08 Channel 3 Output Selection	2	
F1-01	PG Parameter	600		F5-04	DO-08 Channel 4 Output Selection	4	
F1-02	Operation Selection at PG Open Circuit (PGO)	1		F5-05	DO-08 Channel 5 Output Selection	6	
F1-03	Operation Selection at Overspeed (OS)	1		F5-06	DO-08 Channel 6 Output Selection	37	

Table 10.2 Parameters (Continued)

No.	Name	Default	Setting	No.	Name	Default	Setting
F5-07	DO-08 Channel 7 Output Selection	0F		H3-02	Terminal A1 Gain Setting	100.0	
F5-08	DO-08 Channel 8 Output Selection	0F		H3-03	Terminal A1 Bias Setting	0.0	
F5-09	DO-08 Output Mode Selection	0		H3-04	Terminal A3 Signal Level Selection	0	
F6-01	Operation Selection after Communication Error	1		H3-05	Terminal A3 Function Selection	2	
F6-02	Selection of External Fault from Communication Option Card	0		H3-06	Terminal A3 Gain Setting	100.0	
F6-03	Stopping Method for External Fault from Communication Option Card	1		H3-07	Terminal A3 Bias Setting	0.0	
F6-04	Trace Sampling from Communications Option Card	0		H3-08	Terminal A2 Signal Level Selection	2	
F6-06	Torque Reference/Torque Limit Selection from Communications Option	0		H3-09	Terminal A2 Function Selection	0	
H1-01	Multi-Function Digital Input Terminal S3 Function Selection	24		H3-10	Terminal A2 Gain Setting	100.0	
H1-02	Multi-Function Digital Input Terminal S4 Function Selection	14		H3-11	Terminal A2 Bias Setting	0.0	
H1-03	Multi-Function Digital Input Terminal S5 Function Selection	3 (0)*6		H3-12	Analog Input Filter Time Constant	0.03	
H1-04	Multi-Function Digital Input Terminal S6 Function Selection	4 (3)*6		H4-01	Terminal FM Monitor Selection	2	
H1-05	Multi-Function Digital Input Terminal S7 Function Selection	6 (4)*6		H4-02	Terminal FM Gain Setting	1.00	
H1-06	Multi-Function Digital Input Terminal S8 Function Selection	8		H4-03	Terminal FM Bias Setting	0.0	
H1-07	Multi-Function Digital Input Terminal S9 Function Selection	5		H4-04	Terminal AM Monitor Selection	3	
H1-08	Multi-Function Digital Input Terminal S10 Function Selection	32		H4-05	Terminal AM Gain Setting	0.50	
H1-09	Multi-Function Digital Input Terminal S11 Function Selection	7		H4-06	Terminal AM Bias Setting	0.0	
H1-10	Multi-Function Digital Input Terminal S12 Function Selection	15		H4-07	Terminal FM Signal Level Selection	0	
H2-01	Terminal M1 thru M2 Function Selection (Relay)	0		H4-08	Terminal AM Signal Level Selection	0	
H2-02	Terminal M3-M4 Function Selection (Relay)	1		H5-01	MxC Node Address	1F	
H2-03	Terminal M5-M6 Function Selection (Relay)	2		H5-02	Communication Speed Selection	3	
H2-04	Terminal P3 Function Selection (Open Collector)	6		H5-03	Communication Parity Selection	0	
H2-05	Terminal P4 Function Selection (Open Collector)	10		H5-04	Stopping Method After Communication Error	3	
H3-01	Terminal A1 Signal Level Selection	0		H5-05	Communication Fault Detection Selection	1	

Table 10.2 Parameters (Continued)

No.	Name	Default	Set-ting	No.	Name	Default	Set-ting
H5-06	MxC Transmit Wait Time	5		L4-02	Speed Agreement Detection Width	2.0	
H5-07	RTS Control Selection	1		L4-03	Speed Agreement Detection Level(+/-)	0.0	
H5-10	Unit Selection for Memobus Register 0025H	0		L4-04	Speed Agreement Detection Width (+/-)	2.0	
L1-01	Motor Overload Protection Selection	1		L4-05	Frequency Reference Loss Detection Selection	0	
L1-02	Motor Overload Protection Time	1.0		L5-01	Number of Auto Restart Attempts	0	
L1-03	Motor Overheat Alarm Operation Selection	3		L5-02	Auto Restart Operation Selection	0	
L1-04	Motor Overheat Fault Operation Selection	1		L6-01	Torque Detection Selection 1	0	
L1-05	Motor Temperature Input Filter Time	0.20		L6-02	Torque Detection Level 1	150	
L2-01	Momentary Power Loss Detection Selection	0		L6-03	Torque Detection Time 1	0.1	
L2-02	Momentary Power Loss Ridethrough Time	0.5*2		L6-04	Torque Detection Selection 2	0	
L2-03	Momentary Power Loss Minimum Baseblock Time	0.7 *2		L6-05	Torque Detection Level 2	150	
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	1.5		L6-06	Torque Detection Time 2	0.1	
L2-05	Undervoltage Detection Level	190*3		L7-01	Forward Torque Limit	200	
L2-13	Power Frequency Fault Detection Gain	1.0		L7-02	Reverse Torque Limit	200	
L2-21	Undervoltage-detection Level	150 *3		L7-03	Forward Regenerative Torque Limit	200	
L2-27*7	Detection Width of Input Power Frequency Error	6.0		L7-04	Reverse Regenerative Torque Limit	200	
L3-01	Stall Prevention Selection during Accel	1		L7-06	Torque Limit Integral Time Constant	200	
L3-02	Stall Prevention Level during Acceleration	150		L7-07	Torque Limit Control Method Selection during Accel/Decel	0	
L3-03	Stall Prevention Limit during Acceleration	50		L8-02	Overheat Alarm Level	90*2	
L3-04	Stall Prevention Selection during Deceleration	1		L8-03	Overheat Pre-Alarm Operation Selection	3	
L3-05	Stall Prevention Selection during Run	1		L8-07	Output Phase Loss Protection	0	
L3-06	Stall Prevention Level during Run	160		L8-09	Output Ground Fault Detection Selection	1	
L3-14	Stall Prevention Level during Decel	150		L8-10	Heatsink Cooling Fan Operation Selection	0	
L4-01	Speed Agreement detection Level	0.0		L8-11	Heatsink Cooling Fan Operation Delay Time	60	

Table 10.2 Parameters (Continued)

No.	Name	Default	Setting	No.	Name	Default	Setting
L8-12	Ambient Temperature Setting	45		o2-06	Operation Selection when Digital Operator is Disconnected	0	
L8-15	OL2 Characteristic Selection at Low Speeds	1		o2-07	Cumulative Operation Time Setting	0	
L8-42	Factory Adjustment 1	2		o2-08	Cumulative Operation Time Selection	0	
n1-01	Hunting Prevention Selection	1		o2-09	Initialization Specification Selection	0	
n1-02	Hunting Prevention Gain Setting	1.00		o2-10	Fan operation time setting	0	
n1-03	Hunting Prevention Time Constant	10		o2-12	Fault Trace/Fault History Clear Function	0	
n2-01	Speed Feedback Detection Control (AFR) Gain	1.00		o2-14	kWh User Monitor Initialization	0	
n2-02	Speed Feedback Detection Control (AFR) Time Constant	100		o2-18*7	Capacitor maintenance setting	0	
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2	750		o3-01	Copy Function Selection	0	
n5-01	Feed Forward Control Selection	0		o3-02	Copy Allowed Selection	0	
n5-02	Motor Acceleration Time	0.168*3		T1-00	Motor Selection 1/2	1	
n5-03	Feed Forward Control Ratio Gain	1.0		T1-01	Auto-Tuning Mode Selection	0	
o1-01	User Monitor Selection	6		T1-02	Motor Rated Power	5.50*2	
o1-02	User Monitor Selection After Power-Up	1		T1-03	Motor Rated Voltage	200.0*3	
o1-03	Digital Operator Display Selection	0		T1-04	Motor Rated Current	19.60*2	
o1-04	Setting unit for frequency parameters related to V/f characteristics	0		T1-05	Motor Base Frequency	60.0	
o1-05	LCD Brightness Adjustment	3		T1-06	Number of Motor Poles	4	
o2-01	Local/Remote Key Function Selection	1		T1-07	Motor Base Speed	1750	
o2-02	STOP Key Function Selection	1		T1-08	Number of PG Pulses	600	
o2-03	User Parameter Default Value	0		T1-09	Motor No-Load current	5.10	
o2-04	MxC/kVA Selection	5*2		T1-10	Motor Rated Slip	1.50	
o2-05	Frequency Reference Setting Method Selection	0					

* 1. The default will change when the control method is changed. The Open Loop Vector defaults are given.
* 2. The defaults depend on the MxC capacity. The values for a 200 V class MxC of 5.5 kW are given.
* 3. These are values for a 200 V class MxC. Values for a 400 V class MxC are double.
* 4. E1-11 and E1-12 are disregarded when set to 0.0.
* 5. E1-13 is set to the same value as E1-05 by Auto-Tuning.
* 6. The defaults in the parentheses are for 3-wire sequence.
* 7. Applicable for the Varispeed AC with software versions PRG: 1050 or later.
* 8. Applicable for the Varispeed AC with software versions PRG: 1052 or later.

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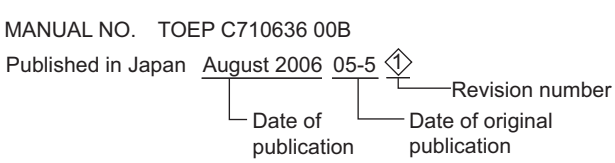

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