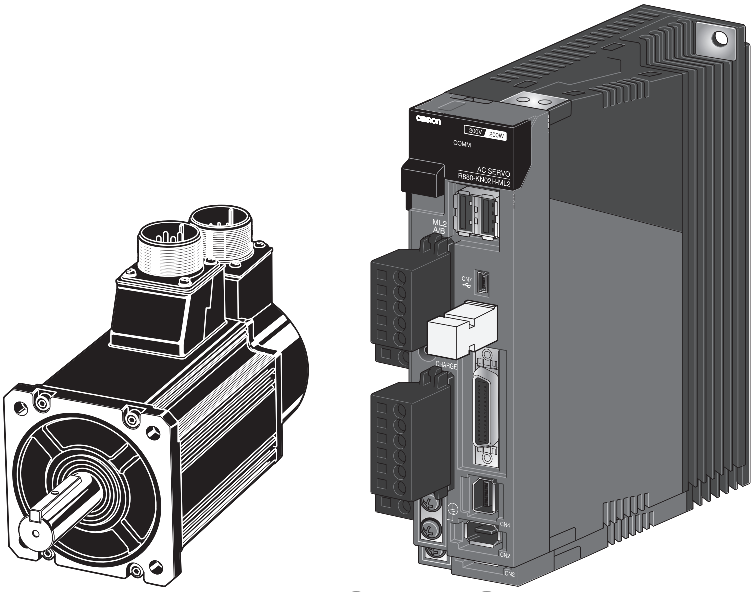
Cat. No. I572-E1-02

OMRON

USER'S MANUAL



OMNUC G5 SERIES

R88M-K□
(AC Servomotors)
R88D-KN□-ML2
(AC Servo Drives)

AC SERVOMOTORS/SERVO DRIVES WITH BUILT-IN MECHATROLINK-II COMMUNICATIONS

Introduction

Thank you for purchasing the OMNUC G5 Series. This user's manual explains how to install and wire the OMNUC G5 Series, set parameters needed to operate the G5 Series, and remedies to be taken and inspection methods to be used should problems occur.

Intended Readers

This manual is intended for the following individuals.

Those having electrical knowledge (certified electricians or individuals having equivalent or more knowledge) and also being qualified for one of the following:

- Those in charge of introducing FA equipment
- Those designing FA systems
- Those managing FA sites

Notes

This manual contains the information you need to know to correctly use the OMNUC G5 Series and peripheral equipment.
Before using the OMNUC G5 Series, read through this manual and gain a full understanding of the information provided herein.
After you finished reading the manual, keep it in a convenient place so that the manual can be referenced at any time.
Make sure this manual will also be delivered to the end-user.

Terms and Conditions Agreement

Warranty, Limitations of Liability

Warranties

- **Exclusive Warranty**

  Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied.

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  OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE.
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  See http://www.omron.com/global/ or contact your Omron representative for published information.

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OMRON COMPANIES SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY.
Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.

Application Considerations

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Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases.
NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Programmable Products

Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.

Disclaimers

Performance Data

Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.

Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

Errors and Omissions

Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

Safety Precautions Document

- So that the OMNUC G5-Series Servomotor and Servo Drive and peripheral equipment are used safely and correctly, be sure to peruse this Safety Precautions document section and the main text before using the product in order to learn all items you should know regarding the equipment as well as all safety information and precautions.
- Make an arrangement so that this manual also gets to the end-user of this product.
- After reading this manual, keep it with you at all times.

Explanation of Display

- The precautions explained in this section describe important information regarding safety and must be followed without fail.
- The display of precautions used in this manual and their meanings are explained below.

⚠ Danger	When an incorrect handling can lead to a dangerous situation, which may result in death or serious injury Or, when a serious property damage may occur
⚠ Caution	When an incorrect handling can lead to a dangerous situation, which may result in a minor or moderate injury, and when only a property damage may occur

Even those items denoted by the caution symbol may lead to a serious outcome depending on the situation. Accordingly, be sure to observe all safety precautions.

Precautions for Safe Use

This symbol indicates an item you should perform or avoid in order to use the product safely.

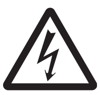
Precautions for Correct Use

This symbol indicates an item you should perform or avoid in order to prevent inoperative, malfunction or any negative effect on performance or function.

Reference

This symbol indicates an item that helps deepen your understanding of the product or other useful tip.

Explanation of Symbols

Example of symbols	
	△ This symbol indicates danger and caution. The specific instruction is described using an illustration or text inside or near △. The symbol shown to the left indicates "beware of electric shock".
	⃠ This symbol indicates a prohibited item (item you must not do). The specific instruction is described using an illustration or text inside or near ⃠. The symbol shown to the left indicates "disassembly prohibited".
	● This symbol indicates a compulsory item (item that must be done). The specific instruction is described using an illustration or text inside or near ●. The symbol shown to the left indicates "grounding required".

For Safe Use of This Product

■Illustrations contained in this manual sometimes depict conditions without covers and safety shields for the purpose of showing the details. When using this product, be sure to install the covers and shields as specified and use the product according to this manual.

■If the product has been stored for an extended period of time, contact your OMRON sales representative.

⚠ Danger

Always connect the frame ground terminals of a 100 V or 200 V type drive and motor to a type-D or higher ground. Always connect the ground terminals of a 400 V type to a type-C or higher ground. Improper grounding may result in electrical shock.

Never touch the parts inside the Servo Drive.
Electric shock may result.

While the power is supplied, do not remove the front cover, terminal covers, cables and options.
Electric shock may result.

Installation, operation and maintenance or inspection by unauthorized personnel is prohibited.
Electric shock or injury may result.

Before carrying out wiring or inspection, turn OFF the power supply and wait for at least 15 minutes.
Electric shock may result.

Do not damage, pull, stress strongly or pinch the cables or place heavy articles on them.
Electric shock, stopping of product operation or burn damage may result.

Never touch the rotating part of the motor during operation.
Injury may result.

Never modify the product.
Injury or equipment damage may result.

Install a stopping device on the machine side to ensure safety.
* The holding brake is not a stopping device to ensure safety.
Injury may result.

Install an immediate stop device externally to the machine so that the operation can be stopped and the power supply cut off immediately.
Injury may result.

When the power is restored after a momentary power interruption, the machine may restart suddenly. Never come close to the machine.
* Implement remedies to ensure safety of people nearby even when the machine is restarted.
Injury may result.

After an earthquake, be sure to conduct safety checks.
Electric shock, injury or fire may result.

Never drive the motor using an external drive source.
Fire may result.

Danger

Do not place flammable materials near the motor, Servo Drive or Regeneration Resistor.
Fire may result.

Install the motor, Servo Drive and Regeneration Resistor to non-flammable materials such as metals.
Fire may result.

When you perform a system configuration using the safety function, be sure to fully understand the relevant safety standards and the descriptions in the operation manual, and apply them to the system design.
Injury or damage may result.

Do not use the cable when it is laying in oil or water.
Electric shock, injury or fire may result.

Never connect a commercial power supply directly to the motor.
Fire or failure may result.

Do not perform wiring or any operation with wet hands.
Electric shock, injury or fire may result.

Do not touch the key grooves with bare hands if a motor with shaft-end key grooves is being used.
Injury may result.

Caution

Use the motor and Servo Drive in the specified combination.
Fire or equipment damage may result.

Do not store or install the product in the following environment:

- Location subject to direct sunlight
- Location where the ambient temperature exceeds the specified level
- Location where the relative humidity exceeds the specified level
- Location subject to condensation due to the rapid temperature change
- Location subject to corrosive or flammable gases
- Location subject to higher levels of dust, salt content or iron dust
- Location subject to splashes of water, oil, chemicals, etc.
- Location where the product may receive vibration or impact directly

Installing or storing the product in these locations may result in fire, electric shock or equipment damage.

The Servo Drive radiator, Regeneration Resistor, motor, etc. may become hot while the power is supplied or remain hot for a while even after the power supply is cut off. Never touch these components.
A burn injury may result.

Storage and Transportation

⚠ Caution

⚠	When transporting the product, do not hold it by the cables or motor shaft. Injury or failure may result.
⚠	Do not overload the products. (Follow the instruction on the product label.) Injury or failure may result.
⚠	Use the motor eye-bolts only when transporting the motor. Do not use them to transport the machine. Injury or failure may result.

Installation and Wiring

⚠ Caution

⚠	Do not step on the product or place heavy articles on it. Injury may result.
⚠	Do not block the intake or exhaust openings. Do not allow foreign objects to enter the product. Fire may result.
⚠	Be sure to observe the mounting direction. Failure may result.
⚠	Provide the specified clearance between the Servo Drive and the inner surface of the control panel or other equipment. Fire or failure may result.
⚠	Do not apply strong impact on the motor shaft or Servo Drive. Failure may result.
⚠	Wire the cables correctly and securely. Runaway motor, injury or failure may result.
⚠	Securely tighten the unit mounting screws, terminal block screws and cable screws. Failure may result.
⚠	Use crimp terminals for wiring. If simple twisted wires are connected directly to the protective ground terminal, fire may result.
⚠	Only use the power supply voltage specified in this manual. Burn damage may result.
⚠	In locations where the power supply infrastructure is poor, make sure the rated voltage can be supplied. Equipment damage may result.
⚠	Provide safety measures, such as a breaker, to protect against short circuiting of external wiring. Fire may result.
⚠	If the product is used in the following locations, provide sufficient shielding measures. • Location where noise generates due to static electricity, etc. • Location where a strong electric or magnetic field generates • Location where exposure to radioactivity may occur • Location where power supply lines are running nearby Using the product in these locations may result in equipment damage.
⚠	Connect an immediate stop relay in series with the brake control relay. Injury or failure may result.
⚠	When connecting the battery, make sure the correct polarity is connected. Battery damage or explosion may result.

Operation and Adjustment

Caution

	Conduct a test operation after confirming that the equipment is not affected. Equipment damage may result.
	Before operating the product in an actual environment, check if it operates correctly based on the parameters you have set. Equipment damage may result.
	Never adjust or set parameters to extreme values, as it will make the operation unstable. Injury may result.
	Separate the motor from the mechanical system and check its operation before installing the motor to the machine. Injury may result.
	If an alarm generated, remove the cause of the alarm and ensure safety, and then reset the alarm and restart the operation. Injury may result.
	Do not use the built-in brake of the motor for normal braking operation. Failure may result.
	Do not operate the Servomotor when an excessive load inertia is installed. Failure may result.
	Install safety devices to prevent idle running or lock of the electromagnetic brake or the gear head, or leakage of grease from the gear head. Injury, damage or taint damage may result.
	If the Servo Drive fails, cut off the power supply to the Servo Drive on the power supply side. Fire may result.
	Do not turn ON and OFF the main Servo Drive power supply frequently. Failure may result.

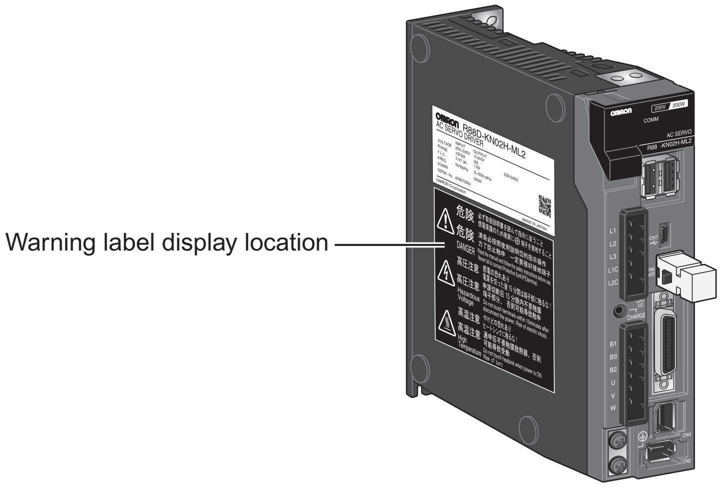
Maintenance and Inspection

Caution

	After replacing the unit, transfer to the new unit all data needed to resume operation, before restarting the operation. Equipment damage may result.
	Never repair the product by disassembling it. Electric shock or injury may result.
	Be sure to turn OFF the power supply when the unit is not going to be used for a prolonged period of time. Injury may result.

Location of Warning Label

This product bears a warning label at the following location to provide handling warnings.
When handling the product, be sure to observe the instructions provided on this label.



(R88D-KN02H-ML2)

Instructions on Warning Label

Disposal

- When disposing of the battery, insulate it using tape, etc. and dispose of it by following the applicable ordinance of your local government.
- Dispose of the product as an industrial waste.

Items to Check after Unpacking

After unpacking, check the following items.

- Is this the model you ordered?
- Is there any damage sustained during shipment?

Accessories of This Product

Safety Precautions document x 1 copy

- Connectors, mounting screws, mounting brackets, and other accessories other than those in the table below are not supplied. They must be prepared by the customer.
- The safety bypass connector is required when the safety function is not used. To use the safety function, provide a Safety I/O Signal Connector separately.
- If any item is missing or a problem is found such as Servo Drive damage, contact the OMRON dealer or sales office where you purchased your product.

<table>
<tr><th colspan="2">Specifications</th><th>Connector for Main circuit power supply terminals and Control circuit power supply terminals</th><th>Connector for External Regeneration Resistor connection terminals and Motor connection terminals</th><th>Safety bypass connector</th></tr>
<tr><td rowspan="4">Single-phase 100 VAC</td><td>50 W</td><td colspan="3" rowspan="11">Included</td></tr>
<tr><td>100 W</td></tr>
<tr><td>200 W</td></tr>
<tr><td>400 W</td></tr>
<tr><td rowspan="6">Single-phase/3-phase 200 VAC</td><td>100 W</td></tr>
<tr><td>200 W</td></tr>
<tr><td>400 W</td></tr>
<tr><td>750 W</td></tr>
<tr><td>1 kW</td></tr>
<tr><td>1.5 kW</td></tr>
<tr><td rowspan="3">3-phase 200 VAC</td><td>2 kW</td></tr>
<tr><td>3 kW</td><td colspan="2" rowspan="2">–</td><td rowspan="2">Included</td></tr>
<tr><td>5 kW</td></tr>
<tr><td rowspan="6">3-phase 400 VAC</td><td>600 W</td><td colspan="3" rowspan="4">Included</td></tr>
<tr><td>1 kW</td></tr>
<tr><td>1.5 kW</td></tr>
<tr><td>2 kW</td></tr>
<tr><td>3 kW</td><td colspan="2" rowspan="2">–</td><td rowspan="2">Included</td></tr>
<tr><td>5 kW</td></tr>
</table>

Manual Revision History

The manual revision symbol is an alphabet appended at the end of the manual number found in the bottom left-hand corner of the front or back cover.

Example

Man.No.	I572-E1-02

Revision symbol

Revision symbol	Revision date	Description of revision and revised page
01	November 2009	First print
02	March 2016	Added information and made corrections.

Structure of This Document

This manual consists of the following chapters.
Read the necessary chapter or chapters referring to below.

		Outline
Chapter 1	Features and System Configuration	This chapter explains the features of this product, name of each part, and applicable EC directives and UL standards.
Chapter 2	Standard Models and External Dimensions	This chapter explains the models of Servo Drive, Servomotor, and peripheral equipment, as well as the external dimensions and mounting dimensions.
Chapter 3	Specifications	This chapter explains the general specifications, characteristics, connector specifications and I/O circuits of the Servo Drive, general specifications, characteristics, encoder specifications of the Servomotor, and all other specifications including those of peripheral equipment.
Chapter 4	System Design	This chapter explains the installation conditions, wiring methods including wiring conforming to EMC directives and regenerative energy calculation methods regarding the Servo Drive, Servomotor and Decelerator, as well as the performance of External Regeneration Resistors, and so on.
Chapter 5	BASIC CONTROL Mode	This chapter explains an outline of operations available in various CONTROL modes and explains the contents of setting.
Chapter 6	Applied Functions	This chapter gives outline of applied functions such as electronic gears, gain switching and soft start, and explains the setting contents.
Chapter 7	Safety Function	This function stops the motor based on a signal from a Safety Controller or safety sensor. An outline of the function is explained together with operation and connection examples.
Chapter 8	Parameters Details	This chapter explains the set value and contents of setting of each parameter.
Chapter 9	Operation	This chapter explains the operating procedures and how to operate in each mode.
Chapter 10	Adjustment Functions	This chapter explains the functions, setting methods and items to note regarding various gain adjustments.
Chapter 11	Error and Maintenance	This chapter explains the items to check when problems occur, error diagnosis using the alarm LED display and measures, error diagnosis based on the operating condition and measures, and periodic maintenance.
Appendix		The appendix lists the parameters.

Table Of Contents

Chapter10 Adjustment Functions

Chapter11 Error and Maintenance

Appendix

Index

1

Features and System Configuration

This chapter explains the features of this product, name of each part, and applicable EC directives and UL standards.

1-1 Outline

Outline of the OMNUC G5 Series

The OMNUC G5-Series AC Servo Drives (Built-in MECHATROLINK-II communications support type) are a series of Servo Drives supporting the MECHATROLINK-II high-speed motion field network.
When you use it with the MECHATROLINK-II Position Control Unit (CJ1W-NCF71 or CS1W-NCF71), you can create a sophisticated positioning control system. Also, you need only one communications cable to connect the Servo Drive and the Controller. Therefore, you can realize a position control system easily with reduced wiring effort.
With real time autotuning, adaptive filter, notch filter, and damping control, you can set up a system that provides stable operation by suppressing vibration in low-rigidity machines.

Features of the OMNUC G5 Series

The OMNUC G5 Series has the following features.

Data Transmission Using MECHATROLINK-II Communications

When you use it with the MECHATROLINK-II Position Control Unit (CJ1W-NCF71 or CS1W-NCF71), you can exchange all control data between the Servo Drive and the Controller through data communications.
Since the various control commands are transmitted via data communications, Servomotor's operational performance is maximized without being limited by interface specifications such as the response frequency of the encoder feedback pulses.
Therefore, you can use the Servo Drive's various control parameters and monitor data on a host controller, and unify the system data for management.

Achievement of Accurate Positioning by Full Closing Control

Feedbacks from the external encoder connected to the motor are used to accurately control positions. Accordingly, position control is not affected by deviation caused by ball screws or temperature.

Wide Range of Power Supplies to Match Any Necessity

The OMNUC G5 Series now has models supporting 400 V for use with large equipment, at overseas facilities and in wide-ranging applications and environment. Since the utilization ratio of facility equipment also increases, the TCO (Total Cost of Ownership) will come down.

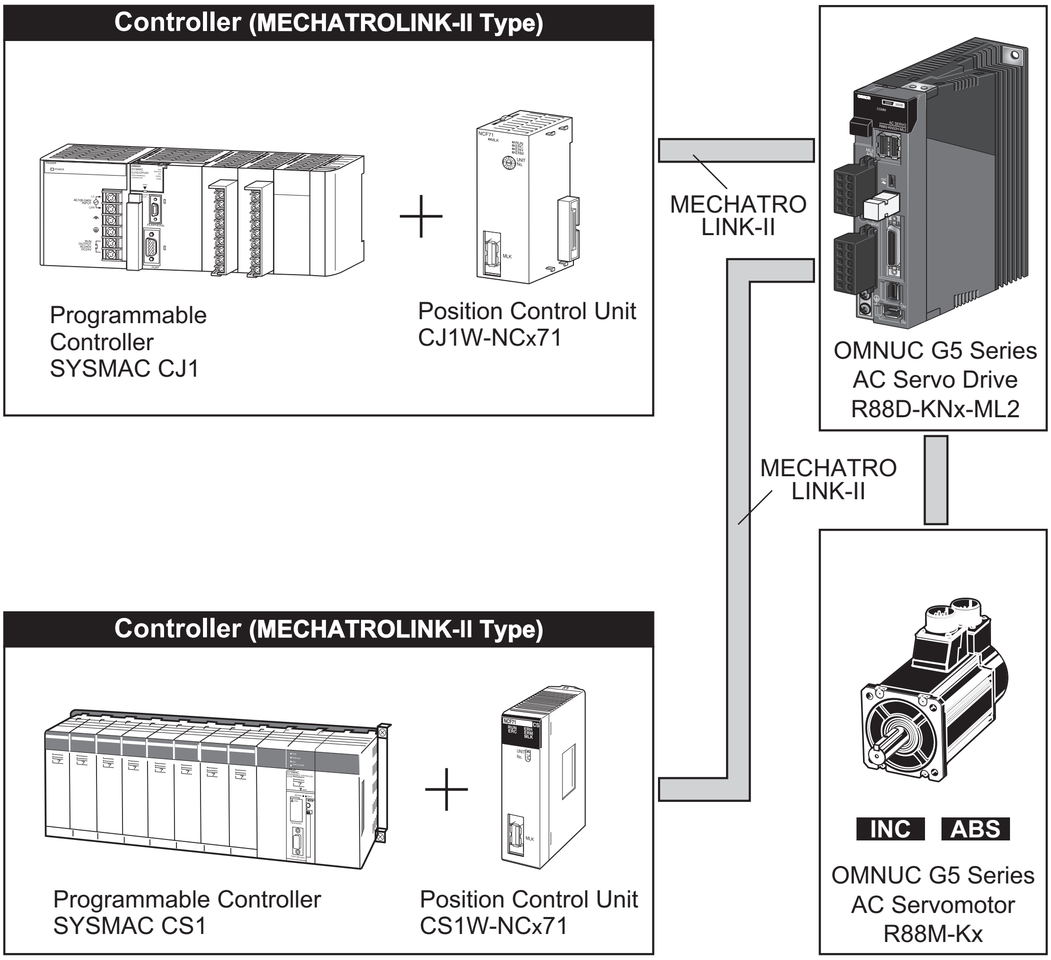
Safe Torque OFF (STO) Function to Ensure Safety

You can cut off the motor current to stop the motor based on a signal from an emergency stop button or other safety equipment. This can be used for an emergency stop circuit that is compliant with safety standards without using an external contactor. Even during the torque OFF status, the present position of the motor is monitored by the control circuits to eliminate the need to perform an origin search when restarting.

Suppressing Vibration of Low-rigidity Mechanisms during Acceleration/Deceleration

The damping control function suppresses vibration of low-rigidity mechanisms or devices whose tips tend to vibrate.
Two damping filters are provided to enable switching the damping frequency automatically according to the rotation direction and also via an external signal. In addition, the settings can be made easily merely by just setting the damping frequency and filter values.

1-2 System Configuration

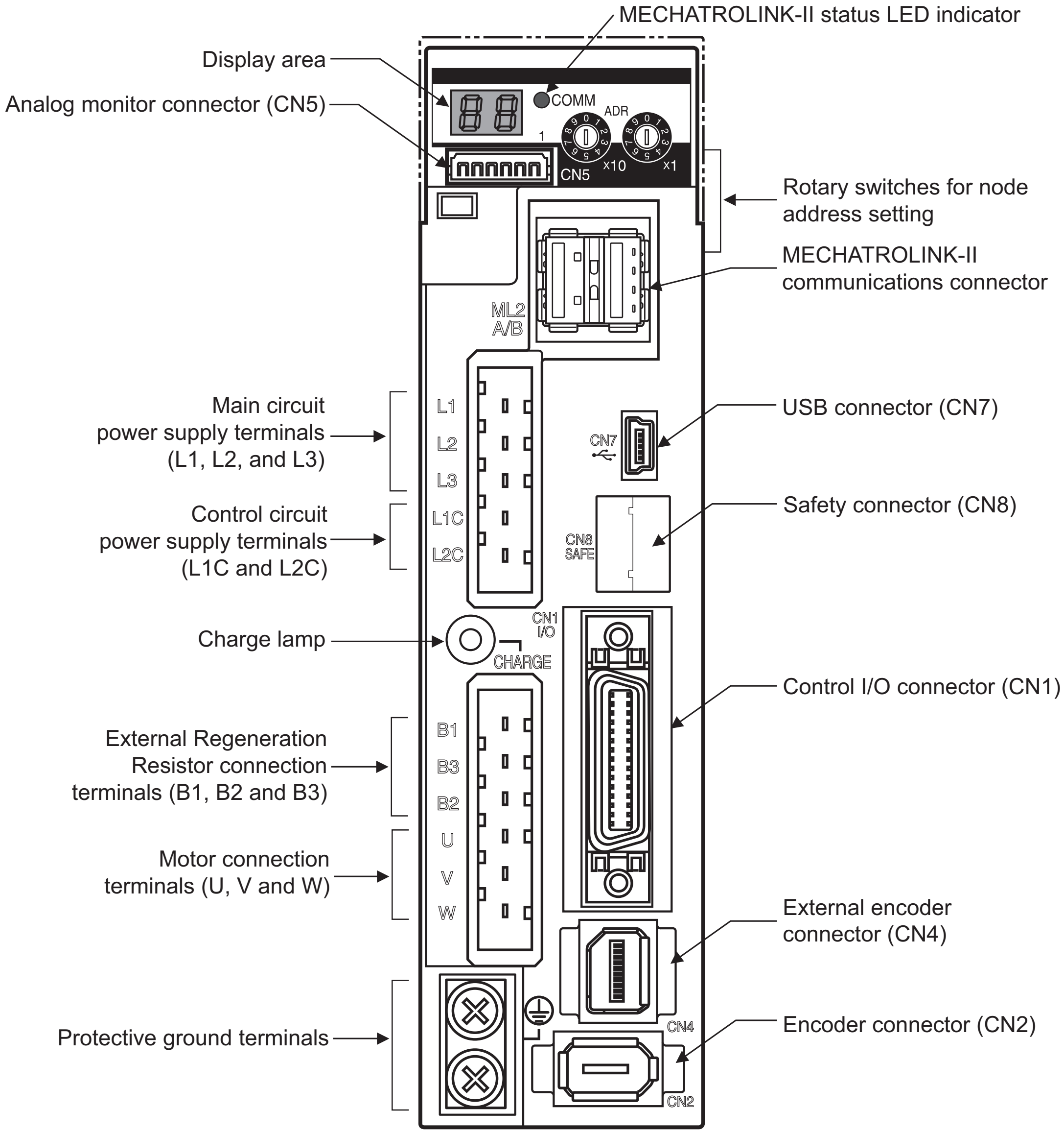


1-3 Names and Functions

This section describes the name and functions of the Servo Drive.

Servo Drive Part Names

The Servo Drive Part Names are defined as shown below.



Servo Drive Functions

The functions of each part are the followings:

Display Area

A 2-digit 7-segment LED indicator shows the node address, alarm codes, and other Servo Drive status.

Charge Lamp

Lits when the main circuit power supply is turned ON.

MECHATROLINK-II Status LED Indicator

Indicates the communications status of the MECHATROLINK-II.
For details, refer to "MECHATROLINK-II Communications Status LED Indicator"(P.9-4).

Control I/O Connector (CN1)

Used for command input signals and I/O signals.

Encoder Connector (CN2)

Connector for the encoder installed in the Servomotor.

External Encoder Connector (CN4)

Connector for an encoder signal used during full closing control.

Analog Monitor Connector (CN5)

2 analog outputs to monitor values like motor rotation speed, torque command value, etc.

MECHATROLINK-II Communications Connectors (ML2A and ML2B)

Connectors for MECHATROLINK-II communications

USB Connector (CN7)

Communications connector for the computer.

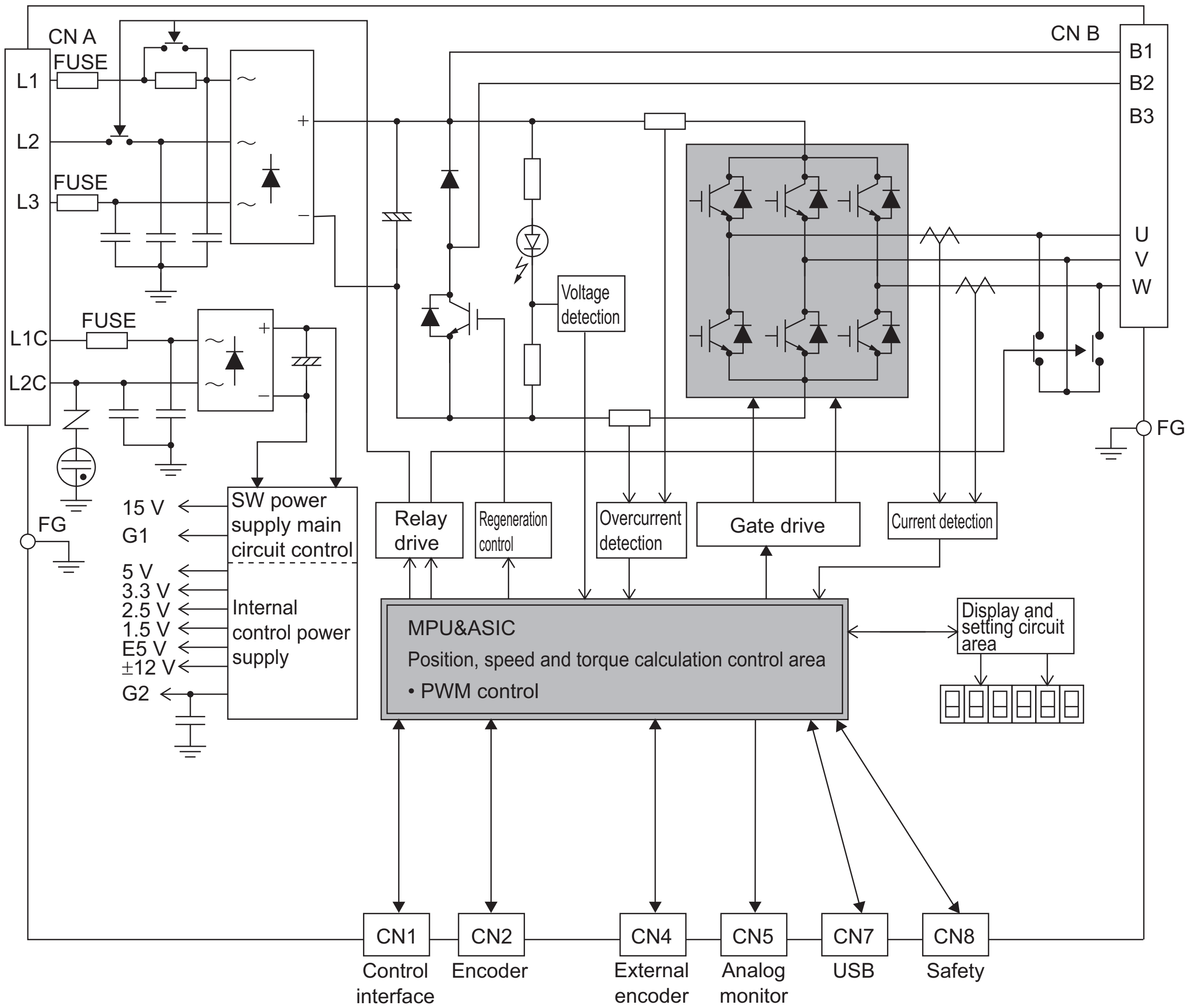
Safety Connector (CN8)

Connector for the safety devices.
If no safety device is used, keep the factory-set safety bypass connector installed.

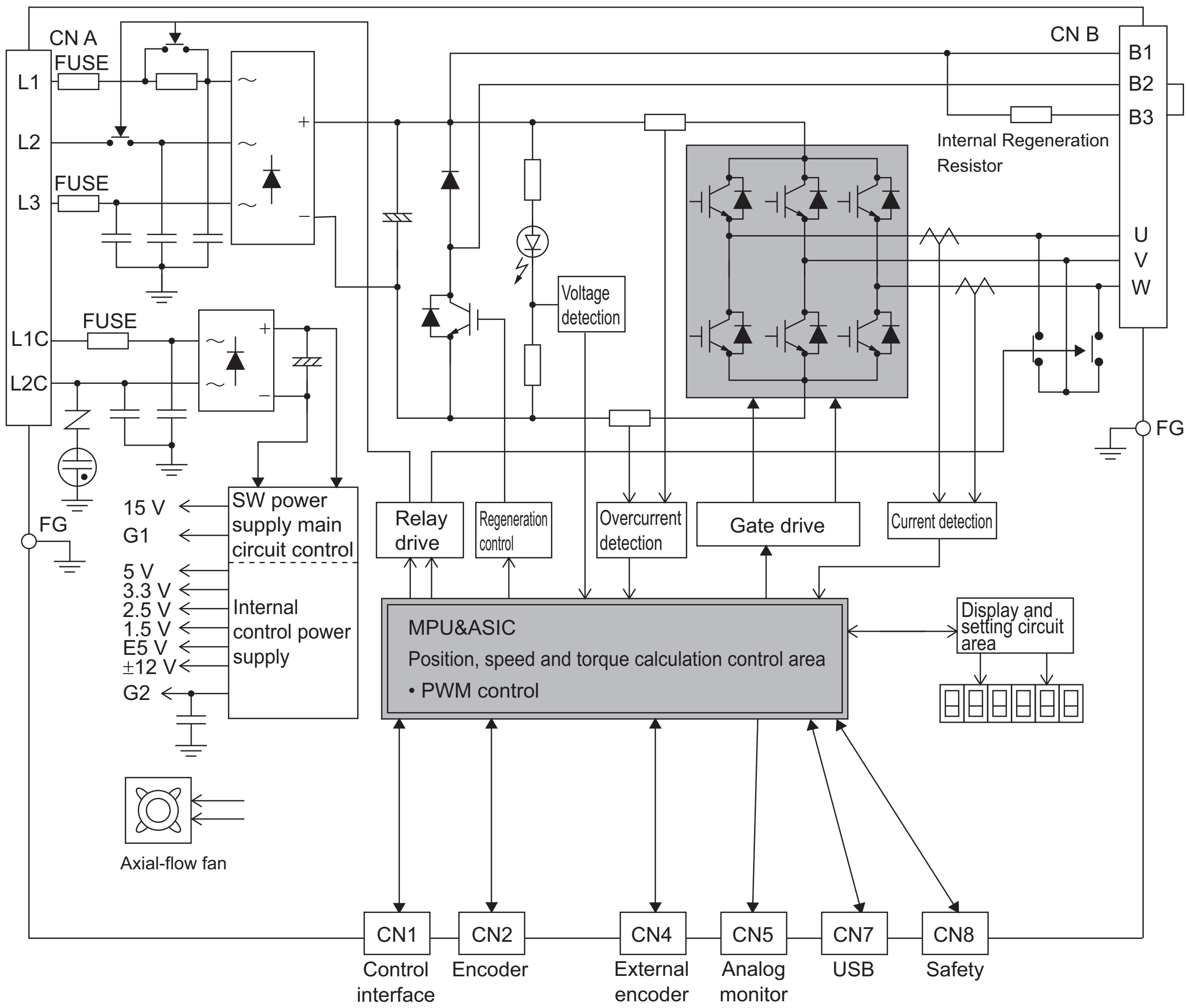
1-4 System Block Diagrams

This is the block diagram of the OMNUC G5-Series AC Servo Drive (Built-in MECHATROLINK-II communications support type).

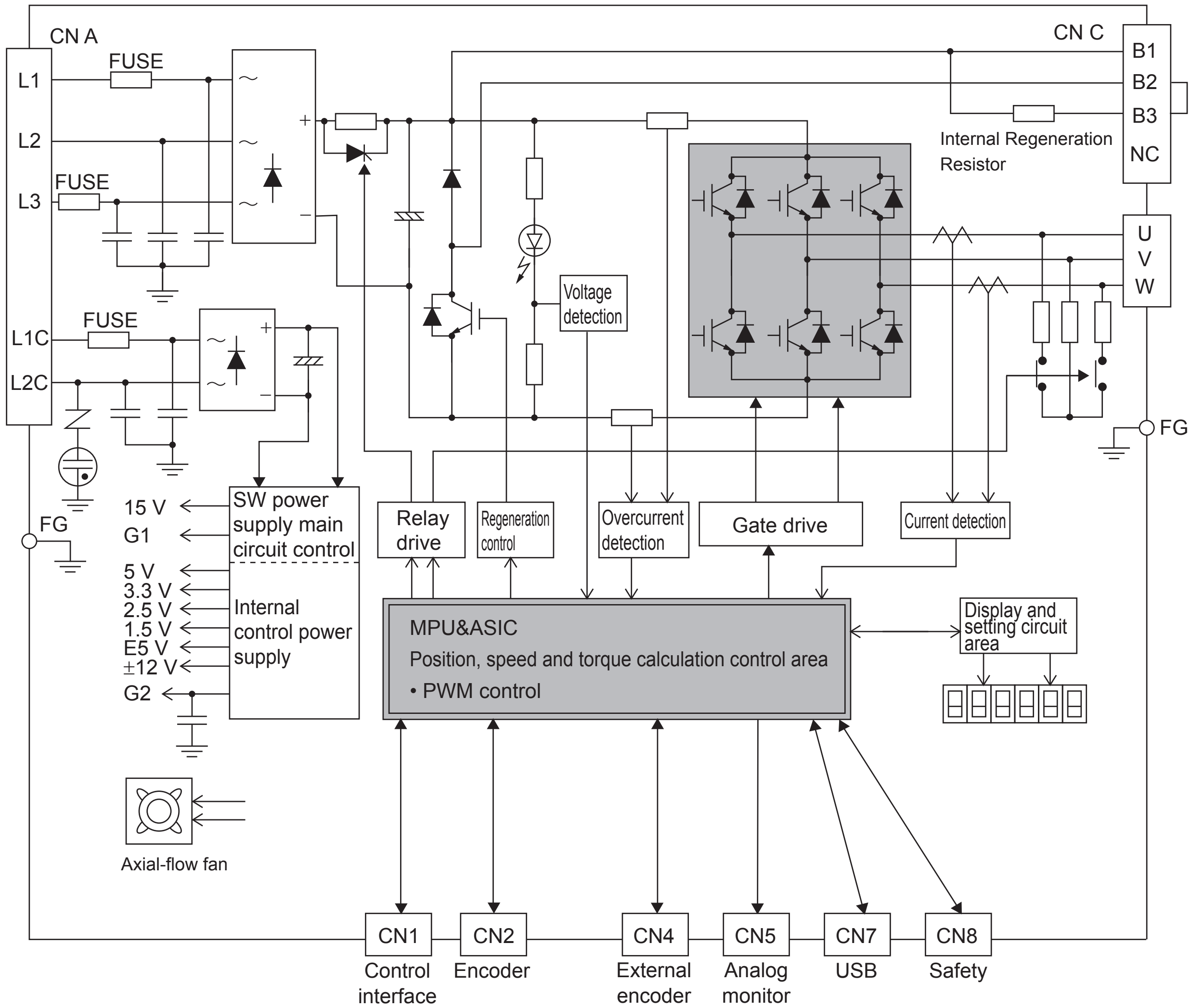
R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2
R88D-KN01H-ML2/-KN02H-ML2/-KN04H-ML2



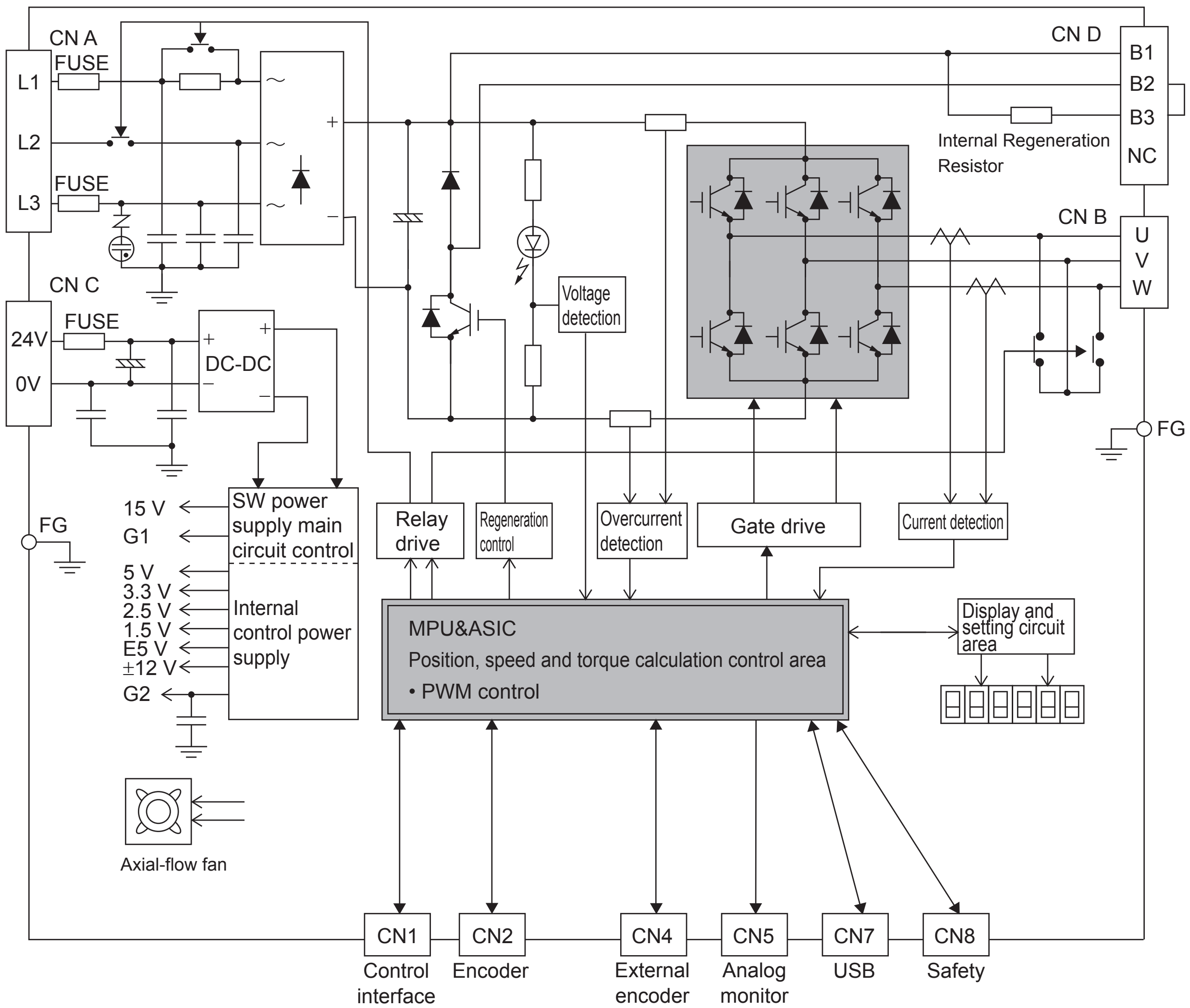
R88D-KN04L-ML2
R88D-KN08H-ML2/-KN10H-ML2/-KN15H-ML2



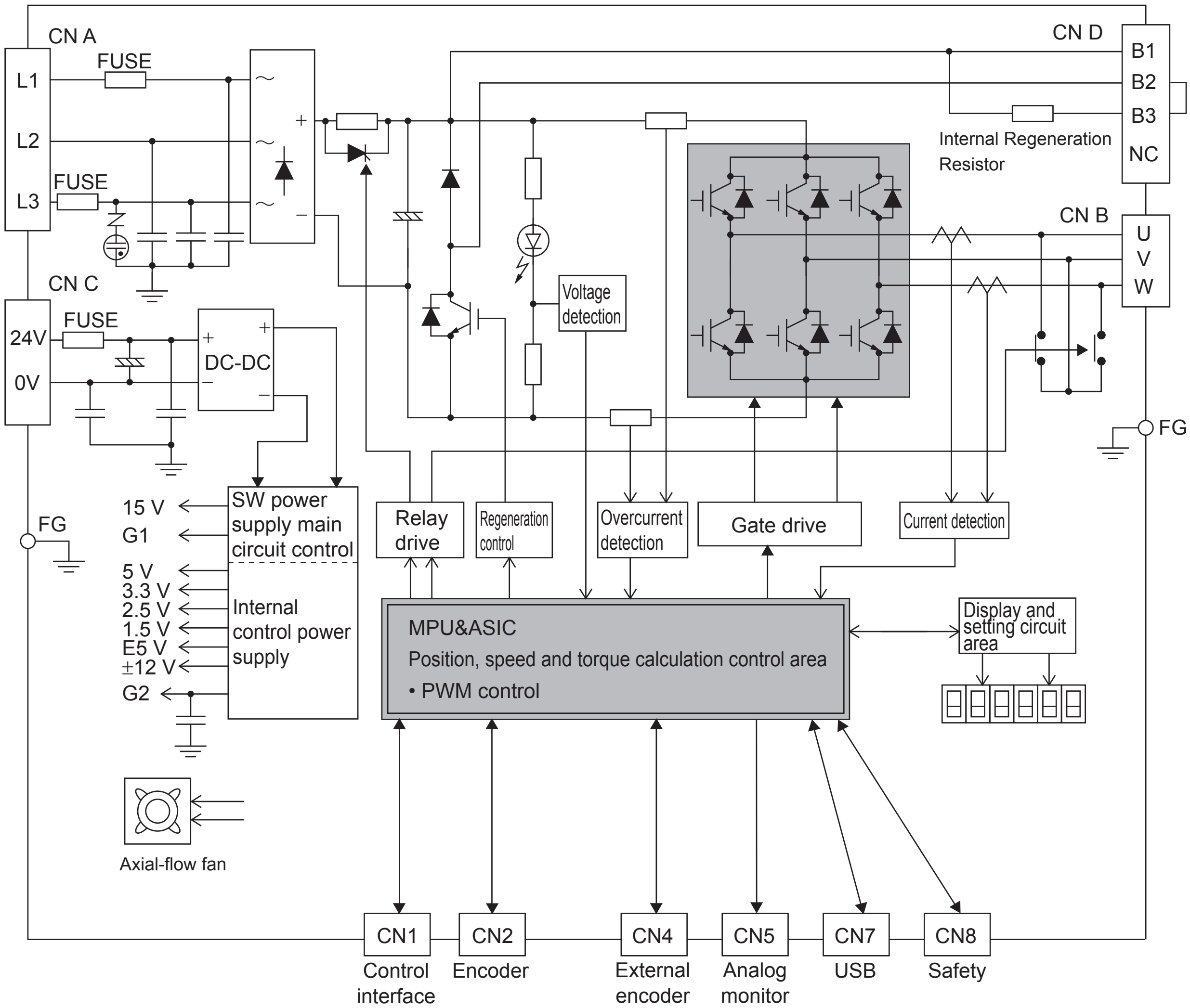
R88D-KN20H-ML2/-KN30H-ML2/-KN50H-ML2



R88D-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2



R88D-KN30F-ML2/-KN50F-ML2



1-5 Applicable Standards

This section describes applicable EMC Directives.

EC Directives

EC directive	Product	Applicable standards
Low voltage command	AC Servo Drive	EN 61800-5-1
	AC Servomotor	EN60034-1/-5
EMC directives	AC Servo Drive	EN 55011 class A group 1
		IEC61800-3
		EN61000-6-2
Machinery Directive	AC Servo Drive	EN954-1 (Category 3) EN ISO13849-1: 2008 (Category 3) (PLc,d) ISO13849-1: 2006 (Category 3) (PLc,d) EN61508 (SIL2) EN62061 (SIL2) EV61800-5-2 (STO) IEC61326-3-1 (SIL2)

Note. To conform to EMC directives, the Servomotor and Servo Drive must be installed under the conditions described in "4-3 Wiring Conforming to EMC Directives" (P.4-21).

UL and cUL Standards

Standard	Product	Applicable standards	File number
UL standards	AC Servo Drive	UL508C	E179149 *1
	AC Servomotor	UL1004-1 *2	E331224
		UL1004	E179189
CSA standards	AC Servo Drive	CSA22.2 No. 14	E179149
	AC Servomotor	CSA22.2 No. 100 *2	E331224
		CSA22.2 No. 100	E179189

*1 The R88D-KN20x-ML2 and lower capacity Servo Drives are UL-listed.
The R88D-KN30x-ML2 and higher capacity Servo Drives are UL-recognized.

*2 Motor capacity is 50 to 750 W when the power supply voltage is 100 V or 200 V and the rated number of motor rotation speed is 3,000 r/min.

The Servo Drives and Servomotors comply with UL 508C (file No. E179149) as long as the following installation conditions 1 and 2 are met.

(1) Use the Servo Drive in a pollution degree 1 or 2 environment as defined in IEC 60664-1 (example: installation in an IP54 control panel).

(2) Be sure to connect a circuit breaker or fuse, which is a UL-listed product with LISTED and UL mark, between the power supply and noise filter.

Refer to the following table for the rated current of the circuit breaker or fuse.
Use copper wiring with a temperature rating of 75°C or higher.

Drive model	Circuit breaker (rated current) (A)
R88D-KN01L-ML2	10
R88D-KN02L-ML2	10
R88D-KN04L-ML2	10
R88D-KN01H-ML2	10
R88D-KN02H-ML2	10
R88D-KN04H-ML2	10
R88D-KN08H-ML2	15
R88D-KN10H-ML2	15
R88D-KN15H-ML2	20
R88D-KN20H-ML2	30
R88D-KN30H-ML2	50
R88D-KN50H-ML2	50
R88D-KN06F-ML2	15
R88D-KN10F-ML2	15
R88D-KN15F-ML2	15
R88D-KN20F-ML2	20
R88D-KN30F-ML2	30
R88D-KN50F-ML2	30

Korean Radio Regulations (KC)

- The G5-series Servo Drives comply with the Korean Radio Regulations (KC).
- The G5-series Servomotors and Linear Motors are exempt from the Korean Radio Regulations (KC).

SEMI F47

- Some Servo Drives conform to the SEMI F47 standard for momentary power interruptions (voltage sag immunity) for no-load or light-load operation.
- This standard applies to semiconductor manufacturing equipment.

Note 1.It does not apply to Servo Drivers with single-phase 100-V specifications or with 24-VDC specifications for the control power input.

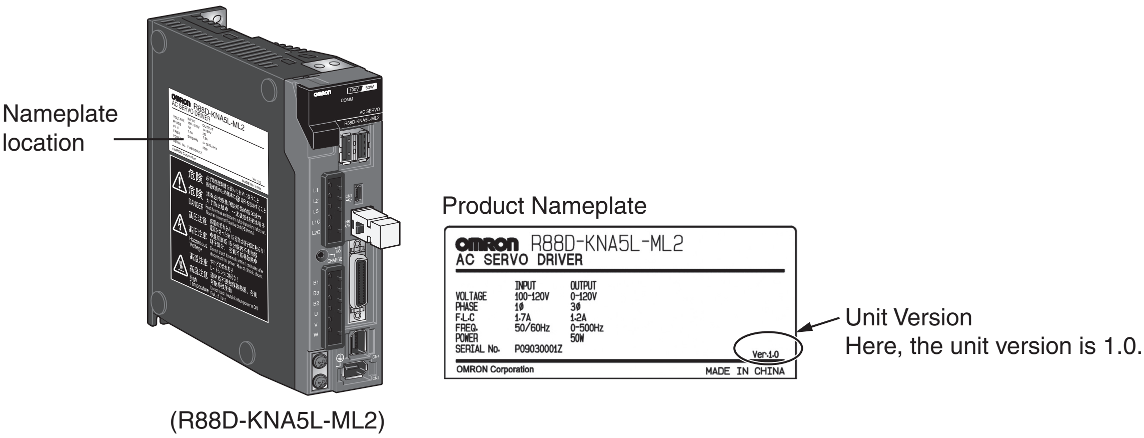
Note 2.Always perform evaluation testing for SEMI F47 compliance in the actual system.

1-6 Unit Versions

The G5-series Servo Drive uses unit versions.
Unit versions are used to manage differences in supported functions when product upgrades are made.

Confirmation Method

The unit version of a G5-series Servo Drive is given on the product's nameplate as shown below.



Unit Versions

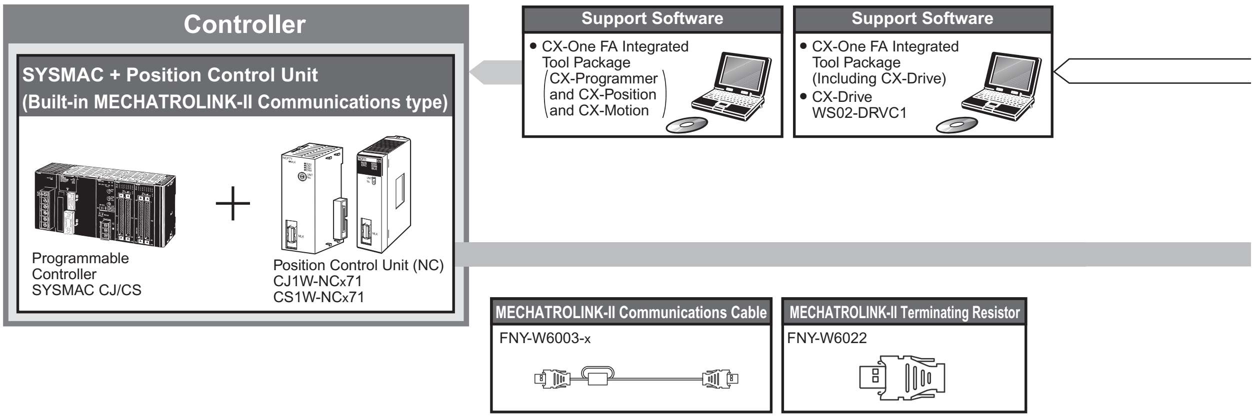
Unit version	Upgraded content	Supported CX-Drive versions
Not indicated	New release	Ver. 1.91 or higher
Ver.1.0	Unit version introduced. No changes in functions.	Ver. 1.91 or higher

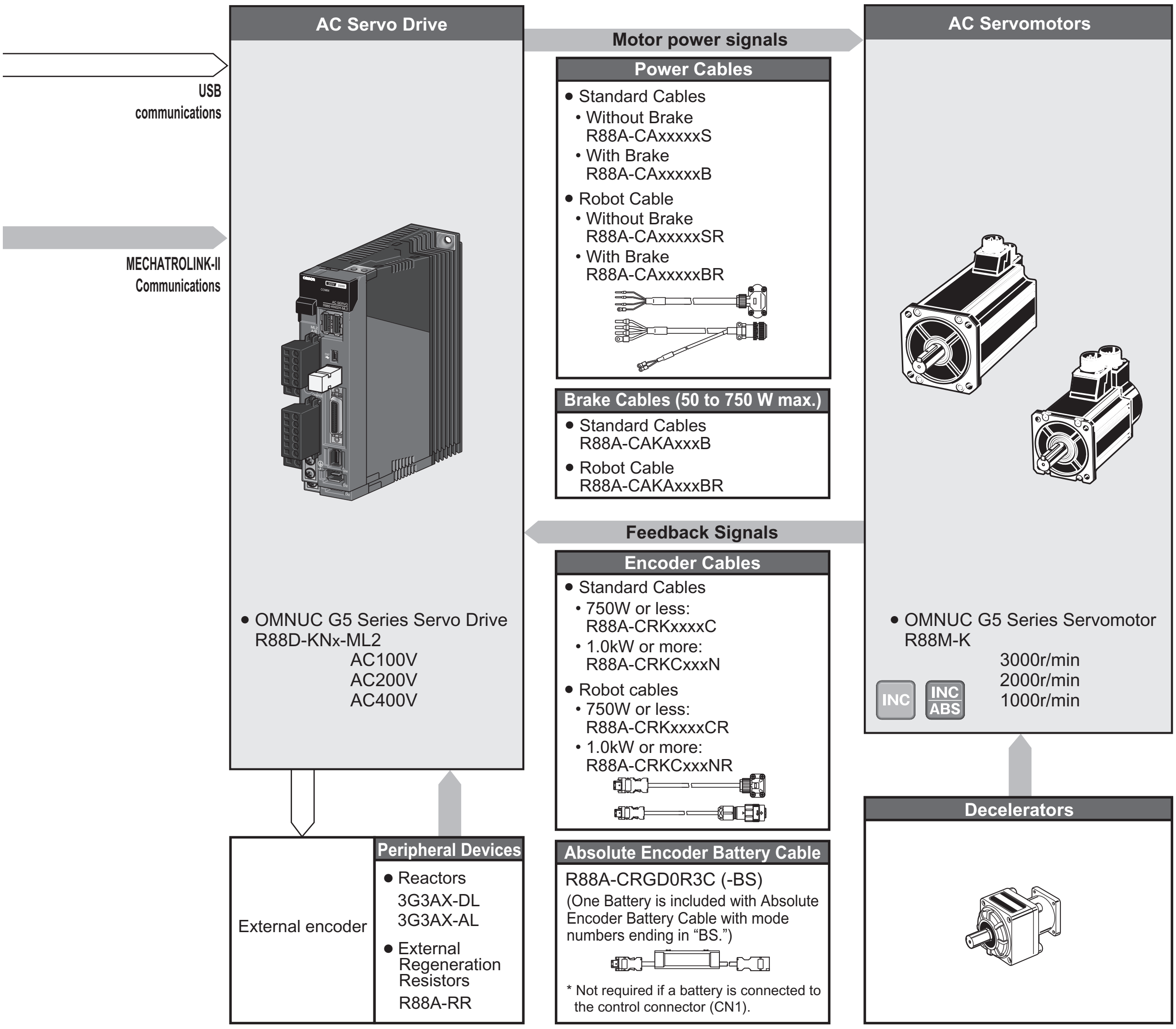
2

Standard Models and External Dimensions

This chapter explains the models of Servo Drive, Servomotor, and peripheral equipment, as well as the external dimensions and mounting dimensions.

2-1 Servo System Configuration




AC Servo Drive
USB communications
MECHATROLINK-II Communications
● OMNUC G5 Series Servo Drive
R88D-KNx-ML2
AC100V
AC200V
AC400V
Motor power signals
Power Cables
● Standard Cables
• Without Brake
R88A-CAxxxxxS
• With Brake
R88A-CAxxxxxB
● Robot Cable
• Without Brake
R88A-CAxxxxxSR
• With Brake
R88A-CAxxxxxBR
Brake Cables (50 to 750 W max.)
● Standard Cables
R88A-CAKAxxxB
● Robot Cable
R88A-CAKAxxxBR
Feedback Signals
Encoder Cables
● Standard Cables
• 750W or less:
R88A-CRKxxxxC
• 1.0kW or more:
R88A-CRKCxxxN
● Robot cables
• 750W or less:
R88A-CRKxxxxCR
• 1.0kW or more:
R88A-CRKCxxxNR
Absolute Encoder Battery Cable
R88A-CRGD0R3C (-BS)
(One Battery is included with Absolute Encoder Battery Cable with mode numbers ending in “BS.”)
* Not required if a battery is connected to the control connector (CN1).
AC Servomotors
● OMNUC G5 Series Servomotor
R88M-K
3000r/min
2000r/min
1000r/min
INC
INC ABS
Decelerators
External encoder
Peripheral Devices
● Reactors
3G3AX-DL
3G3AX-AL
● External Regeneration Resistors
R88A-RR

2-2 How to Read Model

This section describes how to read and understand the model numbers for Servo Drives and Servomotors.

Servo Drive

The Servo Drive model can be identified by the Servo Drive type, applicable Servomotor capacity, power supply voltage, etc.

R88D-KN01H-ML2

OMNUC G5 Series
Servo Drive

Drive Type
N : Network type

Maximum Applicable Servomotor Capacity
A5 : 50 W
01 : 100 W
02 : 200 W
04 : 400 W
08 : 750 W
10 : 1 kW
15 : 1.5 kW
20 : 2 kW
30 : 3 kW
50 : 5 kW

Power Supply Voltage
L : 100 VAC
H : 200 VAC
F : 400 VAC

Network type
ML2: MECHATROLINK-II Communications

Servomotor

The model number provides information such as the Servomotor type, applicable motor capacity, rated rotation speed, and power supply voltage.

R88M-KP10030H-BOS2

OMNUC G5 Series Servomotor

Motor Type
Blank : Cylinder type

Servomotor Capacity
050 : 50 W
100 : 100 W
200 : 200 W
400 : 400 W
600 : 600 W
750 : 750 W
900 : 900 W
1K0 : 1 kW
1K5 : 1.5 kW
2K0 : 2 kW
3K0 : 3 kW
4K0 : 4 kW
5K0 : 5 kW

Rated Rotation Speed
10 : 1,000 r/min
20 : 2,000 r/min
30 : 3,000 r/min

Applied Voltage
F : 400 VAC (incremental encoder specifications)
H : 200 VAC (incremental encoder specifications)
L : 100 VAC (incremental encoder specifications)
C : 400 VAC (absolute encoder specifications)
T : 200 VAC (absolute encoder specifications)
S : 100 VAC (absolute encoder specifications)

Options
No : Straight shaft
B : With brake
O : With oil seal
S2 : With key and tap

2-3 Standard Model List

This section lists the standard models of Servo Drives, Servomotors, Cables, Connectors, and peripheral equipment.

Servo Drive Model List

The table below lists the Servo Drive models.

Specifications		Model
Single-phase 100 VAC	50 W	R88D-KNA5L-ML2
	100 W	R88D-KN01L-ML2
	200 W	R88D-KN02L-ML2
	400 W	R88D-KN04L-ML2
Single-phase/3-phase 200 VAC	100 W	R88D-KN01H-ML2
	200 W	R88D-KN02H-ML2
	400 W	R88D-KN04H-ML2
	750 W	R88D-KN08H-ML2
	1 kW	R88D-KN10H-ML2
	1.5 kW	R88D-KN15H-ML2
3-phase 200 VAC	2 kW	R88D-KN20H-ML2
	3 kW	R88D-KN30H-ML2
	5 kW	R88D-KN50H-ML2
3-phase 400 VAC	600 W	R88D-KN06F-ML2
	1 kW	R88D-KN10F-ML2
	1.5 kW	R88D-KN15F-ML2
	2 kW	R88D-KN20F-ML2
	3 kW	R88D-KN30F-ML2
	5 kW	R88D-KN50F-ML2

Servomotor Model List

The table below lists the Servomotor models by rated number of motor rotations.

3,000-r/min Servomotors

Specifications			Model			
			With incremental encoder		With absolute encoder	
			Straight shaft without key	Straight shaft with key and tap	Straight shaft without key	Straight shaft with key and tap
Without brakes	100 V	50 W	R88M-K05030H	R88M-K05030H-S2	R88M-K05030T	R88M-K05030T-S2
		100 W	R88M-K10030L	R88M-K10030L-S2	R88M-K10030S	R88M-K10030S-S2
		200 W	R88M-K20030L	R88M-K20030L-S2	R88M-K20030S	R88M-K20030S-S2
		400 W	R88M-K40030L	R88M-K40030L-S2	R88M-K40030S	R88M-K40030S-S2
	200 V	50 W	R88M-K05030H	R88M-K05030H-S2	R88M-K05030T	R88M-K05030T-S2
		100 W	R88M-K10030H	R88M-K10030H-S2	R88M-K10030T	R88M-K10030T-S2
		200 W	R88M-K20030H	R88M-K20030H-S2	R88M-K20030T	R88M-K20030T-S2
		400 W	R88M-K40030H	R88M-K40030H-S2	R88M-K40030T	R88M-K40030T-S2
		750 W	R88M-K75030H	R88M-K75030H-S2	R88M-K75030T	R88M-K75030T-S2
		1 kW	R88M-K1K030H	R88M-K1K030H-S2	R88M-K1K030T	R88M-K1K030T-S2
		1.5 kW	R88M-K1K530H	R88M-K1K530H-S2	R88M-K1K530T	R88M-K1K530T-S2
		2 kW	R88M-K2K030H	R88M-K2K030H-S2	R88M-K2K030T	R88M-K2K030T-S2
		3 kW	R88M-K3K030H	R88M-K3K030H-S2	R88M-K3K030T	R88M-K3K030T-S2
		4 kW	R88M-K4K030H	R88M-K4K030H-S2	R88M-K4K030T	R88M-K4K030T-S2
		5 kW	R88M-K5K030H	R88M-K5K030H-S2	R88M-K5K030T	R88M-K5K030T-S2
	400 V	750 W	R88M-K75030F	R88M-K75030F-S2	R88M-K75030C	R88M-K75030C-S2
		1 kW	R88M-K1K030F	R88M-K1K030F-S2	R88M-K1K030C	R88M-K1K030C-S2
		1.5 kW	R88M-K1K530F	R88M-K1K530F-S2	R88M-K1K530C	R88M-K1K530C-S2
		2 kW	R88M-K2K030F	R88M-K2K030F-S2	R88M-K2K030C	R88M-K2K030C-S2
		3 kW	R88M-K3K030F	R88M-K3K030F-S2	R88M-K3K030C	R88M-K3K030C-S2
		4 kW	R88M-K4K030F	R88M-K4K030F-S2	R88M-K4K030C	R88M-K4K030C-S2
		5 kW	R88M-K5K030F	R88M-K5K030F-S2	R88M-K5K030C	R88M-K5K030C-S2

Specifications			Model			
			With incremental encoder		With absolute encoder	
			Straight shaft without key	Straight shaft with key and tap	Straight shaft without key	Straight shaft with key and tap
With brakes	100 V	50 W	R88M-K05030H-B	R88M-K05030H-BS2	R88M-K05030T-B	R88M-K05030T-BS2
		100 W	R88M-K10030L-B	R88M-K10030L-BS2	R88M-K10030S-B	R88M-K10030S-BS2
		200 W	R88M-K20030L-B	R88M-K20030L-BS2	R88M-K20030S-B	R88M-K20030S-BS2
		400 W	R88M-K40030L-B	R88M-K40030L-BS2	R88M-K40030S-B	R88M-K40030S-BS2
	200 V	50 W	R88M-K05030H-B	R88M-K05030H-BS2	R88M-K05030T-B	R88M-K05030T-BS2
		100 W	R88M-K10030H-B	R88M-K10030H-BS2	R88M-K10030T-B	R88M-K10030T-BS2
		200 W	R88M-K20030H-B	R88M-K20030H-BS2	R88M-K20030T-B	R88M-K20030T-BS2
		400 W	R88M-K40030H-B	R88M-K40030H-BS2	R88M-K40030T-B	R88M-K40030T-BS2
		750 W	R88M-K75030H-B	R88M-K75030H-BS2	R88M-K75030T-B	R88M-K75030T-BS2
		1 kW	R88M-K1K030H-B	R88M-K1K030H-BS2	R88M-K1K030T-B	R88M-K1K030T-BS2
		1.5 kW	R88M-K1K530H-B	R88M-K1K530H-BS2	R88M-K1K530T-B	R88M-K1K530T-BS2
		2 kW	R88M-K2K030H-B	R88M-K2K030H-BS2	R88M-K2K030T-B	R88M-K2K030T-BS2
		3 kW	R88M-K3K030H-B	R88M-K3K030H-BS2	R88M-K3K030T-B	R88M-K3K030T-BS2
		4 kW	R88M-K4K030H-B	R88M-K4K030H-BS2	R88M-K4K030T-B	R88M-K4K030T-BS2
		5 kW	R88M-K5K030H-B	R88M-K5K030H-BS2	R88M-K5K030T-B	R88M-K5K030T-BS2
	400 V	750 W	R88M-K75030F-B	R88M-K75030F-BS2	R88M-K75030C-B	R88M-K75030C-BS2
		1 kW	R88M-K1K030F-B	R88M-K1K030F-BS2	R88M-K1K030C-B	R88M-K1K030C-BS2
		1.5 kW	R88M-K1K530F-B	R88M-K1K530F-BS2	R88M-K1K530C-B	R88M-K1K530C-BS2
		2 kW	R88M-K2K030F-B	R88M-K2K030F-BS2	R88M-K2K030C-B	R88M-K2K030C-BS2
		3 kW	R88M-K3K030F-B	R88M-K3K030F-BS2	R88M-K3K030C-B	R88M-K3K030C-BS2
		4 kW	R88M-K4K030F-B	R88M-K4K030F-BS2	R88M-K4K030C-B	R88M-K4K030C-BS2
		5 kW	R88M-K5K030F-B	R88M-K5K030F-BS2	R88M-K5K030C-B	R88M-K5K030C-BS2

Note. Models with oil seals are also available.

2,000-r/min Servomotors

Specifications			Model			
			With incremental encoder		With absolute encoder	
			Straight shaft without key	Straight shaft with key and tap	Straight shaft without key	Straight shaft with key and tap
Without brakes	200 V	1 kW	R88M-K1K020H	R88M-K1K020H-S2	R88M-K1K020T	R88M-K1K020T-S2
		1.5 kW	R88M-K1K520H	R88M-K1K520H-S2	R88M-K1K520T	R88M-K1K520T-S2
		2 kW	R88M-K2K020H	R88M-K2K020H-S2	R88M-K2K020T	R88M-K2K020T-S2
		3 kW	R88M-K3K020H	R88M-K3K020H-S2	R88M-K3K020T	R88M-K3K020T-S2
		4 kW	R88M-K4K020H	R88M-K4K020H-S2	R88M-K4K020T	R88M-K4K020T-S2
		5 kW	R88M-K5K020H	R88M-K5K020H-S2	R88M-K5K020T	R88M-K5K020T-S2
	400 V	400 W	R88M-K40020F	R88M-K40020F-S2	R88M-K40020C	R88M-K40020C-BS2
		600 W	R88M-K60020F	R88M-K60020F-S2	R88M-K60020C	R88M-K60020C-BS2
		1 kW	R88M-K1K020F	R88M-K1K020F-S2	R88M-K1K020C	R88M-K1K020C-S2
		1.5 kW	R88M-K1K520F	R88M-K1K520F-S2	R88M-K1K520C	R88M-K1K520C-S2
		2 kW	R88M-K2K020F	R88M-K2K020F-S2	R88M-K2K020C	R88M-K2K020C-S2
		3 kW	R88M-K3K020F	R88M-K3K020F-S2	R88M-K3K020C	R88M-K3K020C-S2
		4 kW	R88M-K4K020F	R88M-K4K020F-S2	R88M-K4K020C	R88M-K4K020C-S2
		5 kW	R88M-K5K020F	R88M-K5K020F-S2	R88M-K5K020C	R88M-K5K020C-S2
With brakes	200 V	1 kW	R88M-K1K020H-B	R88M-K1K020H-BS2	R88M-K1K020T-B	R88M-K1K020T-BS2
		1.5 kW	R88M-K1K520H-B	R88M-K1K520H-BS2	R88M-K1K520T-B	R88M-K1K520T-BS2
		2 kW	R88M-K2K020H-B	R88M-K2K020H-BS2	R88M-K2K020T-B	R88M-K2K020T-BS2
		3 kW	R88M-K3K020H-B	R88M-K3K020H-BS2	R88M-K3K020T-B	R88M-K3K020T-BS2
		4 kW	R88M-K4K020H-B	R88M-K4K020H-BS2	R88M-K4K020T-B	R88M-K4K020T-BS2
		5 kW	R88M-K5K020H-B	R88M-K5K020H-BS2	R88M-K5K020T-B	R88M-K5K020T-BS2
	400 V	400 W	R88M-K40020F-B	R88M-K40020F-BS2	R88M-K40020C-B	R88M-K40020C-BS2
		600 W	R88M-K60020F-B	R88M-K60020F-BS2	R88M-K60020C-B	R88M-K60020C-BS2
		1 kW	R88M-K1K020F-B	R88M-K1K020F-BS2	R88M-K1K020C-B	R88M-K1K020C-BS2
		1.5 kW	R88M-K1K520F-B	R88M-K1K520F-BS2	R88M-K1K520C-B	R88M-K1K520C-BS2
		2 kW	R88M-K2K020F-B	R88M-K2K020F-BS2	R88M-K2K020C-B	R88M-K2K020C-BS2
		3 kW	R88M-K3K020F-B	R88M-K3K020F-BS2	R88M-K3K020C-B	R88M-K3K020C-BS2
		4 kW	R88M-K4K020F-B	R88M-K4K020F-BS2	R88M-K4K020C-B	R88M-K4K020C-BS2
		5 kW	R88M-K5K020F-B	R88M-K5K020F-BS2	R88M-K5K020C-B	R88M-K5K020C-BS2

Note. Models with oil seals are also available.

1,000-r/min Servomotors

Specifications			Model			
			With incremental encoder		With absolute encoder	
			Straight shaft without key	Straight shaft with key and tap	Straight shaft without key	Straight shaft with key and tap
Without brakes	200 V	900 kW	R88M-K90010H	R88M-K90010H-S2	R88M-K90010T	R88M-K90010T-S2
		2 kW	R88M-K2K010H	R88M-K2K010H-S2	R88M-K2K010T	R88M-K2K010T-S2
		3 kW	R88M-K3K010H	R88M-K3K010H-S2	R88M-K3K010T	R88M-K3K010T-S2
	400 V	900 kW	R88M-K90010F	R88M-K90010F-S2	R88M-K90010C	R88M-K90010C-S2
		2 kW	R88M-K2K010F	R88M-K2K010F-S2	R88M-K2K010C	R88M-K2K010C-S2
		3 kW	R88M-K3K010F	R88M-K3K010F-S2	R88M-K3K010C	R88M-K3K010C-S2
With brakes	200 V	900 kW	R88M-K90010H-B	R88M-K90010H-BS2	R88M-K90010T-B	R88M-K90010T-BS2
		2 kW	R88M-K2K010H-B	R88M-K2K010H-BS2	R88M-K2K010T-B	R88M-K2K010T-BS2
		3 kW	R88M-K3K010H-B	R88M-K3K010H-BS2	R88M-K3K010T-B	R88M-K3K010T-BS2
	400 V	900 kW	R88M-K90010F-B	R88M-K90010F-BS2	R88M-K90010C-B	R88M-K90010C-BS2
		2 kW	R88M-K2K010F-B	R88M-K2K010F-BS2	R88M-K2K010C-B	R88M-K2K010C-BS2
		3 kW	R88M-K3K010F-B	R88M-K3K010F-BS2	R88M-K3K010C-B	R88M-K3K010C-BS2

Note. Models with oil seals are also available.

Servo Drive and Servomotor Combination List

The tables in this section show the possible combinations of OMNUC G5 Series Servo Drives and Servomotors. The Servomotors and Servo Drives can only be used in the listed combinations.
-x at the end of the motor model number is for options, such as the shaft type, brake, oil seal and key.

3,000-r/min Servomotors and Servo Drives

Voltage	Servomotor			Servo Drive
	Rated output	With incremental encoder	With absolute encoder	
Single-phase 100 V	50 W	R88M-K05030H-x	R88M-K05030T-x	R88D-KNA5L-ML2
	100 W	R88M-K10030L-x	R88M-K10030S-x	R88D-KN01L-ML2
	200 W	R88M-K20030L-x	R88M-K20030S-x	R88D-KN02L-ML2
	400 W	R88M-K40030L-x	R88M-K40030S-x	R88D-KN04L-ML2
Single-phase/ 3-phase 200 V	50 W	R88M-K05030H-x	R88M-K05030T-x	R88D-KN01H-ML2 *1
	100 W	R88M-K10030H-x	R88M-K10030T-x	R88D-KN01H-ML2
	200 W	R88M-K20030H-x	R88M-K20030T-x	R88D-KN02H-ML2
	400 W	R88M-K40030H-x	R88M-K40030T-x	R88D-KN04H-ML2
	750 W	R88M-K75030H-x	R88M-K75030T-x	R88D-KN08H-ML2
	1 kW	R88M-K1K030H-x	R88M-K1K030T-x	R88D-KN15H-ML2 *1
	1.5 kW	R88M-K1K530H-x	R88M-K1K530T-x	R88D-KN15H-ML2
3-phase 200 V	2 kW	R88M-K2K030H-x	R88M-K2K030T-x	R88D-KN20H-ML2
	3 kW	R88M-K3K030H-x	R88M-K3K030T-x	R88D-KN30H-ML2
	4 kW	R88M-K4K030H-x	R88M-K4K030T-x	R88D-KN50H-ML2 *1
	5 kW	R88M-K5K030H-x	R88M-K5K030T-x	R88D-KN50H-ML2
3-phase 400 V	750 W	R88M-K75030F-x	R88M-K75030C-x	R88D-KN10F-ML2 *1
	1 kW	R88M-K1K030F-x	R88M-K1K030C-x	R88D-KN15F-ML2 *1
	1.5 kW	R88M-K1K530F-x	R88M-K1K530C-x	R88D-KN15F-ML2
	2 kW	R88M-K2K030F-x	R88M-K2K030C-x	R88D-KN20F-ML2
	3 kW	R88M-K3K030F-x	R88M-K3K030C-x	R88D-KN30F-ML2
	4 kW	R88M-K4K030F-x	R88M-K4K030C-x	R88D-KN50F-ML2 *1
	5 kW	R88M-K5K030F-x	R88M-K5K030C-x	R88D-KN50F-ML2

*1 Use these combinations with caution because the Servo Drive and Servomotor have different capacities.

2,000-r/min Servomotors and Servo Drives

Voltage	Servomotor			Servo Drive
	Rated output	With incremental encoder	With absolute encoder	
Single-phase/ 3-phase 200 V	1 kW	R88M-K1K020H-x	R88M-K1K020T-x	R88D-KN10H-ML2
	1.5 kW	R88M-K1K520H-x	R88M-K1K520T-x	R88D-KN15H-ML2
3-phase 200 V	2 kW	R88M-K2K020H-x	R88M-K2K020T-x	R88D-KN20H-ML2
	3 kW	R88M-K3K020H-x	R88M-K3K020T-x	R88D-KN30H-ML2
	4 kW	R88M-K4K020H-x	R88M-K4K020T-x	R88D-KN50H-ML2 *1
	5 kW	R88M-K5K020H-x	R88M-K5K020T-x	R88D-KN50H-ML2
3-phase 400 V	400 W	R88M-K40020F-x	R88M-K40020C-x	R88D-KN06F-ML2 *1
	600 W	R88M-K60020F-x	R88M-K60020C-x	R88D-KN06F-ML2
	1 kW	R88M-K1K020F-x	R88M-K1K020C-x	R88D-KN10F-ML2
	1.5 kW	R88M-K1K520F-x	R88M-K1K520C-x	R88D-KN15F-ML2
	2 kW	R88M-K2K020F-x	R88M-K2K020C-x	R88D-KN20F-ML2
	3 kW	R88M-K3K020F-x	R88M-K3K020C-x	R88D-KN30F-ML2
	4 kW	R88M-K4K020F-x	R88M-K4K020C-x	R88D-KN50F-ML2 *1
	5 kW	R88M-K5K020F-x	R88M-K5K020C-x	R88D-KN50F-ML2

*1 Use these combinations with caution because the Servo Drive and Servomotor have different capacities.

1,000-r/min Servomotors and Servo Drives

Voltage	Servomotor			Servo Drive
	Rated output	With incremental encoder	With absolute encoder	
Single-phase/3-phase 200 V	900 W	R88M-K90010H-x	R88M-K90010T-x	R88D-KN15H-ML2 *1
3-phase 200 V	2 kW	R88M-K2K010H-x	R88M-K2K010T-x	R88D-KN30H-ML2 *1
	3 kW	R88M-K3K010H-x	R88M-K3K010T-x	R88D-KN50H-ML2 *1
Single-phase/3-phase 400 V	900 W	R88M-K90010F-x	R88M-K90010C-x	R88D-KN10F-ML2 *1
3-phase 400 V	2 kW	R88M-K2K010F-x	R88M-K2K010C-x	R88D-KN30F-ML2 *1
	3 kW	R88M-K3K010F-x	R88M-K3K010C-x	R88D-KN50F-ML2 *1

*1 Use these combinations with caution because the Servo Drive and Servomotor have different capacities.

Cables and Peripheral Devices Model List

The table below lists the models of cables and peripheral devices. The cable include encoder cables, motor power cables, MECHATROLINK-II communications cables, and absolute encoder battery cables. The peripheral devices include External Regeneration Resistors, and reactors.

Encoder Cables (Flexible Cables)

Specifications		Model
[100 V and 200 V] For 3,000-r/min motors of 50 to 750 W (for both absolute encoders and incremental encoders)	1.5 m	R88A-CRKA001-5CR-E
	3 m	R88A-CRKA003CR-E
	5 m	R88A-CRKA005CR-E
	10 m	R88A-CRKA010CR-E
	15 m	R88A-CRKA015CR-E
	20 m	R88A-CRKA020CR-E
[100 V and 200 V] 3,000-r/min motors of 1.0 kW or more For 2,000-r/min motors For 1,000-r/min motors [400 V] For 3,000-r/min motors For 2,000-r/min motors For 1,000-r/min motors	1.5 m	R88-CRKC001-5NR-E
	3 m	R88A-CRKC003NR-E
	5 m	R88A-CRKC005NR-E
	10 m	R88A-CRKC010NR-E
	15 m	R88A-CRKC015NR-E
	20 m	R88A-CRKC020NR-E

Motor Power Cables (Flexible Cables)

Specifications		Model	
		For motor without brake	For motor with brake
[100 V and 200 V] For 3,000-r/min motors of 50 to 750 W	1.5 m	R88A-CAKA001-5SR-E	–
	3 m	R88A-CAKA003SR-E	–
	5 m	R88A-CAKA005SR-E	–
	10 m	R88A-CAKA010SR-E	–
	15 m	R88A-CAKA015SR-E	–
	20 m	R88A-CAKA020SR-E	–
[200 V] For 3,000-r/min motors of 1 to 2 kW For 2,000-r/min motors of 1 to 2 kW For 1,000-r/min motors of 900 W	1.5 m	R88A-CAGB001-5SR-E	R88A-CAGB001-5BR-E
	3 m	R88A-CAGB003SR-E	R88A-CAGB003BR-E
	5 m	R88A-CAGB005SR-E	R88A-CAGB005BR-E
	10 m	R88A-CAGB010SR-E	R88A-CAGB010BR-E
	15 m	R88A-CAGB015SR-E	R88A-CAGB015BR-E
	20 m	R88A-CAGB020SR-E	R88A-CAGB020BR-E
[400 V] For 3,000-r/min motors of 750 W to 2 kW For 2,000-r/min motors of 400 W to 2 kW For 1,000-r/min motors of 900 W	1.5 m	R88A-CAGB001-5SR-E	R88A-CAKF001-5BR-E
	3 m	R88A-CAGB003SR-E	R88A-CAKF003BR-E
	5 m	R88A-CAGB005SR-E	R88A-CAKF005BR-E
	10 m	R88A-CAGB010SR-E	R88A-CAKF010BR-E
	15 m	R88A-CAGB015SR-E	R88A-CAKF015BR-E
	20 m	R88A-CAGB020SR-E	R88A-CAKF020BR-E
For 3,000-r/min motors of 3 to 5 kW For 2,000-r/min motors of 3 to 5 kW For 1,000-r/min motors of 2 to 3 kW	1.5 m	R88A-CAGD001-5SR-E	R88A-CAGD001-5BR-E
	3 m	R88A-CAGD003SR-E	R88A-CAGD003BR-E
	5 m	R88A-CAGD005SR-E	R88A-CAGD005BR-E
	10 m	R88A-CAGD010SR-E	R88A-CAGD010BR-E
	15 m	R88A-CAGD015SR-E	R88A-CAGD015BR-E
	20 m	R88A-CAGD020SR-E	R88A-CAGD020BR-E

Note.There are separate connectors for power and brakes for 100 V and 200 V 3,000-r/min motors of 50 to 750 W. Therefore, when a motor with a brake is used, it requires both a power cable for a motor without a brake and a brake cable.

MECHATROLINK-II Communications Cables

Specifications		Model
MECHATROLINK-II Communications Cable	0.5 m	FNY-W6003-A5
	1 m	FNY-W6003-01
	3 m	FNY-W6003-03
	5 m	FNY-W6003-05
	10 m	FNY-W6003-10
	20 m	FNY-W6003-20
	30 m	FNY-W6003-30
MECHATROLINK-II Terminating Resistor		FNY-W6022

MECHATROLINK-II Repeater Units

Specifications	Model
MECHATROLINK-II Repeater Unit	FNY-REP2000

Absolute Encoder Battery Cables

Specifications		Model
ABS battery cable (battery not supplied)	0.3 m	R88A-CRGD0R3C
ABS battery cable (R88A-BAT01G battery × 1 supplied)	0.3 m	R88A-CRGD0R3C-BS

Absolute Encoder Backup Battery

Specifications	Model
2,000 mA•h 3.6 V	R88A-BAT01G

Analog Monitor Cable

Specifications		Model
Analog monitor cable	1 m	R88A-CMK001S

Connectors

Specifications		Model
Motor connector for encoder cable	[100 V and 200 V] For 3,000-r/min of 50 to 750 W	R88A-CNK02R
	[100 V and 200 V] For 3,000-r/min of 1 to 5 kW For 2,000 r/min, 1,000 r/min [400 V] For 3,000 r/min, 2,000 r/min and 1,000 r/min	R88A-CNK04R
Control I/O connector (CN1)		R88A-CNW01C
Encoder connector (CN2)		R88A-CNW01R
External encoder connector (CN4)		R88A-CNK41L
Safety connector (CN8)		R88A-CNK81S
Power cable connector (for 750 W max.)		R88A-CNK11A
Brake cable connector (for 750 W max.)		R88A-CNK11B

Control Cables

Specifications			Model
Connector-terminal block cables		1 m	XW2Z-100J-B34
		2 m	XW2Z-200J-B34
Connector-terminal block	M3 screw type		XW2B-20G4
	M3.5 screw type		XW2B-20G5
	M3 screw type		XW2D-20G6

External Regeneration Resistors

Specifications	Model
Regeneration process capacity: 20 W, 50 Ω (with 150°C thermal sensor)	R88A-RR08050S
Regeneration process capacity: 20 W, 100 Ω (with 150°C thermal sensor)	R88A-RR080100S
Regeneration process capacity: 70 W, 47 Ω (with 150°C thermal sensor)	R88A-RR22047S1
Regeneration process capacity: 180 W, 20 Ω (with 200°C thermal sensor)	R88A-RR50020S

Reactors

Servo Drive		Reactor
Model	Number of power phases	Model
R88D-KNA5L-ML2	Single-phase	3G3AX-DL2002
R88D-KN01L-ML2		3G3AX-DL2004
R88D-KN02L-ML2		3G3AX-DL2007
R88D-KN04L-ML2		3G3AX-DL2015
R88D-KN01H-ML2	Single-phase	3G3AX-DL2002
	3-phase	3G3AX-AL2025
R88D-KN02H-ML2	Single-phase	3G3AX-DL2004
	3-phase	3G3AX-AL2025
R88D-KN04H-ML2	Single-phase	3G3AX-DL2007
	3-phase	3G3AX-AL2025
R88D-KN08H-ML2	Single-phase	3G3AX-DL2015
	3-phase	3G3AX-AL2025
R88D-KN10H-ML2	Single-phase	3G3AX-DL2015
	3-phase	3G3AX-AL2025
R88D-KN15H-ML2	Single-phase	3G3AX-DL2022
	3-phase	3G3AX-AL2025
R88D-KN20H-ML2	3-phase	3G3AX-AL2055
R88D-KN30H-ML2		
R88D-KN50H-ML2		3G3AX-AL2110
R88D-KN06F-ML2		3G3AX-AL4025
R88D-KN10F-ML2		
R88D-KN15F-ML2		
R88D-KN20F-ML2		3G3AX-AL4055
R88D-KN30F-ML2		
R88D-KN50F-ML2		3G3AX-AL4110

Mounting Brackets (L-Brackets for Rack Mounting)

Specifications	Model
R88D-KNA5L-ML2/-KN01L-ML2/-KN01H-ML2/-KN02H-ML2	R88A-TK01K
R88D-KN02L-ML2/-KN04H-ML2	R88A-TK02K
R88D-KN04L-ML2/-KN08H-ML2	R88A-TK03K
R88D-KN10H-ML2/-KN15H-ML2/-KN06F-ML2/-KN10F-ML2/-KN15F-ML2	R88A-TK04K

2-4 External and Mounting Dimensions

This section describes the external dimensions and the mounting dimensions of Servo Drives, Servomotors, and peripheral devices.

Servo Drive Dimensions

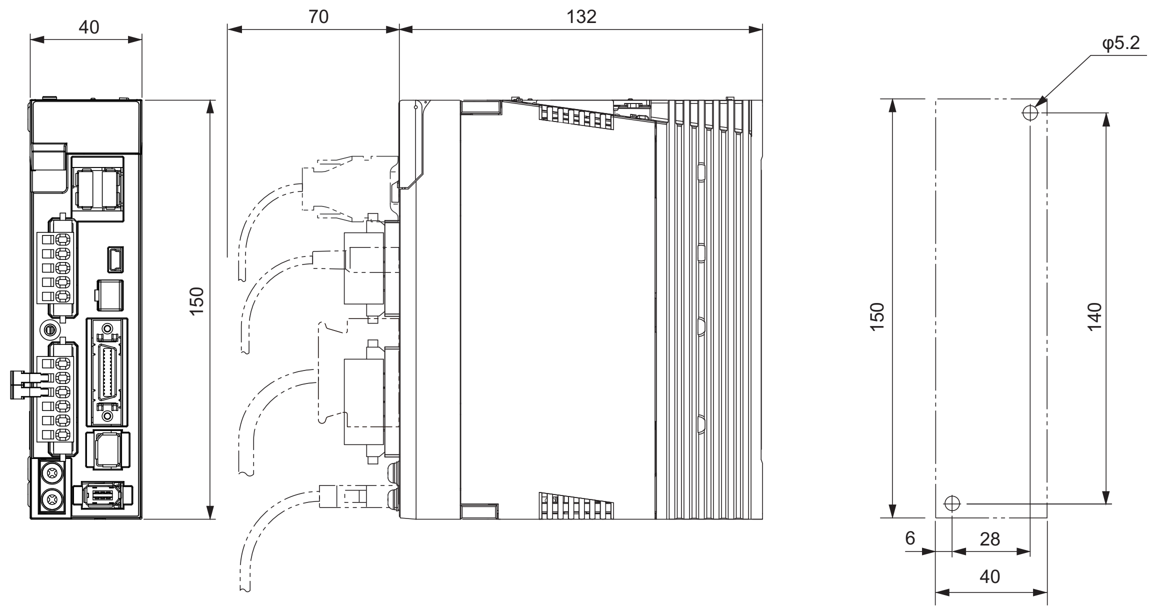
The dimensional description starts with a Servo Drive of the smallest motor capacity, which is followed by the next smallest, and so on.

Single-phase 100 VAC: R88D-KNA5L-ML2/-KN01L-ML2 (50 to 100 W) Single-phase/3-phase 200 VAC: R88D-KN01H-ML2/-KN02H-ML2 (100 to 200 W)

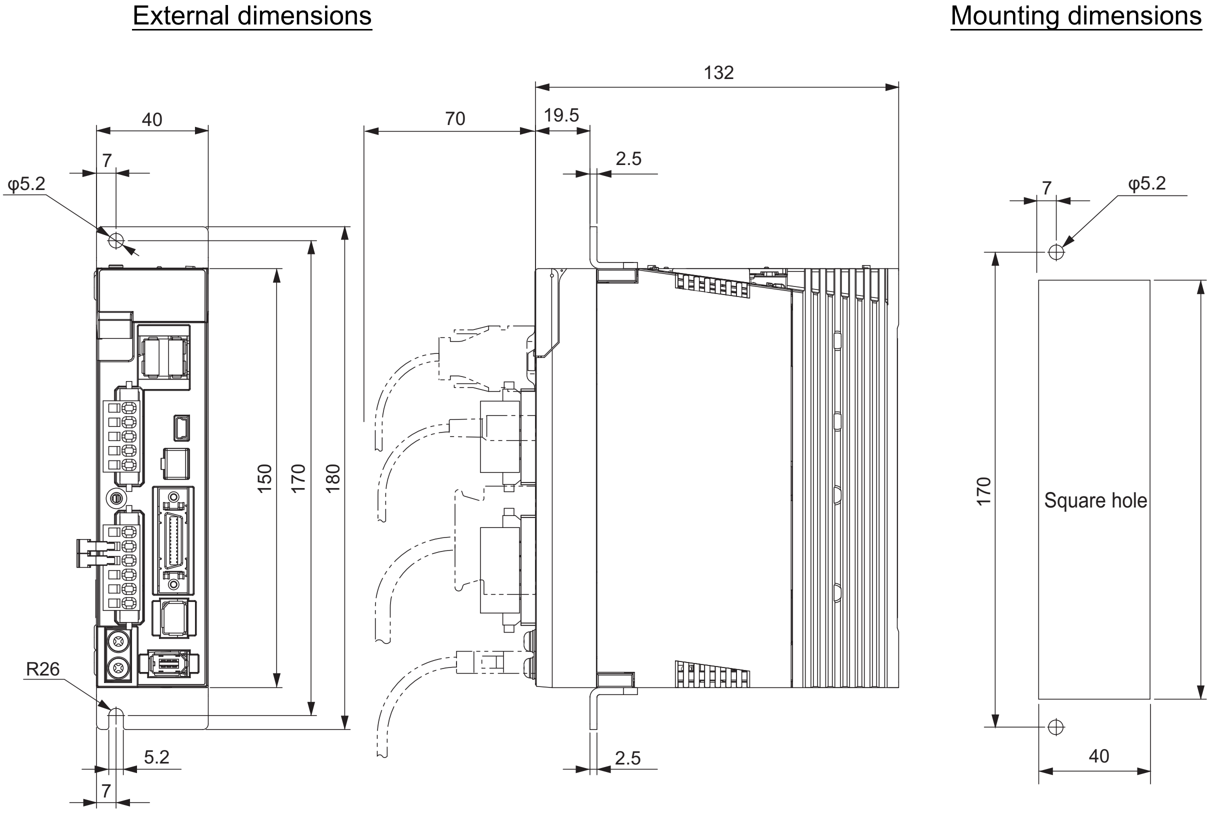
Wall Mounting

External dimensions

Mounting dimensions



Front Mounting (Using Front Mounting Brackets)

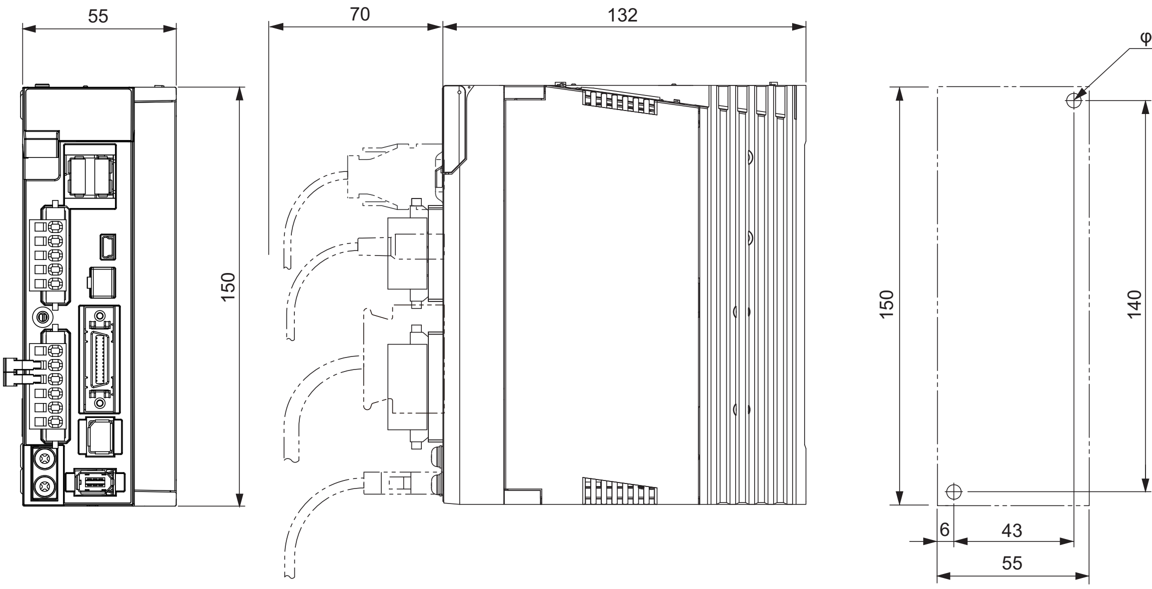


Single-phase/3-phase 100 VAC: R88D-KN02L-ML2 (200 W) Single-phase/3-phase 200 VAC: R88D-KN04H-ML2 (400 W)

Wall Mounting

External dimensions

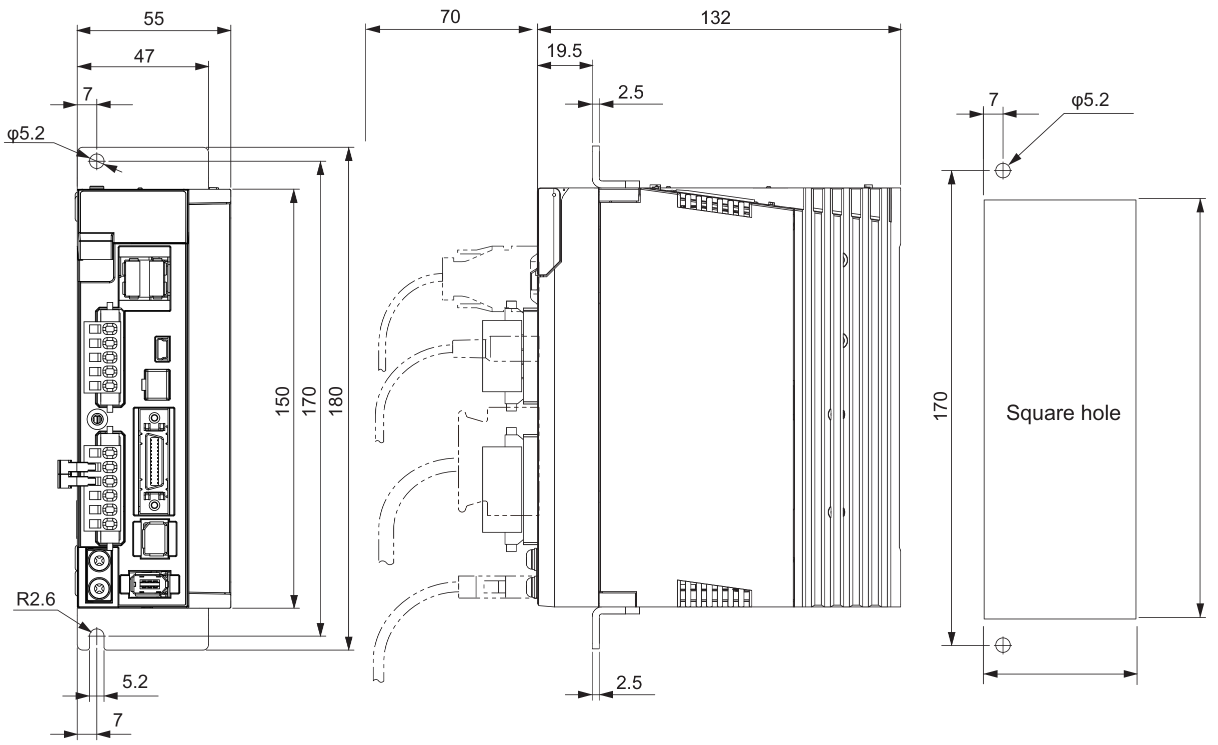
Mounting dimensions



Front Mounting (Using Front Mounting Brackets)

External dimensions

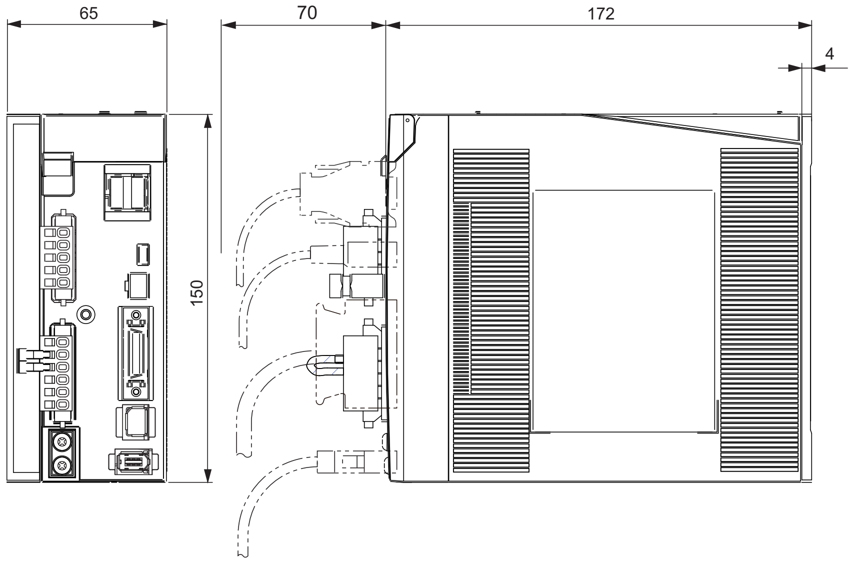
Mounting dimensions



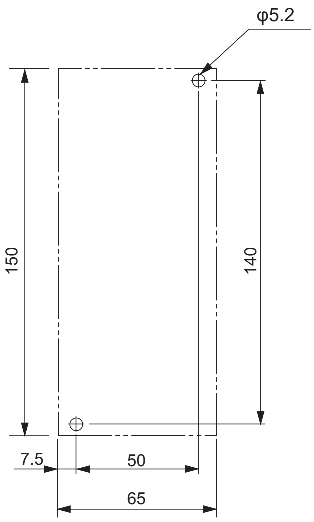
Single-phase/3-phase 100 VAC: R88D-KN04L-ML2 (400 W)
Single-phase/3-phase 200 VAC: R88D-KN08H-ML2 (750 W)

Wall Mounting

External dimensions

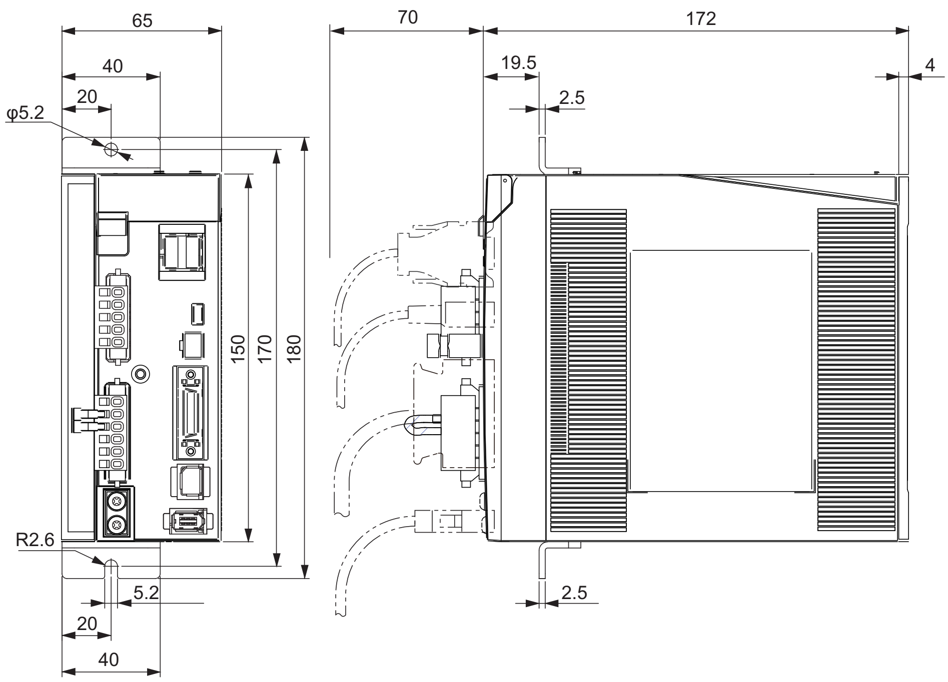


Mounting dimensions

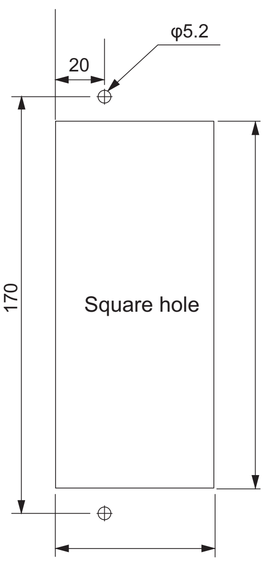


Front Mounting (Using Front Mounting Brackets)

External dimensions



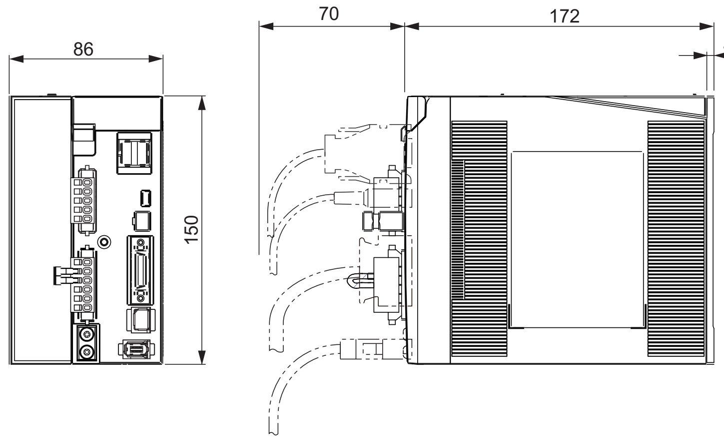
Mounting dimensions



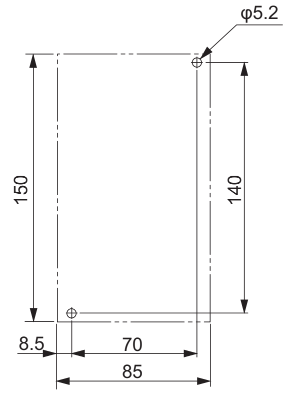
Single-phase/3-phase 200 VAC: R88D-KN10H-ML2/-KN15H-ML2 (900 W to 1.5 kW)

Wall Mounting

External dimensions

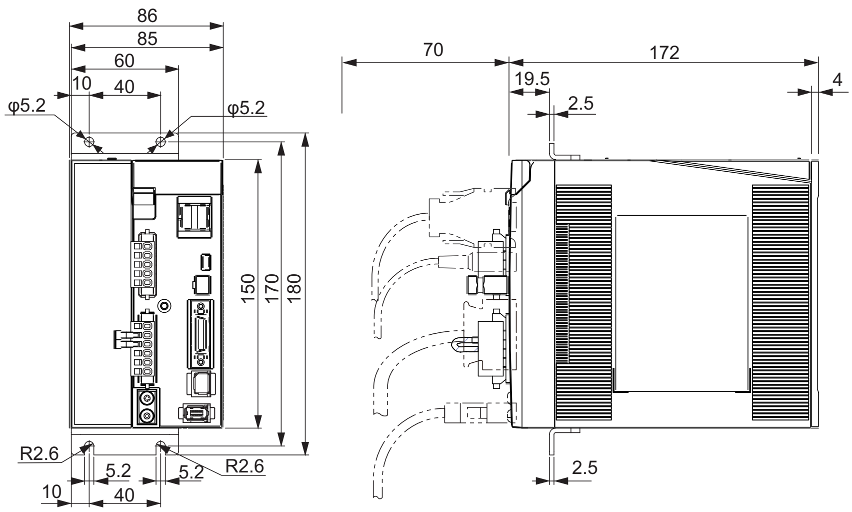


Mounting dimensions

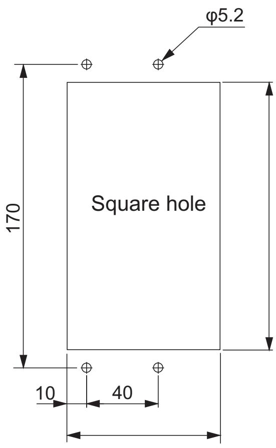


Front Mounting (Using Front Mounting Brackets)

External dimensions



Mounting dimensions

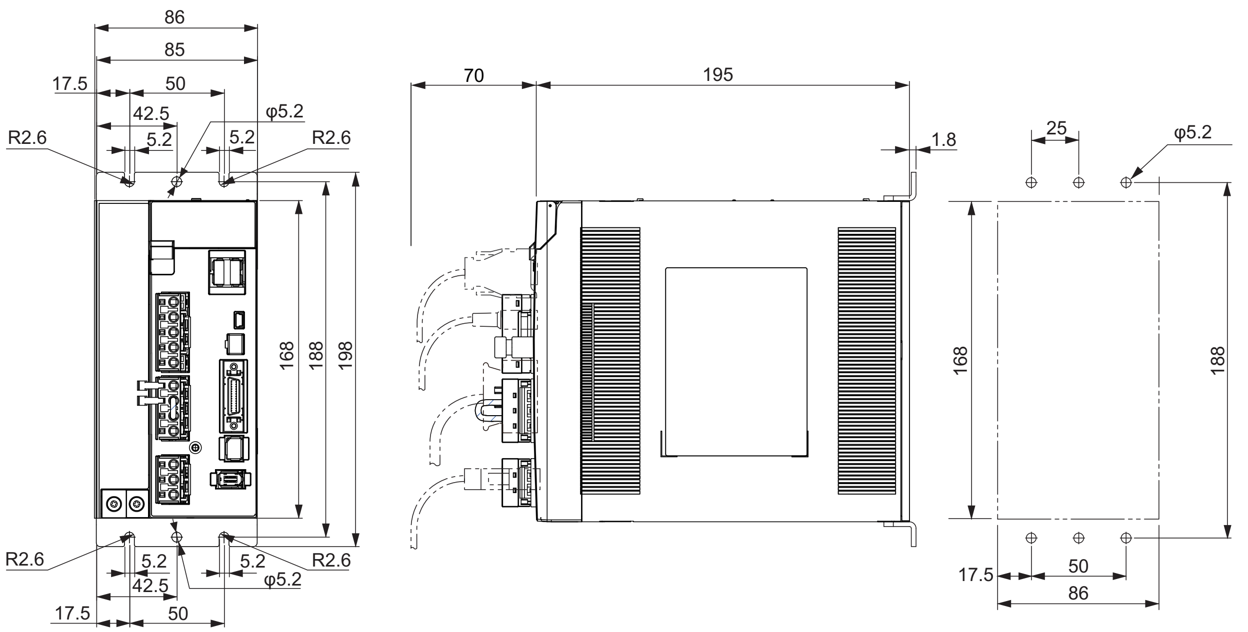


3-phase 200 VAC: R88D-KN20H-ML2 (2 kW)

Wall Mounting

External dimensions

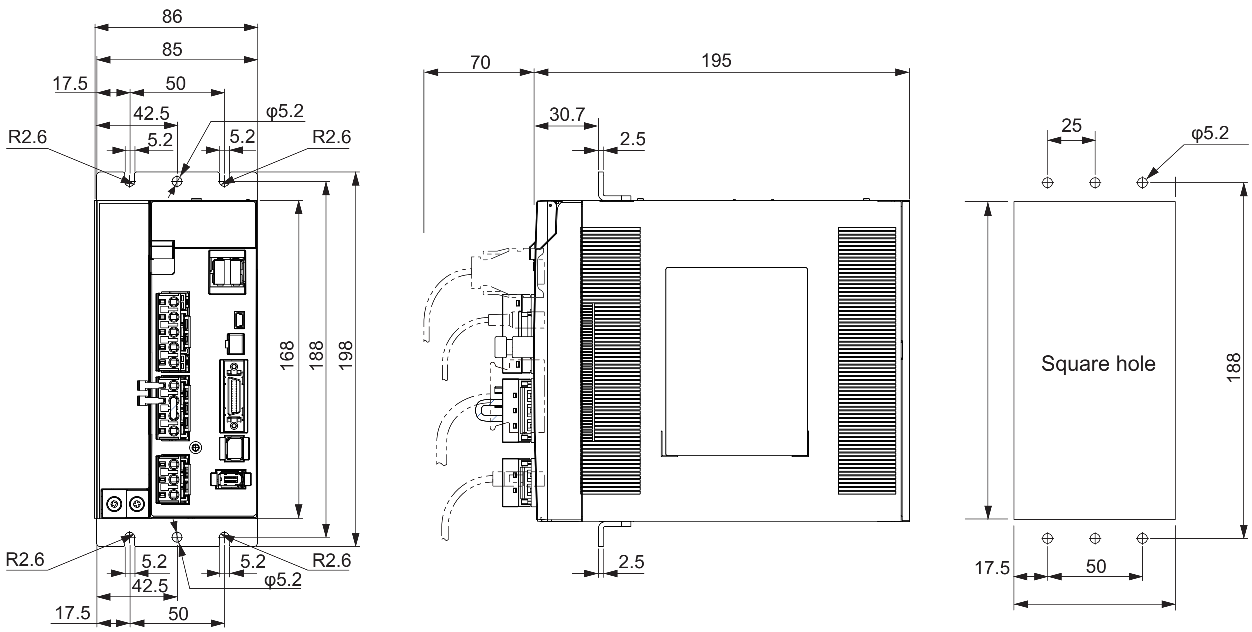
Mounting dimensions



Front Mounting (Using Front Mounting Brackets)

External dimensions

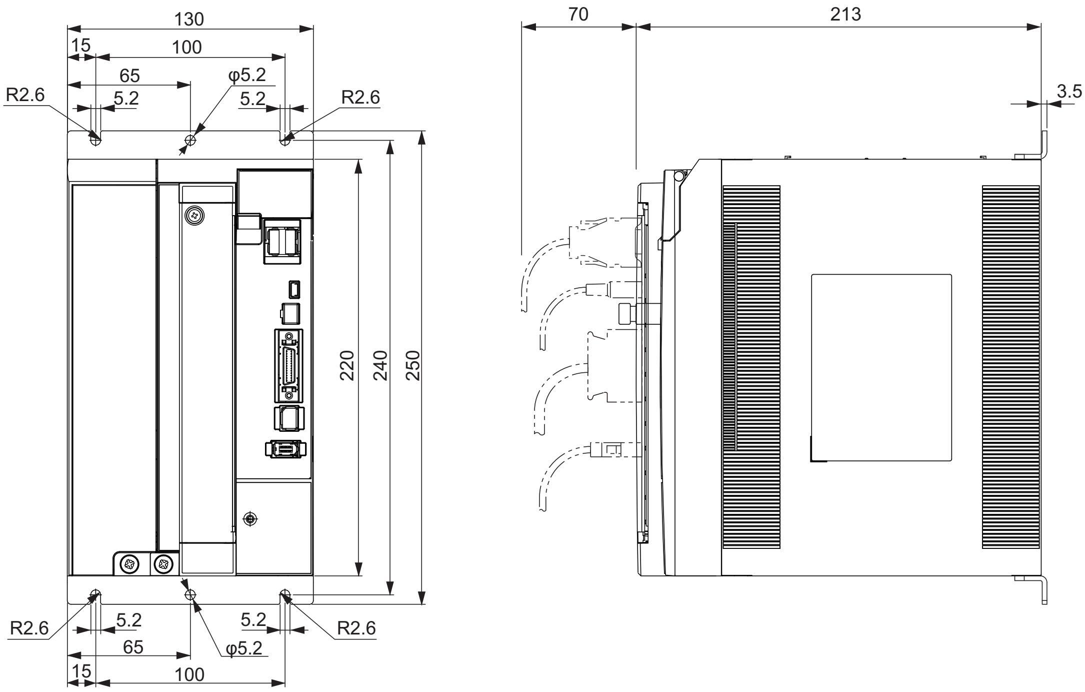
Mounting dimensions



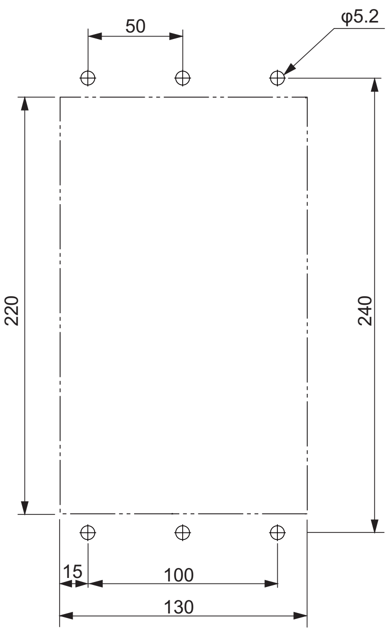
3-phase 200 VAC: R88D-KN30H-ML2/-KN50H-ML2 (3 to 5 kW)

Wall Mounting

External dimensions

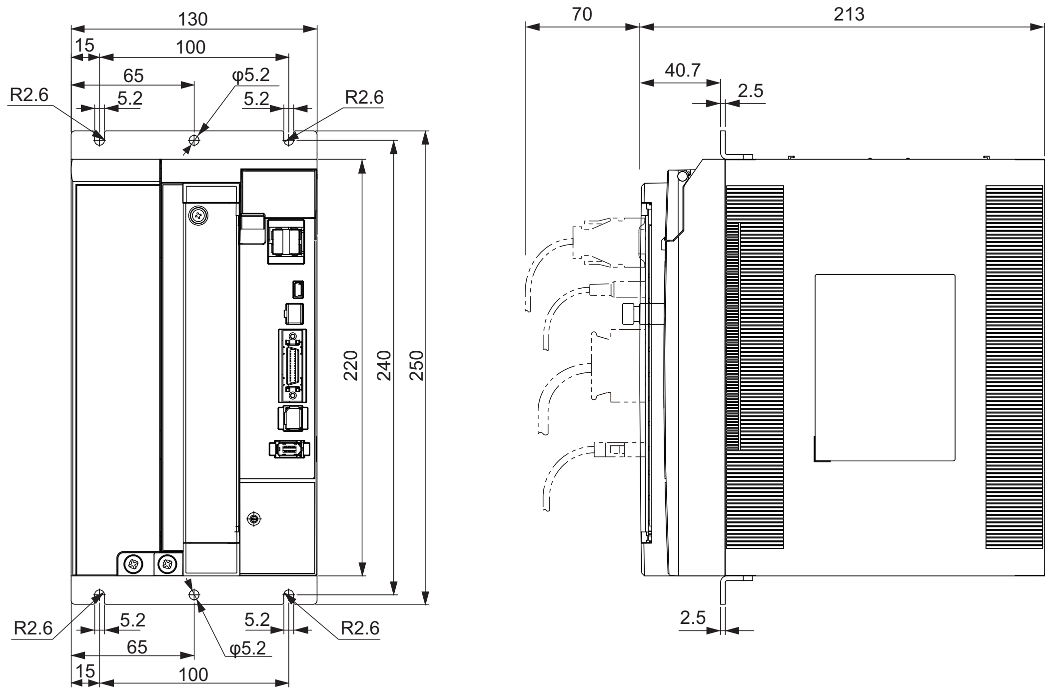


Mounting dimensions

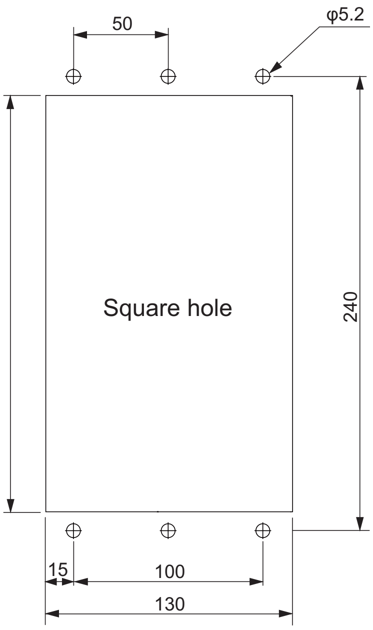


Front Mounting (Using Front Mounting Brackets)

External dimensions



Mounting dimensions

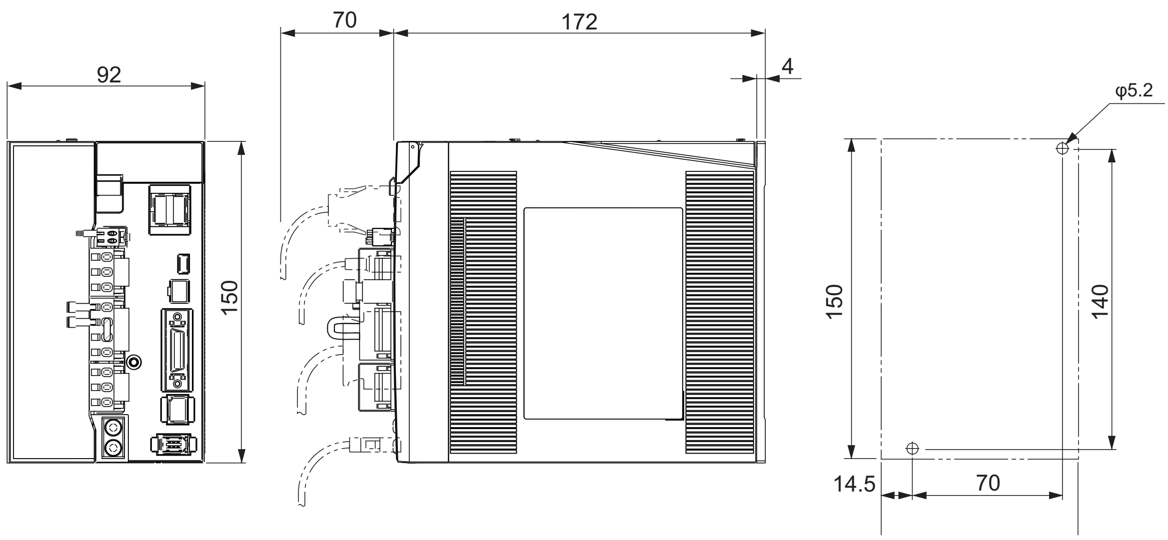


3-phase 400 VAC: R88D-KN06F-ML2/-KN10F-ML2 (600 W to 1.0 kW)
3-phase 400 VAC: R88D-KN15F-ML2 (1.5 kW)

Wall Mounting

External dimensions

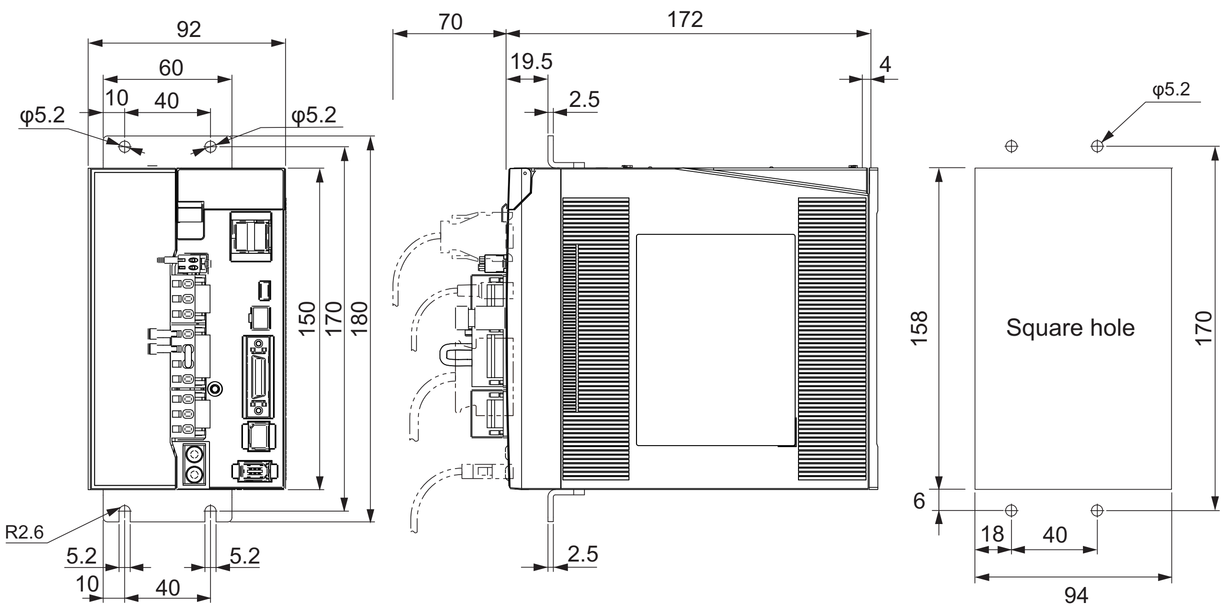
Mounting dimensions



Front Mounting (Using Front Mounting Brackets)

External dimensions

Mounting dimensions

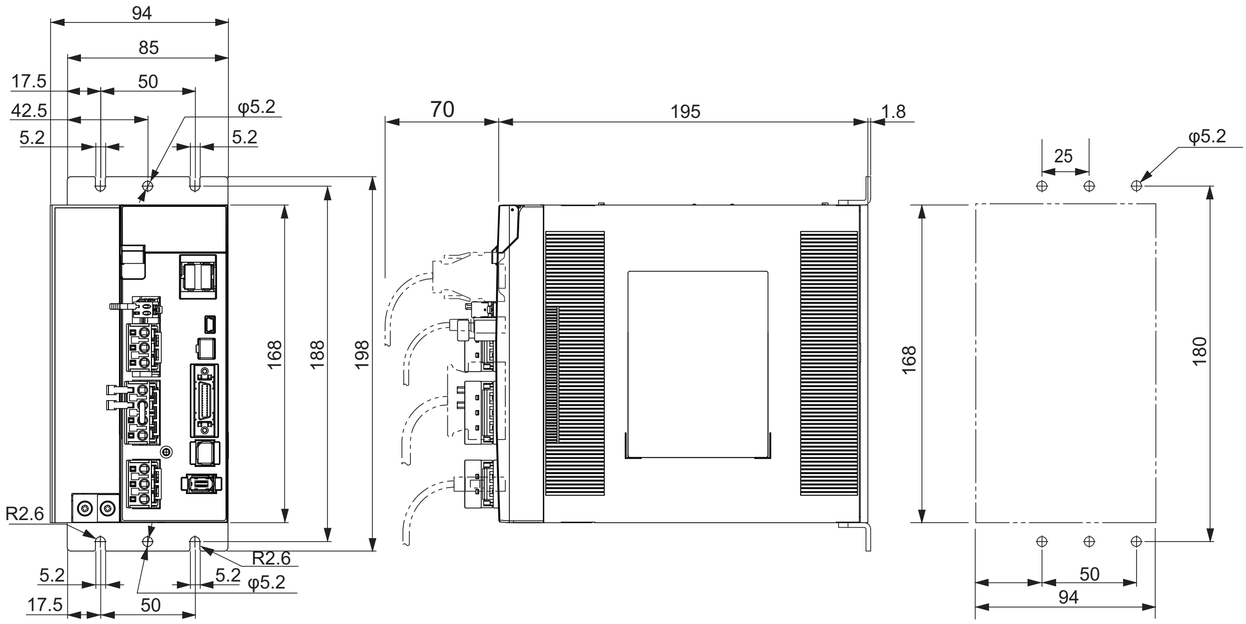


3-phase 400 VAC: R88D-KN20F-ML2 (2 kW)

Wall Mounting

External dimensions

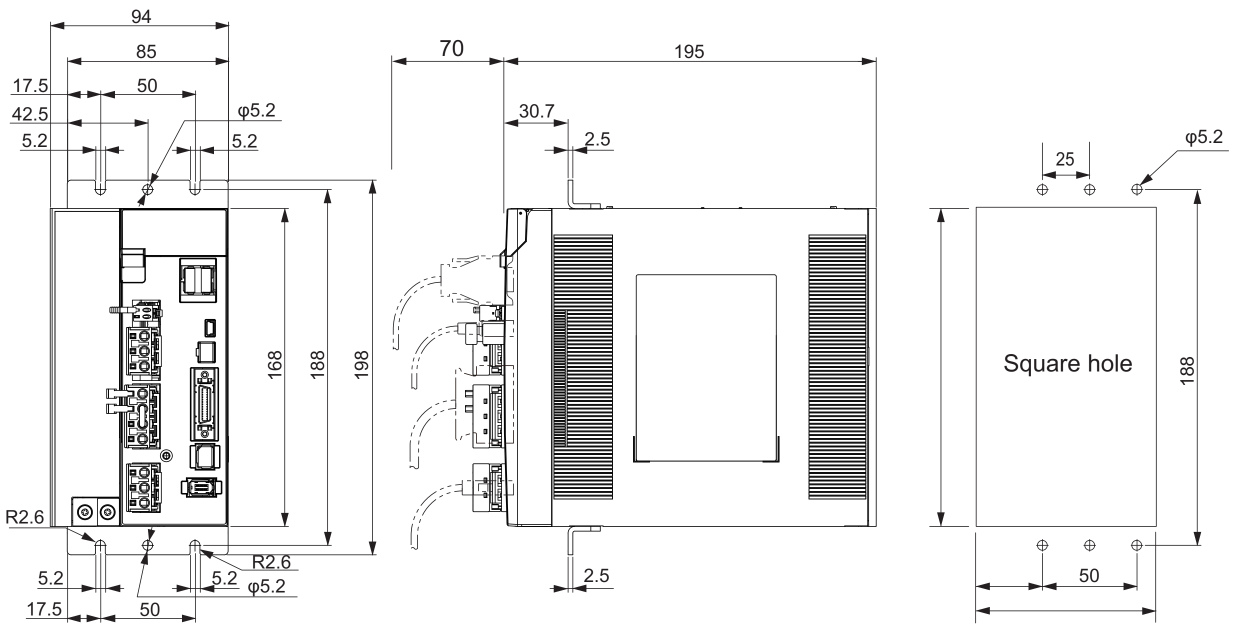
Mounting dimensions



Front Mounting (Using Front Mounting Brackets)

External dimensions

Mounting dimensions

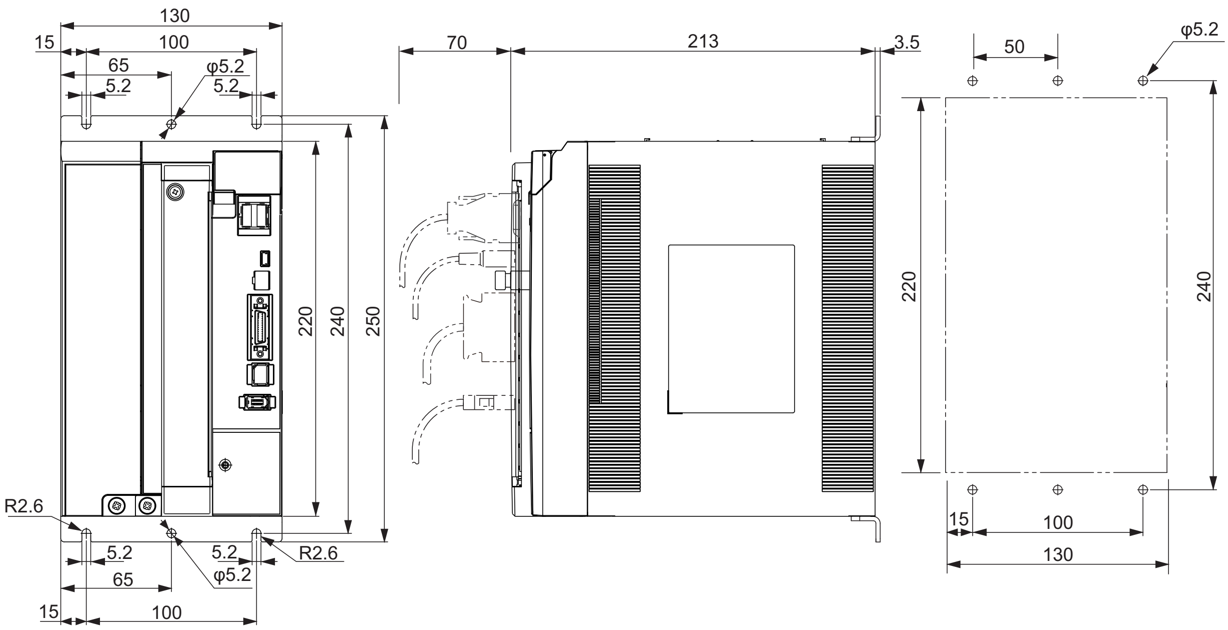


3-phase 400 VAC: R88D-KN30F-ML2/-KN50F-ML2 (3 to 5 kW)

Wall Mounting

External dimensions

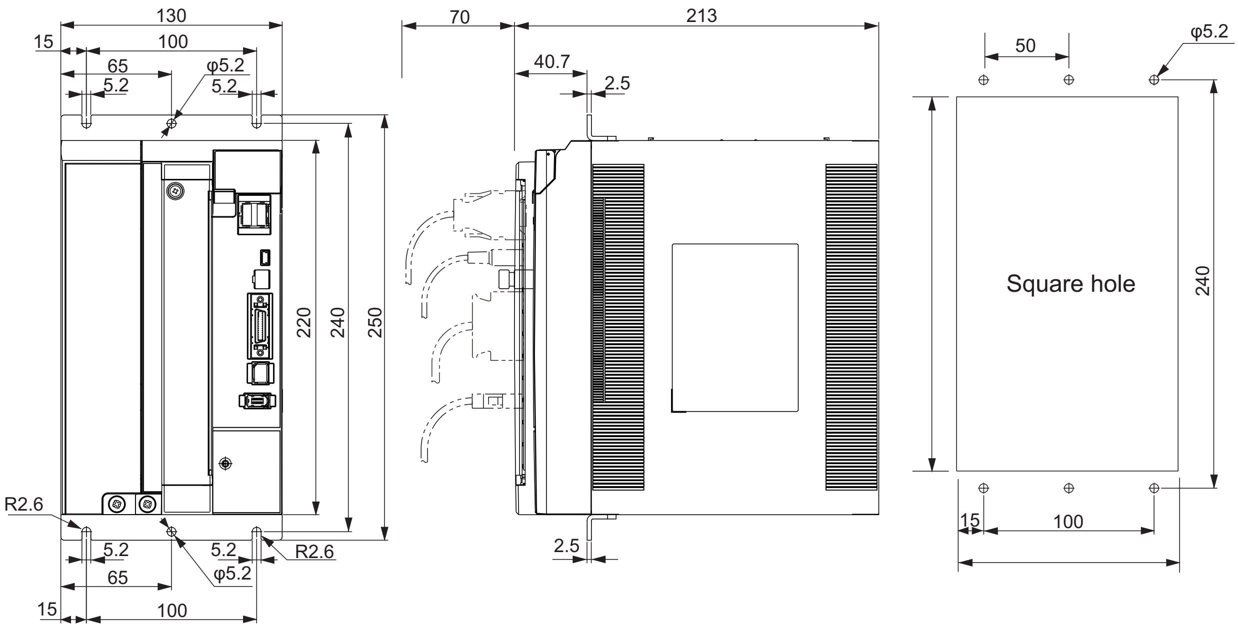
Mounting dimensions



Front Mounting (Using Front Mounting Brackets)

External dimensions

Mounting dimensions



Servomotor Dimensions

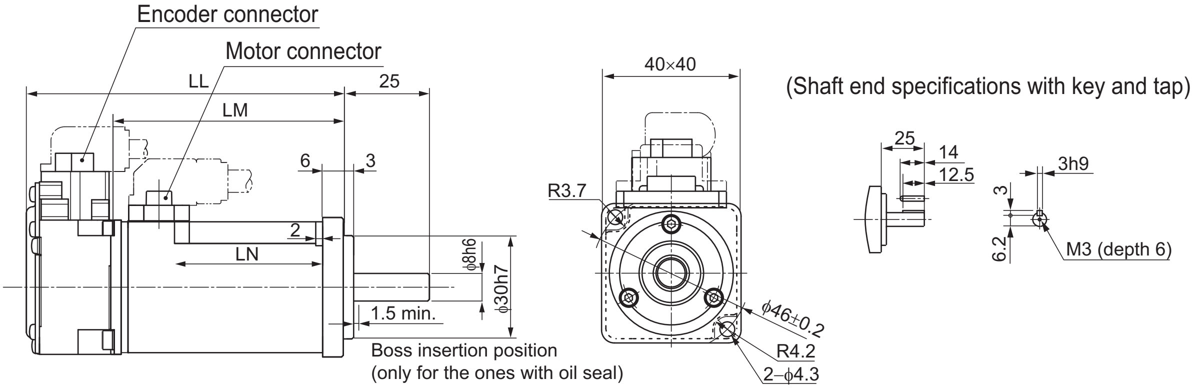
In this description, the Servomotors are grouped by rated rotation speed. The description starts with a Servomotor of the smallest capacity, which is followed by the next smallest, and so on.

3,000-r/min Motors (100 V and 200 V)

50 W/100 W (without Brake)

R88M-K05030H (-S2)/-K10030L (-S2) **INC**

R88M-K05030T (-S2)/-K10030S (-S2) **ABS**



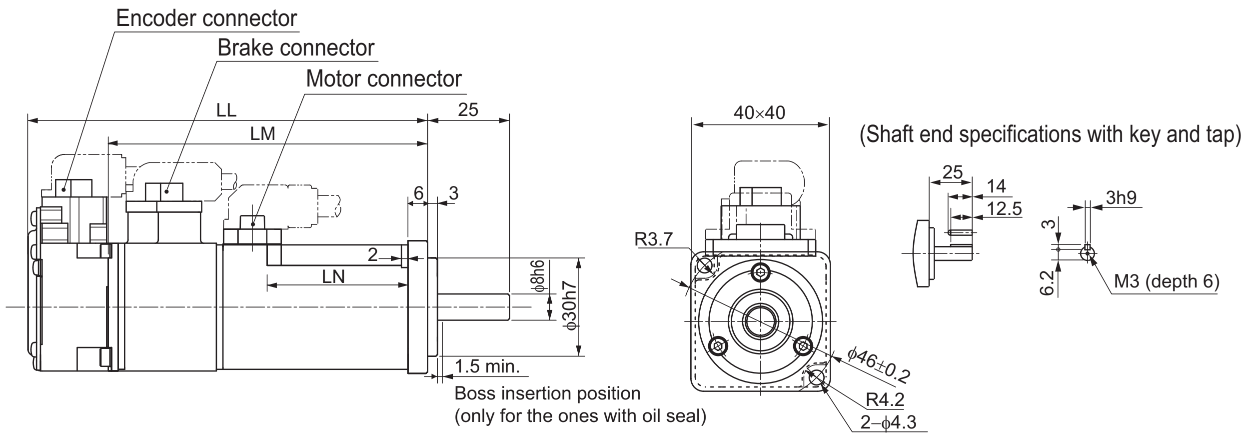
Model	Dimensions (mm)		
	LL	LM	LN
R88M-K05030x	72	48	23
R88M-K10030x	92	68	43

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

50 W/100 W (with Brake)

R88M-K05030H-B (S2)/-K10030L-B (S2) **INC**

R88M-K05030T-B (S2)/-K10030S-B (S2) **ABS**



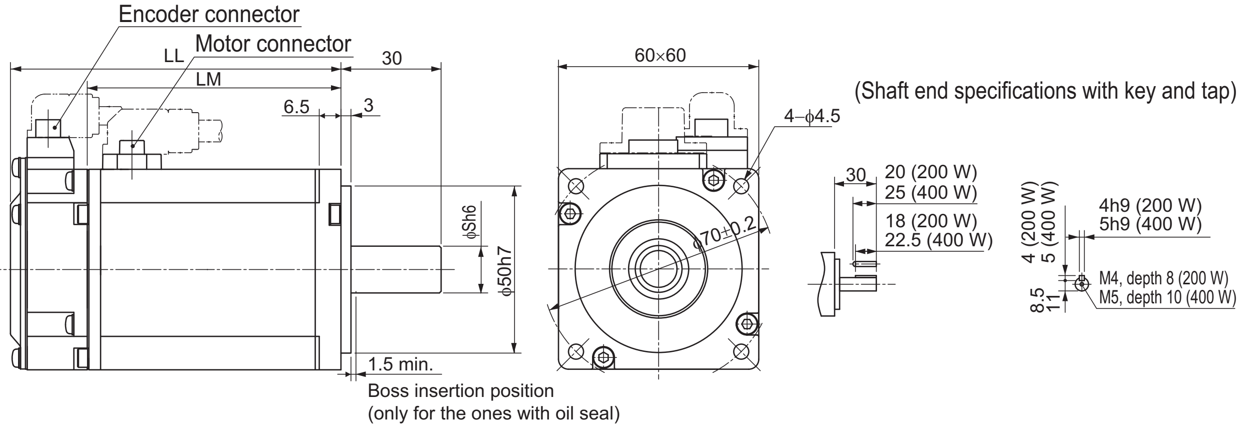
Model	Dimensions (mm)		
	LL	LM	LN
R88M-K05030x-Bx	102	78	23
R88M-K10030x-Bx	122	98	43

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

200 W/400 W (without Brake)

R88M-K20030x (-S2)/-K40030x (-S2) **INC**

R88M-K20030x (-S2)/-K40030x (-S2) **ABS**



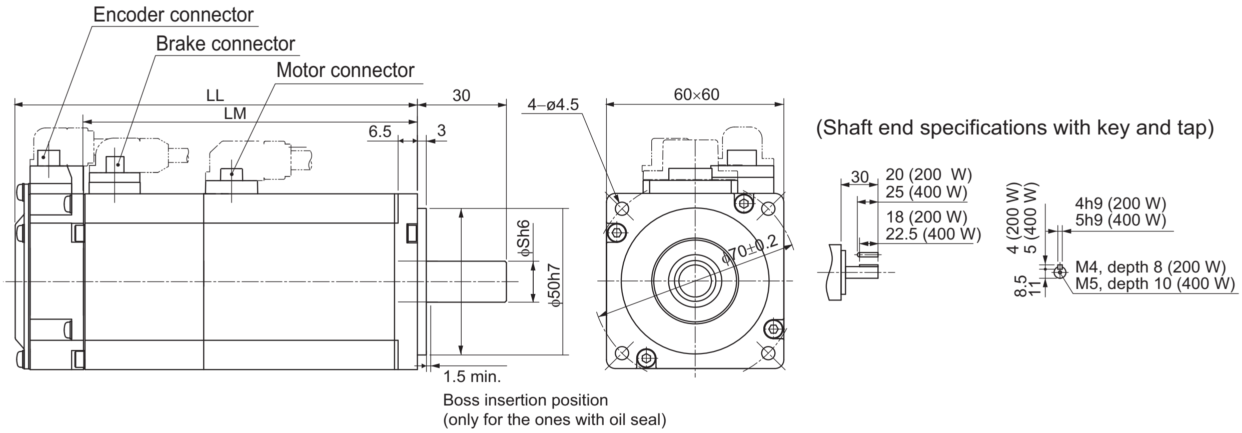
Model	Dimensions (mm)		
	LL	LM	S
R88M-K20030x	79.5	56.5	11
R88M-K40030x	99	76	14

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

200 W/400 W (with Brake)

R88M-K20030x-B (S2)/-K40030x-B (S2) **INC**

R88M-K20030x-B (S2)/-K40030x-B (S2) **ABS**



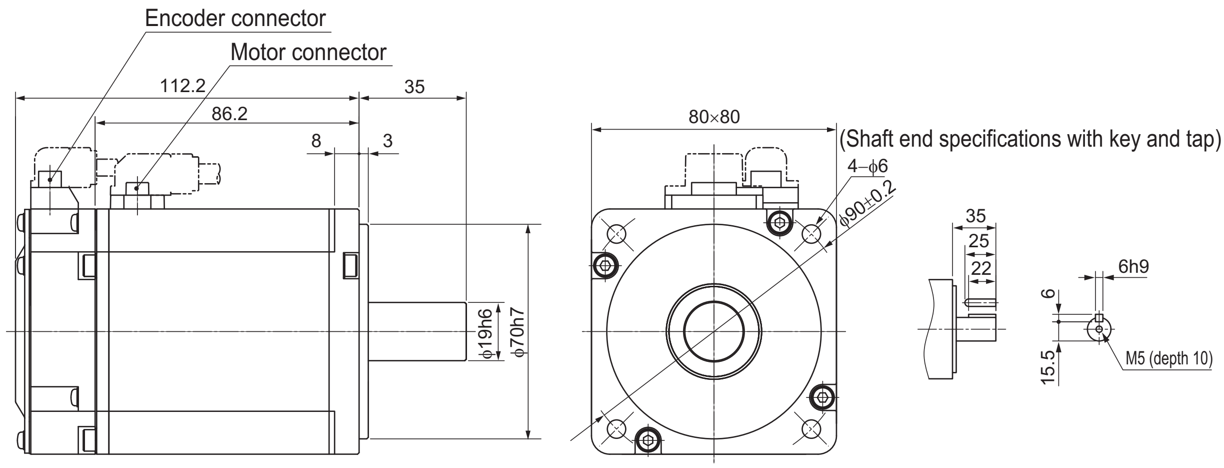
Model	Dimensions (mm)		
	LL	LM	S
R88M-K20030x-Bx	116	93	11
R88M-K40030x-Bx	135.5	112.5	14

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

750 W (without Brake)

R88M-K75030H (-S2) **INC**

R88M-K75030T (-S2) **ABS**

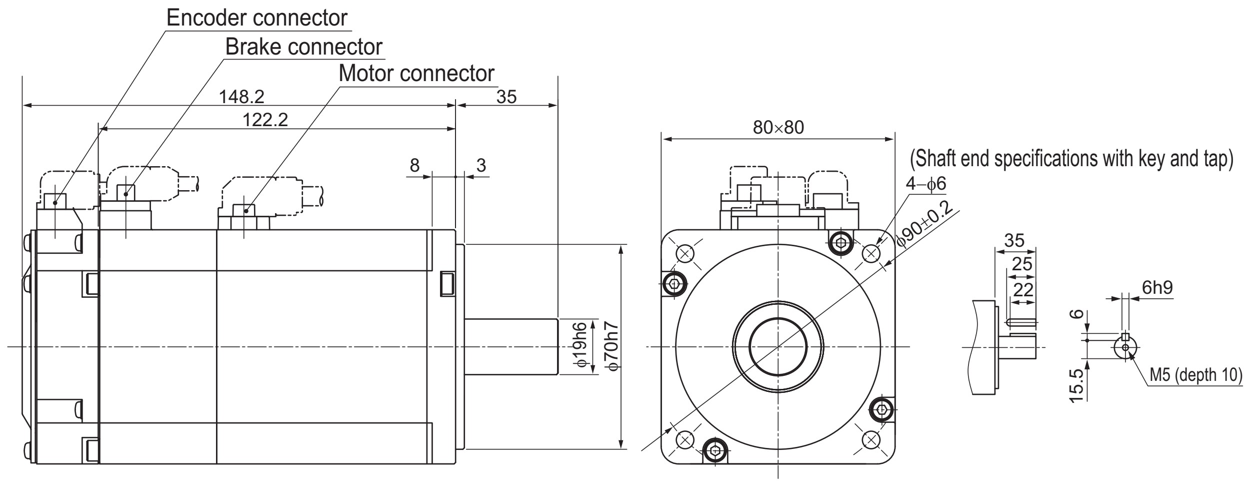


Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

750 W (with Brake)

R88M-K75030H-B (S2) **INC**

R88M-K75030T-B (S2) **ABS**



Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

1 kW/1.5 kW/2 kW (without Brake)

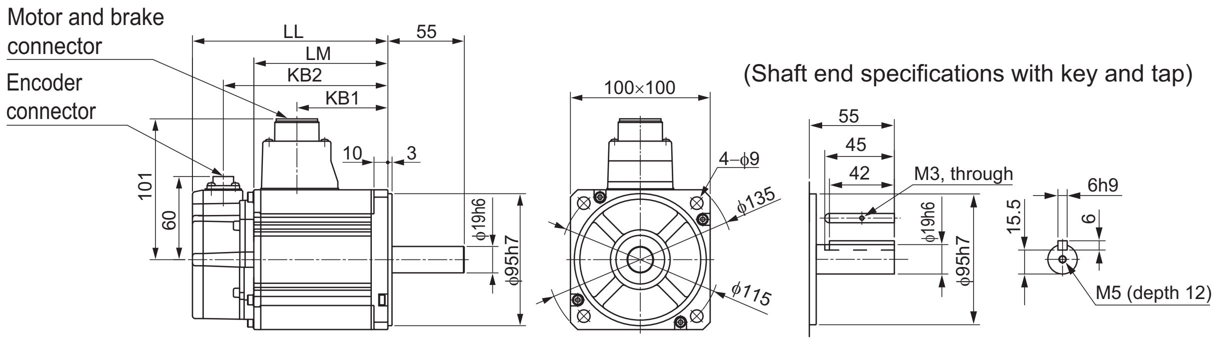
R88M-K1K030H (-S2)/-K1K530H (-S2)/-K2K030H (-S2) **INC**

R88M-K1K030T (-S2)/-K1K530T (-S2)/-K2K030T (-S2) **ABS**

1 kW/1.5 kW/2 kW (with Brake)

R88M-K1K030H-B (S2)/-K1K530H-B (S2)/-K2K030H-B (S2) **INC**

R88M-K1K030T-B (S2)/-K1K530T-B (S2)/-K2K030T-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K1K030x	141	97	66	119
R88M-K1K530x	159.5	115.5	84.5	137.5
R88M-K2K030x	178.5	134.5	103.5	156.5
R88M-K1K030x-Bx	168	124	66	146
R88M-K1K530x-Bx	186.5	142.5	84.5	164.5
R88M-K2K030x-Bx	205.5	161.5	103.5	183.5

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

3 kW (without Brake)

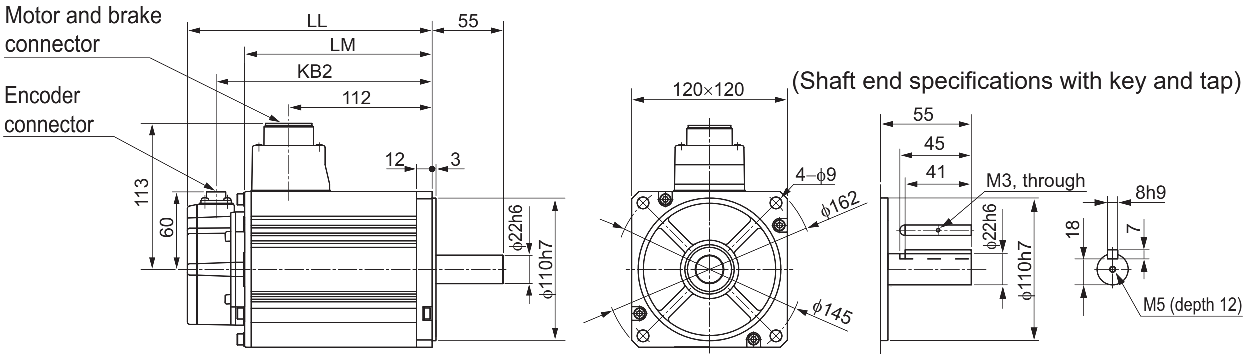
R88M-K3K030H (-S2) **INC**

R88M-K3K030T (-S2) **ABS**

3 kW (with Brake)

R88M-K3K030H-B (S2) **INC**

R88M-K3K030T-B (S2) **ABS**



Model	Dimensions (mm)		
	LL	LM	KB2
R88M-K3K030x	190	146	168
R88M-K3K030x-Bx	215	171	193

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

4 kW/5 kW (without Brake)

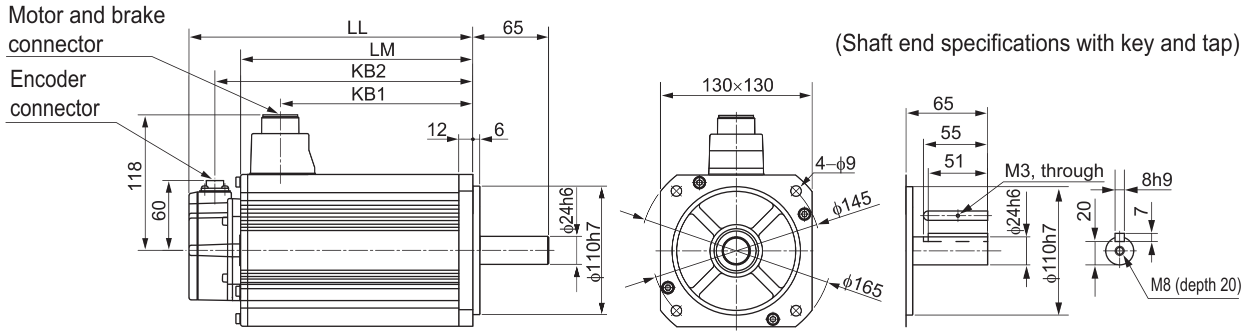
R88M-K4K030H (-S2)/-K5K030H (-S2) **INC**

R88M-K4K030T (-S2)/-K5K030T (-S2) **ABS**

4 kW/5 kW (with Brake)

R88M-K4K030H-B (S2)/-K5K030H-B (S2) **INC**

R88M-K4K030T-B (S2)/-K5K030T-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K4K030x	208	164	127	186
R88M-K5K030x	243	199	162	221
R88M-K4K030x-Bx	236	192	127	214
R88M-K5K030x-Bx	271	227	162	249

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

3,000-r/min Motors (400 V)

750 W/1 kW/1.5 kW/2 kW (without Brake)

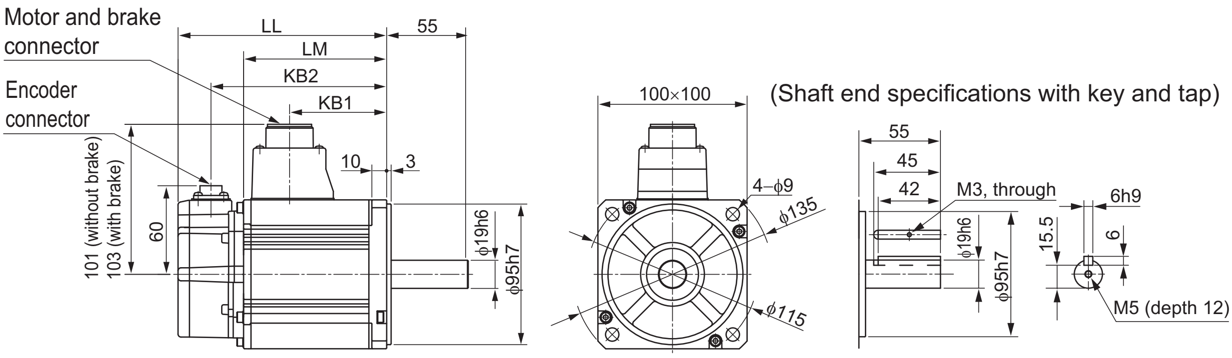
R88M-K75030F (-S2)/-K1K030F (-S2)/-K1K530F (-S2)/-K2K030F (-S2) INC

R88M-K75030C (-S2)/-K1K030C (-S2)/-K1K530C (-S2)/-K2K030C (-S2) ABS

750 W/1 kW/1.5 kW/2 kW (with Brake)

R88M-K75030F-B (S2)/-K1K030F-B (S2)/-K1K530F-B (S2)/-K2K030F-B (S2) INC

R88M-K75030C-B (S2)/-K1K030C-B (S2)/-K1K530C-B (S2)/-K2K030C-B (S2) ABS



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K75030x	131.5	87.5	56.5	109.5
R88M-K1K030x	141	97	66	119
R88M-K1K530x	159.5	115.5	84.5	137.5
R88M-K2K030x	178.5	134.5	103.5	156.5
R88M-K75030x-Bx	158.5	114.5	53.5	136.5
R88M-K1K030x-Bx	168	124	63	146
R88M-K1K530x-Bx	186.5	142.5	81.5	164.5
R88M-K2K030x-Bx	205.5	161.5	100.5	183.5

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

3 kW (without Brake)

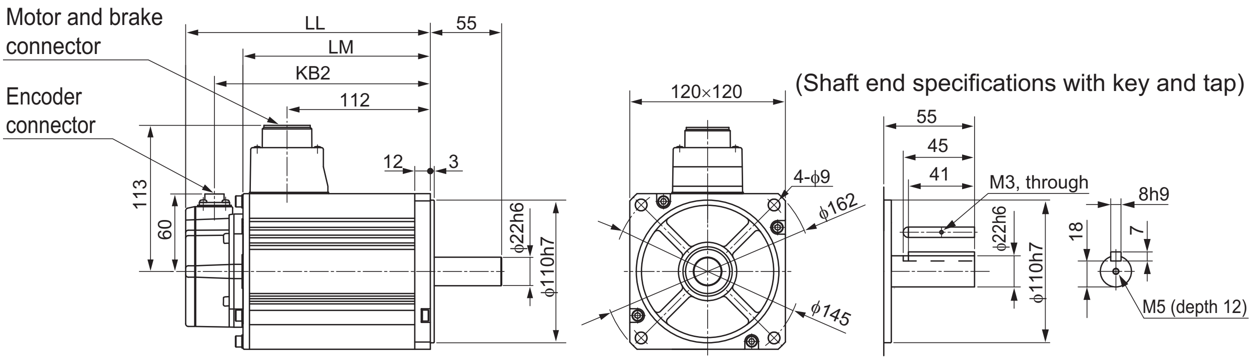
R88M-K3K030F (-S2) **INC**

R88M-K3K030C (-S2) **ABS**

3 kW (with Brake)

R88M-K3K030F-B (S2) **INC**

R88M-K3K030C-B (S2) **ABS**



Model	Dimensions (mm)		
	LL	LM	KB2
R88M-K3K030x	190	146	168
R88M-K3K030x-Bx	215	171	193

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

4 kW/5 kW (without Brake)

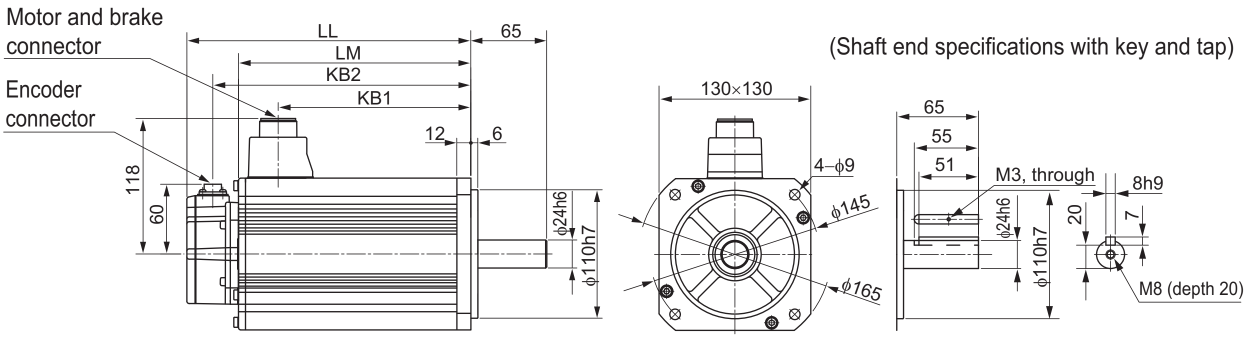
R88M-K4K030F (-S2)/-K5K030F (-S2) **INC**

R88M-K4K030C (-S2)/-K5K030C (-S2) **ABS**

4 kW/5 kW (with Brake)

R88M-K4K030F-B (S2)/-K5K030F-B (S2) **INC**

R88M-K4K030C-B (S2)/-K5K030C-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K4K030x	208	164	127	186
R88M-K5K030x	243	199	162	221
R88M-K4K030x-Bx	233	189	127	211
R88M-K5K030x-Bx	268	224	162	246

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

2,000-r/min Motors (200 V)

1 kW/1.5 kW/2 kW/3 kW (without Brake)

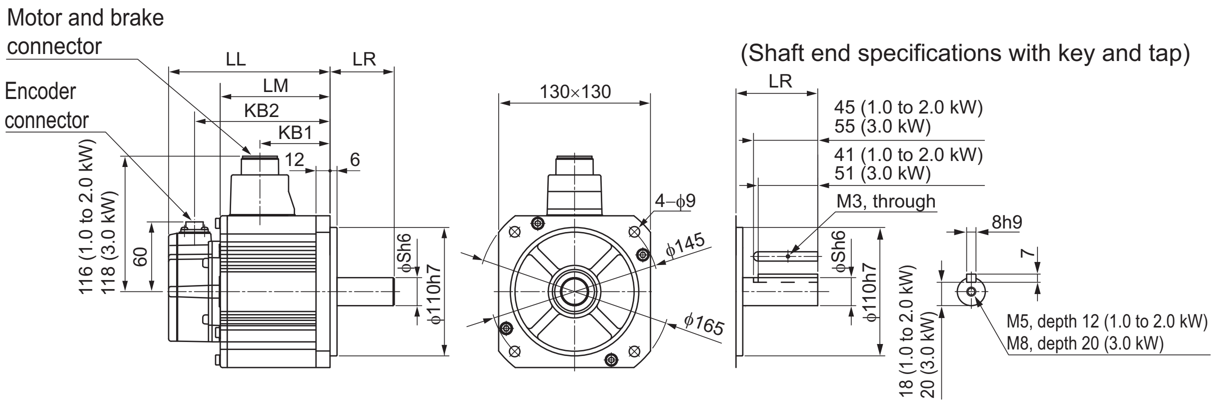
R88M-K1K020H (-S2)/-K1K520H (-S2)/-K2K020H (-S2)/-K3K020H (-S2) **INC**

R88M-K1K020T (-S2)/-K1K520T (-S2)/-K2K020T (-S2)/-K3K020T (-S2) **ABS**

1 kW/1.5 kW/2 kW/3 kW (with Brake)

R88M-K1K020H-B (S2)/-K1K520H-B (S2)/-K2K020H-B (S2)/-K3K020H-B (S2) **INC**

R88M-K1K020T-B (S2)-K1K520T-B (S2)/-K2K020T-B (S2)/-K3K020T-B (S2) **ABS**



Model	Dimensions (mm)					
	LL	LR	LM	S	KB1	KB2
R88M-K1K020x	138	55	94	22	60	116
R88M-K1K520x	155.5	55	111.5	22	77.5	133.5
R88M-K2K020x	173	55	129	22	95	151
R88M-K3K020x	208	65	164	24	127	186
R88M-K1K020x-Bx	166	55	122	22	60	144
R88M-K1K520x-Bx	183.5	55	139.5	22	77.5	161.5
R88M-K2K020x-Bx	201	55	157	22	95	179
R88M-K3K020x-Bx	236	65	192	24	127	214

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

4 kW/5 kW (without Brake)

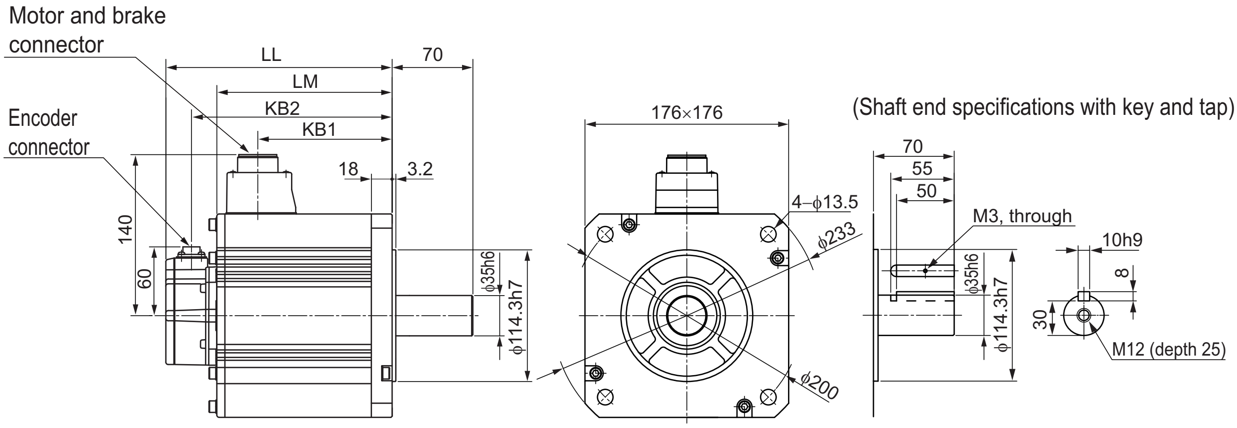
R88M-K4K020H (-S2)/-K5K020H (-S2) INC

R88M-K4K020T (-S2)/-K5K020T (-S2) ABS

4 kW/5 kW (with Brake)

R88M-K4K020H-B (S2)/-K5K020H-B (S2) INC

R88M-K4K020T-B (S2)/-K5K020T-B (S2) ABS



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K4K020x	177	133	96	155
R88M-K5K020x	196	152	115	174
R88M-K4K020x-Bx	206	162	96	184
R88M-K5K020x-Bx	225	181	115	203

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

2,000-r/min Motors (400 V)

400 W/600 W (without Brake)

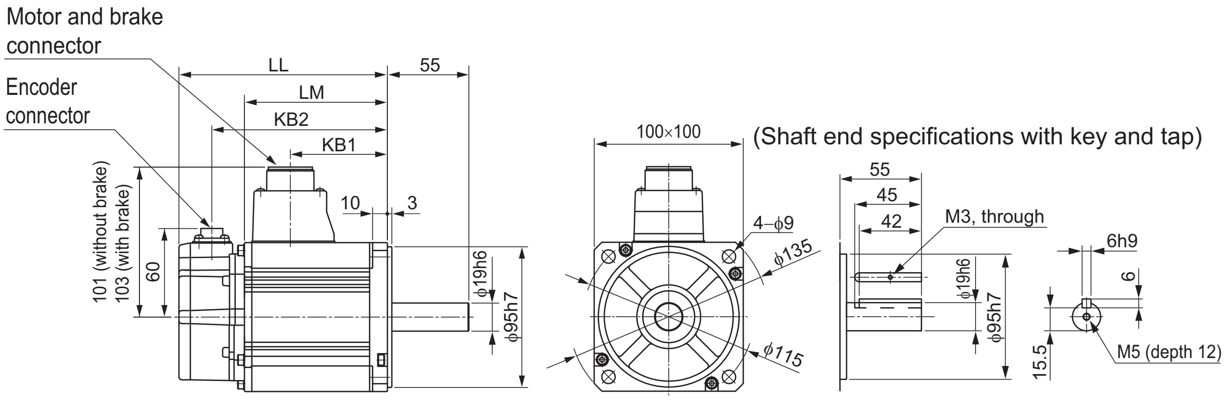
R88M-K40020F (-S2)/-K60020F (-S2) **INC**

R88M-K40020C (-S2)/-K60020C (-S2) **ABS**

400 W/600 W (with Brake)

R88M-K40020F-B (S2)/-K60020F-B (S2) **INC**

R88M-K40020C-B (S2)/-K60020C-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K40020x	131.5	87.5	56.5	109.5
R88M-K60020x	141	97	66	119
R88M-K40020x-Bx	158.5	114.5	53.5	136.5
R88M-K60020x-Bx	168	124	63	146

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

1 kW/1.5 kW/2 kW/3 kW (without Brake)

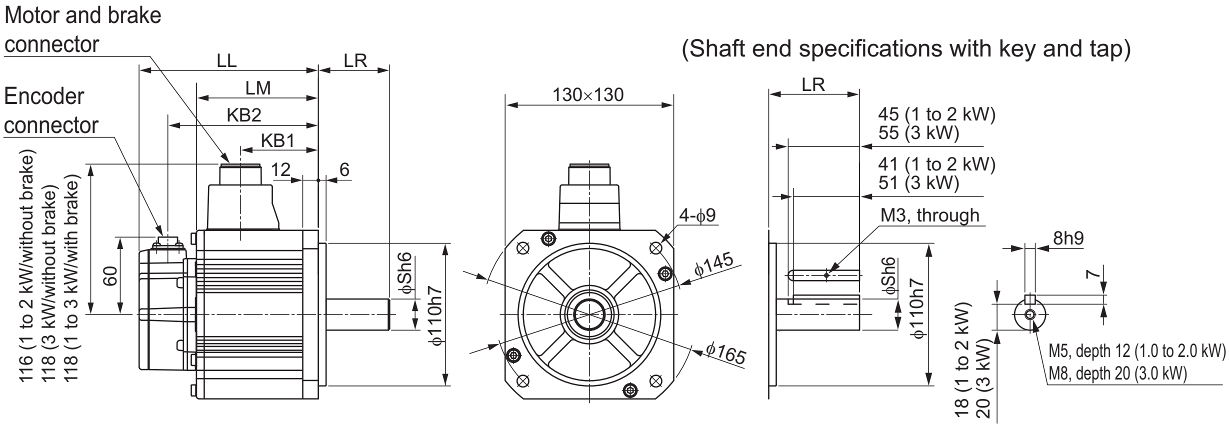
R88M-K1K020F (-S2)/-K1K520F (-S2)/-K2K020F (-S2)/-K3K020F (-S2) INC

R88M-K1K020C (-S2)/-K1K520C (-S2)/-K2K020C (-S2)/-K3K020C (-S2) ABS

1 kW/1.5 kW/2 kW/3 kW (with Brake)

R88M-K1K020F-B (S2)/-K1K520F-B (S2)/-K2K020F-B (S2)/-K3K020F-B (S2) INC

R88M-K1K020C-B (S2)/-K1K520C-B (S2)/-K2K020C-B (S2)/-K3K020C-B (S2) ABS



Model	Dimensions (mm)					
	LL	LR	LM	S	KB1	KB2
R88M-K1K020x	138	55	94	22	60	116
R88M-K1K520x	155.5	55	111.5	22	77.5	133.5
R88M-K2K020x	173	55	129	22	95	151
R88M-K3K020x	208	65	164	24	127	186
R88M-K1K020x-Bx	166	55	122	22	57	144
R88M-K1K520x-Bx	183.5	55	139.5	22	74.5	161.5
R88M-K2K020x-Bx	201	55	157	22	92	179
R88M-K3K020x-Bx	236	65	192	24	127	214

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

4 kW/5 kW (without Brake)

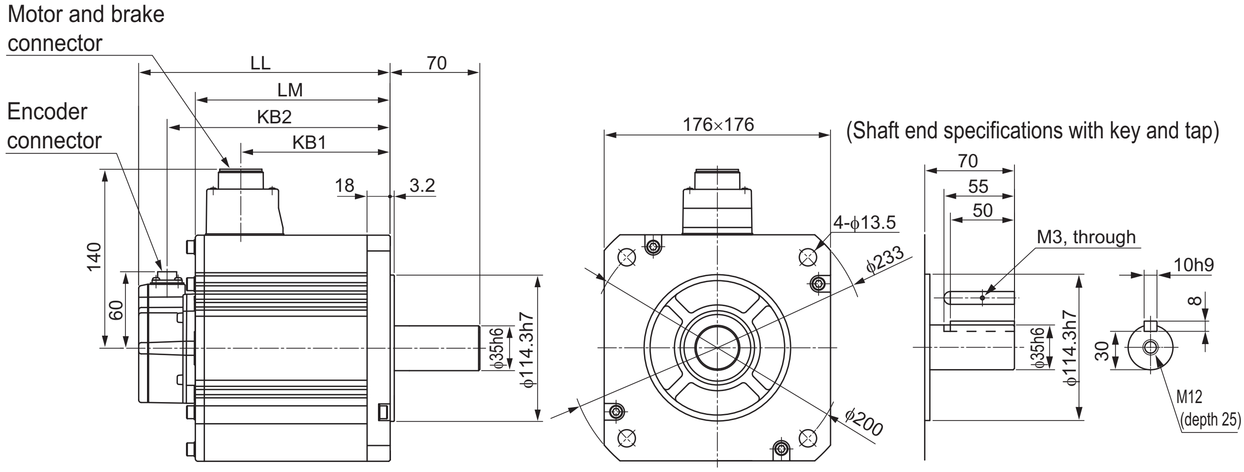
R88M-K4K020F (-S2)/-K5K020F (-S2) **INC**

R88M-K4K020C (-S2)/-K5K020C (-S2) **ABS**

4 kW/5 kW (with Brake)

R88M-K4K020F-B (S2)/-K5K020F-B (S2) **INC**

R88M-K4K020C-B (S2)/-K5K020C-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K4K020x	177	133	96	155
R88M-K5K020x	196	152	115	174
R88M-K4K020x-Bx	202	158	96	180
R88M-K5K020x-Bx	221	177	115	199

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

1,000-r/min Motors (200 V)

900 W (without Brake)

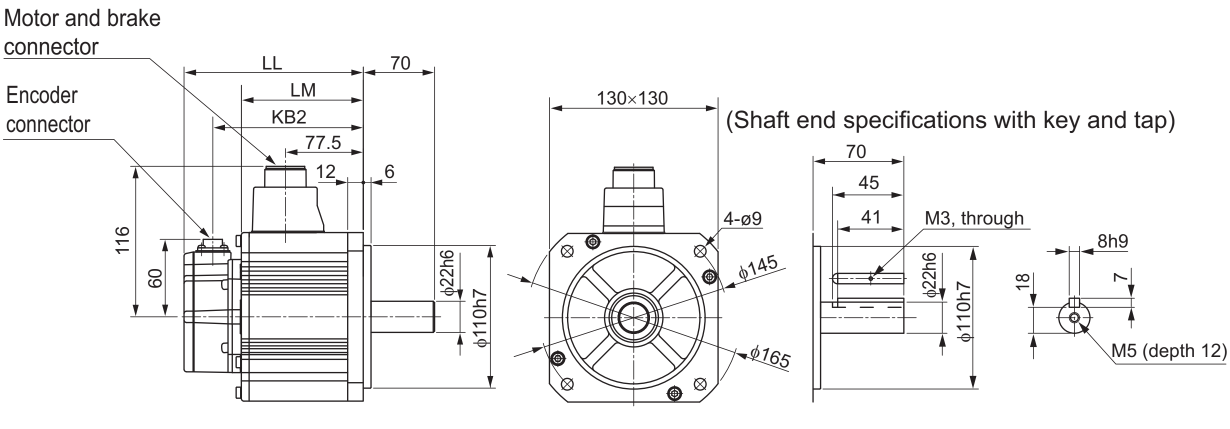
R88M-K90010H (-S2) **INC**

R88M-K90010T (-S2) **ABS**

900 W (with Brake)

R88M-K90010H-B (S2) **INC**

R88M-K90010T-B (S2) **ABS**



Model	Dimensions (mm)		
	LL	LM	KB2
R88M-K90010x	155.5	111.5	133.5
R88M-K90010x-Bx	183.5	139.5	161.5

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

2 kW/3 kW (without Brake)

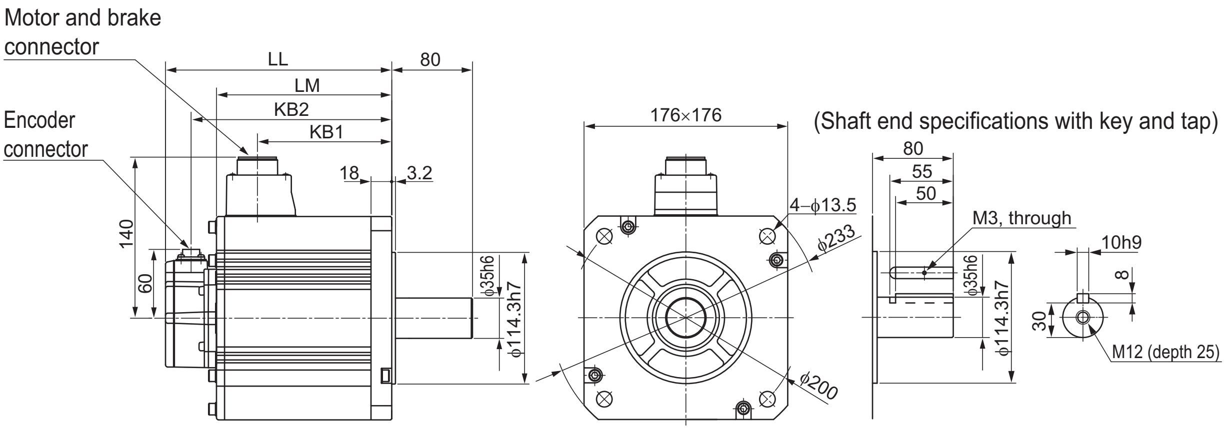
R88M-K2K010H (-S2)/-K3K010H (-S2) **INC**

R88M-K2K010T (-S2)/-K3K010T (-S2) **ABS**

2 kW/3 kW (with Brake)

R88M-K2K010H-B (S2)/-K3K010H-B (S2) **INC**

R88M/-K2K010T-B (S2)/-K3K010T-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K2K010x	163.5	119.5	82.5	141.5
R88M-K3K010x	209.5	165.5	128.5	187.5
R88M-K2K010x-Bx	192.5	148.5	82.5	170.5
R88M-K3K010x-Bx	238.5	194.5	128.5	216.5

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

1,000-r/min Motors (400 V)

900 W (without Brake)

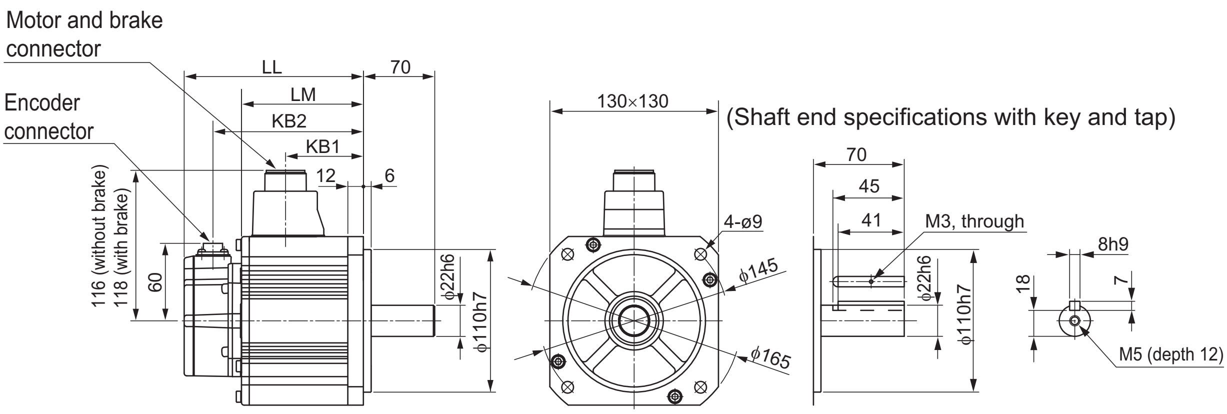
R88M-K90010F (-S2) **INC**

R88M-K90010C (-S2) **ABS**

900 W (with Brake)

R88M-K90010F-B (S2) **INC**

R88M-K90010C-B (S2) **ABS**



Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K90010x	155.5	111.5	77.5	133.5
R88M-K90010x-Bx	183.5	139.5	74.5	161.5

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

2 kW/3 kW (without Brake)

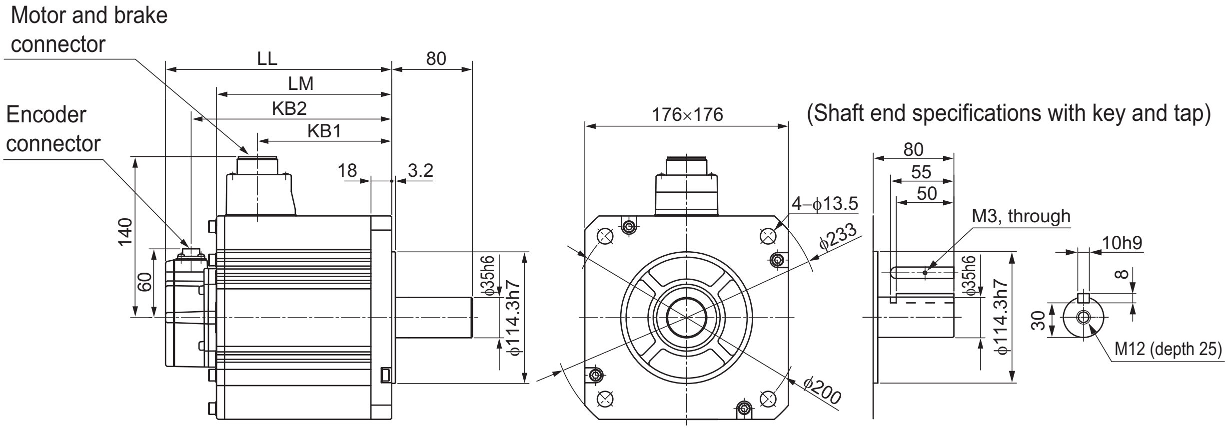
R88M-K2K010F (-S2)/-K3K010F (-S2) **INC**

R88M-K2K010C (-S2)/-K3K010C (-S2) **ABS**

2 kW/3 kW (with Brake)

R88M-K2K010F-B (S2)/-K3K010F-B (S2) **INC**

R88M-K2K010C-B (S2)/-K3K010C-B (S2) **ABS**



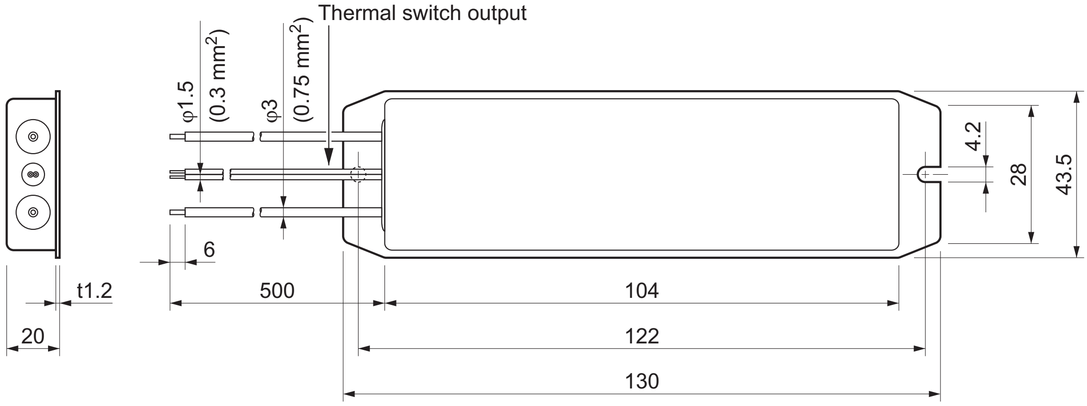
Model	Dimensions (mm)			
	LL	LM	KB1	KB2
R88M-K2K010x	163.5	119.5	82.5	141.5
R88M-K3K010x	209.5	165.5	128.5	187.5
R88M-K2K010x-Bx	192.5	148.5	82.5	170.5
R88M-K3K010x-Bx	238.5	194.5	128.5	216.5

Note. The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

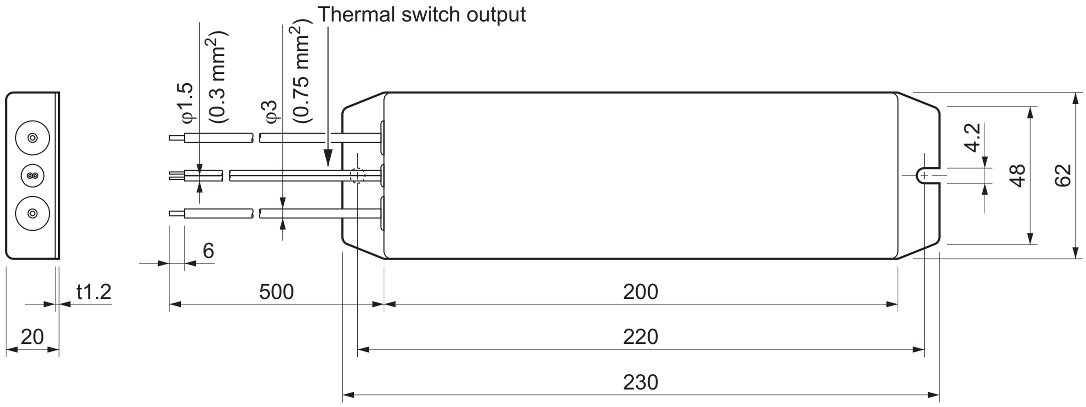
External Regeneration Resistor Dimensions

External Regeneration Resistor

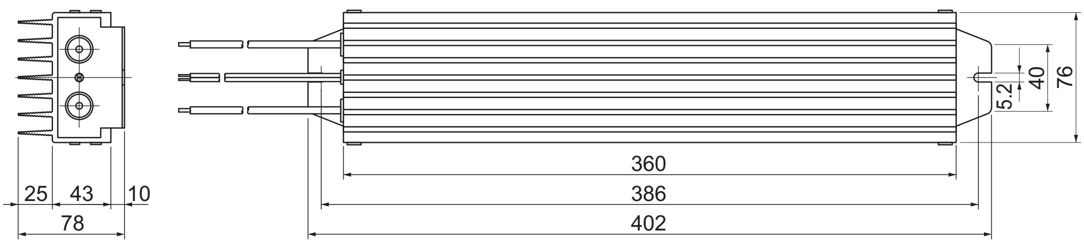
R88A-RR08050S/-RR080100S



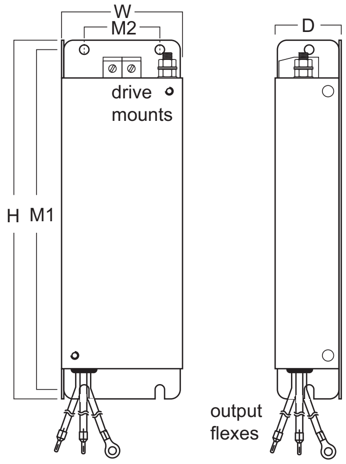
R88A-RR22047S1



R88A-RR50020S



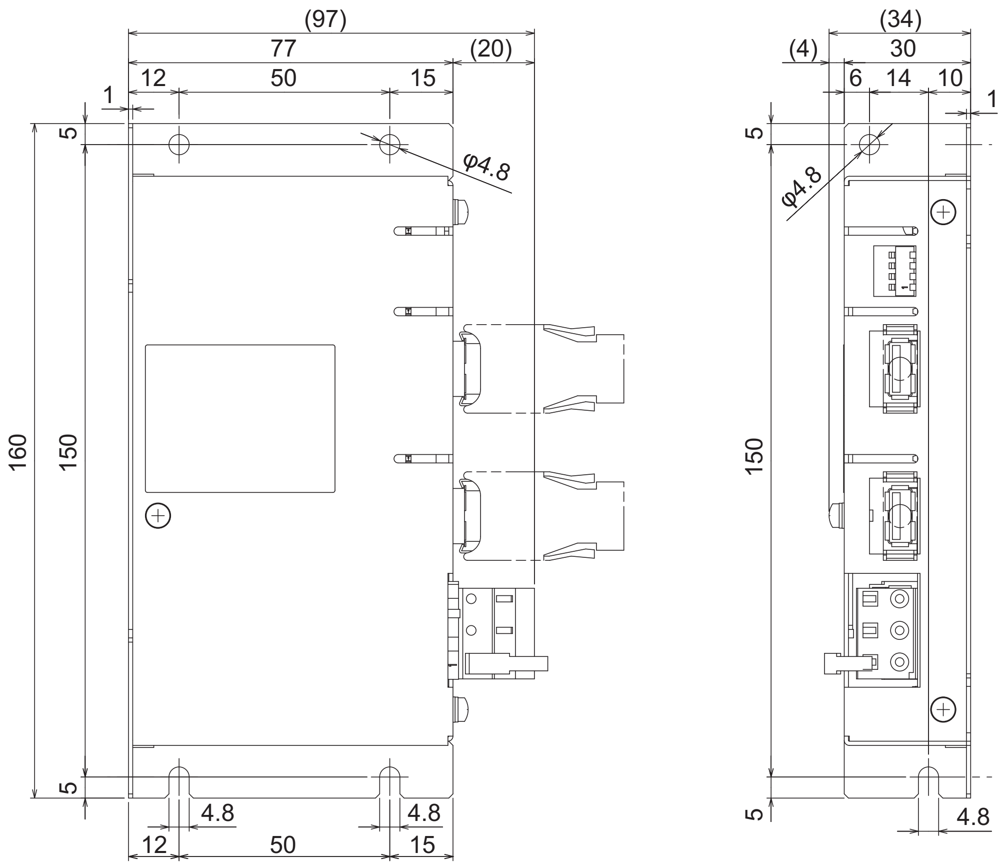
2-5 EMC Filter Dimensions

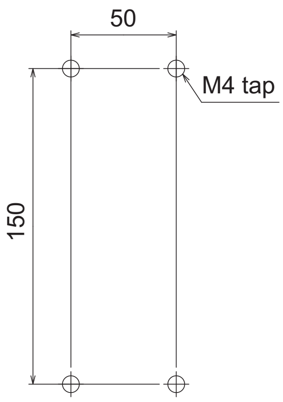


Filter model	External dimensions			Mount dimensions	
	H	W	D	M1	M2
R88A-FIK102-RE	190	42	44	180	20
R88A-FIK104-RE	190	57	30	180	30
R88A-FIK107-RE	190	64	35	180	40
R88A-FIK114-RE	190	86	35	180	60
R88A-FIK304-RE	190	86	40	180	60
R88A-FIK306-RE	245	94	40	235	60
R88A-FIK312-RE	290	130	45	280	100

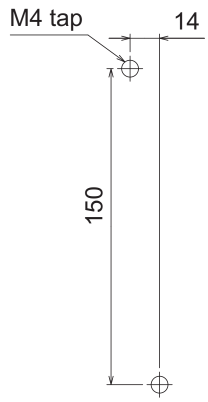
MECHATROLINK-II Repeater Units

FNY-REP2000





Bottom Mounting

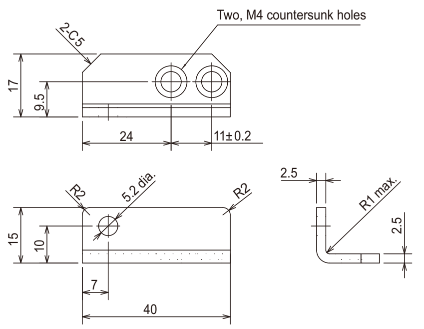


Back Mounting

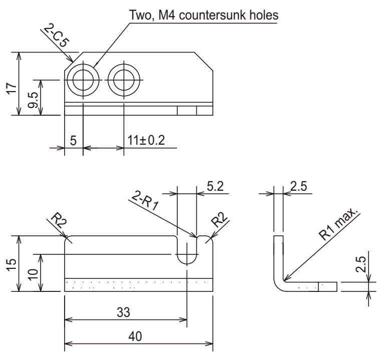
Dimensions of Mounting Brackets (L-Brackets for Rack Mounting)

R88A-TK01K

Top Dimensions

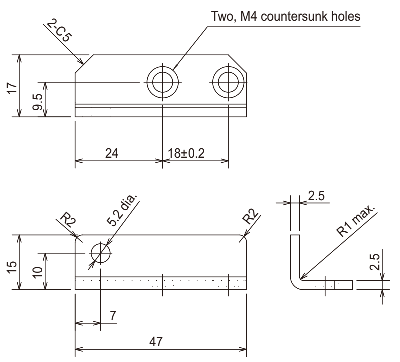


Bottom Dimensions

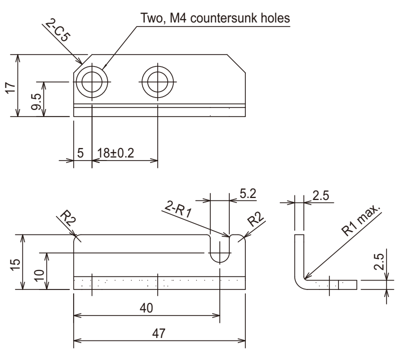


R88A-TK02K

Top Dimensions

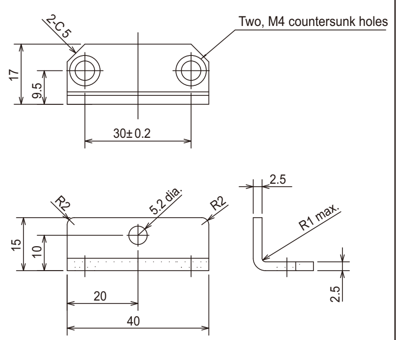


Bottom Dimensions

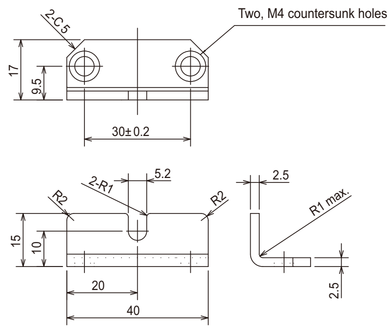


R88A-TK03K

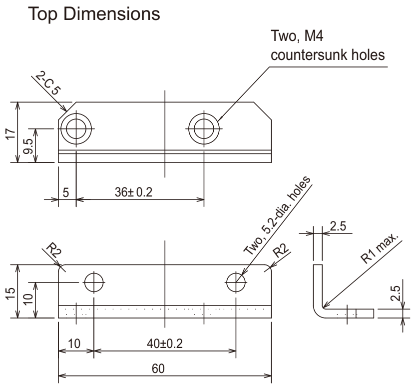
Top Dimensions

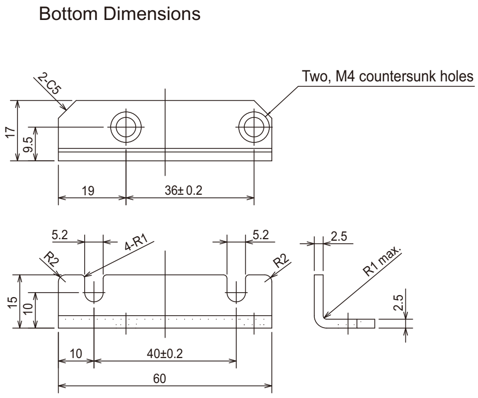


Bottom Dimensions



R88A-TK04K


Top Dimensions
Two, M4
countersunk holes
2-C5
17
9.5
5
36± 0.2
Two, 5.2-dia. holes
R2
R2
2.5
R1 max.
15
10
2.5
10
40±0.2
60


Bottom Dimensions
Two, M4 countersunk holes
2-C5
17
9.5
19
36± 0.2
5.2
4-R1
5.2
2.5
R2
R2
R1 max.
15
10
2.5
10
40±0.2
60

3

Specifications

This chapter explains the general specifications, characteristics, connector specifications and I/O circuits of the Servo Drives, as well as the general specifications, characteristics, encoder specifications of the Servomotors.

3-1 Servo Drive Specifications

Select the Servo Drive matching the Servomotor to be used. Refer to "Servo Drive and Servomotor Combination List"(P.2-10).

General Specifications

Item			Specifications
Ambient operating temperature and operating humidity			0 to +55C, 90% RH max. (with no condensation)
Storage ambient temperature and humidity			-20 to +65C, 90% RH max. (with no condensation)
Operating and storage atmosphere			No corrosive gases
Vibration resistance			10 to 60 Hz and at an acceleration of 5.88 m/s^2 or less (Not to be run continuously at the resonance point)
Impact resistance			Acceleration of 19.6 m/s^2 max. 2 times each in X, Y, and Z directions
Insulation resistance			Between power supply terminal/power terminal and FG terminal: 0.5 MΩ min. (at 500 VDC Megger)
Dielectric strength			Between power supply/power line terminals and FG terminal: 1,500 VAC for 1 min at 50/60 Hz
Protective structure			Built into panel
International standard	EC directive	EMC directive	EN 55011, EN 61000-6-2, IEC 61800-3
		Low voltage command	EN 61800-5-1
		Machinery Directive	EN954-1 (Category 3), EN ISO 13849-1: 2008 (Category 3) (PLc,d), ISO 13849-1: 2006 (Category 3) (PLc,d), EN61508 (SIL2), EN62061 (SIL2), EN61800-5-2 (STO), IEC61326-3-1 (SIL2)
	UL standards		UL 508C
	CSA standards		CSA22.2 No. 14
	Korean Radio Regulations (KC)		Compliant

Note 1.The above items reflect individual evaluation testing. The results may differ under compound conditions.

Note 2.Disconnect all connections to the Servo Drive before attempting a megameter test (insulation resistance measurement) on a Servo Drive. Failure to follow this guideline may result in damaging the Servo Drive. Never perform a dielectric strength test on the Servo Drive. Failure to follow this guideline may result in damaging the internal elements.

Note 3.Depending on the operating conditions, some Servo Drive parts will require maintenance. For details, refer to "11-5 Periodic Maintenance" (P.11-36).

Characteristics

100-VAC Input Type

Item			R88D-KNA5L-ML2	R88D-KN01L-ML2	R88D-KN02L-ML2	R88D-KN04L-ML2
Continuous output current (rms)			1.2 A	1.7 A	2.5 A	4.6 A
Input power supply	Main circuit	Power supply capacity	0.4 KVA	0.4 KVA	0.5 KVA	0.9 KVA
		Power supply voltage	Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz			
		Rated current	1.7 A	2.6 A	4.3 A	7.6 A
		Heat value *1	11W	16.6W	21W	25W
	Control circuit	Power supply voltage	Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz			
		Heat value *1	4W	4W	4W	4W
Control method			All-digital servo			
Inverter method			IGBT-driven PWM method			
PWM frequency			12.0 kHz		6.0 kHz	
Weight			Approx. 0.8 kg	Approx. 0.8 kg	Approx. 1.0 kg	Approx. 1.6 kg
Maximum applicable motor capacity			50 W	100 W	200 W	400 W
Applicable motor	3,000 r/min type	INC	K05030H	K10030L	K20030L	K40030L
		ABS	K05030T	K10030S	K20030S	K40030S
	2,000-r/min type	ABS	–	–	–	–
	1,000-r/min type	ABS	–	–	–	–

*1. The heat value is given for rated operation.

3

Specifications

200-VAC Input Type

Item			R88D-KN01H-ML2	R88D-KN02H-ML2	R88D-KN04H-ML2	R88D-KN08H-ML2	R88D-KN10H-ML2	R88D-KN15H-ML2
Continuous output current (rms)			1.2 A	1.6 A	2.6 A	4.1 A	5.9 A	9.4 A
Input power supply	Main circuit	Power supply capacity	0.5 KVA	0.5 KVA	0.9 KVA	1.3 KVA	1.8 KVA	2.3KVA
		Power supply voltage	Single-phase or 3-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz					
		Rated current	1.6/0.9 *1 A	2.4/1.3 *1 A	4.1/2.4 *1 A	6.6/3.6 *1 A	9.1/5.2 *1 A	14.2/8.1 *1 A
		Heat value *2	14.3/13.7 *1 W	23/19 *1 W	33/24 *1 W	30/35.5 *1 W	57/49 *1 W	104/93 *1 W
	Control circuit	Power supply voltage	Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz					
		Heat value *2	4W	4W	4W	4W	7W	7W
PWM frequency			12.0 kHz		6.0 kHz			
Weight			Approx. 0.8 kg	Approx. 0.8 kg	Approx. 1.0 kg	Approx. 1.6 kg	Approx. 1.8 kg	Approx. 1.8 kg
Maximum applicable motor capacity			100 W	200 W	400 W	750 W	1 kW	1.5 kW
Applicable motor	3,000-r/min type	INC	K05030H K10030H	K20030H	K40030H	K75030H	–	K1K030H K1K530H
		ABS	K05030T K10030T	K20030T	K40030T	K75030T	–	K1K030T K1K530T
	2,000-r/min type	INC	–	–	–	–	K1K020H	K1K520H
		ABS	–	–	–	–	K1K020T	K1K520T
	1,000-r/min type	INC	–	–	–	–	–	K90010H
		ABS	–	–	–	–	–	K90010T
Control method			All-digital servo					
Inverter method			IGBT-driven PWM method					

*1. The left value is for single-phase input power and the right value is for 3-phase input power.

*2. The heat value is given for rated operation.

Item			R88D-KN20H-ML2	R88D-KN30H-ML2	R88D-KN50H-ML2
Continuous output current (rms)			13.4 A	18.7 A	33.0 A
Input power supply	Main circuit	Power supply capacity	3.3 KVA	4.5 KVA	7.5 KVA
		Power supply voltage	3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz		
		Rated current	11.8 A	15.1 A	21.6 A
		Heat value *1	139W	108W	328W
	Control circuit	Power supply voltage	Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz		
		Heat value *1	10W	13W	13W
PWM frequency			6.0 kHz		
Weight			Approx. 2.7 kg	Approx. 4.8 kg	Approx. 4.8 kg
Maximum applicable motor capacity			2 kW	3 kW	5 kW
Applicable motor	3,000-r/min type	INC	K2K030H	K3K030H	K4K030H K5K030H
		ABS	K2K030T	K3K030T	K4K030T K5K030T
	2,000-r/min type	INC	K2K020H	K3K020H	K4K020H K5K020H
		ABS	K2K020T	K3K020T	K4K020T K5K020T
	1,000-r/min type	INC	–	K2K010H	K3K010H
		ABS	–	K2K010T	K3K010T
Control method			All-digital servo		
Inverter method			IGBT-driven PWM method		

*1. The heat value is given for rated operation.

3

Specifications

400-VAC Input Type

Item			R88D-KN06F-ML2	R88D-KN10F-ML2	R88D-KN15F-ML2	R88D-KN20F-ML2	R88D-KN30F-ML2	R88D-KN50F-ML2
Continuous output current (rms)			1.5A	2.9 A	4.7 A	6.7 A	9.4 A	16.5 A
Input power supply	Main circuit	Power supply voltage	3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz					
		Rated current	2.1A	2.8 A	3.9A	5.9 A	7.6 A	12.1 A
		Heat value *1	32.2W	48W	49W	65W	108W	200W
	Control circuit	Power supply voltage	24 VDC (20.4 to 27.6 V)					
		Heat value *1	7W	7W	7W	10W	13W	13W
PWM frequency			6.0 kHz					
Weight			Approx. 1.9 kg	Approx. 1.9 kg	Approx. 1.9 kg	Approx. 2.7 kg	Approx. 4.7 kg	Approx. 4.7 kg
Maximum applicable motor capacity			600 W	1 kW	1.5 kW	2 kW	3 kW	5 kW
Applicable motor	3,000-r/min type	INC	–	K75030F	K1K030F K1K530F	K2K030F	K3K030F	K4K030F K5K030F
		ABS	–	K75030C	K1K030C K1K530C	K2K030C	K3K030C	K4K030C K5K030C
	2,000-r/min type	INC	K40020F K60020F	K1K020F	K1K520F	K2K020F	K3K020F	K4K020F K5K020F
		ABS	K40020C K60020C	K1K020C	K1K520C	K2K020C	K3K020C	K4K020C K5K020C
	1,000-r/min type	INC	–	–	K90010F	–	K2K010F	K3K010F
		ABS	–	–	K90010C	–	K2K010C	K3K010C
Control method			All-digital servo					
Inverter method			IGBT-driven PWM method					

*1. The heat value is given for rated operation.

Protective Functions

Error detection	Description
Control power supply undervoltage	The DC voltage of the main circuit fell below the specified value.
Overvoltage	The DC voltage in the main circuit is abnormally high.
Main power supply undervoltage	The DC voltage of the main circuit is low.
Overcurrent	Overcurrent flowed to the IGBT. Motor power line ground fault or short circuit.
Drive overheat	The temperature of the drive radiator exceeded the specified value.
Overload	Operation was performed with torque significantly exceeding the rating for several seconds to several tens of seconds.
Regeneration overload	The regenerative energy exceeds the processing capacity of the Regeneration Resistor.
Encoder communications error	The encoder wiring is disconnected.
Encoder communications data error	Communications cannot be performed between the encoder and the drive.
Error counter overflow	The number of accumulated pulses in the error counter exceeded the set value for the Error Counter Overflow Level (Pn014).
Excessive hybrid error	During full closing control, difference between position of load from external encoder and position of motor due to encoder was larger than the number of pulses set by Internal/External Feedback Pulse Error Counter Overflow Level (Pn328).
Overspeed	The motor rotation speed exceeded the maximum number of rotations.
Electronic gear setting error	The set value for the Electronic Gear Ratio (Pn009 to Pn010) is not appropriate.
Error counter overflow	Error counter value based on the encoder pulse reference exceeded 2^{27} (134217728).
Safety input error	Either the Safety input 1 or 2 is off, or both of them are off.
Interface I/O setting error	An error was detected in the interface I/O signal.
Overrun limit error	The motor exceeded the allowable operating range set in the Overrun Limit Setting (Pn514) with respect to the position command input.
Parameter error	Data in the Parameter Save area was corrupted when the power supply was turned ON and data was read from the EEPROM.
Parameters destruction	The checksum for the data read from the EEPROM when the power supply was turned ON does not match.
Drive prohibition input error	The forward drive prohibition and reverse drive prohibition inputs are both turned OFF.
Absolute encoder system down error ABS	The voltage supplied to the absolute encoder is lower than the specified value.
Absolute encoder counter overflow error ABS	The multi-rotation counter of the absolute encoder exceeds the specified value.
Absolute encoder overspeed error ABS	The motor rotation speed exceeds the specified value when only the battery power supply of the absolute encoder is used.
Absolute encoder initialization error ABS	An error was detected during the absolute encoder initialization.
Absolute encoder 1-rotation counter error ABS	A 1-turn counter error was detected.
Absolute encoder multi-rotation counter error ABS	A multi-rotation counter error or phase-AB signal error was detected.

Error detection	Description
Absolute encoder status error ABS	The rotation of the absolute encoder is higher than the specified value.
Encoder phase-Z error	A phase Z pulse was not detected regularly.
Encoder CS signal error	A logic error was detected in the CS signal.
External encoder communications error	An error was detected in external encoder connection and communications data.
External encoder status error	An external encoder error code was detected.
Phases-A, B and Z connection error	An error occurred in connection of phases A, B, and Z of external encoder.
Node address setting error	At power-on, the rotary switches for node address setting were set in any value outside the specified range.
Communications error	The errors not to receive the expected data from the MECHATROLINK-II communications cycles occurred continuously, and exceeded the number of times set in the Communications Control (Pn800).
Transmission cycle error	During the MECHATROLINK-II communications, synchronization frames (SYNC) were not received in conformity with the transmission cycles.
Watchdog data error	An error occurred in the synchronization data that was exchanged between the master and slave nodes during each MECHATROLINK-II communications cycle.
Emergency stop input error	The emergency stop input circuit opened.
Transmission cycle setting error	The transmission cycle setting was incorrect when the MECHATROLINK-II CONNECT command was received.
SYNC command error	A SYNC-related command was issued while MECHATROLINK-II was in asynchronous communications mode.
Parameter setting error	The electronic gear ratio is outside the allowable parameter setting range; either it is smaller than 1/100 x or larger than 100 x.
Motor non-conformity	The combination of the Servomotor and Servo Drive is not appropriate. The encoder was not connected when the power supply was turned ON.

Main Circuit and Motor Connections

When wiring the main circuit, use proper wire sizes, grounding systems, and noise resistance.

R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN04L-ML2/-KN01H-ML2/ -KN02H-ML2/-KN04H-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2

Main Circuit Connector Specifications (CNA)

Symbol	Name	Function
L1	Main circuit power supply input	R88D-KNxL-ML2 (50 to 400 W) : Single-phase 100 to 115 VAC (85 to 132 V) 50/60 Hz R88D-KNxH-ML2 (100 W to 1.5 kW) : Single-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz (100 W to 1.5 kW) : 3-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz Note. Single-phase should connect to L1 and L3.
L2		
L3		
L1C	Control circuit power supply input	R88D-KNxL-ML2 : Single-phase 100 to 115 VAC (85 to 132 V) 50/60 Hz R88D-KNxH-ML2 : Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz
L2C		

Motor Connector Specifications (CNB)

Symbol	Name	Function	
B1	External Regeneration Resistor connection terminals	R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN01H-ML2 /-KN02H-ML2/-KN04H-ML2: Normally, do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, connect an External Regeneration Resistor between B1 and B2. R88D-KN04L-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2: Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.	
B2			
B3			
U	Motor connection terminals	Phase U	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		Phase V	
W		Phase W	

R88D-KN20H-ML2

Main Circuit Connector Specifications (CNA)

Symbol	Name	Function
L1	Main circuit power supply input	R88D-KNxH-ML2 (2 kW) : 3-phase: 200 to 230 VAC (170 to 253 V) 50/60 Hz Note. Single-phase should connect to L1 and L3.
L2		
L3		
L1C	Control circuit power supply input	R88D-KNx-ML2 : Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz
L2C		

Motor Connector Specifications (CNB)

Symbol	Name	Function	
U	Motor connection terminals	Phase U	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		Phase V	
W		Phase W	

External Regeneration Resistor Connector Specifications (CNC)

Symbol	Name	Function
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are short-circuited. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.
B2		
B3		
NC		Do not connect.

Precautions for Correct Use

- Tighten the ground screws with the torque of 0.7 to 0.8 N•m (M4) or 1.4 to 1.6 N•m (M5).

R88D-KN30H-ML2/R88D-KN50H-ML2

Main Circuit Terminal Block Specifications

Symbol	Name	Function	
L1	Main circuit power supply input	R88D-KNxH-ML2 (3 to 5 kW): 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz	
L2			
L3			
L1C	Control circuit power supply input	R88D-KNxH-ML2 : Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz	
L2C			
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are short-circuited. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.	
B2			
B3			
NC		Do not connect.	
U	Motor connection terminals	Phase U	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		Phase V	
W		Phase W	

Precautions for Correct Use

- Tighten the terminal block screws to the torque of 0.75 N•m (M4) or 1.5 N•m (M5).
- If the torque for terminal block screws exceeds 1.2 N•m (M4) or 2.0 N•m (M5), the terminal block may be damaged.
- Tighten the fixing screw of the terminal block cover to the torque of 0.2 N•m (M3).
- Tighten the ground screws to the torque of 0.7 to 0.8 N•m (M4) or 1.4 to 1.6 N•m (M5).

R88D-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2

Main Circuit Connector Specifications (CNA)

Symbol	Name	Function
L1	Main circuit power supply input	R88D-KNxF-ML2 (600 W to 2 kW) : 3-phase: 380 to 480 VAC (323 to 528 V) 50/60 Hz
L2		
L3		

Motor Connector Specifications (CNB)

Symbol	Name	Function	
U	Motor connection terminals	Phase U	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		Phase V	
W		Phase W	

Control Circuit Connector Specifications (CNC)

Symbol	Name	Function
24 V	Control circuit power supply input	24 VDC ± 15%
0 V		

External Regeneration Resistor Connector Specifications (CND)

Symbol	Name	Function
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are short-circuited. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.
B2		
B3		
NC		Do not connect.

R88D-KN30F-ML2/R88D-KN50F-ML2

Main Circuit Terminal Block Specifications (TB1)

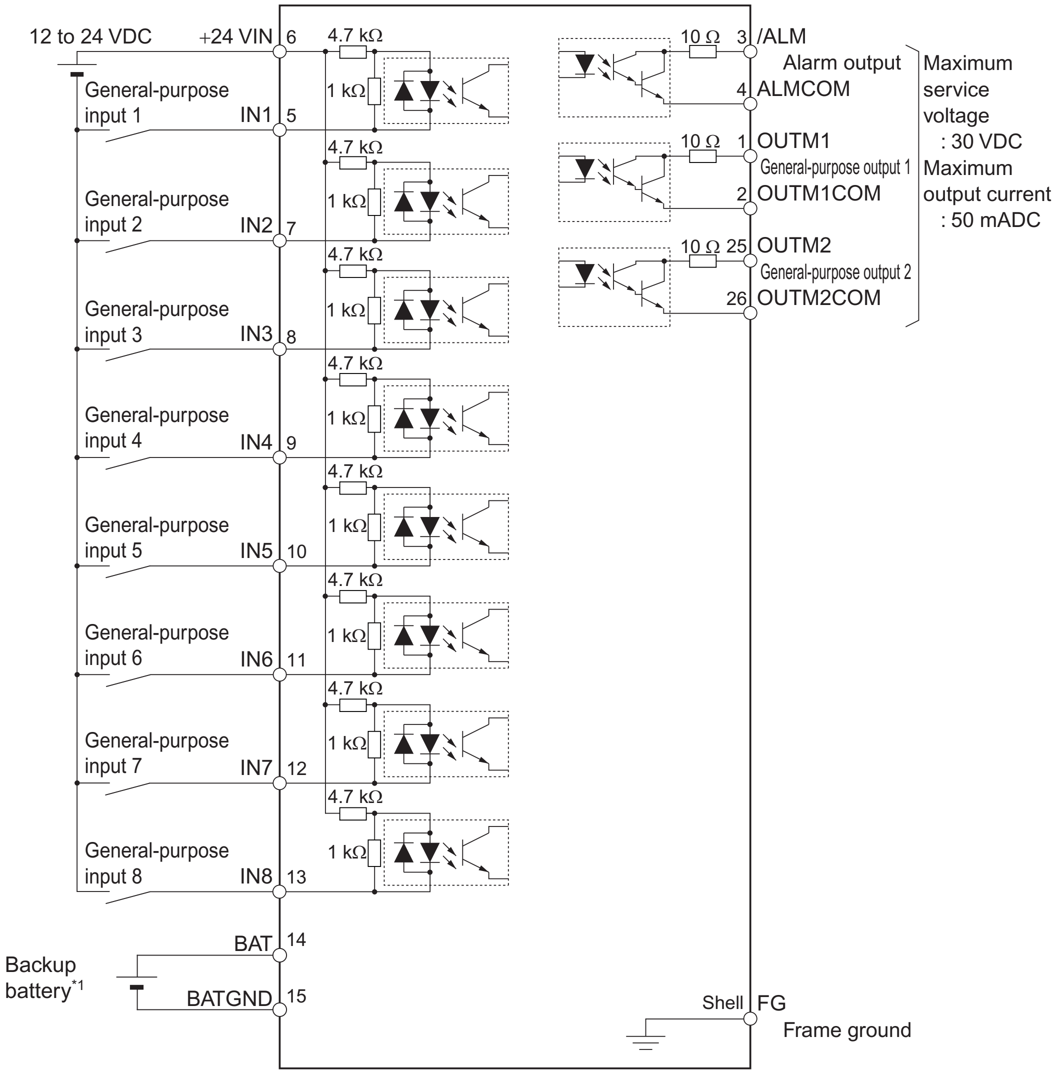
Symbol	Name	Function
24 V	Control circuit power supply input	24 VDC ± 15%
0 V		

Main Circuit Terminal Block Specifications (TB2)

Symbol	Name	Function	
L1	Main circuit power supply input	R88D-KNxH-ML2 (3 to 5 kW): 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz	
L2			
L3			
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are short-circuited. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.	
B2			
B3			
NC		Do not connect.	
U	Motor connection terminals	Phase U	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		Phase V	
W		Phase W	

Control I/O Connector Specifications (CN1)

Control I/O Signal Connections and External Signal Processing



*1. Inputs type for pins 5, and 7 to 13 can be determined by parameter setting.
*2. Outputs type for pins 1, 2, 25 and 26 can be determined by parameter setting.
*3. A cable equipped with a battery is not required, when a backup battery is connected.
*4. It is not necessary to wire input pins that are not being used.

Control I/O Signal List

CN1 Control Inputs

Pin number	Symbol	Signal Name	Signal Default	CONTROL mode
6	+24 VIN	Power supply input 12 to 24 VDC.		The input terminal + of the external power supply (12 to 24 VDC) for sequence inputs
5	IN1	General-purpose input 1	Emergency Stop Input	These are the general-purpose inputs. The input functions are selective by parameters. The External Latch Signals 1 to 3 can be allocated only to IN5 to 7 (or pins 10 to 12) respectively. Refer to "Sequence I/O Signal"(P.6-1) for the allocation.
7	IN2	General-purpose input 2	Forward Drive prohibition Input	
8	IN3	General-purpose input 3	Reverse Drive prohibition Input	
9	IN4	General-purpose input 4	Origin Proximity Input	
10	IN5	General-purpose input 5	External Latch Signal 3	
11	IN6	General-purpose input 6	External Latch Signal 2	
12	IN7	General-purpose input 7	External Latch Signal 1	
13	IN8	General-purpose input 8	Monitor Input 0	
14	BAT	Backup battery input ABS		Backup battery connection terminals when the absolute encoder power is interrupted. (Connection to this terminal is not necessary if you use the absolute encoder battery cable for backup.)
15	BATGND			

CN1 Control Outputs

Pin number	Symbol	Signal Name	Signal Default	CONTROL mode
3	/ALM	Alarm Output		The output is OFF when an alarm is generated for the Servo Drive.
4	ALMCOM			
1	OUTM1	General-purpose Output 1	Brake interlock Output	These are the general-purpose outputs. The output functions are selective by parameters. Refer to "Sequence I/O Signal"(P.6-1) for the allocations.
2	OUTM1COM			
25	OUTM2	General-purpose Output 2	Servo Ready Output	
26	OUTM2COM			

CN1 Pin Arrangement

2	OUTM1COM	General-purpose Output 1 Common
4	ALMCOM	Alarm Output Common
6	+24 VIN	12 to 24-VDC Power Supply Input
8	IN3 (NOT)	General-purpose Input 3 (Reverse Drive Prohibition Input)
10	IN5 (EXT3)	General-purpose Input 5 (External Latch Input 3)
12	IN7 (EXT1)	General-purpose Input 7 (External Latch Input 1)
1	OUTM1 (BKIR)	General-purpose Output 1 (Brake Interlock Output)
3	/ALM	Alarm Output
5	IN1 (STOP)	General-purpose Input 1 (Emergency Stop Input)
7	IN2 (POT)	General-purpose Input 2 (Forward Drive Prohibition Input)
9	IN4 (DEC)	General-purpose Input 4 (Origin Proximity Input)
11	IN6 (EXT2)	General-purpose Input 6 (External Latch Input 2)
13	IN8 (MON0)	General-purpose Input 8 (Monitor Input 0)
15	BATGND	Absolute Encoder Backup Battery Input
17		*
19		*
21		*
23		*
25	OUTM2 (READY)	General-purpose Output 2 (Servo Ready Output)
14	BAT	Absolute Encoder Backup Battery Input
16		*
18		*
20		*
22		*
24		*
26	OUTM2COM	General-purpose Output 2 Common

Note Do not connect anything to unused pins (those marked with *).

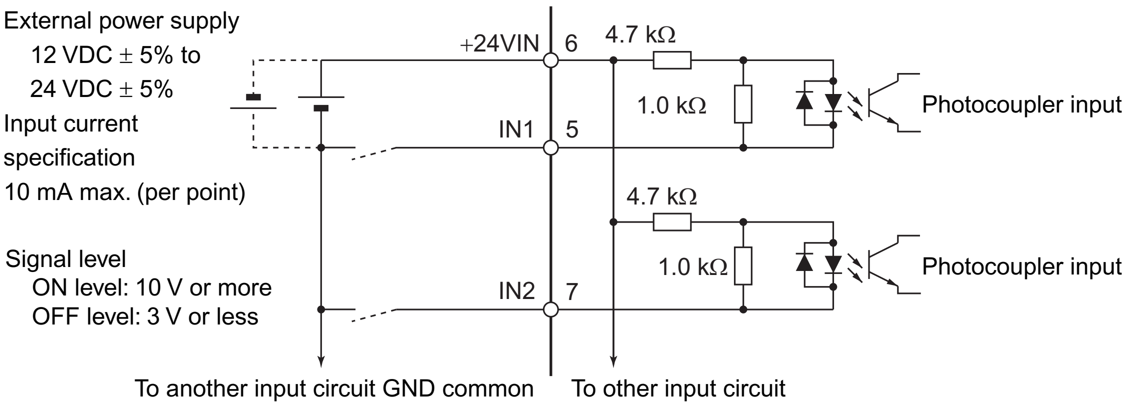
The input functions for general-purpose inputs 1 to 8 (or IN1 to IN8) and the output functions for general-purpose outputs (OUTM1 and OUTM2) are selective and determined by the user parameters Pn400 to Pn407 (Input Signal Selection 1 to 8) and Pn410 and Pn411 (Output Signal Selection 1 and 2) respectively. The functions that are allocated by defaultare given in parentheses. Refer to "Sequence I/O Signal"(P.6-1) for the allocation.

To use an absolute encoder, connect a battery to either Pin 14 which is the backup battery input, or 15 which is the battery holder for absolute encoder cable. (Never connect to both.)

Connectors for CN1 (Pin 26)

Name	Model	Manufacturer	OMRON model number
Plug	10126-3000PE	Sumitomo 3M	R88A-CNW01C
Cable Case	10326-52A0-008		

Control Input Circuits



Control Input Details

This is the detailed information about the CN1 Connector input pins.

General-purpose Inputs (IN1 to IN8)

Pin 5	: General-purpose Input 1 (IN1)	[Emergency Input (STOP)]
Pin 7	: General-purpose Input 2 (IN2)	[Forward Drive Prohibition Input (POT)]
Pin 8	: General-purpose Input 3 (IN3)	[Reverse Drive Prohibition Input (NOT)]
Pin 9	: General-purpose Input 4 (IN4)	[Origin Proximity Input (DEC)]
Pin 10	: General-purpose Input 5 (IN5)	[External Latch Input 3 (EXT3)]
Pin 11	: General-purpose Input 6 (IN6)	[External Latch Input 2 (EXT2)]
Pin 12	: General-purpose Input 7 (IN7)	[External Latch Input 1 (EXT1)]
Pin 13	: General-purpose Input 8 (IN8)	[Monitor Input 0 (MON0)]

Note:The functions that are allocated by default are given in brackets.
Refer to "Sequence I/O Signal"(P.6-1) for the allocation procedures.

Emergency Stop Input (STOP)

- STOP is used when an external sequence such as the host forcibly turns OFF the servo.
- If the Immediate Stop Input (STOP) turns ON during the Servomotor rotation, the dynamic brake makes a deceleration stop. After the motor stops, it remains in servo-free state.
- If the Immediate Stop Input (STOP) turns ON when the motor is energized, a Forced alarm input error (Alarm No. 87.0) will occur.
- This input is allocated to the pin 5 with the NC contact in the default setting.

Precautions for Safe Use

Turn ON the Immediate Stop Input (STOP) at the same time when you turn OFF the main power. When the main power turns OFF due to an external immediate stop, the motor will continue to rotate due to residual voltage. This may cause human injuries or damages to the machine and devices.

Forward Drive Prohibition Input (POT) and Reverse Drive Prohibition Input (NOT)

- The two signals are the inputs to prohibit forward and reverse rotation (over-travel inputs).
- When one input is ON, the Servo Drive can rotate in the specified direction.
- In the Drive Prohibition state, Servomotor switches to servo lock state after deceleration stop.
- The maximum torque at deceleration stop is the same as the maximum servomotor torque.
- In the Drive Prohibition state, the Servo Drive does not switch to an alarming state.
- When the Drive Prohibition Input Selection (Pn504) is set to 1, the operation at a drive prohibit input can be selected on the Stop Selection for Drive Prohibition Input (Pn505).
- When the Drive Prohibition Input Selection (Pn504) is set to 2, the Drive Prohibition Input Protection (E380) works at a drive prohibition input.
- In factory setting, the Forward Drive Prohibition Input (POT) is allocated to Pin 7, while the Reverse Drive Prohibition Input (NOT) is to Pin 8.

Precautions for Correct Use

Both signals are disabled (in a state in which drive prohibition will not operation) in the default settings. If prohibiting the drive input is required, set the Drive Prohibit Input Selection (Pn504) to either 0 or 2. The setting on the Input Signal Selection 1 to 8 (Pn400 to 407) can change the logic and allocation for general-purpose inputs 1 to 8.

Origin Proximity Input (DEC)

- This is the deceleration signal at origin searches.
- When the Origin Proximity Input is ON while the Servomotor travels at the origin search feed speed, it decelerates to the origin search approach speed.
- When the first origin input is entered after the Origin Proximity Input turns OFF, the Servomotor decelerates to the origin search creep speed, and controls positions for the origin search final travel distance.
- After positioning completes, the position is the origin.
- In factory setting, the Origin Proximity Input is assigned to Pin 9.

Precautions for Correct Use

The Origin Proximity Input (DEC) signals can be entered in the speed control mode and the torque control mode. However, the inputs do not relate the operation.

External Latch Input Signals (EX1, EX2 and EX3)

- These are the external input signals to latch the present value on the feedback pulse counter.
- The Encoder position data is obtained at the moment when the External Latch Input is turned on.
- In factory setting, the External Latch Input 1 is allocated to Pin 12, the External Latch Input 2 to Pin 11, and the External Latch Input 3 to Pin 10.

Precautions for Correct Use

- The external latch inputs are detected by signal raises. The minimal signal width must be 1 ms.
- The external latch inputs can only be set to NO (normally open) contact.
- The external latch inputs can be allocated to pins 10 to 12 only.

Monitor Inputs (MON0, MON1 and MON2)

- They are the monitor inputs.
- They do not give any influences to the operation. Only the host controller can monitor them.
- In factory setting, the MON0 is allocated to Pin 13.

Forward External Torque Limit Input (PCL) and Reverse External Torque Limit Input (NCL)

- One of them turns ON when the torque is limited to the value set by the Forward External Torque Limit (Pn525) or the Reverse External Torque Limit (Pn526).
- While the input is on, the operation continues within the torque limit.
- In factory setting, the inputs are not allocated.

Backup Battery Inputs (BAT)

Pin 42 : Backup Battery + Input (BAT)

Pin 43 : Backup Battery – Input (BATGND)

Function:

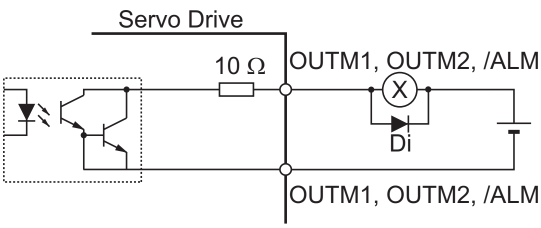
- They are the backup battery connection terminals used when the absolute encoder power is interrupted.
- Normally, the battery is connected to the battery holder for the absolute encoder battery cable. Do not connect anything to these terminals.

Precautions for Correct Use

Be sure not to connect to both of the absolute encoder battery cable and the backup battery inputs at the same time. Such connection may result in malfunction.

Control Output Circuits

Sequence Output



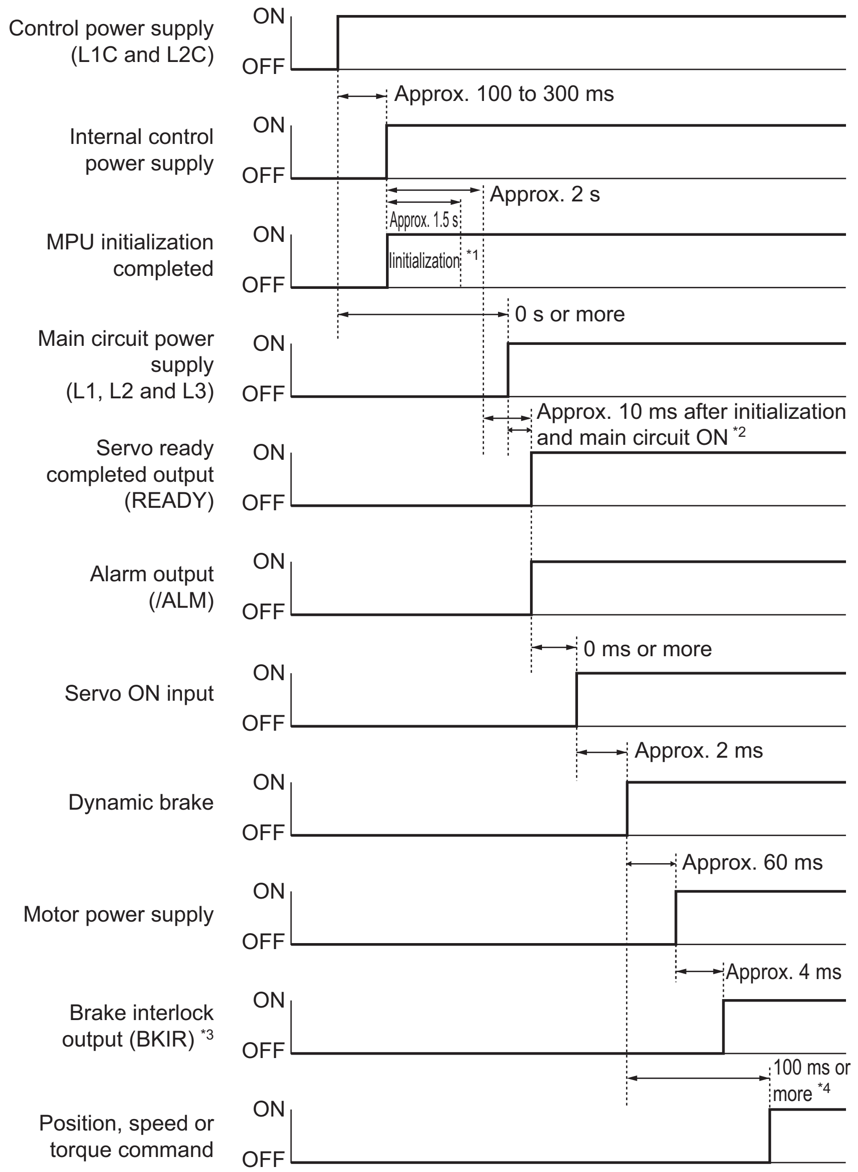
External power supply 12 to 24 VDC
Maximum service voltage: 30 VDC or less
Maximum output current: 50mA max.

Di: Surge voltage prevention diode
(Use a high-speed diode.)

Control Output Details

The chart below illustrates the timings of the command inputs after the control power-on. Enter the Servo ON, and the position, speed or torque command in the correct timing as shown in the chart.

Control Output Sequence



*1. Once the internal control power is established, the protective function starts working about 1.5 s after the MPU starts initializing itself. Be sure that all I/O signals that are connected to the Servo Drive, especially the Forward/Reverse Drive Prohibition Input (POT/NOT), the Origin Proximity Input (DEC), the external encoder input, are settled before the protective function starts working. The period can be extended by the Power Supply ON Initialization Time (Pn618).

*2. The Servo ready completed output (READY) turns ON only when all of these conditions are met: The MPU initialization is completed. The Main power is established. No alarm exists. MECHATROLINK-II communications are established. The servo is synchronized (Phase alignment).

*3. The Brake Interlock Output (BKIR) turns ON when the OR condition is met: a release request by the servo control and by the MECHATROLINK-II communications.

*4. During this period, the Servo ON signal is input on the hardware, but it is not processed.

Alarm Output (/ALM)

Pin 3: Alarm Output (/ALM)
Pin 4: Alarm output common (ALMCOM)

Function

The output is turned OFF when the drive detects an error.
This output is OFF at power supply ON, but turns ON when the drive's initial processing has been completed.

General-purpose Output (OUTM1 and OUTM2)

Pin 1 : General-purpose Output 1 (OUTM1) – [Brake Interlock Output (BKIR)]
Pin 2 : General-purpose Output 1 Common (OUTM1COM)
Pin 25 : General-purpose Output 2 (OUTM2) – [Servo Ready Output (READY)]
Pin 26 : General-purpose Output 2 Common (OUTM2COM)

Note:The functions that are allocated by default are given in brackets.
Refer to the description in Output Signals in Section "Sequence I/O Signal"(P.6-1) for the allocation.

Servo Ready Completed Output (READY)

- The output signal indicates the Drive is ready to be energized.
- It turns ON when no error is detected after main circuit power-ON.
- In factory setting, the Outputs are allocated to Pin 25 and 26.

Brake Interlock Output (BKIR)

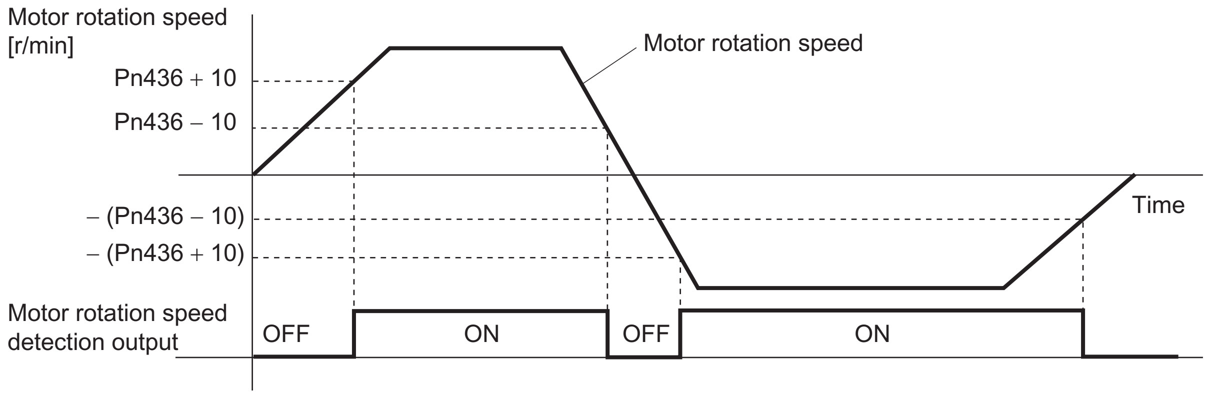
- It outputs the external brake timing signal as set by the Brake Timing when Stopped (Pn437), the Brake Timing During Operation (Pn438), and the Brake Release Speed Setting (Pn439).
- In factory setting, the Outputs are allocated to Pin 1 and 2.

Positioning Completion Output 1 (INP1) and Positioning Completion Output 2 (INP2)

- The INP1 turns ON when the error counter accumulated pulse is less than or equal to the Positioning Completion Range 1 (Pn431) set value.
- The INP2 turns ON when the error counter accumulated pulse is less than or equal to the Positioning Completion Range 2 (Pn442) set value.
- The output turns ON according to Positioning Completion Condition Selection (Pn432).
- The output is always OFF except in the POSITION CONTROL mode (including the FULL CLOSING CONTROL mode).
- In factory setting, the output is not allocated.

Motor Rotation Speed Detection Output (TGON)

- It turns on when the motor rotation speed exceeds the value set by the Rotation Speed for Motor Rotation Detection (Pn436).
- The output is effective both in forward and reverse directions regardless the actual direction that the motor rotates.
- The detection contains a hysteresis of 10 r/min.
- In factory setting, the output is not allocated.

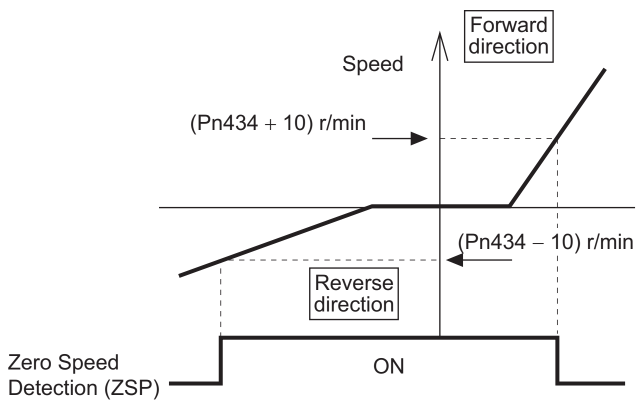


Torque Limiting Output (TLIMT)

- The output turns ON when the output torque reaches the limit as set by the No.1 Torque Limit (Pn013) or the No.2 Torque Limit (Pn522).
- The output is always OFF except in the POSITION CONTROL mode (including the FULL CLOSING CONTROL mode) and the Speed Control mode.
- In factory setting, the output is not allocated.

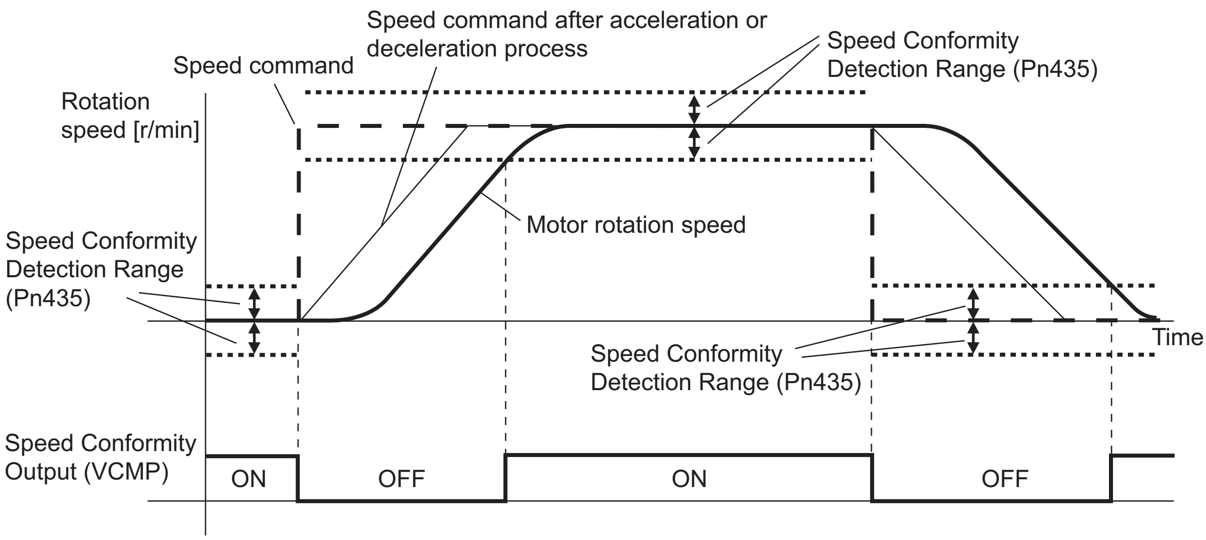
Zero Speed Detection Output (ZSP)

- It turns ON when the motor rotation speed goes below the value set by the Zero Speed Detection (Pn434).
- The output is effective both in forward and reverse directions regardless the actual direction that the motor rotates.
- The detection contains a hysteresis of 10 r/min.
- In factory setting, the output is not allocated.



Speed Conformity Output (VCMP)

- The output turns ON when the motor rotation speed fills into the range set by the Speed Conformity Detection Range (Pn435).
- It is determined to be conforming when the difference between the commanded speed before acceleration or deceleration process inside the Drive and the motor rotation speed is within the set range of Speed Conformity Detection Range (Pn435).
- A hysteresis of 10 r/min is set for the detection.
- The output is always OFF except in the POSITION CONTROL mode (including the FULL CLOSING CONTROL mode).
- In factory setting, the output is not allocated.



Warning Output (WARN1 and WARN2)

- The Warning Output 1 (WARN1) turns ON when the warning set by the Warning Output Selection 1 (Pn440) is detected.
- The Warning Output 2 (WARN2) turns ON when the warning set by the Warning Output Selection 2 (Pn441) is detected.
- In factory setting, the output is not allocated.

Position Command Status Output (PCMD)

- The output turns ON when a position command is entered during the POSITION CONTROL mode.
- The output is always OFF except in the POSITION CONTROL mode (including the FULL CLOSING CONTROL mode).
- In factory setting, the output is not allocated.

Speed Limiting Output (VLIMT)

- The output turns ON when the motor rotation speed reaches the limit set by the Speed Limit Value Setting (Pn321).
- The output is always OFF except in the TORQUE CONTROL mode.
- In factory setting, the output is not allocated.

Alarm Clear Attribute Output (ALM-ATB)

- The output turns ON when an alarm which can be reset occurs.
- In factory setting, the output is not allocated.

Speed Command Status Output (VCMD)

- The output turns ON when a speed command is entered during the SPEED CONTROL mode.
- The output is always OFF except in the SPEED CONTROL mode.
- In factory setting, the output is not allocated.

Encoder Connector Specifications (CN2)

Pin number	Symbol	Name	Function and interface
1	E5V	Encoder power supply +5 V	Power supply output for the encoder
2	E0V	Encoder power supply GND	
3	BAT+	Battery +	Backup power supply output for the absolute encoder
4	BAT–	Battery –	
5	PS+	Encoder + phase S input	Encoder signal I/O (serial signal)
6	PS–	Encoder – phase S input	
Shell	FG	Frame ground	Frame ground

Connectors for CN2 (6 Pins)

Name	Model	Manufacturer	OMRON model number
Drive connector	53460-0629	Molex Japan	–
Cable connector	55100-0670		R88A-CNW01R

External Encoder Connector Specifications (CN4)

These are the specifications of the connector that connect with the external encoder.

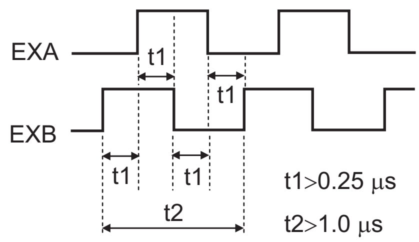
Pin number	Symbol	Name	Function and interface
1	E5V	External encoder power supply output	Use at 5.2 V ± 5% and at or below 250 mA.
2	E0V		This is connected to the control circuit ground connected to connector CN1.
3	+EXS	External encoder signal I/O (Serial signal)	Performs the serial signal input and output.
4	-EXS		
5	+EXA	External encoder signal input (Phase A, B, and Z signals)	Performs the input and output of phase A, B, and Z signals.
6	-EXA		
7	+EXB		
8	-EXB		
9	+EXZ		
10	-EXZ		
Shell	FG	Frame ground	Frame ground

Connectors for CN4 (10 Pins)

Name	Model	Manufacturer	OMRON model number
MUF Connector	MUF-PK10K-X	JST Mfg. Co., Ltd.	R88A-CNK41L

External Encoder Input Signals List

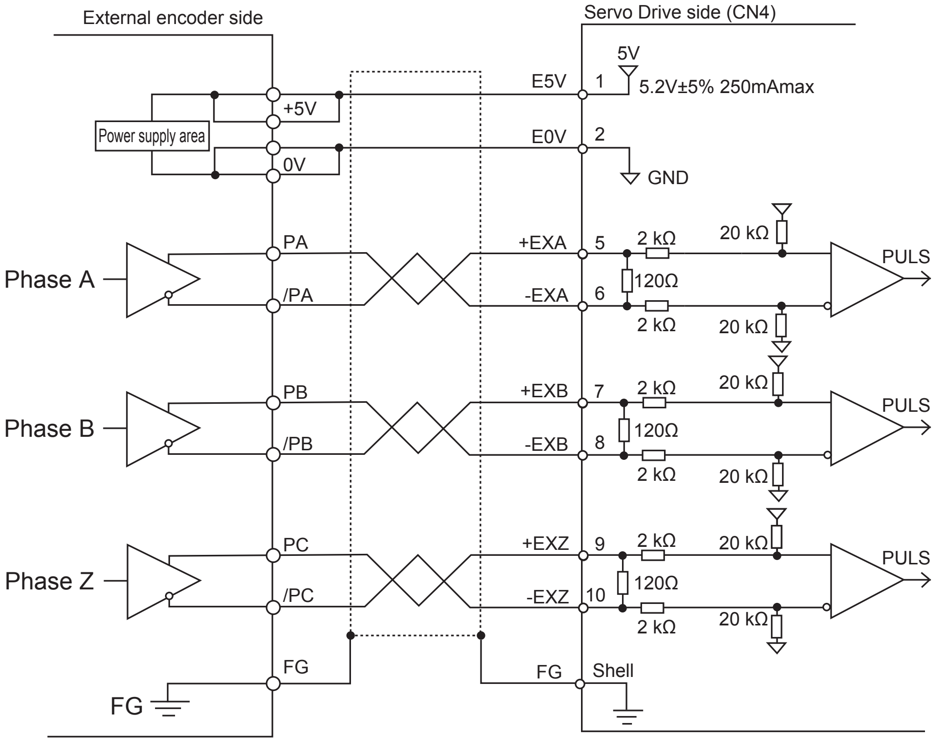
External encoder I/O (CN4)

Pin number	Symbol	Name	Function and interface
1	E5V	External encoder power supply output	External encoder power supply 5.2 VDC ± 5%, 250 mA max. If the above capacity is to be exceeded, provide a separate power supply.
2	E0V		
3	+EXS	External encoder signal Serial interface	This is an external encoder serial bi-directional signal.*1 (Conforming to EIA485) Maximum response frequency 400 Mpps
4	–EXS		
5	+EXA	External encoder signal 90° phase difference input (Phases A, B and Z)	This is an external encoder 90 phase input signal.*1 Maximum response frequency 4 Mpps (quadruple multiplier) 
6	–EXA		
7	+EXB		
8	–EXB		
9	+EXZ		
10	–EXZ		

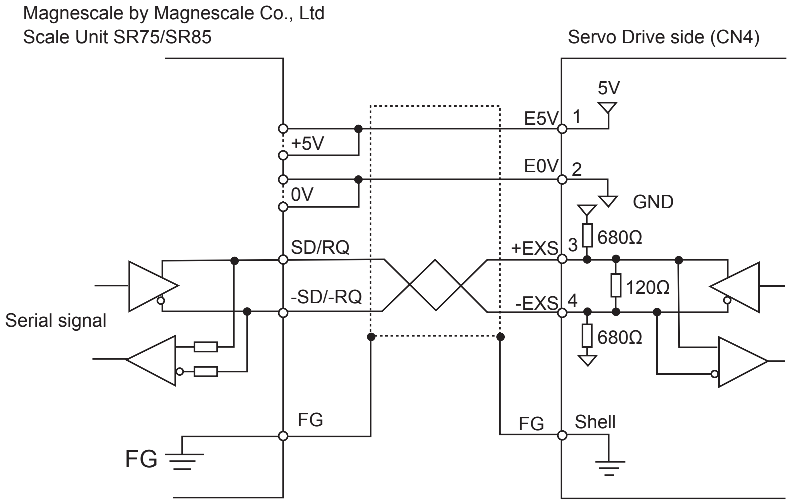
*1 Connect external encoder signals to the serial interface (+EXS/–EXS) or 90° phase difference input according to the encoder type.

Example of Connection with External Encoder

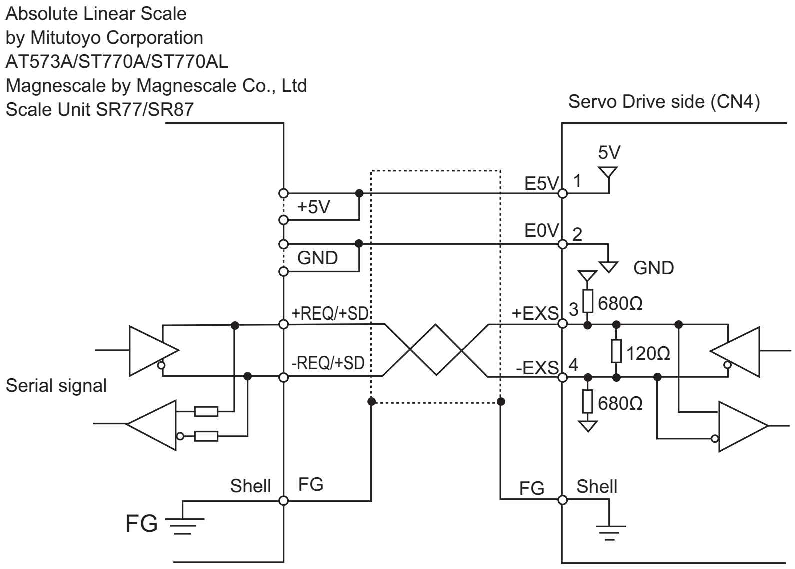
■ 90° Phase Difference Output Type (Pn323 = 0)



■ Serial Communications Type, Incremental Encoder Specifications (Pn323 = 1)



■ Serial Communications Type, Absolute Encoder Specifications (Pn323 = 2)



Monitor Connector Specifications (CN5)

Monitor Output Signals List

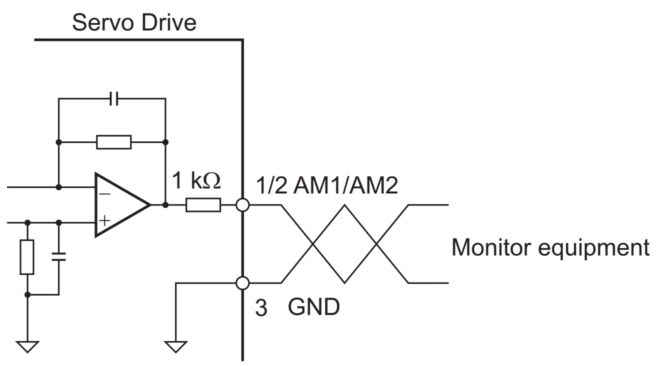
Monitor output (CN5)

Pin Number	Symbol	Name	Function and interface
1	AM1	Analog monitor output 1	Outputs the analog signal for the monitor. Default setting: Motor rotation speed 1 V/(500 r/min) You can use Pn416 and Pn417 to change the item and unit. You can use Pn421 to change the output method.
2	AM2	Analog monitor output 2	Outputs the analog signal for the monitor. Default setting: Torque command 1 V/(33%) You can use Pn418 and Pn419 to change the item and unit. You can use Pn421 to change the output method.
3	GND	Analog monitor ground	Ground for analog monitors 1, 2
4	–	Not used	Do not connect.
5	–	Not used	Do not connect.
6	–	Not used	Do not connect.

Connectors for CN5 (6 pins)

Name	Model	Manufacturer
Connector housing	51004-0600	Molex Japan
Connector terminal	50011-8000	Molex Japan

Monitor output circuit



USB Connector Specifications (CN7)

Through the USB connection with computer, operations such as parameter setting and changing, monitoring of control status, checking error status and error history, and parameter saving and loading can be performed.

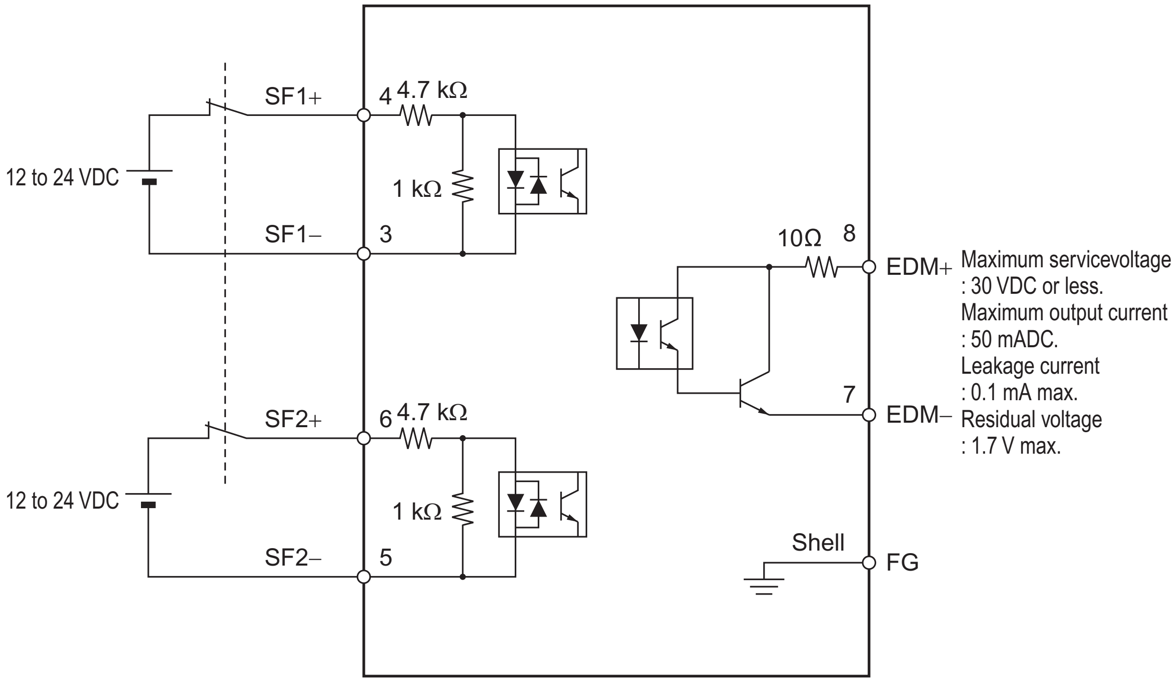
Pin number	Symbol	Name	Function and interface
1	VBUS	USB signal terminal	Use this function for computer communication.
2	D−		
3	D+		
4	−	Reserved for manufacturer use	Do not connect.
5	GND	Signal ground	Signal ground

Precautions for Correct Use

- Use a commercially available USB cable that is shield, equipped with a ferrite core for noise immunity, and supporting for USB2.0.
  The Mini B type USB cable can be used.

Safety Connector Specifications (CN8)

Connection of Safety I/O Signals and Processing of External Signals



Safety I/O Signals List

Safety I/O (CN8)

Pin Number	Symbol	Name	Function and interface
1	–	Reserved	Do not connect.
2	–		
3	SF1–	Safety input 1	Inputs 1 and 2 for operating the STO function, which are 2 independent circuits. This input turns OFF the power transistor drive signals in the Servo Drive to cut off the current output to the motor.
4	SF1+		
5	SF2–	Safety input 2	
6	SF2+		
7	EDM–	EDM output	A monitor signal is output to detect a safety function failure.
8	EDM+		
Shell	FG	Frame ground	Connected to the ground terminal inside the Servo Drive.

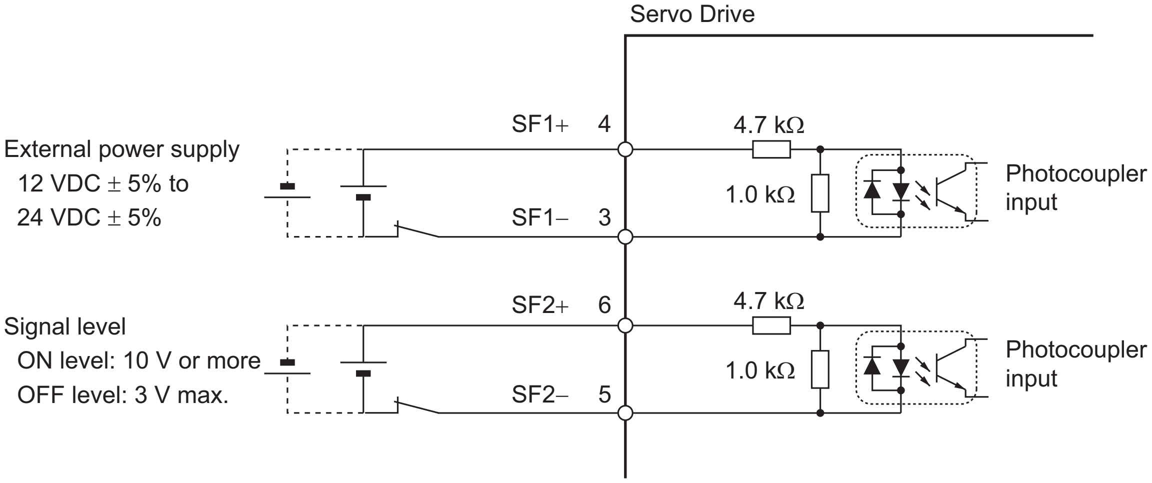
Connector for CN8 (8 pins)

Name	Model	Manufacturer	OMRON model number
Industrial Mini I/O Connector (D-SHAPE1)	2013595-1	Tyco Electronics AMP KK	R88A-CNK81S

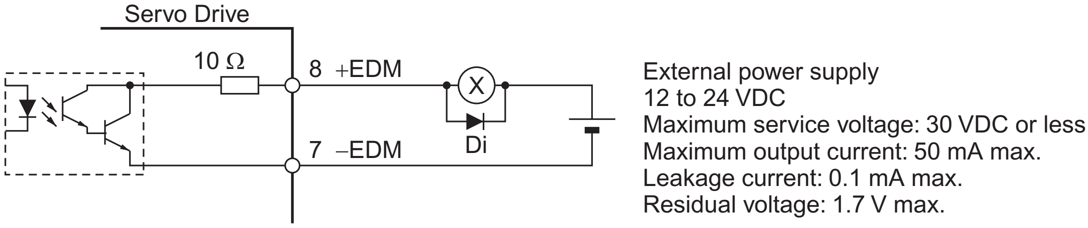
3

Specifications

Safety Input Circuit



EDM Output Circuit



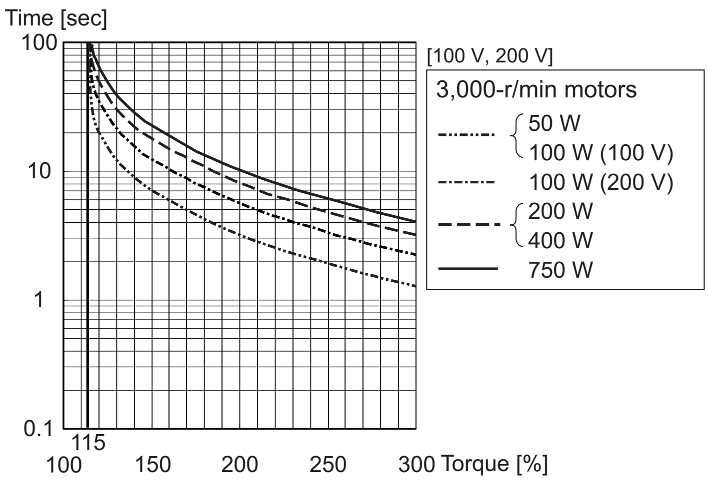
Di: Surge voltage prevention diode
(Use a high-speed diode.)

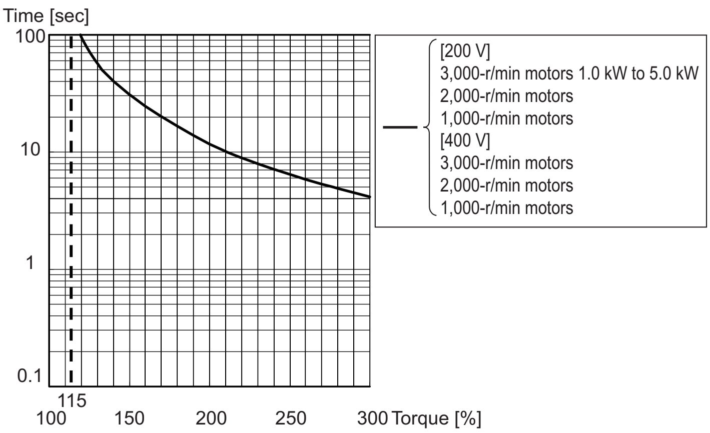
3-2 Overload Characteristics (Electronic Thermal Function)

An overload protection function (electronic thermal) is built into the Servo Drive to protect the drive and motor from overloading.
If an overload does occur, first eliminate the cause of the error and then wait at least 1 minute for the motor temperature to drop before turning ON the power again.
If the alarm reset is repeated at short intervals, the motor windings may burn out.

Overload Characteristics Graphs

The following graphs show the characteristics of the load ratio and electronic thermal function's operation time.





When the torque command = 0, and a constant torque command is continuously applied after 3 or more times the overload time constant has elapsed, the overload time t [s] is:
t [s] = –Overload time constant [s] × $\log_e$ (1 – Overload level [%] / Torque command [%]) ^{2}
(The overload time constant [s] depends on the motor. The standard overload level is 115%.)

3-3 Servomotor Specifications

The following OMNUC G5-Series AC Servomotors are available.
- 3,000-r/min motors
- 2,000-r/min motors
- 1,000-r/min motors

There are various options available, such as models with brakes, or different shaft types. Select a Servomotor based on the mechanical system's load conditions and the installation environment.

General Specifications

Item			3,000-r/min motors		1,000-r/min motors 2,000-r/min motors
			50 to 750 W	1 to 5 kW	900 W to 5 kW
Ambient operating temperature and operating humidity			0 to +40°C, 20% to 85% RH (with no condensation)		
Storage ambient temperature and humidity			–20 to +65°C, 20% to 85% RH (with no condensation) Maximum allowable temperature: 80°C for 72 hours maximum (standard humidity)		
Operating and storage atmosphere			No corrosive gases		
Vibration resistance *1			Acceleration of 49 m/s^2 24.5 m/s^2 max. in X, Y, and Z directions when the motor is stopped		
Impact resistance			Acceleration of 98 m/s^2 max. 3 times each in X, Y, and Z directions		
Insulation resistance			Between power terminal and FG terminal: 20 MΩ min. (at 500 VDC Megger)		
Dielectric strength			1,500 VAC between power terminal and FG terminal (sensed current 10 mA) for 1 min (voltage 100 V, 200 V) 1,800 VAC between power terminal and FG terminal (sensed current 10 mA) for 1 min (voltage 400 V) 1,000 VAC between brake terminal and FG terminal (sensed current 10 mA) for 1 min		
Insulation class			Type B	Type F	
Protective structure			IP67 (except for through-shaft parts and motor and encoder connector pins)		
International standard	EC directive	Low voltage directive	EN60034-1/-5		
	UL standards		UL1004-1	UL1004	
	CSA standards		CSA22.2 No. 100		

*1. The amplitude may be amplified by machine resonance. Do not exceed 80% of the specified value for extended periods of time.

Note 1. Do not use the cable when it is laying in oil or water.

Note 2. Do not expose the cable outlet or connections to stress due to bending or the weight of the cable itself.

Note 3. Disconnect all connections to the Servomotor before attempting a megameter test (insulation resistance measurement) on a Servomotor. Failure to follow this guideline may result in damaging the Servomotor. Never perform a dielectric strength test on the Servomotor. Failure to follow this guideline may result in damaging the internal elements.

Characteristics

3,000-r/min Motors

Item		Unit	100 VAC K05030H / K05030T	100 VAC K10030L / K10030S	100 VAC K20030L / K20030S	100 VAC K40030L / K40030S
Rated output *1		W	50	100	200	400
Rated torque *1		N • m	0.16	0.32	0.64	1.3
Rated rotation speed		r/min	3,000			
Momentary maximum rotation speed		r/min	6,000			
Momentary maximum torque *1		N • m	0.48	0.95	1.91	3.8
Rated current *1		A (rms)	1.1	1.6	2.5	4.6
Momentary maximum current *1		A (0-p)	4.7	6.9	10.6	19.5
Rotor inertia	Without brake	kg • m^2	0.025×10^{-4}	0.051×10^{-4}	0.14×10^{-4}	0.26×10^{-4}
	With brake	kg • m^2	0.027×10^{-4}	0.054×10^{-4}	0.16×10^{-4}	0.28×10^{-4}
Applicable load inertia		–	30 times the rotor inertia max. *2			
Torque constant *1		N • m/A	0.11±10%	0.14±10%	0.20±10%	0.21±10%
Power rate *1	Without brake	kW/s	10.1	19.8	28.9	62.3
	With brake	kW/s	9.4	18.7	25.3	57.8
Mechanical time constant	Without brake	ms	1.43	1.03	0.61	0.48
	With brake	ms	1.54	1.09	0.70	0.52
Electrical time constant		ms	0.82	0.91	3.0	3.4
Allowable radial load *3		N	68	68	245	245
Allowable thrust load *3		N	58	58	98	98
Weight	Without brake	kg	Approx. 0.31	Approx. 0.45	Approx. 0.78	Approx. 1.2
	With brake	kg	Approx. 0.51	Approx. 0.65	Approx. 1.2	Approx. 1.6
Radiator plate dimensions (material)			100 × 80 × t10 (Al)		130 × 120 × t12 (Al)	
Applicable drives (R88D-)			KNA5L-ML2	KN01L-ML2	KN02L-ML2	KN04L-ML2
Brake specifications	Brake inertia	kg • m^2	2×10^{-7}	2×10^{-7}	1.8×10^{-6}	1.8×10^{-6}
	Excitation voltage *4	V	24 VDC ± 5%			
	Power consumption (at 20°C)	W	7	7	9	9
	Current consumption (at 20°C)	A	0.3	0.3	0.36	0.36
	Static friction torque	N • m	0.29 min.	0.29 min.	1.27 min.	1.27 min.
	Attraction time *5	ms	35 max.	35 max.	50 max.	50 max.
	Release time *5	ms	20 max.	20 max.	15 max.	15 max.
	Backlash		±1°			
	Allowable work per braking	J	39.2	39.2	137	137
	Allowable total work	J	4.9×10^3	4.9×10^3	44.1×10^3	44.1×10^3

Model (R88M-) Item		Unit	100 VAC K05030H / K05030T	K10030L / K10030S	K20030L / K20030S	K40030L / K40030S
Brake specifications	Allowable angular acceleration	rad/s^2	30,000 max. (Speed of 2,800 r/min or more must not be changed in less than 10 ms.)			
	Brake limit	–	10 million times min.			
	Rating	–	Continuous			
	Insulation class	–	Type F			

Item		Unit	200 VAC K05030H / K05030T	200 VAC K10030H / K10030T	200 VAC K20030H / K20030T	200 VAC K40030H / K40030T
Rated output *1		W	50	100	200	400
Rated torque *1		N • m	0.16	0.32	0.64	1.3
Rated rotation speed		r/min	3,000			
Momentary maximum rotation speed		r/min	6,000			
Momentary maximum torque *1		N • m	0.48	0.95	1.91	3.8
Rated current *1		A (rms)	1.1	1.1	1.5	2.4
Momentary maximum current *1		A (0-p)	4.7	4.7	6.5	10.2
Rotor inertia	Without brake	kg • m^2	0.025×10^{-4}	0.051×10^{-4}	0.14×10^{-4}	0.26×10^{-4}
	With brake	kg • m^2	0.027×10^{-4}	0.054×10^{-4}	0.16×10^{-4}	0.28×10^{-4}
Applicable load inertia		–	30 times the rotor inertia max.*2			
Torque constant *1		N • m/A	0.11±10%	0.21±10%	0.32±10%	0.40±10%
Power rate *1	Without brake	kW/s	10.1	19.8	28.9	62.3
	With brake	kW/s	9.4	18.7	25.3	57.8
Mechanical time constant	Without brake	ms	1.43	1.07	0.58	0.43
	With brake	ms	1.54	1.13	0.66	0.46
Electrical time constant		ms	0.82	0.90	3.2	3.4
Allowable radial load *3		N	68	68	245	245
Allowable thrust load *3		N	58	58	98	98
Weight	Without brake	kg	Approx. 0.31	Approx. 0.46	Approx. 0.79	Approx. 1.2
	With brake	kg	Approx. 0.51	Approx. 0.66	Approx. 1.2	Approx. 1.6
Radiator plate dimensions (material)			100 × 80 × t10 (Al)		130 × 120 × t12 (Al)	
Applicable drives (R88D-)			KN01H-ML2	KN01H-ML2	KN02H-ML2	KN04H-ML2
Brake specifications	Brake inertia	kg • m^2	2×10^{-7}	2×10^{-7}	1.8×10^{-6}	1.8×10^{-6}
	Excitation voltage *4	V	24 VDC ± 5%			
	Power consumption (at 20°C)	W	7	7	9	9
	Current consumption (at 20°C)	A	0.3	0.3	0.36	0.36
	Static friction torque	N • m	0.29 min.	0.29 min.	1.27 min.	1.27 min.
	Attraction time *5	ms	35 max.	35 max.	50 max.	50 max.
	Release time *5	ms	20 max.	20 max.	15 max.	15 max.
	Backlash		±1°			
	Allowable work per braking	J	39.2	39.2	137	137
	Allowable total work	J	4.9×10^{3}	4.9×10^{3}	44.1×10^{3}	44.1×10^{3}
	Allowable angular acceleration	rad/s^2	30,000 max. (Speed of 2,800 r/min or more must not be changed in less than 10 ms.)			
	Brake limit	–	10 million times min.			
	Rating	–	Continuous			
	Insulation class	–	Type F			

Model (R88M-) Item		Unit	200 VAC K75030H K75030T	200 VAC K1K030H K1K030T	200 VAC K1K530H K1K530T
Rated output *1		W	750	1000	1500
Rated torque *1		N • m	2.4	3.18	4.77
Rated rotation speed		r/min	3,000		
Momentary maximum rotation speed		r/min	6,000	5,000	
Momentary maximum torque *1		N • m	7.1	9.55	14.3
Rated current *1		A (rms)	4.1	6.6	8.2
Momentary maximum current *1		A (0-p)	17.4	28	35
Rotor inertia	Without brake	kg • m^2	0.87×10^{-4}	2.03×10^{-4}	2.84×10^{-4}
	With brake	kg • m^2	0.97×10^{-4}	2.35×10^{-4}	3.17×10^{-4}
Applicable load inertia		–	20 times the rotor inertia max.	15 times the rotor inertia max. *2	
Torque constant *1		N • m/A	0.45±10%	0.37	0.45
Power rate *1	Without brake	kW/s	65.4	49.8	80.1
	With brake	kW/s	58.7	43.0	71.8
Mechanical time constant	Without brake	ms	0.37	0.61	0.49
	With brake	ms	0.42	0.71	0.55
Electrical time constant		ms	5.3	5.8	6.3
Allowable radial load *3		N	392	490	490
Allowable thrust load *3		N	147	196	196
Weight	Without brake	kg	Approx. 2.3	Approx. 3.5	Approx. 4.4
	With brake	kg	Approx. 3.1	Approx. 4.5	Approx. 5.4
Radiator plate dimensions (material)			170 × 160 × t12 (Al)	320 × 300 × t20 (Al)	
Applicable drives (R88D-)			KN08H-ML2	KN15H-ML2	KN15H-ML2
Brake specifications	Brake inertia	kg • m^2	0.75×10^{-5}	0.33×10^{-4}	0.33×10^{-4}
	Excitation voltage *4	V	24 VDC ± 5%	24 VDC ± 10%	
	Power consumption (at 20°C)	W	10	19	19
	Current consumption (at 20°C)	A	0.42	0.81±10%	0.81±10%
	Static friction torque	N • m	2.45 min.	7.8 min.	7.8 min.
	Attraction time *5	ms	70 max.	50 max.	50 max.
	Release time *5	ms	20 max.	15 max. *6	15 max. *6
	Backlash		±1°		
	Allowable work per braking	J	196	392	392
	Allowable total work	J	1.47×10^5	4.9×10^5	4.9×10^5
	Allowable angular acceleration	rad/s^2	30,000	10,000	
	Brake limit	–	10 million times min.		
	Rating	–	Continuous		
	Insulation class	–	Type F		

Model (R88M-) Item		Unit	AC200V K2K030H K2K030T	K3K030H K3K030T	K4K030H K4K030T	K5K030H K5K030T
Rated output *1		W	2000	3000	4000	5000
Rated torque *1		N • m	6.37	9.55	12.7	15.9
Rated rotation speed		r/min	3000			
Momentary maximum rotation speed		r/min	5000		4500	4500
Momentary maximum torque *1		N • m	19.1	28.6	38.2	47.7
Rated current *1		A (rms)	11.3	18.1	19.6	24.0
Momentary maximum current *1		A (0-p)	48	77	83	102
Rotor inertia	Without brake	kg • m^2	3.68×10^{-4}	6.50×10^{-4}	12.9×10^{-4}	17.4×10^{-4}
	With brake	kg • m^2	4.01×10^{-4}	6.85×10^{-4}	14.2×10^{-4}	18.6×10^{-4}
Applicable load inertia		–	30 times the rotor inertia max.*2			
Torque constant *1		N • m/A	0.44	0.41	0.49	0.49
Power rate *1	Without brake	kW/s	110	140	126	146
	With brake	kW/s	101	116	114	136
Mechanical time constant	Without brake	ms	0.44	0.41	0.51	0.50
	With brake	ms	0.48	0.49	0.56	0.54
Electrical time constant		ms	6.7	11	12	13
Allowable radial load *3		N	490	490	784	784
Allowable thrust load *3		N	196	196	343	343
Weight	Without brake	kg	Approx. 5.3	Approx. 8.3	Approx. 11.0	Approx. 14.0
	With brake	kg	Approx. 6.3	Approx. 9.4	Approx. 12.6	Approx. 16.0
Radiator plate dimensions (material)			380×350×t30 (A)			
Applicable drives (R88D-)			KN20H-ML2	KN30H-ML2	KN50H-ML2	KN50H-ML2
Brake specifications	Brake inertia	kg • m^2	0.33×10^{-4}	0.33×10^{-4}	1.35×10^{-4}	1.35×10^{-4}
	Excitation voltage *4	V	24 VDC±10%			
	Power consumption (at 20°C)	W	19	19	22	22
	Current consumption (at 20°C)	A	0.81±10%	0.81±10%	0.90±10%	0.90±10%
	Static friction torque	N • m	7.8 min.	11.8 min.	16.1 min.	16.1 min.
	Attraction time *5	ms	50 max.	80 max.	110 max.	110 max.
	Release time *5	ms	15 max*6	15 max.*6	50 max.*7	50 max.*7
	Backlash		±1°			
	Allowable work per braking	J	392	392	1470	1470
	Allowable total work	J	4.9×10^5	4.9×10^5	2.2×10^6	2.2×10^6
	Allowable angular acceleration	rad/s^2	10,000			
	Brake limit	–	10 million times min.			
	Rating	–	Continuous			
	Insulation class	–	Type F			

Model (R88M-) Item			Unit	400 VAC K75030F K75030C	K1K030F K1K030C	K1K530F K1K530C	K2K030F K2K030C
Rated output *1			W	750	1000	1500	2000
Rated torque *1			N • m	2.39	3.18	4.77	6.37
Rated rotation speed			r/min	3,000			
Momentary maximum rotation speed			r/min	5,000			
Momentary maximum torque *1			N • m	7.16	9.55	14.3	19.1
Rated current *1			A (rms)	2.4	3.3	4.2	5.7
Momentary maximum current *1			A (0-p)	10	14	18	24
Rotor inertia	Without brake		kg • m^2	1.61×10^{-4}	2.03×10^{-4}	2.84×10^{-4}	3.68×10^{-4}
	With brake		kg • m^2	1.93×10^{-4}	2.35×10^{-4}	3.17×10^{-4}	4.01×10^{-4}
Applicable load inertia			–	30 times the rotor inertia max. *2			
Torque constant *1			N • m/A	0.78	0.75	0.89	0.87
Power rate *1	Without brake		kW/s	35.5	49.8	80.1	110
	With brake		kW/s	29.6	43	71.8	101
Mechanical time constant	Without brake		ms	0.67	0.60	0.49	0.45
	With brake		ms	0.8	0.70	0.55	0.49
Electrical time constant			ms	5.9	5.8	6.5	6.6
Allowable radial load *3			N	490	490	490	490
Allowable thrust load *3			N	196	196	196	196
Weight	Without brake		kg	Approx. 3.1	Approx. 3.5	Approx. 4.4	Approx. 5.3
	With brake		kg	Approx. 4.1	Approx. 4.5	Approx. 5.4	Approx. 6.3
Radiator plate dimensions (material)				320 × 300 × t20 (Al)			
Applicable drives (R88D-)				KN10F-ML2	KN15F-ML2	KN15F-ML2	KN20F-ML2
Brake specifications	Brake inertia		kg • m^2	0.33×10^{-4}	0.33×10^{-4}	0.33×10^{-4}	0.33×10^{-4}
	Excitation voltage *4		V	24 VDC ± 10%			
	Power consumption (at 20°C)		W	17	19	19	19
	Current consumption (at 20°C)		A	0.70±10%	0.81±10%	0.81±10%	0.81±10%
	Static friction torque		N • m	2.5 min.	7.8 min.	7.8 min.	7.8 min.
	Attraction time *5		ms	50 max.	50 max.	50 max.	50 max.
	Release time *5		ms	15 max. *6	15 max. *6	15 max. *6	15 max. *6
	Backlash			±1°			
	Allowable work per braking		J	392	392	392	392
	Allowable total work		J	4.9×10^5	4.9×10^5	4.9×10^5	4.9×10^5
	Allowable angular acceleration		rad/s^2	10,000			
	Brake limit		–	10 million times min.			
	Rating		–	Continuous			
	Insulation class		–	Type F			

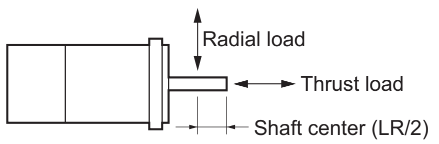
Model (R88M-) Item		Unit	400 VAC K3K030F K3K030C	400 VAC K4K030F K4K030C	400 VAC K5K030F K5K030C
Rated output *1		W	3000	4000	5000
Rated torque *1		N • m	9.55	12.7	15.9
Rated rotation speed		r/min	3,000		
Momentary maximum rotation speed		r/min	5,000	4,500	
Momentary maximum torque *1		N • m	28.6	38.2	47.7
Rated current *1		A (rms)	9.2	9.9	12.0
Momentary maximum current *1		A (0-p)	39	42	51
Rotor inertia	Without brake	kg • m^2	6.50×10^{-4}	12.9×10^{-4}	17.4×10^{-4}
	With brake	kg • m^2	7.85×10^{-4}	14.2×10^{-4}	18.6×10^{-4}
Applicable load inertia		–	30 times the rotor inertia max. *2		
Torque constant *1		N • m/A	0.81	0.98	0.98
Power rate *1	Without brake	kW/s	140	126	146
	With brake	kW/s	116	114	136
Mechanical time constant	Without brake	ms	0.40	0.51	0.50
	With brake	ms	0.49	0.56	0.54
Electrical time constant		ms	12	13	13
Allowable radial load *3		N	490	784	784
Allowable thrust load *3		N	196	343	343
Weight	Without brake	kg	Approx. 8.3	Approx. 11.0	Approx. 14.0
	With brake	kg	Approx. 9.4	Approx. 12.6	Approx. 16.0
Radiator plate dimensions (material)			380 × 350 × t30 (Al)		
Applicable drives (R88D-)			KN30F-ML2	KN50F-ML2	KN50F-ML2
Brake specifications	Brake inertia	kg • m^2	0.33×10^{-4}	1.35×10^{-4}	1.35×10^{-4}
	Excitation voltage *4	V	24 VDC ± 10%		
	Power consumption (at 20°C)	W	19	22	22
	Current consumption (at 20°C)	A	0.81±10%	0.90±10%	0.90±10%
	Static friction torque	N • m	11.8 min.	16.1 min.	16.1 min.
	Attraction time *5	ms	80 max.	110 max.	110 max.
	Release time *5	ms	15 max. *6	50 max. *7	50 max. *7
	Backlash		±1°		
	Allowable work per braking	J	392	1470	1470
	Allowable total work	J	4.9×10^5	2.2×10^6	2.2×10^6
	Allowable angular acceleration	rad/s^2	10,000		
	Brake limit	–	10 million times min.		
	Rating	–	Continuous		
	Insulation class	–	Type F		

*1. These are the values when the motor is combined with a drive at normal temperature (20°C, 65%). The momentary maximum torque indicates the standard value.

*2. Applicable load inertia.

- The operable load inertia ratio (load inertia/rotor inertia) depends on the mechanical configuration and its rigidity. For a machine with high rigidity, operation is possible even with high load inertia. Select an appropriate motor and confirm that operation is possible.
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

*3. The allowable radial and thrust loads are the values determined for a limit of 20,000 hours at normal operating temperatures.
The allowable radial loads are applied as shown in the following diagram.



*4. This is a non-excitation brake. (It is released when excitation voltage is applied.)

*5. The operation time is the value (reference value) measured with a surge suppressor (CR50500 by Okaya Electric Industries Co., Ltd.).

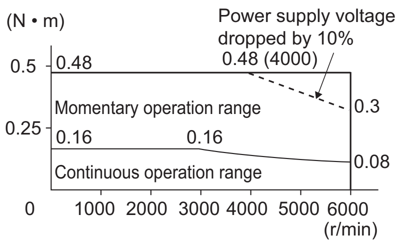
*6. Direct current switching with a varistor (Z15D151 by Ishizuka Electronics Co.).

*7. Direct current switching with a varistor (TNR9G820K by Nippon Chemi-Con Corporation).

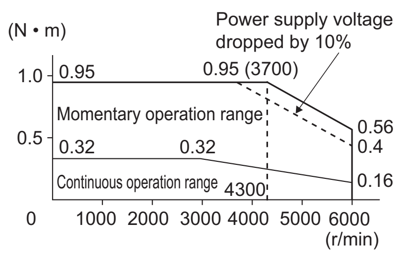
Torque-Rotation Speed Characteristics for 3,000-r/min Motors

- 3,000-r/min motor (100 VAC)
  The following graphs show the characteristics with a 3-m standard cable and a 100-VAC input.

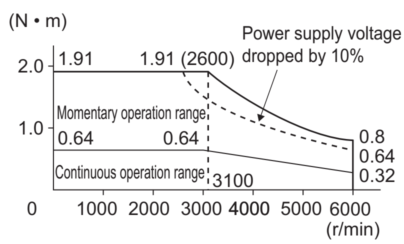
• R88M-K05030H/T (50 W)



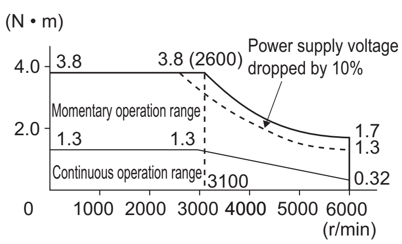
• R88M-K10030L/S (100 W)



• R88M-K20030L/S (200 W)



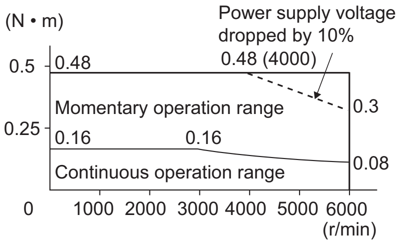
• R88M-K40030L/S (400 W)



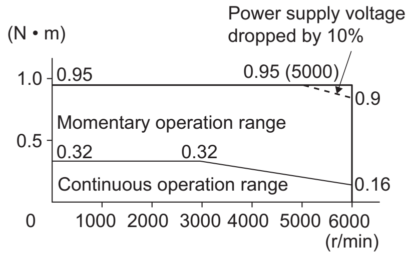
Note:The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

- 3,000-r/min motor (200 VAC)
  The following graphs show the characteristics with a 3-m standard cable and a 200-VAC input.

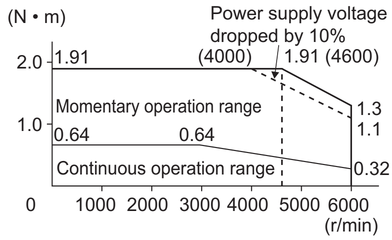
• R88M-K05030H/T (50 W)



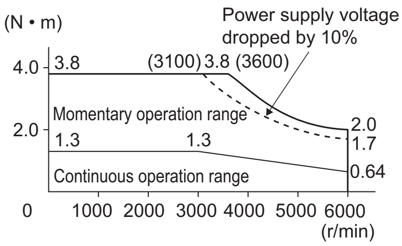
• R88M-K10030H/T (100 W)



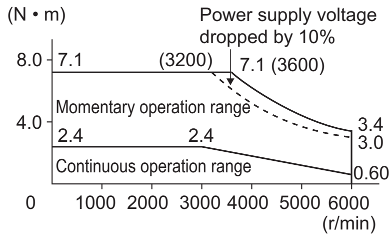
• R88M-K20030H/T (200 W)



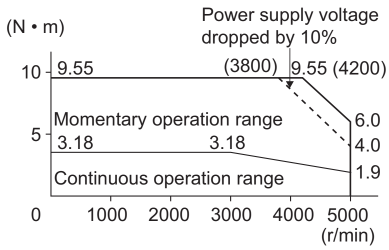
• R88M-K40030H/T (400 W)



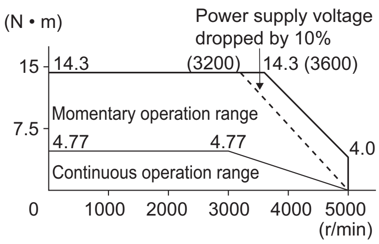
• R88M-K75030H/T (750 W)



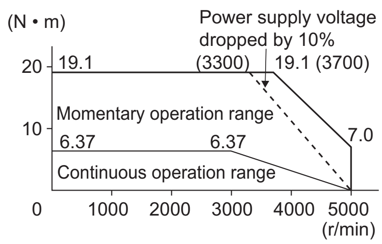
• R88M-K1K030H/T (1 kW)



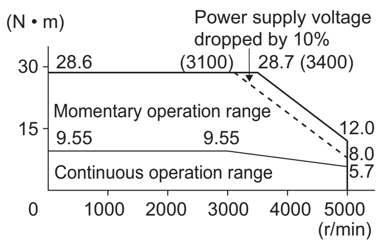
• R88M-K1K530H/T (1.5 kW)



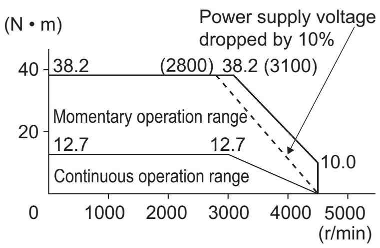
• R88M-K2K030H/T (2 kW)



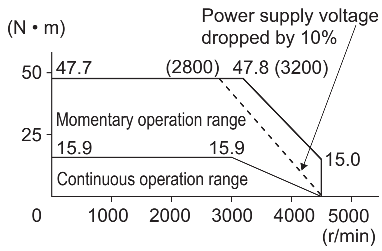
• R88M-K3K030H/T (3 kW)



• R88M-K4K030H/T (4 kW)



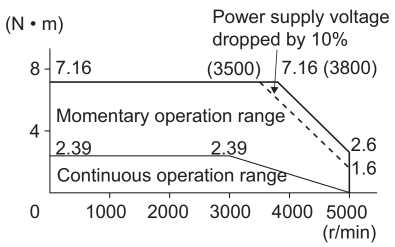
• R88M-K5K030H/T (5 kW)



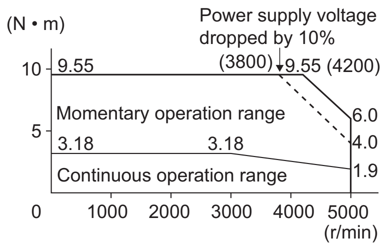
Note:The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

- 3,000-r/min motor (400 VAC)
  The following graphs show the characteristics with a 3-m standard cable and a 400-VAC input.

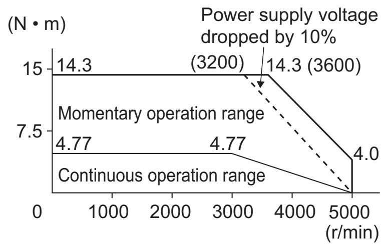
• R88M-K75030F/C (750 W)



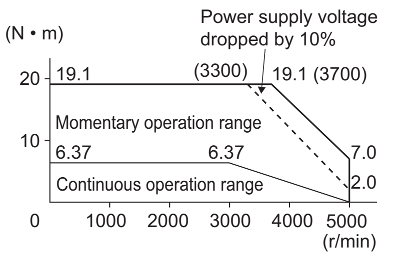
• R88M-K1K030F/C (1 kW)



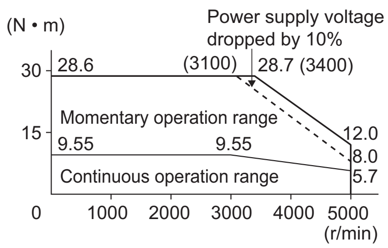
• R88M-K1K530F/C (1.5 kW)



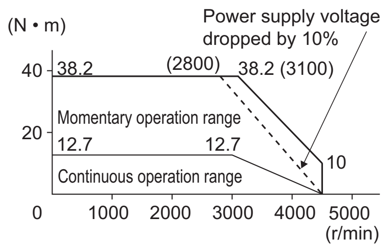
• R88M-K2K030F/C (2 kW)



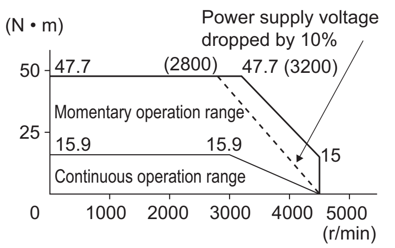
• R88M-K3K030F/C (3 kW)



• R88M-K4K030F/C (4 kW)



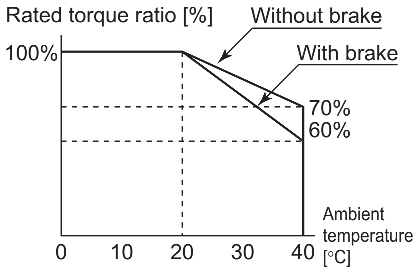
• R88M-K5K030F/C (5 kW)



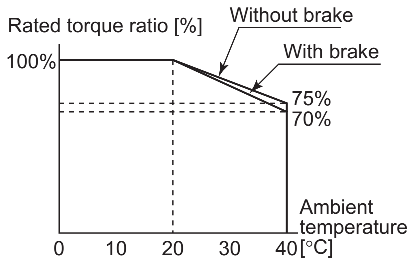
Note:The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

Use the following Servomotors in the ranges shown in the graphs below. Using outside of these ranges may cause the motor to generate heat, which could result in encoder malfunction.

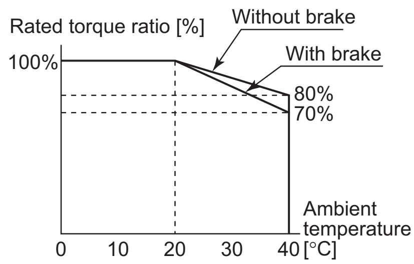
• R88M-K05030L/S/H/T
(50 W: With oil seal)



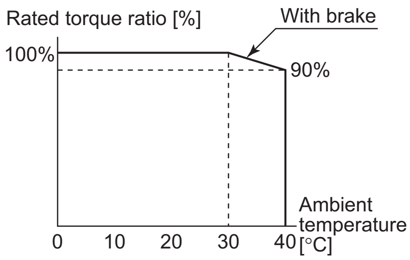
• R88M-K10030L/S/H/T
(100 W: With oil seal)



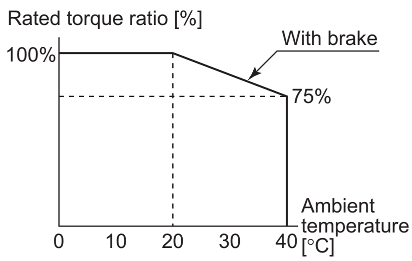
• R88M-K20030L/SH/T
(200 W: With oil seal)



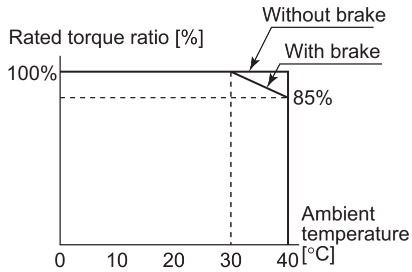
• R88M-K40030L/S/H/T
(400 W: Without oil seal)



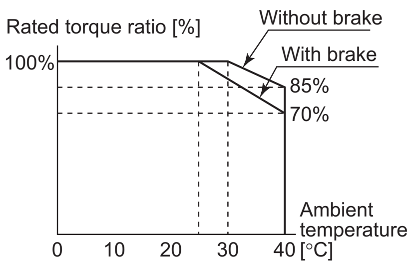
• R88M-K40030L/S/H/T
(400 W: With oil seal)



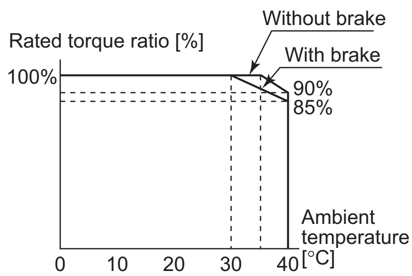
• R88M-K1K530H/T/F/C
(1.5 kW)



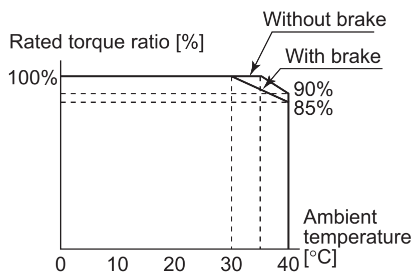
• R88M-K2K030H/T/F/C
(2 kW)



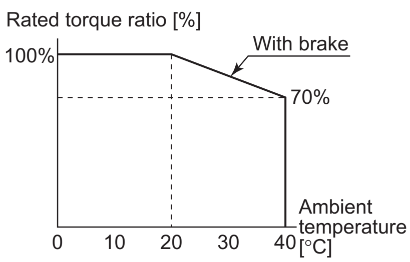
• R88M-K3K030H/T/F/C
(3 kW)



• R88M-K4K030H/T/F/C
(4 kW)



• R88M-K5K030H/T/F/C
(5 kW)



2,000-r/min Motors

Model (R88M-) Item		Unit	200 VAC K1K020H K1K020T	200 VAC K1K520H K1K520T	200 VAC K2K020H K2K020T
Rated output *1		W	1,000	1,500	2,000
Rated torque *1		N • m	4.77	7.16	9.55
Rated rotation speed		r/min	2,000		
Momentary maximum rotation speed		r/min	3,000		
Momentary maximum torque *1		N • m	14.3	21.5	28.6
Rated current *1		A (rms)	5.7	9.4	11.5
Momentary maximum current *1		A (0-p)	24	40	49
Rotor inertia	Without brake	kg • m^2	4.60×10^{-4}	6.70×10^{-4}	8.72×10^{-4}
	With brake	kg • m^2	5.90×10^{-4}	7.99×10^{-4}	10.0×10^{-4}
Applicable load inertia		–	10 times the rotor inertia max. *2		
Torque constant *1		N • m/A	0.63	0.58	0.64
Power rate *1	Without brake	kW/s	49.5	76.5	105
	With brake	kW/s	38.6	64.2	91.2
Mechanical time constant	Without brake	ms	0.80	0.66	0.66
	With brake	ms	1.02	0.80	0.76
Electrical time constant		ms	9.4	10	10
Allowable radial load *3		N	490	490	490
Allowable thrust load *3		N	196	196	196
Weight	Without brake	kg	Approx. 5.2	Approx. 6.7	Approx. 8.0
	With brake	kg	Approx. 6.7	Approx. 8.2	Approx. 9.5
Radiator plate dimensions (material)			275 × 260 × t15 (Al)		
Applicable drives (R88D-)			KN10H-ML2	KN15H-ML2	KN20H-ML2
Brake specifications	Brake inertia	kg • m^2	1.35×10^{-4}	1.35×10^{-4}	1.35×10^{-4}
	Excitation voltage *4	V	24 VDC ± 10%		
	Power consumption (at 20°C)	W	14	19	19
	Current consumption (at 20°C)	A	0.59±10%	0.79±10%	0.79±10%
	Static friction torque	N • m	4.9 min.	13.7 min.	13.7 min.
	Attraction time *5	ms	80 max.	100 max.	100 max.
	Release time *5	ms	70 max. *6	50 max. *6	50 max. *6
	Backlash		±1°		
	Allowable work per braking	J	588	1,176	1,176

Model (R88M-) Item		Unit	200 VAC K1K020H K1K020T	200 VAC K1K520H K1K520T	200 VAC K2K020H K2K020T
Brake specifications	Allowable total work	J	7.8×10^{5}	1.5×10^{6}	1.5×10^{6}
	Allowable angular acceleration	rad/s^2	10,000		
	Brake limit	–	10 million times min.		
	Rating	–	Continuous		
	Insulation class	–	Type F		

Model (R88M-) Item		Unit	200 VAC K3K020H K3K020T	200 VAC K4K020H K4K020T	200 VAC K5K020H K5K020T
Rated output *1		W	3,000	4,000	5,000
Rated torque *1		N • m	14.3	19.1	23.9
Rated rotation speed		r/min	2,000		
Momentary maximum rotation speed		r/min	3,000		
Momentary maximum torque *1		N • m	43.0	57.3	71.6
Rated current *1		A (rms)	17.4	21.0	25.9
Momentary maximum current *1		A (0-p)	74	89	110
Rotor inertia	Without brake	kg • m^2	12.9×10^{-4}	37.6×10^{-4}	48.0×10^{-4}
	With brake	kg • m^2	14.2×10^{-4}	38.6×10^{-4}	48.8×10^{-4}
Applicable load inertia		–	10 times the rotor inertia max. *2		
Torque constant *1		N • m/A	0.59	0.70	0.70
Power rate *1	Without brake	kW/s	159	97.1	119
	With brake	kW/s	144	94.5	117
Mechanical time constant	Without brake	ms	0.57	0.65	0.63
	With brake	ms	0.63	0.66	0.64
Electrical time constant		ms	12	20	19
Allowable radial load *3		N	784	784	784
Allowable thrust load *3		N	343	343	343
Weight	Without brake	kg	Approx. 11.0	Approx. 15.5	Approx. 18.6
	With brake	kg	Approx. 12.6	Approx. 18.7	Approx. 21.8
Radiator plate dimensions (material)			380 × 350 × t30 (Al)	470 × 440 × t30 (Al)	
Applicable drives (R88D-)			KN30H-ML2	KN50H-ML2	KN50H-ML2

3

Specifications

Item		Unit	200 VAC K3K020H / K3K020T	200 VAC K4K020H / K4K020T	200 VAC K5K020H / K5K020T
Brake specifications	Brake inertia	kg • m^2	1.35×10^{-4}	4.7×10^{-4}	4.7×10^{-4}
	Excitation voltage *4	V	24 VDC ± 10%		
	Power consumption (at 20°C)	W	22	31	31
	Current consumption (at 20°C)	A	0.90±10%	1.3±10%	1.3±10%
	Static friction torque	N • m	16.2 min.	24.5 min.	24.5 min.
	Attraction time *5	ms	110 max.	80 max.	80 max.
	Release time *5	ms	50 max. *6	25 max. *7	25 max. *7
	Backlash		±1°		
	Allowable work per braking	J	1470	1372	1372
	Allowable total work	J	2.2×10^6	2.9×10^6	2.9×10^6
	Allowable angular acceleration	rad/s^2	10,000		
	Brake limit	–	10 million times min.		
	Rating	–	Continuous		
	Insulation class	–	Type F		

Item	Model (R88M-)	Unit	400 VAC K40020F / K40020C	K60020F / K60020C	K1K020F / K1K020C	K1K520F / K1K520C
Rated output *1		W	400	600	1,000	1,500
Rated torque *1		N • m	1.91	2.86	4.77	7.16
Rated rotation speed		r/min	2,000			
Momentary maximum rotation speed		r/min	3,000			
Momentary maximum torque *1		N • m	5.73	8.59	14.3	21.5
Rated current *1		A (rms)	1.2	1.5	2.8	4.7
Momentary maximum current *1		A (0-p)	4.9	6.5	12	20
Rotor inertia	Without brake	kg • m^2	1.61×10^{-4}	2.03×10^{-4}	4.60×10^{-4}	6.70×10^{-4}
Rotor inertia	With brake	kg • m^2	1.90×10^{-4}	2.35×10^{-4}	5.90×10^{-4}	7.99×10^{-4}
Applicable load inertia		–	10 times the rotor inertia max. *2			
Torque constant *1		N • m/A	1.27	1.38	1.27	1.16
Power rate *1	Without brake	kW/s	22.7	40.3	49.5	76.5
Power rate *1	With brake	kW/s	19.2	34.8	38.6	64.2
Mechanical time constant	Without brake	ms	0.70	0.62	0.79	0.66
Mechanical time constant	With brake	ms	0.83	0.72	1.01	0.79
Electrical time constant		ms	5.7	5.9	10	10
Allowable radial load *3		N	490	490	490	490
Allowable thrust load *3		N	196	196	196	196
Weight	Without brake	kg	Approx. 3.1	Approx. 3.5	Approx. 5.2	Approx. 6.7
Weight	With brake	kg	Approx. 4.1	Approx. 4.5	Approx. 6.7	Approx. 8.2
Radiator plate dimensions (material)			320 × 300 × t20 (Al)		275 × 260 × t15 (Al)	
Applicable drives (R88D-)			KN06F-ML2	KN06F-ML2	KN10F-ML2	KN15F-ML2
Brake specifications	Brake inertia	kg • m^2	1.35×10^{-4}	1.35×10^{-4}	1.35×10^{-4}	1.35×10^{-4}
Brake specifications	Excitation voltage *4	V	24 VDC ± 10%			
Brake specifications	Power consumption (at 20°C)	W	17	17	14	19
Brake specifications	Current consumption (at 20°C)	A	0.70±10%	0.70±10%	0.59±10%	0.79±10%
Brake specifications	Static friction torque	N • m	2.5 min.	2.5 min.	4.9 min.	13.7 min.
Brake specifications	Attraction time *5	ms	50 max.	50 max.	80 max.	100 max.
Brake specifications	Release time *5	ms	15 max. *7	15 max. *7	70 max. *6	50 max. *6
Brake specifications	Backlash		±1°			
Brake specifications	Allowable work per braking	J	392	392	588	1176
Brake specifications	Allowable total work	J	4.9×10^{5}	4.9×10^{5}	7.8×10^{5}	1.5×10^{6}
Brake specifications	Allowable angular acceleration	rad/s^2	10,000			
Brake specifications	Brake limit	–	10 million times min.			
Brake specifications	Rating	–	Continuous			
Brake specifications	Insulation class	–	Type F			

Model (R88M-) Item		Unit	400 VAC K2K020F K2K020C	K3K020F K3K020C	K4K020F K4K020C	K5K020F K5K020C
Rated output *1		W	2,000	3,000	4,000	5,000
Rated torque *1		N • m	9.55	14.3	19.1	23.9
Rated rotation speed		r/min	2,000			
Momentary maximum rotation speed		r/min	3,000			
Momentary maximum torque *1		N • m	28.7	43.0	57.3	71.6
Rated current *1		A (rms)	5.9	8.7	10.6	13.0
Momentary maximum current *1		A (0-p)	25	37	45	55
Rotor inertia	Without brake	kg • m^2	8.72×10^{-4}	12.9×10^{-4}	37.6×10^{-4}	48.0×10^{-4}
	With brake	kg • m^2	10.0×10^{-4}	14.2×10^{-4}	38.6×10^{-4}	48.8×10^{-4}
Applicable load inertia		–	10 times the rotor inertia max. *2			
Torque constant *1		N • m/A	1.27	1.18	1.40	1.46
Power rate *1	Without brake	kW/s	105	159	97.1	119
	With brake	kW/s	91.2	144	94.5	117
Mechanical time constant	Without brake	ms	0.68	0.56	0.60	0.60
	With brake	ms	0.78	0.61	0.61	0.61
Electrical time constant		ms	10	12	21	19
Allowable radial load *3		N	490	784	784	784
Allowable thrust load *3		N	196	343	343	343
Weight	Without brake	kg	Approx. 8.0	Approx. 11.0	Approx. 15.5	Approx. 18.6
	With brake	kg	Approx. 9.5	Approx. 12.6	Approx. 18.7	Approx. 21.8
Radiator plate dimensions (material)			275 × 260 × t15 (Al)	380 × 350 × t30 (Al)	470 × 440 × t30 (Al)	
Applicable drives (R88D-)			KN20F-ML2	KN30F-ML2	KN50F-ML2	KN50F-ML2

Model (R88M-)			400 VAC			
			K2K020F	K3K020F	K4K020F	K5K020F
Item		Unit	K2K020C	K3K020C	K4K020C	K5K020C
Brake specifications	Brake inertia	kg • m^2	1.35×10^{-4}	1.35×10^{-4}	4.7×10^{-4}	4.7×10^{-4}
	Excitation voltage *4	V	24 VDC ± 10%			
	Power consumption (at 20°C)	W	19	22	31	31
	Current consumption (at 20°C)	A	0.79±10%	0.90±10%	1.3±10%	1.3±10%
	Static friction torque	N • m	13.7 min.	16.2 min.	24.5 min.	24.5 min.
	Attraction time *5	ms	100 max.	110 max.	80 max.	80 max.
	Release time *5	ms	50 max. *6	50 max. *6	25 max. *7	25 max. *7
	Backlash		±1°			
	Allowable work per braking	J	1176	1470	1372	1372
	Allowable total work	J	1.5×10^{6}	2.2×10^{6}	2.9×10^{6}	2.9×10^{6}
	Allowable angular acceleration	rad/s^2	10,000			
	Brake limit	–	10 million times min.			
	Rating	–	Continuous			
	Insulation class	–	Type F			

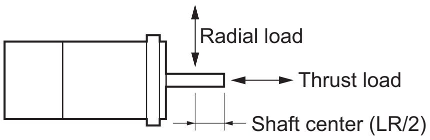
*1. These are the values when the motor is combined with a drive at normal temperature (20°C, 65%). The momentary maximum torque indicates the standard value.

*2. Applicable load inertia.

- The operable load inertia ratio (load inertia/rotor inertia) depends on the mechanical configuration and its rigidity. For a machine with high rigidity, operation is possible even with high load inertia. Select an appropriate motor and confirm that operation is possible.
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

*3. The allowable radial and thrust loads are the values determined for a limit of 20,000 hours at normal operating temperatures.

The allowable radial loads are applied as shown in the following diagram.



*4. This is a non-excitation brake. (It is released when excitation voltage is applied.)

*5. The operation time is the value (reference value) measured with a surge suppressor (CR50500 by Okaya Electric Industries Co., Ltd.).

*6. Direct current switching with a varistor (TNR9G820K by Nippon Chemi-Con Corporation).

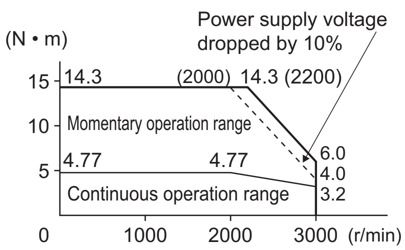
*7. Direct current switching with a varistor (Z15D151 by Ishizuka Electronics Co.).

Torque-Rotation Speed Characteristics for 2,000-r/min Motors

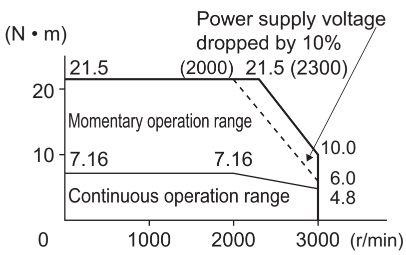
- 2,000-r/min motor (200 VAC)

The following graphs show the characteristics with a 3-m standard cable and a 200-VAC input.

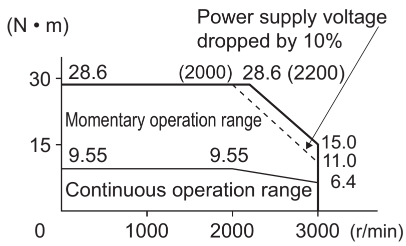
- R88M-K1K020H/T (1 kW)



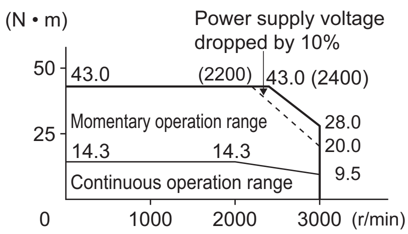
- R88M-K1K520H/T (1.5 kW)



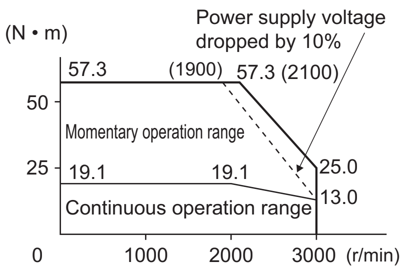
- R88M-K2K020H/T (2 kW)



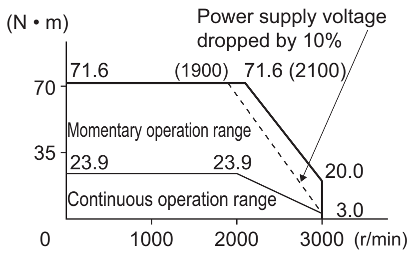
- R88M-K3K020H/T (3 kW)



- R88M-K4K020H/T (4 kW)



- R88M-K5K020H/T (5 kW)

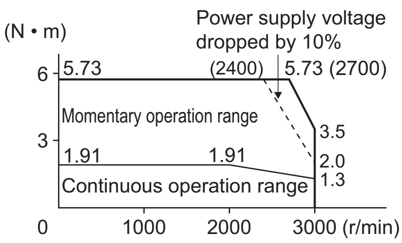


Note: The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

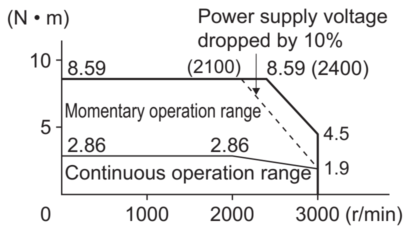
- 2,000-r/min motor (400 VAC)

  The following graphs show the characteristics with a 3-m standard cable and a 400-VAC input.

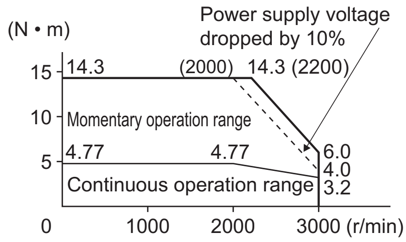
• R88M-K40020F/C (400 W)



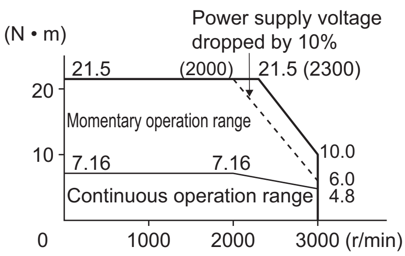
• R88M-K60020F/C (600 W)



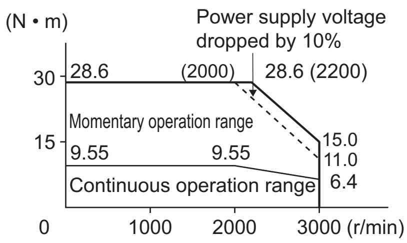
• R88M-K1K020F/C (1 kW)



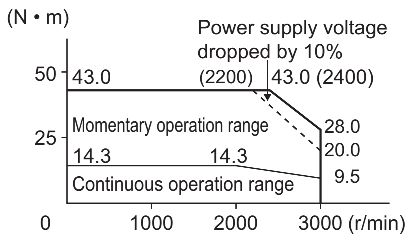
• R88M-K1K520F/C (1.5 kW)



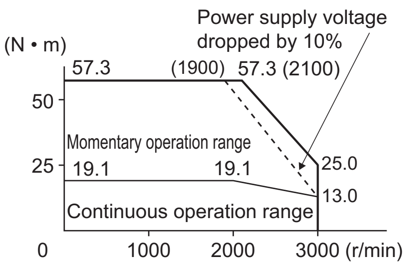
• R88M-K2K020F/C (2 kW)



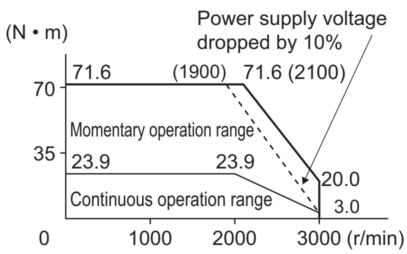
• R88M-K3K020F/C (3 kW)



• R88M-K4K020F/C (4 kW)



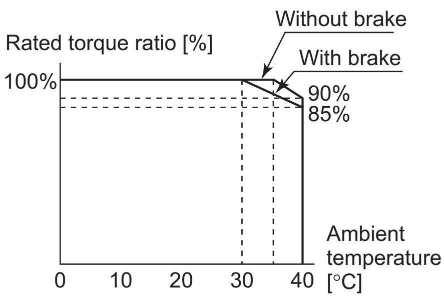
• R88M-K5K020F/C (5 kW)



Note:The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

Use the following Servomotors in the ranges shown in the graphs below. Using outside of these ranges may cause the motor to generate heat, which could result in encoder malfunction.

• R88M-K5K020H/T/F/C (5 kW)



1,000-r/min Motors

Model (R88M-) Item		Unit	200 VAC K90010H K90010T	K2K010H K2K010T	K3K010H K3K010T
Rated output *1		W	900	2,000	3,000
Rated torque *1		N • m	8.59	19.1	28.7
Rated rotation speed		r/min	1,000		
Momentary maximum rotation speed		r/min	2,000		
Momentary maximum torque *1		N • m	19.3	47.7	71.7
Rated current *1		A (rms)	7.6	17.0	22.6
Momentary maximum current *1		A (0-p)	24	60	80
Rotor inertia	Without brake	kg • m^2	6.70×10^{-4}	30.3×10^{-4}	48.4×10^{-4}
	With brake	kg • m^2	7.99×10^{-4}	31.4×10^{-4}	49.2×10^{-4}
Applicable load inertia		–	10 times the rotor inertia max. *2		
Torque constant *1		N • m/A	0.86	0.88	0.96
Power rate *1	Without brake	kW/s	110	120	170
	With brake	kW/s	92.4	116	167
Mechanical time constant	Without brake	ms	0.66	0.75	0.63
	With brake	ms	0.78	0.78	0.64
Electrical time constant		ms	11	18	21
Allowable radial load *3		N	686	1176	1470
Allowable thrust load *3		N	196	490	490
Weight	Without brake	kg	Approx. 6.7	Approx. 14.0	Approx. 20.0
	With brake	kg	Approx. 8.2	Approx. 17.5	Approx. 23.5
Radiator plate dimensions (material)			270 × 260 × t15 (Al)		
Applicable drives (R88D-)			KN15H-ML2	KN30H-ML2	KN50H-ML2
Brake specifications	Brake inertia	kg • m^2	1.35×10^{-4}	4.7×10^{-4}	4.7×10^{-4}
	Excitation voltage *4	V	24 VDC ± 10%		
	Power consumption (at 20°C)	W	19	31	34
	Current consumption (at 20°C)	A	0.79±10%	1.3±10%	1.4±10%
	Static friction torque	N • m	13.7 min.	24.5 min.	58.8 min.
	Attraction time *5	ms	100 max.	80 max.	150 max.
	Release time *5	ms	50 max. *6	25 max. *7	50 max. *7
	Backlash		±1°		

Model (R88M-)			200 VAC		
			K90010H	K2K010H	K3K010H
Item		Unit	K90010T	K2K010T	K3K010T
Brake specifications	Allowable work per braking	J	1176	1372	1372
	Allowable total work	J	1.5×10^6	2.9×10^6	2.9×10^6
	Allowable angular acceleration	rad/s^2	10,000		
	Brake limit	–	10 million times min.		
	Rating	–	Continuous		
	Insulation class	–	Type F		

Model (R88M-)			400 VAC		
			K90010F	K2K010F	K3K010F
Item		Unit	K90010C	K2K010C	K3K010C
Rated output *1		W	900	2,000	3,000
Rated torque *1		N • m	8.59	19.1	28.7
Rated rotation speed		r/min	1,000		
Momentary maximum rotation speed		r/min	2,000		
Momentary maximum torque *1		N • m	19.3	47.7	71.7
Rated current *1		A (rms)	3.8	8.5	11.3
Momentary maximum current *1		A (0-p)	12	30	40
Rotor inertia	Without brake	$kg \cdot m^2$	6.70×10^{-4}	30.3×10^{-4}	48.4×10^{-4}
	With brake	$kg \cdot m^2$	7.99×10^{-4}	31.4×10^{-4}	49.2×10^{-4}
Applicable load inertia		–	10 times the rotor inertia max. *2		
Torque constant *1		N • m/A	1.72	1.76	1.92
Power rate *1	Without brake	kW/s	110	120	170
	With brake	kW/s	92.4	116	167
Mechanical time constant	Without brake	ms	0.66	0.76	0.61
	With brake	ms	0.79	0.78	0.62
Electrical time constant		ms	11	18	22
Allowable radial load *3		N	686	1176	1470
Allowable thrust load *3		N	196	490	490
Weight	Without brake	kg	Approx. 6.7	Approx. 14.0	Approx. 20.0
	With brake	kg	Approx. 8.2	Approx. 17.5	Approx. 23.5
Radiator plate dimensions (material)			270 × 260 × t15 (Al)	470 × 440 × t30 (Al)	
Applicable drives (R88D-)			KN15F-ML2	KN30F-ML2	KN50F-ML2

3

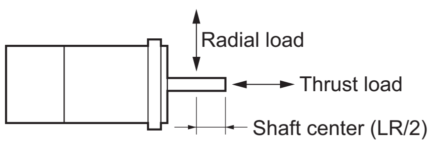
Specifications

Model (R88M-)			400 VAC		
			K90010F	K2K010F	K3K010F
Item		Unit	K90010C	K2K010C	K3K010C
Brake specifications	Brake inertia	kg • m^2	1.35×10^{-4}	4.7×10^{-4}	4.7×10^{-4}
	Excitation voltage *4	V	24 VDC ± 10%		
	Power consumption (at 20°C)	W	19	31	34
	Current consumption (at 20°C)	A	0.79±10%	1.3±10%	1.4±10%
	Static friction torque	N • m	13.7 min.	24.5 min.	58.8 min.
	Attraction time *5	ms	100 max.	80 max.	150 max.
	Release time *5	ms	50 max. *6	25 max. *7	50 max. *7
	Backlash		±1°		
	Allowable work per braking	J	1176	1372	1372
	Allowable total work	J	1.5×10^{6}	2.9×10^{6}	2.9×10^{6}
	Allowable angular acceleration	rad/s^2	10,000		
	Brake limit	–	10 million times min.		
	Rating	–	Continuous		
	Insulation class	–	Type F		

*1. These are the values when the motor is combined with a drive at normal temperature (20°C, 65%). The momentary maximum torque indicates the standard value.

*2. Applicable load inertia.
- The operable load inertia ratio (load inertia/rotor inertia) depends on the mechanical configuration and its rigidity. For a machine with high rigidity, operation is possible even with high load inertia. Select an appropriate motor and confirm that operation is possible.
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

*3. The allowable radial and thrust loads are the values determined for a limit of 20,000 hours at normal operating temperatures.
The allowable radial loads are applied as shown in the following diagram.



*4. This is a non-excitation brake. (It is released when excitation voltage is applied.)

*5. The operation time is the value (reference value) measured with a surge suppressor (CR50500 by Okaya Electric Industries Co., Ltd.).

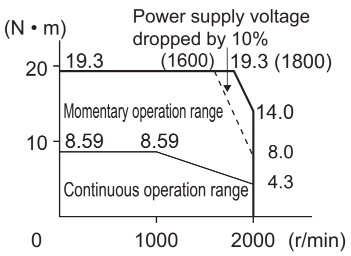
*6. Direct current switching with a varistor (TNR9G820K by Nippon Chemi-Con Corporation).

*7. Direct current switching with a varistor (Z15D151 by Ishizuka Electronics Co.).

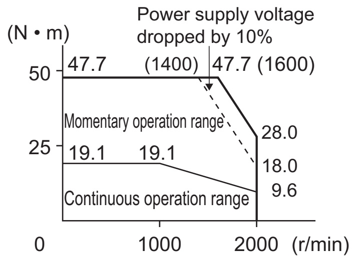
Torque-Rotation Speed Characteristics for 1,000-r/min Motors

- 1,000-r/min motor (200/400 VAC)
  The following graphs show the characteristics with a 3-m standard cable and a 200-VAC input.

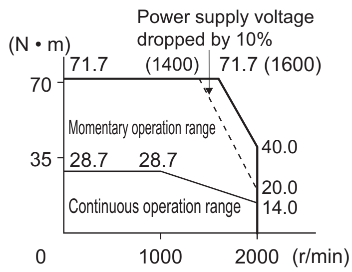
• R88M-K90010H/T/F/C
(900 W)



• R88M-K2K010H/T/F/C
(2 kW)



• R88M-K3K010H/T/F/C
(3 kW)



Note:The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

Temperature Characteristics of the Motor and Mechanical System

- OMNUC G5-Series AC Servomotors use rare earth magnets (neodymium-iron magnets). The temperature coefficient for these magnets is approx. -0.13%/°C.
  As the temperature drops, the motor's momentary maximum torque increases, and as the temperature rises, the motor's momentary maximum torque decreases.
- The momentary maximum torque rises by 4% at a normal temperature of 20°C compared to a temperature of -10°C. Conversely, the momentary maximum torque decreases about 8% when the magnet warms up to 80°C from the normal temperature.
- Generally, when the temperature drops in a mechanical system, the friction torque and the load torque increase. For that reason, overloading may occur at low temperatures.
  In particular, in systems that use a Decelerator, the load torque at low temperatures may be nearly twice as much as the load torque at normal temperatures.
  Check whether overloading may occur during starting at low temperature.
  Also check to see whether abnormal motor overheating or alarms occur at high temperatures.
- An increase in load friction torque seemingly increases load inertia.
  Therefore, even if the drive gains are adjusted at a normal temperature, the motor may not operate properly at low temperatures. Check to see whether there is optimal operation even at low temperatures.

3

Specifications

Encoder Specifications

Incremental Encoder Specifications

Item	Specifications
Encoder system	Optical encoder
	20 bits
Number of output pulses	Phases A and B: 262,144 pulses/rotation Phase Z: 1 pulse/rotation
Power supply voltage	5 VDC ± 5%
Power supply current	180 mA (max.)
Output signals	+S, –S
Output interface	RS485 compliance

Absolute Encoder Specifications

Item	Specifications
Encoder system	Optical encoder
	17 bits
Number of output pulses	Phases A and B: 32,768 pulses/rotation Phase Z: 1 pulse/rotation
Maximum rotations	–32,768 to +32,767 rotations
Power supply voltage	5 VDC ± 5%
Power supply current	110 mA (max.)
Applicable battery voltage	3.6 VDC
Current consumption of battery	265 μA (for a maximum of 5 s right after power interruption) 100 μA (for operation during power interruption) 3.6 μA (when power is supplied to the drive)
Output signals	+S, –S
Output interface	RS485 compliance

Note: Multi-rotation Data Backup

- The multi-rotation data will be lost if the battery cable connector is disconnected at the motor when connecting the battery cable for the absolute encoder and battery.
- If you do not use an absolute encoder battery cable and connect the battery to CN1, the multi-rotation data will be lost if CN2 is disconnected.

3-4 Cable and Connector Specifications

This section specifies the cables and connectors that are used to connect the Servo Drive and the Servomotor. Select ones in accordance with the Servomotor specifications.

Encoder Cable Specifications

These cables are used to connect the encoder between a drive and a motor. Select the cable matching the motor. All cables and motors listed are flexible, shielded and have IP67 protection.

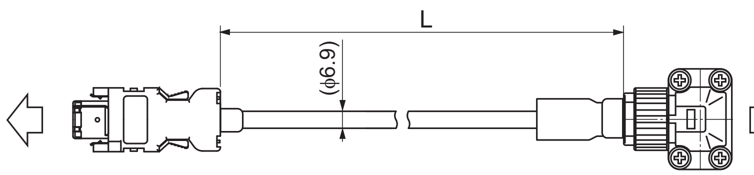
Encoder Cables (Flexible Cables)

R88A-CRKAxCR-E

Cable types
(For both absolute encoders and incremental encoders: [100 V and 200 V] For 3,000-r/min motors of 50 to 750 W)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CRKA001-5CR-E	1.5 m	6.9 dia.	Approx. 0.1 kg
R88A-CRKA003CR-E	3 m		Approx. 0.1 kg
R88A-CRKA005CR-E	5 m		Approx. 0.2 kg
R88A-CRKA010CR-E	10 m		Approx. 0.4 kg
R88A-CRKA015CR-E	15 m		Approx. 0.6 kg
R88A-CRKA020CR-E	20 m		Approx. 0.8 kg

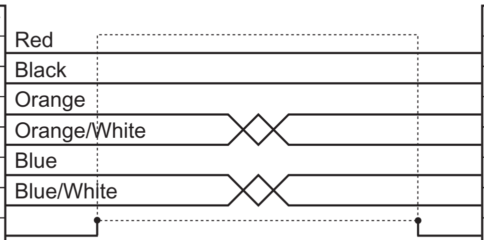
Connection configuration and external dimensions



Wiring

Drive side

Symbol	Number
E5V	1
E0V	2
BAT+	3
BAT−	4
S+	5
S−	6
FG	Shell



Motor side

Number	Symbol
6	E5V
3	E0V
5	BAT+
2	BAT−
7	S+
4	S−
1	FG

[Drive side connector]
Connector model
55100-0670 (Molex Japan)

Cable
0.34 mm^2 × 2C + 0.22 mm^2 × 2P
or
AWG22 × 2C + AWG24 × 2P

[Motor side connector]
Angle clamp model
JN6FR07SM1 (Japan Aviation Electronics)
Connector pin model
LY10-C1-A1-1000 (Japan Aviation Electronics)

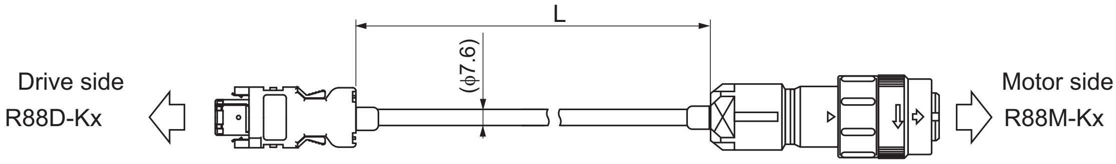
R88A-CRKCxNR

Cable types

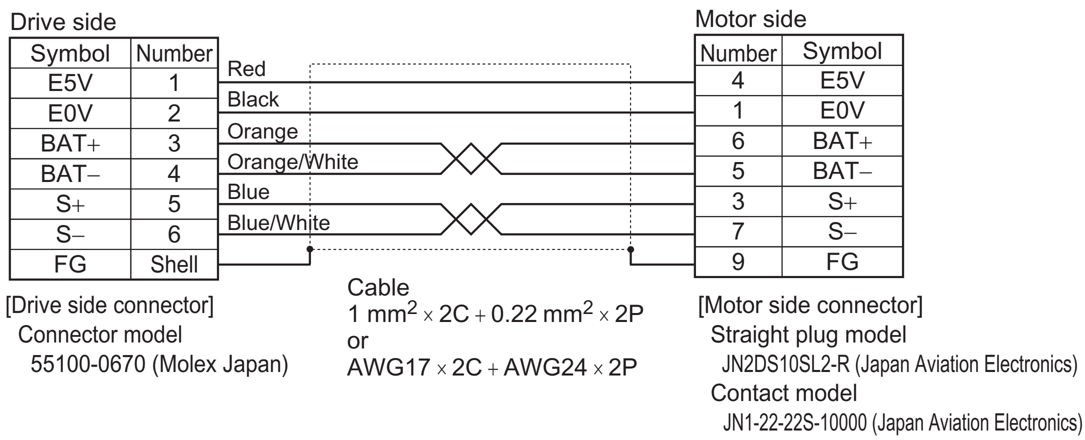
(For both absolute encoders and incremental encoders: [100 V and 200 V] For 3,000-r/min motors of 1 kW or more, [400 V] 3,000-r/min motors, 2,000-r/min motors and 1,000-r/min motors)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CRKC001-5NR-E	1.5 m	7.6 dia.	Approx. 0.1 kg
R88A-CRKC003NR-E	3 m		Approx. 0.2 kg
R88A-CRKC005NR-E	5 m		Approx. 0.4 kg
R88A-CRKC010NR-E	10 m		Approx. 0.7 kg
R88A-CRKC015NR-E	15 m		Approx. 1.1 kg
R88A-CRKC020NR-E	20 m		Approx. 1.5 kg

Connection configuration and external dimensions



Wiring



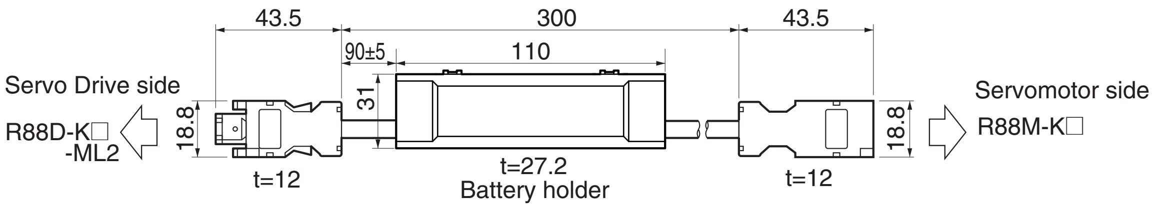
Absolute Encoder Battery Cable Specifications

Use the following Cable when using an absolute encoder.

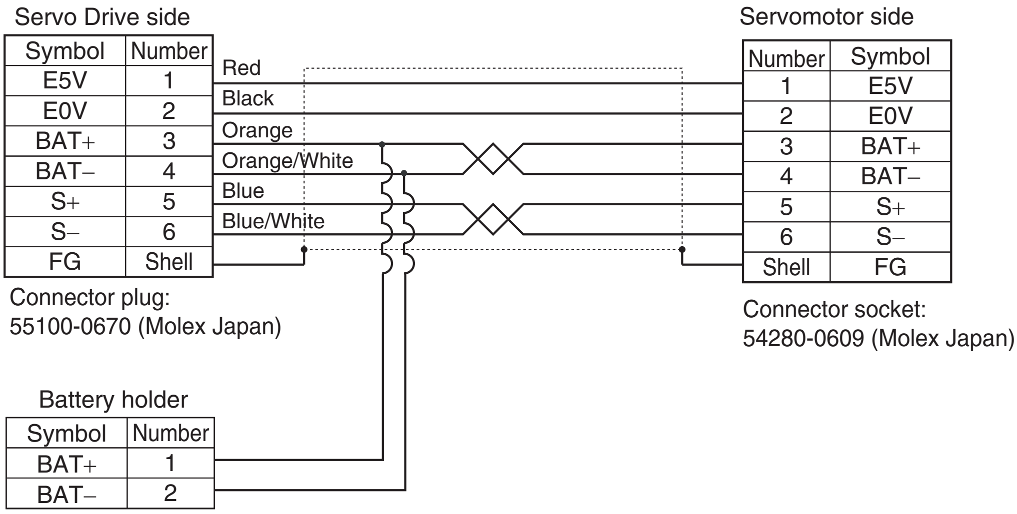
Cable Model

Model	Length (L)	Battery	Weight
R88A-CRGD0R3C	0.3 m	Not included	Approx. 0.1 kg
R88A-CRGD0R3C-BS	0.3 m	R88A-BAT01G 1 included	Approx. 0.1 kg

Connection Configuration and External Dimensions



Wiring



Motor Power Cable Specifications

These cables connect the drive and motor. Select the cable matching the motor.

All cables and connectors listed are flexible, shielded and have IP67 protection.

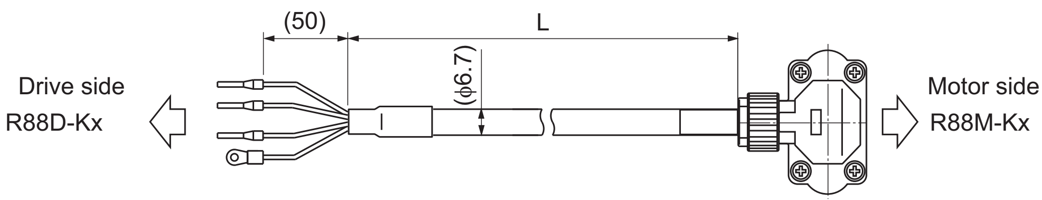
Power Cables without Brakes (Flexible Cables)

R88A-CAKAxSR-E

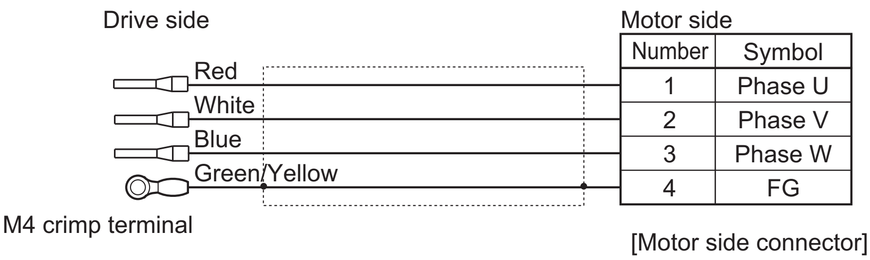
Cable types
[100 V and 200 V] (For 3,000-r/min motors of 50 to 750 W)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CAKA001-5SR-E	1.5 m	6.7 dia.	Approx. 0.1 kg
R88A-CAKA003SR-E	3 m		Approx. 0.2 kg
R88A-CAKA005SR-E	5 m		Approx. 0.3 kg
R88A-CAKA010SR-E	10 m		Approx. 0.5 kg
R88A-CAKA015SR-E	15 m		Approx. 0.7 kg
R88A-CAKA020SR-E	20 m		Approx. 1.0 kg

Connection configuration and external dimensions



Wiring



Cable
0.5 mm^2 × 4C or AWG20 × 4C

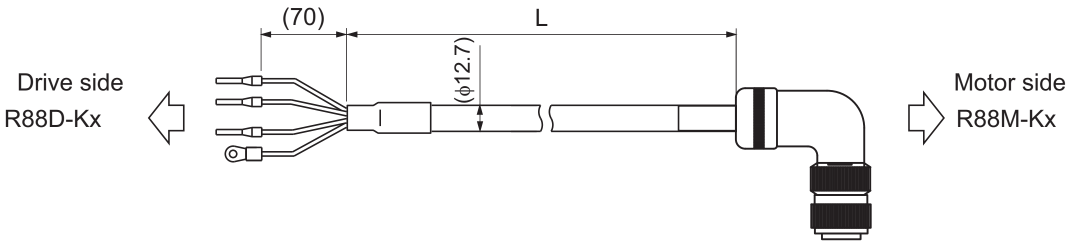
[Motor side connector]
Angle plug model
JN8FT04SJ1 (Japan Aviation Electronics)
Connector pin model
ST-TMH-S-C1B-3500-A534G (Japan Aviation Electronics)

R88A-CAGBxSR-E

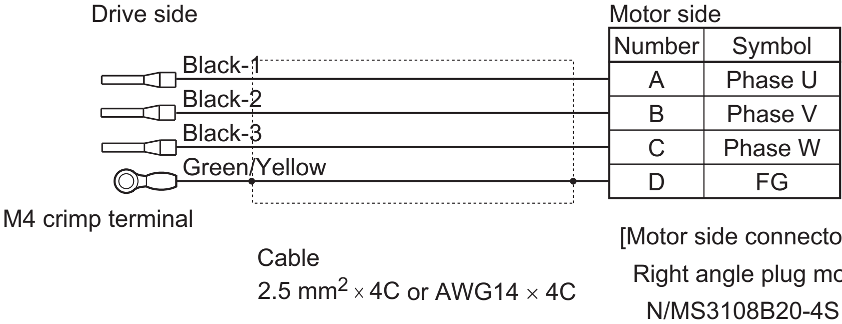
Cable types
200 V:
(For 3,000-r/min motors of 1 to 2 kW, 2,000-r/min motors of 1 to 2 kW, 1,000-r/min motors of 900 W)
400 V:
(For 3,000-r/min motors of 750W to 2 kW, 2,000-r/min motors of 400 W to 2 kW, 1,000-r/min motors of 900 W)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CAGB001-5SR-E	1.5 m	12.7 dia.	Approx. 0.5 kg
R88A-CAGB003SR-E	3 m		Approx. 0.8 kg
R88A-CAGB005SR-E	5 m		Approx. 1.3 kg
R88A-CAGB010SR-E	10 m		Approx. 2.4 kg
R88A-CAGB015SR-E	15 m		Approx. 3.5 kg
R88A-CAGB020SR-E	20 m		Approx. 4.6 kg

Connection configuration and external dimensions



Wiring



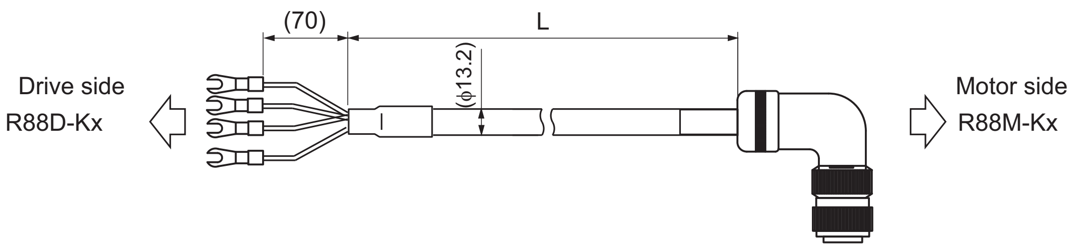
[Motor side connector]
Right angle plug model
N/MS3108B20-4S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-12A (Japan Aviation Electronics)

R88A-CAGDxSR-E

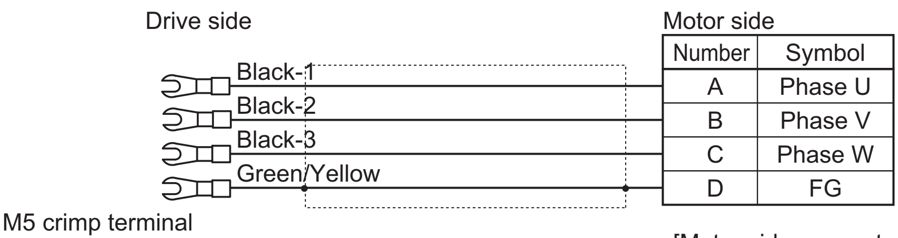
Cable types
(For 3,000-r/min motors of 3 to 5 kW, 2,000-r/min motors of 3 to 5 kW, 1,000-r/min motors of 2 to 3 kW)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CAGD001-5SR-E	1.5 m	13.2 dia.	Approx. 0.8 kg
R88A-CAGD003SR-E	3 m		Approx. 1.4 kg
R88A-CAGD005SR-E	5 m		Approx. 2.2 kg
R88A-CAGD010SR-E	10 m		Approx. 4.2 kg
R88A-CAGD015SR-E	15 m		Approx. 6.3 kg
R88A-CAGD020SR-E	20 m		Approx. 8.3 kg

Connection configuration and external dimensions



Wiring



Cable
4 mm^2 × 4C or AWG11 × 4C

[Motor side connector]
Right angle plug model
N/MS3108B22-22S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-12A (Japan Aviation Electronics)

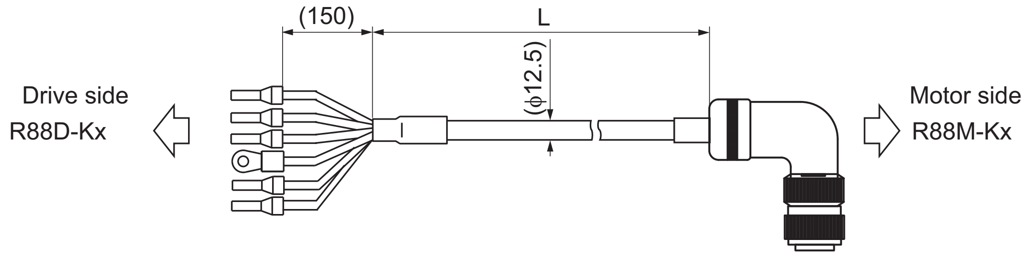
Power Cables with Brakes (Flexible Cables)

R88A-CAGBxBR-E

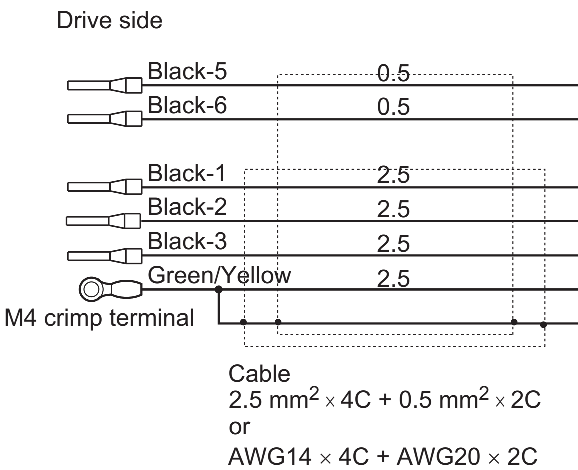
Cable types
200 V:
(For 3,000-r/min motors of 1 to 2 kW, 2,000-r/min motors of 1 to 2 kW, 1,000-r/min motors of 900 W)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CAGB001-5BR-E	1.5 m	12.5 dia.	Approx. 0.5 kg
R88A-CAGB003BR-E	3 m		Approx. 0.9 kg
R88A-CAGB005BR-E	5 m		Approx. 1.5 kg
R88A-CAGB010BR-E	10 m		Approx. 2.8 kg
R88A-CAGB015BR-E	15 m		Approx. 4.2 kg
R88A-CAGB020BR-E	20 m		Approx. 5.5 kg

Connection configuration and external dimensions



Wiring



Number	Symbol
G	Brake
H	Brake
A	NC
F	Phase U
I	Phase V
B	Phase W
E	FG
D	FG
C	NC

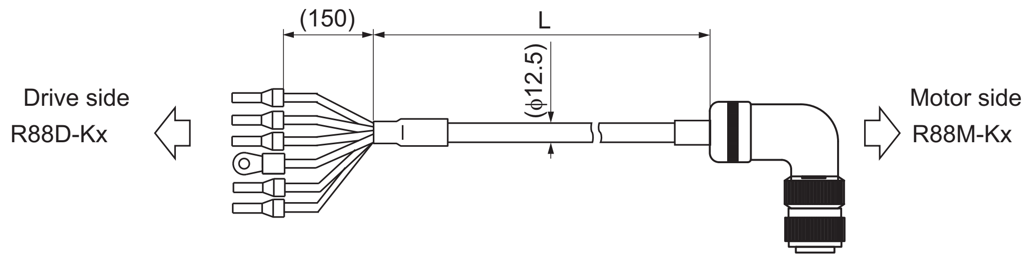
[Motor side connector]
Right angle plug model
N/MS3108B20-18S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-12A (Japan Aviation Electronics)

R88A-CAKFxBR-E

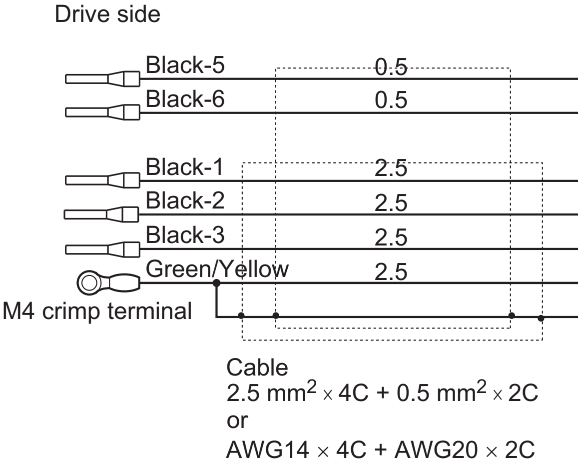
Cable types
400 V:
(For 3,000-r/min motors of 750W to 2 kW, 2,000-r/min motors of 400 W to 2 kW, 1,000-r/min motors of 900 W)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CAKF001-5BR-E	1.5 m	12.5 dia.	Approx. 0.6 kg
R88A-CAKF003BR-E	3 m		Approx. 1.0 kg
R88A-CAKF005BR-E	5 m		Approx. 1.5 kg
R88A-CAKF010BR-E	10 m		Approx. 2.7 kg
R88A-CAKF015BR-E	15 m		Approx. 4.0 kg
R88A-CAKF020BR-E	20 m		Approx. 5.3 kg

Connection configuration and external dimensions



Wiring



Number	Symbol
A	Brake
B	Brake
I	NC
D	Phase U
E	Phase V
F	Phase W
G	FG
H	FG
C	NC

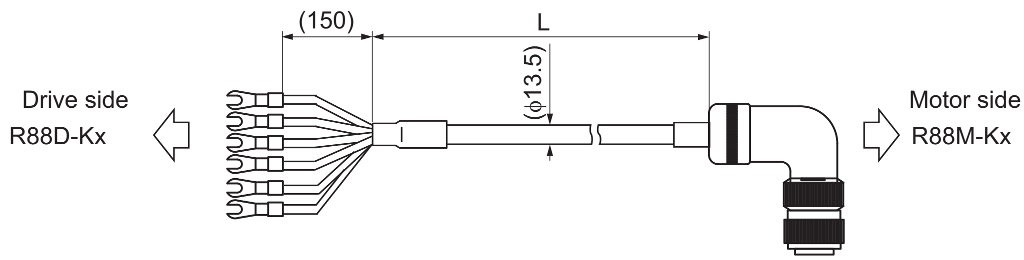
[Motor side connector]
Right angle plug model
N/MS3108B24-11S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-16A (Japan Aviation Electronics)

R88A-CAGDxBR-E

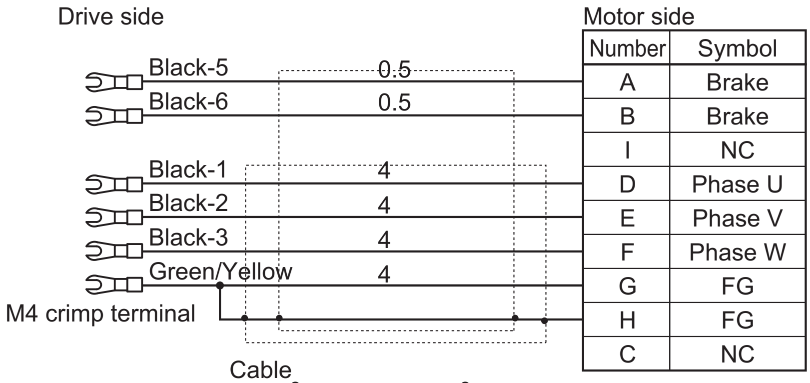
Cable types
(For 3,000-r/min motors of 3 to 5 kW, 2,000-r/min motors of 3 to 5 kW, 1,000-r/min motors of 2 to 3 kW)

Model	Length (L)	Outer diameter of sheath	Weight
R88A-CAGD001-5BR-E	1.5 m	13.5 dia.	Approx. 0.9 kg
R88A-CAGD003BR-E	3 m		Approx. 1.6 kg
R88A-CAGD005BR-E	5 m		Approx. 2.5 kg
R88A-CAGD010BR-E	10 m		Approx. 4.7 kg
R88A-CAGD015BR-E	15 m		Approx. 7.0 kg
R88A-CAGD020BR-E	20 m		Approx. 9.2 kg

Connection configuration and external dimensions



Wiring



Cable
4 mm^2 × 4C + 0.5 mm^2 × 2C
or
AWG11 × 4C + AWG20 × 2C

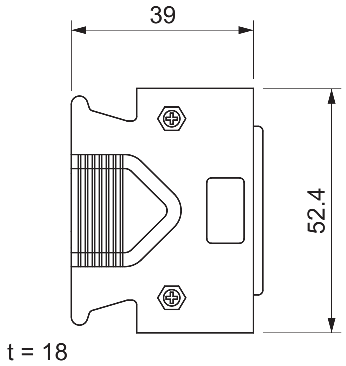
[Motor side connector]
Right angle plug model
N/MS3108B24-11S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-16A (Japan Aviation Electronics)

Connector Specifications

Control I/O Connector (R88A-CNW01C)

This is the connector to be connected to the drive's control I/O connector (CN1).
Use this connector when preparing a control cable by yourself.

Dimensions



Connector plug model
10150-3000PE (Sumitomo 3M)
Connector case model
10350-52A0-008 (Sumitomo 3M)

Encoder Connectors

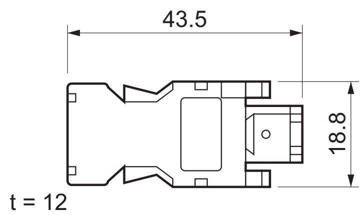
These connectors are used for encoder cables.
Use them when preparing an encoder cable by yourself.

Dimensions

R88A-CNW01R (Drive's CN2 side)

This connector is a soldering type.
Use the following cable.

- Applicable wire: AWG16 max.
- Insulating cover outer diameter: 2.1 mm dia. max.
- Outer diameter of sheath: 6.7 ± 0.5 mm dia.

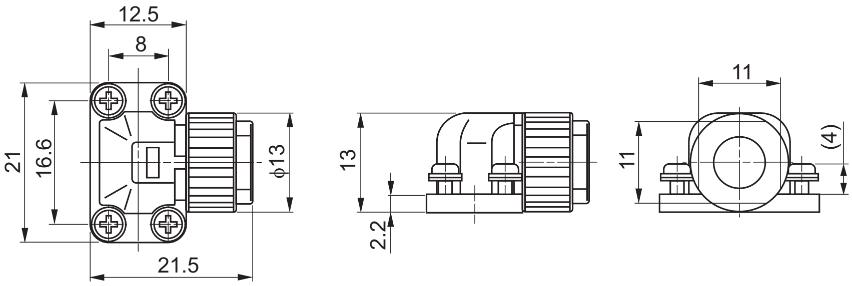


Connector plug model
55100-0670 (Molex Japan)

R88A-CNK02R (motor side) **ABS**
Use the following cable.

- Applicable wire: AWG22 max.
- Insulating cover outer diameter: 1.3 mm dia. max.
- Outer diameter of sheath: 5 ± 0.5 mm dia.

Adaptive motors
100-V, 3,000-r/min motors of 50 to 400 W
200-V, 3,000-r/min motors of 50 to 750 W



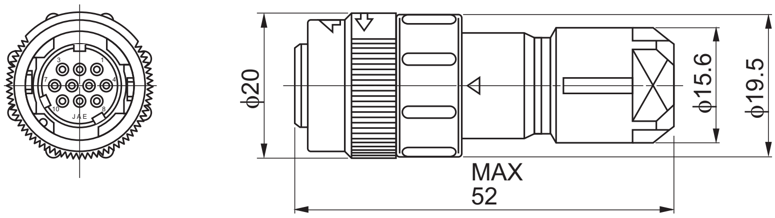
Angle clamp model JN6FR07SM1
(Japan Aviation Electronics)
Connector pin model LY10-C1-A1-10000
(Japan Aviation Electronics)

The cable direction from the angle plug can be reversed.

R88A-CNK04R (motor side) **ABS**
Use the following cable.

- Applicable wire: AWG20 max.
- Outer diameter of sheath: 6.5 to 8.0 dia.

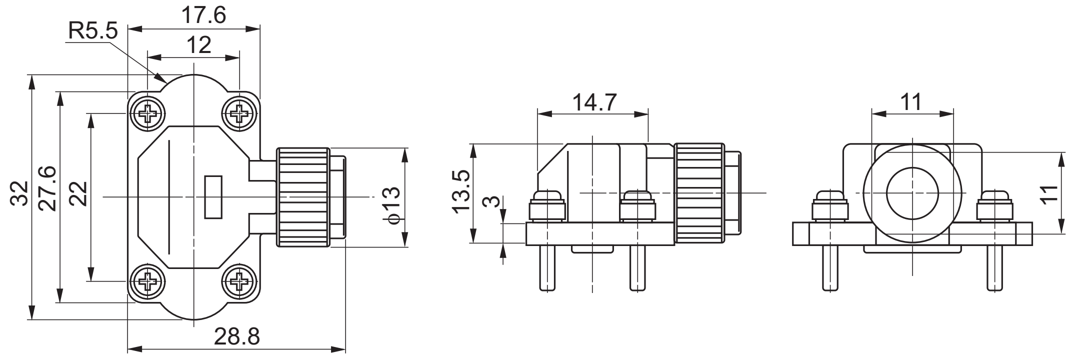
Adaptive motors
200-V, 3,000-r/min motors of 1.0 to 5.0 kW
200-V, 2,000-r/min motors of all capacities
200-V, 1,000-r/min motors of all capacities
400-V, 3,000-r/min motors of all capacities
400-V, 2,000-r/min motors of all capacities
400-V, 1,000-r/min motors of all capacities



Straight plug model JN2DS10SL2-R
(Japan Aviation Electronics)
Contact model JN1-22-22S-PKG100
(Japan Aviation Electronics)

Power Cable Connector (R88A-CNK11A)

This connector is used for power cables.
Use it when preparing a power cable by yourself.

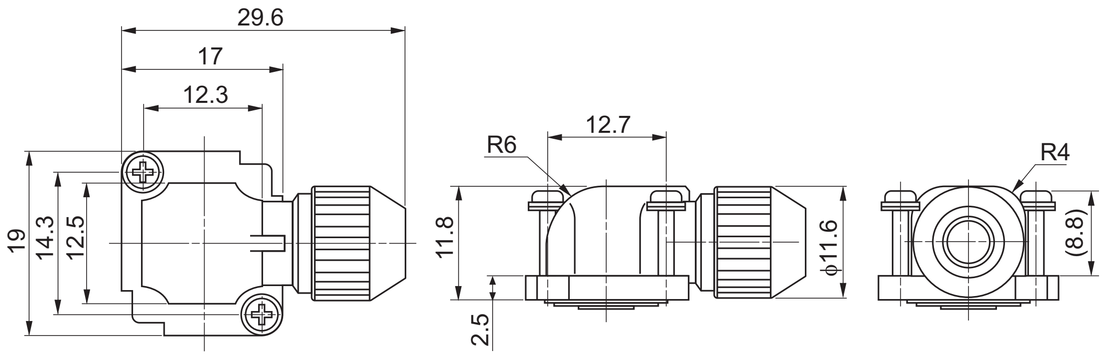


Angle plug model JN8FT04SJ1
(Japan Aviation Electronics)
Socket contact model ST-TMH-S-C1B-3500-(A534G)
(Japan Aviation Electronics)

The cable direction from the angle plug can be reversed.
Note. If you reverse the direction, you cannot attach the Connector to Servomotors of 50 W and 100 W.

Brake Cable Connector (R88A-CNK11B)

This connector is used for brake cables.
Use it when preparing a brake cable by yourself.



Angle plug model JN4FT02SJ1-R
(Japan Aviation Electronics)
Socket contact model ST-TMH-S-C1B-3500-(A534G)
(Japan Aviation Electronics)

The cable direction from the angle plug can be reversed.

3

Specifications

Analog Monitor Cable Specifications

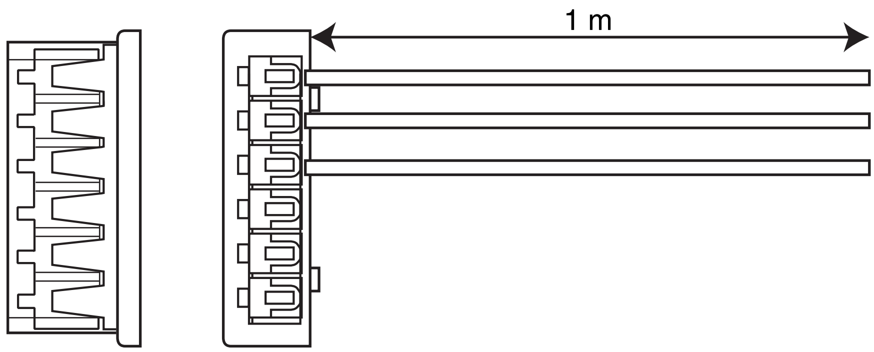
Analog Monitor Cable (R88A-CMK001S)

Connection configuration and external dimensions

Symbol	No.	
AM1	1	Red
AM2	2	White
GND	3	Black
	4	
	5	
	6	

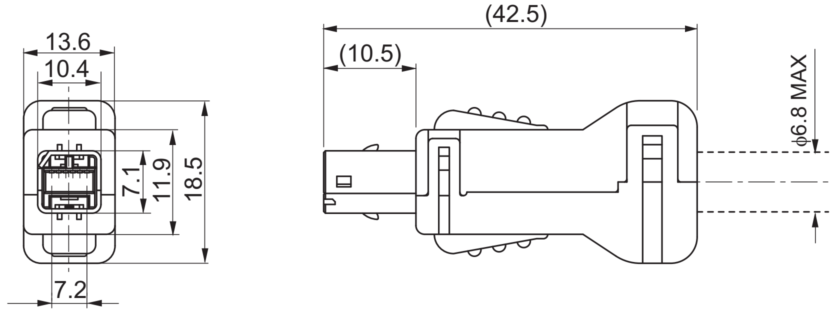
Cable: AWG24 × 3C UL1007

Connector housing: 51004-0600 (Molex Japan)
Connector terminal: 50011-8000 (Molex Japan)



External Encoder Connector (R88A-CNK41L)

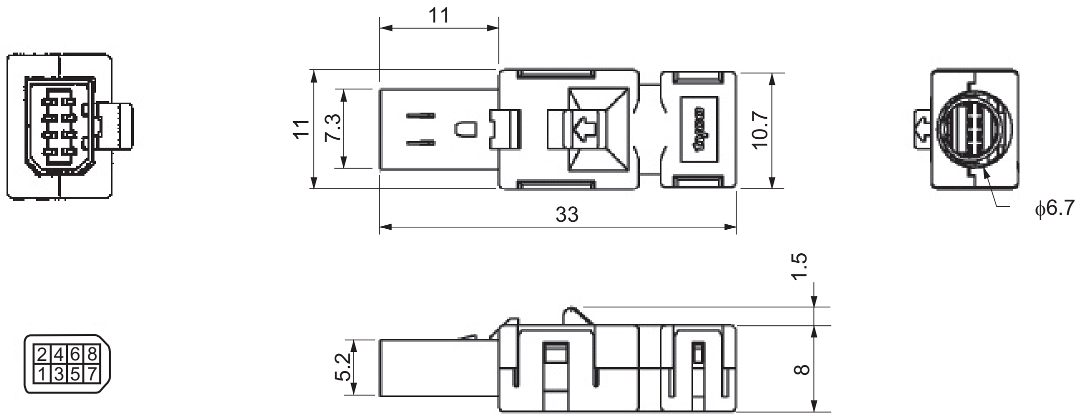
Use this connector to connect to an external encoder in full closing control.



Connector plug model
MUF-PK10K-X (J.S.T. Mfg. Co., Ltd.)

Safety I/O Signal Connector (R88A-CNK81S)

Use this connector to connect to safety devices.



Note:For information on wiring, refer to "Safety Connector Specifications (CN8)"(P.3-30).

MECHATROLINK-II Communications Cable Specifications

The MECHATROLINK-II Communications Cable is equipped with a connector on each end and a core.

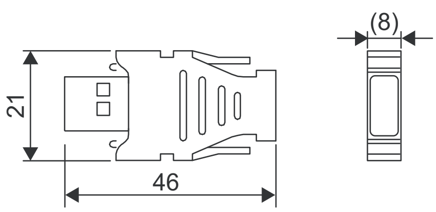
Cable Types

Name	Model	Length (L)
MECHATROLINK-II Communications Cable	FNY-W6003-A5	0.5 m
	FNY-W6003-01	1 m
	FNY-W6003-03	3 m
	FNY-W6003-05	5 m
	FNY-W6003-10	10 m
	FNY-W6003-20	20 m
	FNY-W6003-30	30 m
MECHATROLINK-II Terminating Resistor	FNY-W6022	–

Connection Configuration and Dimensions

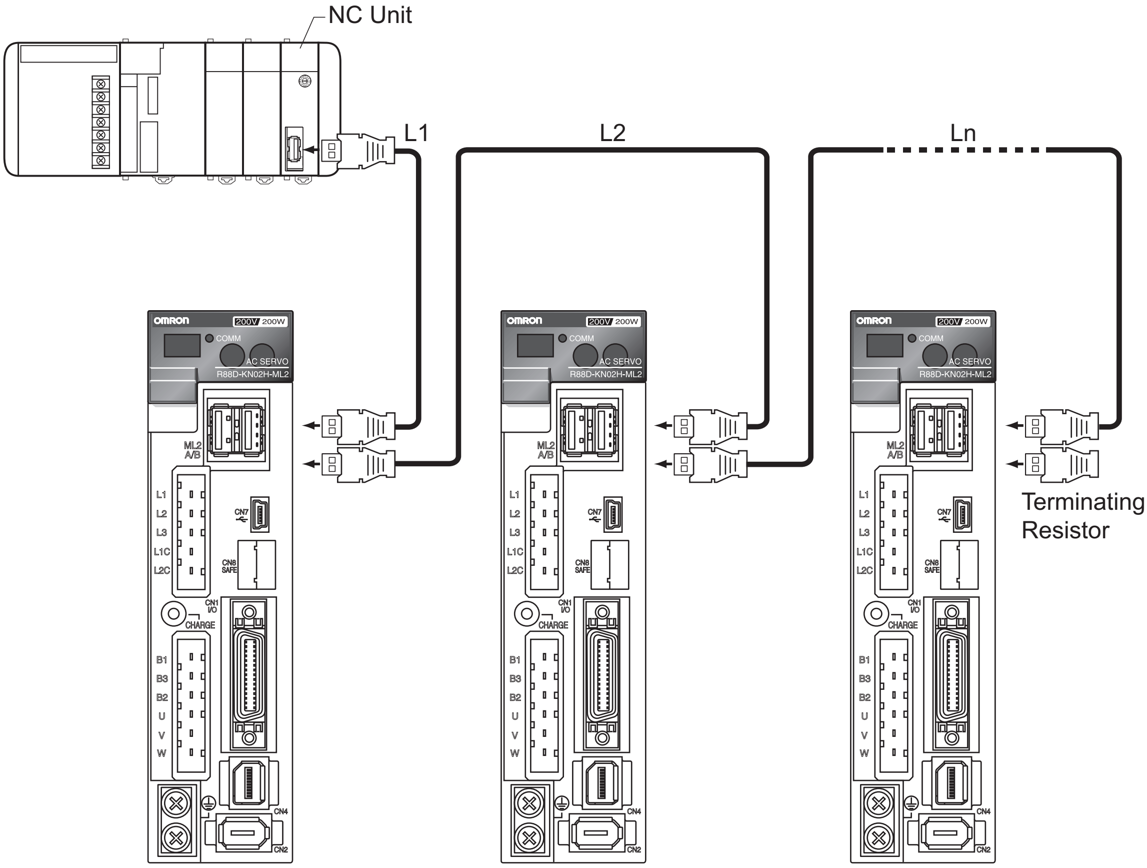
MECHATROLINK-II Communications Cable

MECHATROLINK-II Terminating Resistor



Wiring

This is an example to connect a host controller and the Servo Drive by the MECHATROLINK-II Communications Cable.



Note 1.The cable between the two nodes (L1, L2 ... or Ln) must be 0.5 m or longer.

Note 2.The total length of the cable (L1 + L2 + ... Ln) must be equal to or shorter than 50 m.

Control Cable Specifications

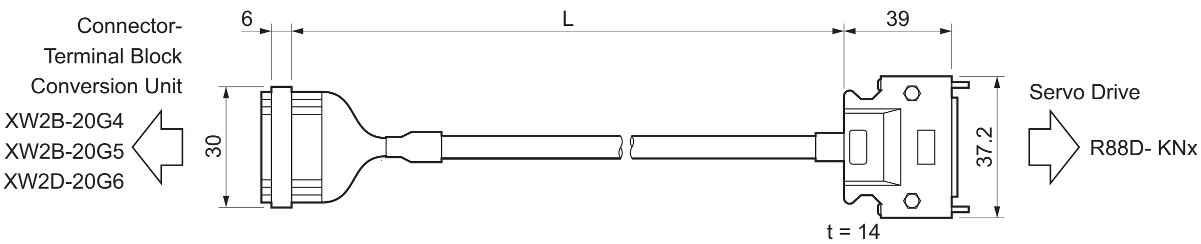
Cables for Servo Drives (XW2Z-xJ-B34)

These are the cables to connect to the connector terminal blocks for the G5-series Servo Drives (Built-in MECHATROLINK-II Communications type).

Cable Types

Model	Length (L)	Outer diameter of sheath	Weight
XW2Z-100J-B34	1 m	8.8 dia.	Approx. 0.1 kg
XW2Z-200J-B34	2 m		Approx. 0.2 kg

Connection Configuration and Dimensions



Wiring

Terminal block connector / Servo Drive connector (CN1)

Signal	No.	No.	Signal
+24 V	1	6	+24 VIN
0 V	2		
+24 V	3		
0 V	4		
+24 V	5		
0 V	6		
STOP	7	5	STOP
DEC	8	9	DEC
POT	9	7	POT
NOT	10	8	NOT
EXT3	11	10	EXT3
EXT2	12	11	EXT2
EXT1	13	12	EXT1
BATGND	14	15	BATGND
BAT	15	14	BAT
BKIRCOM	16	2	BKIRCOM
BKIR	17	1	BKIR
ALMCOM	18	4	ALMCOM
ALM	19	3	ALM
FG	20	Shell	FG

[Servo Drive Connector]
Connector plug:
10126-3000PE (Sumitomo 3M)
Connector case:
10326-52A0-008 (Sumitomo 3M)

[Terminal Block Connector]
Connector socket:
XG4M-2030 (OMRON)
Strain relief:
XG4T-2004 (OMRON)

[Cable]
AWG28 × 3P + AWG28 × 8C UL2464

* Before you use, confirm that the signals of Servo Drive connector are set as shown above.

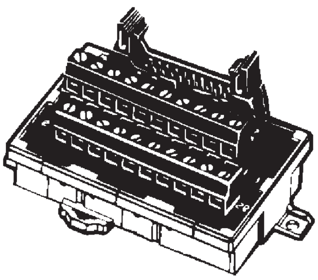
Connector-Terminal Block Conversion Unit (XW2B-20Gx)

The Unit is used with a Connector Terminal Block Cable (XW2Z-xJ-B34). They convert the control input signal (CN1) of the G5-series Servo Drive into a terminal block.

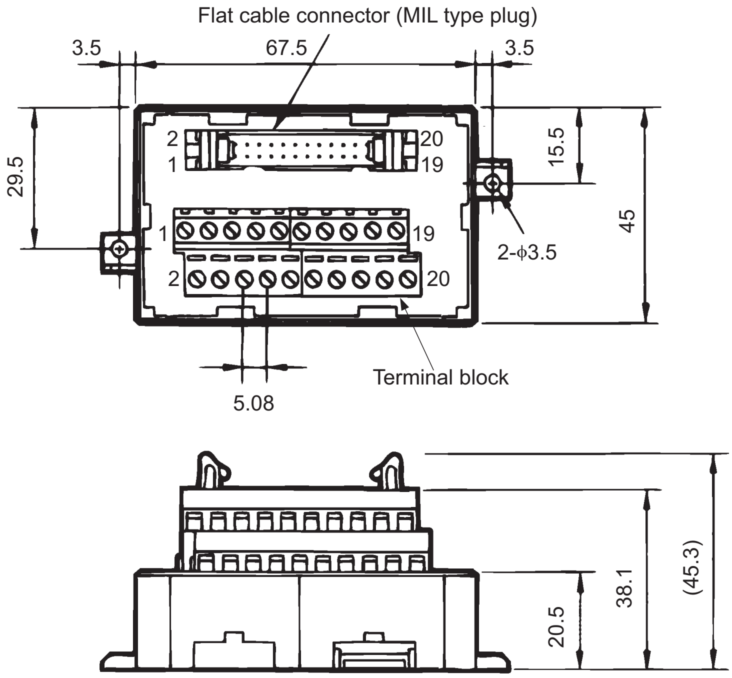
Terminal Block Models

Model	Description
XW2B-20G4	M3 screw terminal block
XW2B-20G5	M3.5 screw terminal block
XW2D-20G6	M3 screw terminal block

XW2B-20G4

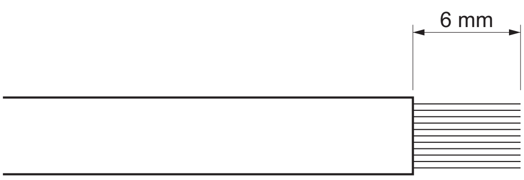


Dimensions



Precautions for Correct Use

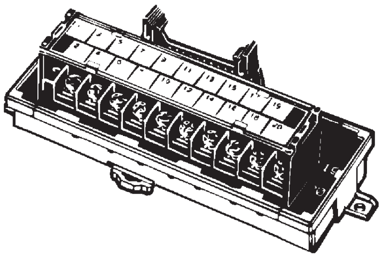
- Use 0.3 to 1.25 mm^2 wire (AWG22 to 16).
- The wire inlet is 1.8 mm (height) × 2.5 mm (width).
- Strip the insulation from the end of the wire for 6 mm as shown below.



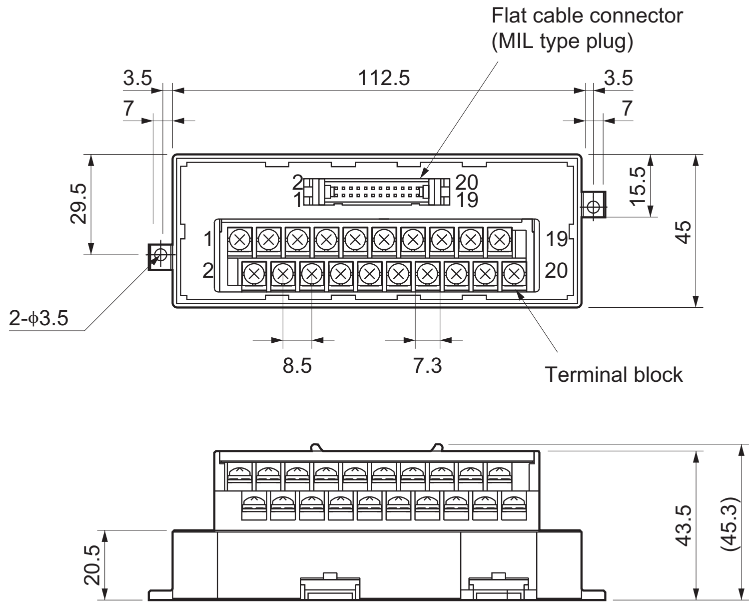
3

Specifications

XW2B-20G5



Dimensions

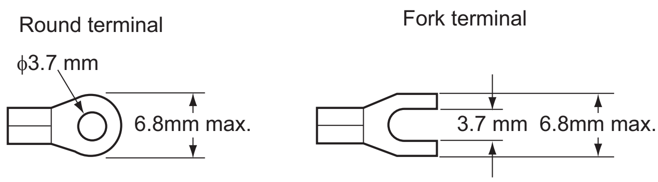


Note The pitch of terminals is 8.5 mm.

3

Precautions for Correct Use

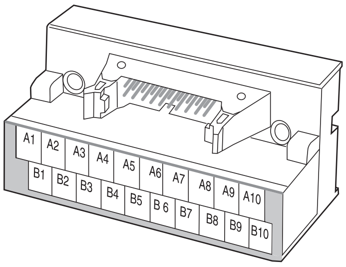
- When using crimp terminals, use crimp terminals with the following dimensions.



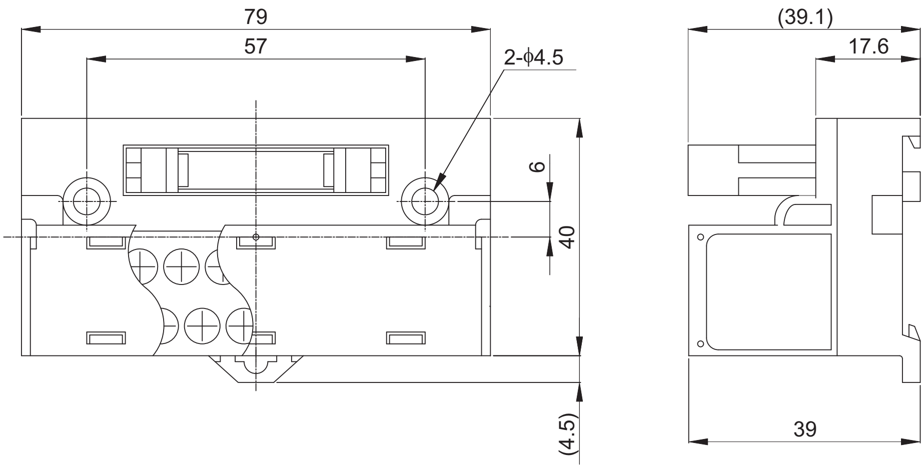
Applicable crimp terminals		Applicable wires
Round terminals	1.25–3	AWG22–16 (0.30 to 1.25 mm^2)
	2–3.5	AWG16–14 (1.25 to 2.0 mm^2)
Fork terminals	1.25Y–3	AWG22–16 (0.30 to 1.25 mm^2)
	2–3.5	AWG16–14 (1.25 to 2.0 mm^2)

- When connecting wires and crimp terminals to a terminal block, tighten them with a tightening torque of 0.59 N•m.

XW2D-20G6

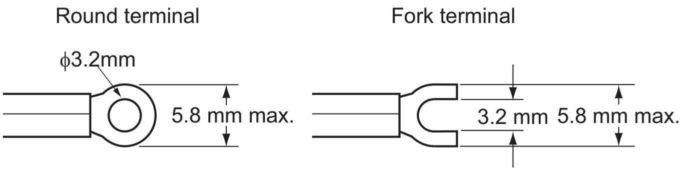


Dimensions



Precautions for Correct Use

- When using crimp terminals, use crimp terminals with the following dimensions.

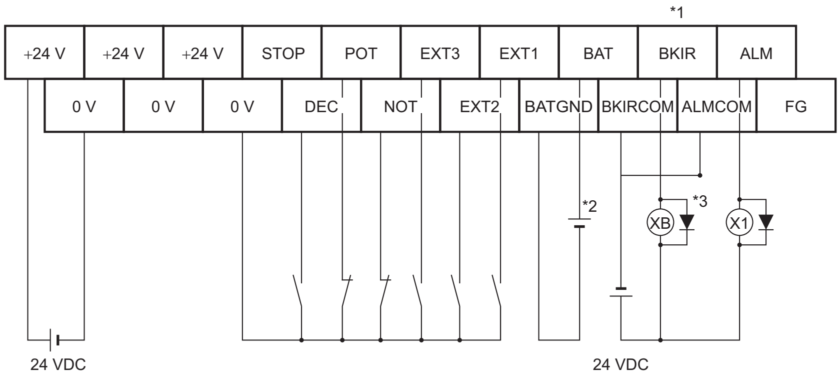


Applicable crimp terminals		Applicable wires
Round terminals	1.25–3	AWG22–16 (0.30 to 1.25 mm^2)
Fork terminals	1.25Y–3	AWG22–16 (0.30 to 1.25mm^2)

- When connecting wires and crimp terminals to a terminal block, tighten them with a tightening torque of 0.7 N•m.

Terminal Block Wiring Example

The example is common for XW2B-20G4, -20G5, and XW2D-20G6.



*1. Assign the brake interlock output (BKIR) to CN1-1 pin.

*2. This is the absolute encoder backup battery of 2.8 to 4.5 V. Secure the battery in place by cable clips with double-sided adhesive tape. Connect the battery to either the connector terminal block or the absolute encoder backup battery cable (with a battery). The absolute encoder backup battery is not required when the Servomotor is equipped with an incremental encoder.

*3. The XB contact is used to turn ON/OFF the electromagnetic brake.

3-5 External Regeneration Resistor Specifications

External Regeneration Resistor Specifications

R88A-RR08050S

Model	Resistance value	Nominal capacity	Regeneration absorption for 120°C temperature rise	Heat radiation condition	Thermal switch output specifications
R88A-RR08050S	50 Ω	80 W	20 W	Aluminum 350 × 350, Thickness: 3.0	Operating temperature 150°C ± 5% NC contact Rated output (resistive load): 125 VAC, 0.1 A max. 30 VDC, 0.1 A max. (minimum current: 1 mA)

R88A-RR080100S

Model	Resistance value	Nominal capacity	Regeneration absorption for 120°C temperature rise	Heat radiation condition	Thermal switch output specifications
R88A-RR080100S	100 Ω	80 W	20 W	Aluminum 350 × 350, Thickness: 3.0	Operating temperature 150°C ± 5% NC contact Rated output (resistive load): 125 VAC, 0.1 A max. 30 VDC, 0.1 A max. (minimum current: 1 mA)

R88A-RR22047S1

Model	Resistance value	Nominal capacity	Regeneration absorption for 120°C temperature rise	Heat radiation condition	Thermal switch output specifications
R88A-RR22047S1	47 Ω	220 W	70 W	Aluminum 350 × 350, Thickness: 3.0	Operating temperature: 150°C ± 5°C NC contact Rated output (resistiveload): 250 VAC, 0.2 A max. 42 VDC, 0.2 A max. (minimum current: 1 mA)

R88A-RR50020S

Model	Resistance value	Nominal capacity	Regeneration absorption for 120°C temperature rise	Heat radiation condition	Thermal switch output specifications
R88A-RR50020S	20 Ω	500 W	180 W	Aluminum 600 × 600, Thickness: 3.0	Operating temperature 200°C ± 7°C NC contact Rated output (resistive load): 250 VAC, 0.2 A max. 42 VDC, 0.2 A max. (minimum current: 1 mA)

3-6 Reactor Filter Specifications

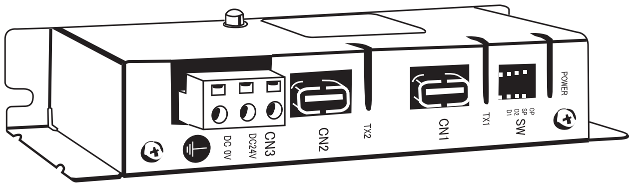
Use reactors to suppress harmonic currents. Connect it to a Servo Drive. Select the proper reactor model according to the Servo Drive to be used.

Specifications

Servo Drive		Reactor			
Model	Number of power phases	Model	Rated current	Inductance	Weight
R88D-KNA5L-ML2	Single-phase	3G3AX-DL2002	1.6 A	21.4 mH	Approx. 0.8 kg
R88D-KN01L-ML2		3G3AX-DL2004	3.2 A	10.7 mH	Approx. 1.0 kg
R88D-KN02L-ML2		3G3AX-DL2007	6.1 A	6.75 mH	Approx. 1.3 kg
R88D-KN04L-ML2		3G3AX-DL2015	9.3 A	3.51 mH	Approx. 1.6 kg
R88D-KN01H-ML2	Single-phase	3G3AX-DL2002	1.6 A	21.4 mH	Approx. 0.8 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN02H-ML2	Single-phase	3G3AX-DL2004	3.2 A	10.7 mH	Approx. 1.0 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN04H-ML2	Single-phase	3G3AX-DL2007	6.1 A	6.75 mH	Approx. 1.3 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN08H-ML2	Single-phase	3G3AX-DL2015	9.3 A	3.51 mH	Approx. 1.6 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN10H-ML2	Single-phase	3G3AX-DL2015	9.3 A	3.51 mH	Approx. 1.6 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN15H-ML2	Single-phase	3G3AX-DL2022	13.8 A	2.51 mH	Approx. 2.1 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN20H-ML2	3-phase	3G3AX-AL2055	20.0 A	0.88 mH	Approx. 4.0 kg
R88D-KN30H-ML2					
R88D-KN50H-ML2		3G3AX-AL2110	37.0 A	0.35 mH	Approx. 5.0 kg
R88D-KN06F-ML2		3G3AX-AL4025	6.0 A	7.7 mH	Approx. 2.7 kg
R88D-KN10F-ML2					
R88D-KN15F-ML2					
R88D-KN20F-ML2		3G3AX-AL4055	10.0 A	3.5 mH	Approx. 4.0 kg
R88D-KN30F-ML2					
R88D-KN50F-ML2		3G3AX-AL4110	20.0 A	1.3 mH	Approx. 6.0 kg

3-7 MECHATROLINK-II Repeater Unit Specifications

The MECHATROLINK-II Repeater Units are necessary to extend the MECHATROLINK-II connection distance.

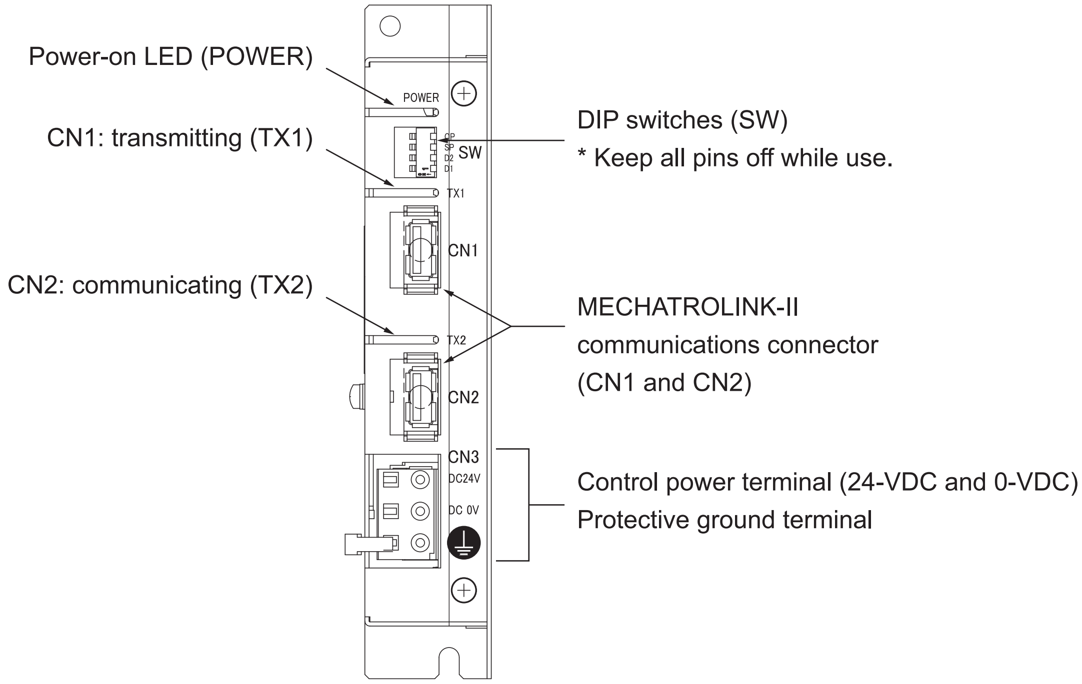


Specifications

FNY-REP2000

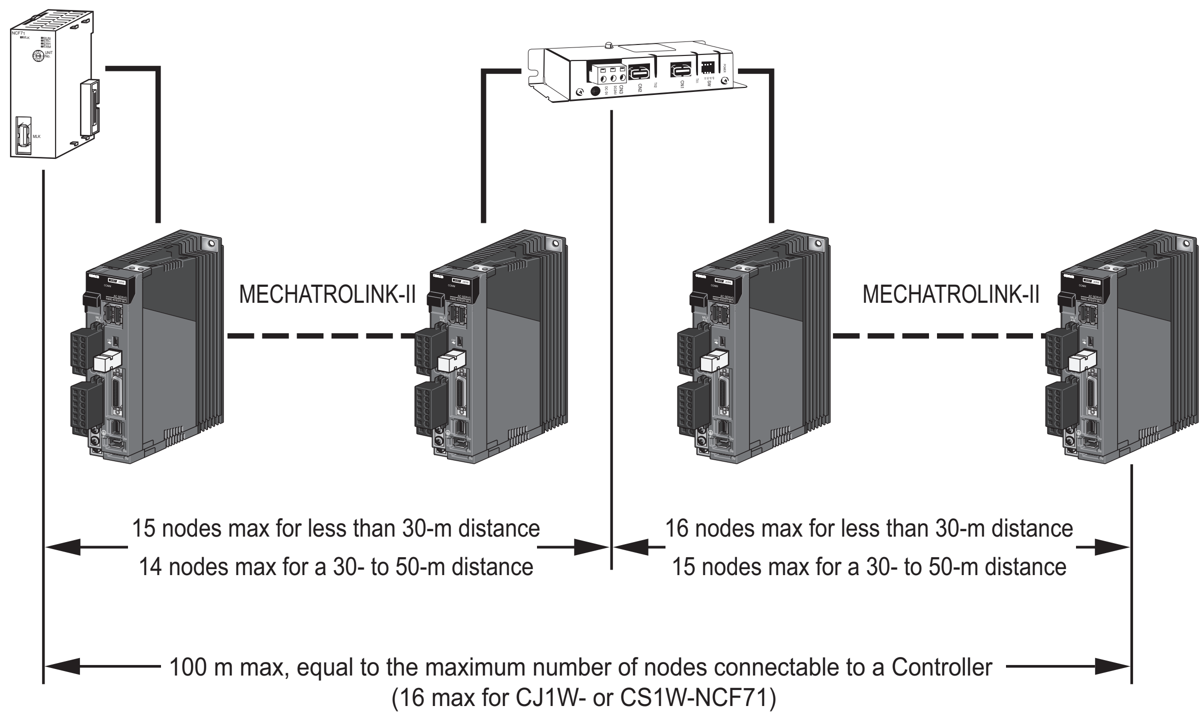
Item	Description
Cable length	Between a Controller and a Repeater Unit: 50 m max Between a Repeater Unit and a Terminating Resistor: 50 m max
Maximum number of connectable node	Between a Controller and a Repeater Unit: 14 nodes in every 50 m, or 15 nodes in every 30 m, Between a Repeater Unit and a Terminating Resistor: 15 nodes in every 50 m, or 16 nodes in every 30 m The total number of Servo Drives in upstream and downstream of a Repeater Unit must not exceed the maximum number of nodes connectable to a MECHATROLINK-II Communication Unit. When the CS1W- or CJ1W-NCF71 Controller is used, the maximum number of connectable nodes is 16.
LED Indicator	3 indicators (Power, CN1: transmitting, and CN2: communicating)
Power supply current	180 mA max
External power supply	24 VDC (± 4.8 V), 100 mA
Weight	0.5 kg

Repeater Unit Part Names



Connection Method

This is an example to connect a Host Controller, a Repeater Unit and plural Servo Drives.



4

System Design

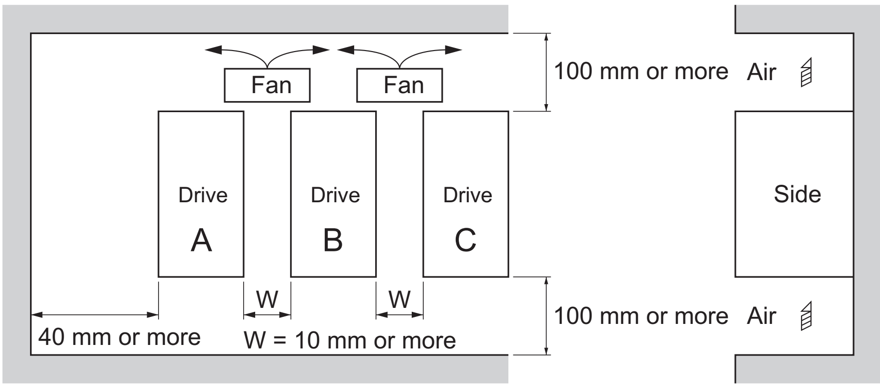
This chapter explains the installation conditions, wiring methods including wiring conforming to EMC directives and regenerative energy calculation methods regarding the Servo Drive, Servomotor, as well as the performance of External Regeneration Resistors, and so on.

4-1 Installation Conditions

Servo Drive Installation Conditions

Dimension Conditions around Equipment

- Install drives according to the dimensions shown in the following illustration to ensure proper heat dispersion inside the drive and convection inside the panel. If the drives are installed side by side, install a fan for air circulation to prevent uneven temperatures inside the panel.



- Servo Drives of 100 V or 200 V with a capacity of 750 W max. can be installed side by side with a 1-mm clearance (W in above illustration). For ambient temperature requirements, refer to Environment Operating Conditions below.
- If the mounting surface of the Servo Drive is coated, remove the coating to allow electrical conduction. If you make your own mounting bracket, we recommend that you apply electrically conductive plating.

Mounting Direction

- Mount the drives in a direction (perpendicular) so that the model number can be seen properly.

Environment Operating Conditions

- The environment in which drives are operated must meet the following conditions. Drives may malfunction if operated under any other conditions.
  Operating ambient temperature: 0 to +55°C (Take into account temperature rises in the following individual drives themselves.)
  Operating humidity: 90% RH max. (with no condensation)
  Operating atmosphere: No corrosive gases.
  Altitude: 1,000 m max.
- For Servo Drives of 100 V or 200 V with a capacity of 750 W max., the specifications for operating ambient temperature depend on the Servo Drive (A, B, and C) when the clearance between Servo Drives is 1 mm.

Drive A	: 0 to 50°C
Drive B	: 0 to 40°C
Drive C	: 0 to 45°C

Ambient Temperature Control

- To operate in environments in which there is minimal temperature rise is recommended to maintain a high level of reliability.
- When the drive is installed in a closed space, such as a box, ambient temperature may rise due to temperature rise in each unit. Use a fan or air conditioner to prevent the drive's ambient temperature from exceeding 55°C.
- Drive surface temperatures may rise to as much as 30°C above the ambient temperature. Use heat-resistant materials for wiring, and keep its distance from any devices or wiring that are sensitive to heat.
- The service life of a Servo Drive is largely determined by the ambient temperature around the internal electrolytic capacitors. When an electrolytic capacitor reaches its limit, electrostatic capacity drops and internal resistance increases. This leads to overvoltage alarms, malfunctioning due to noise, and damage to individual elements.
- If a drive is always operated at the ambient temperature of 55°C and with 100% output of the rated torque and rated rotation speed, its limit is expected to be approx. 28,000 hours (excluding the axial-flow fan). A drop of 10°C in the ambient temperature will double the expected limit for drive.

Keeping Foreign Objects Out of Units

- Place a cover over the drive or take other preventative measures to prevent foreign objects, such as drill filings, from getting into the drive during installation. Be sure to remove the cover after installation is complete. If the cover is left on during operation, drive's heat dissipation is blocked, which may result in malfunction.
- Take measures during installation and operation to prevent foreign objects such as metal particles, oil, machining oil, dust, or water from getting inside of drives.

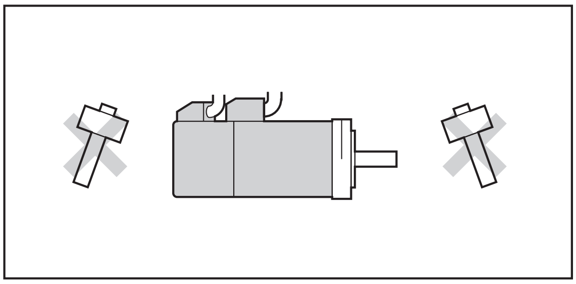
Servomotor Installation Conditions

Environment Operating Conditions

- The environment in which the motor is operated must meet the following conditions. Operating the motor out of the following ranges may result in malfunction of the motor.
  Operating ambient temperature: 0 to +40°C*1
  Operating humidity: 85% RH max. (with no condensation)
  Operating atmosphere: No corrosive gases.
  *1. The operating ambient temperature is the temperature at a point 5 cm from the motor.

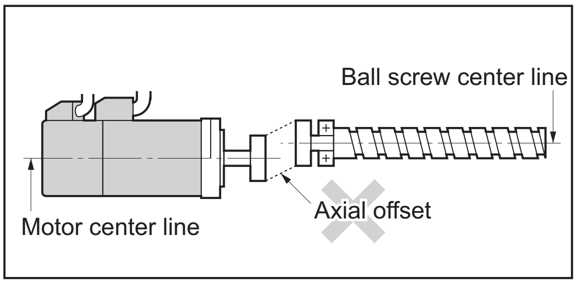
Impact and Load

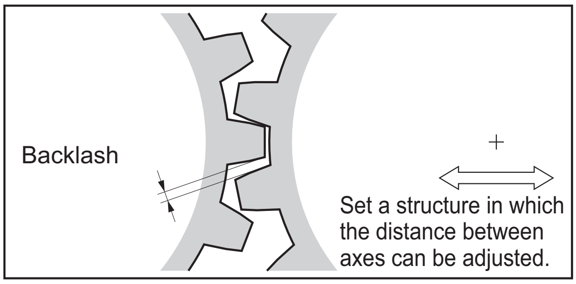
- The motor is resistant to impacts of up to 98 m/s^2. Do not apply heavy impacts or loads during transport, installation, or removal of the motor.
- When transporting, hold the motor body itself. And do not hold the encoder, cable, or connector areas. Failure to follow this guideline may result in damaging the motor.
- Always use a pulley remover to remove pulleys, couplings, or other objects from the shaft.
- After assembly, secure cables so that there is no impact or load placed on the cable outlet.

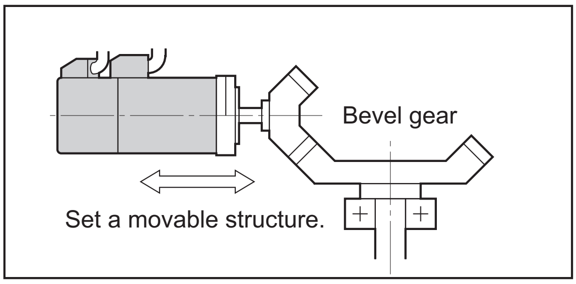


Connecting to Mechanical Systems

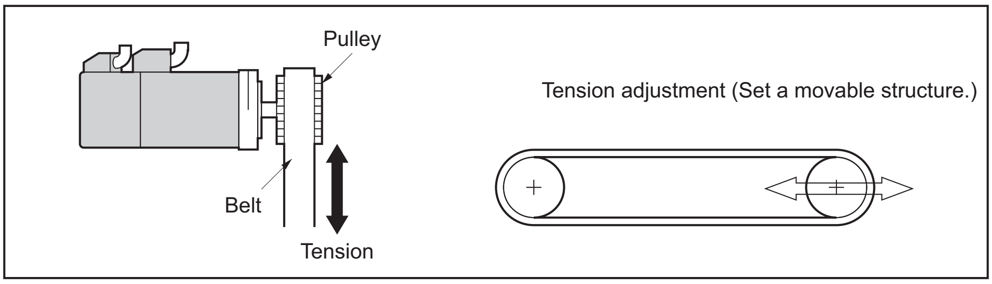
- For the allowable axial loads for motors, refer to "Characteristics" (P.3-2). If an axial load greater than that specified is applied to a motor, it may reduce the limit of the motor bearings and may break the motor shaft.
- When connecting to a load, use couplings that can sufficiently absorb mechanical eccentricity and declination.
- For spur gears, an extremely large radial load may be applied depending on the gear precision. Use spur gears with a high degree of precision (for example, JIS class 2: normal line pitch error of 6 μm max. for a pitch circle diameter of 50 mm).
- If the gear precision is not adequate, allow backlash to ensure that no radial load is placed on the motor shaft.
- When using bevel gears, a load is applied in the thrust direction depending on the structural precision, the gear precision, and temperature changes. Provide appropriate backlash or take other measures to ensure that a thrust load larger than the specified level is not applied.
- Do not put rubber packing on the flange surface. If the flange is mounted with rubber packing, the motor flange may crack under the tightening force.







- When connecting to a V-belt or timing belt, consult the manufacturer for belt selection and tension.
- A radial load twice as large as the belt tension can be placed on the motor shaft. Do not allow the allowable radial load or more to be placed on the motor shaft. If an excessive radial load is applied, the motor shaft and bearings may be damaged.
- Set up a movable pulley in the middle of the motor shaft and the load shaft so that the belt tension can be adjusted.



Water and Drip Resistance

- The protective structure for the motors is as follows.
  Equivalent to IP67 (except for through-shaft parts and motor connector pins and encoder connector pins)

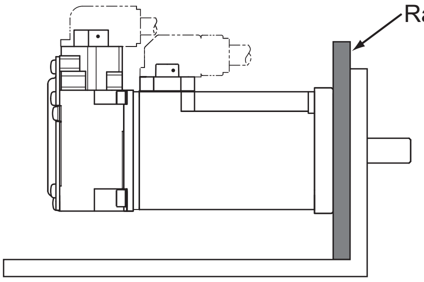
Oil-water Measures

Use the Servomotor with oil seal if you are using it in an environment where oil drops can attach to the through-shaft part. The operating conditions of the Servomotor with oil seal are as follows.

- Place the oil level below the lip of the oil seal.
- Prepare a good lubricated condition under which oil droplets splash on the oil seal.
- If you are using the Servomotor with the axis in upward direction, make sure that no oil accumulates on the lip of the oil seal.

Radiator Plate Installation Conditions

- When you mount a Servomotor onto a small device, be sure to provide enough radiation space on the mounting area. Otherwise the Servomotor temperature rises too high to break. One of the preventive measures is to install a radiator plate between the motor attachment area and the motor flange. (See below) Refer to the "Servomotor Specifications" (P.3-33) for the radiator plate specifications.



- The temperature rise differs by the mounting part materials and the installation environment. Check the actual rise by using a real Servomotor.
- Depending on the environment, such as when the Servomotor is installed near a heating element, the Servomotor temperature may rise significantly. In this case, take any of the following measures.
  - Lower the load ratio.
  - Review the heat radiation conditions of the Servomotor.
  - Install a cooling fan and apply forced air cooling to the Servomotor.

Other Precautions

- Take measures to protect the motor shaft from corrosion. The motor shafts are coated with anti-corrosion oil when shipped, but anti-corrosion oil or grease should also be applied when connecting the components which apply load to the shaft.

⚠ Caution

Do not apply the commercial power supply directly to the motor. Failure to follow this guideline may result in fire occurring.

Never repair the product by disassembling it. Failure to follow this guideline may result in electric shock or injury.

Decelerator Installation Conditions

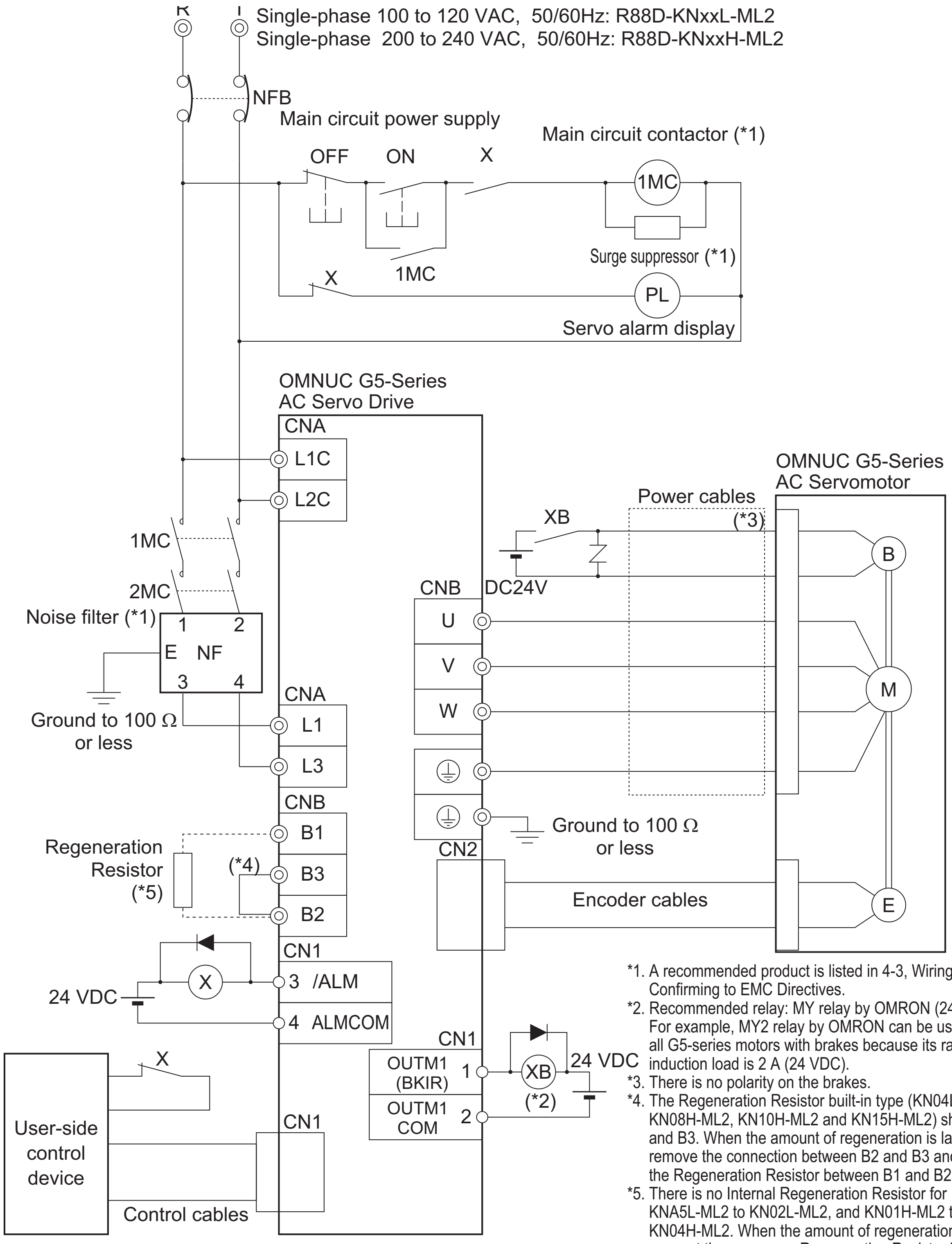
Using Another Company's Decelerator (Reference)

If the system configuration requires another company's decelerator to be used in combination with an OMNUC G5-Series motor, select the decelerator so that the load on the motor shaft (i.e., both the radial and thrust loads) is within the allowable range. (Refer to "Characteristics" (P.3-2) for details on the allowable loads for the motors.)
Also, select the decelerator so that the allowable input rotation speed and allowable input torque of the decelerator are not exceeded.

4-2 Wiring

Peripheral Equipment Connection Examples

R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN04L-ML2
R88D-KN01H-ML2/-KN02H-ML2/-KN04H-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2 (Single-phase Input)



*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

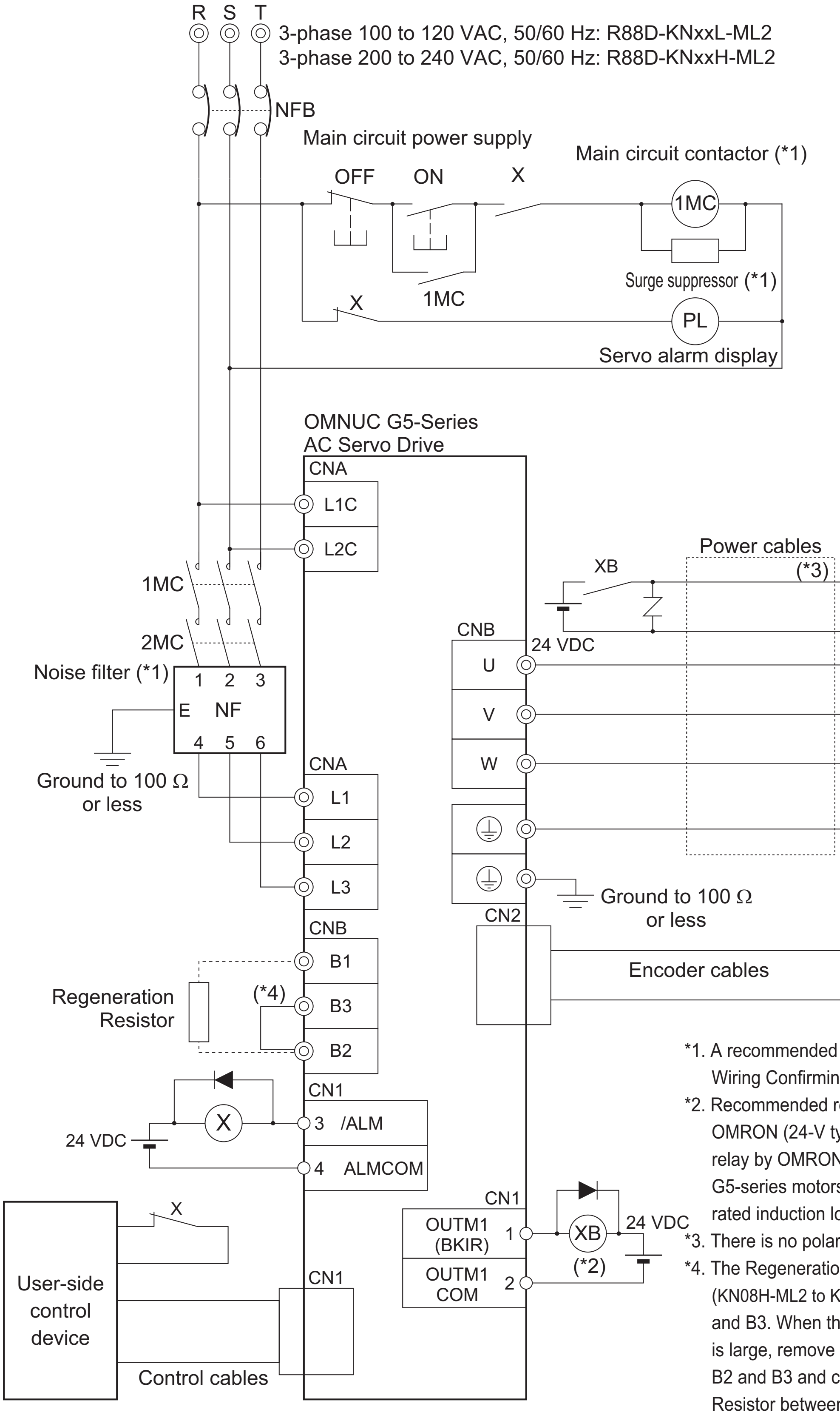
*2. Recommended relay: MY relay by OMRON (24-V type) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).

*3. There is no polarity on the brakes.

*4. The Regeneration Resistor built-in type (KN04L-ML2, KN08H-ML2, KN10H-ML2 and KN15H-ML2) shorts B2 and B3. When the amount of regeneration is large, remove the connection between B2 and B3 and connect the Regeneration Resistor between B1 and B2.

*5. There is no Internal Regeneration Resistor for KNA5L-ML2 to KN02L-ML2, and KN01H-ML2 to KN04H-ML2. When the amount of regeneration is large, connect the necessary Regeneration Resistor between B1 and B2.

R88D-KN01H-ML2/-KN02H-ML2/-KN04H-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2 (3-phase Input)



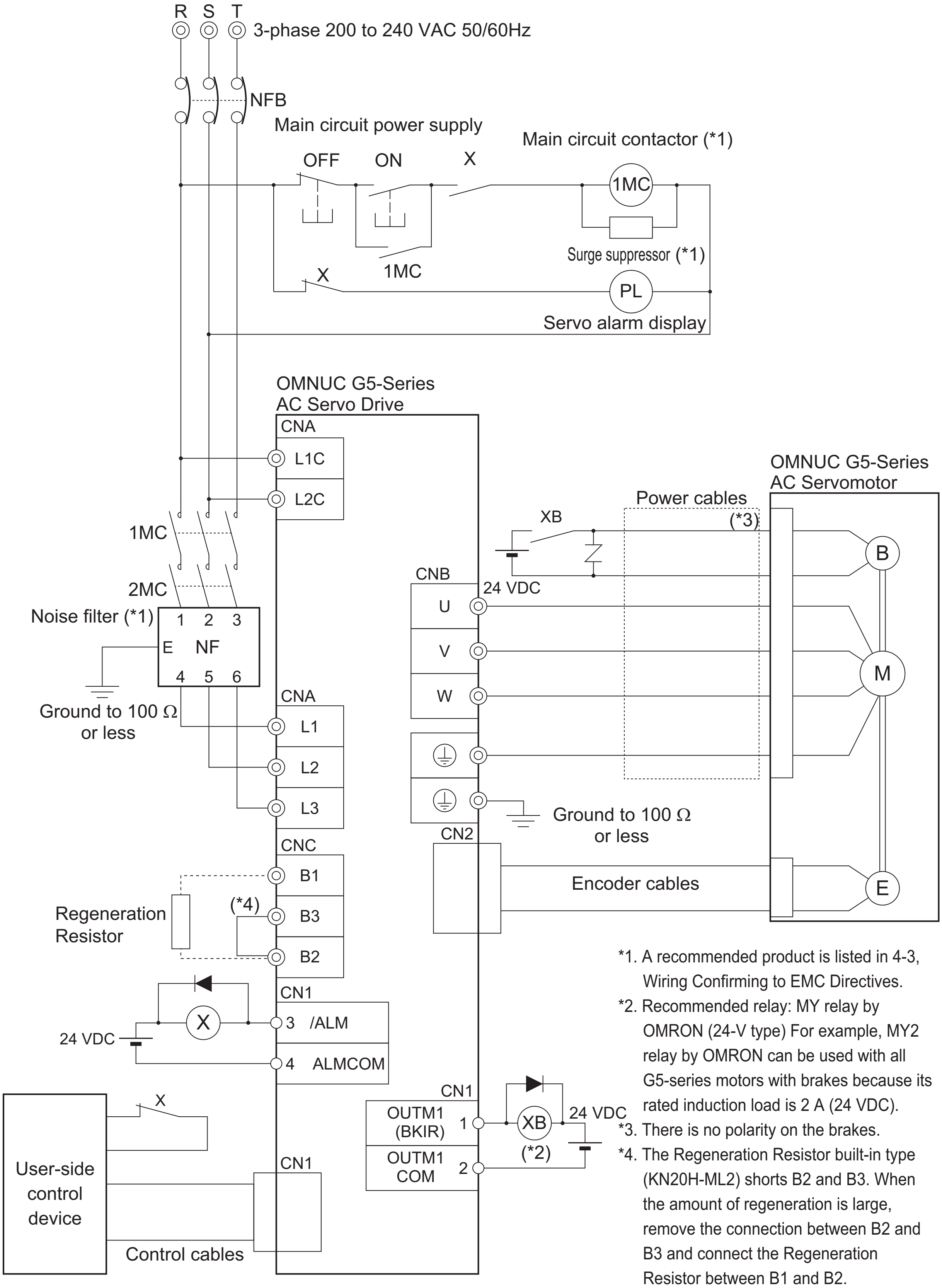
*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V type) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).

*3. There is no polarity on the brakes.

*4. The Regeneration Resistor built-in type (KN08H-ML2 to KN15H-ML2) shorts B2 and B3. When the amount of regeneration is large, remove the connection between B2 and B3 and connect the Regeneration Resistor between B1 and B2.

R88D-KN20H-ML2



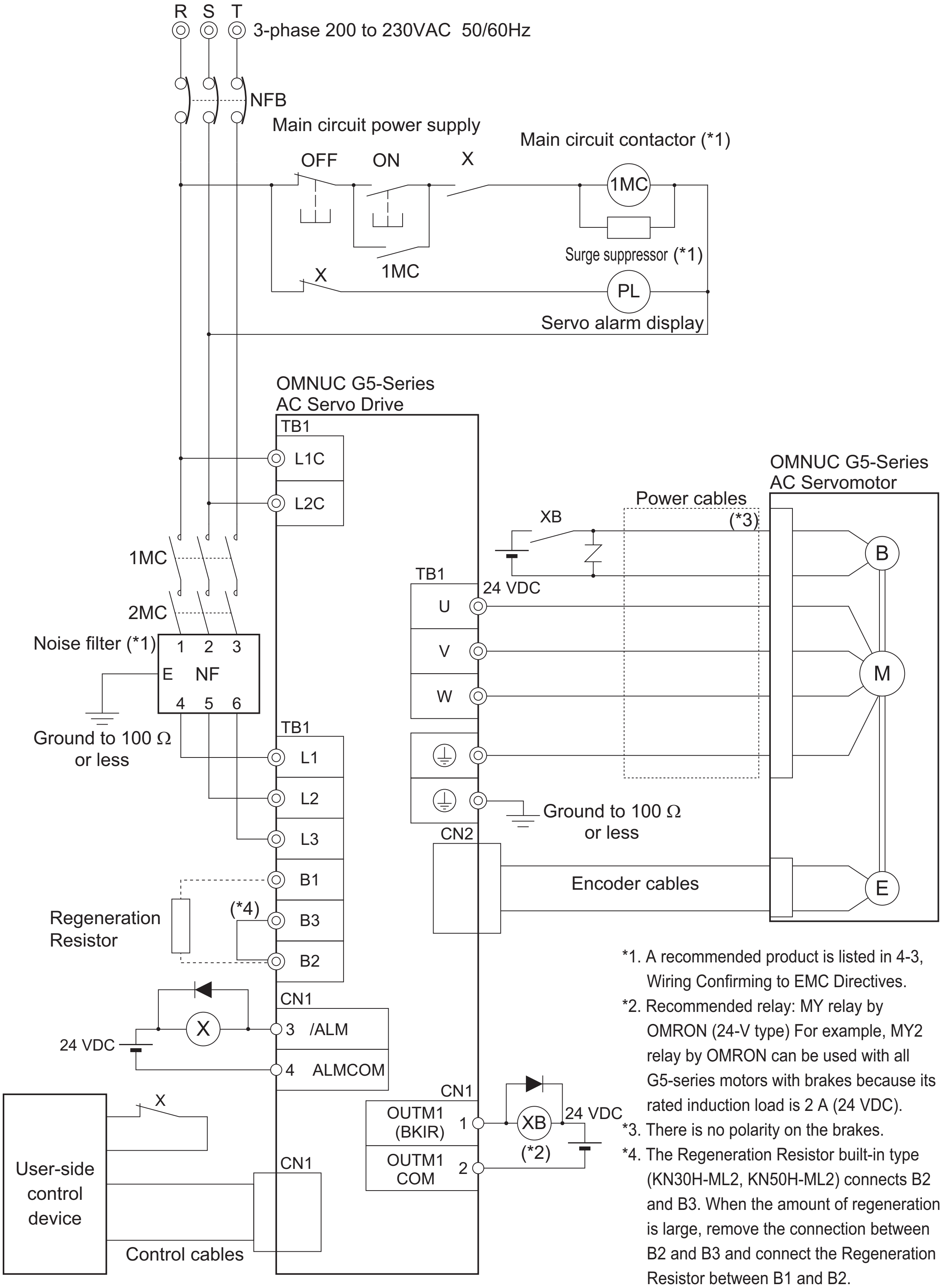
*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V type) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).

*3. There is no polarity on the brakes.

*4. The Regeneration Resistor built-in type (KN20H-ML2) shorts B2 and B3. When the amount of regeneration is large, remove the connection between B2 and B3 and connect the Regeneration Resistor between B1 and B2.

R88D-KN30H/-KN50H-ML2



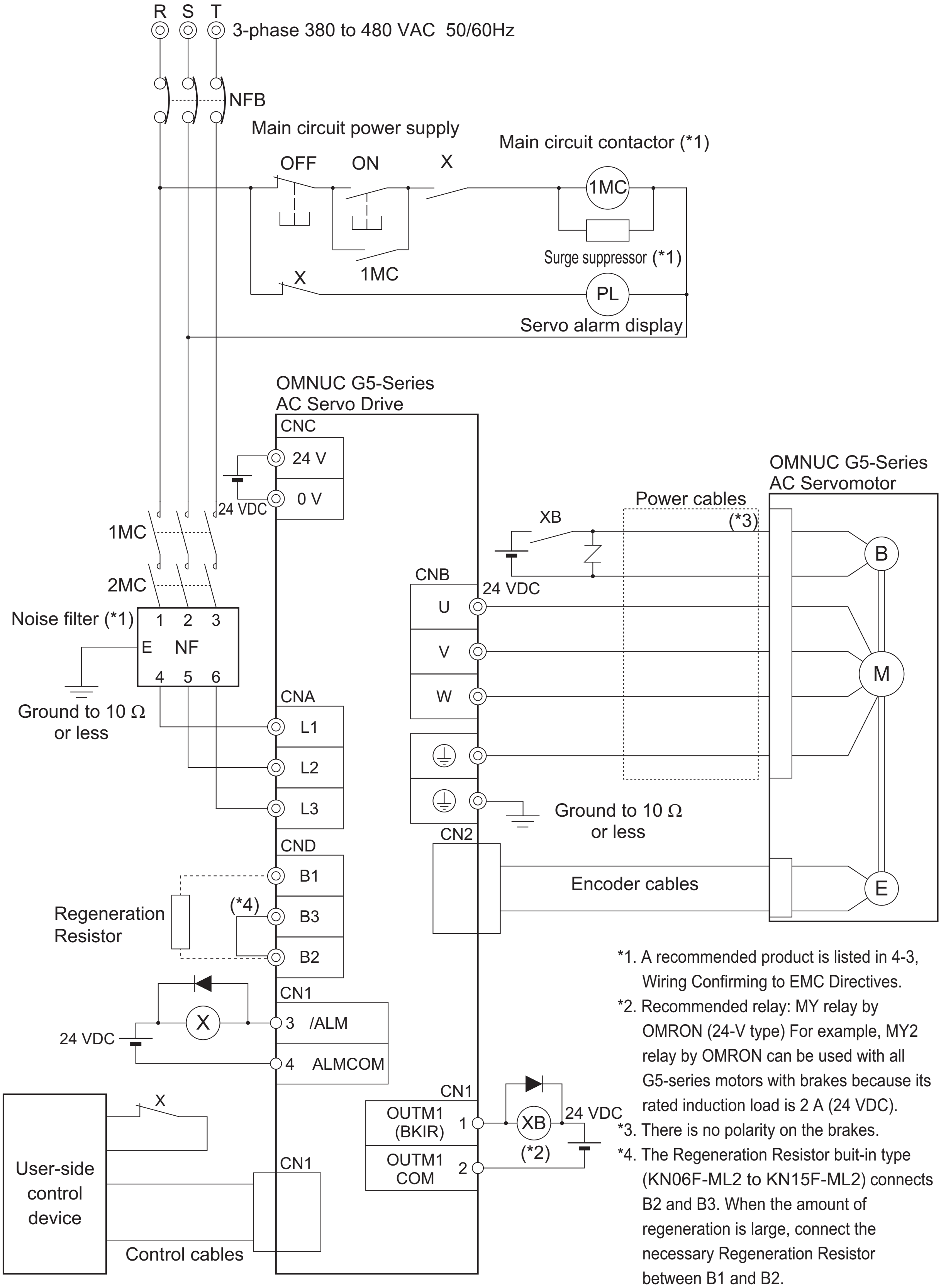
*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V type) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).

*3. There is no polarity on the brakes.

*4. The Regeneration Resistor built-in type (KN30H-ML2, KN50H-ML2) connects B2 and B3. When the amount of regeneration is large, remove the connection between B2 and B3 and connect the Regeneration Resistor between B1 and B2.

R88D-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2



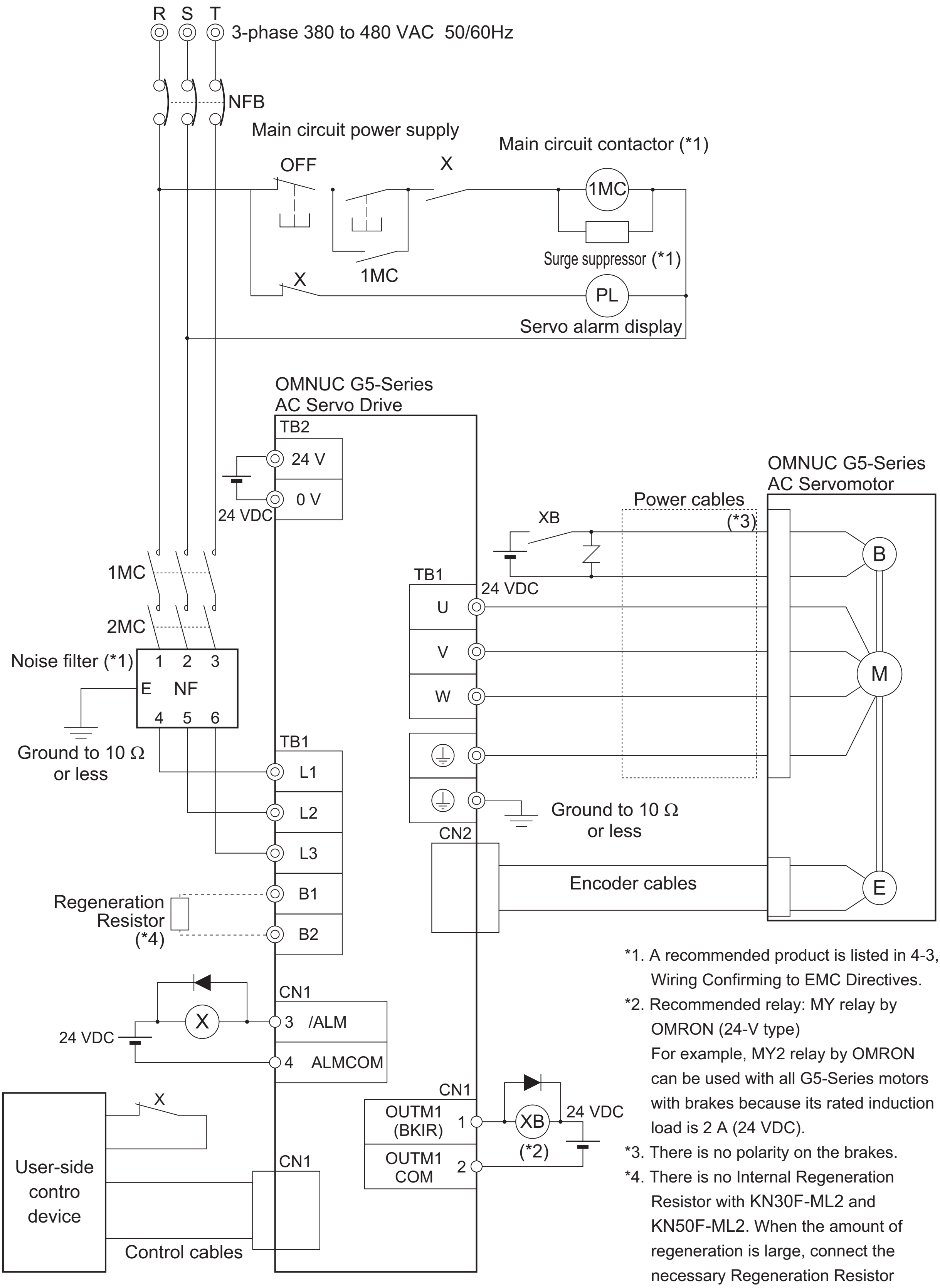
*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V type) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).

*3. There is no polarity on the brakes.

*4. The Regeneration Resistor buit-in type (KN06F-ML2 to KN15F-ML2) connects B2 and B3. When the amount of regeneration is large, connect the necessary Regeneration Resistor between B1 and B2.

R88D-KN30F-ML2/-KN50F-ML2



*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V type)
For example, MY2 relay by OMRON can be used with all G5-Series motors with brakes because its rated induction load is 2 A (24 VDC).

*3. There is no polarity on the brakes.

*4. There is no Internal Regeneration Resistor with KN30F-ML2 and KN50F-ML2. When the amount of regeneration is large, connect the necessary Regeneration Resistor between B1 and B2.

Main Circuit and Motor Connections

When wiring the main circuit, use proper wire sizes, grounding systems, and noise resistance.

R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN04L-ML2/-KN01H-ML2/ -KN02H-ML2/-KN04H-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2

Main Circuit Connector Specifications (CNA)

Symbol	Name	Function
L1	Main circuit power supply input	R88D-KNxL-ML2 (50 to 400 W) : Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz R88D-KNxH-ML2 (100 W to 1.5 kW) : Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz (100 W to 1.5 kW): 3-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz
L2		
L3		
L1C	Control circuit power supply input	R88D-KNxL-ML2 : Single-phase 100 to 120 VAC (85 to 132 V) 50/60Hz R88D-KNxH-ML2 : Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz
L2C		

Motor Connector Specifications (CNB)

Symbol	Name	Function	
B1	External Regeneration Resistor connection terminals	R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN01H-ML2 /-KN02H-ML2/-KN04H-ML2: Normally, do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, connect an External Regeneration Resistor between B1 and B2. R88D-KN04L-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2: Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.	
B2			
B3			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		White	
W		Blue	
⏚		Green/ Yellow	
⏚	Frame ground	This is the ground terminal. Ground to 100 Ω or less.	

R88D-KN20H-ML2

Main Circuit Connector Specifications (CNA)

Symbol	Name	Function
L1	Main circuit power supply input	R88D-KN20H-ML2 (2 kW) : 3-phase: 200 to 230 VAC (170 to 253 V) 50/60 Hz
L2		
L3		
L1C	Control circuit power supply input	R88D-KN20H-ML2 : Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz
L2C		

Motor Connector Specifications (CNB)

Symbol	Name	Function	
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		White	
W		Blue	
⏚		Green/ Yellow	
⏚	Frame ground	This is the ground terminal. Ground to 100 Ω or less.	

External Regeneration Resistor Connector Specifications (CNC)

Symbol	Name	Function
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.
B2		
B3		
N		

R88D-KN30H-ML2/-KN50H-ML2

Terminal Block Specifications

Symbol	Name	Function	
L1	Main circuit power supply input	R88D-KNxH-ML2 (3 to 5 kW): 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz	
L2			
L3			
L1C	Control circuit power supply input	R88D-KNxH-ML2: Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz	
L2C			
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are connected. Do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.	
B2			
B3			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		White	
W		Blue	
⏚		Green/ Yellow	
⏚	Frame ground	This is the ground terminal. Ground to 100 Ω or less.	

R88D-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2

Main Circuit Connector Specifications (CNA)

Symbol	Name	Function
L1	Main circuit power supply input	R88D-KNxF-ML2 (600 W to 2 kW) : 3-phase: 380 to 480 VAC (323 to 528 V) 50/60 Hz
L2		
L3		

Motor Connector Specifications (CNB)

Symbol	Name	Function	
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		White	
W		Blue	
⏚		Green/ Yellow	
⏚	Frame ground	This is the ground terminal. Ground to 10 Ω or less.	

Control Circuit Connector Specifications (CNC)

Symbol	Name	Function
24 V	Control circuit power supply input	24 VDC (21.6 to 26.4 V)
0 V		

External Regeneration Resistor Connector Specifications (CND)

Symbol	Name	Function
B1	External Regeneration Resistor connection terminals	Normally B2 and B3 are connected. Do not short B1 and B2. Doing so may cause malfunctions. If there is high regenerative energy, remove the short-circuit bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2.
B2		
B3		
N		

R88D-KN30F/-KN50F-ML2

Terminal Block Specifications (TB1)

Symbol	Name	Function	
L1	Main circuit power supply input	R88D-KNxF-ML2 (3 to 5 kW): 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz	
L2			
L3			
B1	External Regeneration Resistor connection terminals	A Regeneration Resistor is not built in. Connect an External Regeneration Resistor between B1 and B2, if necessary.	
B2			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be sure to wire them correctly.
V		White	
W		Blue	
⏚		Green/ Yellow	
⏚	Frame ground	This is the ground terminal. Ground to 100 Ω or less.	
NC	–	Do not connect.	
24 V	Control circuit power supply input	R88D-KNxF-ML2: 24 VDC (21.6 to 26.4 V)	
0 V			
⏚	Frame ground	This is the ground terminal. Ground to 10 Ω or less.	
NC	–	Do not connect.	

Terminal Block Wire Sizes

100-VAC Input Type Wire Sizes: R88D-KNxxL-ML2

Model (R88D-)			KNA5L-ML2	KN01L-ML2	KN02L-ML2	KN04L-ML2
Item		Unit				
Power supply capacity		kVA	0.4	0.4	0.5	0.9
Main circuit power supply input (L1 and L3, or L1, L2 and L3)	Rated current	A	1.7	2.6	4.3	7.6
	Wire size	–	AWG14 to 18			
Control circuit power supply input (L1C and L2C)	Wire size	–	AWG18			
Motor connection terminals (U, V, W, and FG) *1*2	Rated current	A	1.2	1.7	2.5	4.6
	Wire size	–	AWG14 to 18			
Frame ground (FG)	Wire size	–	AWG14			
	Screw size	–	M4			
	Tightening torque	N•m	1.2			

*1. Connect OMRON Power Cables to the motor connection terminals.

*2. Use the same wire sizes for B1 and B2.

4

System Design

200 VAC Input Type Wire Sizes: R88D-KNxxH-ML2

Model (R88D-) Item		Unit	KN01H-ML2	KN02H-ML2	KN04H-ML2	KN08H-ML2	KN10H-ML2
Power supply capacity		kVA	0.5	0.5	0.9	1.3	1.8
Main circuit power supply input (L1 and L3, or L1, L2 and L3)	Rated current	A	1.6/0.9 *1	2.4/1.3 *1	4.1/2.4 *1	6.6/3.6 *1	9.1/5.2 *1
	Wire size	–	AWG14 to 18				AWG14
	Screw size	–	–	–	–	–	–
	Tightening torque	N•m	–	–	–	–	–
Control circuit power supply input (L1C and L2C)	Wire size	–	AWG18				
	Screw size	–	–	–	–	–	–
	Tightening torque	N•m	–	–	–	–	–
Motor connection terminals (U, V, W, and FG) *2*3	Rated current	A	1.2	1.6	2.6	4.1	5.9
	Wire size	–	AWG14 to 18				AWG14
	Screw size	–	–	–	–	–	–
	Tightening torque	N•m	–	–	–	–	–
Frame ground (FG)	Wire size	–	AWG14				
	Screw size	–	M4				
	Tightening torque	N•m	1.2				

Model (R88D-) Item		Unit	KN15H-ML2	KN20H-ML2	KN30H-ML2	KN50H-ML2
Power supply capacity		kVA	2.3	3.3	4.5	7.5
Main circuit power supply input (L1 and L3, or L1, L2 and L3)	Rated current	A	14.2/8.1 *1	11.8	15.1	21.6
	Wire size	–	AWG14		AWG12	
	Screw size	–	–	–	M5	
	Tightening torque	N•m	–	–	2.0	
Control circuit power supply input (L1C and L2C)	Wire size	–	AWG18			
	Screw size	–	–	–	M5	
	Tightening torque	N•m	–	–	2.0	
Motor connection terminals (U, V, W, and FG) *2*3	Rated current	A	9.4	13.4	18.7	33.0
	Wire size	–	AWG14		AWG12	
	Screw size	–	–	–	M5	
	Tightening torque	N•m	–	–	2.0	
Frame ground (FG)	Wire size	–	AWG14		AWG12	
	Screw size	–	M4		M5	
	Tightening torque	N•m	1.2		2.0	

*1. The left value is for single-phase input and the right value is for 3-phase input.

*2. Connect an OMRON power cable to the motor connection terminals.

*3. Use the same wire sizes for B1 and B2.

400 VAC Input Type Wire Sizes: R88D-KNxxF-ML2

Model (R88D-)			KN06F -ML2	KN10F -ML2	KN15F -ML2	KN20F -ML2	KN30F -ML2	KN50F -ML2
Item		Unit						
Main circuit power supply input (L1 and L3, or L1, L2 and L3)	Rated current	A	2.1	2.8	3.9	5.9	7.6	12.1
	Wire size	–	AWG14				AWG12	
	Screw size	–	–	–	–	–	M5	
	Tightening torque	N•m	–	–	–	–	2.0	
Control circuit power supply input (L1C and L2C)	Wire size	–	AWG20 to 24				AWG18	
	Screw size	–	–	–	–	–	M5	
	Tightening torque	N•m	–	–	–	–	2.0	
Motor connection terminals (U, V, W, and FG) *1*2	Rated current	A	1.5	2.9	4.7	6.7	9.4	16.5
	Wire size	–	AWG14				AWG12	
	Screw size	–	–	–	–	–	M5	
	Tightening torque	N•m	–	–	–	–	2.0	
Frame ground (FG)	Wire size	–	AWG14				AWG12	
	Screw size	–	M4				M5	
	Tightening torque	N•m	1.2				2.0	

*1. Connect OMRON Power Cables to the motor connection terminals.

*2. Use the same wire sizes for B1 and B2.

Wire Sizes and Allowable Current (Reference)

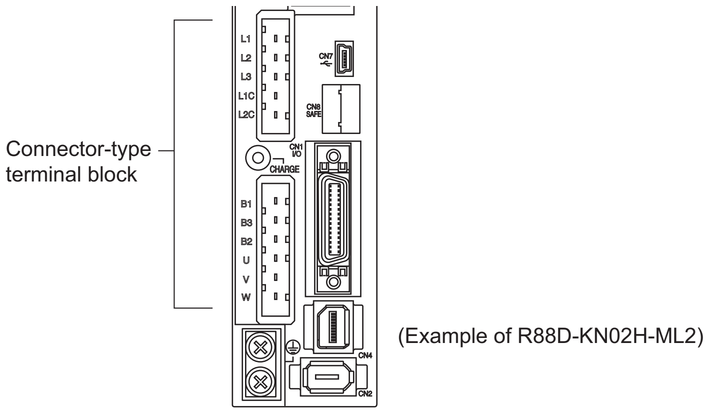
The following table shows the allowable current when there are 3 power supply wires. Use a current below these specified values.

600-V Heat-resistant Vinyl Wire (HIV)

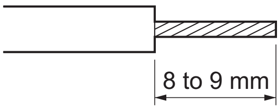
AWG size	Nominal cross-sectional area (mm^2)	Configuration (wires/mm^2)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				30°C	40°C	50°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
–	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5
14	2.0	7/0.6	9.53	23	20	16
12	3.5	7/0.8	5.41	33	29	24
10	5.5	7/1.0	3.47	43	38	31
8	8.0	7/1.2	2.41	55	49	40
6	14.0	7/1.6	1.35	79	70	57

Terminal Block Wiring Procedure

On a Servo Drive with 2.0 kW or less, a connector-type terminal block is used.
The procedure for wiring these terminal blocks is explained below.



1. **Remove the terminal block from the Servo Drive before wiring.**
   The Servo Drive may be damaged if the wiring is done with the terminal block in place.
2. **Strip off 8 to 9 mm of the covering from the end of each wire.**
   Refer to "Terminal Block Wire Sizes" (P.4-17) for applicable wire sizes.



3. **Open the wire insertion slots in the terminal block using a tool.**
   There are 2 ways to open the wire insertion slots, as follows.
   - Pry the slot open using the lever that comes with the Servo Drive. (Figure A)
   - Insert a flat-blade screwdriver (end width: 3.0 to 3.5 mm) into the opening for the driver of the terminal block, and press down firmly to open the slot. (Figure B)

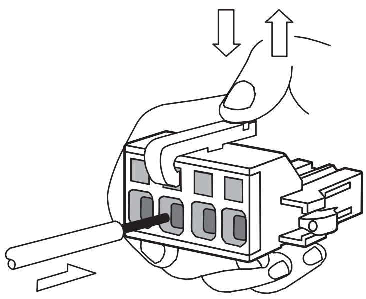


Figure A

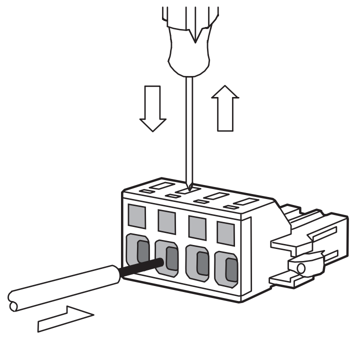


Figure B

4. **With the wire insertion slot held open, insert the end of the wire.**
   After inserting the wire, let the slot close by releasing the pressure from the lever or the screwdriver.
5. **Mount the terminal block to the Servo Drive.**
   After all of the terminals have been wired, return the terminal block to its original position on the Servo Drive.

4

System Design

4-3 Wiring Conforming to EMC Directives

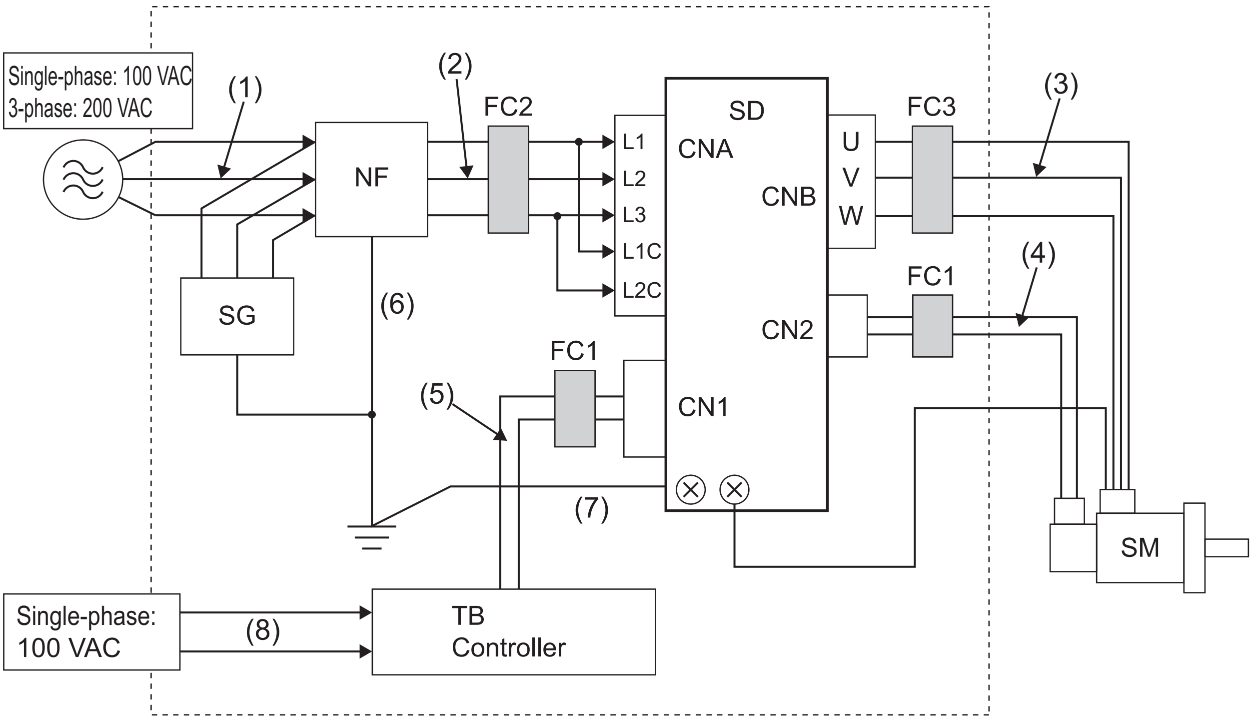
Conformance to the EMC directives (EN55011 Class A Group 1 (EMI) and EN61000-6-2 (EMS)) can be ensured by wiring under the conditions described in this section.
These conditions are for conformance of OMNUC G5-Series products to the EMC directives. EMC-related performance of these products, however, may be influenced by the configuration, wiring, and other conditions of the equipment in which the products are installed. The EMC conformance of the system as a whole must be confirmed by the customer.

The following are the requirements for EMC directive conformance.

- The Servo Drive must be installed in a metal case (control panel). (The motor does not, however, have to be covered with a metal plate.)
- Noise filters and lightening surge absorptive elements (surge absorbers) must be installed on power supply lines.
- Braided shielded cables must be used for all encoder cables. (Use tin-plated, mild steel wires for the shielding.)
- All cables, I/O wiring, and power lines connected to the Servo Drive may have clamp cores installed to improve the noise immunity.
- The shields of all cables must be directly connected to a ground plate.

Wiring Method

R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN04L-ML2/-KN01H-ML2/-KN02H-ML2/ -KN04H-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2/-KN20H-ML2/-KN30H-ML2/-KN50H-ML2



*1. For models with a single-phase power supply input (R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN04L-ML2/-KN01H-ML2/-KN02H-ML2/-KN04H-ML2/-KN08H-ML2), the main circuit power supply input terminals are L1 and L3.

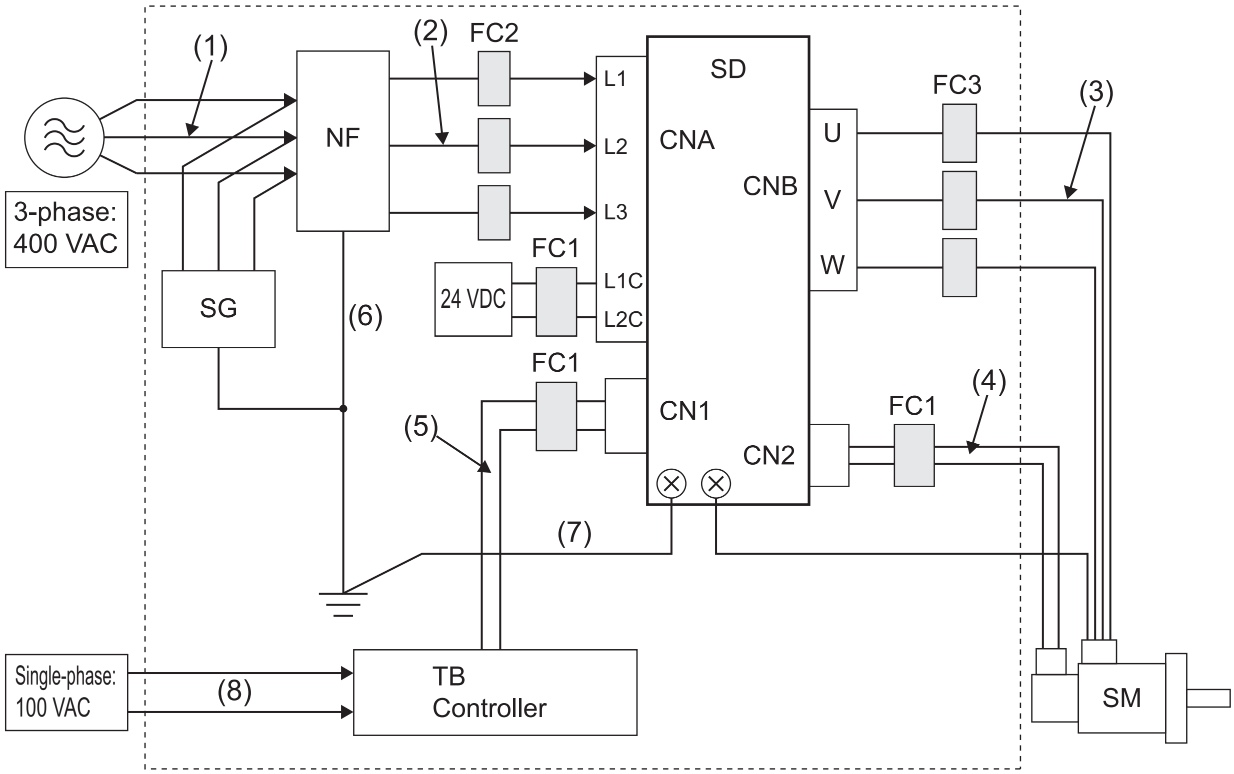
- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use a ground plate for the frame ground for each unit, as shown in the above diagrams, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.
- No-fuse breaker, surge absorber, and noise filter should be positioned near the input terminal block (ground plate), and I/O lines should be separated and wired at the shortest distance.

Unit Details

Symbol	Name	Manufacturer	Model	Comment
SG	Surge absorber	Okaya Electric Industries Co., Ltd.	R•A•V-781BWZ-4	Single-phase 100/200 VAC
			R•A•V-781BXZ-4	3-phase 200 VAC
NF	Noise filter	Okaya Electric Industries Co., Ltd.	SUP-EK5-ER-6	Single-phase 100/200 VAC (5 A)
			3SUP-HU10-ER-6	3-phase 200 VAC (10 A)
			3SUP-HU30-ER-6	3-phase 200 VAC (30 A)
			3SUP-HL50-ER-6B	3-phase 200 VAC (50 A)
SD	Servo Drive	OMRON	–	*1
SM	Servomotor	OMRON	–	*1
FC1	Clamp core	TDK	ZCAT3035-1330	–
FC2	Clamp core	Konno Industry	RJ8035	For R88D-KN20H-ML2/-KN30H-ML2/-KN50H-ML2
FC2	Clamp core	TDK	ZCAT3035-1330	For other models
FC3	Clamp core	TDK	ZCAT3035-1330	–
TB	Controller	–	–	Switch box

*1. A specified combination of Servo Drive and Servomotor must be used.

R88D-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2/-KN30F-ML2/-KN50F-ML2



Unit Details

Symbol	Name	Manufacturer	Model	Comment
SG	Surge absorber	Okaya Electric Industries Co., Ltd.	R•A•V-801BXZ-4	
NF	Noise filter	Schaffner EMC Inc.	FN258L-16-07	3-phase 400 VAC (16 A)
			FN258L-30-07	3-phase 400 VAC (30 A)
SD	Servo Drive	OMRON	–	*1
SM	Servomotor	OMRON	–	*1
FC1	Clamp core	TDK	ZCAT3035-1330	–
FC2	Clamp core	TDK	ZCAT3035-1330	For R88D-KN06F-ML2/ -KN10F-ML2/-KN15F-ML2
FC2	Clamp core	Konno Industry	RJ8035	For R88D-KN20F-ML2/ -KN30F-ML2/-KN50F-ML2
FC3	Clamp core	TDK	ZCAT3035-1330	–
TB	Controller	–	–	Switch Box

*1. A specified combination of Servo Drive and Servomotor must be used.

Cable Details

Symbol	Supplies from	Connects to	Cable name	Length	Comment	Shielded	Ferrite
(1)	AC power supply	Noise filter	Power supply line	2 m	–	No	No
(2)	Noise filter	Servo Drive	Power supply line	2 m	–	No	Optional
(3)	Servo Drive	Servomotor	Power cable	20 m	–	No	Optional
(4)	Servo Drive	Servomotor	Encoder cazble	20 m	–	Yes	Optional
(5)	Switch box	Servo Drive	I/O cable	2 m	–	No	Optional
(6)	Frame ground	Noise filter	FG line	1.5 m	–	No	No
(7)	Frame ground	Noise filter	FG line	1.5 m	–	No	No
(8)	AC power supply	Controller	Power supply line	1.5 m	–	No	No

Noise Filter for Power Supply Input

We recommend you to use the noise filter for the Servo Drive.

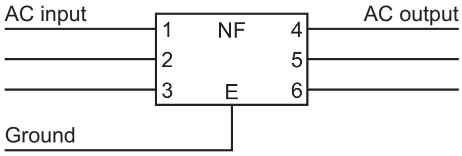
Drive		Noise filter for power supply input			
Phase	**Model**	**Model**	**Rated current**	**Leakage current (60 Hz) max**	**Manufacturer**
Single-phase	R88D-K□A5L□□	SUP-EK5-ER-6	5A	1.0mA (at 250 VAC)	Okaya Electric Industries Co., Ltd.
	R88D-K□01L□□				
	R88D-K□02L□□				
Single-phase	R88D-K□04L□□	3SUP-HU10-ER-6	10A	3.5mA (at 500 VAC)	
Single-phase	R88D-K□01H□□	SUP-EK5-ER-6	5A	1.0mA (at 250 VAC)	
3-phase		3SUP-HU10-ER-6	10A	3.5mA (at 500 VAC)	
Single-phase	R88D-K□02H□□	SUP-EK5-ER-6	5A	1.0mA (at 250 VAC)	
3-phase		3SUP-HU10-ER-6	10A	3.5mA (at 500 VAC)	
Single-phase	R88D-K□04H□□	SUP-EK5-ER-6	5A	1.0mA (at 250 VAC)	
3-phase		3SUP-HU10-ER-6	10A	3.5mA (at 500 VAC)	
Single or 3-phase	R88D-K□08H□□				
	R88D-K□10H□□	3SUP-HU30-ER-6	30A	3.5mA (at 500 VAC)	
	R88D-K□15H□□				
3-phase	R88D-K□20H□□	3SUP-HU50-ER-6	50A	3.5mA (at 500 VAC)	
	R88D-K□30H□□	3SUP-HL50-ER-6B	50A	8.0mA (at 500 VAC)	
	R88D-K□50H□□				
	R88D-K□06F□□	FN258L-16-07	16A	0.8mA (at 440 VAC/50 Hz)	Schaffner EMC Inc.
	R88D-K□10F□□				
	R88D-K□15F□□				
	R88D-K□20F□□				
	R88D-K□30F□□	FN258L-30-07	30A	0.8mA (at 440 VAC/50 Hz)	
	R88D-K□50F□□				

- For operations, if no-fuse breakers are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring or make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.
- The noise filter must be installed as close as possible to the entrance of the control panel. Wire as shown at the left in the following illustration.

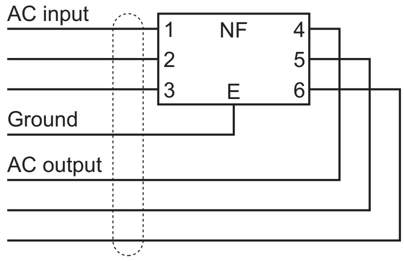
4

System Design

Separate the input and output.

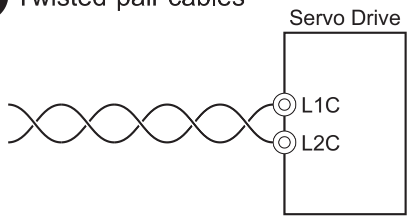


The effect of the noise filter is small.

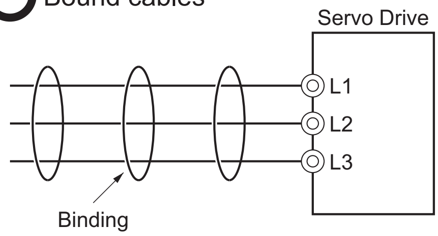


- Use twisted-pair cables for the power supply cables, or bind the cables.

Twisted-pair cables



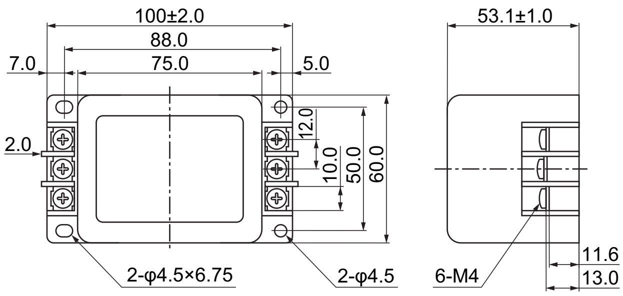
Bound cables



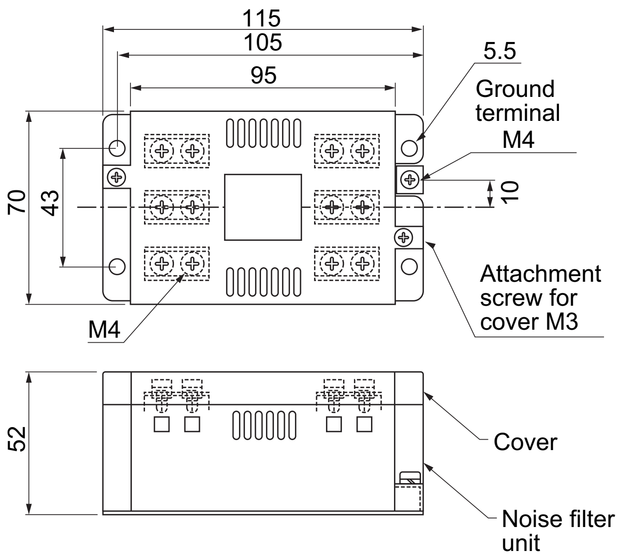
- Separate power supply lines and signal lines when wiring.

External Dimensions

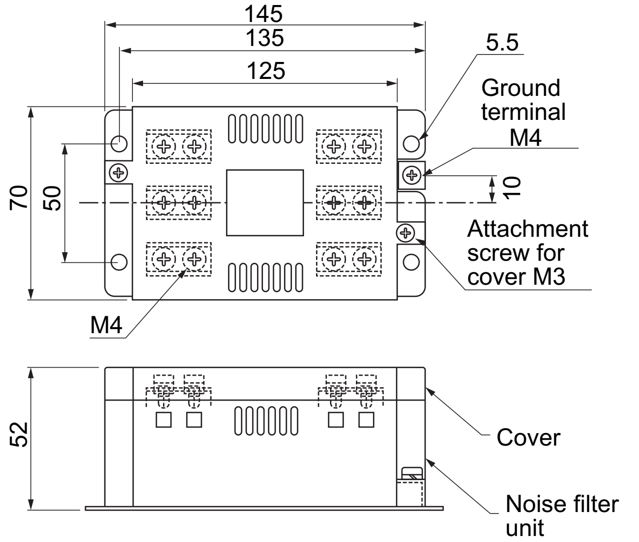
SUP-EK5-ER-6



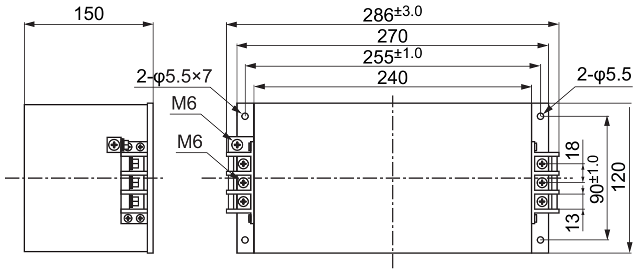
3SUP-HU10-ER-6



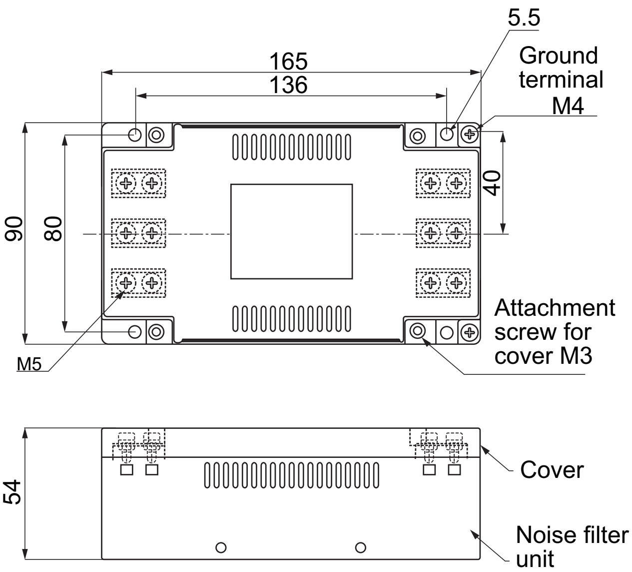
3SUP-HU30-ER-6



3SUP-HL50-ER-6B

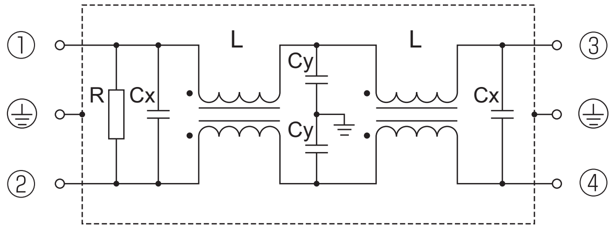


3SUP-HU50-ER-6

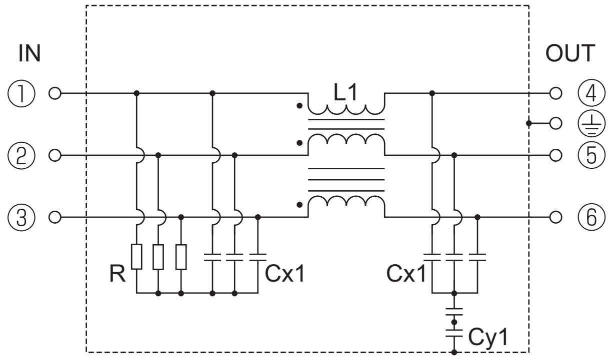


Circuit Diagram

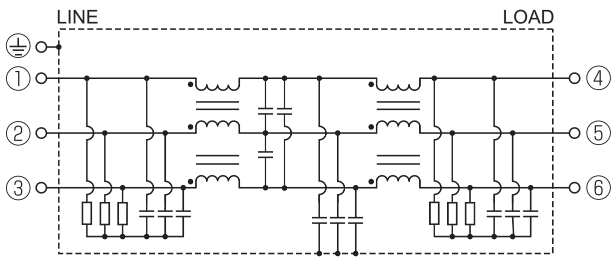
SUP-EK5-ER-6



3SUP-HU10-ER-6/3SUP-HU30-ER-6
3SUP-HU50-ER-6



3SUP-HL50-ER-6B



Control Panel Structure

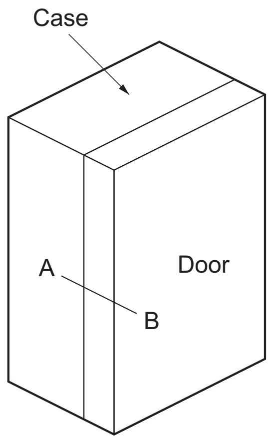
Openings in the control panel, such as holes for cables, panel mounting holes, and gaps around the door, may allow electromagnetic waves into the panel. To prevent this, observe the recommendations described below when designing or selecting a control panel.

Case Structure

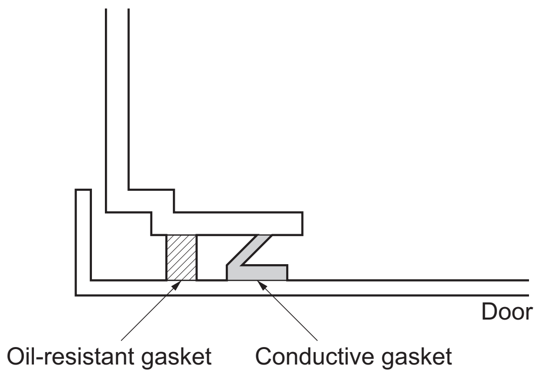
- Use a metal control panel with welded joints at the top, bottom, and sides so that the surfaces are electrically conductive.
- If assembly is required, strip the paint off the joint areas (or mask them during painting), to make them electrically conductive.
- The panel may warp and gaps may appear when screws are tightened. Be sure that no gaps appear when tightening screws.
- Do not leave any conductive part unconnected.
- Ground all units within the case to the case itself.

Door Structure

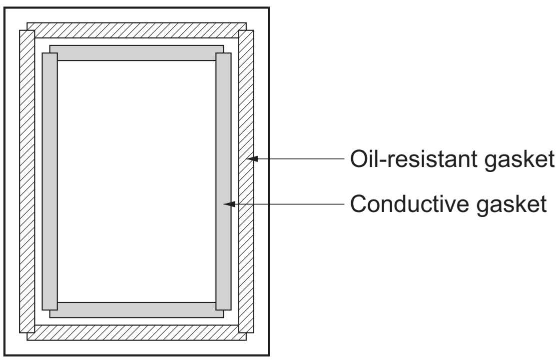
- Use a metal door.
- Use a water-draining structure where the door and case fit together, and leave no gaps. (Refer to the diagrams.)
- Use a conductive gasket between the door and the case. (Refer to the diagrams.)
- Strip the paint off the sections of the door and case that will be in contact with the conductive gasket (or mask them during painting), so that they are electrically conductive.
- The panel may warp and gaps may appear when screws are tightened. Be sure that no gaps appear when tightening screws.



[Control panel]



[A-B cross-section diagram]



[Door (interior side)]

Selecting Connection Component

This section explains the criteria for selecting the connection components required to improve noise resistance. Understand each component's characteristics, such as its capacity, performance, and applicable range when selecting the connection components.
For more details, contact the manufacturers directly.

No-fuse Breaker (NFB)

When selecting a no-fuse breaker, consider the maximum input current and the inrush current.

Maximum Input Current

- The momentary maximum output of Servo Drive is approx. 3 times the rated output, and can be output for up to 3 seconds.
  Therefore, select no-fuse breakers with an operation time of at least 5 seconds at 300% of the rated current ratio. General and low-speed no-fuse breakers are generally suitable.
- Select a no-fuse breaker with a rated current greater than the total effective load current of all the motors (when multiple Servo Drives are used). (The rated current of the power supply input for each motor is provided in "Main Circuit and Motor Connections" (P.4-13).)
- Add the current consumption of other controllers, and any other components when selecting.

Inrush Current

- The following table lists the Servo Drive inrush currents.
- With low-speed no-fuse breakers, an inrush current 10 times the rated current can flow for 0.02 second.
- When the power of multiple Servo Drives are turned ON simultaneously, select a no-fuse breaker with a 20-ms allowable current that is greater than the total inrush current, shown in the following table.

Drive model	Inrush current (A0-p)	
	Main circuit power supply	Control circuit power supply
R88D-KNA5L-ML2	7	14
R88D-KN01L-ML2	7	14
R88D-KN02L-ML2	7	14
R88D-KN04L-ML2	15	14
R88D-KN01H-ML2	14	28
R88D-KN02H-ML2	14	28
R88D-KN04H-ML2	14	28
R88D-KN08H-ML2	29	28
R88D-KN10H-ML2	29	28
R88D-KN15H-ML2	29	28
R88D-KN20H-ML2	29	14
R88D-KN30H-ML2	22	14
R88D-KN50H-ML2	22	14

Drive model	Inrush current (A0-p)	
	Main circuit power supply	Control circuit power supply
R88D-KN06F-ML2	28	48
R88D-KN10F-ML2	28	48
R88D-KN15F-ML2	28	48
R88D-KN20F-ML2	32	48
R88D-KN30F-ML2	32	48
R88D-KN50F-ML2	32	48

Leakage Breaker

- Select leakage breakers designed for protection against ground faults.
- When selecting leakage breakers, remember to add the leakage current from devices other than the motor, such as devices using a switching power supply, noise filters, inverters, and so on.
  To prevent malfunction due to inrush current, we recommend using a leakage breaker of 10 times the total of all leakage current values.
- The leakage breaker is activated at 50% of the rated current. Select a leakage breaker with enough capacity.
- For details on leakage breakers selection method, refer to the manufacturer's catalog.
- Because switching takes place inside the Servo Drives, high-frequency current leaks from the SW elements of the Servo Drive, the armature of the motor, and the cables.
  High-frequency, surge-resistant leakage breakers, because they do not detect high-frequency current, can prevent operation with high-frequency leakage current.
  When using a general leakage breaker, use 3 times the total of the leakage current given in the following table as a reference value.

Servo Drive model	Input power supply	Leakage current (Cable: 3 m)	Increase per 10 m of cable
R88D-KNA5L-ML2	Single-phase 100 V	0.38 mA	0.1 mA
R88D-KN01L-ML2	Single-phase 100 V	0.39 mA	
R88D-KN02L-ML2	Single-phase 100 V	0.41 mA	
R88D-KN04L-ML2	Single-phase 100 V	0.46 mA	0.12 mA
R88D-KN01H-ML2	Single-phase 200 V	0.83 mA	0.23 mA
	3-phase 200 V	1.03 mA	
R88D-KN02H-ML2	Single-phase 200 V	0.84 mA	
	3-phase 200 V	1.02 mA	
R88D-KN04H-ML2	Single-phase 200 V	0.96 mA	0.3 mA
	3-phase 200 V	1.27 mA	
R88D-KN08H-ML2	Single-phase 200 V	1.01 mA	1.1 mA
	3-phase 200 V	1.39 mA	
R88D-KN10H-ML2	Single-phase 200 V	0.88 mA	0.93 mA
	3-phase 200 V	1.14 mA	
R88D-KN15H-ML2	Single-phase 200 V	0.96 mA	
	3-phase 200 V	1.18 mA	

Servo Drive model	Input power supply	Leakage current (Cable: 3 m)	Increase per 10 m of cable
R88D-KN20H-ML2	3-phase 200 V	1.53 mA	1.23 mA
R88D-KN30H-ML2	3-phase 200 V	1.52 mA	
R88D-KN50H-ML2	3-phase 200 V	1.39 mA	
R88D-KN06F-ML2	3-phase 400 V	2.28 mA	1.8 mA
R88D-KN10F-ML2	3-phase 400 V	2.20 mA	
R88D-KN15F-ML2	3-phase 400 V	2.55 mA	2.03 mA
R88D-KN20F-ML2	3-phase 400 V	2.92 mA	2.4 mA
R88D-KN30F-ML2	3-phase 400 V	3.92 mA	3.23 mA
R88D-KN50F-ML2	3-phase 400 V	3.54 mA	2.9 mA

Note: These values vary greatly depending on the installation conditions of the motor power cable and the measurement conditions. Use them for reference only.

Surge Absorber

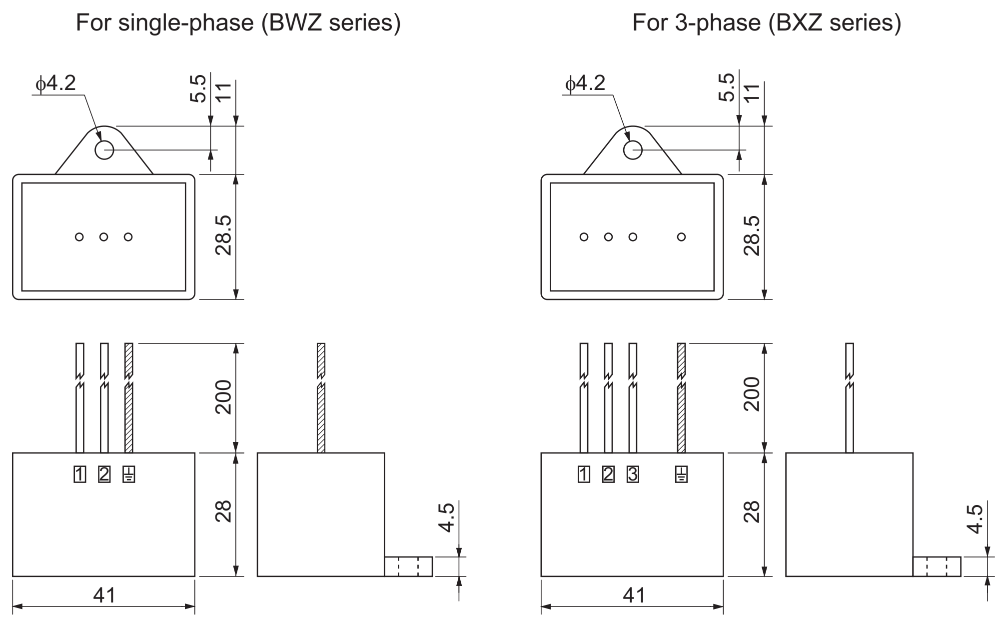
- Use surge absorbers to absorb lightning surge voltage and abnormal voltage from power supply input lines.
- When selecting surge absorbers, take into account the varistor voltage, the surge immunity and the energy tolerated dose.
- For 200-VAC systems, use surge absorbers with a varistor voltage of 620 V.
- The surge absorbers shown in the following table are recommended.

Manufacturer	Model	Surge immunity		Type	Comment
Okaya Electric Industries Co., Ltd.	R•A•V-781BWZ-4	700 V ± 20%	2500 A	Block	Single-phase 100/ 200 VAC
Okaya Electric Industries Co., Ltd.	R•A•V-781BXZ-4	700 V ± 20%	2500 A		3-phase 200 VAC
Okaya Electric Industries Co., Ltd.	R•A•V-801BXZ-4	800 V ± 20%	2500 A		3-phase 400 VAC

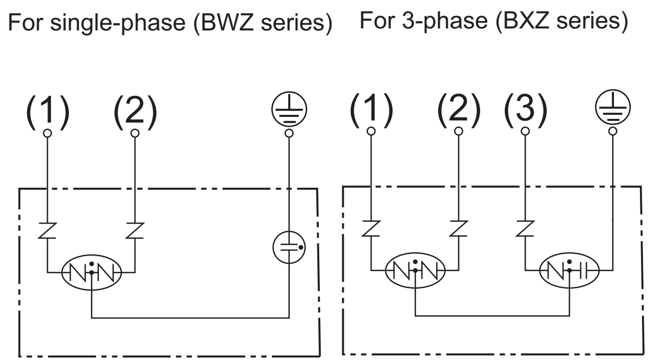
Note 1. Refer to the manufacturers' catalog for operating details.

Note 2. The surge immunity is for a standard impulse current of 8/20 μs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

External Dimensions



Equalizing Circuits



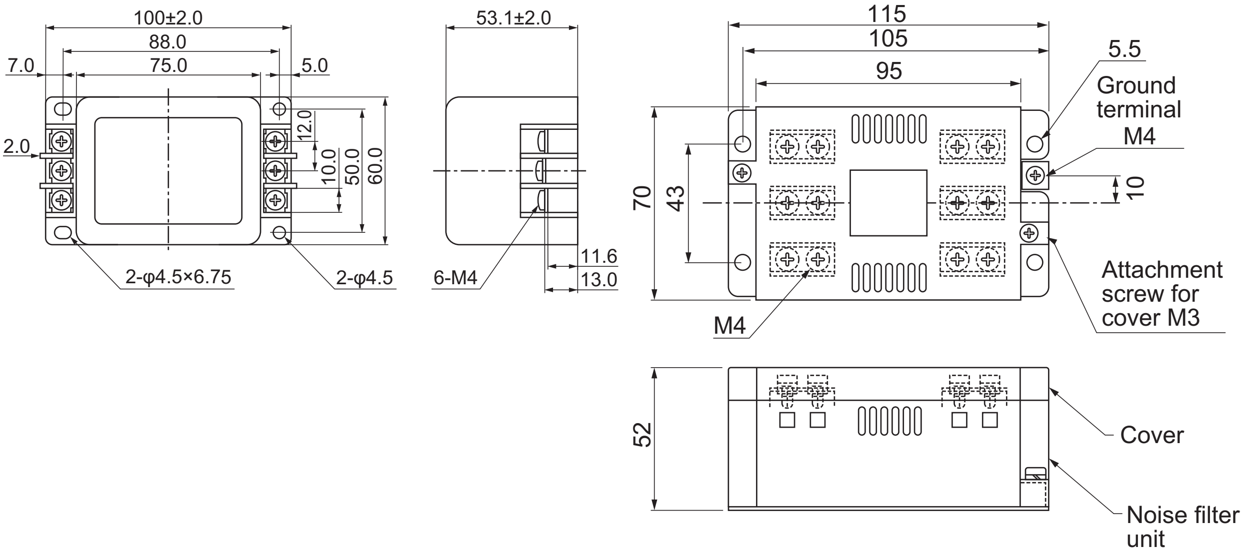
Noise Filter for Power Supply Input

We recommend you to use the noise filter for the Servo Drive.

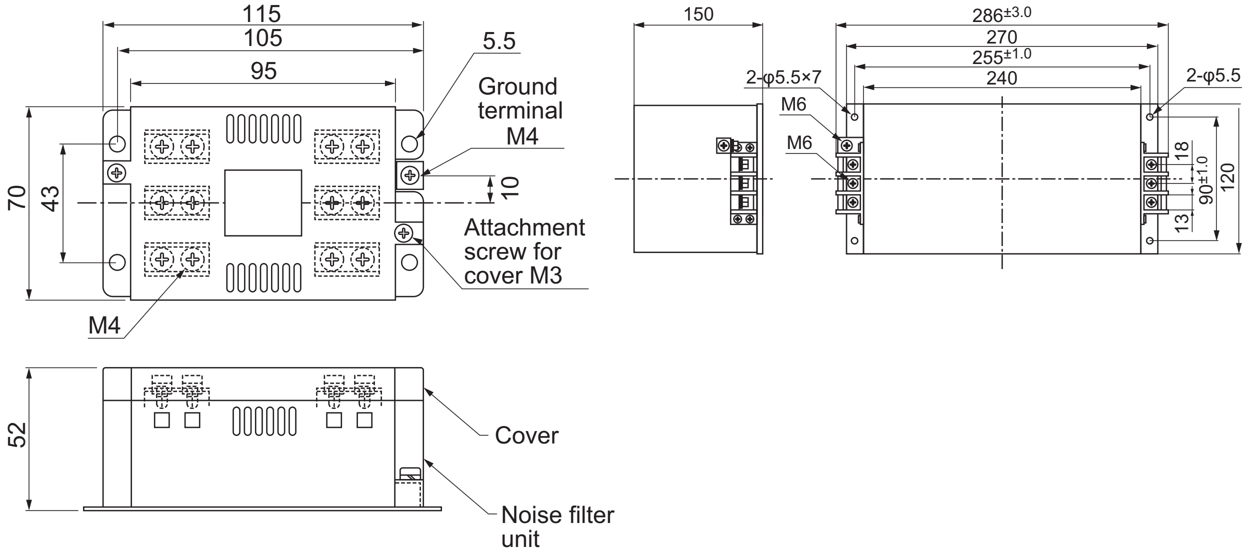
Drive		Noise filter for power supply input			
Phase	Model	Model	Rated current	Leakage current (60 Hz) max	Manufacturer
Single-phase	R88D-K□A5L□□	SUP-EK5-ER-6	5 A	1.0 mA (at 250 VAC)	Okaya Electric Industries Co., Ltd.
	R88D-K□01L□□				
	R88D-K□02L□□				
Single-phase	R88D-K□04L□□	3SUP-HU10-ER-6	10 A	3.5 mA (at 500 VAC)	
Single-phase	R88D-K□01H□□	SUP-EK5-ER-6	5 A	1.0 mA (at 250 VAC)	
3-phase		3SUP-HU10-ER-6	10 A	3.5 mA (at 500 VAC)	
Single-phase	R88D-K□02H□□	SUP-EK5-ER-6	5 A	1.0 mA (at 250 VAC)	
3-phase		3SUP-HU10-ER-6	10 A	3.5 mA (at 500 VAC)	
Single-phase	R88D-K□04H□□	SUP-EK5-ER-6	5 A	1.0 mA (at 250 VAC)	
3-phase		3SUP-HU10-ER-6	10 A	3.5 mA (at 500 VAC)	
Single or 3-phase	R88D-K□08H□□				
	R88D-K□10H□□	3SUP-HU30-ER-6	30 A	3.5 mA (at 500 VAC)	
	R88D-K□15H□□				
3-phase	R88D-K□20H□□	3SUP-HU50-ER-6	50 A	3.5 mA (at 500 VAC)	
	R88D-K□30H□□	3SUP-HL50-ER-6B	50 A	8.0 mA (at 500 VAC)	
	R88D-K□50H□□				
	R88D-K□06F□□	FN258L-16-07	16 A	0.8 mA (at 440 VAC/50 Hz)	Schaffner EMC Inc.
	R88D-K□10F□□				
	R88D-K□15F□□				
	R88D-K□20F□□				
	R88D-K□30F□□	FN258L-30-07	30 A	0.8 mA (at 440 VAC/50 Hz)	
	R88D-K□50F□□				

External Dimensions

SUP-EK5-ER-63SUP-HQ10-ER-6

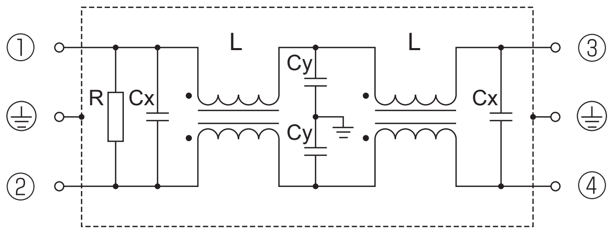


3SUP-HU30-ER-63SUP-HL50-ER-6B

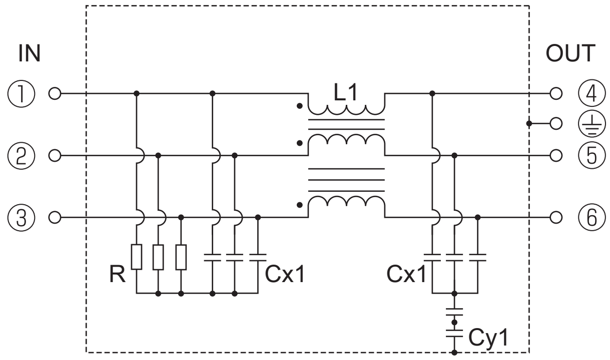


Circuit Diagram

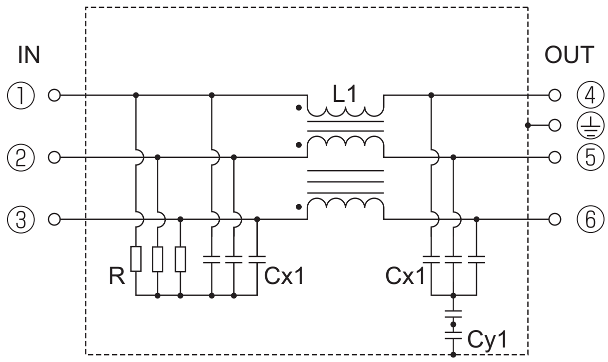
SUP-EK5-ER-6



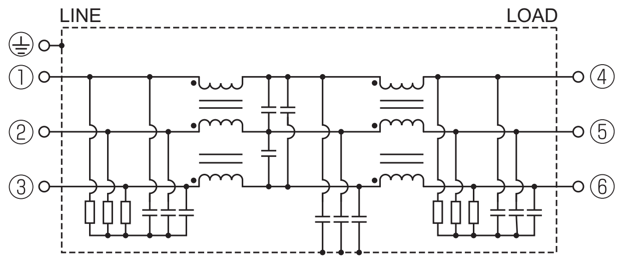
3SUP-HQ10-ER-6



3SUP-HU30-ER-6



3SUP-HL50-ER-6B



Noise Filter for the Brake Power Supply

- Use the following noise filter for the brake power supply.

Model	Rated current	Rated voltage	Leakage current	Manufacturer
SUP-EK5-ER-6	5 A	250 V	1.0 mA (at 250 Vrms, 60 Hz)	Okaya Electric Industries Co., Ltd.

Note. Noise can also be reduced by 1.5 turns with the ZCAT3035-1330 (TDK) Radio Noise Filter.

Radio Noise Filter and Emission Noise Prevention Clamp Core

Use one of the following filters to prevent switching noise of PWM of the Servo Drive and to prevent noise emitted from the internal clock circuit.

Model	Manufacturer	Application
3G3AX-ZCL1 *1	OMRON	For Drive output and power cable
3G3AX-ZCL2 *2	OMRON	For Drive output and power cable
ESD-R-47B *3	NEC TOKIN	For Drive output and power cable
ZCAT3035-1330 *4	TDK	For Encoder cable and I/O cable
RJ8035	Konno Industry	For power lines

*1. Generally used for 1.5 kW or higher.

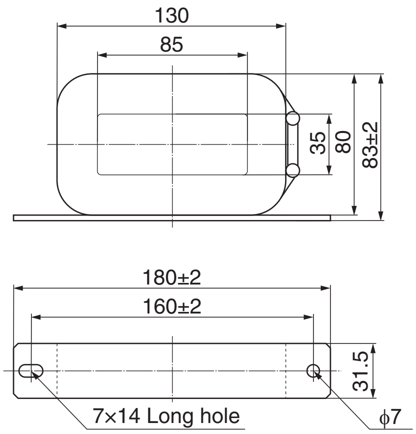
*2. Generally used for 1.5 kW or lower. The maximum number of windings is 3 turns.

*3. Generally used for 50/100 W. The maximum number of windings is 2 turns.

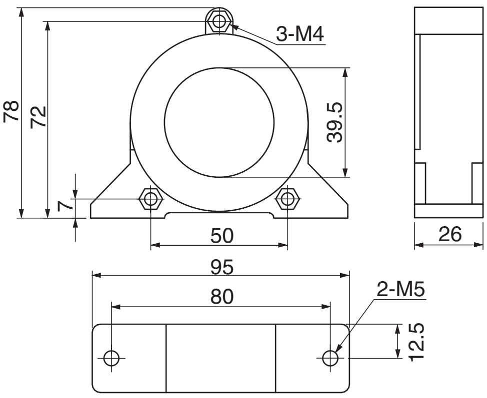
*4. Also used on the Drive output power lines to comply with the EMC directives. Only a clamp is used. This clamp can also be used to reduce noise current on a FG line.

External Dimensions

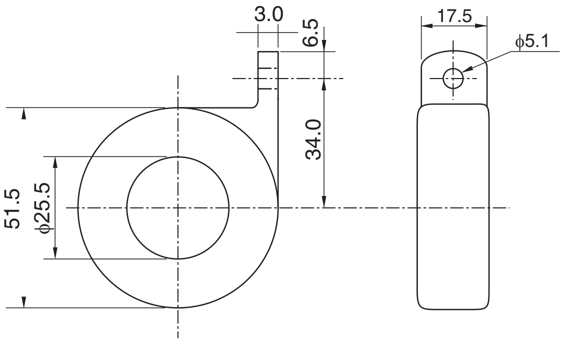
3G3AX-ZCL1



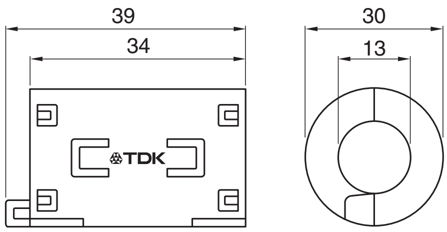
3G3AX-ZCL2



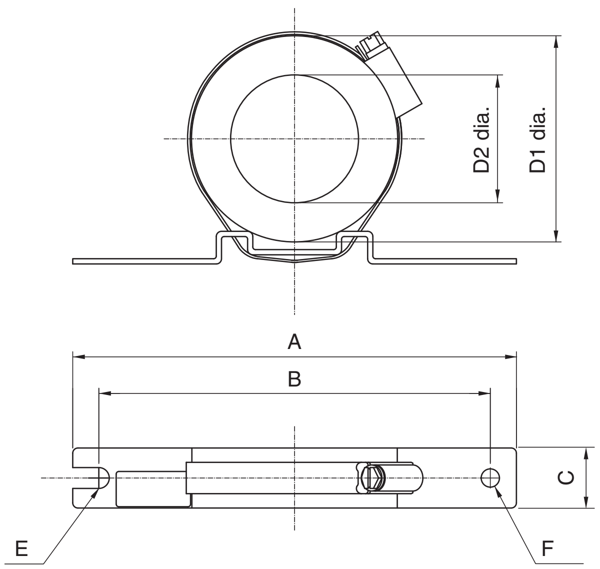
ESD-R-47B



ZCAT3035-1330



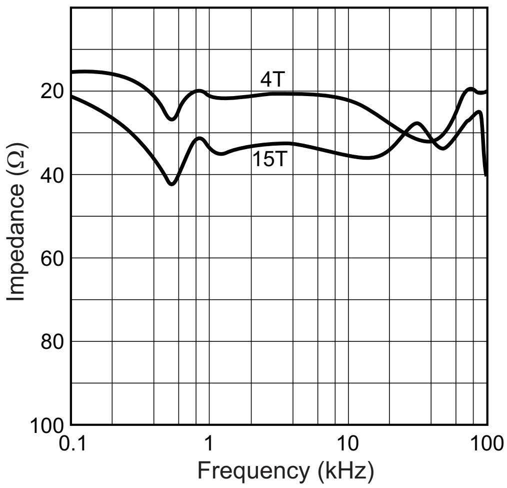
RJ8035



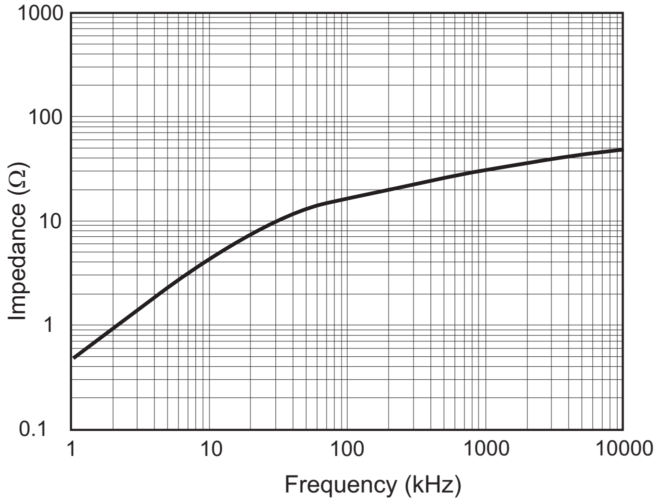
Model	Current	Dimensions (unit: mm)							
		A	B	C	D1	D2	Core thickness	E	F
RJ8035	35 A	170	150	23	80	53	24	R3.5	7

Impedance Characteristics

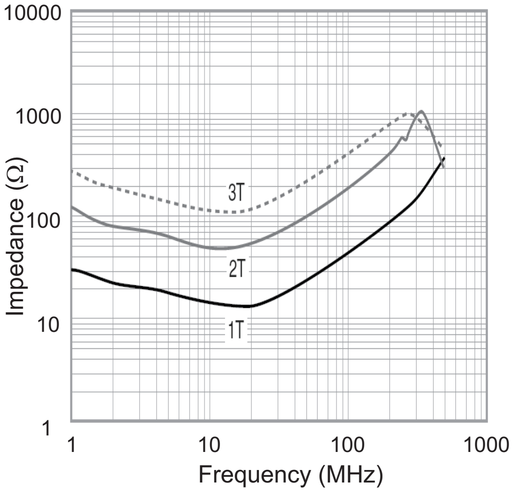
3G3AX-ZCL1



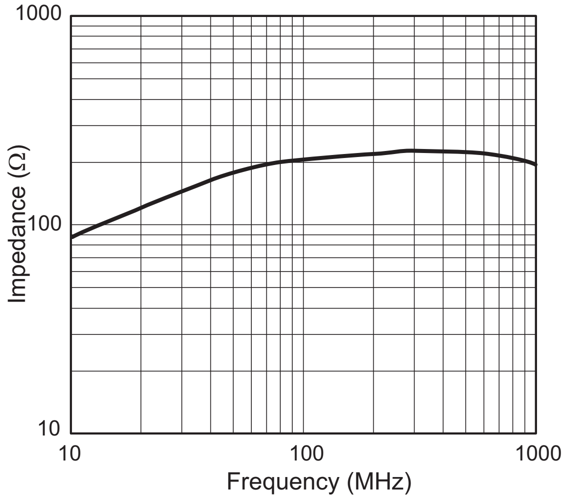
3G3AX-ZCL2



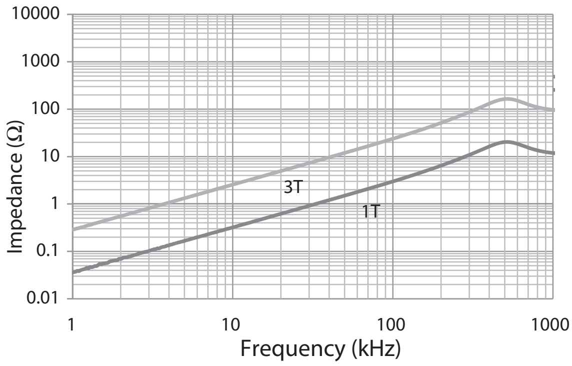
ESD-R-47B



ZCAT3035-1330



RJ8035



Surge Suppressor

- Install surge suppressors for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc.
- The following table shows the types of surge suppressors and recommended products.

Type	Feature	Recommended product
Diodes	Diodes are used for relatively small loads such as relays when the reset time is not a critical issue. At power shutoff the surge voltage is the lowest, but the rest time takes longer. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time (e.g. RU2 of Sanken Electric Co., Ltd.).
Thyristors and varistors	Thyristors and varistors are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is critical. The surge voltage at power shutoff is approx. 1.5 times the varistor voltage.	Select the varistor voltage as follows. 24-VDC systems: varistor voltage 39 V 100-VDC systems: varistor voltage 200 V 100-VAC systems: varistor voltage 270 V 200-VAC systems: varistor voltage 470 V
Capacitor + resistor	The capacitor plus resistor combination is used to absorb vibration in the surge at power supply shutoff. The reset time can be shortened by selecting the appropriate capacitance and resistance.	Okaya Electric Industries Co., Ltd. XEB12002 0.2 μF-120 Ω XEB12003 0.3 μF-120 Ω

- Thyristors and varistors are made by the following manufacturers. Refer to manufacturer's documentation for details on these components.
  Thyristors: Ishizuka Electronics Co.
  Varistor: Ishizuka Electronics Co., Panasonic Corporation

Contactor

- Select contactors based on the circuit's inrush current and the maximum momentary phase current.
- The drive inrush current is covered in the preceding explanation of no-fuse breaker selection.
  And the maximum momentary phase current is approx. twice the rated current.

Improving Encoder Cable Noise Resistance

Take the following steps during wiring and installation to improve the encoder's noise resistance.

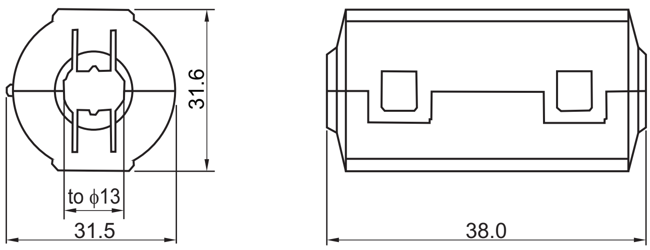
- Always use the specified encoder cables.
- Do not roll cables. If cables are long and are rolled, mutual induction and inductance will increase and cause malfunctions. Always use cables fully extended.
- When installing noise filters for encoder cables, use Clamp cores.
- The following table shows the recommended Clamp cores.

Manufacturer	Product name	Model	Specifications
NEC TOKIN	Clamp core	ESD-SR-250	For cable dia. up to 13 mm
TDK	Clamp core	ZCAT3035-1330	For cable dia. up to 13 mm

- Do not place the encoder cable with the following cables in the same duct.
  Control cables for brakes, solenoids, clutches, and valves.

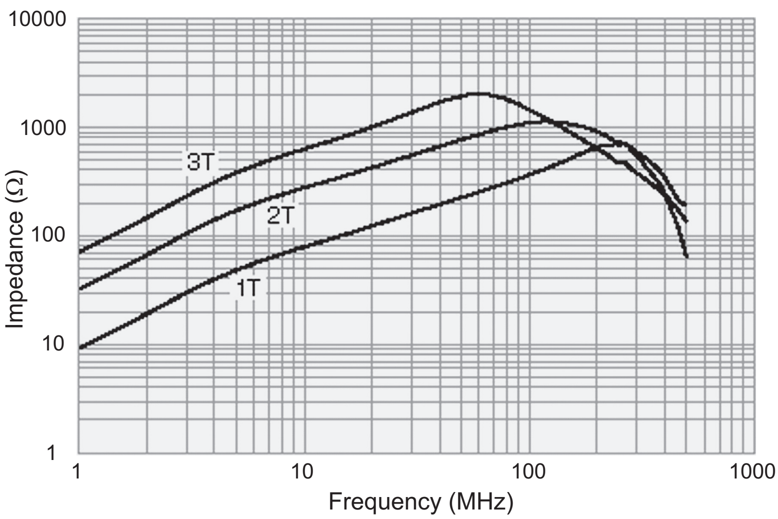
External Dimensions

ESD-SR-250



Impedance Characteristics

ESD-SR-250



Refer to the following sections for the dimensions and impedance characteristics of the ZCAT3035-1330: "External Dimensions" (P.4-32) and "Impedance Characteristics" (P.4-38).

4

System Design

Improving Control I/O Signal Noise Resistance

Positioning can be affected and I/O signal errors can occur if control I/O is influenced by noise.

- Use completely separate power supplies for the control power supply (especially 24 VDC) and the external operation power supply. In particular, do not connect the 2 power supply ground wires.
- Install a noise filter on the primary side of the control power supply.
- If motors with brakes are being used, do not use the same 24-VDC power supply for both the brakes and the control I/O. Additionally, do not connect the ground wires. Connecting the ground wires may cause I/O signal errors.
- Keep the power supply for pulse commands and error counter reset input lines separated from the control power supply as far as possible. In particular, do not connect the 2 power supply ground wires.
- We recommend using line drivers for the pulse command and error counter reset outputs.
- Always use twisted-pair shielded cable for the pulse command and error counter reset signal lines, and connect both ends of the shield cable to frame grounds.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-μF laminated ceramic capacitors between the control power supply and ground at the drive input section or the controller output section.
- For open collector inputs/outputs, keep the length of wires to within 2 m.

Reactor to Reduce Harmonic Current

Harmonic Current Measures

- Use a Reactor to suppress harmonic currents. The Reactor functions to suppress sudden and quick changes in electric currents.
- The Guidelines for Suppressing Harmonic Currents in Home Appliances and General Purpose Components require that manufacturers take appropriate remedies to suppress harmonic current emissions onto power supply lines.
- Select the proper Reactor model according to the Servo Drive to be used.

Servo Drive		Reactor			
Model	Number of power phases	Model	Rated current	Inductance	Weight
R88D-KNA5L-ML2	Single-phase	3G3AX-DL2002	1.6 A	21.4 mH	Approx. 0.8 kg
R88D-KN01L-ML2		3G3AX-DL2004	3.2 A	10.7 mH	Approx. 1.0 kg
R88D-KN02L-ML2		3G3AX-DL2007	6.1 A	6.75 mH	Approx. 1.3 kg
R88D-KN04L-ML2		3G3AX-DL2015	9.3 A	3.51 mH	Approx. 1.6 kg
R88D-KN01H-ML2	Single-phase	3G3AX-DL2002	1.6 A	21.4 mH	Approx. 0.8 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN02H-ML2	Single-phase	3G3AX-DL2004	3.2 A	10.7 mH	Approx. 1.0 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN04H-ML2	Single-phase	3G3AX-DL2007	6.1 A	6.75 mH	Approx. 1.3 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN08H-ML2	Single-phase	3G3AX-DL2015	9.3 A	3.51 mH	Approx. 1.6 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN10H-ML2	Single-phase	3G3AX-DL2015	9.3 A	3.51 mH	Approx. 1.6 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN15H-ML2	Single-phase	3G3AX-DL2022	13.8 A	2.51 mH	Approx. 2.1 kg
	3-phase	3G3AX-AL2025	10.0 A	2.8 mH	Approx. 2.8 kg
R88D-KN20H-ML2	3-phase	3G3AX-AL2055	20.0 A	0.88 mH	Approx. 4.0 kg
R88D-KN30H-ML2					
R88D-KN50H-ML2		3G3AX-AL2110	37.0 A	0.35 mH	Approx. 5.0 kg
R88D-KN06F-ML2		3G3AX-AL4025	6.0 A	7.7 mH	Approx. 2.7 kg
R88D-KN10F-ML2					
R88D-KN15F-ML2					
R88D-KN20F-ML2		3G3AX-AL4055	10.0 A	3.5 mH	Approx. 4.0 kg
R88D-KN30F-ML2					
R88D-KN50F-ML2		3G3AX-AL4110	20.0 A	1.3 mH	Approx. 6.0 kg

Selecting Other Parts for Noise Resistance

This section explains the criteria for selecting the connection components required to improve noise resistance.
Understand each component's characteristics, such as its capacity, performance, and applicable range when selecting the connection components.
For more details, contact the manufacturers directly.

Noise Filters for Motor Output

- Use noise filters without built-in capacitors on the motor output lines.
- Select a noise filter with a rated current at least twice the Servo Drive's continuous output current.
- The following table shows the noise filters that are recommended for motor output lines.

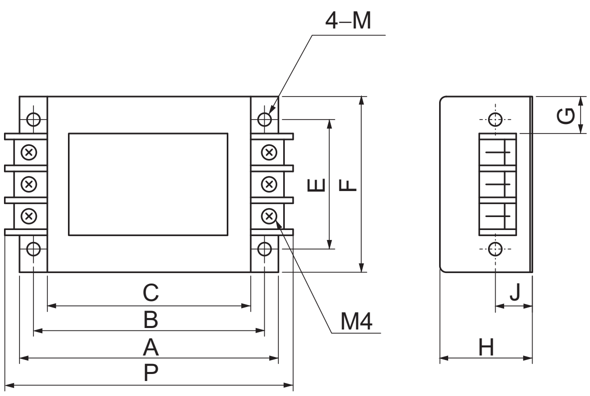
Manufacturer	Model	Rated current	Comment
OMRON	3G3AX-NFO01	6 A	For inverter output
	3G3AX-NFO02	12 A	
	3G3AX-NFO03	25 A	
	3G3AX-NFO04	50 A	
	3G3AX-NFO05	75 A	
	3G3AX-NFO06	100 A	

Note 1. Motor output lines cannot use the same noise filters for power supplies.

Note 2. General noise filters are made for power supply frequencies of 50/60 Hz. If these noise filters are connected to the PWM output of the Servo Drive, a very large (about 100 times larger) leakage current may flow through the noise filter's capacitor and the Servo Drive could be damaged.

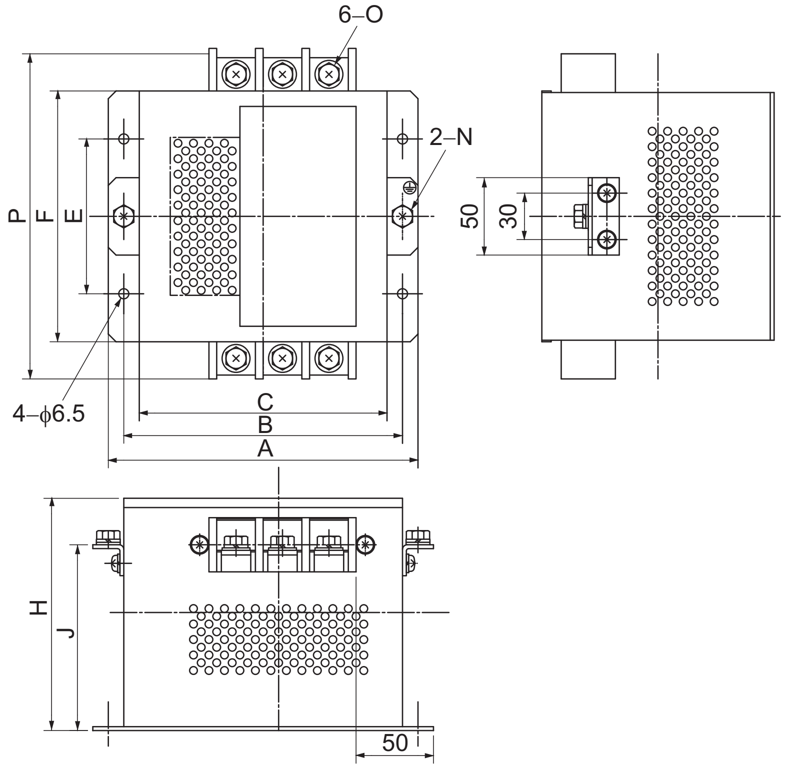
External Dimensions

3G3AX-NFO01/-NFO02



Model	Dimensions (mm)									
	A	B	C	E	F	G	H	J	M	P
3G3AX-NFO01	140	125	110	70	95	22	50	20	4.5 dia.	156
3G3AX-NFO02	160	145	130	80	110	30	70	25	5.5 dia.	176

3G3AX-NFO03/-NFO04/-NFO05/-NFO06



Model	Dimensions (mm)									
	A	B	C	E	F	H	J	N	O	P
3G3AX-NFO03	160	145	130	80	112	120	–	–	M4	154
3G3AX-NFO04	200	180	160	100	162	150	120	M5	M5	210
3G3AX-NFO05	220	200	180	100	182	170	140	M6	M6	230
3G3AX-NFO06	220	200	180	100	182	170	140	M8	M8	237

4-4 Regenerative Energy Absorption

A Servo Drive uses its built-in capacitors to absorb the regenerative energy produced during motor deceleration. If the amount of regenerative energy is too much for the built-in capacitors to absorb, it also uses an Internal Regeneration Resistor. An overvoltage error occurs, however, if the amount of regenerative energy from the Servomotor is too large. If this occurs, reduce the regenerative energy by changing operating patterns or increase the regeneration process capacity by connecting External Regeneration Units.

Precautions for Correct Use

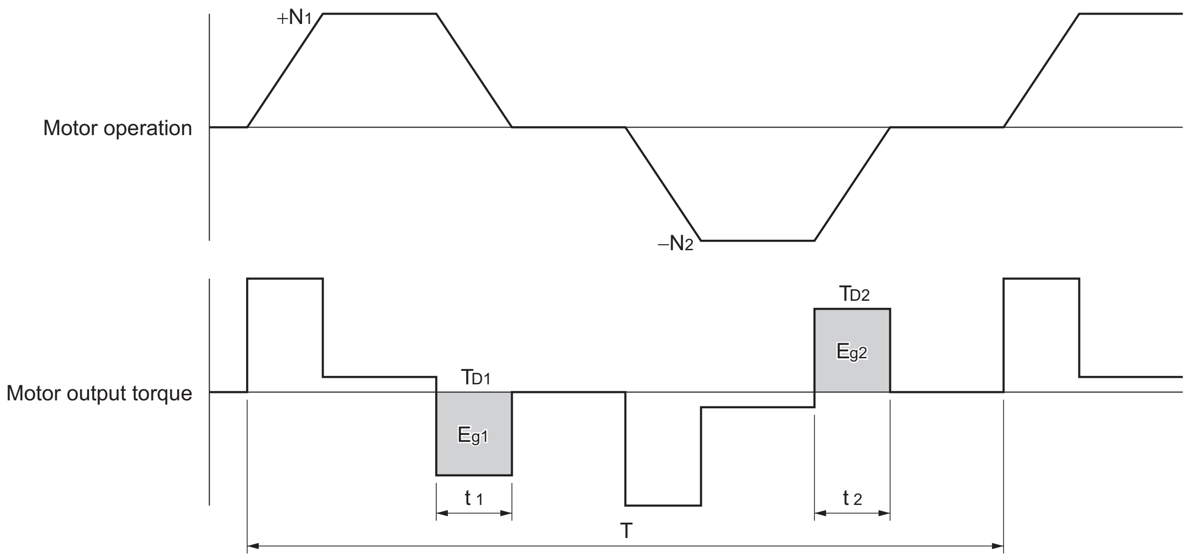
- Some Servo Drive models do not have any built-in Internal Regeneration Resistor.
- The regeneration absorption capacity of a Servo Drive varies depending on the Servo Drive model.
  For information on whether or not your Servo Drive has an Internal Regeneration Resistor and its regeneration absorption capacity, refer to Servo Drive Regeneration Absorption Capacity (P.4-48).

4

System Design

Regenerative Energy Calculation

The method for calculating regenerative energy on the horizontal axis is indicated below.



- In the output torque graph, acceleration in the forward direction is shown as positive, and acceleration in the reverse direction is shown as negative.
- The regenerative energy values in each region can be derived from the following equations.

$\cdot\ E_{g1} = \frac{1}{2} \cdot \frac{2\pi}{60} \cdot N_1 \cdot T_{D1} \cdot t_1 \quad [J]$

$\cdot\ E_{g2} = \frac{1}{2} \cdot \frac{2\pi}{60} \cdot N_2 \cdot T_{D2} \cdot t_2 \quad [J]$

N_1, N_2 : Rotation speed at start of deceleration [r/min]

T_{D1}, T_{D2} : Deceleration torque [N·m]

t_1, t_2 : Deceleration time [s]

Note. Due to the loss of motor winding resistance and PWM, the actual regenerative energy will be approx. 90% of the values derived from these equations.

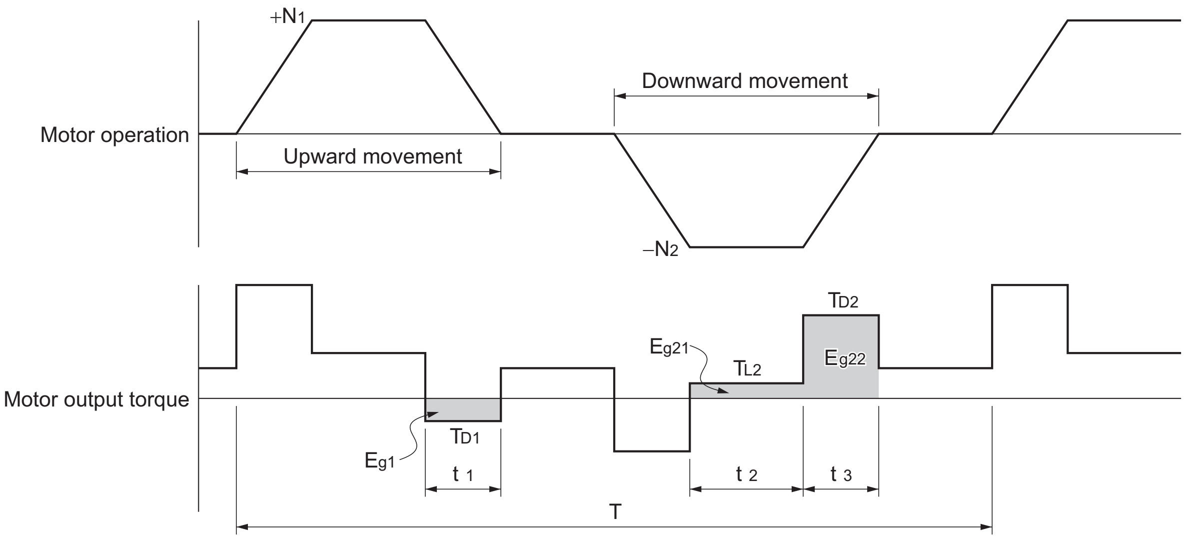
- For Servo Drive models with internal capacitors used for absorbing regenerative energy (i.e., Servo Drive models of 400 W or less), the values for both Eg_1 or Eg_2 (unit: J) must be lower than the drive's regeneration absorption capacity. (The capacity depends on the model.For details, refer to the next section.)
- For Servo Drive models with an Internal Regeneration Resistor used for absorbing regenerative energy (i.e., Servo Drive models of 500 W or more), the average amount of regeneration Pr (unit: W) must be calculated, and this value must be lower than the drive's regeneration absorption capacity. (The capacity depends on the model.For details, refer to the next section.)

  The average regeneration power (Pr) is the regeneration power produced in 1 cycle of operation [W].

  $P_r = (E_{g1} + E_{g2}) / T$[W]

  T: Operation cycle [s]

The method for calculating regenerative energy on the vertical axis is indicated below.



- In the output torque graph, acceleration in the forward direction (rising) is shown as positive, and acceleration in the reverse direction (falling) is shown as negative.

- The regenerative energy values in each region can be derived from the following equations.

$$\cdot\ E_{g1} = \frac{1}{2} \cdot \frac{2\pi}{60} \cdot N_1 \cdot T_{D1} \cdot t_1 \quad [J]$$

$$\cdot\ E_{g21} = \frac{2\pi}{60} \cdot N_2 \cdot T_{L2} \cdot t_2 \quad [J]$$

$$\cdot\ E_{g22} = \frac{1}{2} \cdot \frac{2\pi}{60} \cdot N_2 \cdot T_{D2} \cdot t_3 \quad [J]$$

$$\cdot\ E_{g2} = E_{g21} + E_{g22} \quad [J]$$

N_1, N_2	: Rotation speed at start of deceleration	[r/min]
T_{D1}, T_{D2}	: Deceleration torque	[N·m]
T_{L2}	: Torque during downward movement	[N·m]
t_1, t_3	: Deceleration time	[s]
t_2	: Constant-speed driving time during downward movement	[s]

Note. Due to the loss of winding resistance, the actual regenerative energy will be approx. 90% of the values derived from these equations.

Determining the Capacity of Regenerative Energy Absorption by Built-in Capacitors

If both the values E_{g1} and E_{g2} [J] mentioned above are equal to or less than the value of the Servo Drive's regenerative energy that can be absorbed by built-in capacitors Ec [J], the Servo Drive can process regenerative energy only by its built-in capacitors.
If either the value E_{g1} or E_{g2} [J] exceeds the value of the Servo Drive's regenerative energy that can be absorbed by built-in capacitors Ec [J], however, use the following equations to determine the average regeneration power Pr [W].

- $E_g = (E_{g1} - E_c) + (E_{g2} - E_c)$ [J]
- $P_r = E_g / T$ [W]

P_r: Average regeneration power that must be absorbed in 1 cycle of operation [W]
E_g: Regenerative energy that must be absorbed in 1 cycle of operation [J]
E_c: Regenerative energy that can be absorbed by built-in capacitors [J]
T : Operation cycle [s]

Note. If the expression (Eg1 - Ec) result is zero or less, regard it as 0. The expression (Eg2 - Ec) must also be handled in the same way.

The above expressions calculate the average regeneration power Pr [W], which cannot be absorbed by the built-in capacitors. If this average regeneration power Pr [W] is equal to or less than the average amount of regeneration that can be absorbed by the Servo Drive's Internal Regeneration Resistor, the Servo Drive can independently process the regenerative energy.

If this average regeneration power Pr [W] cannot be processed only by the Servo Drive, take the following processes.

- Connect an External Regeneration Resistor. (Regeneration process capacity improves.)
- Reduce the rotation speed. (The amount of regeneration is proportional to the square of the rotation speed.)
- Lengthen the deceleration time. (Regenerative energy per unit time decreases.)
- Lengthen the operation cycle, i.e., the cycle time. (Average regenerative power decreases.)

Servo Drive Regeneration Absorption Capacity

The following table shows the regenerative energy (and amount of regeneration) that each Servo Drive can absorb. If these values are exceeded, take the processes above.

Servo Drive model	Regenerative energy absorbable by built-in capacitor (J)	Internal regeneration resistor	Allowable minimum regeneration resistance (Ω)
		Average amount of regenerative energy absorbable (W)	
R88D-KNA5L-ML2	16	–	17
R88D-KN01L-ML2	16	–	17
R88D-KN02L-ML2	22	–	17
R88D-KN04L-ML2	32	17	13
R88D-KN01H-ML2	25	–	34
R88D-KN02H-ML2	25	–	34
R88D-KN04H-ML2	36	–	34
R88D-KN08H-ML2	62	12	25
R88D-KN10H-ML2	99	18	25
R88D-KN15H-ML2	99	18	25
R88D-KN20H-ML2	99	72	10
R88D-KN30H-ML2	150	60	7
R88D-KN50H-ML2	150	60	5
R88D-KN06F-ML2	128	21	100
R88D-KN10F-ML2	128	21	100
R88D-KN15F-ML2	128	21	100
R88D-KN20F-ML2	128	29	40
R88D-KN30F-ML2	285	60	40
R88D-KN50F-ML2	285	60	29

Regenerative energy to be absorbed by built-in capacitor varies depending on the input voltage to the main circuit power supply for the Servo Drive. The above value for each Servo Drive model is calculated when the input voltage is as follows.

Model	Main circuit power supply input voltage
R88D-KN☐☐L-ML2	100 VAC
R88D-KN☐☐H-ML2	200 VAC
R88D-KN☐☐F-ML2	400 VAC

4

System Design

Regenerative Energy Absorption with an External Regeneration Resistor

If the regenerative energy exceeds the regeneration absorption capacity of the drive, connect an External Regeneration Resistor.
Connect the External Regeneration Resistor between B1 and B2 terminals on the drive.
Double-check the terminal names when connecting the resistor because the drive may be damaged if connected to the wrong terminals.
The External Regeneration Resistor will heat up to approx. 120°C. Do not place it near equipment and wiring that is easily affected by heat. Attach radiator plates suitable for the heat radiation conditions.

External Regeneration Resistor

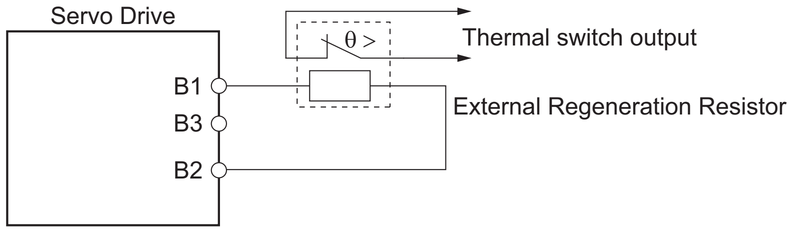
Characteristics

Model	Resistance value	Nominal capacity	The amount of regeneration absorption for 120°C temperature rise	Heat radiation condition	Thermal switch output specifications
R88A-RR08050S	50 Ω	80 W	20 W	Aluminum 350 × 350, Thickness: 3.0	Operating temperature 150°C ± 5% NC contact Rated output (resistive load): 125 VAC, 0.1 A max. 30 VDC, 0.1 A max. (minimum current: 1 mA)
R88A-RR080100S	100 Ω	80 W	20 W	Aluminum 350 × 350, Thickness: 3.0	Operating temperature 150°C ± 5% NC contact Rated output (resistive load): 125 VAC, 0.1 A max. 30 VDC, 0.1 A max. (minimum current: 1 mA)
R88A-RR22047S1	47 Ω	220 W	70 W	Aluminum 350 × 350, Thickness: 3.0	Operating temperature: 150 ± 5°C NC contact Rated output (resistiveload): 250 VAC, 0.2 A max. 42 VDC, 0.2 A max. (minimum current: 1 mA)
R88A-RR50020S	20 Ω	500 W	180 W	Aluminum 600 × 600, Thickness: 3.0	Operating temperature 200 ± 7°C NC contact Rated output (resistive load): 250 VAC, 0.2 A max. 42 VDC, 0.2 A max. (minimum current: 1 mA)

Connecting an External Regeneration Resistor

R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN01H-ML2/-KN02H-ML2/-KN04H-ML2

Normally B2 and B3 are open.
If an External Regeneration Resistor is necessary, connect the External Regeneration Resistor between B1 and B2 as shown in the diagram below.

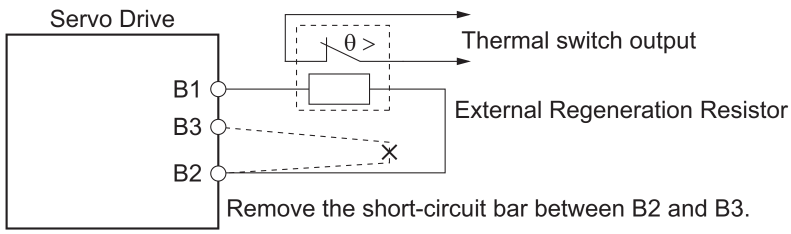


Precautions for Correct Use

- Connect the thermal switch output so that the main circuit power supply is shut OFF when the contacts open.
  When using multiple External Regeneration Resistors, connect each thermal switch in series.
  The resistor may be damaged by burning, or cause fire if it is used without setting up a power supply shutoff sequence using the output from the thermal switch.

R88D-KN04L-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2/-KN20H-ML2/-KN30H-ML2/-KN50H-ML2/-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2/-KN30F-ML2/-KN50F-ML2

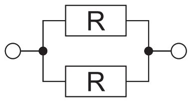
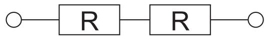
Normally B2 and B3 are short-circuited.
If an External Regeneration Resistor is necessary, remove the short-circuit bar between B2 and B3, and then connect the External Regeneration Resistor between B1 and B2 as shown in the diagram below.

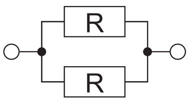
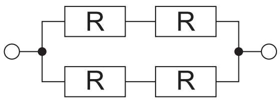
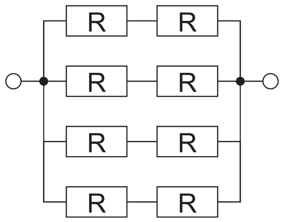


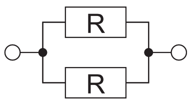
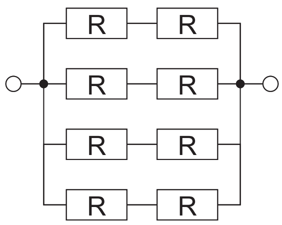
Precautions for Correct Use

- Connect the thermal switch output so that the main circuit power supply is shut OFF when the contacts open.
  When using multiple External Regeneration Resistors, connect each thermal switch in series.
  The resistor may be damaged by burning, or cause fire if it is used without setting up a power supply shutoff sequence using the output from the thermal switch.

Combining External Regeneration Resistors

Regeneration absorption capacity *1	20 W	40 W	70 W	140 W
Model	R88A-RR08050S R88A-RR080100S	R88A-RR08050S R88A-RR080100S	R88A-RR22047S1	R88A-RR22047S1
Resistance value *2	50 Ω/100 Ω	25 Ω/50 Ω	47 Ω	94 Ω
Connection method				

Regeneration absorption capacity *1	140 W	280 W	560 W
Model	R88A-RR22047S1	R88A-RR22047S1	R88A-RR22047S1
Resistance value *2	23.5 Ω	47 Ω	23.5 Ω
Connection method			

Regeneration absorption capacity *1	180 W	360 W	1440 W
Model	R88A-RR50020S	R88A-RR50020S	R88A-RR50020S
Resistance value *2	20 Ω	10 Ω	10 Ω
Connection method			

*1. Select a combination that has an absorption capacity greater than the average regeneration power (Pr).

*2. Do not use a combination with resistance values lower than the allowable minimum regeneration resistance of each drive. For information on the allowable minimum regeneration resistance, refer to "Servo Drive Regeneration Absorption Capacity" (P.4-48).

Precautions for Safe Use

- Surface temperatures on regeneration resistance can reach 200°C.
  Do not place objects that tend to catch fire nearby. To prevent people from touching them, install a cover that enables heat dissipation.

4-5 Large Load Inertia Adjustment and Dynamic Brake

The applicable load inertia of the Servomotor is the value of the load inertia at which the Servo Drive circuit is not destroyed in normal usage conditions. Use the Servomotor at or below the applicable load inertia, and note the cautions below regarding adjustment and dynamic braking.

Adjustment When the Load Inertia Is Large

In the instances below, realtime autotuning may not function properly. In this event, improve the load conditions, or perform manual tuning to set the gain and the inertia ratio.

- When the load inertia is less than 3 times or over 20 times the rotor inertia, or is over the applicable load inertia ratio.
- When the load inertia varies.
- When the load has low mechanical rigidity.
- When backlash or non-linear conditions occur in the load.
- When the acceleration/deceleration torque is less than the unbalanced load or viscous friction torque.
- When a speed of 100 r/min or higher or an acceleration/deceleration of 2000 r/min per second or higher continues for no more than 50 ms.

Dynamic Brake When the Load Inertia Is Large

Because the dynamic brake is used for emergency stopping, the rating is for short time intervals. To prevent wire breakage, smoke, and fire during dynamic braking, pay attention to the following points.

- Do not intentionally start and stop the motor by Servo ON/OFF.
- Do not drive the motor using an externally applied power. Do not turn ON the power while the motor is rotating.
- If motor rotation stops due to dynamic braking, establish a stop time of at least 3 minutes until the Servo is turned ON again.

The dynamic brake converts the rotational energy of the motor into heat by the dynamic brake resistance.
The rotational energy of the motor is calculated using the equation below.

· Rotational energy of motor $= \frac{1}{2} \cdot J \cdot \omega^2 = \frac{1}{2} \cdot J \cdot (2\pi)^2 \cdot (\frac{N}{60})^2$

J	: Load inertia + rotor inertia of motor	[W]
N	: Motor speed	[r/min]

When the load inertia is large or the rotation speed is high, the load on the dynamic brake circuit increases. Set the maximum operating rotation speed appropriately for the load inertia.

You can specify in the parameters whether or not the dynamic brake operates in the conditions below.
A 5 kW or less Servo Drive enters the dynamic braking state when the control power turns OFF, regardless of the settings.

• Main circuit power supply OFF	(Pn507 Stop Selection with Main Power Supply OFF)
• When the Servo is OFF	(Pn506 Stop Selection with Servo OFF)
• When an error occurs	(Pn510 Stop Selection for Alarm Detection)
• When drive prohibition is input	(Pn505 Stop Selection for Drive Prohibition Input)

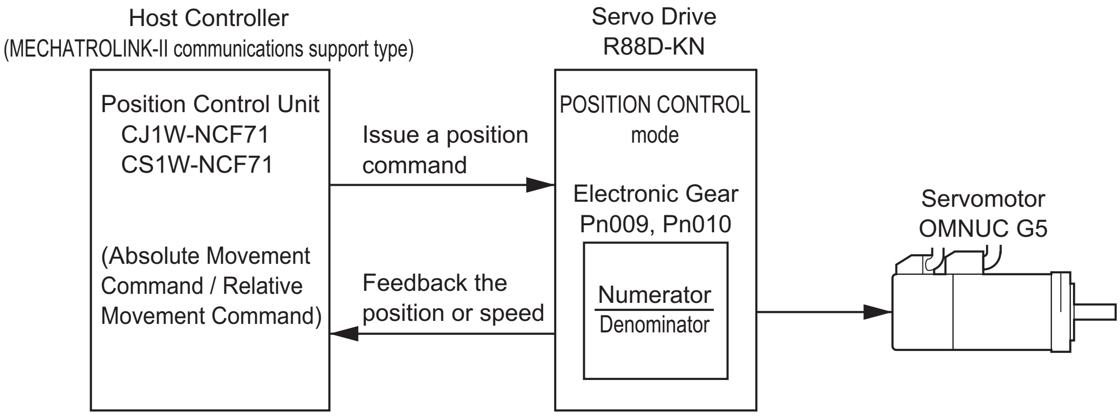
5

BASIC CONTROL Mode

This chapter explains an outline of operations available in various CONTROL modes and explains the contents of setting.

5-1 Position Control

The CJ1W- and CS1W-NCx71 Position Control Units for MECHATROLINK-II issue the position control commands. The Servo Drive uses the commands and rotates the motor in the values obtained by multiplying the command by the Electronic Gear Ratio (determined by the settings in Pn009 or Pn010)



Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn009	Electronic Gear Ratio Numerator	Set the numerator of the electronic gear ratio for the command pulse input.	P.8-4
Pn010	Electronic Gear Ratio Denominator	Set the denominator of the electronic gear ratio for the command pulse input.	P.8-4

Electronic Gear Function (Pn009, Pn010)

This function sets the position command for the position control part a value calculated by multiplying the pulse command input from the Host Controller with the set electronic gear ratio.

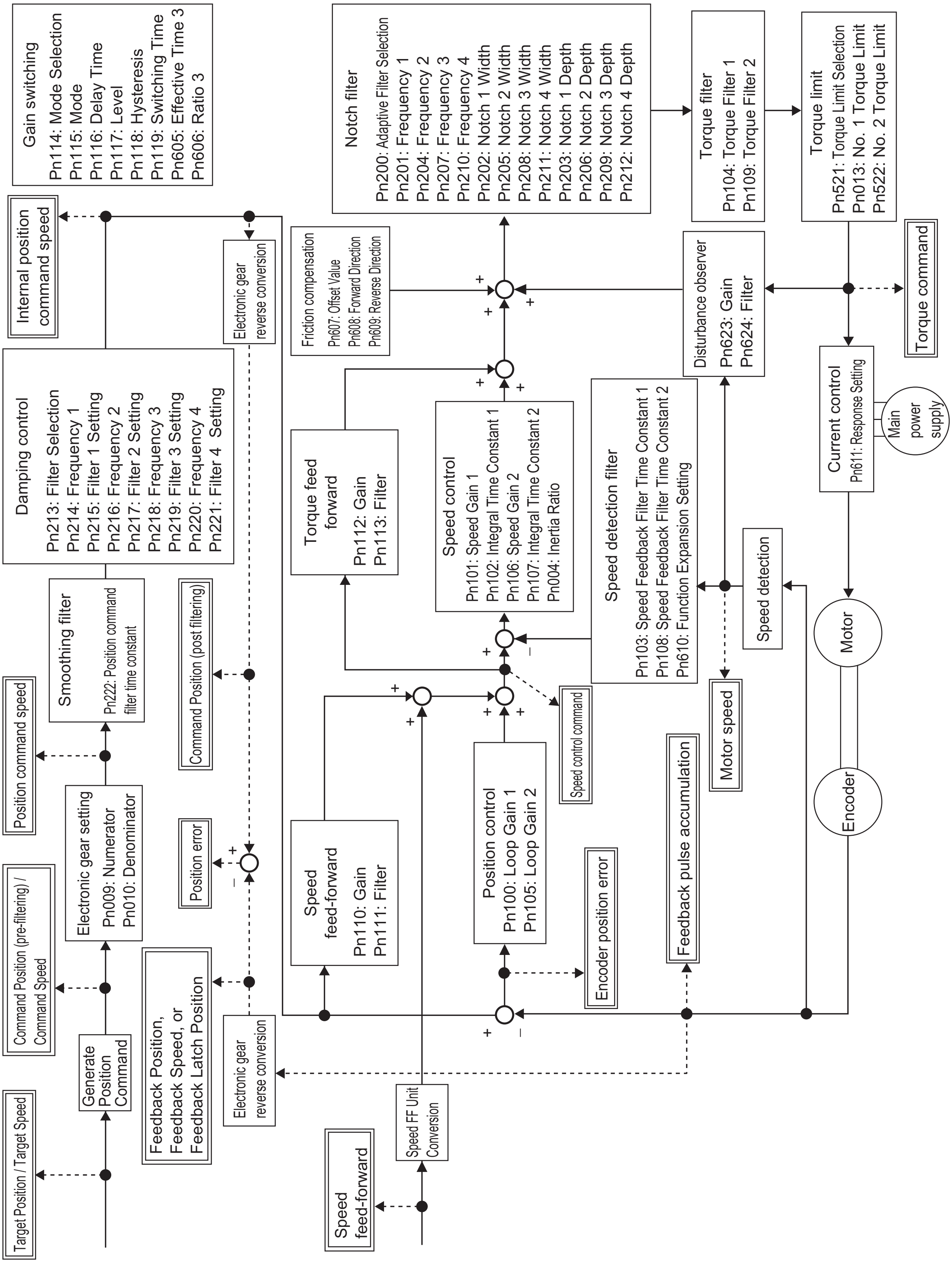
Parameter number	Parameter name	Explanation	Setting range	Unit
Pn009	Electronic Gear Ratio Numerator	Set the numerator of the electronic gear ratio for the command pulse input.	0 to 2^{30}	–
Pn010	Electronic Gear Ratio Denominator	Set the denominator of the electronic gear ratio for the command pulse input.	0 to 2^{30}	–

- For details on the electronic gear function, refer to "6-6 Electronic Gear Function" (P.6-19).

Related Functions

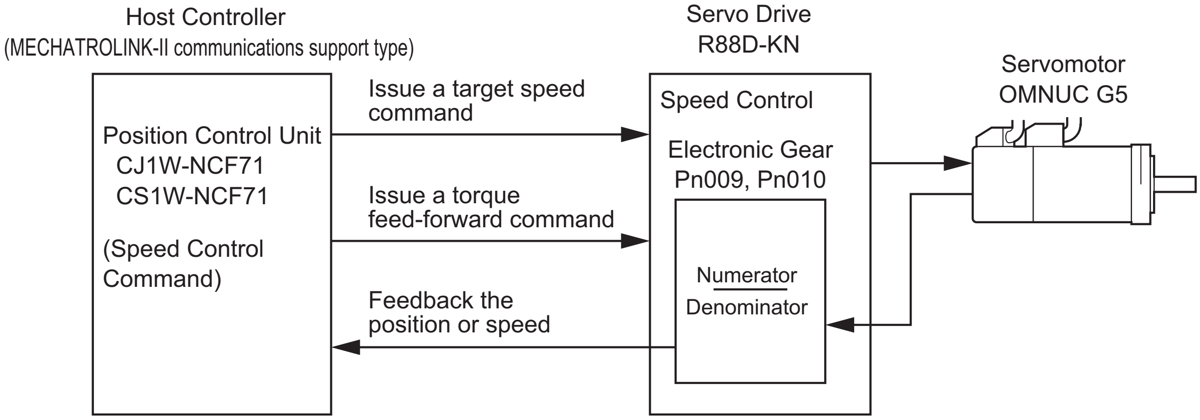
Parameter number	Parameter name	Explanation	Reference
Pn222	Position Command Filter Time Constant	Set the time constant of the first-order lag filter for the position command.	P.8-23
Pn431	Positioning Completion Range 1	Set the threshold of position error for output of the positioning completion signal.	P.8-35
Pn432	Positioning Completion Condition Selection	Select the condition under which the positioning completion signal is output.	P.8-35
Pn433	Positioning Completion Hold Time	Set the INP signal output time.	P.8-36

Parameter Block Diagram for POSITION CONTROL mode



5-2 Speed Control

The CJ1W- and CS1W-NCx71 Position Control Units for MECHATROLINK-II issue the speed control commands. The Servo Drive uses the commands and rotates the motor in the commanded speed output. The present value to be fed back from the Servo Drive to the Controller is the values obtained by dividing the command by the Electronic Gear Ratio (determined by the settings in Pn009 or Pn010).



5

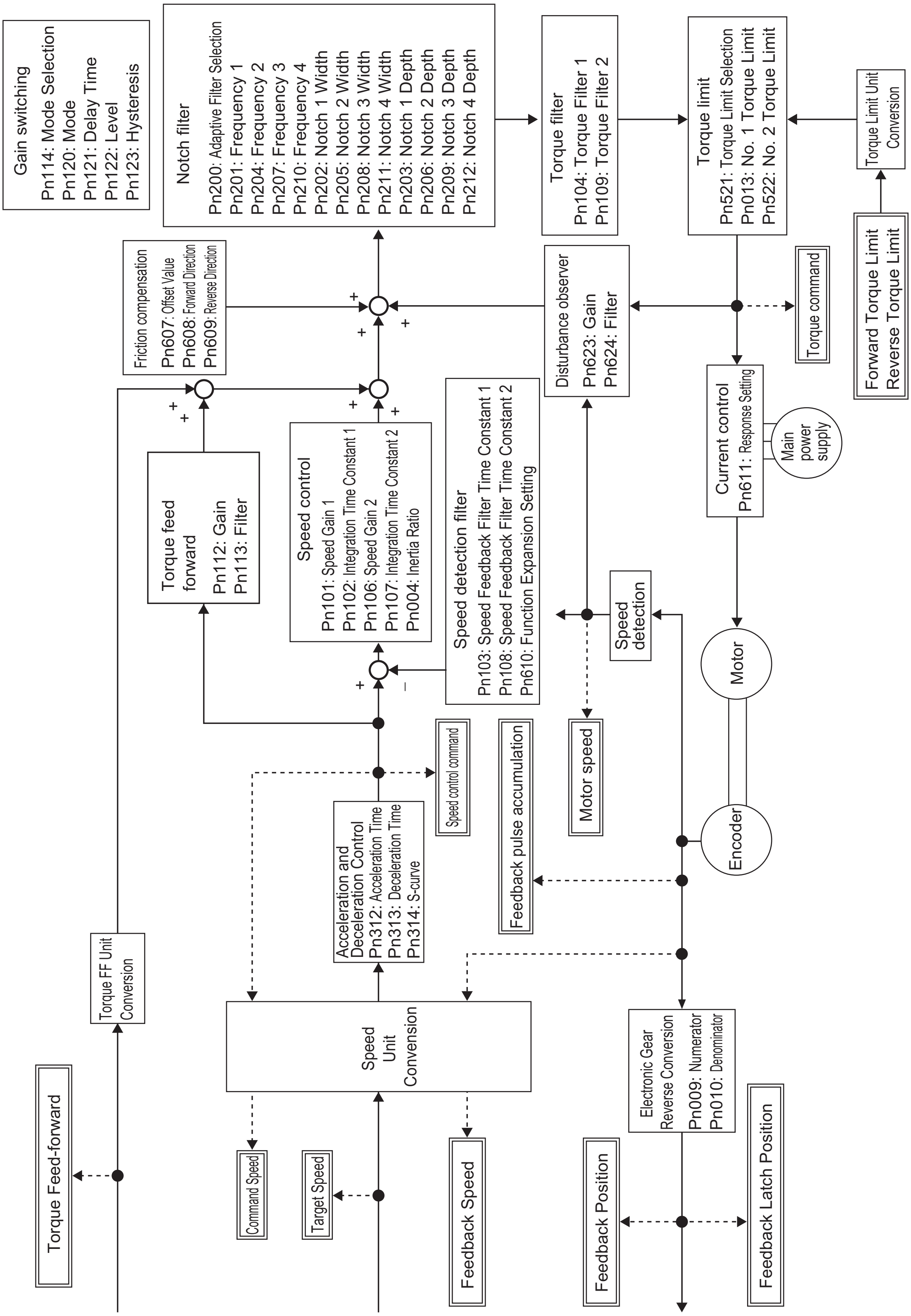
Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn312	Soft Start Acceleration Time	Set the acceleration time for internally set speed control. Set the time until 1,000 r/min is reached.	P.8-25
Pn313	Soft Start Deceleration Time	Set the deceleration time for internally set speed control. Set the time until 1,000 r/min is reached.	P.8-25
Pn314	S-curve Acceleration/ Deceleration Time Setting	Set the S-curve time in the time width centered on the inflection points for acceleration and deceleration.	P.8-25

Related Functions

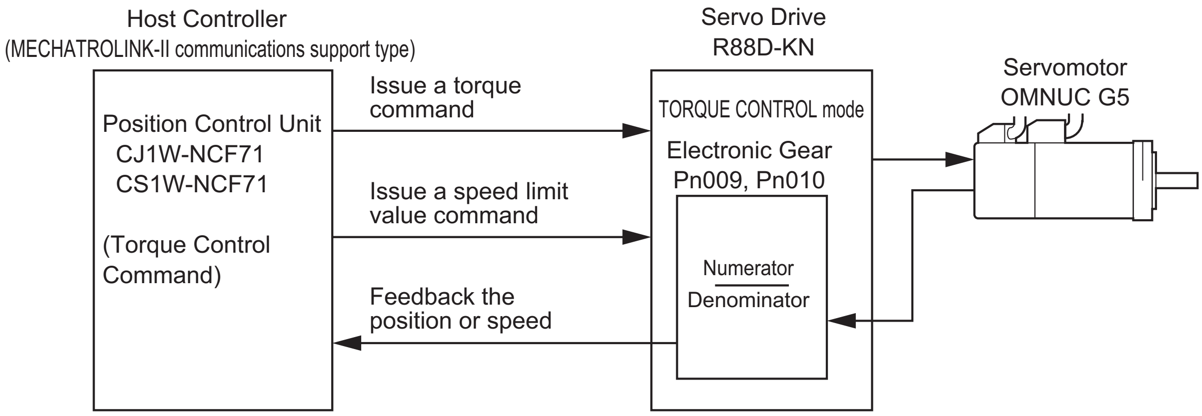
Parameter number	Parameter name	Explanation	Reference
Pn435	Speed Conformity Detection Range	Set the detection threshold for speed conformity output. If the difference between the speed command and motor speed is within the set threshold, a speed conformity output is output. This setting has a hysteresis of 10 r/min for detection.	P.8-37
Pn436	Rotation Speed for Motor Rotation Detection	Set the detection threshold for Motor rotation speed detection output. A Motor rotation speed detection output is output when the motor speed exceeds the set value. This setting has a hysteresis of 10 r/min for detection.	P.8-37

Parameter Block Diagram for SPEED CONTROL mode



5-3 Torque Control

The CJ1W- and CS1W-NCx71 Position Control Units for MECHATROLINK-II issue the torque control commands. The Servo Drive uses the commands and rotates the motor in the commanded torque output. The present value to be fed back from the Drive to the Controller is the values obtained by dividing the command by the Electronic Gear Ratio (determined by the settings in Pn009 or Pn010).



Precautions for Correct Use

- While the motor speed is restricted by the Speed Limit Command, the Torque Command to the motor differs from the Torque Command issued by the Host Controller. The Torque Command to the motor is the resulting value that controls the motor speed within the Speed Limit.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn317	Speed Limit Selection	Select the input location for the speed limit.	P.8-26

Speed Limit Selection (Pn317)

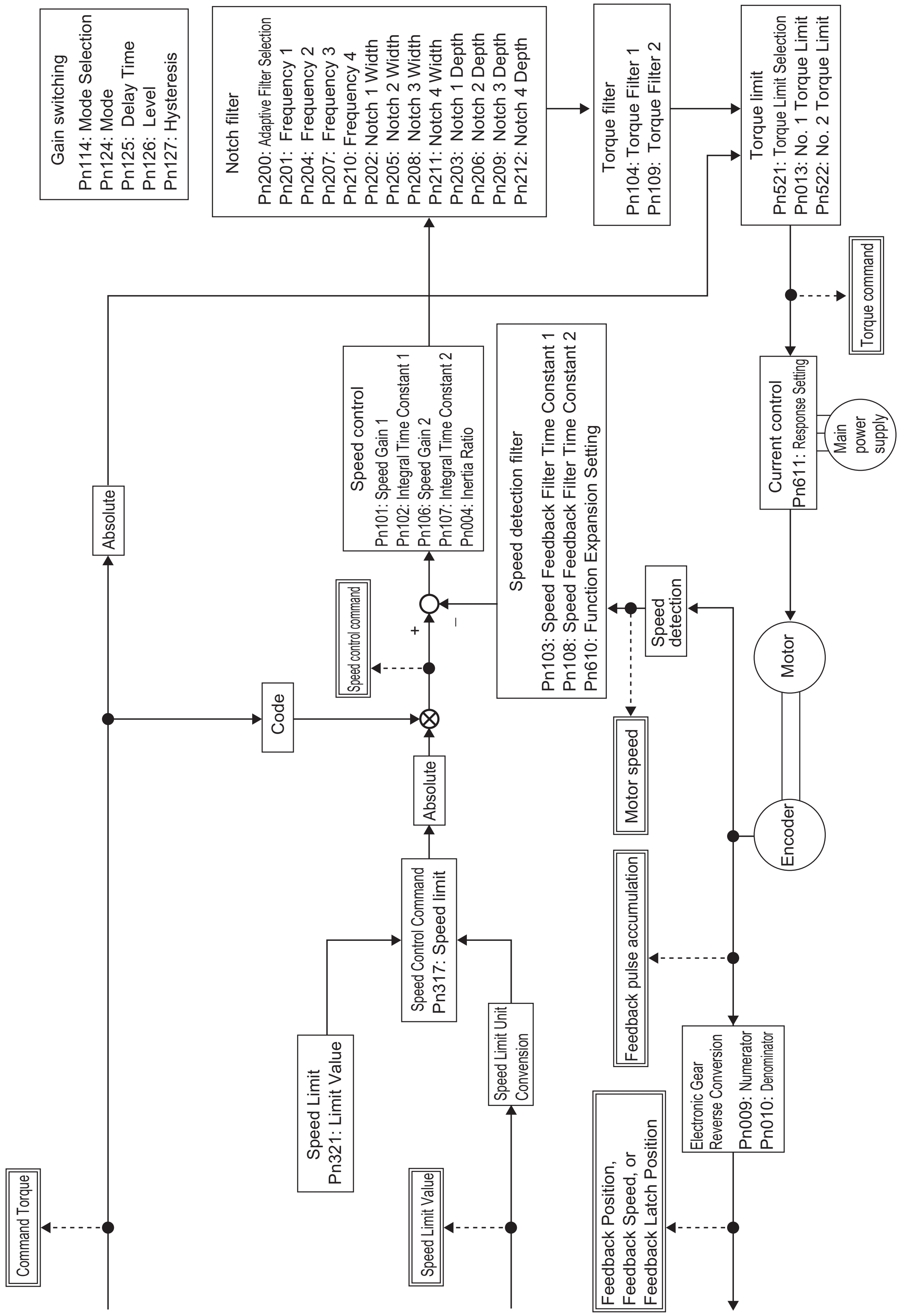
Restricts the speed as the protection during torque control.
Controls that the speed does not exceed the Speed Limit during torque control.

Parameter number	Parameter name	Explanation	Setting range	Unit
Pn317	Speed Limit Selection	Selects the input type of the Speed Limit during torque control. 0: Control the speed by the Speed Limit Setting (Pn321). 1: Control the speed by either one of the smaller value: the Speed Limit value (VLIMT) by MECHATROLINK-II communications, or the Speed Limit Setting (Pn321)	0 to 1	–

Related Functions

Parameter number	Parameter name	Explanation	Reference
Pn321	Speed Limit Value Setting	Set the speed limit value applicable during torque control. During torque control, the speed is controlled so as not to exceed the level set by the speed limit value.	P.8-26

Parameter Block Diagram for TORQUE CONTROL mode



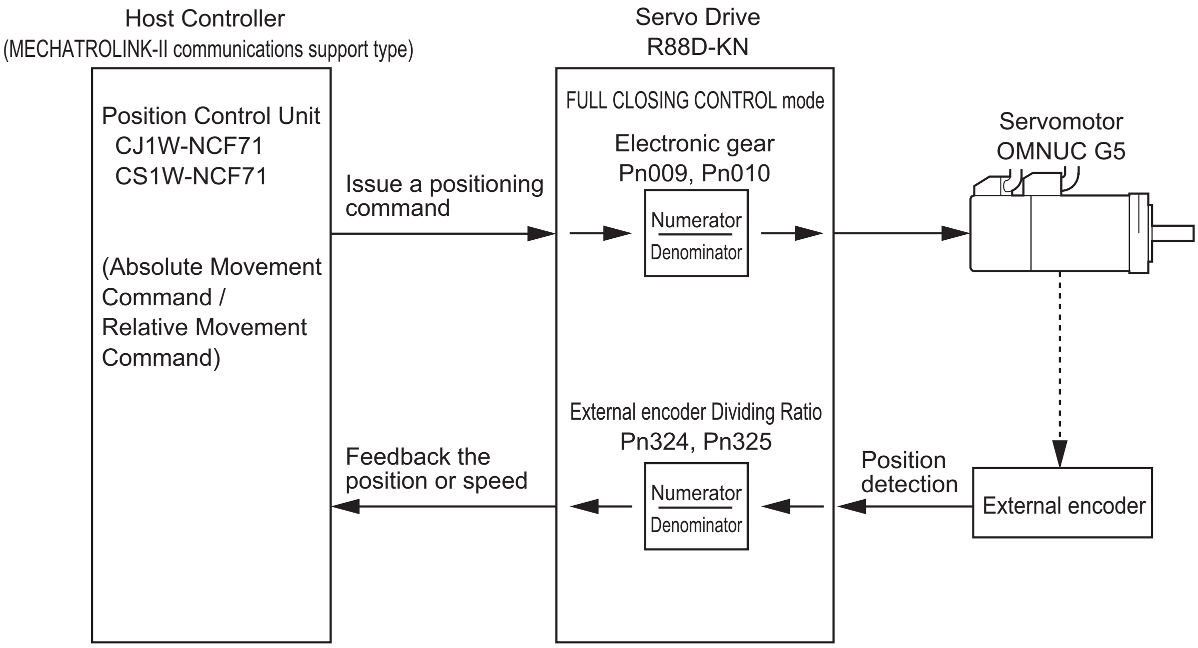
5

BASIC CONTROL Mode

5-4 Full Closing Control

An externally provided scale is used to directly detect the position of the control target and feedback the detected machine position to perform position control. This way, controls become possible that is not affected by ball screw error, temperature change, etc. You can achieve highly accurate positioning by configuring a full closing control system.

Outline of Operation



Precautions for Correct Use

- If the electronic gear ratio is 1 : 1, 1 command pulse from the encoder constitutes 1 external encoder pulse. Since the electronic gear ratio is set differently than in the POSITION CONTROL mode, set the external encoder dividing ratio correctly.
- To prevent machine damage due to an external encoder setting error, set the following parameters to appropriate values.
  - Internal/External Feedback Pulse Error Counter Overflow Level (Pn328)
  - Internal/External Feedback Pulse Error Counter Reset (Pn329)
- For the setting of external encoder ratio, it is recommended that 1/40 ≤ External encoder ratio ≤ 160 be satisfied.
  If the external encoder ratio is set excessively small, control to the unit of 1 external encoder pulse may be disabled.
  If the external encoder ratio is increased, on the other hand, operating noise may increase.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn000	Rotation Direction Switching	Set the relation between the command direction and the motor rotation direction.	P.8-1
Pn001	CONTROL mode Selection	Select the CONTROL mode.	P.8-1
Pn009	Electronic Gear Ratio Numerator	Set the numerator of the electronic gear ratio for the command pulse input.	P.8-4
Pn010	Electronic Gear Ratio Denominator	Use this parameter to set the denominator of the electronic gear ratio for the command pulse input.	P.8-4
Pn323	External Feedback Pulse Type Selection	Select the external encoder type.	P.8-27
Pn324	External Feedback Pulse Dividing Numerator	Set the numerator of the external encoder divider setting.	P.8-28
Pn325	External Feedback Pulse Dividing Denominator	Set the denominator of the external encoder divider setting.	P.8-28
Pn326	External Feedback Pulse Direction Switching	Set the polarity of the external encoder feedback pulse.	P.8-28
Pn327	External Feedback Pulse Phase-Z Setting	Set whether to enable or disable the disconnection detection function of phase Z when a 90° phase difference output type external encoder is used.	P.8-29
Pn328	Internal/External Feedback Pulse Error Counter Overflow Level	Set the threshold of A250 "internal/external feedback pulse error counter overflow" in the command unit.	P.8-29
Pn329	Internal/External Feedback Pulse Error Counter Reset	The hybrid error becomes 0 every time the motor rotates by the set value.	P.8-29

Rotation Direction Switching (Pn000)

Set the relation between the command direction and the motor rotation direction.
0: A forward direction command sets the direction to CW as viewed from the shaft end.
1: A forward direction command sets the direction to CCW as viewed from the shaft end.
Take note that if Pn000 = 1, the scale count direction becomes opposite to the count direction used for monitoring the total external encoder feedback pulses, etc.

CONTROL mode Selection (Pn001)

Select the full closing control (set value: 6).

Electronic Gear Function (Pn009, Pn010)

This function sets the position command for the position control part a value calculated by multiplying the pulse command input from the Host Controller with the set electronic gear ratio.

Parameter number	Parameter name	Explanation	Setting range	Unit
Pn009	Electronic Gear Ratio Numerator	Set the numerator of the electronic gear ratio for the command pulse input.	0 to 1073741824	–
Pn010	Electronic Gear Ratio Denominator	Set the denominator of the electronic gear ratio for the command pulse input.	0 to 1073741824	–

- For details on the electronic gear function, refer to "6-6 Electronic Gear Function" (P.6-19).

External Feedback Pulse Type Selection (Pn323, Pn326)

Set the external encoder output type and direction.

Parameter number	Parameter name	Explanation	Setting range	Unit
Pn323	External Feedback Pulse Type Selection	Select the type of the external encoder to be used. 0: 90° phase difference output type 1: Serial communications (Incremental encoder specifications) 2: Serial communications (Absolute encoder specifications)	0 to 2	–
Pn326	External Feedback Pulse Direction Switching	If the count directions of the external encoder feedback pulse and the encoder total feedback pulses do not match, set the reversal of the external encoder feedback pulse direction. 0: Not reversed, 1: Reversed	0 to 1	–

Supportive Scales

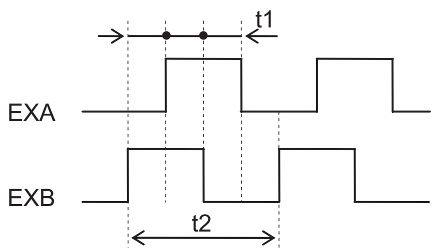
The corresponding scale for each output type is as follows.

Pn323 set value	External encoder type	Corresponding scale examples	Maximum input frequency *1
0	90° phase difference output type *2*3	External encoder of 90° phase difference output type	0 to 4 Mpps (After quadruple multiplier)
1	Serial communication type (Incremental encoder specifications)*3	Sony Manufacturing Systems Corporation SR75, SR85	0 to 400 Mpps
2	Serial communication type (Absolute encoder specifications)*3	Mitutoyo Corporation AT573, ST771A, ST773A Sony Manufacturing Systems Corporation SR77, SR87	0 to 400 Mpps

*1. These are the feedback speeds from the external encoder at which Servo Drive can respond. Check the external encoder operation manual for its maximum output frequency.

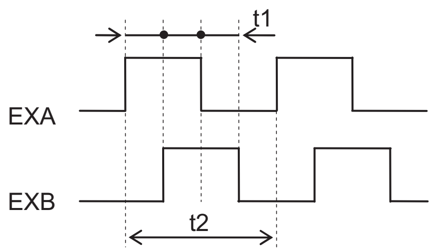
*2. These are the directions that the Drive counts the pulse of external encoder of 90° phase difference output type.

Count-down direction



EXB is 90° ahead of EXA.
t1>0.25 μs
t2>1.0 μs

Count-up direction



EXB is 90° behind EXA.
t1>0.25 μs
t2>1.0 μs

*3. For the external encoder connection direction, set the rotation direction so that count-up occurs when the motor shaft is rotating in the CCW direction, and count-down occurs when the motor shaft is rotating in the CW direction. If the connection direction cannot be selected due to installation conditions, etc., the count direction can be reversed using External Feedback Pulse Direction Switching (Pn326).

Precautions for Correct Use

- Take note that if Pn000 = 1, the encoder count direction becomes opposite to the count direction used for monitoring the total external encoder feedback pulses, etc.
  If Pn000 = 0, the count direction matches the count direction for monitoring.
- Even when the drive speed is within the specified range, an acceleration error occurs if the motor shaft rotation speed exceeds the maximum speed.
- To check the installation direction, use the front panel monitor or the monitoring function of CX-Drive and check the count directions of the external encoder total feedback pulses and the encoder total feedback pulses. If they match, the connection is set up correctly.

Reference

Maximum Input Frequency

- For example, the maximum speed when an external encoder with a resolution of 0.01 μm is used for the serial communication type is 0.01 μm × (400 × 10^6) pps = 4.00 m/s.
  An overspeed error protection is generated, however, if the motor shaft rotation speed exceeds the maximum speed.

External Feedback Pulse Dividing Ratio Setting (Pn324, Pn325)

Set the dividing ratio for the encoder resolution and external encoder resolution.

Parameter number	Parameter name	Explanation	Setting range	Unit
Pn324	External Feedback Pulse Dividing Numerator	Set the numerator of the external encoder divider setting. Normally, set the number of encoder output pulses per motor rotation. If the set value is 0, the encoder resolution is set automatically.	0 to 1048576	–
Pn325	External Feedback Pulse Dividing Denominator	Set the denominator of the external encoder divider setting. Normally, set the number of external encoder output pulses per motor rotation.	1 to 1048576	–

Check the number of encoder feedback pulses and the number of external encoder output pulses per motor rotation, and set External Feedback Pulse Dividing Numerator (Pn324) and External Feedback Pulse Dividing Denominator (Pn325) so that the following formula works out.

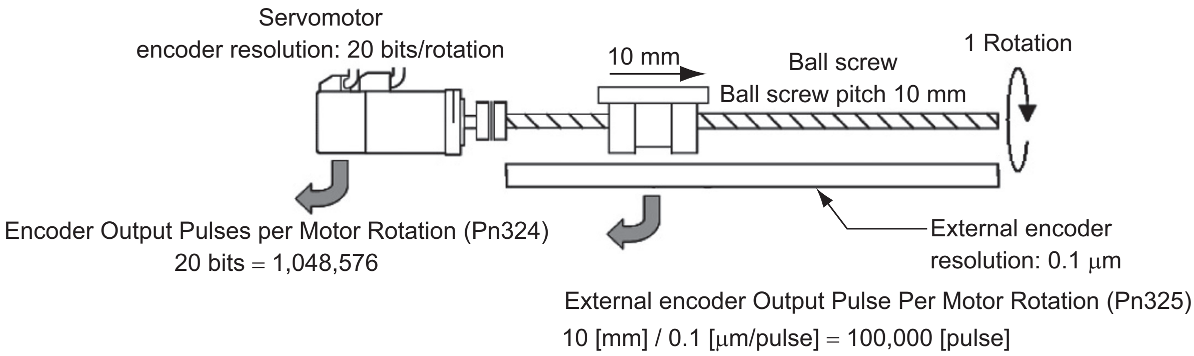
$$\frac{\text{Pn324}}{\text{Pn325}} = \frac{\text{Encoder resolution per motor rotation [pulse]}}{\text{External encoder resolution per motor rotation [pulse]}}$$

Precautions for Correct Use

- If this divider setting is wrong, there will be deviations between the position calculated from encoder pulses and the position calculated from external encoder. If the movement distance is long, these deviations accumulate and cause an internal/external feedback pulse error counter overflow level error.

■ Setting Examples

- Ball screw pitch 10 mm
- External encoder resolution 0.1 μm
- Encoder resolution 20 bits



$$\frac{\text{Pn324}}{\text{Pn325}} = \frac{\text{Encoder resolution per motor rotation [pulse]}}{\text{External encoder resolution per motor rotation [pulse]}} = \frac{1{,}048{,}576}{100{,}000}$$

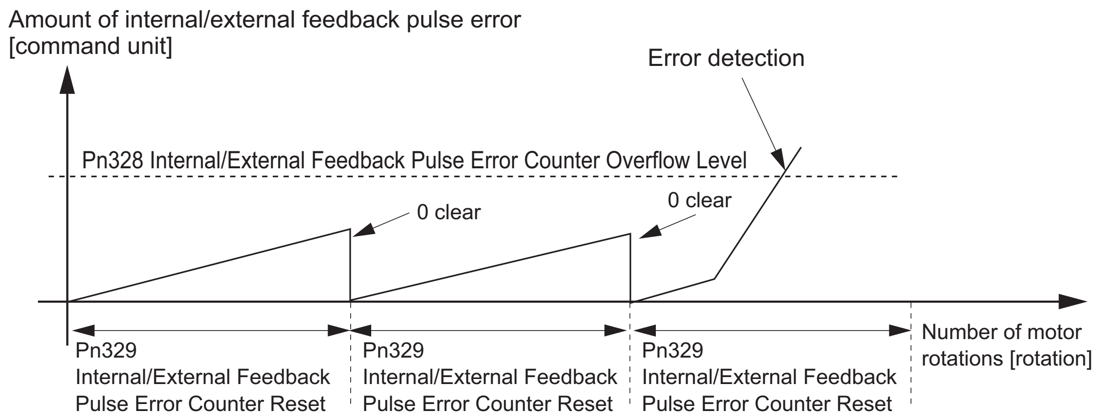
External Feedback Pulse Error Setting (Pn328, Pn329)

The difference between the encoder position and external encoder position is detected, and if the difference exceeds the value of Internal/External Feedback Pulse Error Counter Overflow Level (Pn328), an error occurs.

Parameter number	Parameter name	Explanation	Setting range	Unit
Pn328	Internal/External Feedback Pulse Error Counter Overflow Level	Set the allowable difference (hybrid error) between the encoder-detected position and external encoder-detected position in the command unit.	1 to 2^{27}	Command unit
Pn329	Internal/External Feedback Pulse Error Counter Reset	The hybrid error becomes 0 every time the motor rotates by the set value. If the set value is 0, the hybrid error is not cleared.	0 to 100	Rotation

Pn329: Internal/External Feedback Pulse Error Counter Reset

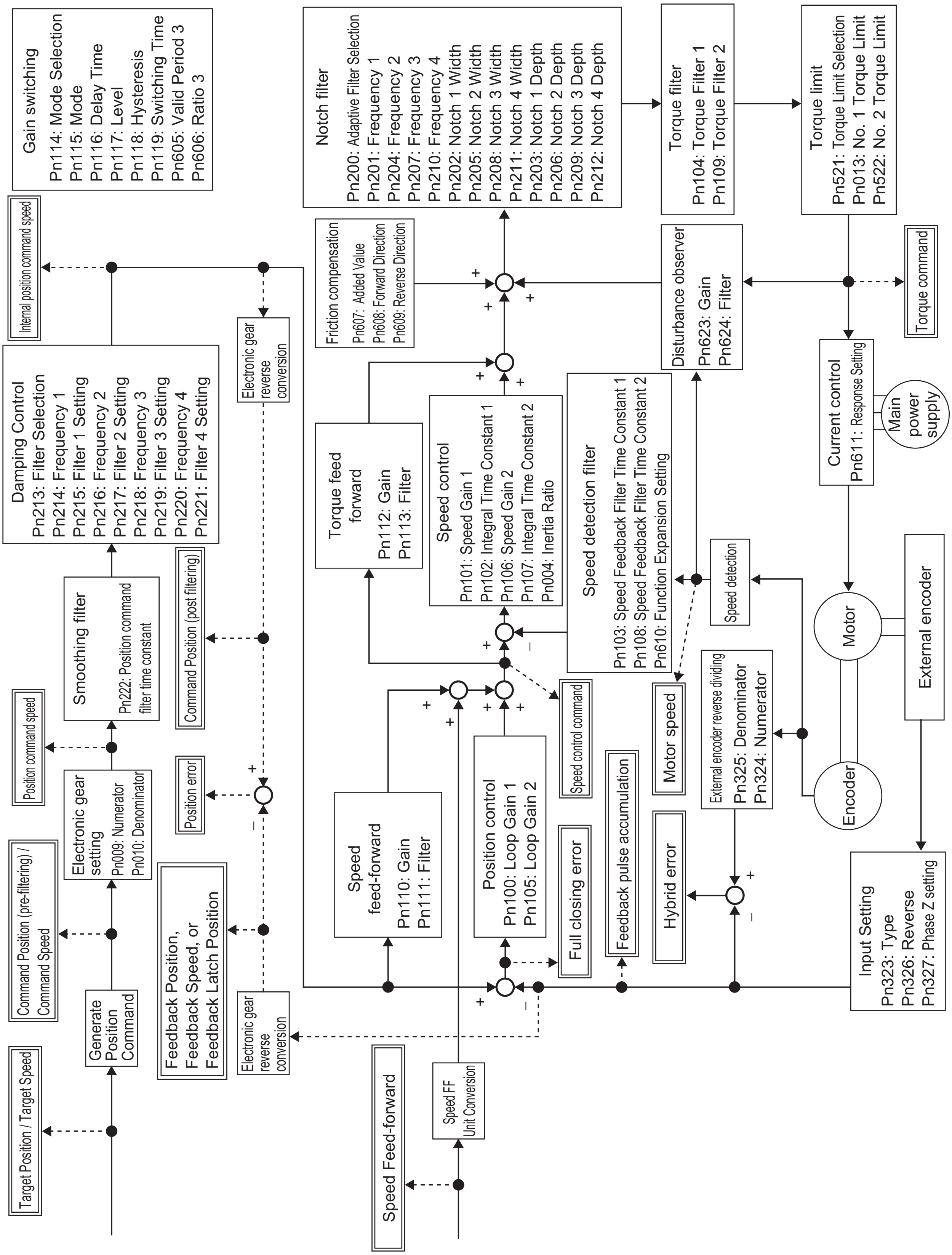
Every time the motor rotates for the amount set by Pn329, the internal/external feedback pulse error is cleared.
This function can be used when there is deviation between the position calculated from encoder pulses and the position calculated from external encoder due to slipping, etc, and internal/external feedback pulse errors accumulate.



Precautions for Correct Use

- An internal/external feedback pulse error counter overflow level error occurs when the external encoder is abnormal, connection is wrong, or connection point between the motor and load is loose, among others. Accordingly, check these items when an error occurs.
- Be sure to set an appropriate value for Internal/External Feedback Pulse Error Counter Reset (Pn329). If an extremely small value is set, this function may not operate.
- Use with extra caution on safety by installing limit sensors, etc.

Parameter Block Diagram for FULL CLOSING CONTROL mode



6

Applied Functions

This chapter gives outline of applied functions such as electronic gears, gain switching and soft start, and explains the setting contents.

6-1 Sequence I/O Signal

You can set a sequence in various operating conditions.
For the connection of I/O signals and processing of external signals, refer to "Control I/O Connector Specifications (CN1)" (P.3-13).

Input Signals

You can allocate any function of input signals to the input pins for the control I/O connector (CN1). In addition, you can change logics. However, refer to "Input Signal Allocation Method" (P.6-2) for more information because some signals have an allocation limit.
If the G Series is being replaced, set the unit to the default setting before using it.

Input Signal Default Setting

The allocation of the default input signals is as follows. Refer to "Input Signal Allocation Method" (P.6-2) when you change the allocation to use.

Applicable parameters	Input signals	Factory default setting (hex)	Default setting state					
			Position control or full closing control		Speed control		Torque control	
			Signal name	Logic *1	Signal name	Logic*1	Signal name	Logic*1
Pn400	IN1	00949494h	STOP	NC	STOP	NC	STOP	NC
Pn401	IN2	00818181h	POT	NC	POT	NC	POT	NC
Pn402	IN3	00828282h	NOT	NC	NOT	NC	NOT	NC
Pn403	IN4	00222222h	DEC	NO	DEC	NO	DEC	NO
Pn404	IN5	002B2B2Bh	EXT3	NO	EXT3	NO	EXT3	NO
Pn405	IN6	00212121h	EXT2	NO	EXT2	NO	EXT2	NO
Pn406	IN7	00202020h	EXT1	NO	EXT1	NO	EXT1	NO
Pn407	IN8	002E2E2Eh	MON0	NO	MON0	NO	MON0	NO

*1. NO (normally open) contact and NC (normally close) contact in the table above refer to the following states.
NO: Disabled (OFF) when signal input is open with COM–
Enabled (ON) when signal input is shorted with COM–

NC: Disabled (OFF) when signal input is shorted with COM–
Enabled (ON) when signal input is open with COM–
"–" indicates the status where no function is allocated.

Parameters that Can Be Allocated

Use the following parameters when changing the input signal allocation to use.
For the setting method, refer to "Input Signal Allocation Method" (P.6-2).

Parameter number	Parameter name	Explanation	Reference
Pn400	Input Signal Selection 1	Set the IN1 input function allocation. This parameter is based on the hex display standard.(Take note that the display on the front panel is based on the decimal display.)	P.8-30
Pn401	Input Signal Selection 2	Set the IN2 input function allocation.	P.8-30
Pn402	Input Signal Selection 3	Set the IN3 input function allocation.	P.8-30
Pn403	Input Signal Selection 4	Set the IN4 input function allocation.	P.8-30
Pn404	Input Signal Selection 5	Set the IN5 input function allocation.	P.8-30
Pn405	Input Signal Selection 6	Set the IN6 input function allocation.	P.8-30
Pn406	Input Signal Selection 7	Set the IN7 input function allocation.	P.8-30
Pn407	Input Signal Selection 8	Set the IN8 input function allocation.	P.8-31

Input Signal Allocation Method

Input the setting for each CONTROL mode in any of the parameters of Pn400 to Pn407 to allocate signals.

Set the parameters based on the hex display standard.
Set the set value of the function for each CONTROL mode in "**" below.
Refer to the function number table provided later for the set value of each function. Logic setting is included in the function numbers.

00******h
Position control/full closing control
Speed control
Torque control

Example:
Position control or full closing control: Monitor Input 0 is NO (normally open) contact (2Eh)
Speed control: Disabled (00h)
Torque control: Forward External Torque Limit Input is NO (normally open) contact (2Ch)

002C002Eh
Position control/full closing control
Speed control
Torque control

Function Number Table

The set values to be used for allocations are as follows.

Signal name	Symbol	Set value	
		NO	NC
Disabled	–	00h	Setting not available
Forward drive prohibition input	POT	01h	81h
Reverse drive prohibition input	NOT	02h	82h
Emergency Stop Input	STOP	14h	94h
External Latch Input 1	EXT1	20h	Setting not available
External Latch Input 2	EXT2	21h	Setting not available
Origin Proximity Input	DEC	22h	A2h
External Latch Input 3	EXT3	2Bh	Setting not available
Forward External Torque Limit Input	PCL	2Ch	ACh
Reverse External Torque Limit Input	NCL	2Dh	ADh
Monitor Input 0	MON0	2Eh	AEh
Monitor Input 1	MON1	2Fh	AFh
Monitor Input 2	MON2	30h	B0h

Precautions for Correct Use

- Do not use any values other than the settings listed.
- Do not allocate the same function to plural input signals. If you allocate the same function to multiple input signals, interface input duplicate allocation error 1 (Alarm No.33.0) or interface input duplicate allocation error 2 (Alarm No.33.1) occurs.
- The External Latch Input 1, 2, and 3 (EXT1, EXT2 and EXT3) can be allocated only to IN5 to IN7. If you allocate them to any inputs other than above, an external latch input allocation error (Alarm No.33.8) occurs.
- If you use the External Latch Input 1, 2, or 3 (EXT1, EXT2 or EXT3), you must set it for all Control modes. Otherwise, an external latch input allocation error (Alarm No.33.8) occurs.
- The External Latch Input 1, 2, and 3 (EXT1, EXT2 and EXT3) can be set only to NO (normally open) contact.
- The control input pins that are set to disable do not affect the operation.
- The functions that are used by plural Control modes, such as Emergency Stop Input, and Origin Proximity Input, must be allocated to the same pin, in the same logic. If they are allocated to different pins, an interface input duplicate allocation error 1 (Alarm No.33.0) or an interface input duplicate allocation error 2 (Alarm No.33.1) occurs.
  If the logic is inconsistent, an interface input function number error 1 (Alarm No.33.2) or an interface input function number error 2 (Alarm No.33.3) occurs.

Output Signals

You can allocate any function of output signals to the output pins for the control I/O connector (CN1).
If the G Series is being replaced, set the unit to the default setting before using it.

Output Signal Default Setting

The allocation of the default input signals is as follows. Refer to "Output Signal Allocation Method" (P.6-4) when you change the allocation to use.

Applicable parameters	Output Signals	Factory default setting (hex)	Default setting state					
			Position control or full closing control		Speed control		Torque control	
			Signal name	Logic*1	Signal name	Logic	Signal name	Logic
Pn410	OUTM1	00030303h	BKIR	NO	BKIR	NO	BKIR	NO
Pn411	OUTM2	00020202h	READY	NO	READY	NO	READY	NO

*1.*NO (normally open) contact and NC (normally close) contact refer to the following states.
NO: When the function is disabled (OFF state), output transistor is OFF.
When the function is enabled (ON state), output transistor is ON.
NC: When the function is disabled, output transistor is ON.
When the function is enabled, output transistor is OFF.

Parameters that Can Be Allocated

Use the following parameters when changing the output signal allocation to use.
For the setting method, refer to "Output Signal Allocation Method".

Parameter number	Parameter name	Explanation	Reference
Pn410	Output Signal Selection 1	Set the OUTM1 input function allocation. This parameter is based on the hex display standard. Refer to the output signal function number table for details.	P.8-31
Pn411	Output Signal Selection 2	Set the OUTM2 input function allocation.	P.8-31

Output Signal Allocation Method

Input the setting for each CONTROL mode in any of the parameters of Pn410 to Pn411 to allocate signals.

Set up the parameters based on the hex display standard in the same manner as the input signal allocation method.
Set the set value of the function for each CONTROL mode in "**" below.
Refer to the function number table provided below for the set value of each function. Logic setting is included in the function numbers.

00******h

Position control/full closing control
Speed control
Torque control

Example:
Position control or full closing control: Speed conformity output (08h)
Speed control: Motor rotation speed detection output (05h)
Torque control: Zero speed detection signal (07h)

00070508h

Position control/full closing control
Speed control
Torque control

Function Number Table

The set values to be used for allocations are as follows.

Signal name	Symbol	Set value	
		NO (or normally open) contact	NC (or normally close) contact
Disabled	–	00h	00h
Servo ready completed output	READY	02h	82h
Brake interlock output	BKIR	03h	Setting not available
Positioning completion output	INP1	04h	84h
Motor rotation speed detection output	TGON	05h	85h
Torque limiting output	TLIMT	06h	86h
Zero speed detection output	ZSP	07h	87h
Speed conformity output	VCMP	08h	88h
Warning output 1	WARN1	09h	89h
Warning output 2	WARN2	0Ah	8Ah
Position command status output	PCMD	0Bh	8Bh
Positioning completion output 2	INP2	0Ch	8Ch
Speed limiting output	VLIMT	0Dh	8Dh
Alarm clear attribute output	ALM-ATB	0Eh	8Eh
Speed command status output	VCMD	0Fh	8Fh

Precautions for Correct Use

- Do not use any values other than the settings listed.
- You can allocate the same function to multiple output signals.
- When you set the control output pin to disable, the output transistor stays always off.
- If you use the Brake Interlock Output (BKIR), you must set the function in all control mode. Otherwise, an interface output function number error 1 (Alarm No.33.4) or an interface output function number error 2 (Alarm No.33.5) occurs.
- The Brake Interlock Output (BKIR) can be set only to NO (normally open) contact.

6-2 Forward and Reverse Drive Prohibition Functions

When the forward drive prohibition input (POT) and the reverse drive prohibition input (NOT) are turned OFF, the motor stops rotating.
You can stop the motor from rotating beyond the device's operating range by connecting limit inputs.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn400 to Pn407	Input Signal Selection 1 to 8	Set the input signal allocation and logic.	P.8-30
Pn504	Drive Prohibition Input Selection	Set the operation to be performed upon forward and reverse drive prohibition input.	P.8-41
Pn505	Stop Selection for Drive Prohibition Input	Set the deceleration and stop methods upon forward and reverse drive prohibition input.	P.8-42
Pn511	Emergency Stop Torque	Set the torque limit for an emergency stop.	P.8-46
Pn710	MECHATROLINK-II Communications I/O Monitor Setting	Select whether to reflect the input to the MECHATROLINK-II communications I/O monitor, when either the Forward Drive Prohibition Input or the Reverse Drive Prohibition Input is allocated to the input signal, and the Drive Prohibition Input Selection is set to disabled (Pn504=1).	P.8-61

Input Signal Selection Function (Default setting: Pn401, Pn402)

In the default setting, the allocations are as follows.

Parameter number	Parameter name	Default setting			
		Set value	Position Control or full closing control	Speed control	Torque control
Pn401	Input Signal Selection 2	00818181h	POT (NC)	POT (NC)	POT (NC)
Pn402	Input Signal Selection 3	00828282h	NOT (NC)	NOT (NC)	NOT (NC)

- Refer to "6-1 Sequence I/O Signal" (P.6-1) for details on input signal selections 1 to 8.

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Applied Functions

Drive Prohibition Input Selection (Pn504)

Set the operation of the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT). Install limit switches at both ends of the axis to prohibit the Servomotor from driving in the direction specified by the switch. This can be used to prevent the workpiece from driving too far and thus prevent damage to the machine. Set the operation to be performed upon forward and reverse drive prohibition input.

Drive Prohibition Input Selection (Pn504)	Explanation
0	**Forward drive prohibition input and reverse drive prohibition input enabled.** The operation when a signal is input is as follows. Forward drive prohibition input shorted: Forward limit switch not operating and status normal. Forward drive prohibition input open: Forward direction prohibited and reverse direction permitted. Reverse drive prohibition input shorted: Reverse limit switch not operating and status normal. Reverse drive prohibition input open: Reverse direction prohibited and forward direction permitted. The Servomotor decelerates and stops according to the sequence set in Stop Selection for Drive Prohibition Input (Pn505).*1 If the forward and the reverse prohibition inputs are both open, a drive prohibition input error 1 (Alarm No.38.0) occurs because it is taken that Servo Drive is in error condition.
1	**Forward and reverse drive prohibition input disabled.**
2	**Forward and reverse drive prohibition input enabled.** If either the forward or the reverse prohibition input is open, a drive prohibition input error 1 (Alarm No.38.0) occurs.

*1.For details, refer to explanation for Stop Selection for Drive Prohibition Input (Pn505).

Precautions for Correct Use

Both signals are disabled (in a state in which drive prohibition will not operation) in the default settings. If prohibiting the drive input is required, set the Drive Prohibit Input Selection (Pn504) to either 0 or 2.

Stop Selection for Drive Prohibition Input (Pn505)

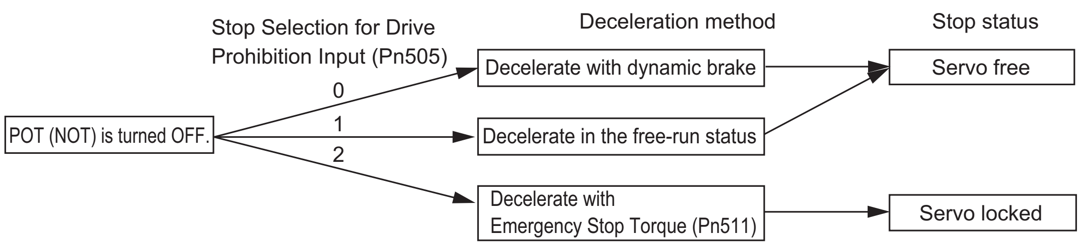
Set the deceleration and stop methods upon a forward or reverse drive prohibition is input.

Pn504 set value*1	Pn505 set value	Decelerating*2		After stopping	
		Deceleration method	Error counter	Operation after stop	Error counter
0	0	Dynamic brake	Clear	Torque command = 0 for drive prohibition direction	Held
	1	Free-run	Clear	Torque command = 0 for drive prohibition direction	Held
	2	Emergency stop*3	Held	Torque command and Torque limit are as specified.	Cleared after deceleration completes, then held.

*1.While the Drive Prohibition Input Selection (Pn504) is set to 2, a Drive prohibit input error (Alarm No.38.0) occurs as soon as either the Forward or Reverse Drive Prohibition Input is on. The subsequent operation conforms not to the set value but to the setting on the Stop Selection for Alarm Detection (Pn510). It is the same when any other errors occur. The operation by the Stop Selection for Alarm Detection (Pn510) has the priority.

*2.The term "During deceleration" means the distance till the motor decreases its speed to 30 r/min or less from the normal operation. Once it decelerates to 30 r/min or lower speed, the operation conforms to the description for “post-stopping”, regardless of the actual motor speed.

*3.The "Emergency Stop" means that the Servomotor stops immediately by control while the Servo-ON state is kept. The torque limit at this time is controlled by the Emergency Stop Torque (Pn511) set value.



Precautions for Correct Use

- At an emergency stop, an Error counter overflow (Alarm No.24.0) or an Overrun limit error (Alarm No.34.0) may occur. This is because the emergency stop forces the motor to decelerate quickly, and the position control produces a large positional deviation momentary. If the error occurs, set the Error Counter Overflow Level (Pn014) and the Overrun Limit Setting (Pn514) in appropriate values.
- A load on the vertical axis and so forth may fall due to its own weight in the drive prohibition input state. To prevent the load from falling, set emergency stop torque for deceleration and servo lock for stop (set value: 2) in Stop Selection for Drive Prohibition Input (Pn505), or limit the operation using the Host Controller rather than using this function.
- A command warning (Warning No. 95) occurs, if a command is given to the drive prohibition direction while the Servomotor stops (when decelerated to 30 r/min or lower) and the Drive Prohibition Input is ON.

Reference

While the Forward Drive Prohibition Input (POT) is OFF, the Servomotor cannot be driven in the forward direction, but it can be driven in the reverse direction. Conversely, while the reverse drive prohibition input (NOT) is OFF, the Servomotor cannot be driven in the reverse direction, but it can be driven in the forward direction.

Emergency Stop Torque (Pn511)

This is the torque limit when the Stop Selection for Drive Prohibition Input (Pn505) is set to 2, and the Servomotor decelerates due to a drive prohibition input.
The settable range is 0 to 500%. When it is set to 0%, the normal torque limit is used.

MECHATROLINK-II Communications I/O Monitor Setting (Pn710)

Select whether to reflect the input to the MECHATROLINK-II communications I/O monitor, when either the Forward Drive Prohibition Input or the Reverse Drive Prohibition Input is allocated to the input signal, and the Drive Prohibition Input Selection (Pn504) is set to 1 (i.e., disabled).

Ph710 set value	Description
0	Disable the MECHATROLINK-II communications I/O monitor also.
1	Enable the MECHATROLINK-II communications I/O monitor.

6-3 Overrun Protection

The function detects an overrun limit error (Alarm No.34.0) and stops the Servomotor if the motor exceeds the allowable operating range set by the Overrun Limit Setting (Pn514) with respect to the position command input.
The function can also prevent the Servomotor clash into the machine edge due to its vibration.

Operating Conditions

The overrun limit works under the following conditions.

	Conditions
Operating Mode	POSITION CONTROL mode, FULL CLOSING CONTROL mode
Others	• Servo-ON state • The functions other than control parameters are set correctly. (i.e., torque limit, etc.) This includes the torque limit. The motor operates normally without any failures.

Conditions for Clearing the Position Command Input Range

The position command input range will be cleared to zero under any of the following conditions.

- When the power supply is turned ON,
- While the position error is cleared. This includes the case of Servo-OFF, and when the error counter is cleared due to deceleration stop by the drive prohibit input.
- When a trial operation via USB communication starts up and when it ends.
- During speed control or torque control,
- When the position data is initialized. This includes the cases of a component setup request, an origin return, a coordinate system setup, and an adjustment command.

Precautions for Correct Use

- Note this function is not intended to protect against abnormal position commands.
- When this function works, the Servomotor decelerates according to the Stop Selection for Alarm Detection (Pn510) and stops. Take this deceleration operation into account when you set the overrun limit (Pn514). Otherwise, the loads during deceleration may hit and cause damage to the machine edges.
- The function is disabled when the communications frequency characteristic function is enabled.

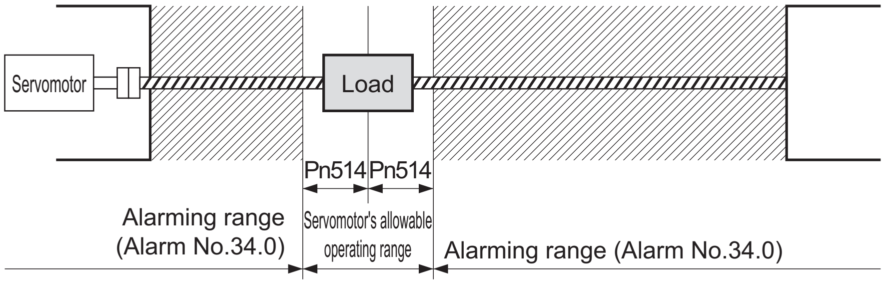
Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference page
Pn514	Overrun Limit Setting	Sets the Servomotor's allowable operating range for the position command input range.	P.8-47

Operation Example

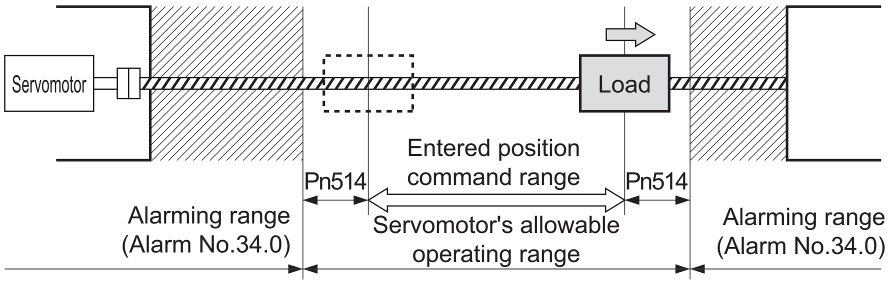
No Position Command Input (Servo-ON)

No position command is entered. The Servomotor's allowable operating range is the range set by Pn514 in both right and left. An overrun limit error occurs (Alarm No.34.0) if the load enters the alarming range, or the shaded area in the drawing below, due to the oscillation.



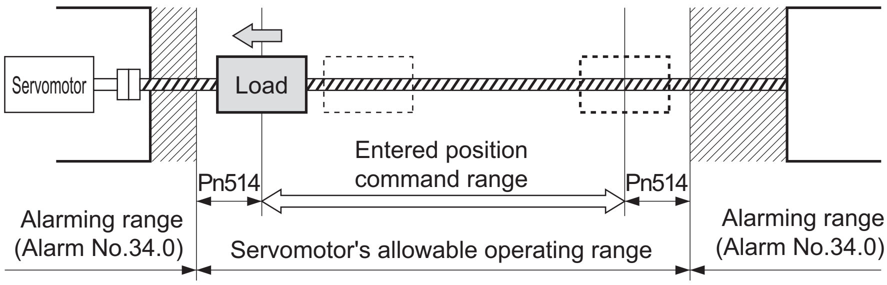
Right Side Operation (Servo-ON)

When a rightward position command is entered, the Servomotor's allowable operating range increases for the commanded amount. The range will be the result where the rotation set by Pn514 is added in both sides by the position command.



Left Side Operation (Servo-ON)

When a leftward position command is entered, the Servomotor's allowable operating range further increases.



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Applied Functions

6-4 Backlash Compensation

The function compensates backlashes at position controls and full closing controls.

Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference page
Pn704	Backlash Compensation Selection	Select whether to enable or disable the backlash compensation during position control. Set the compensation direction.	P.8-60
Pn705	Backlash Compensation Amount	Set the compensation amount during position control.	P.8-60
Pn706	Backlash Compensation Time Constant	Set the backlash compensation time constant during position control.	P.8-60

Backlash Compensation Selection (Pn704)

It is used to select whether to enable or disable the backlash compensation during position control, and to set the compensation direction.

Set value	Description
0	Disable the backlash compensation.
1	Compensate the backlash at the first forward operation after a Servo-ON.
2	Compensate the backlash at the first reverse operation after a Servo-ON.

Setting Method

The backlash compensation works in different directions depending on the setting in the Backlash Compensation Selection (Pn704) and on whether the set value for the Backlash Compensation Amount (Pn705) is a positive or negative figure.

Pn704	Pn705 is a positive value	Pn705 is a negative value
1	Compensate in positive direction when it is in forward operation.	Compensate in negative direction when it is in forward operation.
2	Compensate in positive direction when it is in reverse operation.	Compensate in negative directions when it is in reverse operation.

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Applied Functions

Precautions for Correct Use

- The backlash compensation status is retained when you switch from position control to speed control or to torque control. When you switch back to position control, the backlash compensation resumes the status retained during the previous position control.
- To determine the actual position of the Servomotor, offset the Servomotor position data acquired via MECHATROLINK-II communications for the backlash compensation amount.
- A backlash compensation is performed on the first position command in the set directional operation after the Servo-ON. Any prior operations in reverse direction are not compensated. But the first reverse operation after the initial backlash compensation is compensated. A backlash compensation is not performed twice or more as long as the operation continues in the same direction.
- When the Servo-OFF status occurs while backlash compensation is performed, the backlash compensation amount is cleared. This is done by presetting the position command data of the Servo Drive to the Servomotor position data that includes the backlash compensation amount. When the Servo-ON occurs again, backlash compensation is performed as described above.

Reference

Conditions for Clearing the Backlash Compensation
The backlash compensation is cleared to zero under any of the following conditions:

- When the position error is reset. This includes the cases of Serve OFF, and when the error counter is reset by the drive prohibition input.
- When the position data is initialized. This excludes the commands of an origin return and a coordinate system setup, but includes the commends of an equipment setup request and an adjustment.

6-5 Brake Interlock

This function lets you set the output timing for the brake interlock output (BKIR) that activates the holding brake when the servo is turned ON, an alarm generates, or the servo is turned OFF.

Parameters Requiring Settings

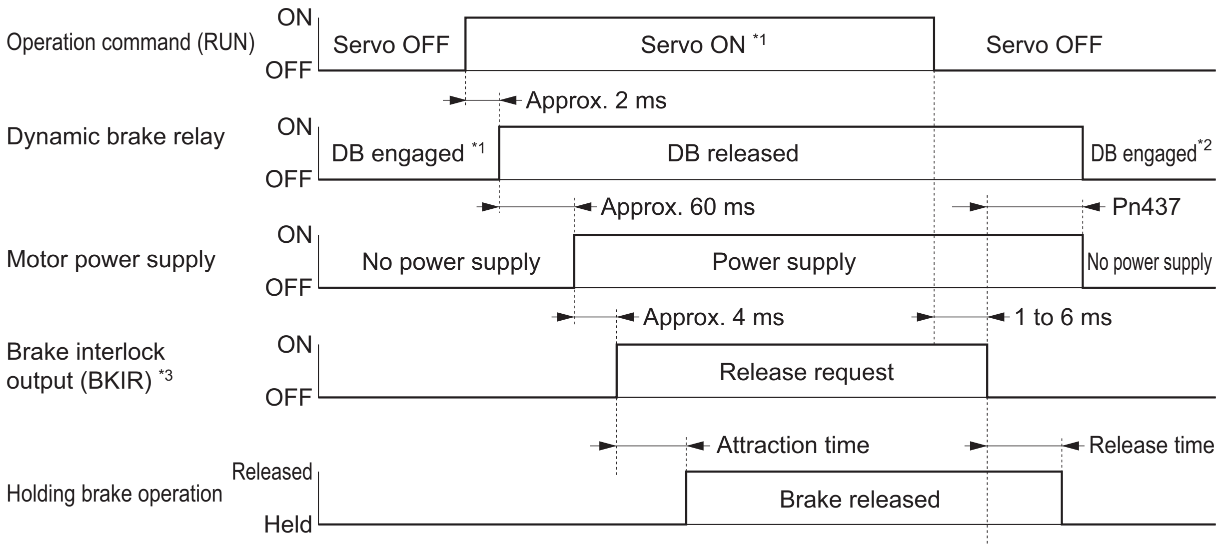
Parameter number	Parameter name	Explanation	Reference
Pn437	Brake Timing when Stopped	Set the time after a servo OFF command is issued upon servo lock stop, until the brake interlock output (BKIR) turns OFF and power supply stops.	P.8-38
Pn438	Brake Timing during Operation	Set the time after a servo OFF command is issued while the motor is rotating, until the brake interlock output (BKIR) turns OFF and power supply stops. If the speed drops to 30 r/min or below before the time set here, BKIR turns OFF.	P.8-38

Precautions for Correct Use

- The brake on a Servomotor with brake is a non-excitation brake designed only to hold when the operation is stopped.
  Accordingly, set an appropriate time so that the brake actuates after the motor stops.
- If the brake is applied while the Servomotor is rotating, the brake disc will wear abnormally or sustain damage, resulting in a bearing or encoder failure in the Servomotor.

Operating Example

Servo ON/OFF Operation Timings <when Motor Is Stopped>



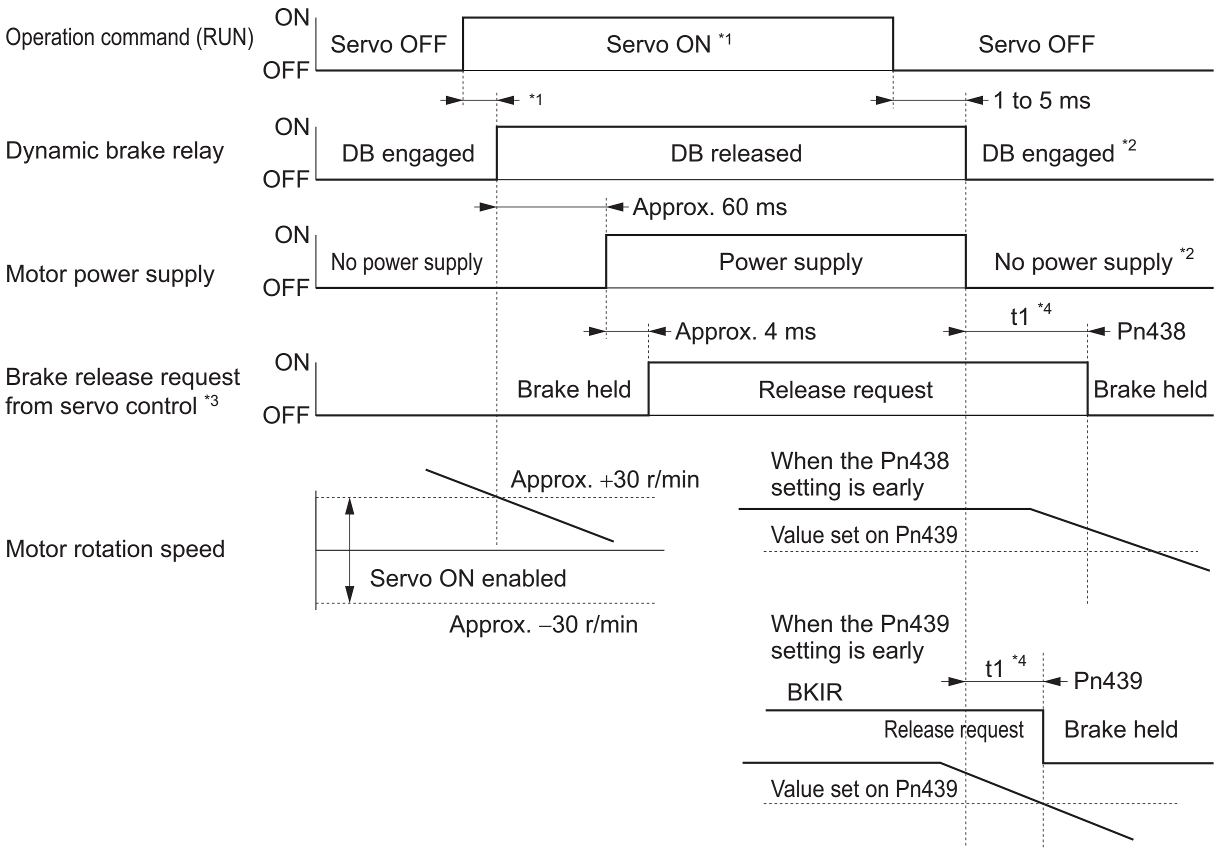
*1. The servo does not turn ON until the motor rotation speed drops to approx. 30 r/min or below.

*2. The dynamic brake operation when the servo is OFF depends on Stop Selection with Servo OFF (Pn506).

*3. The Brake Interlock output (BKIR) is output when the OR condition is met by a release request command from the Servo control and from the MECHATROLINK-II. In the above example, the MECHATROLINK-II makes no release request. The BKIR is assigned to the general-purpose output (CN1).

Servo ON/OFF Operation Timings <When Motor Is Rotating>

Based on these operation timings, regenerative energy is produced if the motor rotation stops abnormally.
Accordingly, repeated operations cannot be performed. Provide a wait time of at least 10 minutes for the motor to cool down.



*1. The servo does not turn ON until the motor rotation speed drops to approx. 30 r/min or below. If a Servo-ON is commanded during motor rotation, the Command warning (Warning No. 95) occurs. The Servo-ON command is ignored.
*2. The dynamic brake operation when the servo is OFF depends on Stop Selection with Servo OFF (Pn506).
*3. The Brake Interlock output (BKIR) signal is output when the OR condition is met by a release request command from the Servo control and from the MECHATROLINK-II. In the above example, the MECHATROLINK-II makes no release request. The BKIR signal is assigned to the general-purpose output (CN1).
*4. The mark t1 refers to the period until the value becomes lower than the set value on the Brake Timing during Operation (Pn438) or the Brake Release Speed Setting (Pn439), whichever is shorter.

Note: Even when the servo ON input is turned ON again while the motor is decelerating, the system does not enter the servo ON state until the motor stops.

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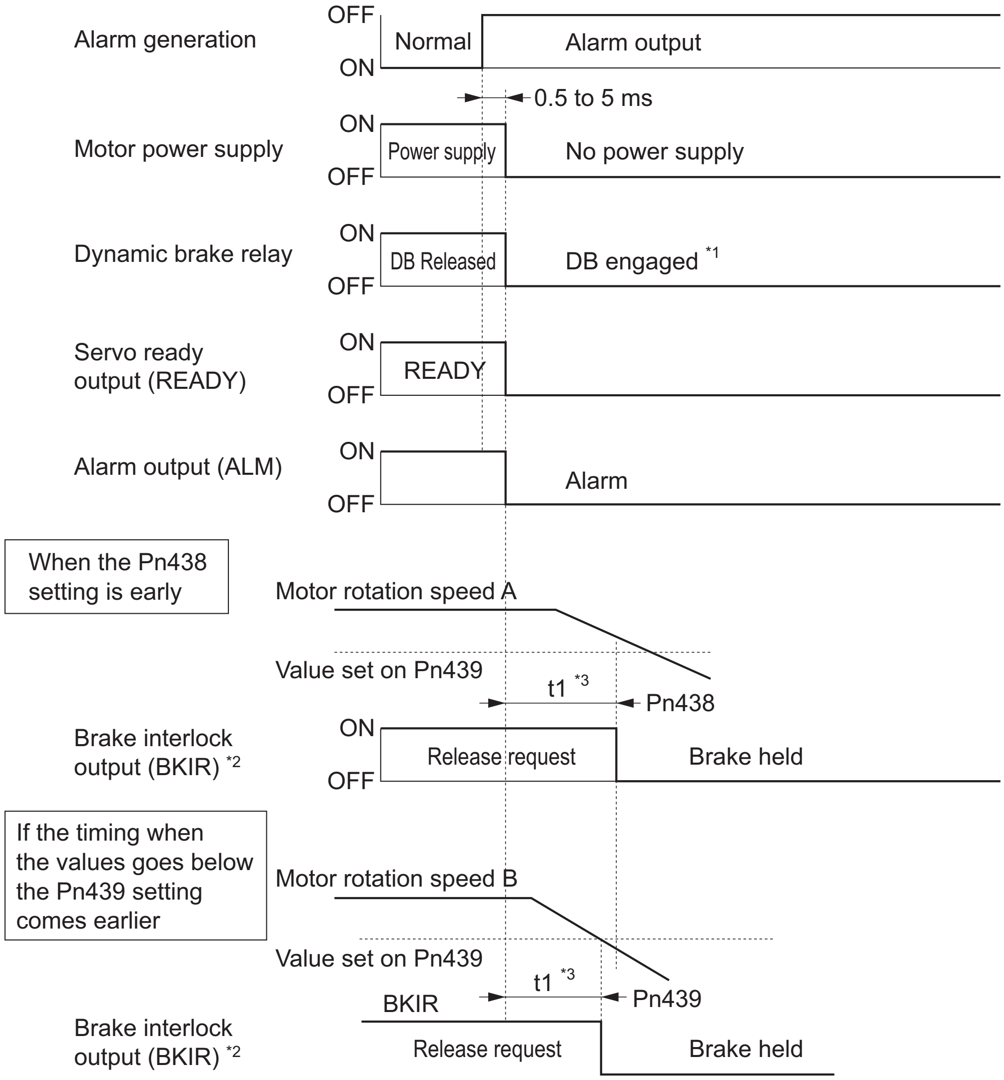
Applied Functions

Operation Timings when Alarm Generates (Servo ON)



*1. Dynamic brake operation at an alarm depends on the Stop Selection for Alarm Detection (Pn510) setting.

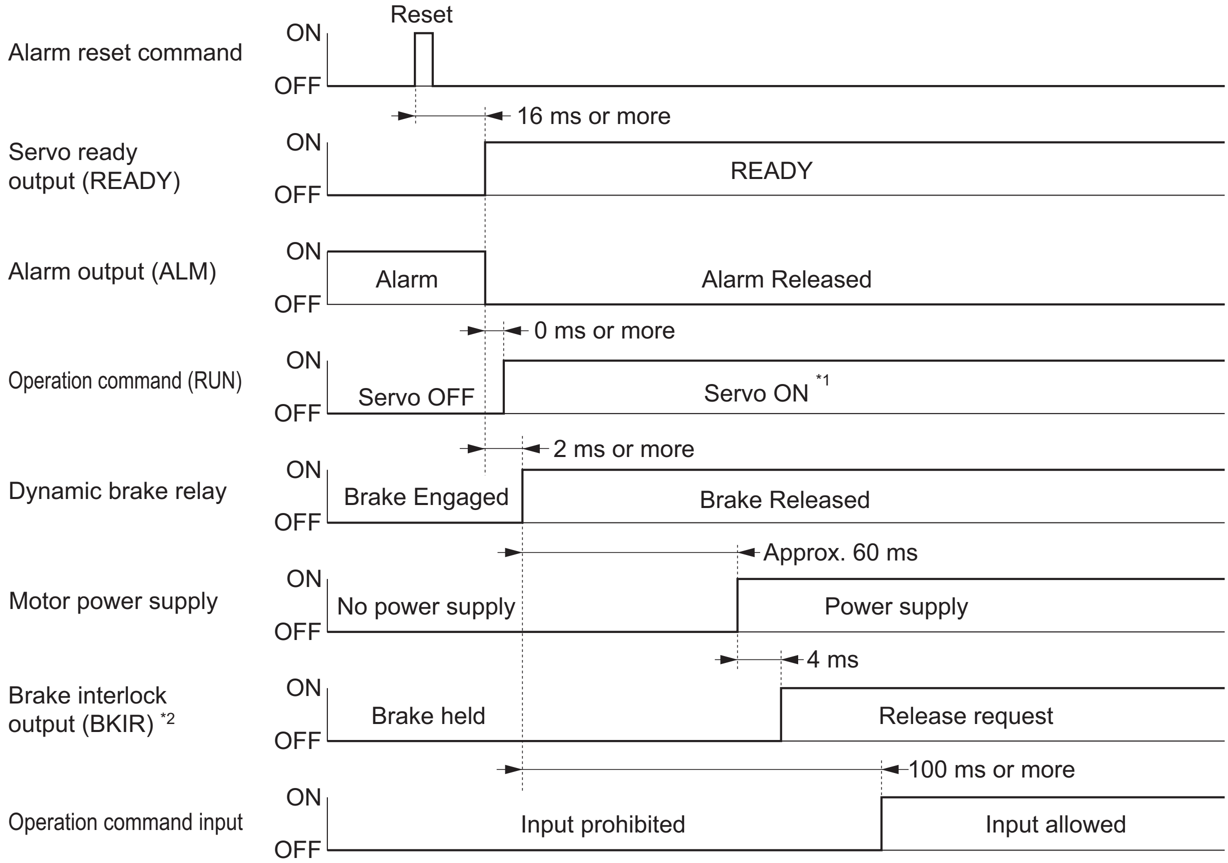
*2. The Brake Interlock output (BKIR) signal is output when the OR condition is met by a release request command from the Servo control and from the MECHATROLINK-II. In the above example, the MECHATROLINK-II makes no release request. The BKIR signal is assigned to the general-purpose output (CN1).

*3. The mark t1 refers to the period until the value becomes lower than the set value on the Brake Timing during Operation (Pn438) or the Brake Release Speed Setting (Pn439), whichever is shorter.

Note 1.Even when the servo ON input is turned ON again while the motor is decelerating, the system does not enter the servo ON state until the motor stops.

Note 2.If the main circuit power supply turns OFF while the motor is operating, a phase loss alarm or main circuit voltage low alarm occurs, in which case this operation timing is applied.

Operation Timings at Alarm Reset



*1. The servo does not turn ON until the motor rotation speed drops to approx. 30 r/min or below.

*2. The Brake Interlock output (BKIR) signal is output when the OR condition is met by a release request command from the Servo control and from the MECHATROLINK-II. In the above example, the MECHATROLINK-II makes no release request. The BKIR signal is assigned to the general-purpose output (CN1).

Note:After the alarm has been reset, the system enters the servo OFF state (motor not excited). To turn the servo ON, issue a servo ON command again after resetting the alarm, according to the above timings.

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Applied Functions

6-6 Electronic Gear Function

This function controls the position by using the value multiplied the position command entered on the Host Controller by the preset electronic gear ratio. The functions is used in the POSITION CONTROL and FULL CLOSING CONTROL modes.
In speed or torque control, the number of encoder pulses from the motor is divided by the electronic gear and converted to the command unit for feedback.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn009	Electronic Gear Ratio Numerator *1	Set the numerator of the electronic gear ratio. If the set value is 0, the encoder resolution is automatically set as the numerator. *2 • 131072 for a 17-bit absolute encoder • 1048576 for a 20-bit incremental encoder	P.8-4
Pn010	Electronic Gear Ratio Denominator *1	Set the denominator of the electronic gear ratio.	

*1. The electronic gear ratio must be set between 1/1000 x and 1000 x. If it is set outside the range, the Parameter setting error (Alarm No.93.0) occurs.

*2. If the Pn009 is set to 0, the encoder resolution is set to the numerator during full closing controls also.

Electronic Gear Ratio Setting (Pn009, Pn010)

Electronic gear ratio numerator (Pn006)	Electronic Gear Ratio Denominator (Pn010)	Description
0	1 to 1073741824	When the Electronic Gear Ratio Numerator (Pn009) is 0, The processing changes with the set value of Electronic Gear Ratio Denominator (Pn010). Position command → $\frac{\text{Encoder resolution*1}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$ → Position command Position command = Encoder resolution / Electronic Gear Ratio Denominator (Pn010)
1 to 1073741824		When the Electronic Gear Ratio Numerator (Pn009) is other than 0, The processing changes with the set values of Electronic Gear Ratio Numerator 1 (Pn009) and Electronic Gear Ratio Denominator (Pn010). Position command → $\frac{\text{Electronic Gear Ratio Numerator 1 (Pn009)}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$ → Position command Position command = Electronic Gear Ratio Numerator (Pn009) / Electronic Gear Ratio Denominator (Pn010)

*1 The encoder resolution is set as the numerator for full closing control.

Precautions for Correct Use

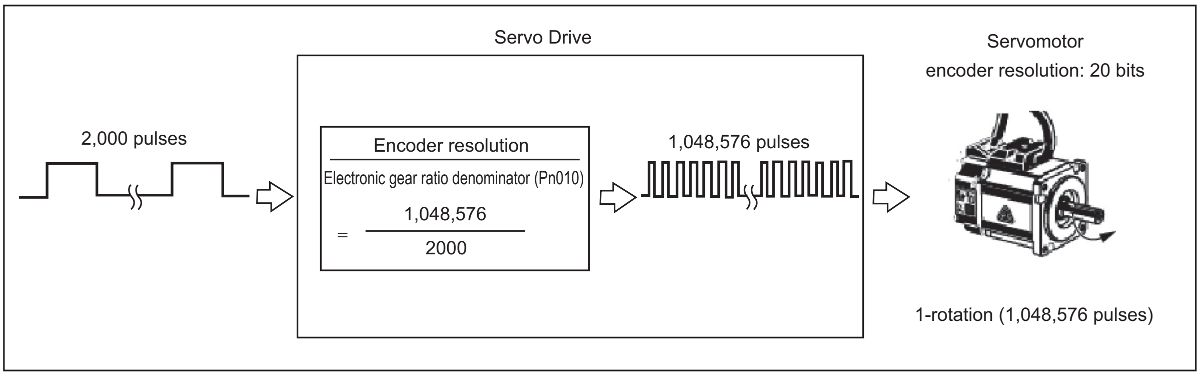
- The electronic gear ratio must be set between 1/1000 x and 1000 x. If it is set outside the range, the Parameter setting error (Alarm No.93.0) occurs.
- To make the position command milder after the electronic gear setting, adjust it by the Position Command Filter Time Constant (Pn222) or by the Position Command FIR Filter Time Constant (Pn818)."

Operation Example

The example uses a motor with a 20- bit encoder (1048576 pulses per rotation)

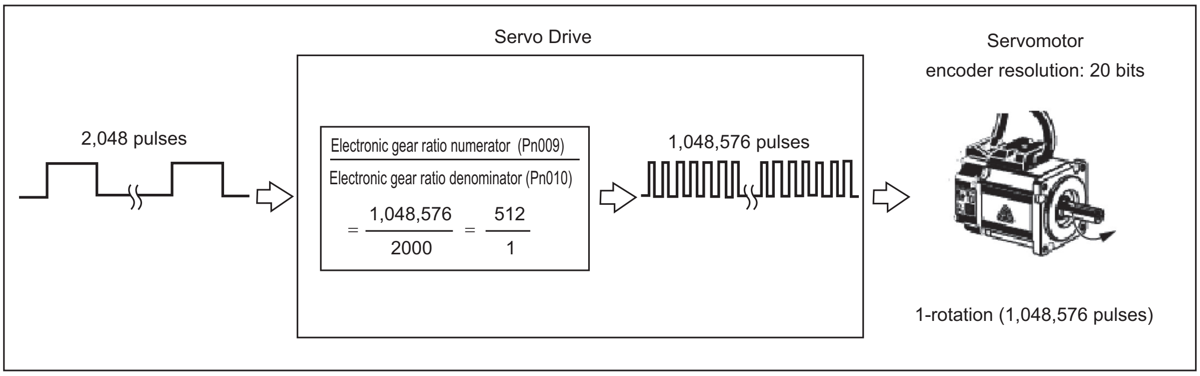
When the Electronic Gear Ratio Numerator (Pn009) is set to 0

- If you set Pn010 = 2,000, the operation is the same as the 2,000 (pulses/rotation) Servomotor.



When the Electronic Gear Ratio Numerator (Pn009) is set to a value other than 0

- If you set Pn009 and Pn010 = 1,048,576 and 2,048, respectively, the operation is the same as the 2,048 (pulses/rotation) Servomotor.



6-7 Torque Limit Switching

The function switches the torque limit by the operation directions, and depending on the Forward External Torque Limit (PCL), the Reverse External Torque Limit (NCL), and the Forward/Reverse Torque Limit Input Commands from the MECHATROLINK-II communications.

This function is used in the following conditions.

- When push-motion operation, such as pressing, is performed.
- When the torque at startup and during deceleration should be suppressed to protect the mechanical system, etc.

The Torque Limit Selection (Pn521) is used to select a method to switch the torque limit.

Operating Conditions

The torque limit switching function works under the following conditions.

	Conditions
Operating Mode *1	POSITION CONTROL mode, SPEED CONTROL mode, FULL CLOSING CONTROL mode
Others	• Servo-ON state • The factors other than control parameters are set correctly. This includes the torque limit. The motor operates normally without any failures.

*1.This switching function is disabled in the TORQUE CONTROL mode. Only the No.1 Torque Limit (Pn013) is effective.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn521	Torque Limit Selection	Select the torque limit based on the various parameters and input signals.	P.8-49
Pn013	No. 1 Torque Limit	Set the No. 1 motor output torque limit value.	P.8-4
Pn522	No. 2 Torque Limit	Set the No. 2 motor output torque limit value.	P.8-50
Pn525	Forward External Torque Limit	Set the forward torque limit using a network signal.	P.8-50
Pn526	Reverse External Torque Limit	Set the reverse torque limit using a network signal.	P.8-50

Torque Limits in POSITION, SPEED, TORQUE, and FULL CLOSING CONTROL Modes

The term Torque FF refers to torque feed forward function.

Set value	Position Control / Full Closing Control					Speed Control				
	Forward Torque Limit		Reverse Torque Limit		Torque FF	Forward Torque Limit		Reverse Torque Limit		Torque FF
	PCL ON *1	PCL OFF *2	NCL ON *1	NCL OFF *2		PCL ON *1	PCL OFF *2	NCL ON *1	NCL OFF *2	
0,1	Pn013				Disabled	Pn013				Enabled
2	Pn013		Pn522			Pn013		Pn522		
3	Pn522	Pn013	Pn522	Pn013		Pn522	Pn013	Pn522	Pn013	
4	Pn013		Pn522			Pn013 or P_TLIM*3		Pn522 or N_TLIM*4		Disabled
5						Pn013 or P_TLIM*3	Pn013	Pn522 or N_TLIM*4	Pn522	
6	Pn525	Pn013	Pn526	Pn522		Pn525	Pn013	Pn526	Pn522	Enabled

Set value	Torque Control		
	Forward Torque Limit	Reverse Torque Limit	Torque FF
0,1	Pn013		Disabled
2			
3			
4			
5			
6			

*1.PCL ON refers to the case when either the external input signals (PCL and NCL) or the MECHATROLINK-II communications option fields (P-CL and N-CL) is on.
*2.PCL OFF refers to the case when both of the external input signals (PCL and NCL) and the MECHATROLINK-II communications option fields (P-CL and N-CL) are off.
*3.Whichever the smaller: the Pn013 or the MECHATROLINK-II Command Option value 1 (P_TLIM)
*4.Whichever the smaller: the Pn522 or the MECHATROLINK-II Command Option value 2 (N_TLIM)

Torque Limit Settings by Servomotors

- The torque limit setting range is between 0% and 300%. The standard factory setting is 300%. This is not the case when a Servo Drive and a Servomotor are used in the following combinations.

Servo Drive	Applicable Servomotor	Maximum torque limit [%]
R88D-KN15x-ML2	R88M-K90010x	225
R88D-KN30x-ML2	R88M-K2K010x	250
R88D-KN50x-ML2	R88M-K3K010x	250

6-8 Soft Start

This function is used to control the rotation speed. It sets the acceleration and deceleration against the rotation speed command in the Servo Drive.
The function can be used for step rotation speed commands, and allows soft starts. The S-curve Acceleration and Deceleration function is used to reduce any impacts by acceleration changes.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn312	Soft Start Acceleration Time	Sets the acceleration time for the rotation speed command input.	P.8-25
Pn313	Soft Start Deceleration Time	ets the deceleration time for the rotation speed command input.	P.8-25
Pn314	S-curve Acceleration/ Deceleration Time Setting	Sets the acceleration or deceleration processing S-curve time for the rotation speed command input.	P.8-25

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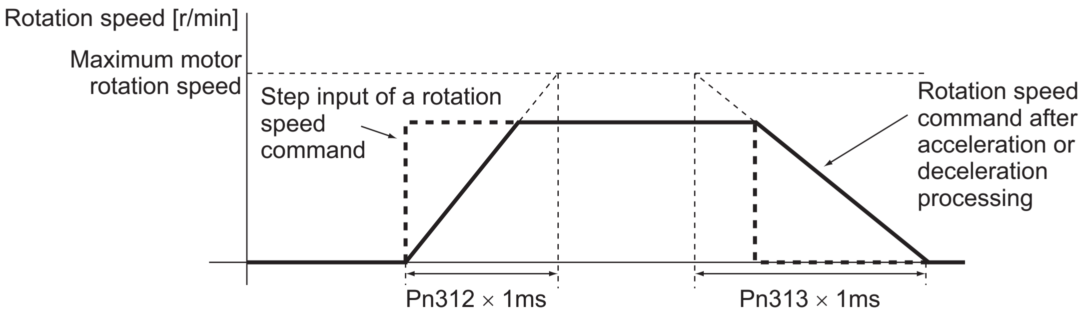
Soft Start Acceleration or Deceleration Time

Set the time required for a step speed command to reach the maximum motor rotation speed into the Soft Start Acceleration Time (Pn312). In the same manner, set the time required for the command to decrease the speed from the maximum motor rotation speed to 0 r/min into the Soft Start Deceleration Time (Pn313).
The time taken for acceleration or deceleration is calculated by the following formula, where Vc [r/min] is the target rotation speed of the speed command.

Acceleration Time [ms] = Vc / Maximum motor rotation speed × Pn312 × 1 ms

Deceleration Time [ms] = Vc / Maximum motor rotation speed × Pn313 × 1 ms

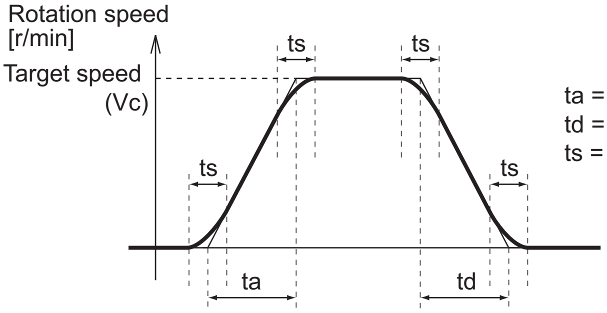


Precautions for Correct Use

- Do not set the Soft Start Acceleration Time and the Soft Start Deceleration Time when the position loop structure with a Host Controller is used.

S-curve Acceleration or Deceleration Time

The function sets the S-curve time for the acceleration and deceleration time set by the Soft Start Acceleration Time (Pn312) and the Soft Start Deceleration Time (Pn313). The S-curve time is a duration around an inflection point during acceleration and deceleration.



ta = Vc / Maximum motor rotation speed × Pn312 × 1 ms
td = Vc / Maximum motor rotation speed × Pn313 × 1 ms
ts = Pn314 × 1 ms

Note Be sure that ts is smaller than the values obtained by the divisions of $\frac{ta}{2}$ and $\frac{td}{2}$.

6-9 Gain Switching Function

This function switches the position loop and speed loop gain.
Select enable or disable using GAIN SWITCHING INPUT OPERATING mode Selection (Pn114). Set the switching condition using gain switching setting.
If the load inertia changes or you want to change the responsiveness depending on whether the motor is stopping and operating, you can perform an optimal control by gain switching.
The function is used when the realtime autotuning does not work effectively, such as:

- When the load inertia fluctuates in 200 ms or less.
- When the motor rotation speed does not exceed 500 r/min, or load torque does not exceed 50% of the rated torque.
- When external force is constantly applied, as with a vertical axis.

Precautions for Correct Use

- When the gain 2 has been selected, realtime autotuning does not operate normally. If using the gain switching, set the Realtime Autotuning to "Disabled" (Pn002 = 0).

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn114	GAIN SWITCHING INPUT OPERATING mode Selection	Set whether to enable or disable gain switching function.	P.8-10
POSITION CONTROL mode and FULL CLOSING CONTROL mode			
Pn115	SWITCHING mode in Position Control	Set the condition for switching between gain 1 and gain 2.	P.8-11
Pn116	Gain Switching Delay Time in Position Control	Set the time to return from the gain 2 to gain 1. (Unit: 0.1 ms)	P.8-12
Pn117	Gain Switching Level in Position Control	Set the judgment level for switching between the gain 1 and gain 2.	P.8-13
Pn118	Gain Switching Hysteresis in Position Control	Set the hysteresis width to be provided in the judgment level set in Gain Switching Level (Pn117).	P.8-13
Pn119	Position Gain Switching Time	Set the number of phased switches from low to high gain. (Unit: 0.1 ms)	P.8-13
SPEED CONTROL mode			
Pn120	SWITCHING mode in Speed Control	Set the condition for switching between gain 1 and gain 2.	P.8-14
Pn121	Gain Switching Delay Time in Speed Control	Set the time to return from the gain 2 to gain 1. (Unit: 0.1 ms)	P.8-15
Pn122	Gain Switching Level in Speed Control	Set the judgment level for switching between the gain 1 and gain 2.	P.8-15
Pn123	Gain Switching Hysteresis in Speed Control	Set the hysteresis width to be provided in the judgment level set in Gain Switching Level (Pn122).	P.8-16
TORQUE CONTROL mode			
Pn124	SWITCHING mode in Torque Control	Set the condition for switching between gain 1 and gain 2.	P.8-16
Pn125	Gain Switching Delay Time in Torque Control	Set the time to return from the gain 2 to gain 1. (Unit: 0.1 ms)	P.8-18
Pn126	Gain Switching Level in Torque Control	Set the judgment level for switching between the gain 1 and gain 2.	P.8-18
Pn127	Gain Switching Hysteresis in Torque Control	Set the hysteresis width to be provided in the judgment level set in Gain Switching Level (Pn126).	P.8-18

Gain Switching Setting for Each CONTROL mode

The settable switching conditions vary depending on the CONTROL mode used. Set the parameters for each CONTROL mode.
Refer to “Chapter 8 Parameters Details” for explanation of each gain.

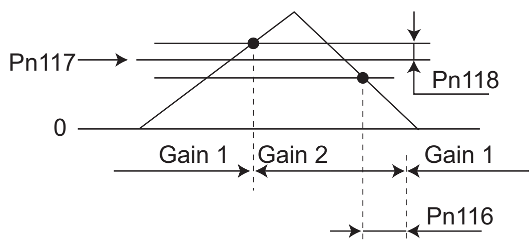
Position Control Mode and Full Closing Control Mode

In the POSITION CONTROL mode and FULL CLOSING CONTROL MODE, it varies as follows according to SWITCHING mode in Position Control (Pn115).

Pn115 set value	Description			
	Gain switching conditions	Gain switching delay time in position control (Pn116)*1	Gain switching level in position control (Pn117)	Gain switching hysteresis in position control (Pn118) *2
0	Always Gain 1 (Pn100 to Pn104).	Disabled	Disabled	Disabled
1	Always Gain 2 (Pn105 to Pn109).	Disabled	Disabled	Disabled
2	Gain switching command input via MECHATROLINK-II communications *3	Disabled	Disabled	Disabled
3	Torque command change amount (Refer to Figure A)	Enabled	Enabled *4 (× 0.05%)	Enabled*4 (× 0.05%)
4	Always Gain 1 (Pn100 to 104).	Disabled	Disabled	Disabled
5	Command speed (Refer to Figure B)	Enabled	Enabled (r/min)	Enabled (r/min)
6	Amount of position error (Refer to Figure C).	Enabled	Enabled *5 (pulse)	Enabled*5 (pulse)
7	When the position command is entered (Refer to Figure D).	Enabled	Disabled	Disabled
8	When the positioning complete signal (INP) is OFF (Refer to Figure E).	Enabled	Disabled	Disabled
9	Actual motor speed (Refer to Figure B).	Enabled	Enabled (r/min)	Enabled (r/min)
10	Combination of position command input and rotation speed (Refer to Figure F).	Enabled	Enabled *6 (r/min)	Enabled *6 (r/min)

*1.The Gain Switching Delay Time in Position Control (Pn116) becomes effective when the gain is switched from 2 to 1.

*2.The Gain Switching Hysteresis in Position Control (Pn118) is defined in the drawing below.



*3.When the Gain switching command of MECHATROLINK-II communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

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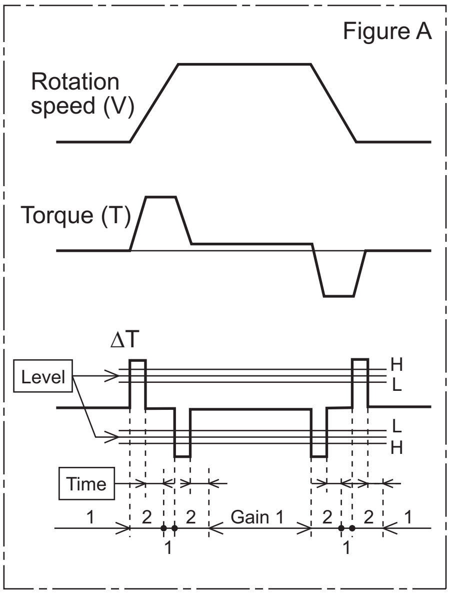
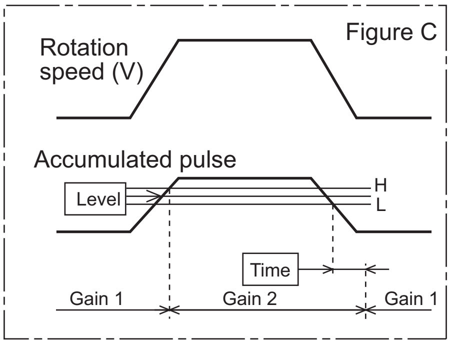
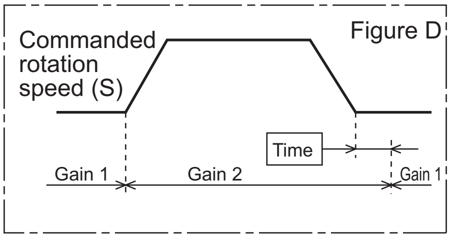
*4.The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.

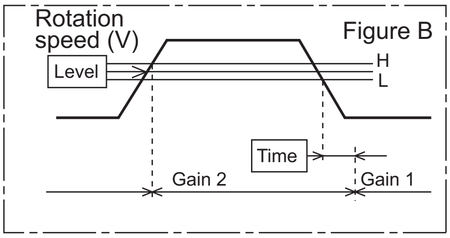
*5.The unit (pulse) of hysteresis is the resolution of the encoder in position control. It is the resolution of the external encoder in full closing control.

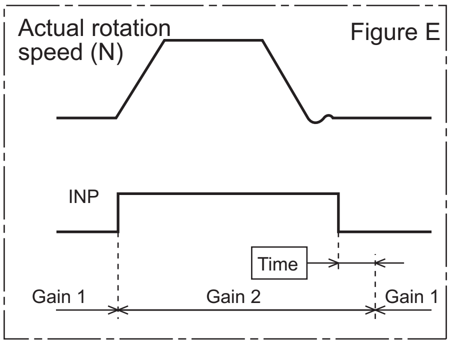
*6. When the set value is 10, meanings of the Gain switching delay time in position control, the Gain switching level in position control, and the Gain switching hysteresis in position control differ from the normal case. (Refer to Figure F).

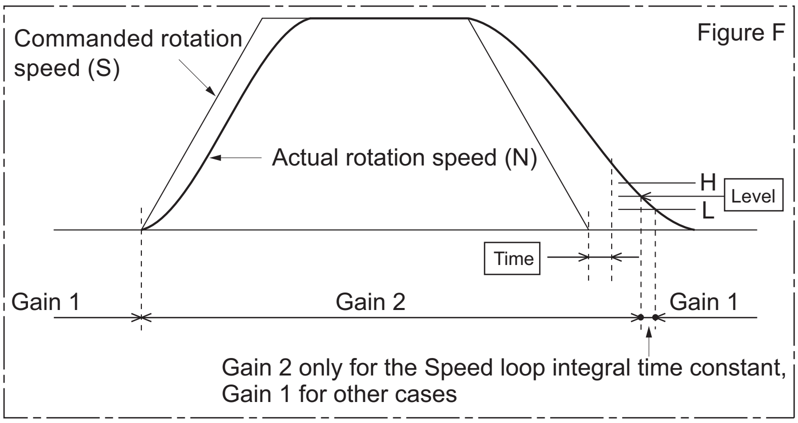












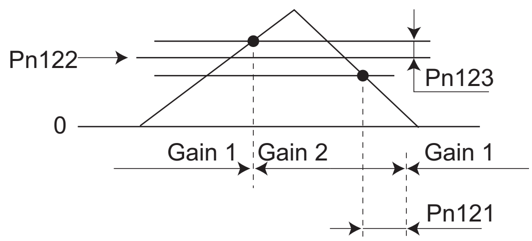
SPEED CONTROL mode

In the SPEED CONTROL mode, it varies as follows according to SWITCHING mode in Speed Control (Pn120).

Pn120 set value	Description			
	Gain switching conditions	Gain Switching Delay Time in Speed Control (Pn121) *1	Gain Switching Level in Speed Control (Pn122)	Gain Switching Hysteresis in Speed Control (Pn123)*2
0	Always the Gain 1 (Pn100 to Pn104).	Disabled	Disabled	Disabled
1	Always the Gain 2 (Pn105 to Pn109).	Disabled	Disabled	Disabled
2	Gain switching command input via MECHATROLINK-II communications *3	Disabled	Disabled	Disabled
3	Torque command variation (Refer to Figure A)	Enabled	Enabled *4 (× 0.05%)	Enabled *4 (× 0.05%)
4	Speed command change amount (Refer to Figure B)	Enabled	Enabled*5 (10r/min/s)	Enabled *5 (10r/min/s)
5	Speed command (Refer to Figure C)	Enabled	Enabled (r/min)	Enabled (r/min)

*1.The Gain Switching Delay Time in Speed Control (Pn121) becomes effective when the gain is switched from 2 to 1.

*2.The Gain Switching Hysteresis in Speed Control (Pn123) is defined in the drawing below.



*3. When the Gain switching command of MECHATROLINK-II communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4.The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.

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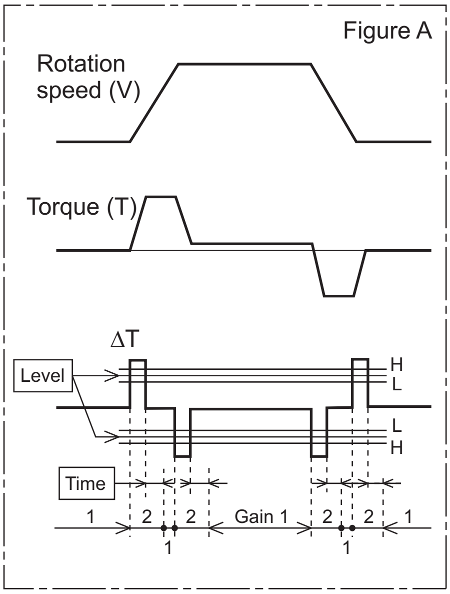
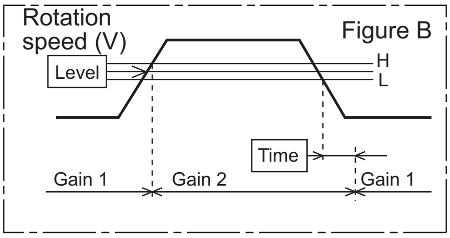
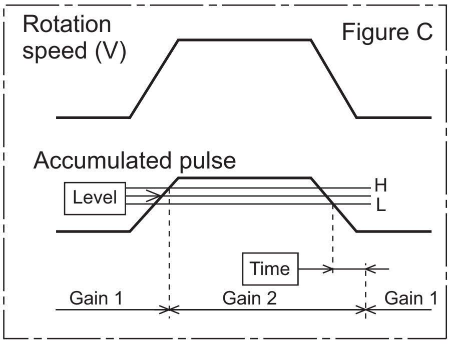
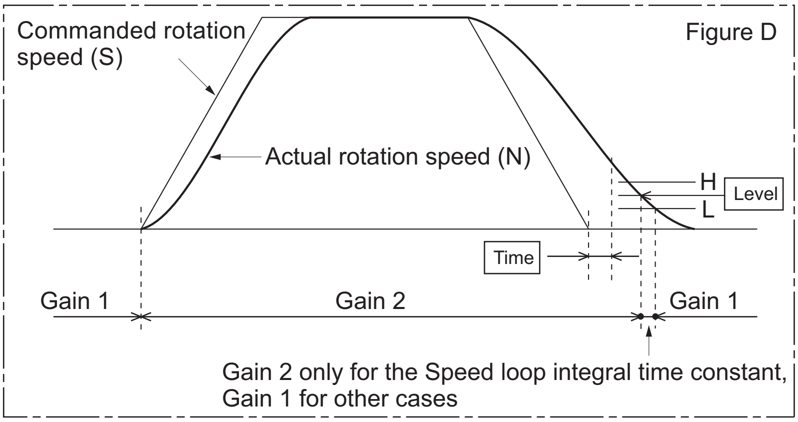
*5.When the set value is 10, meanings of the Gain switching delay time in speed control, the Gain switching level in speed control, and the Gain switching hysteresis in speed control differ from the normal case. (Refer to Figure D).









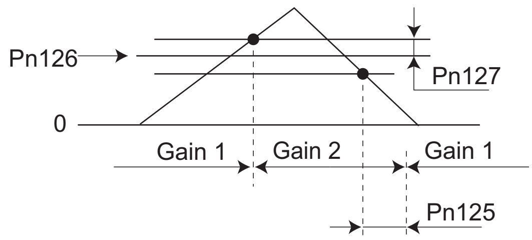
TORQUE CONTROL mode

In the TORQUE CONTROL mode, it varies as follows according to SWITCHING mode in Torque Control (Pn124).

Pn124 set value	Description			
	Gain switching conditions	Gain Switching Delay Time in Torque Control (Pn125) *1	Gain Switching Level in Torque Control (Pn126)	Gain Switching Hysteresis in Torque Control (Pn127) *2
0	Always Gain 1 (Pn100 to Pn104).	Disabled	Disabled	Disabled
1	Always Gain 2 (Pn105 to Pn109).	Disabled	Disabled	Disabled
2	Gain switching command input via MECHATROLINK-II communications *3	Disabled	Disabled	Disabled
3	Torque command change amount (Refer to Figure A)	Enabled	Enabled *4 (0.05%)	Enabled *4 (0.05%)

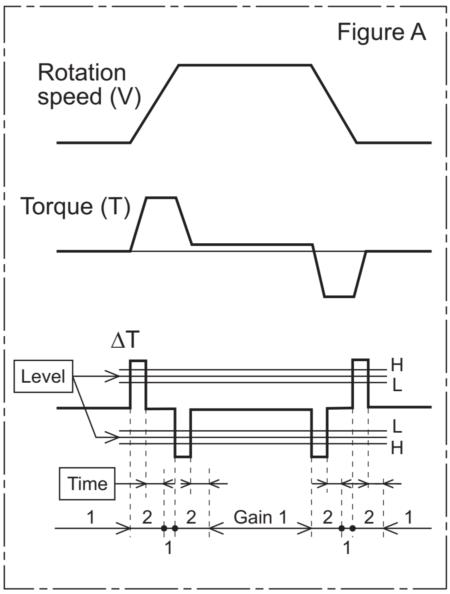
*1.The Gain Switching Delay Time in Torque Control (Pn125) becomes effective when the gain is switched from 2 to 1.

*2.The Gain Switching Hysteresis in Torque Control (Pn127) is defined in the drawing below.



*3.When the Gain switching command of MECHATROLINK-II communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4.The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.



6

Applied Functions

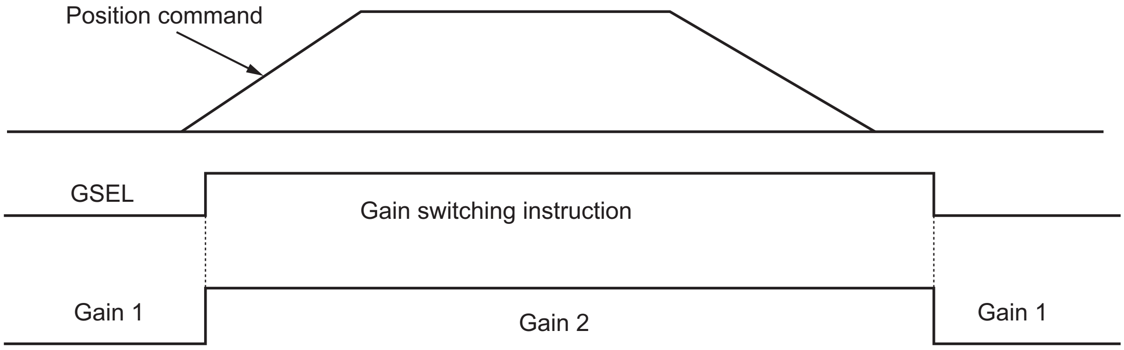
Timing by Gain Switching Setting

Switching between Gain 1 (Pn100 to Pn104) and Gain 2 (Pn105 to Pn109) occurs at the following timings. Take note that, in the case of position loop gains, switching occurs based on the setting of Pn119.

The details of gain switching setting vary depending on the CONTROL mode used. For the details of settings available in each mode, refer to "Gain Switching Setting for Each CONTROL mode" (P.6-28).

GAIN SWITCHING mode = 2: Gain Switching (GSEL)

Instant switching occurs when a gain switching command is issued from the network.

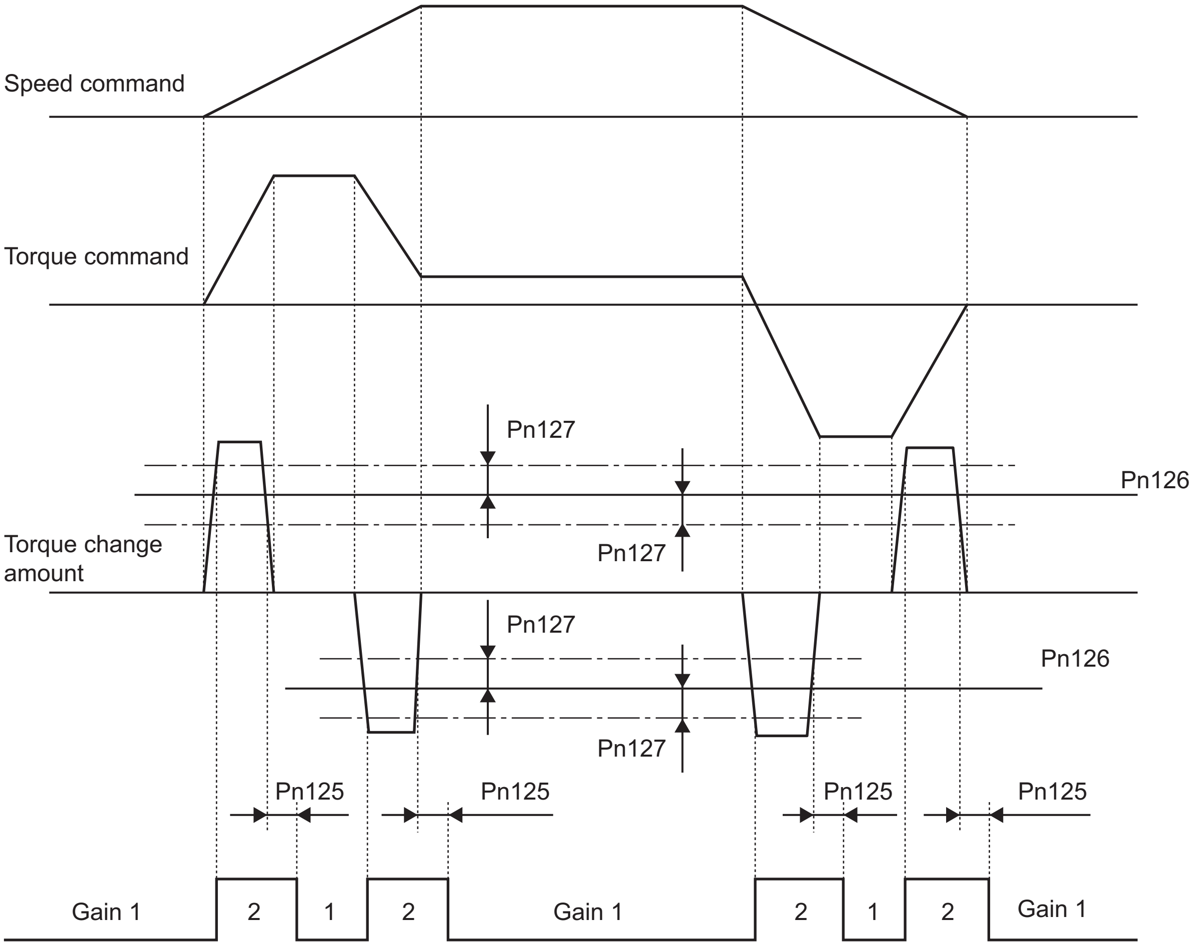


GAIN SWITCHING mode = 3: Switching by Torque Command Change Amount

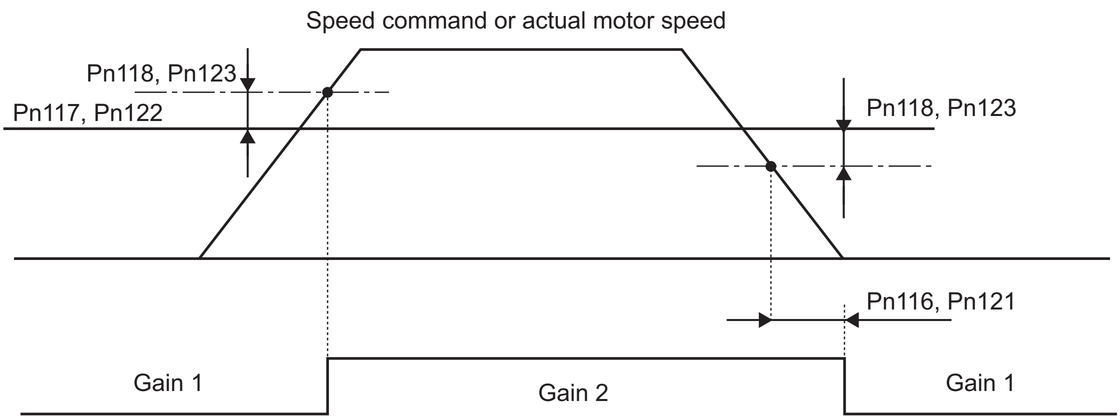
Torque command change amount (angular acceleration and deceleration speed command) is set in units of 0.05%/166 µs.

If the amount of change fluctuates and the switching time is not met, the switching is cancelled.

In the case of switching due to a change amount of 4% over 2 ms, a value of approx. 6 will apply. (Change of 0.33% per 166 µs.)

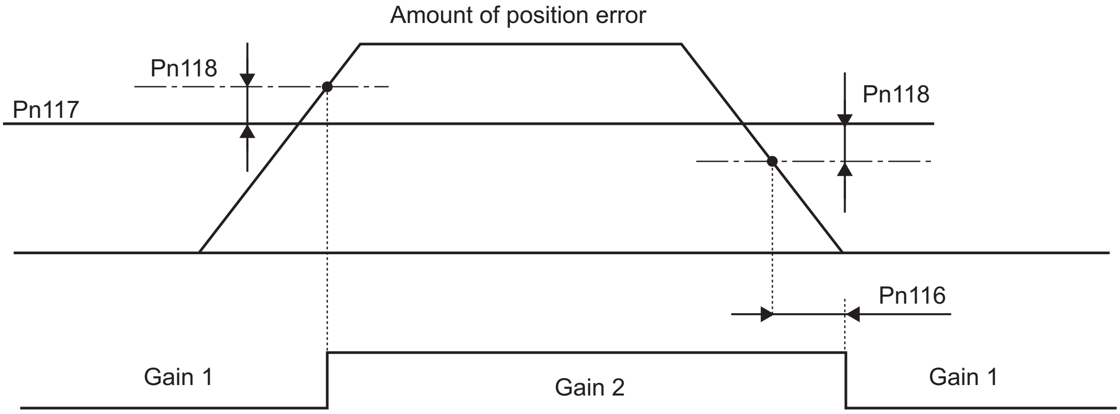


GAIN SWITCHING mode = 5, 9: Switching by Speed Command or Actual Motor Speed



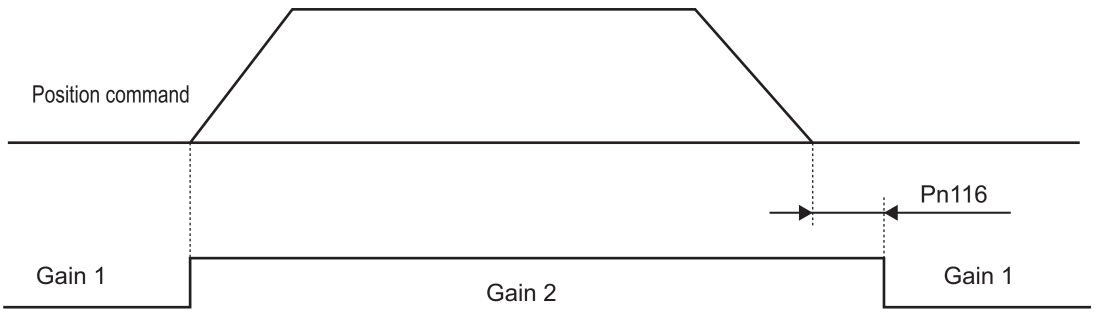
GAIN SWITCHING mode (Pn031) = 6: Switching by Amount of Position Error

Gain switching is performed based on the accumulated count in the error counter.



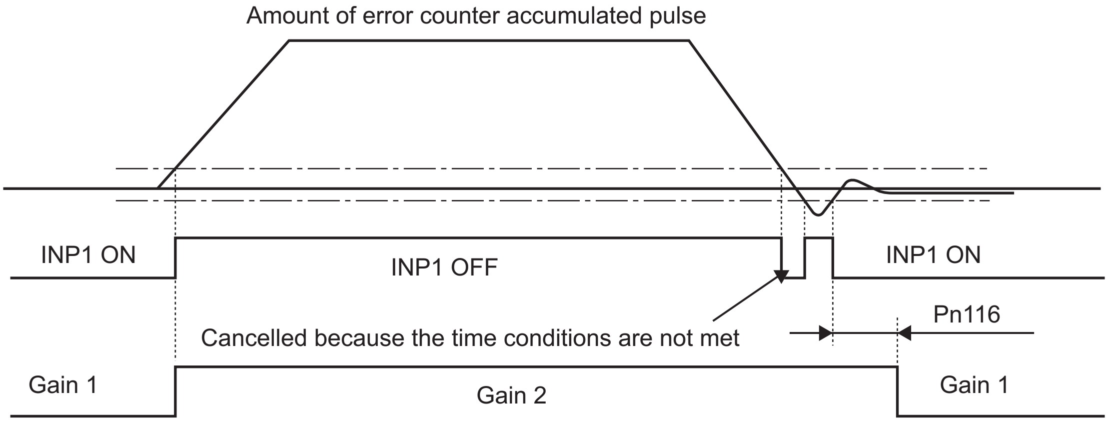
GAIN SWITCHING mode = 7: Switching by Position Command Received

Gain switching is performed when a position command corresponding to 1 command unit or more is received.



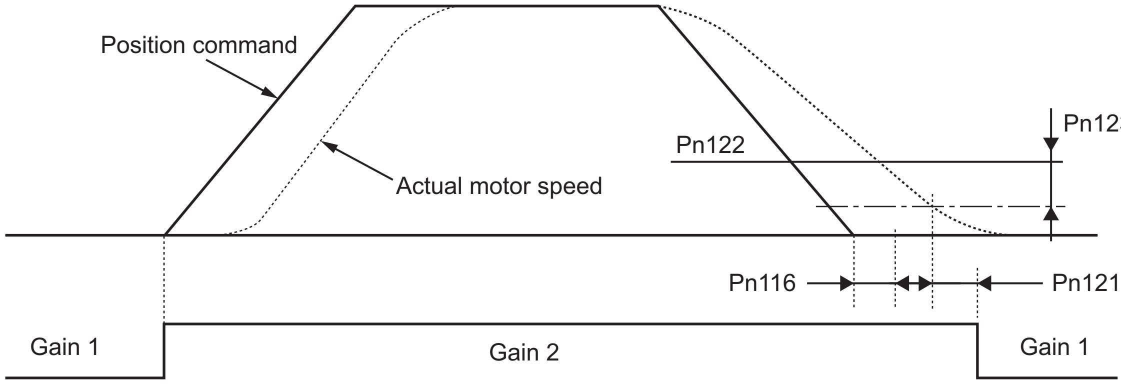
GAIN SWITCHING mode = 8: Switching by Positioning Completion Signal OFF

Switching to the gain 2 is performed when the error counter accumulated pulse exceeds the Positioning Completion Range 1 (Pn431).



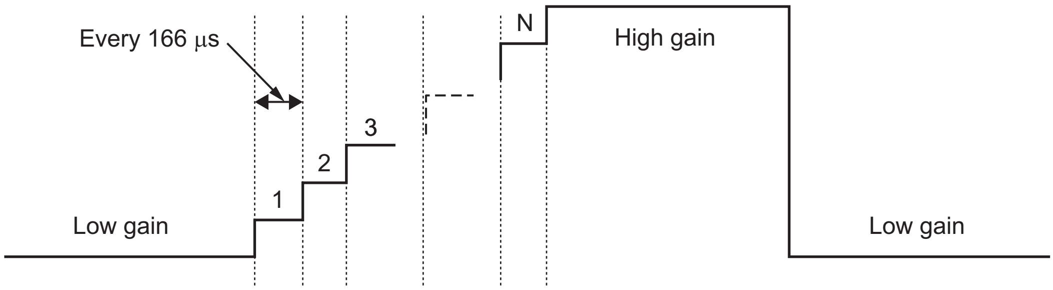
GAIN SWITCHING mode = 10: Switching by Combination of Position Command Received and Speed

Switching to the gain 2 occurs when a position command is received.
If no position command is issued for the period of Gain Switching Delay Time in Speed Control (Pn121) and the speed also becomes the same as or less than the result of Gain Switching Level (Pn122) - Gain Switching Hysteresis (Pn123) [r/min], switching to the Gain 1 occurs.



Position Gain Switching Time (Pn119)

At the time of gain switching, the speed loop gain, speed loop integral time constant, torque command filter time constant and speed detection filter switch simultaneously as the switching command. Under this function, however, switching occurs at the set timings so as to reduce mechanical vibration and resonance resulting from switching from low to high gain.
The switching time is set in units of 166 µs according to the internal cycle. Set 20 in Pn035. If the position loop gain is to be raised from 30 to 50 [1/s], increment the gain by 166 µs at a time. (3.32 ms) If the position loop gain is to be lowered from 50 to 30 [1/s], lower the gain instantly.



6

Applied Functions

6-10 Gain Switching 3 Function

The function adds a new setting to the gain switching function of the GAIN SWITCHING INPUT OPERATING mode Selection (Pn114). It switches the gain right before a stop.
The positioning time can be reduced by keeping the gain immediately before the stop at a higher level for a certain period of time.

Operating Conditions

You can use the gain 3 switching function in the following situations for position control or full closing control.

	Conditions
Operating mode	POSITION CONTROL mode, SPEED CONTROL mode
Others	• Servo-ON state. • The factors other than control parameters are set correctly. • This includes the torque limit. The motor operates normally without any failures.

Parameters Requiring Settings

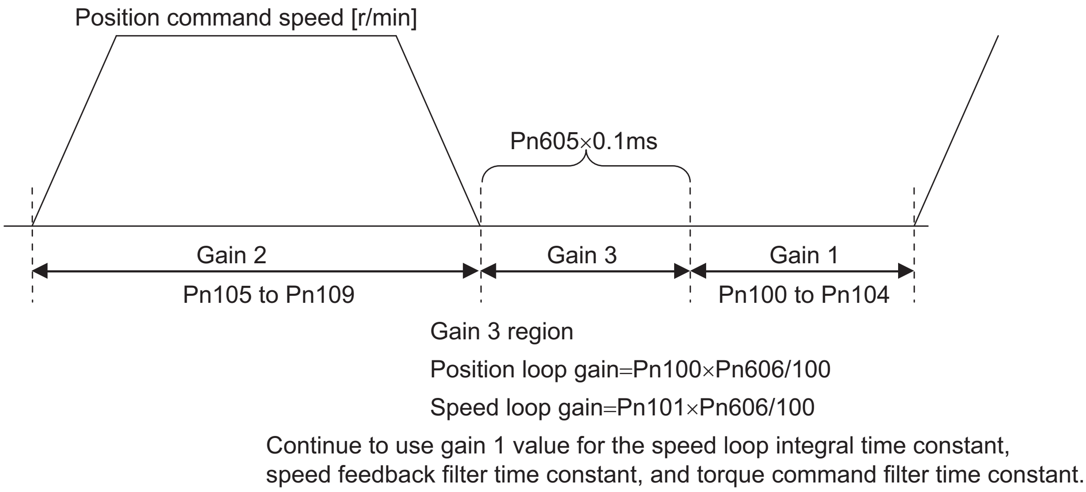
Parameter number	Parameter name	Explanation	Reference
Pn605	Gain 3 Effective Time	Set effective time of gain 3.	P.8-52
Pn606	Gain 3 Ratio Setting	Set gain 3 as a multiple of gain 1.	P.8-52

Operation Example

When the conventional gain switching function works correctly, set a time to use the Gain 3 into the Gain 3 Effective Time (Pn605), and the magnification of Gain 3 against Gain 1 into the Gain 3 Ratio Setting (Pn606).

Operation Timings of Gain 1, 2 and 3

When the SWITCHING mode in Position Control (Pn115) is set to 7, i.e., when the command pulses are received as the switching condition, the operation will be as shown below:



Precautions for Correct Use

- If gain 3 is not used, set the Gain 3 Effective Time (Pn605) to 0 and Gain 3 Ratio Setting (Pn606) to 100.
- In the gain 3 region, only the position loop gain and the speed loop gain are treated as gain 3, and the gain 1 setting is applied to all other gains.
- If the gain 2 switching condition is established in the gain 3 region, this switches to gain 2.
- If gain 2 is switching to gain 3, Position Gain Switching Time (Pn119) is enabled.
- Take note that there is a gain 3 region even when gain 2 is switched to gain 1 due to a parameter change and so forth.

7

Safety Function

This function stops the motor based on a signal from a Safety Controller or safety sensor.
An outline of the function is explained together with operation and connection examples.

7-1 Safe Torque OFF (STO) Function

The safe torque OFF (hereinafter referred to as STO) function is used to cut off the motor current and stop the motor through the input signals from a safety equipment, such as a Safety Controller or safety sensor, that is connected to the safety connector (CN8).
When the STO function is operating, the Servo Drive turns OFF the servo ready completed output (READY) to go into the safety status.

Precautions for Safe Use

- When using the STO function, be sure to execute a risk assessment of the equipment to confirm that the system safety requirements are met.
- There are following risks even when the STO function is operating. Be sure to take safety into account as part of the risk assessment.
  - The motor runs if external force is present (e.g., force of gravity on the vertical axis, etc.). If holding is required, implement appropriate measures, such as providing external brakes. Take note that the brakes for the Servo Drive with brakes are used for the holding purpose only, and cannot be used for control.
  - Even if there is no external force, when Stop Selection for Alarm Detection (Pn510) is set to free-run (with the dynamic brake disabled), the motor operates as free-run and the stop distance is long.
  - In case of internal failure of components, the motor may operate in the range of up to 180 degrees of electrical angle.
  - The power supply to the motor is cut off by the STO function, but the power supply to the Servo Drive will not be cut off nor electrically insulated. For Servo Drive maintenance, cut off the power supply to the Servo Drive through another means.
- Do not use EDM output for other than the failure monitoring function. The EDM output signal is not a safety output.
- Be sure to check the wiring when installing. Especially check the following:
  - The wiring is not short-circuited or disconnected.
  - The polarity of EDM circuit is not reversed.
  - SF1, SF2 and EDM operate properly.
- The system with incorrect wiring may damage the safety function.
- The dynamic brake and external brake release signal output are not safety-related parts. Make sure to design the equipment not to be dangerous even if the external brake release fails during the STO status.
- When using the STO function, connect an equipment that meets the safety standards.
- The PFH value is 2.30×10^{-8}.

The STO function meets the following safety standards.

I/O Signal Specifications

Safety Input Signal

There are 2 types of safety input circuits to operate the STO function.

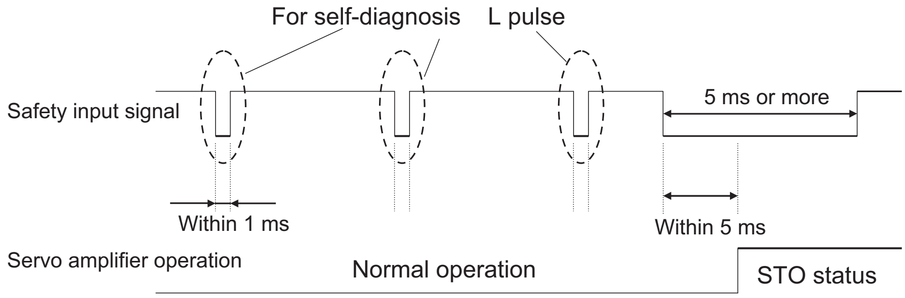
Signal name	Symbol	Pin number	Description	CONTROL mode			
				Position	Speed	Torque	Full closing
Safety input 1	SF+	CN8-4	• The upper arm drive signal of the power transistor inside the Servo Drive is cut off.	√	√	√	√
	SF–	CN8-3		√	√	√	√
Safety input 2	SF2+	CN8-6	• The lower arm drive signal of the power transistor inside the Servo Drive is cut off.	√	√	√	√
	SF2–	CN8-5		√	√	√	√

- When the safety input is either 1 or 2, the STO function starts operating within 5 ms of the input, and the motor output torque will be reduced to 0.
- Connect the equipment so that the safety input circuit is turned OFF when you operate the STO function.
- Use Stop Selection for Alarm Detection (Pn510) to set the operation when the safety input is turned OFF.

Precautions for Correct Use

- L-pulse for self-diagnosis of safety equipment

  When you are connecting a safety equipment, such as a Safety Controller or a safety sensor, the safety output signal of the equipment may include L pulse for self-diagnosis. To avoid malfunction due to this L-pulse for self-diagnosis, a filter that can remove the L pulse for self-diagnosis is built in with the safety input circuit. If the OFF time of the safety input signal is 1 ms or less, the safety input circuit does not recognize it as OFF. To make sure that OFF is recognized, maintain the OFF status of safety input signal for at least 5 ms.



External Device Monitor (EDM) Output Signal

This is a monitor output signal that is used to monitor the status of safety input signals using an external device.
Connect a safety equipment, such as a safety controller or a safety sensor, to the external device monitoring terminal.

Signal name	Symbol	Pin number	Description	CONTROL mode			
				Position	Speed	Torque	Full closing
EDM output	EDM+	CN8-8	• Monitor signal is output to detect malfunctioning of the safety function. * This output signal is not a safety output.	√	√	√	√
	EDM–	CN8-7		√	√	√	√

Relationship Between Safety Input Signal and EDM Output Signal

Normally when both of the Safety inputs 1 and 2 are off, i.e., when the STO function works for both safety input circuits, the EDM output is on.
You can detect a failure of the safety input circuit and the EDM output circuit by monitoring all of the following 4 signal statuses using an external device.
These are the two cases of errors:

- Both of the Safety inputs 1 and 2 are off. But the EDM output circuit signal does not become on.
- Either or both the Safety inputs 1 or/and 2 are on. But the EDM output circuit signal is on.

Signal name	Symbol	Signal status			
Safety input 1	SF1	ON	ON	OFF	OFF
Safety input 2	SF2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

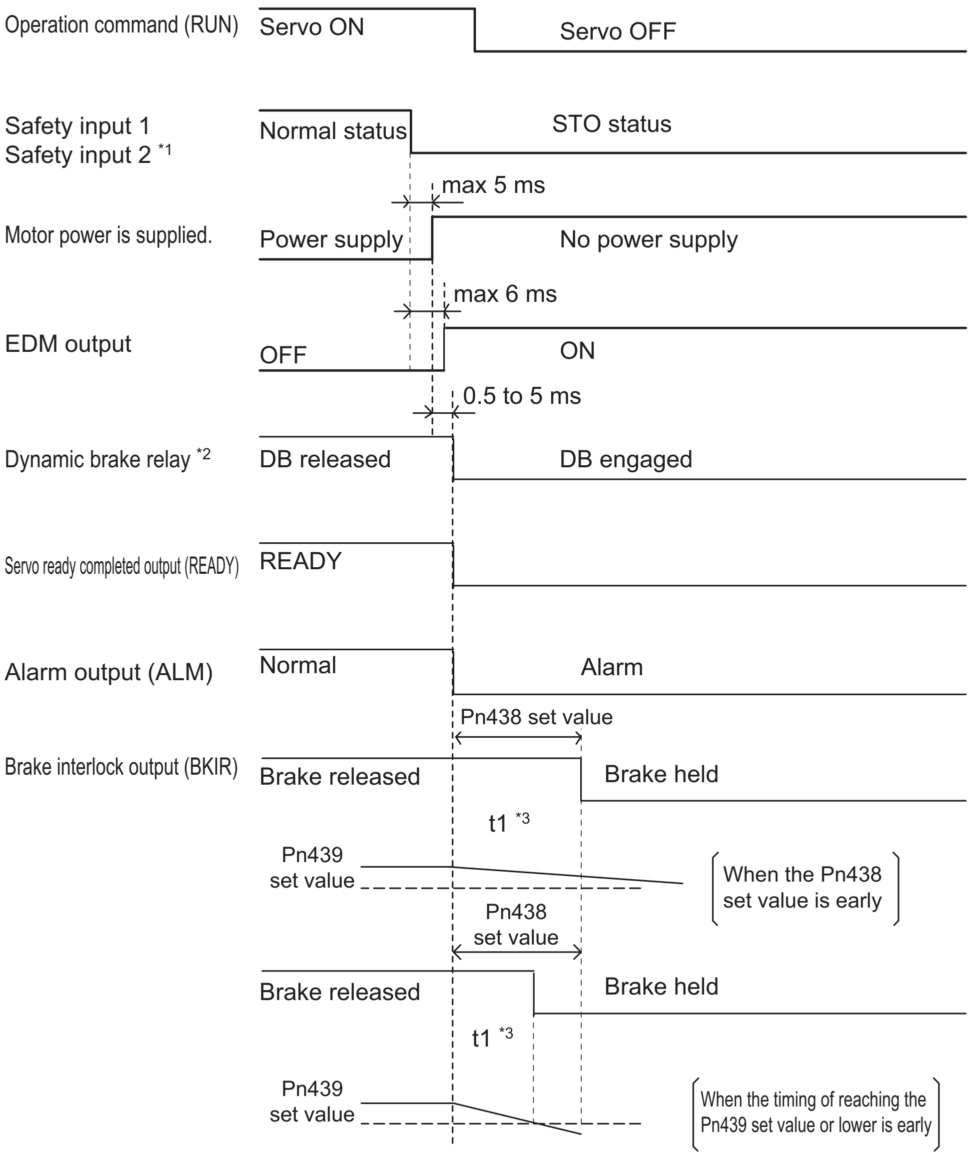
- The maximum delay time is 6 ms after the safety input signal is input and until the EDM output signal is output.

7

Safety Function

7-2 Operation Example

Operation Timings to a Safety Status

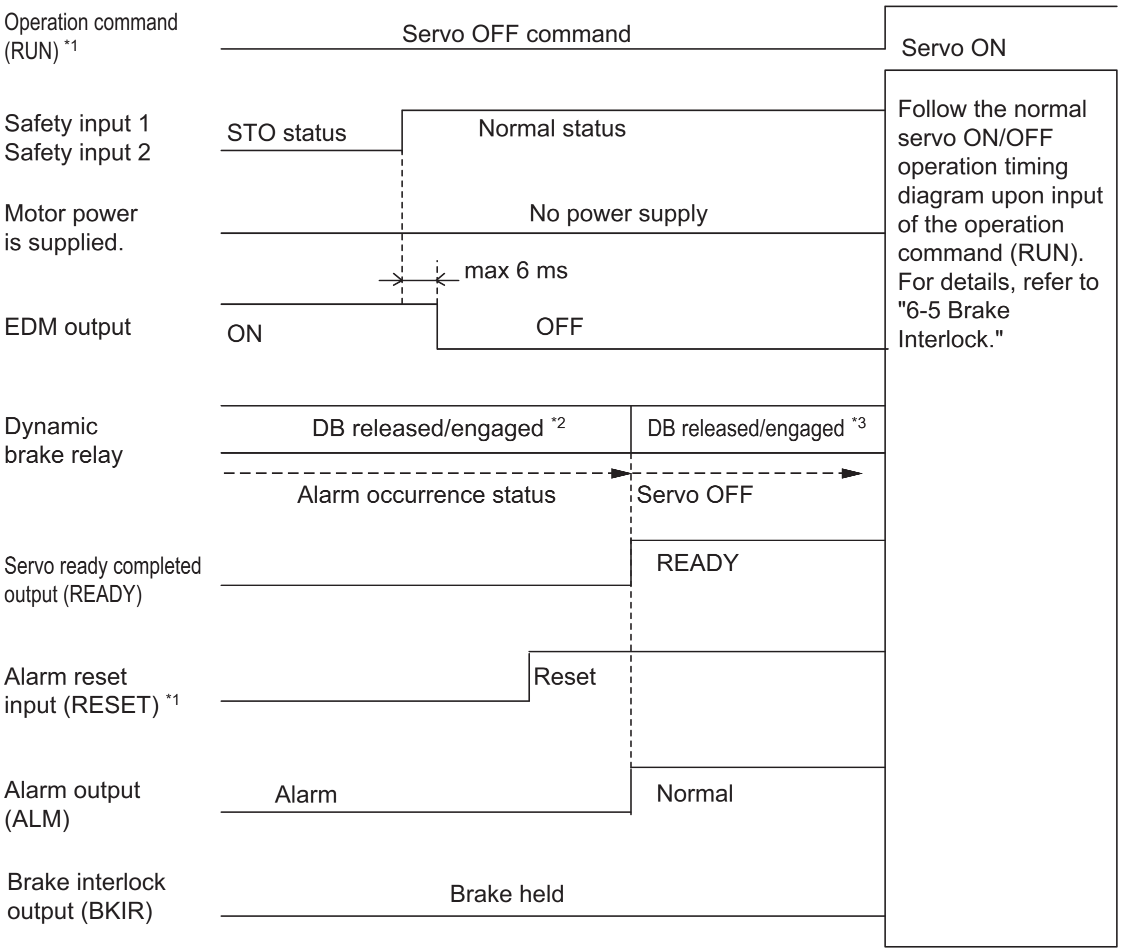


*1. Safety inputs 1 and 2 transition to the STO status when either one of them is turned OFF.

*2. The dynamic brake is based on the Stop Selection for Alarm Detection (Pn510) setting.

*3. t1 is the set value of the Brake Timing during Operation (Pn438), or the time needed for the motor rotation speed to drop to or below the Brake Release Speed Setting (Pn439), whichever occurs first.

Timings of Return from the Safety Status



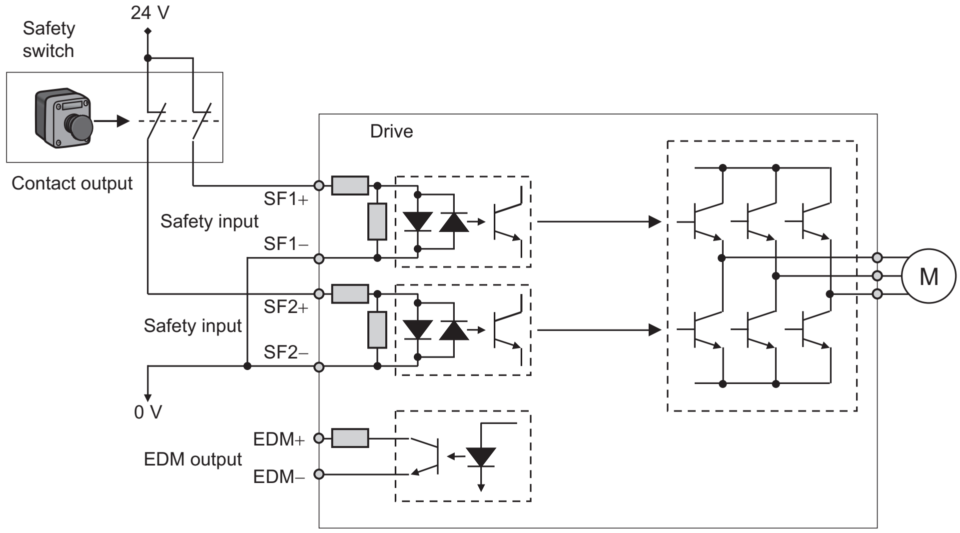
*1. Make sure that servo ON input is turned OFF when you return the input signals of safety inputs 1 and 2 to ON. Alarm clear must be performed because alarms occurs. Be sure to execute the alarm clear when both safety inputs 1 and 2 are returned to the ON status. An alarm occurs immediately if the alarm reset is executed when even one of these is still in the OFF status. Depending on the timing, another error (Alarm No. 99.0) may occur. If another error occurs, you must turn OFF the power supply, then turn it ON again.

*2. Since this is a status where alarms occurs, the dynamic brake is based on the Stop Selection for Alarm Detection (Pn510).

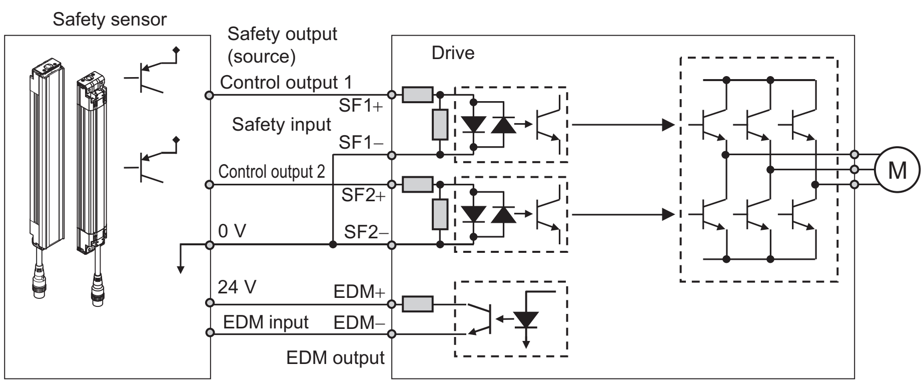
*3. Since this is a normal servo OFF status, the dynamic brake is based on the Stop Selection with Servo OFF (Pn506) setting.

7-3 Connection Examples

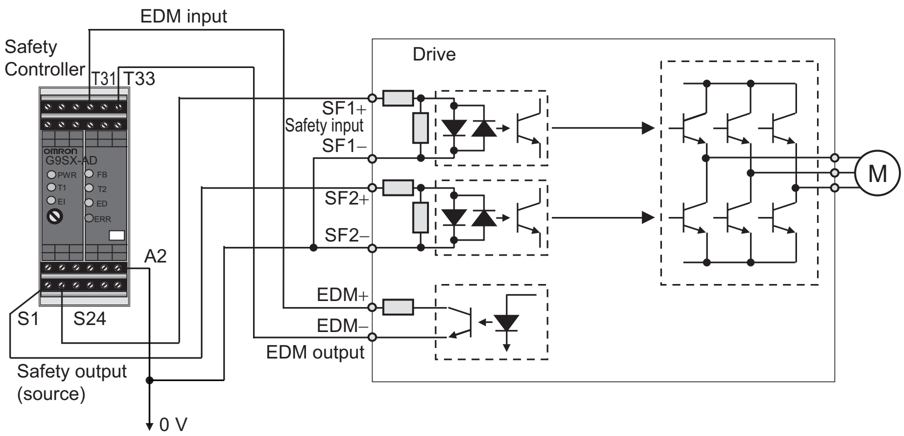
Connection Example 1: Connection with a Safety Switch



Connection Example 2: Connection with a Safety Sensor



Connection Example 3: Connection with a Safety Controller



8

Parameters Details

This chapter explains the set value and contents of setting of each parameter.

8-1 Basic Parameters

- Some parameters are enabled when the power is turned ON after it is turned OFF. They are indicated in the table below. Ensure you turn off the power, confirm that the power indicator goes off, and turn on the power again, after you change the settings of these parameters.
- Do not change the parameters that are indicated as Reserved for manufacturer use, or Reserved for the system. Also, do not change the set values that are indicted as Unused or Reserved for the system.
- See below for the data attributes.

A : Always enabled

B : Prohibited to change during motor rotation or commanding.
If it is changed during motor rotation or commanding, the reflection timing is unknown.

C : Enabled after a power reset, or after the CONFIG command is executed via MECHATROLINK-II communications.

R : Enabled after a power reset.
It is not enabled by the CONFIG command via MECHATROLINK-II communications.

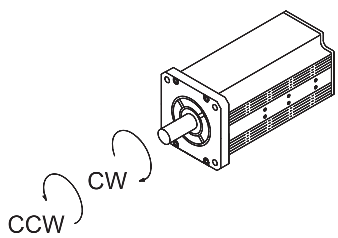
Pn000	Rotation Direction Switching						All
Setting range	0 to 1	Unit	–	Default setting	1	Data attribute	C

- It switches the motor rotation direction for a position, speed or torque command.

Explanation of Set Values

Set value	Description
0	A forward direction command sets the motor rotation direction to CW.
1	A forward direction command sets the motor rotation direction to CCW.

- Regarding the motor rotation direction, when seen from load-side axis, clockwise is referred to as CW and counterclockwise as CCW.



Pn001	CONTROL mode Selection						All
Setting range	0 to 6	Unit	–	Default setting	0	Data attribute	R

- Set the CONTROL mode to be used.

Explanation of Set Values

Set value	Description
0 to 5	Switch control
6	Full closing control

Pn002	REALTIME AUTOTUNING mode Selection						All
Setting range	0 to 6	Unit	–	Default setting	1	Data attribute	B

- Set the OPERATING mode for realtime autotuning.
- Refer to "10-3 Realtime Autotuning (P.10-6)".

Explanation of Set Values

Set value	Description
0	Disabled
1	This mode focuses on stability.
2	This mode focuses on positioning. It is used for a horizontal axis, for example, which has only a small friction without any load unbalance, such as for a ball screw drive. In the speed control or the torque control, it is same as the set value 1 which focuses on stability.
3	This mode focuses on positioning. It is used for a vertical axis which has unbalanced load. In the torque control, it is same as the set value 1 which focuses on stability.
4	Used when friction is large. It shortens the positioning stabilization time when the friction is large, such as for a belt drive. In the speed control, it is same as the set value 3. In the torque control, it is same as the set value 1.
5	It is used for a vertical axis which has a large friction and unbalanced load.
6	It is used for customizing the realtime autotuning function by the REALTIME AUTOTUNING CUSTOMIZATION mode Setting (Pn632).

Pn003	Realtime Autotuning Machine Rigidity Setting						All
Setting range	0 to 31	Unit	–	Default setting	13 *1	Data attribute	B

*1.It is 11 for a Drive with 200 V and 1 kW or greater, or for a Drive with 400 V.

- Set the machine rigidity to one of 32 levels when realtime autotuning is enabled.
- The higher the machine rigidity set value is, the higher the responsiveness is. However, the more vibration occurs.

Low ←Machine rigidity→ High

Low ←Servo gain→ High

Pn003	0.1 - - - - - - - - - - - - - - - - 31

Low ←Responsiveness→ High

- Refer to "10-3 Realtime Autotuning (P.10-6)".

Precautions for Correct Use

- If the set value is changed suddenly by a large amount, the gain may change rapidly, subjecting the machine to shock. Always start with the small setting, and gradually increase the setting while monitoring machine operation.

Pn004	Inertia Ratio						All
Setting range	0 to 10,000	Unit	%	Default setting	250	Data attribute	B

- Set the load inertia as a percentage of the motor rotor inertia.
- Pn004 = (Load inertia / Rotor inertia) × 100%
- When realtime autotuning is enabled, the inertia ratio is continuously estimated and saved in EEPROM every 30 minutes.
- If the inertia ratio is set correctly, the setting unit for the Speed Loop Gain 1 (Pn101) and Speed Loop Gain 2 (Pn106) is Hz.
- If the Inertia Ratio (Pn004) is set larger than the actual value, the setting for speed loop gain increases. If the Inertia Ratio (Pn004) is set smaller than the actual value, the setting for speed loop gain decreases.

Pn005	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn006	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn007	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

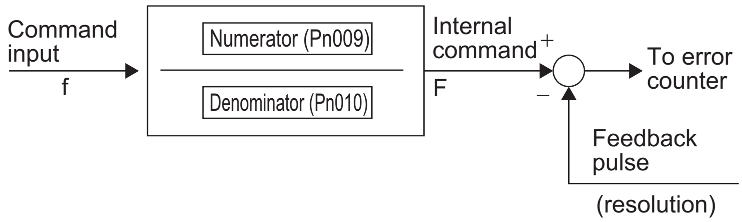
Pn008	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn009	Electronic Gear Ratio Numerator					Position / Full closing	
Setting range	0 to 1073741824	Unit	–	Default setting	1	Data attribute	C

Pn010	Electronic Gear Ratio Denominator					Position / Full closing	
Setting range	1 to 1073741824	Unit	–	Default setting	1	Data attribute	C

- Set the electronic gear function.
- The electronic gear can be used for the following:
  - To set any value for the motor rotation and travel distance per input command.
- Refer to "6-6 Electronic Gear Function (P.6-19)".

- Electronic Gear Block Diagram:



- The electronic gear ratio is set using the following equations.
  If the Numerator = 0, the Numerator is automatically set to the encoder resolution. The number of command input per rotation can be set by the Pn010.

$$\text{Electronic gear ratio} = \frac{\text{Encoder resolution}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$$

If Numerator $\neq$ 0:

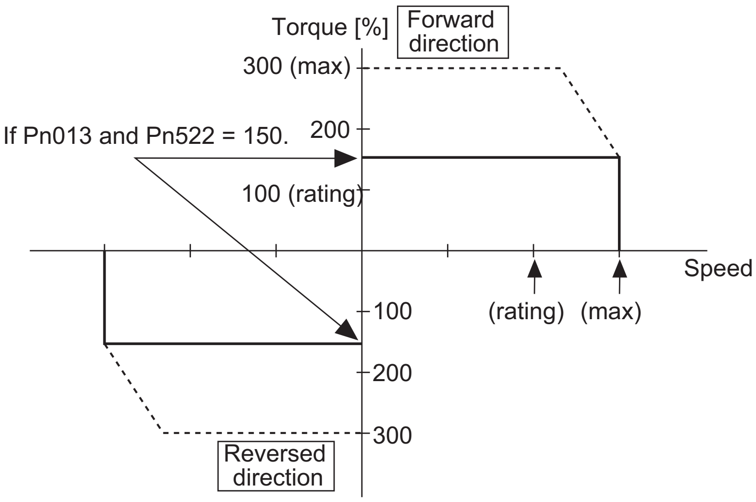
$$\text{Electronic gear ratio} = \frac{\text{Electronic Gear Ratio Numerator (Pn009)}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$$

Pn011	Unused					All	
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn012	Unused					All	
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn013	No. 1 Torque Limit					All	
Setting range	0 to 500	Unit	%	Default setting	500	Data attribute	B

- Set the limit values for the motor output torques (Pn013: No.1, Pn522: No.2).
- Refer to the Torque Limit Selection (Pn521) for the torque limit selection.
- During torque control, it limits the maximum torque in forward and reverse directions. The settings on the Torque Limit Selection (Pn521) and the No.2 Torque Limit (Pn522) are ignored.
- Set the value in units of 1% of the rated torque (100%).
  E.g. When the maximum torque is limited to 150%.



- Refer to "6-7 Torque Limit Switching (P.6-22)" for the torque control and the torque limit selection.

Pn014	Error Counter Overflow Level					Position Full closing	
Setting range	0 to 134217728	Unit	Command unit	Default setting	100000	Data attribute	A

- Set the range of the error counter overflow level.
- When the set value is 0, the detective function by the Error counter overflow (Alarm No.24) is disabled.
- The unit used must conform to the setting by the Position Setting Unit Selection (Pn520).

Pn015	Operation Switch when Using Absolute Encoder					Position Full closing	
Setting range	0 to 2	Unit	–	Default setting	1	Data attribute	C

- Set the operating method for the 17-bit absolute encoder.

Explanation of Set Values

Set value	Description
0	Use as absolute encoder.
1	Use as incremental encoder.
2	Use as absolute encoder but ignore multi-rotation counter overflow.

Pn016	Regeneration Resistor Selection						All
Setting range	0 to 3	Unit	–	Default setting	3*1	Data attribute	C

*1 It is 0 for a Drive with 100 V and 400 W, with 200 V and 750 W or greater, or with 400 V.

- The setting is different whether the Regeneration Resistor built in the Drive is directly used, or it is removed and replaced by an external regeneration resistor. In the latter case, the Resistor is connected to the external regeneration resistor connection terminal.

Explanation of Set Values

Set value	Description
0	Regeneration Resistor used: Built-in Resistor The regeneration processing circuit operates and the regeneration overload (Alarm No.18) is enabled according to the Built-in Resistor (with approx. 1% duty).
1	Regeneration Resistor used: External Resistor The regeneration processing circuit operates, and regeneration overload (Alarm No.18) causes a trip when the operating rate of the Regeneration Resistor exceeds 10%.
2	Regeneration Resistor used: External Resistor The regeneration processing circuit operates, but regeneration overload (Alarm No.18) does not occur.
3	Regeneration Resistor used: None The regeneration processing circuit and regeneration overload (Alarm No.18) do not operate, and all regenerative energy is processed by the built-in capacitor.

Precautions for Correct Use

- Do not touch the External Regeneration Resistor. A burn injury may result.
- Always provide a temperature fuse or other protective measure when using an External Regeneration Resistor. Regardless of whether the regeneration overload is enabled or disabled, the Regeneration Resistor can generate heat and may cause burning.
- To use the Built-in Regeneration Resistor, always set this parameter to 0.

Pn017	External Regeneration Resistor Setting						All
Setting range	0 to 4	Unit	–	Default setting	0	Data attribute	C

- Select the method to calculate the regeneration resistance load ratio, when the External Resistor is selected on the Regeneration Resistor Selection (Pn016 = 1 or 2).

Explanation of Set Values

Set value	Description
0	Regeneration load ratio is 100% when operating rate of the External Regeneration Resistor is 10%.
1	Reserved
2	Reserved
3	Reserved
4	Reserved

8-2 Gain Parameters

Refer to "10-2 Gain Adjustment (P.10-4)" for the settings for gain adjustment.

Pn100	Position Loop Gain 1					Position Full closing	
Setting range	0 to 30000	Unit	0.1/s	Default setting	480*1	Data attribute	B

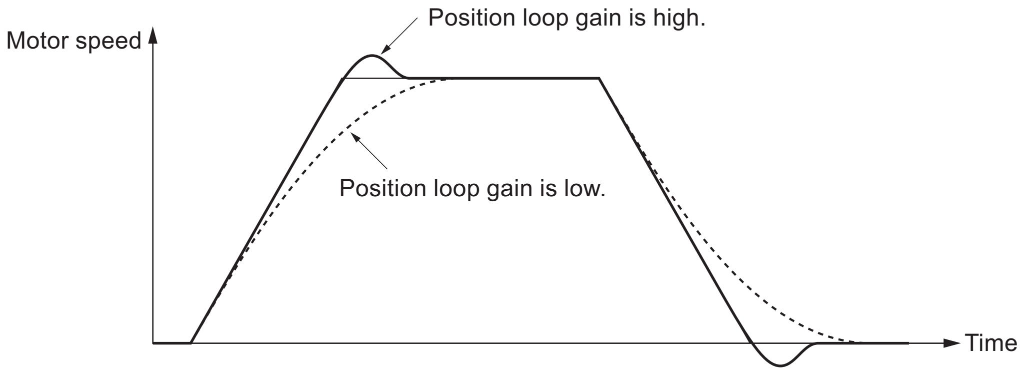
*1.It is 320 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the position loop response in accordance with the machine rigidity.
- The responsiveness of the servo system is determined by the position loop gain.
- Servo systems with a high position loop gain have a high responsiveness and fast positioning.
- To increase the position loop gain, you must improve machine rigidity and increase the specific damping frequency. This should be 500 to 700 (0.1/s) for ordinary machine tools, 300 to 500 (0.1/s) for general-use and assembly machines, and 100 to 300 (0.1/s) for industrial robots. The default position loop gain is 480 (0.1/s), so be sure to lower the set value for machines with low machine rigidity.
- Increasing the position loop gain in systems with low machine rigidity or systems with low specific damping frequencies may cause machine resonance, resulting in an overload alarm.
- If the position loop gain is low, you can shorten the positioning time using feed forward.
- This parameter is automatically changed by executing realtime autotuning function. To set it manually, set the REALTIME AUTOTUNING mode Selection (Pn002) to 0.

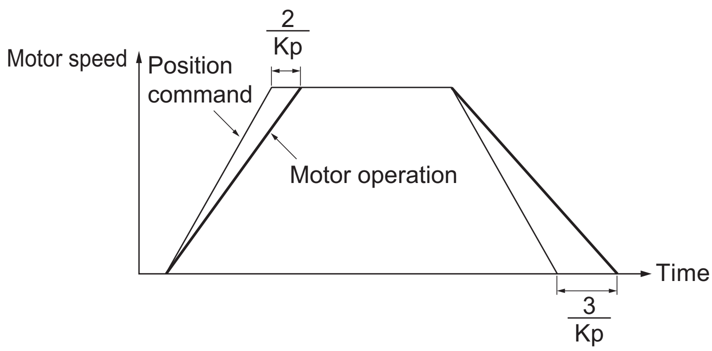
Position loop gain is generally expressed as follows:

$$\text{Position loop gain (Kp)} = \frac{\text{Command pulse frequency (pulse/s)}}{\text{Error counter accumulated pulse (pulse)}} \quad (0.1/\text{s})$$

Response when the position loop gain is operated



- If the speed loop gain and position loop gain are optimally set, the motor operation for the command delays 2/Kp at acceleration and delays 3/Kp at deceleration.

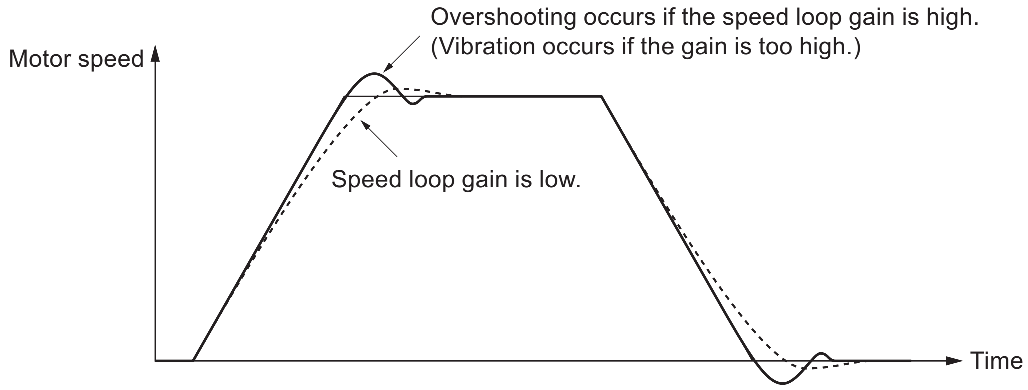


Pn101	Speed Loop Gain 1						All
Setting range	1 to 32767	Unit	0.1 Hz	Default setting	270*1	Data attribute	B

*1.It is 180 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Determine speed loop responsiveness.
- The setting for the speed loop gain must be increased to increase the position loop gain and improve the responsiveness of the entire servo system. Setting too high, however, may result in vibration.
- The setting unit for Pn101 is Hz if the Inertia Ratio (Pn004) is set correctly.

When the speed loop gain is changed, the response is as shown in the following diagram.

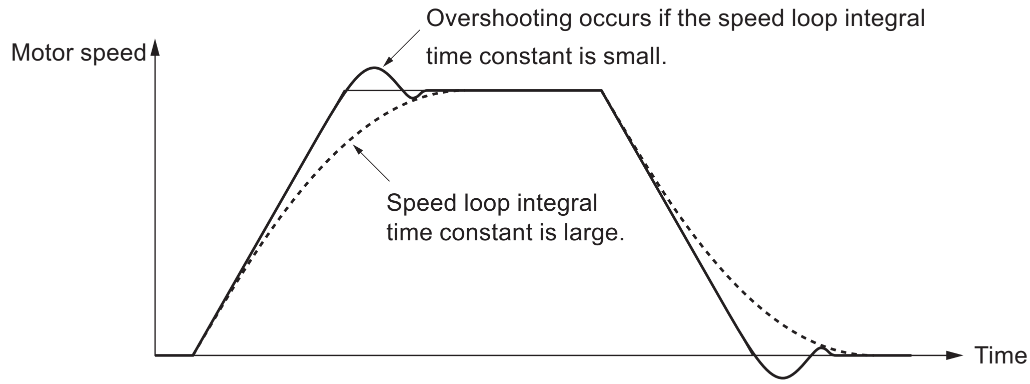


Pn102	Speed Loop Integral Time Constant 1						All
Setting range	1 to 10000	Unit	0.1 ms	Default setting	210*1	Data attribute	B

*1.It is 310 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the speed loop integration time constant.
- The smaller the set value, the faster the error comes close to 0 when stopping. Set to 9,999 to maintain integration. Set to 10,000 to invalidate the effect of integration.

When the speed loop integral time constant is changed, the response is as shown in the following diagram.



Pn103	Speed Feedback Filter Time Constant 1						All
Setting range	0 to 5	Unit	–	Default setting	0	Data attribute	B

- Set the time constant for the low pass filter (LPF) after speed detection to one of 6 levels (0 to 5).
- Increasing the set value increases the time constant and decreases the noise generated by the motor. Responsiveness, however, also decreases.
- Normally, use the default set value.

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Pn104	Torque Command Filter Time Constant 1						All
Setting range	0 to 2500	Unit	0.01 ms	Default setting	84*1	Data attribute	B

*1.It is 126 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the time constant for the first-order lag filter inserted into the torque command.
- This parameter may be effective in suppressing vibration due to torsion resonance.

Pn105	Position Loop Gain 2						Position Full closing
Setting range	0 to 30000	Unit	0.1/s	Default setting	570*1	Data attribute	B

*1.It is 380 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the responsiveness of the position control system for the second position loop.

Pn106	Speed Loop Gain 2						All
Setting range	1 to 32767	Unit	0.1 Hz	Default setting	270*1	Data attribute	B

*1.It is 180 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the responsiveness of the second speed loop.

Pn107	Speed Loop Integration Time Constant 2						All
Setting range	1 to 10000	Unit	0.1 ms	Default setting	10000	Data attribute	B

- Set the second speed loop integration time constant.

Pn108	Speed Feedback Filter Time Constant 2						All
Setting range	0 to 5	Unit	–	Default setting	0	Data attribute	B

- Set the second speed feedback filter.

Pn109	Torque Command Filter Time Constant 2						All
Setting range	0 to 2500	Unit	0.01 ms	Default setting	84*1	Data attribute	B

*1.It is 126 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the second torque filter time constant.
- The parameters from Pn105 to Pn109 are the gain and time constants to be selected when the GAIN SWITCHING INPUT OPERATING mode Selection (Pn114) is enabled.
- The gain switching condition is switched according to the condition set in the SWITCHING mode (Pn115, Pn120 and Pn124).
- If the mechanical system inertia changes greatly or if you want to change the responsiveness depending on whether the motor is rotating or being stopped, you can achieve the appropriate control by setting the gains and time constants beforehand for each of these conditions, and switching them according to the condition.
- This parameter is automatically changed by executing realtime autotuning function. To set it manually, set the REALTIME AUTOTUNING mode Selection (Pn002) to 0.

Pn110	Speed Feed-forward Amount					Position / Full closing	
Setting range	0 to 1000	Unit	0.1%	Default setting	300	Data attribute	B

- Set the feed-forward amount.
- Increasing the set value decreases the position error and increases the responsiveness. Overshooting, however, will occur more easily.
- Refer to "10-11 Feed-forward Function (P.10-36)".

Pn111	Speed Feed-forward Command Filter					Position / Full closing	
Setting range	0 to 6400	Unit	0.01 ms	Default setting	50	Data attribute	B

- Set the time constant for the first-order lag filter inserted into the feed forward.
- Setting the filter may improve operation if speed overshooting occurs or the noise during operation is large when the feed forward is set high.
- Refer to "10-11 Feed-forward Function (P.10-36)".

Pn112	Torque Feed-forward Amount					Position / Speed / Full closing	
Setting range	0 to 1000	Unit	0.1%	Default setting	0	Data attribute	B

- Set the feed-forward amount in torque control. Increasing the set value decreases the position error and increases the responsiveness. Overshooting, however, will occur more easily.
- Refer to "10-11 Feed-forward Function (P.10-36)".

Pn113	Torque Feed-forward Command Filter					Position / Speed / Full closing	
Setting range	0 to 6400	Unit	0.01 ms	Default setting	0	Data attribute	B

- Set the time constant for the first-order lag filter inserted into the feed forward.
- Setting the filter may improve operation if speed overshooting occurs or the noise during operation is large when the feed forward is set high.
- Refer to "10-11 Feed-forward Function (P.10-36)".

Pn114	GAIN SWITCHING INPUT OPERATING mode Selection					All	
Setting range	0 to 1	Unit	–	Default setting	1	Data attribute	B

- Select either PI/P operation switching or gain 1/gain 2 switching.
- The PI/P operation switching is the switching made by the speed loop PI/P control command in MECHATROLINK-II communications.
- Refer to "6-9 Gain Switching Function (P.6-26)" for the Gain 1/Gain 2 switching.

Explanation of Set Values

Set value	Description
0	Gain 1 (PI/P switching enabled)
1	Gain 1/gain 2 switching available

Pn115	SWITCHING mode in Position Control					Position / Full closing	
Setting range	0 to 10	Unit	–	Default setting	0	Data attribute	B

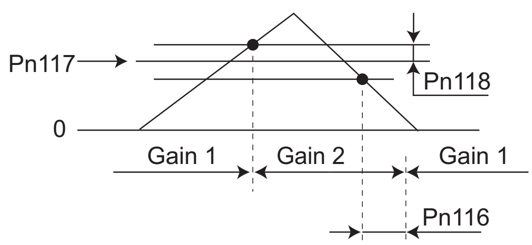
- Select the conditions for switching between gain 1 and gain 2 when the GAIN SWITCHING INPUT OPERATING mode Selection (Pn114) is set to 1.
- The gain is always gain 1 regardless of the gain input if the SWITCHING mode in Position Control (Pn115) is 2 and the Torque Limit Selection (Pn521) is 3 or 6.

Explanation of Settings

Pn115 set value	Description			
	Gain switching conditions	Gain switching delay time in position control (Pn116) *1	Gain switching level in position control (Pn117)	Gain switching hysteresis in position control (Pn118) *2
0	Always Gain 1 (Pn100 to Pn104).	Disabled	Disabled	Disabled
1	Always Gain 2 (Pn105 to Pn109).	Disabled	Disabled	Disabled
2	Gain switching command input via MECHATROLINK-II communications *3	Disabled	Disabled	Disabled
3	Torque command variation (Refer to Figure A)	Enabled	Enabled *4 (× 0.05%)	Enabled *4 (× 0.05%)
4	Always Gain 1 (Pn100 to 104).	Disabled	Disabled	Disabled
5	Command speed (Refer to Figure B)	Enabled	Enabled (r/min)	Enabled(r/min)
6	Amount of position error (Refer to Figure C).	Enabled	Enabled *5 (pulse)	Enabled *5 (pulse)
7	When the position command is entered (Refer to Figure D).	Enabled	Disabled	Disabled
8	When the positioning complete signal (INP) is OFF (Refer to Figure E).	Enabled	Disabled	Disabled
9	Actual motor speed (Refer to Figure B).	Enabled	Enabled (r/min)	Enabled (r/min)
10	Combination of position command input and rotation speed (Refer to Figure F).	Enabled	Enabled *6 (r/min)	Enabled *6 (r/min)

*1. The Gain Switching Delay Time in Position Control (Pn116) becomes effective when the gain is switched from 2 to 1.

*2. The Gain Switching Hysteresis in Position Control (Pn118) is defined in the drawing below.

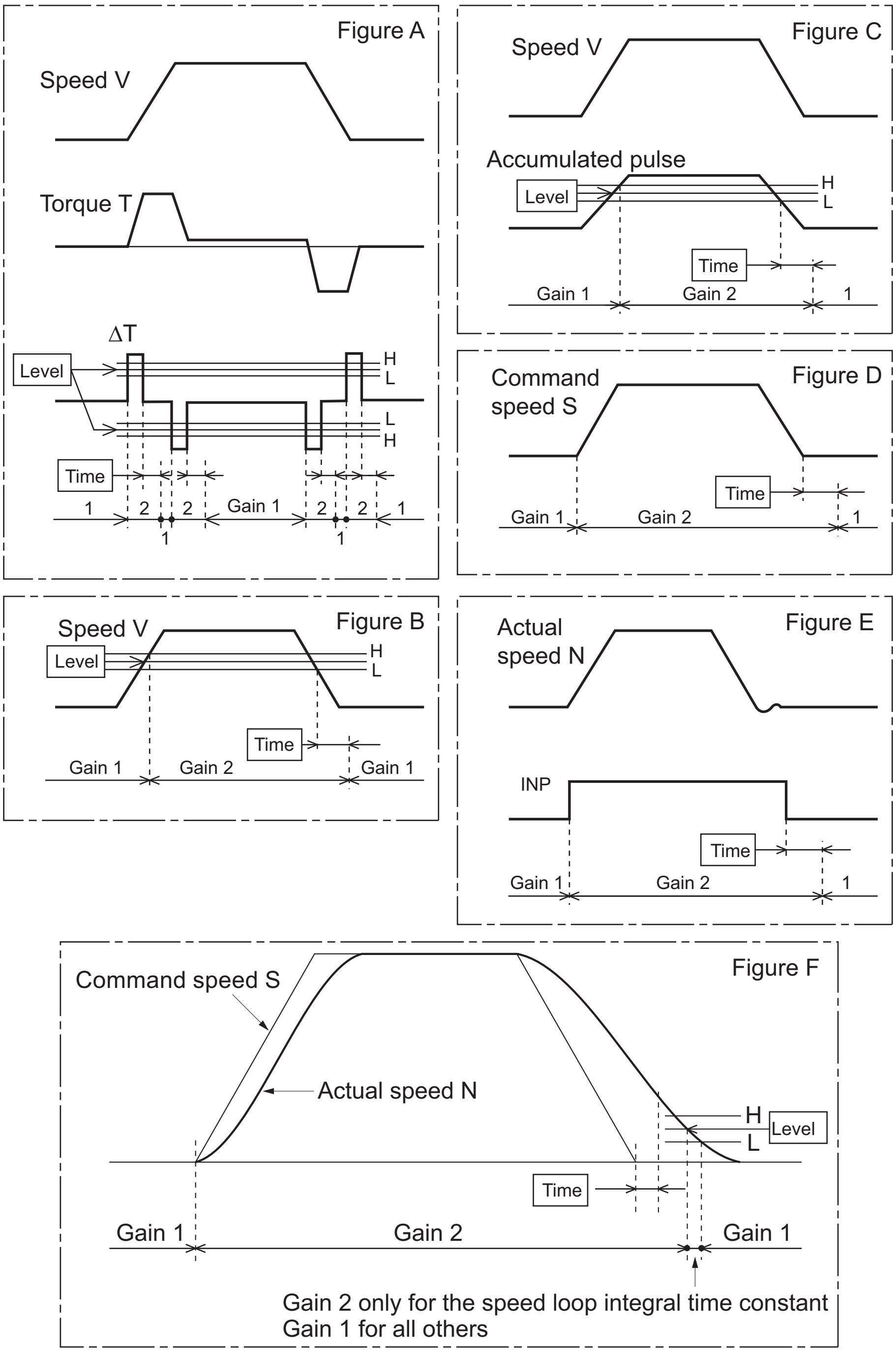


*3. When the Gain switching command of MECHATROLINK-II communications is 0, the gain switches to 1. When the command is 1, the gain switches to 2.

*4. The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.

*5. The unit (pulse) of hysteresis is the resolution of the encoder in position control. It is the resolution of the external encoder in full closing control.

*6. When the set value is 10, meanings of the Gain switching delay time in position control, the Gain switching level in position control, and the Gain switching hysteresis in position control differ from the normal case. (Refer to Figure F).



Pn116	Gain Switching Delay Time in Position Control				Position Full closing		
Setting range	0 to 10000	Unit	0.1 ms	Default setting	50	Data attribute	B

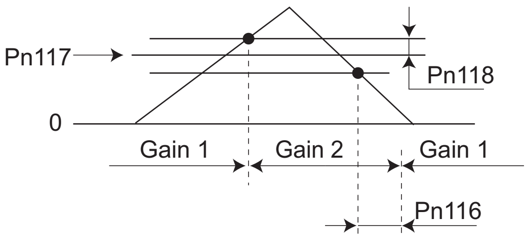
- Set the delay time when returning from gain 2 to gain 1 if the SWITCHING mode in Position Control (Pn115) is set to 3 or 5 to 10.

Pn117	Gain Switching Level in Position Control					Position / Full closing	
Setting range	0 to 20000	Unit	–	Default setting	50	Data attribute	B

- This is enabled when the SWITCHING mode in Position Control (Pn115) is 3, 5, 6, 9 or 10. It sets the judgment level for switching between gain 1 and gain 2.
- The unit depends on the SWITCHING mode in Position Control (Pn115).

Pn118	Gain Switching Hysteresis in Position Control					Position / Full closing	
Setting range	0 to 20000	Unit	–	Default setting	33	Data attribute	B

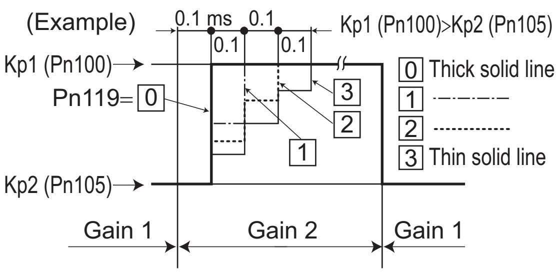
- Set the hysteresis width above and below the judgment level set in the Gain Switching Level in Position Control (Pn117).
- The unit depends on the setting of the SWITCHING mode in Position Control (Pn115).
- The following shows the definitions for the Gain Switching Delay Time in Position Control (Pn116), Gain Switching Level in Position Control (Pn117), and Gain Switching Hysteresis in Position Control (Pn118).



- The settings for the Gain Switching Level in Position Control (Pn117) and the Gain Switching Hysteresis in Position Control (Pn118) are enabled as absolute values (positive/negative).

Pn119	Position Gain Switching Time					Position / Full closing	
Setting range	0 to 10000	Unit	0.1 ms	Default setting	33	Data attribute	B

- When the position loop gain increases, the gain changes in the set time.
- When switching between gain 1 and gain 2 is enabled, set the gradual switching time only for position loop gain at gain switching.
- It inhibits the sudden increase of position loop gain, if the Position Loop Gain 1 (Pn100) and the Position Loop Gain 2 (Pn105) differs greatly during position control.



Pn120	SWITCHING mode in Speed Control						Speed
Setting range	0 to 5	Unit	–	Default setting	0	Data attribute	B

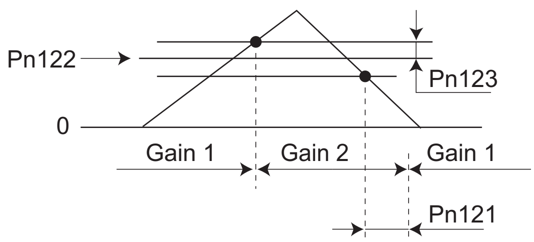
- Select the conditions for switching between gain 1 and gain 2 when the GAIN SWITCHING INPUT OPERATING mode Selection (Pn114) is set to 1.
- The gain is always gain 1 regardless of the gain input if the SWITCHING mode in Speed Control (Pn120) is 2 and the Torque Limit Selection (Pn521) is 3 or 6.

Explanation of Settings

Pn120 set value	Description			
	Gain switching conditions	Gain switching delay time in speed control (Pn121) *1	Gain switching level in speed control (Pn122)	Gain switching hysteresis in speed control (Pn123) *2
0	Always the Gain 1 (Pn100 to Pn104).	Disabled	Disabled	Disabled
1	Always the Gain 2 (Pn105 to Pn109).	Disabled	Disabled	Disabled
2	Gain switching command input via MECHATROLINK-II communications *3	Disabled	Disabled	Disabled
3	Torque command variation (Refer to Figure A)	Enabled	Enabled *3 (0.05%)	Enabled *3 (0.05%)
4	Speed command variation (Refer to Figure B)	Enabled	Enabled *4 (10 r/min/s)	Enabled *4 (10 r/min/s)
5	Speed command (Refer to Figure C)	Enabled	Enabled (r/min)	Enabled (r/min)

*1. The Gain switching delay time in speed control (Pn121) becomes effective when the gain is switched from 2 to 1.

*2. The Gain switching hysteresis in speed control (Pn123) is defined in the drawing below.



*3. When the Gain switching command of MECHATROLINK-II communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4. The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.

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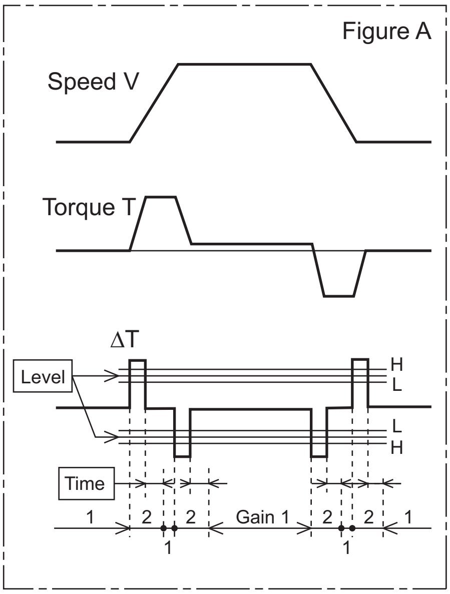
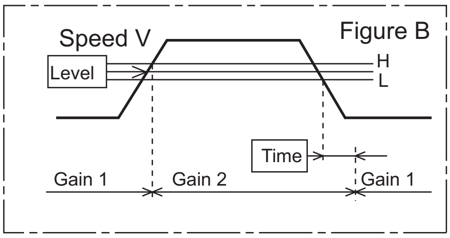
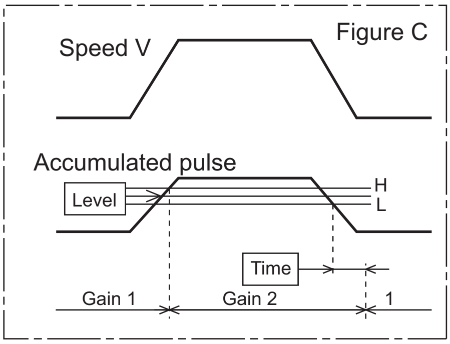
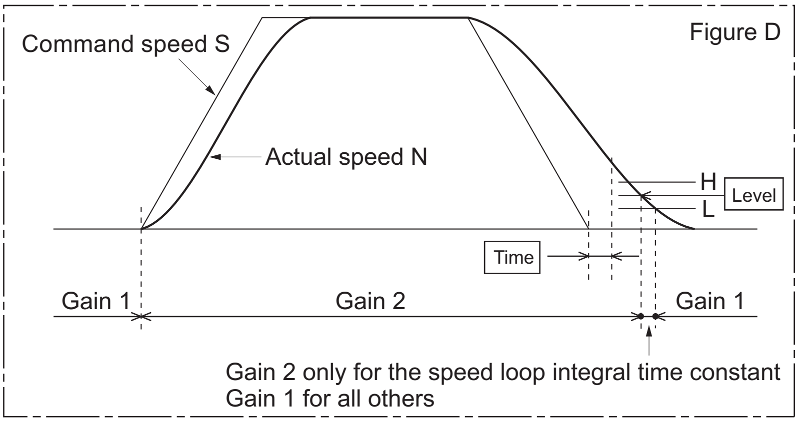
*5. When the set value is 10, meanings of the Gain switching delay time in speed control (Pn121), the Gain switching level in speed control (Pn122), and the Gain switching hysteresis in speed control (Pn123) differ from the normal case. (Refer to Figure D).









Pn121	Gain Switching Delay Time in Speed Control						Speed
Setting range	0 to 10000	Unit	0.1 ms	Default setting	0	Data attribute	B

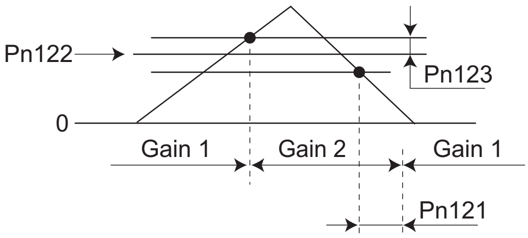
- Set the delay time when returning from gain 2 to gain 1 if the SWITCHING mode in Speed Control (Pn120) is set to 3 to 5.

Pn122	Gain Switching Level in Speed Control						Speed
Setting range	0 to 20000	Unit	–	Default setting	0	Data attribute	B

- In SPEED CONTROL mode, this is enabled when the SWITCHING mode in Speed Control (Pn120) is set to 3 to 5. Set the judgment level for switching between gain 1 and gain 2.
- The unit depends on the SWITCHING mode in Speed Control (Pn120).

Pn123	Gain Switching Hysteresis in Speed Control						Speed
Setting range	0 to 20000	Unit	–	Default setting	0	Data attribute	B

- Set the hysteresis width above and below the judgment level set in the Gain Switching Level in Speed Control (Pn122).
- The unit depends on the setting of the SWITCHING mode in Speed Control (Pn120).
- The following shows the definitions for the Gain Switching Delay Time in Speed Control (Pn121), Gain Switching Level in Speed Control (Pn122), and Gain Switching Hysteresis in Speed Control (Pn123).



- The settings for the Gain Switching Level in Speed Control (Pn122) and the Gain Switching Hysteresis in Speed Control (Pn123) are enabled absolute values (positive/negative).

Pn124	SWITCHING mode in Torque Control						Torque
Setting range	0 to 3	Unit	–	Default setting	0	Data attribute	B

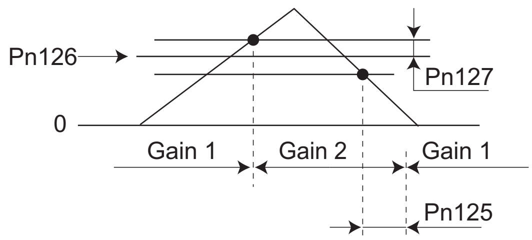
- Select the switching condition between gain 1 and gain 2 when the GAIN SWITCHING INPUT OPERATING mode Selection (Pn114) is set to 1.
- The gain is always gain 1 regardless of the gain input if the SWITCHING mode in Torque Control (Pn124) is 2 and the Torque Limit Selection (Pn521) is 3 or 6.

Explanation of Settings

Pn124 set value	Description			
	Gain switching conditions	**Gain switching delay time in torque control (Pn125) *1**	**Gain switching level in torque control (Pn126)**	**Gain switching hysteresis in torque control (Pn127) *2**
0	Always Gain 1 (Pn100 to Pn104).	Disabled	Disabled	Disabled
1	Always Gain 2 (Pn105 to Pn109).	Disabled	Disabled	Disabled
2	Gain switching command input via MECHATROLINK-II communications *3	Disabled	Disabled	Disabled
3	Torque command variation (Refer to Figure A)	Enabled	Enabled *4 (0.05%)	Enabled *4 (0.05%)

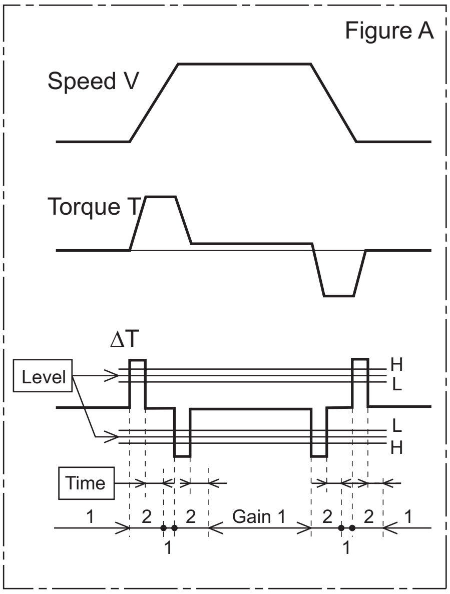
*1. The Gain Switching Delay Time in Toque Control (Pn125) becomes effective when the gain is switched from 2 to 1.

*2. The Gain Switching Hysteresis in Torque Control (Pn127) is defined in the drawing below..



*3. When the Gain switching command of MECHATROLINK-II communications is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4. The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.



Pn125	Gain Switching Delay Time in Torque Control						Torque
Setting range	0 to 10000	Unit	0.1 ms	Default setting	0	Data attribute	B

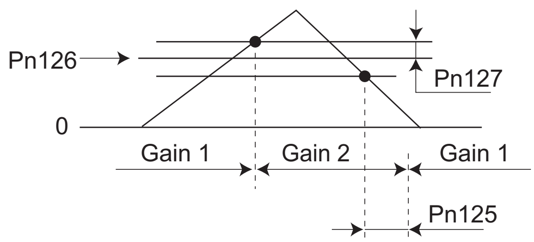
- Set the delay time when returning from gain 2 to gain 1 if the SWITCHING mode in Torque Control (Pn124) is set to 3.

Pn126	Gain Switching Level in Torque Control						Torque
Setting range	0 to 20000	Unit	–	Default setting	0	Data attribute	B

- This is enabled when the SWITCHING mode in Torque Control (Pn124) is set to 3. It sets the judgment level for switching between gain 1 and gain 2.
- The unit depends on the setting of SWITCHING mode in Torque Control (Pn124).

Pn127	Gain Switching Hysteresis in Torque Control						Torque
Setting range	0 to 20000	Unit	–	Default setting	0	Data attribute	B

- Set the hysteresis width above and below the judgment level set in the Gain Switching Level in Torque Control (Pn126).
- The unit depends on the setting of SWITCHING mode in Torque Control (Pn124).
- The following shows the definitions for the Gain Switching Delay Time in Torque Control (Pn125), Gain Switching Level in Torque Control (Pn126), and Gain Switching Hysteresis in Torque Control (Pn127).



- The settings for the Gain Switching Level in Torque Control (Pn126) and the Gain Switching Hysteresis in Torque Control (Pn127) are enabled as absolute values (positive/negative).

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Parameters Details

8-3 Vibration Suppression Parameters

Pn200	Adaptive Filter Selection					Position Speed Full closing	
Setting range	0 to 4	Unit	–	Default setting	0	Data attribute	B

- Set the operation of the adaptive filter.
- The adaptive filter is normally disabled in the TORQUE CONTROL mode.
- Refer to "10-6 Adaptive Filter (P.10-25)".

Explanation of Set Values

Set value	Description
0	Disabled. The current values are held for the parameters related to notch filters 3 and 4.
1	One adaptive filter is enabled. The parameter related to notch filter 3 is updated based on the applicable result.
2	Two adaptive filters are enabled. The parameters related to notch filters 3 and 4 are updated based on the applicable result.
3	The resonance frequency is measured.The measurement result can be checked using CX-Drive.The current values are held for the parameters related to notch filters 3 and 4.
4	Adaptive result is cleared.Parameters related to notch filters 3 and 4 are disabled and the adaptive result is cleared.

Pn201	Notch 1 Frequency Setting					All	
Setting range	50 to 5000	Unit	Hz	Default setting	5000	Data attribute	B

- Set the frequency of resonance suppression notch filter 1.
- The notch filter function is disabled if this parameter is set to 5000.
- Refer to "10-7 Notch Filter (P.10-28)".

Pn202	Notch 1 Width Setting					All	
Setting range	0 to 20	Unit	–	Default setting	2	Data attribute	B

- Set the width of resonance suppression notch filter 1 to one of 20 levels.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- Refer to "10-7 Notch Filter (P.10-28)".

Pn203	Notch 1 Depth Setting					All	
Setting range	0 to 99	Unit	–	Default setting	0	Data attribute	B

- Set the notch depth of resonance suppression notch filter 1.
- Increasing the setting value shortens the notch depth and the phase lag.
- Refer to "10-7 Notch Filter (P.10-28)".

Pn204	Notch 2 Frequency Setting					All	
Setting range	50 to 5000	Unit	Hz	Default setting	5000	Data attribute	B

- Set the notch frequency of resonance suppression notch filter 2.
- The notch filter function is disabled if this parameter is set to 5000.
- Refer to "10-7 Notch Filter (P.10-28)".

Pn205	Notch 2 Width Setting						All
Setting range	0 to 20	Unit	–	Default setting	2	Data attribute	B

- Select the notch width of resonance suppression notch filter 2.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- Refer to "10-7 Notch Filter (P.10-28)".

Pn206	Notch 2 Depth Setting						All
Setting range	0 to 99	Unit	–	Default setting	0	Data attribute	B

- Set the notch depth of resonance suppression notch filter 2.
- Increasing the setting value shortens the notch depth and the phase lag.
- Refer to "10-7 Notch Filter (P.10-28)".

Pn207	Notch 3 Frequency Setting						All
Setting range	50 to 5000	Unit	Hz	Default setting	5000	Data attribute	B

- Set the notch frequency of resonance suppression notch filter 3.
- The notch filter function is disabled if this parameter is set to 5000.
- While the adaptive filter is enabled, the resonance frequency 1 that is assumed by the adaptive filter is automatically set. If no resonance point is found, the value 5000 is set.
- Refer to "10-6 Adaptive Filter (P.10-25)" and "10-7 Notch Filter (P.10-28)".

Pn208	Notch 3 Width Setting						All
Setting range	0 to 20	Unit	–	Default setting	2	Data attribute	B

- Select the notch width of resonance suppression notch filter 3.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- While the adaptive filter is enabled, it is set automatically.
- Refer to "10-6 Adaptive Filter (P.10-25)" and "10-7 Notch Filter (P.10-28)".

Pn209	Notch 3 Depth Setting						All
Setting range	0 to 99	Unit	–	Default setting	0	Data attribute	B

- Set the notch depth of resonance suppression notch filter 3.
- Increasing the setting value shortens the notch depth and the phase lag.
- While the adaptive filter is enabled, it is set automatically.
- Refer to "10-6 Adaptive Filter (P.10-25)" and "10-7 Notch Filter (P.10-28)".

Pn210	Notch 4 Frequency Setting						All
Setting range	50 to 5000	Unit	Hz	Default setting	5000	Data attribute	B

- Set the notch frequency of resonance suppression notch filter 4.
- The notch filter function is disabled if this parameter is set to 5000.
- While the adaptive filter is enabled, the resonance frequency 2 that is assumed by the adaptive filter is automatically set. If no resonance point is found, the value 5000 is set.
- Refer to "10-6 Adaptive Filter (P.10-25)" and "10-7 Notch Filter (P.10-28)".

Pn211	Notch 4 Width Setting						All
Setting range	0 to 20	Unit	–	Default setting	2	Data attribute	B

- Select the notch width of resonance suppression notch filter 4.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- While the adaptive filter is enabled, it is set automatically.
- Refer to "10-6 Adaptive Filter (P.10-25)" and "10-7 Notch Filter (P.10-28)".

Pn212	Notch 4 Depth Setting						All
Setting range	0 to 99	Unit	–	Default setting	0	Data attribute	B

- Set the notch depth of resonance suppression notch filter 4.
- Increasing the setting value shortens the notch depth and the phase lag.
- While the adaptive filter is enabled, it is set automatically.
- Refer to "10-6 Adaptive Filter (P.10-25)" and "10-7 Notch Filter (P.10-28)".

Pn213	Damping Filter Selection						Position Full closing
Setting range	0 to 3	Unit	–	Default setting	0	Data attribute	B

- Set the method to switch among four damping control filters.

Explanation of Set Values

Set value	Explanation
0	Damping filter 1 or 2 enabled
1	Reserved for manufacturer use *1
2	Reserved for manufacturer use *1
3	It is switched with position command direction. • Forward direction: Damping filters 1 / 3 enabled • Reverse direction: Damping filters 2 / 4 enabled

*1 The set value 1 and 2 are for manufacturer's use only. Users are not allowed to set 1 and 2 for this parameter.

Pn214	Damping Frequency 1						Position Full closing
Setting range	0 to 2000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- Set damping frequency 1 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- The range of setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to "10-5 Damping Control (P.10-21)".

Pn215	Damping Filter 1 Setting					Position Full closing	
Setting range	0 to 1000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- First set the Damping Frequency 1 (Pn214). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- Set value is restricted in the following manner.
  Upper limit: Up to the Damping Frequency 1
  Lower limit: Damping frequency + damping filter setting ≥ 100
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn216	Damping Frequency 2					Position Full closing	
Setting range	0 to 2000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- Set the Damping Frequency 2 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- Setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn217	Damping Filter 2 Setting					Position Full closing	
Setting range	0 to 1000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- First set the Damping Frequency 2 (Pn216). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- Set value is restricted in the following manner.
  Upper limit: Up to the Damping Frequency 2
  Lower limit: Damping frequency + damping filter setting ≥ 100
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn218	Damping Frequency 3					Position Full closing	
Setting range	0 to 2000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- Set the Damping Frequency 3 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- Setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn219	Damping Filter 3 Setting					Position Full closing	
Setting range	0 to 1000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- First set the Damping Frequency 3 (Pn218). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- Set value is restricted in the following manner.
  Upper limit: Up to the Damping Frequency 3
  Lower limit: Damping frequency + damping filter setting ≥ 100
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn220	Damping Frequency 4					Position Full closing	
Setting range	0 to 2000	Unit	0.1 Hz	Default setting	0	Data attribute	B

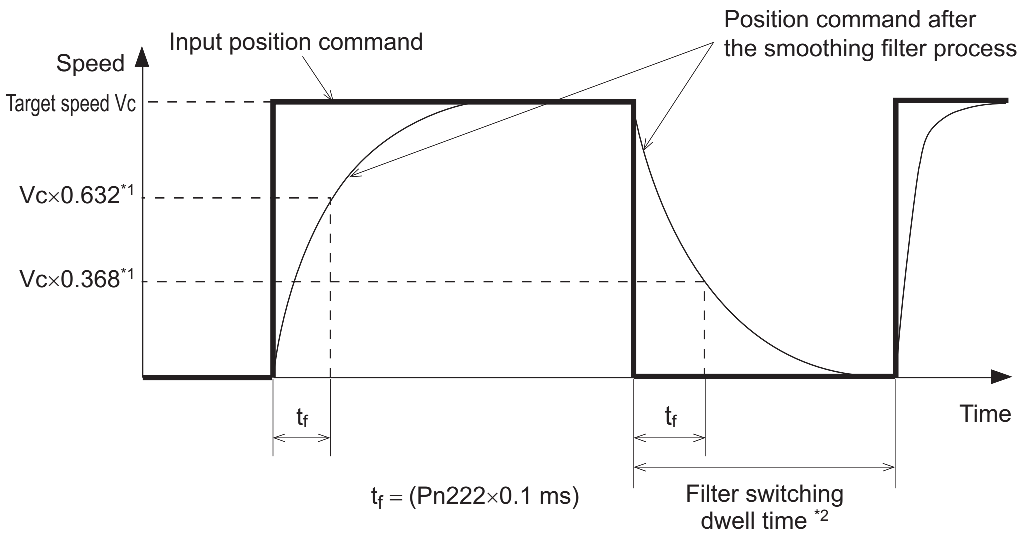
- Set the Damping Frequency 4 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- Setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn221	Damping Filter 4 Setting					Position Full closing	
Setting range	0 to 1000	Unit	0.1 Hz	Default setting	0	Data attribute	B

- First set the Damping Frequency 4 (Pn220). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- Set value is restricted in the following manner.
  Upper limit: Up to the Damping Frequency 4
  Lower limit: Damping frequency + damping filter setting ≥ 100
- Refer to "10-5 Damping Control (P.10-21)" for more information on settings.

Pn222	Position Command Filter Time Constant					Position Full closing	
Setting range	0 to 10000	Unit	0.1 ms	Default setting	0	Data attribute	B

- The Position Command Filter Time Constant is the first-order lag filter that is inserted after the electronic gear ratio for the command input.
- The Constant is used to reduce the stepping movement of the motor and achieve a smooth operation when the electronic gear ratio is set in 10 times or greater.
- It sets the first-order lag filter time constant, as shown below, for the square-wave command of target speed Vc.



*1 The actual process involves calculation error.

*2 If accumulated pulses remain within the filter after the filter set value has been changed, etc., the motor may operate at a speed higher than the command speed immediately after switching the filter.

8-4 Analog Control Parameters

Pn300	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn301	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn302	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn303	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn304	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn305	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn306	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn307	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn308	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn309	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

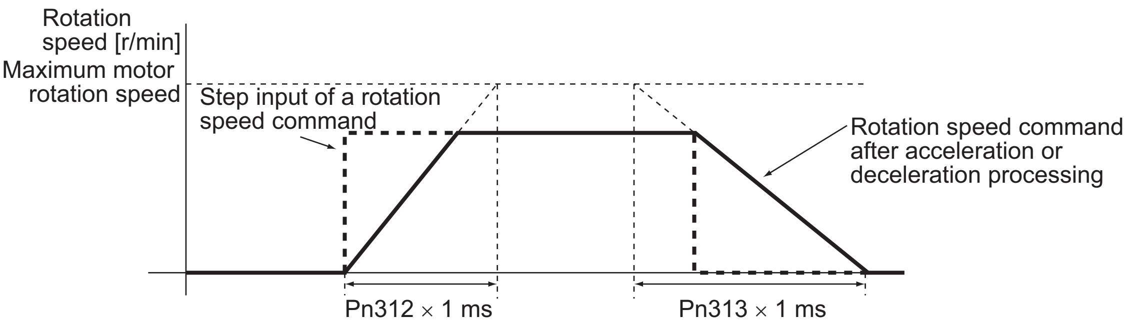
Pn310	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn311	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn312	Soft Start Acceleration Time						Speed
Setting range	0 to 10000	Unit	ms/maximum motor speed	Default setting	0	Data attribute	B

Pn313	Soft Start Deceleration Time						Speed
Setting range	0 to 10000	Unit	ms/maximum motor speed	Default setting	0	Data attribute	B

- Control the speed by setting acceleration/deceleration to the speed command inside the Servo Drive.
- A soft start can be set when inputting speed commands of stepping movement or when using internal speed setting.
- Do not set acceleration/deceleration time settings when using the Servo Drive in combination with an external position loop. (Set both Pn312 and Pn313 to 0.)
- Refer to "6-8 Soft Start (P.6-24)".

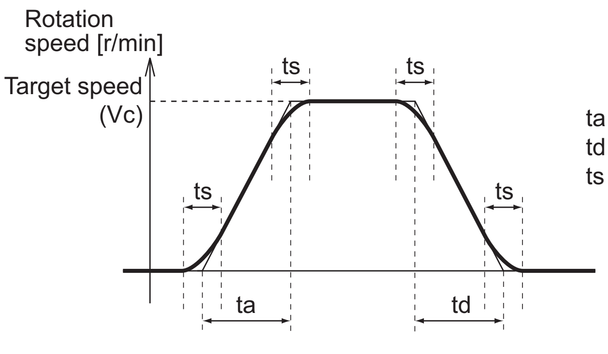


Precautions for Correct Use

- Do not set the Soft Start Acceleration Time and the Soft Start Deceleration Time when the position loop structure with a Host Controller is used.

Pn314	S-curve Acceleration/Deceleration Time Setting						Speed
Setting range	0 to 1000	Unit	ms	Default setting	0	Data attribute	B

- Set the pseudo-S-curve acceleration/deceleration value to add to the speed command to enable smooth operation. This is useful for applications where impact may occur due to a large change in acceleration or deceleration when starting or stopping with linear acceleration or deceleration.
- Refer to "6-8 Soft Start (P.6-24)".



ta = Vc / Maximum motor rotation speed × Pn312 × 1 ms
td = Vc / Maximum motor rotation speed × Pn313 × 1 ms
ts = Pn314 × 1 ms

Be sure that ts is smaller than the values obtained by the divisions of

$\frac{ta}{2}$ and $\frac{td}{2}$.

Pn315	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn316	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn317	Speed Limit Selection						Torque
Setting range	0 to 1	Unit	–	Default setting	0	Data attribute	B

- Select the speed limit.
- The speed limit is used as a protection during torque control.
- Refer to "5-3 Torque Control (P.5-6)".

Explanation of Set Values

Set value	Description
0	Select the value set on the Speed Limit Value Setting (Pn321).
1	Select either the speed limit value (VLIM) via MECHATROLINK-II communications or the value set by the Speed Limit Value Setting (Pn321), whichever is smaller.

Pn318	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn319	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn320	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn321	Speed Limit Value Setting						Torque
Setting range	0 to 20000	Unit	r/min	Default setting	50	Data attribute	B

- Set the speed limit value for torque control.
- It controls that the speed during torque control does not exceed the set value.
- Refer to "5-3 Torque Control (P.5-6)".

Pn322	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn323	External Feedback Pulse Type Selection						Full closing
Setting range	0 to 2	Unit	–	Default setting	0	Data attribute	R

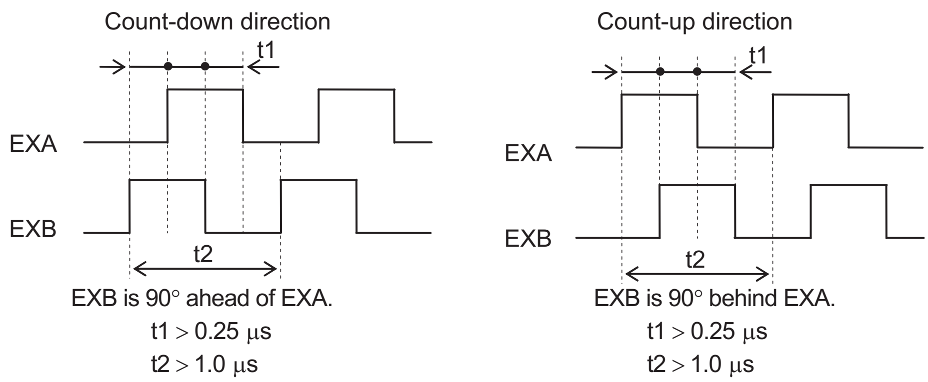
- Select the external encoder type. Ensure that the setting conforms to the external encoder type which is actually used.
- Refer to "5-4 Full Closing Control (P.5-9)".

Explanation of Set Values

Set value	Description	Maximum input frequency*1
0	90° phase difference output type*2*3	0-4 Mpps (Multiplication × 4)
1	Serial communications type (Incremental encoder specifications)	0-400 Mpps
2	Serial communications type (Absolute encoder specifications)	0-400 Mpps

*1. The maximum input frequency means the feedback speed [pps] of the external encoder, which can be processed by the Drive. Confirm the instruction manual of the external encoder for the maximum output frequency on the external encoder.

*2. These are the directions that the Drive counts the Scale of 90° phase difference output type.



*3 For the external encoder connection direction, set the direction so that count-up occurs when the motor shaft is rotating in the CCW direction, and count-down occurs when the motor shaft is rotating in the CW direction If the connection direction cannot be selected due to installation conditions, etc., the count direction can be reversed using External Feedback Pulse Direction Switching (Pn326).

Precautions for Correct Use

- Take note that if Pn000 = 1, the encoder count direction becomes opposite to the count direction used for monitoring the total external encoder feedback pulses, etc.
  If Pn000 = 0, the count direction matches the count direction for monitoring.
- Even when the speed command is within the Drive's speed command range, an acceleration alarm occurs if the speed command exceeds the maximum speed of motor shaft rotation.

Pn324	External Feedback Pulse Dividing Numerator						Full closing
Setting range	0 to 1048576	Unit	–	Default setting	0	Data attribute	R

Pn325	External Feedback Pulse Dividing Denominator						Full closing
Setting range	1 to 1048576	Unit	–	Default setting	10000	Data attribute	R

- Check the number of encoder pulses per motor rotation and number of external encoder pulses per motor rotation, and set External Feedback Pulse Dividing Numerator (Pn324) and External Feedback Pulse Dividing Denominator (Pn325).

$$\frac{\text{Pn324}}{\text{Pn325}} = \frac{\text{Encoder resolution per motor rotation [pulse]}}{\text{External encoder resolution per motor rotation [pulse]}}$$

- Set Pn324 to 0 to have encoder resolution automatically set as numerator.
- Refer to "5-4 Full Closing Control (P.5-9)".

Precautions for Correct Use

- If this ratio is incorrect, the deviation between the position calculated from encoder pulses and position calculated from external encoder pulses increases. Particularly when the moving distance is long, an excessive deviation error occurs.

Reference

In the example below: ball screw pitch in 10 mm, encoder in 0.1 µm/pulse, and encoder resolution in 20 bits (or 1048576 pulses)

$$\frac{\text{Pn324}}{\text{Pn325}} = \frac{\text{Encoder resolution per motor rotation [pulse]}}{\text{External encoder resolution per motor rotation [pulse]}} = \frac{1048576}{100000}$$

Pn326	External Feedback Pulse Direction Switching						Full closing
Setting range	0 to 1	Unit	–	Default setting	0	Data attribute	R

- The direction of external encoder feed back count can be reversed.
- Refer to "5-4 Full Closing Control (P.5-9)".

Explanation of Set Values

Set value	Description
0	External encoder feedback pulse count direction non-reverse
1	External encoder feedback pulse count direction reverse

Pn327	External Feedback Pulse Phase-Z Setting						Full closing
Setting range	0 to 1	Unit	–	Default setting	0	Data attribute	R

- Set to enable or disable the Phase-Z disconnection detection when an external encoder of 90° phase difference output type is used.

Explanation of Set Values

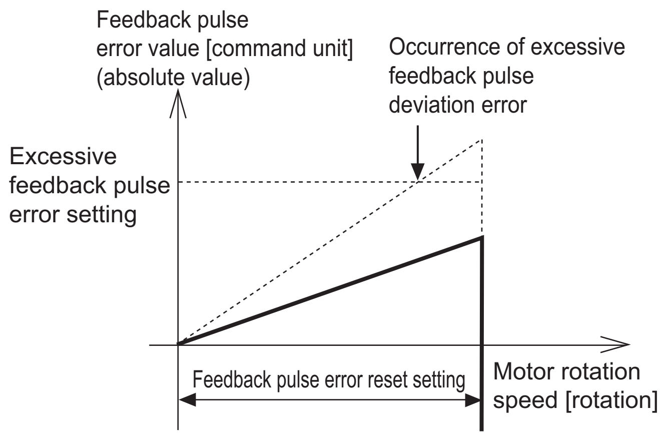
Set value	Explanation
0	Phase-Z disconnection detection enabled
1	Phase-Z disconnection detection disabled

Pn328	Internal/External Feedback Pulse Error Counter Overflow Level						Full closing
Setting range	1 to 134217728	Unit	Command unit	Default setting	16000	Data attribute	C

- Set the allowable difference (feedback pulse error) between the motor (encoder) position and load (external encoder) position in command units.
- Refer to "5-4 Full Closing Control (P.5-9)".

Pn329	Internal/External Feedback Pulse Error Counter Reset						Full closing
Setting range	0 to 100	Unit	Rotation	Default setting	0	Data attribute	C

- The feedback pulse error is reset every time the motor rotates for the amount set by the Internal/External Feedback Pulse Error Counter Reset (Pn329). This can be used for purposes where feedback pulse error accumulates due to slippage.
- Refer to "5-4 Full Closing Control (P.5-9)".



- Ensure that an appropriate value is set to the Internal/External Feedback Pulse Error Counter Reset (Pn329), before you use the feedback pulse error counter reset. When the set value is extremely small, the protective function may not work to prevent any erroneous operation due to improper connection of the external encoder.

Precautions for Correct Use

- Provide enough safety measures. This includes to mount limit sensors.

8

Parameters Details

8-5 Interface Monitor Setting Parameters

Pn400	Input Signal Selection 1						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00949494h	Data attribute	C

- Set the function and logic for the general-purpose input 1 (IN1).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn401	Input Signal Selection 2						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00818181h	Data attribute	C

- Set the function and logic for the general-purpose input 2 (IN2).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn402	Input Signal Selection 3						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00828282h	Data attribute	C

- Set the function and logic for the general-purpose input 3 (IN3).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn403	Input Signal Selection 4						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00222222h	Data attribute	C

- Set the function and logic for the general-purpose input 4 (IN4).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn404	Input Signal Selection 5						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	002B2B2Bh	Data attribute	C

- Set the function and logic for the general-purpose input 5 (IN5).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn405	Input Signal Selection 6						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00212121h	Data attribute	C

- Set the function and logic for the general-purpose input 6 (IN6).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn406	Input Signal Selection 7						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00202020h	Data attribute	C

- Set the function and logic for the general-purpose input 7 (IN7).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn407	Input Signal Selection 8						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	002E2E2Eh	Data attribute	C

- Set the function and logic for the general-purpose input 8 (IN8).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn408	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn409	Unused						All
Setting range	–	Unit	–	Default setting		Data attribute	–

Pn410	Output Signal Selection 1						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00030303h	Data attribute	C

- Set the function assignment for the general-purpose output 1 (OUTM1).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn411	Output Signal Selection 2						All
Setting range	0 to 00FFFFFFh	Unit	–	Default setting	00020202h	Data attribute	C

- Set the function assignment for the general-purpose output 2 (OUTM2).
- Refer to the Details of Control Inputs in "3-1 Servo Drive Specifications (P.3-1)", as well as "6-1 Sequence I/O Signal (P.6-1)".

Pn412	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn413	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn414	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn415	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn416	Analog Monitor 1 Selection						All
Setting range	0 to 21	Unit	–	Default setting	0	Data attribute	A

- Analog signals of various monitors can be output from the analog monitor connector on the front panel.
- The monitor type to output and the scaling (or output gain) are selective. They can be set by parameters.
- Refer to "10-1 Analog Monitor (P.10-1)".

Explanation of Set Values

Set value	Explanation		
	Monitor type	Unit	Output gain when Pn417 = 0
0	Motor speed	r/min	500
1	Position command speed	r/min	500
2	Internal position command speed	r/min	500
3	Speed control command	r/min	500
4	Torque command	% (rated torque ratio)	33
5	Command position error	pulse (command unit)	3000
6	Encoder position error	pulse (encoder unit)	3000
7	Full closing error	pulse (external encoder unit)	3000
8	Hybrid Error	pulse (command unit)	3000
9	P-N voltage	V	80
10	Regeneration load ratio	%	33
11	Motor load ratio	%	33
12	Forward direction torque limit	% (rated torque ratio)	33
13	Reverse direction torque limit	% (rated torque ratio)	33
14	Speed limit value	r/min	500
15	Inertia ratio	%	500
16 to 18	Reserved	–	–
19	Encoder temperature	°C	10
20	Drive temperature	°C	10
21	Encoder 1-rotation data	pulse (encoder unit)	110000

Pn417	Analog Monitor 1 Scale Setting						All
Setting range	0 to 214748364	Unit	–	Default setting	0	Data attribute	A

- Set output gain for analog monitor 1.
- Refer to "10-1 Analog Monitor (P.10-1)".

Pn418	Analog Monitor 2 Selection						All
Setting range	0 to 21	Unit	–	Default setting	4	Data attribute	A

- Same as the Analog Monitor 1, analog signals of various monitors can be output from the analog monitor connector on the front panel.
- Refer to the Analog Monitor 1 Selection (Pn416) for the method to set this parameter.

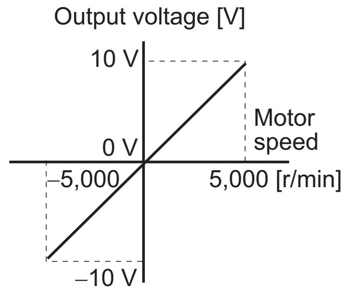
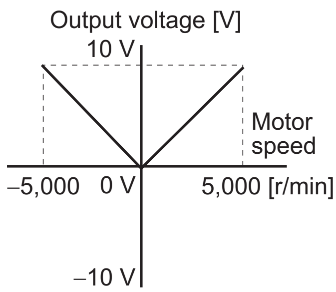
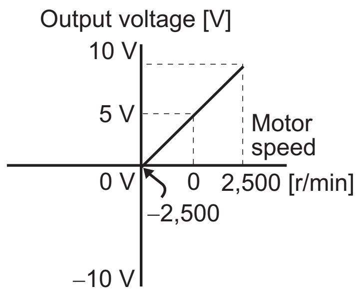
Pn419	Analog Monitor 2 Scale Setting						All
Setting range	0 to 214748364	Unit	–	Default setting	0	Data attribute	A

- Set output gain for analog monitor 2.
- Refer to the Analog Monitor 1 Scale Setting (Pn417) for the method to set this parameter.

Pn420	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn421	Analog Monitor Output Selection						All
Setting range	0 to 2	Unit	–	Default setting	0	Data attribute	A

- Select the analog monitor output voltage direction.

Set value	Output range	Data output
0	–10 to 10 V	
1	0 to 10 V	
2	0 to 10 V (5 V as a center)	

- This is the case when the Motor Speed is selected by the Analog Monitor 1 Selection or the Analog Monitor 2 Selection, and the value 0 is set on the Analog Monitor 1 Scale Setting or the Analog Monitor 2 Scale Setting (where 1 V = 500 r/min).

Pn422	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn423	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn424	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn425	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn426	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn427	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

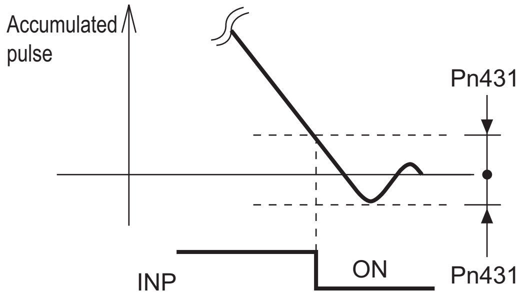
Pn428	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn429	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn430	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn431	Positioning Completion Range 1					Position / Full closing	
Setting range	0 to 262144	Unit	Command unit	Default setting	10	Data attribute	A

- Use this parameter in combination with the Positioning Completion Condition Selection (Pn432) to set the timing to output the positioning completion output (INP1).
- The positioning completion output (INP1) turns ON when the absolute value of position error counter during position control goes below the positioning completion range set by this parameter.
- Unit for setting is command unit, but it can be changed to encoder unit with Position Setting Unit Selection (Pn520). However, note that unit for error counter overflow level changes as well.
- If an extremely small value is set to this parameter, it may take time to output the INP signal, or chattering may occur at outputs.
- The setting on the Positioning Completion Range does not give any influence to the final positioning accuracy.



Pn432	Positioning Completion Condition Selection					Position / Full closing	
Setting range	0 to 3	Unit	–	Default setting	0	Data attribute	A

- Use this in combination with the Positioning Completion Range 1 (Pn431) to set the operation for positioning completion output (INP1).

Explanation of Set Values

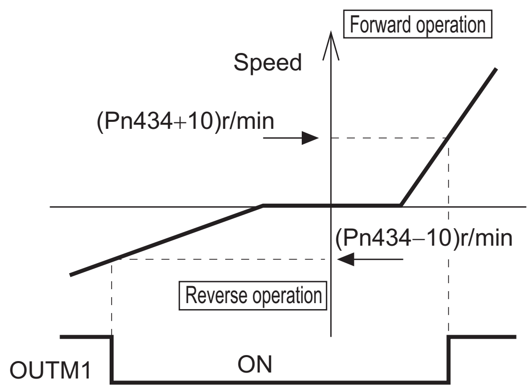
Set value	Description
0	Positioning completion output (INP1) turns ON when the position error is within the Positioning Completion Range 1 (Pn431).
1	Positioning completion output (INP1) turns ON when the position error is within the Positioning Completion Range 1 (Pn431) and there is no position command.
2	Positioning completion output (INP1) turns ON when the zero speed detection output (ZSP) is ON, the position error is within the Positioning Completion Range 1 (Pn431), and there is no position command.
3	Positioning completion output turns ON when the position error is within the Positioning Completion Range 1 (Pn431) and there is no position command. The ON status is then held until the Positioning Completion Hold Time (Pn433) elapses. After that, it turns ON or OFF based on the position error at the time.

Pn433	Positioning Completion Hold Time					Position Full closing	
Setting range	0 to 30000	Unit	1 ms	Default setting	0	Data attribute	A

- Set the hold time for the case when the Positioning Completion Condition Selection (Pn432) is set to 3.
- When Positioning Completion Hold Time (Pn433) is set to 0, hold time becomes infinite and ON status is held until the next position command comes in.
- When a position command is entered during holding, the status changes to OFF.

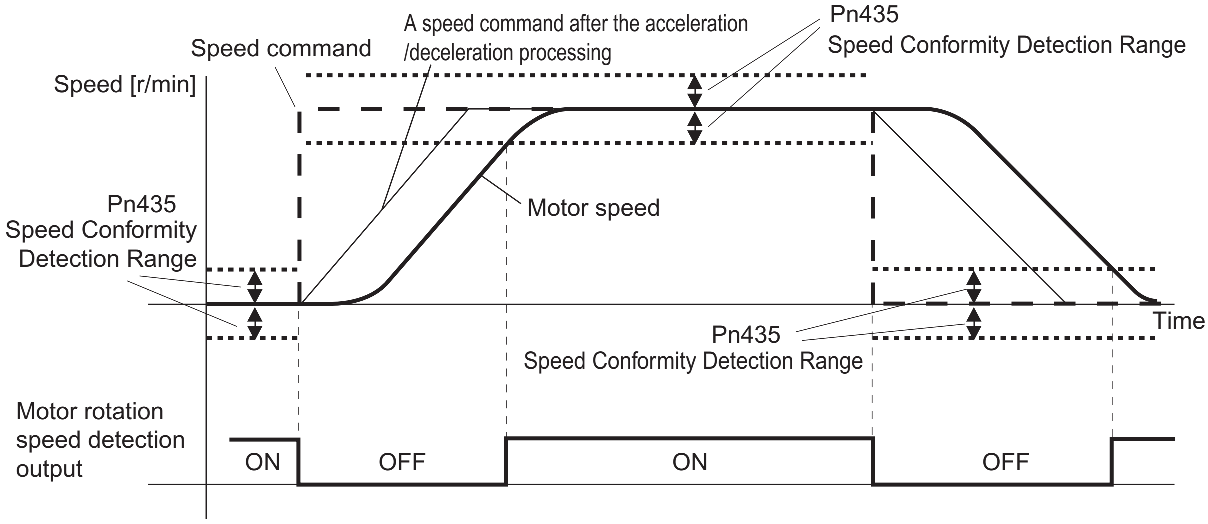
Pn434	Zero Speed Detection					All	
Setting range	10 to 20000	Unit	r/min	Default setting	50	Data attribute	A

- Set the output timing of the Zero speed detection output (ZSP) in rotation speed [r/min].
- The Zero speed detection output (ZSP) becomes ON when the motor speed is lower than the set value on this parameter.
- The set value in this parameter is valid in both forward and reverse directions, regardless of the actual motor rotation direction. The setting has a hysteresis of 10 r/min.
- Refer to the Control Output Details in "3-1 Servo Drive Specifications (P.3-1)" for the Zero speed detection output (ZSP).



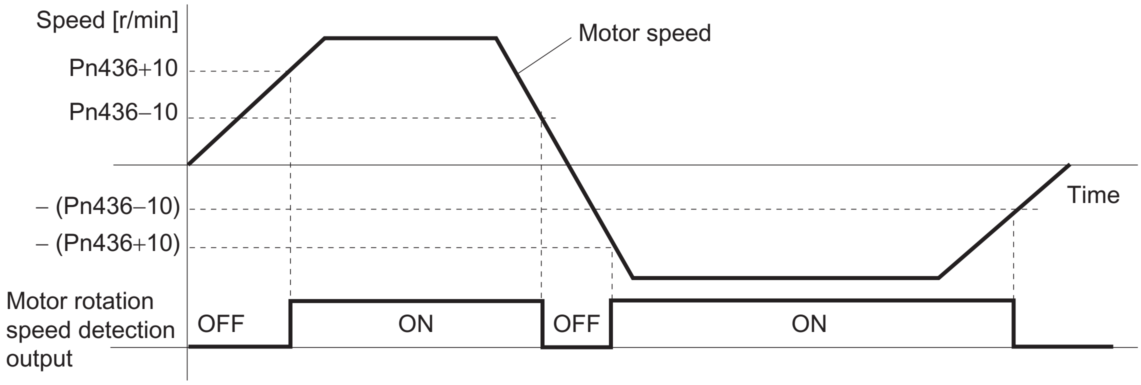
Pn435	Speed Conformity Detection Range						Speed
Setting range	10 to 20000	Unit	r/min	Default setting	50	Data attribute	A

- It outputs the Speed conformity output (VCMP) when the speed command conforms to the motor speed.
- It is regarded as conformed when the difference between the speed command before the acceleration or deceleration process inside the Drive and the motor speed is smaller than the set value on the Speed Conformity Detection Range (Pn435).
- The setting has a hysteresis of 10 r/min.
- Refer to the Control Output Details in "3-1 Servo Drive Specifications (P.3-1)" for the Speed conformity output (VCMP).



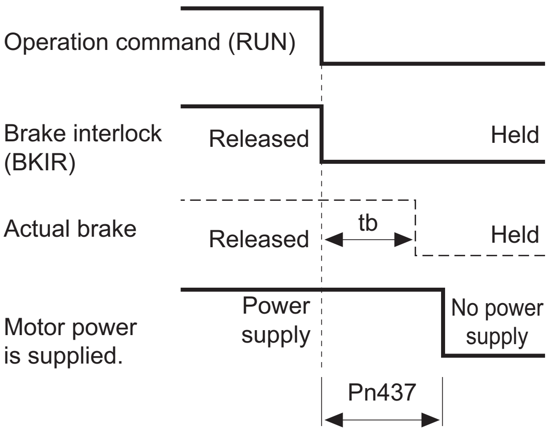
Pn436	Rotation Speed for Motor Rotation Detection						Speed
Setting range	10 to 20000	Unit	r/min	Default setting	1000	Data attribute	A

- It outputs the Motor rotation speed detection output (TGON) when the motor speed reaches the set arrival speed.
- The setting has a hysteresis of 10 r/min.
- Refer to the Control Output Details in "3-1 Servo Drive Specifications (P.3-1)" for the Motor rotation speed detection output (TGON).



Pn437	Brake Timing when Stopped						All
Setting range	0 to 10000	Unit	1 ms	Default setting	0	Data attribute	B

- Set the time required for the Servomotor to be de-energized (servo free) after the brake interlock output (BKIR) turns ON (i.e., brake held), when servo OFF status is entered while the Servomotor is stopped.
- When the Servomotor is stopped and the operation command (RUN) is turned OFF, the brake interlock output (BKIR) turns ON, and the servo turns OFF after waiting for the setting time (set value × ms).



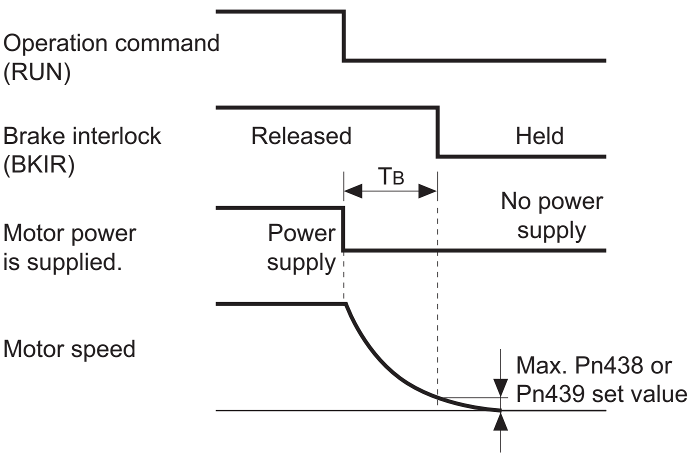
Make the setting as follows to prevent the machine (workpiece) from moving or falling due to the delay time in the brake operation (tb).

Brake timing when stopped (set value × 1 ms) ≥ tb

- For details, refer to "6-5 Brake Interlock (P.6-14)".

Pn438	Brake Timing during Operation						All
Setting range	0 to 10000	Unit	1 ms	Default setting	0	Data attribute	B

- Set the required time for the brake interlock output (BKIR) to turn OFF after the operation command (RUN) is detected to be OFF, when servo OFF status is entered while the Servomotor is operating. While the motor is operating and the operation command (RUN) is turned OFF, the motor decelerates to reduce rotation speed, and the brake interlock output (BKIR) turns ON after the setting time (set value × 1 ms) has elapsed.

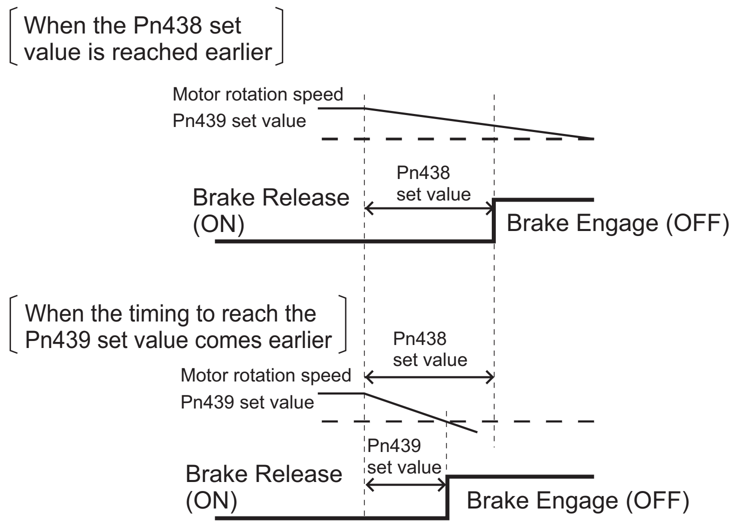


The Time ta in above drawing is either the Brake timing during operation (i.e., the set value × 1 ms) or the time taken until it goes below the value set on the Brake Release Speed Setting (Pn439), whichever is shorter.

- For details, refer to "6-5 Brake Interlock (P.6-14)".

Pn439	Brake Release Speed Setting						All
Setting range	30 to 3000	Unit	r/min	Default setting	30	Data attribute	B

- Set the number of motor rotations from when the OFF of Run command (RUN) is detected to when the Brake interlock output (BKIR) becomes off, in case when the servo off occurs during the motor rotation.
- Refer to "6-5 Brake Interlock (P.6-14)".



Pn440	Warning Output Selection 1						All
Setting range	0 to 13	Unit	–	Default setting	0	Data attribute	A

- Select the warning type to be output by the Warning Output 1.
- Refer to "11-2 Warning (P.11-4)".

Explanation of Set Values

Set value	Description
0	Output by all types of warnings
1	Overload warning
2	Excessive regeneration warning
3	Battery warning
4	Fan warning
5	Encoder communications warning
6	Encoder communications warning
7	Vibration warning
8	Service life warning
9	External encoder error warning
10	External encoder communications error warning
11	Data setting warning
12	Command warning
13	MECHATROLINK-II communications warning

Pn441	Warning Output Selection 2						All
Setting range	0 to 13	Unit	–	Default setting	0	Data attribute	A

- Select the warning type to be output by the Warning Output 2.
- Refer to the Warning Output 1 (Pn440) for the parameter setting method.
- Refer to "11-2 Warning (P.11-4)".

Pn442	Positioning Completion Range 2						Position Full closing
Setting range	0 to 262144	Unit	Command unit	Default setting	10	Data attribute	A

- Set the positioning completion range to output the Positioning completion output 2 (INP2).
- The positioning completion output 2 (INP2) is always ON when the position error is below the set value, regardless of the setting on the Positioning Completion Condition Selection (Pn432).
- The positioning completion output 2 (INP2) does not involve determination by the position commands. It is ON as long as the position error is below the set value.
- The setting unit is command. It can be changed to encoder unit by the Position Setting Unit Selection (Pn520). However, note that unit for error counter overflow level change as well.
- Refer to the Positioning Completion Range 1 (Pn431) for the parameter setting method.

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Parameters Details

8-6 Extended Parameters

Pn500	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn501	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn502	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn503	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn504	Drive Prohibition Input Selection						All
Setting range	0 to 2	Unit	–	Default setting	1	Data attribute	C

- Set the operation of the Forward drive prohibition input (POT) and the Reverse drive prohibition input (NOT).
- Refer to "6-2 Forward and Reverse Drive Prohibition Functions (P.6-6)".

Explanation of Set Values

Set value	Explanation
0	Forward drive prohibition input and reverse drive prohibition input enabled.
1	Forward drive prohibition input and reverse drive prohibition input disabled.
2	Forward drive prohibition input and reverse drive prohibition input enabled.

- Install limit switches at both ends of the axis to prohibit the motor from traveling in the direction specified by the switch. This can be used to prevent the workpiece from traveling too far and thus prevent damage to the machine.
- When the parameter is set to 0, the operation is as follows:
  - Forward drive prohibition input (POT) shorted: Forward limit switch not operating and status normal.
  - Forward drive prohibition input (POT) open: Forward direction prohibited and reverse direction permitted.
  - Reverse drive prohibition input (NOT) shorted: Reverse limit switch not operating and status normal.
  - Reverse drive prohibition input (NOT) open: Reverse direction prohibited and forward direction permitted.
- If this is set to 0, the Servomotor decelerates and stops according to the sequence set in the Stop Selection for Drive Prohibition Input (Pn505) For details, refer to explanation for Stop Selection for Drive Prohibition Input (Pn505).

8

Parameters Details

Reference

- If this parameter is set to 0 and the forward and reverse prohibition inputs are both open, a drive prohibition input error (Alarm No.38) occurs because it is taken that Servo Drive is in error condition.
- If this parameter is set to 2, a drive prohibition input error (Alarm No.38) occurs when the connection between either the forward or reverse prohibition input and COM is open.
- If a limit switch above the workpiece is turned OFF when using a vertical axis, the upward torque decreases, and there may be repeated vertical movement of the workpiece. If this occurs, set the Stop Selection for Drive Prohibition Input (Pn505) to 2 or perform limit processing using the Host Controller rather than using this function.

Pn505	Stop Selection for Drive Prohibition Input						All
Setting range	0 to 2	Unit	–	Default setting	0	Data attribute	C

- Set the drive conditions during deceleration and after stopping, when the Forward or Reverse drive prohibition input is enabled.
- Refer to "6-2 Forward and Reverse Drive Prohibition Functions (P.6-6)".
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

Explanation of Set Values

Set value	Explanation
0	During deceleration*1: Dynamic brake operation, Clear the error counter. After stopping: Torque command is 0 for the drive prohibition direction. Hold the error counter.
1	During deceleration: Free-run, Clear the error counter. After stopping: Torque command is 0 for the drive prohibition direction. Hold the error counter.
2	During deceleration: Emergency stop*2, Hold the error counter. After stopping: Both torque command and torque limit are as specified. Clear the error counter after deceleration completes, then hold it.

*1. The term "During deceleration" means the distance till the motor decreases its speed to 30 r/min or less from the normal operation. Once it decelerates to 30 r/min or lower speed, the operation conforms to the description for "after stopping", regardless of the actual speed.

*2. The "Emergency Stop" means that the Servomotor stops immediately by control while the Servo-ON state is kept. The torque limit at this time is controlled by the Emergency Stop Torque (Pn511) set value.

Precautions for Correct Use

- At an emergency stop, an Error counter overflow (Alarm No.24.0) or an Overrun limit error (Alarm No.34.0) may occur. This is because the emergency stop forces the motor to decelerate quickly, and the position control creates a large positional deviation momentary. If the error occurs, set the Error Counter Overflow Level (Pn014) and the Overrun Limit Setting (Pn514) in appropriate values.
- A command warning (Warning No. 95) occurs, if a command is given to the drive prohibition direction while the Servomotor stops (or decreases the speed to 30 r/min or lower) and the Drive Prohibition Input is on.

Pn506	Stop Selection with Servo OFF						All
Setting range	0 to 9	Unit	–	Default setting	0	Data attribute	B

- Set the states during deceleration and after stopping, which follow the Servo-OFF.
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

Explanation of Set Values

Set value	Stopping method during deceleration *1	Operation after stopping (approx. 30 r/min or lower)	Error counter
0, 4	Dynamic brake operation	Dynamic brake operation	Clear*2
1, 5	Free-run	Dynamic brake operation	Clear *2
2, 6	Dynamic brake operation	Servo free	Clear *2
3, 7	Free-run	Servo free	Clear *2
8	Emergency stop*3	Dynamic brake operation	Clear *2
9	Emergency stop*3	Servo free	Clear *2

*1. Decelerating refers to a period between when the motor is running and when the motor speed reaches 30 r/min or less. Once the motor reaches a speed of 30 r/min or less and moves to the after stop status, follow the subsequent operation based on the after stop status regardless of the motor speed.

*2. The motor may make a sudden motion.

*3. Emergency stop refers to immediate stop operation applying control with servo is still kept ON. At that time, the torque command value is restricted by the Emergency Stop Torque (Pn511).

Precautions for Correct Use

- If an error occurs when servo is in Servo OFF state, the operation conforms to the settings of Stop Selection for Alarm Detection (Pn510). Additionally, if the main power supply is turned OFF when servo motor is in Servo OFF state, it conforms to the settings of Stop Selection with Main Power Supply OFF (Pn507).

Pn507	Stop Selection with Main Power Supply OFF						All
Setting range	0 to 9	Unit	–	Default setting	0	Data attribute	B

- Set the states during deceleration and after stopping, which follow the main power off.
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

Explanation of Set Values

Set value	Stopping method during deceleration [*1]	Operation after stopping (approx. 30 r/min or lower)	Error counter
0, 4	Dynamic brake operation	Dynamic brake operation	Clear[*2]
1, 5	Free-run	Dynamic brake operation	Clear [*2]
2, 6	Dynamic brake operation	Servo free	Clear[*2]
3, 7	Free-run	Servo free	Clear[*2]
8	Emergency stop[*3]	Dynamic brake operation	Clear[*2]
9	Emergency stop[*3]	Servo free	Clear[*2]

*1. Decelerating refers to a period between when the motor is running and when the motor speed reaches 30 r/min or less. Once the motor reaches a speed of 30 r/min or less and moves to the after stop status, follow the subsequent operation based on the after stop status regardless of the motor speed.

*2. The motor may make a sudden motion.

*3. Emergency stop refers to immediate stop operation applying control with Servo is still kept ON. At that time, the torque command value is restricted by the Emergency Stop Torque (Pn511).

Precautions for Correct Use

- If an error occurs when the main power supply is turned OFF, the operation conforms to the settings of Stop Selection for Alarm Detection (Pn510).
- If the main power supply is turned OFF in Servo ON state, and if the Undervoltage Alarm Selection (Pn508) is set to 1, Main power supply undervoltage (AC cut-off detection) (Alarm No.13.1),"occurs. Follow the Stop Selection for Alarm Detection (Pn510).

Pn508	Undervoltage Alarm Selection						All
Setting range	0 to 1	Unit	–	Default setting	1	Data attribute	B

- Select either to let the servo off or to stop the alarm when a main power alarm occurs.

Explanation of Set Values

Set value	Explanation
0	Servo is turned OFF based on the setting of the Stop Selection with Main Power Supply OFF (Pn507) and turn it back to Servo ON state by turning ON the main power supply.
1	The Main power supply undervoltage (Alarm No.13.1) occurs. Stops the operation by the alarm.

Pn509	Momentary Hold Time						All
Setting range	70 to 2000	Unit	1 ms	Default setting	70	Data attribute	C

- Set main power supply alarm detection time.
- The main power supply OFF detection is disabled if this is set to 2000.

Pn510	Stop Selection for Alarm Detection						All
Setting range	0 to 7	Unit	–	Default setting	0	Data attribute	B

- Select the stopping method at an alarm.
- Refer to the Emergency Stop Operation at Alarms in "11-3 Alarms (P.11-6)".
- The dynamic brake is rated for short-term operation. Use it only for emergency stopping. Design the system to stop for at least three minutes after the dynamic brake operates. Otherwise, the dynamic brake circuits may fail or the dynamic brake resistor may burn.

Explanation of Set Values

Set value	Stopping method during deceleration*1	After stopping	Error counter
0	Dynamic brake operation	Dynamic brake operation	Clear*2
1	Free-run	Dynamic brake operation	Clear*2
2	Dynamic brake operation	Servo free	Clear*2
3	Free-run	Servo free	Clear*2
4	Operation A: Emergency stop*3 Operation B: Dynamic brake operation	Dynamic brake operation	Clear*2
5	Operation A: Emergency stop*3 Operation B: Free-run	Dynamic brake operation	Clear*2
6	Operation A: Emergency stop*3 Operation B: Dynamic brake operation	Servo free	Clear*2
7	Operation A: Emergency stop*3 Operation B: Free-run	Servo free	Clear*2

*1. Decelerating refers to a period between when the motor is running and when the motor speed reaches 30 r/min or less. Once the motor reaches a speed of 30 r/min or less and moves to the after stop status, follow the subsequent operation based on the after stop status regardless of the motor speed.

*2. The motor may make a sudden motion.

*3. The Operation A and Operation B indicate whether to have an emergency stop at an error. An emergency stop takes place by the Operation A, when an emergency stop alarm occurs. It is the normal stop by Operation B, when the alarm occurred does not support the emergency stop.

Pn511	Emergency Stop Torque						All
Setting range	0 to 500	Unit	%	Default setting	0	Data attribute	B

- Set the torque limit for emergency stops.
- Set the torque limit for the following cases.
  - Drive prohibition deceleration with the Stop Selection for Drive Prohibition Input (Pn505) set to 2.
  - Deceleration with the Stop Selection with Main Power Supply OFF (Pn507) set to 8 or 9.
  - Deceleration with the Stop Selection with Servo OFF (Pn506) set to 8 or 9.
- The normal torque limit is applied if this parameter is set to 0.
- Set the value in units of 1% of the rated torque (100%).

Pn512	Overload Detection Level Setting						All
Setting range	0 to 500	Unit	%	Default setting	0	Data attribute	A

- Set the overload detection level.
- When the parameter is set to 0, the setting is 115%.
- Internally there is a limit of 115%, so higher values are limited to 115%.
- This object is set as a percentage of the rated torque.

Pn513	Overspeed Detection Level Setting						All
Setting range	0 to 20000	Unit	r/min	Default setting	0	Data attribute	A

- Set the overspeed detection level.
- The overspeed detection level setting is 1.2 times the maximum motor rotation speed if this parameter is set to 0.
- This parameter should normally be set to 0. The setting should be changed only when it is necessary to lower the overspeed detection level.
- The set value of this parameter is limited to 1.2 times the maximum motor rotation speed.
- The detection margin of error for the set value is ±3 r/min for a 7-core absolute encoder and ±36 r/min for a 5-core incremental encoder.

Pn514	Overrun Limit Setting						Position / Full closing
Setting range	0 to 1000	Unit	0.1 rotation	Default setting	10	Data attribute	A

- Set the allowable operating range for the position command input range.
- If the set value is exceeded, motor operation range setting protection is activated.
- Refer to "6-3 Overrun Protection (P.6-10)".

Pn515	Control Input Signal Read Setting						All
Setting range	0 to 3	Unit	–	Default setting	0	Data attribute	C

- Select the cycle to read the control input signals.
- The External Latch Input 1, 2 and 3 (EXT1, 2, and 3) are excluded.
- The Servo Drive reads an input signal multiple times at the specified cycle. If the Servo Drive reads the same signal for multiple consecutive cycles, then the input signal is valid.

Explanation of Set Values

Set value	Description
0	0.166 ms
1	0.333 ms
2	1 ms
3	1.666 ms

Pn516	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn517	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn518	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn519	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn520	Position Setting Unit Selection						Position Full closing
Setting range	0 to 1	Unit	–	Default setting	0	Data attribute	C

- Select the setting unit of Positioning Completion Range 1 and 2 (Pn431 and Pn442), and Error Counter Overflow Level (Pn014).

Explanation of Set Values

Set value	Description
0	Command unit
1	Encoder unit (External encoder unit)

Precautions for Correct Use

- The positioning completion of MECHATROLINK-II communication status is always detected in command unit, regardless of the setting on this parameter.

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Parameters Details

Pn521	Torque Limit Selection					Position Speed Full closing	
Setting range	0 to 6	Unit	–	Default setting	1	Data attribute	B

- Select the method to set the forward and reverse torque limits, and the torque feed forward function during speed control.
- Refer to "6-7 Torque Limit Switching (P.6-22)".

Explanation of Set Values

Torque FF: Torque feed forward function

<table>
<tr><th rowspan="3">Set value</th><th colspan="5">Position Control / Full Closing Control</th><th colspan="5">Speed Control</th></tr>
<tr><th colspan="2">Forward Torque Limit</th><th colspan="2">Reverse Torque Limit</th><th rowspan="2">Torque FF</th><th colspan="2">Forward Torque Limit</th><th colspan="2">Reverse Torque Limit</th><th rowspan="2">Torque FF</th></tr>
<tr><th>PCL ON*1</th><th>PCL OFF*2</th><th>NCL ON*1</th><th>NCL OFF*2</th><th>PCL ON*1</th><th>PCL OFF*2</th><th>NCL ON*1</th><th>NCL OFF*2</th></tr>
<tr><td>0,1</td><td colspan="4">Pn013</td><td rowspan="6">Disabled</td><td colspan="4">Pn013</td><td rowspan="3">Enabled</td></tr>
<tr><td>2</td><td colspan="2">Pn013</td><td colspan="2">Pn522</td><td colspan="2">Pn013</td><td colspan="2">Pn522</td></tr>
<tr><td>3</td><td>Pn522</td><td>Pn013</td><td>Pn522</td><td>Pn013</td><td>Pn522</td><td>Pn013</td><td>Pn522</td><td>Pn013</td></tr>
<tr><td>4</td><td colspan="2" rowspan="2">Pn013</td><td colspan="2" rowspan="2">Pn522</td><td colspan="2">Pn013 or P_TLIM*3</td><td colspan="2">Pn522 or N_TLIM*4</td><td rowspan="2">Disabled</td></tr>
<tr><td>5</td><td>Pn013 or P_TLIM*3</td><td>Pn013</td><td>Pn522 or N_TLIM*4</td><td>Pn522</td></tr>
<tr><td>6</td><td>Pn525</td><td>Pn013</td><td>Pn526</td><td>Pn522</td><td>Pn525</td><td>Pn013</td><td>Pn526</td><td>Pn522</td><td>Enabled</td></tr>
</table>

<table>
<tr><th rowspan="2">Set value</th><th colspan="3">Torque Control</th></tr>
<tr><th>Forward Torque Limit</th><th>Reverse Torque Limit</th><th>Torque FF</th></tr>
<tr><td>0,1</td><td colspan="2" rowspan="6">Pn013</td><td rowspan="6">Disabled</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
</table>

*1.PCL ON refers to the case when either the external input signals (PCL and NCL) or the MECHATROLINK-II communications option fields (P-CL and N-CL) is on.

*2.PCL OFF refers to the case when both of the external input signals (PCL and NCL) and the MECHATROLINK-II communications option fields (P-CL and N-CL) are off.

*3.Whichever the smaller: the Pn013 or the MECHATROLINK-II Command Option value 1 (P_TLIM)

*4.Whichever the smaller: the Pn522 or the MECHATROLINK-II Command Option value 2 (N_TLIM)

- When the parameter is set to 0 or 1, the Forward and Reverse Torque Limit Inputs are restricted by the No.1 Torque Limit (Pn013).
- During torque control, the value set on the No.1 Torque Limit (Pn013) becomes the forward and reverse limits, regardless of the set value on this parameter. The Torque feed forward function is also disabled.

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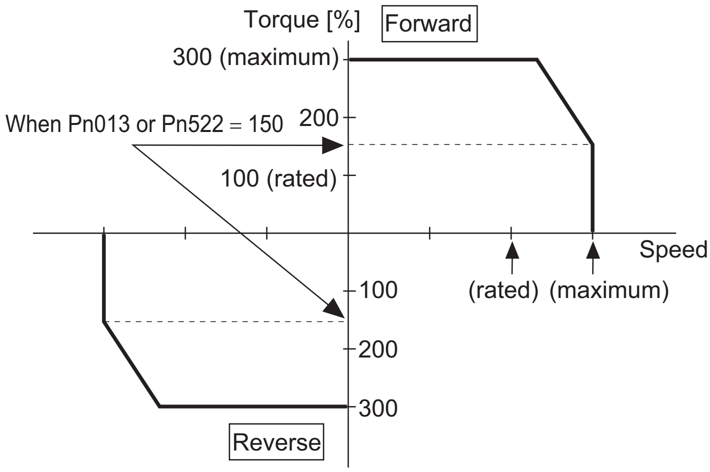
Parameters Details

Pn522	No. 2 Torque Limit					Position Speed Full closing	
Setting range	0 to 500	Unit	%	Default setting	500	Data attribute	B

- Set the limit value for the output torque (Pn013: No. 1 Torque Limit, Pn522: No. 2 Torque Limit) of the motor.
- Refer to information on the Torque Limit Selection (Pn521) to select the torque limits.
- During torque control, maximum torques for both forward and reverse directions are limited. Settings in Torque Limit Selection (Pn521) and No. 2 Torque Limit (Pn522) is ignored.
- Set the value in units of 1% of the rated torque (100%).
  [Example] Maximum torque is limited to 150%



- Refer to "5-3 Torque Control (P.5-6)" for more information on torque limits and the torque limit selection.

Pn523	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn524	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn525	Forward External Torque Limit					Position Speed Full closing	
Setting range	0 to 500	Unit	%	Default setting	500	Data attribute	B

- Set the forward external torque limit upon torque limit switching input.
- Set the value in units of 1% of the rated torque (100%).

Pn526	Reverse External Torque Limit					Position Speed Full closing	
Setting range	0 to 500	Unit	%	Default setting	500	Data attribute	B

- Set the reverse external torque limit upon torque limit switching input.
- Set the value in units of 1% of the rated torque (100%).

Pn527	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn528	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn529	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn530	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn531	Axis Number						All
Setting range	0 to 127	Unit	–	Default setting	1	Data attribute	C

- Set the axis number for USB communications. Normally, do not change the set value.

Pn532	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

- Set the maximum command pulse input.

Pn533	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn534	Reserved for manufacturer use.						All
Setting range	–	Unit	–	Default setting	4	Data attribute	–

- Do not change the set value.

8-7 Special Parameters

Pn600	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn601	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn602	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn603	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn604	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn605	Gain 3 Effective Time						Position Full closing
Setting range	0 to 10000	Unit	0.1 ms	Default setting	0	Data attribute	B

- Set effective time of gain 3 of 3-step gain switching.
- Refer to "6-10 Gain Switching 3 Function (P.6-37)".

Pn606	Gain 3 Ratio Setting						Position Full closing
Setting range	50 to 1000	Unit	%	Default setting	100	Data attribute	B

- Set gain 3 as a multiple of gain 1.
- Refer to "6-10 Gain Switching 3 Function (P.6-37)".

Pn607	Torque Command Value Offset						All
Setting range	–100 to 100	Unit	%	Default setting	0	Data attribute	B

- Set offset torque to add to torque command
- Refer to "10-9 Friction Torque Compensation Function (P.10-33)".
- Set the value in units of 1% of the rated torque (100%).

Pn608	Forward Direction Torque Offset						All
Setting range	–100 to 100	Unit	%	Default setting	0	Data attribute	B

- Set the value to add to the torque command in the forward direction operation.
- Refer to "10-9 Friction Torque Compensation Function (P.10-33)".
- Set the value in units of 1% of the rated torque (100%).

Pn609	Reverse Direction Torque Offset						All
Setting range	–100 to 100	Unit	%	Default setting	0	Data attribute	B

- Set offset torque to add to torque command for reverse direction operation.
- Refer to "10-9 Friction Torque Compensation Function (P.10-33)".
- Set the value in units of 1% of the rated torque (100%).

Pn610	Function Expansion Setting						Position
Setting range	0 to 63	Unit	–	Default setting	0	Data attribute	B

- Set each function per bit.
- Set the decimal value that has been converted from bit.
- Refer to "10-8 Disturbance Observer Function (P.10-31)" and "10-12 Instantaneous Speed Observer Function (P.10-39)".

Bit	Function	Set value	
		0	1
bit 0	Instantaneous speed observer function	Disabled	Enabled
bit 1	Disturbance observer function	Disabled	Enabled
bit 2	Disturbance observer operation setting	Enabled at all time	Only when gain 1 is selected
bit 3	Reserved for manufacturer use	Fixed to 0.	
bit 4	Electric current response improvement function	Disabled	Enabled
bit 5	Reserved for manufacturer use	Fixed to 0.	

Reference

[Example]

- Instantaneous speed observer function: enabled
- Disturbance observer function: enabled
- Disturbance observer operation setting: enabled at all time
- Inertia ratio switching function: disabled
- Electric current response improvement function: enabled
  If the settings are as described above, the bit will be 10011, and the decimal value 19. Therefore, the set value will be 19.

Pn611	Electric Current Response Setting						All
Setting range	50 to 100	Unit	%	Default setting	100	Data attribute	B

- Make fine adjustment on electric current response with default setting as 100%.

Pn612	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn613	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn614	Alarm Detection Allowable Time Setting						All
Setting range	0 to 1000	Unit	ms	Default setting	200	Data attribute	B

- Set the allowable time required until the motor stops by an emergency stop due to an alarm.
- When he time exceeds the set value, the operation forcibly turns to an alarming state.
- When the parameter is set to 0, the protection by allowable time does not function.
- Refer to the Emergency Stop Operation at Alarms in "11-3 Alarms (P.11-6)".

Pn615	Overspeed Detection Level Setting at Emergency Stop						All
Setting range	0 to 20000	Unit	r/min	Default setting	0	Data attribute	A

- If the motor speed exceeds the set value during an emergency stop due to an alarm, the Overspeed 2 (Alarm No.26.1) occurs.
- The overspeed detection level setting is 1.2 times the maximum motor rotation speed if this parameter is set to 0.
- This parameter should normally be set to 0. The setting should be changed only when it is necessary to lower the overspeed detection level.
- Refer to "Emergency Stop Operation at Alarms" (P.11-12) in "11-3 Alarms (P.11-6)".

Pn616	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn617	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn618	Power Supply ON Initialization Time						All
Setting range	0 to 100	Unit	0.1 s	Default setting	0	Data attribute	R

- Set initialization time after power supply ON to the standard 1.5 seconds plus some.
- Refer to the Control Output Sequence in "3-1 Servo Drive Specifications (P.3-1)" for the details at power on.

Pn619	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn620	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn621	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn622	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn623	Disturbance Torque Compensation Gain						Position Speed
Setting range	–100 to 100	Unit	%	Default setting	0	Data attribute	B

- Set compensation gain for disturbance torque.
- Refer to "10-8 Disturbance Observer Function (P.10-31)".

Pn624	Disturbance Observer Filter Setting						Position Speed
Setting range	10 to 2500	Unit	0.01 ms	Default setting	53	Data attribute	B

- Set filter time constant for disturbance torque compensation.
- Refer to "10-8 Disturbance Observer Function (P.10-31)".

Pn625	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn626	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn627	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn628	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn629	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn630	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn631	Realtime Autotuning Estimated Speed Selection						All
Setting range	0 to 3	Unit	–	Default setting	1	Data attribute	B

- Set the speed to estimate the load characteristic while the realtime autotuning is enabled.
- The higher the set value is, the earlier the load characteristic change is followed. But the estimated variation against the disturbance becomes greater.
- Estimated results is updated in every 30 minutes, and saved in EEPEOM.
- Refer to "10-3 Realtime Autotuning (P.10-6)".

Explanation of Set Values

Set value	Mode	Description
0	No change	Stops the load estimation.
1	Little change	Estimates in every minute from the load characteristic changes.
2	Gradual change	Estimates in every second from the load characteristic changes.
3	Sharp change	Estimates the optimum from the load characteristic changes.

Pn632	REALTIME AUTOTUNING CUSTOMIZATION mode Setting						All
Setting range	–32768 to 32767	Unit	–	Default setting	0	Data attribute	B

- Set the details of autotuning function, when the Realtime Autotuning Mode Selection (Pn002) is set to 6.
- Refer to "10-3 Realtime Autotuning (P.10-6)".

Explanation of Set Values

Bit	Name	Description
0 to 1	Load characteristic estimation *1	Select to enable or disable the load characteristic estimation. 0: Disable 1: Enable
2 to 3	Inertia ratio updating	Select whether to update the present set value on the Inertial Ratio (Pn004) by the load characteristic estimation result. 0: Use the present set value. 1: Update by the estimation result.
4 to 6	Torque compensation	Select whether to update three parameters, Torque Command Value Offset (Pn607), Forward Direction Torque Offset (Pn608), and Reverse Direction Torque Offset (Pn609), by the load characteristic estimation result. 0: Use the present set value. 1: Disable the torque compensation. Clear the above three parameters to zero. 2: Vertical mode, Update Pn607. Clear Pn608 and Pn609 to zero. 3: Friction compensation (small), Update Pn607. Set a small compensation to Pn608 and Pn609. 4: Friction compensation (intermediate), Update Pn607. Set an intermediate compensation to Pn608 and Pn609. 5: Friction compensation (large), Update Pn607. Set a large compensation to Pn608 and Pn609.

Bit	Name	Description
7	Rigidity setting	Select to enable or disable the basic gain setting by the Realtime Autotuning Machine Rigidity Setting (Pn003). 0: Disable 1: Enable
8	Fixed parameter setting	Select whether to allow changes on the parameters which normally are fixed. 0: Use the present setting. 1: Set it to a fixed value.
9 to 10	Gain switch setting	Select the method to set the parameters that relate to gain switching while the Realtime Autotuning is enabled. 0: Use the present setting. 1: Disable the gain switching. 2: Enable the gain switching.

*1. When the load characteristic estimation is set to disabled, the inertial ratio updating is also disabled, regardless the latter is set to update by the estimation result. When the torque compensation are updated by the estimation result, the load characteristic estimation is disabled.

Precautions for Safe Use

- This parameter must be set in units of bits. Users must be fully aware that proper operation of your system is not guaranteed, if you have incorrect 1parameter setting. Pay a particular attention when you set them.

Reference

Procedure to set the parameter bit by bit
Follow these steps and calculate the set values, when you make any setting other than 0.

(1) Confirm the least significant bit (LSB) in each set value.

E.g. LSB of Torque compensation function: 4

(2) Multiply the set value by the (LSB) power of 2.

E.g. To set the torque compensation to Friction compensation (small): The set value is 3. The exponent is 4.

$2^4 \times 3 = 48$

(3) Repeat Step (1) and (2) for all bit settings. Add all results and set the outcome to Pn632.

E.g. When all of the Load characteristic estimation, the Inertia ratio updating, the Rigidity setting, and the Gain switch setting are enabled, the Torque compensation is set to Friction compensation (small), and the Fixed parameter setting is set to a Fixed value:

$2^0 \times 1 + 2^2 \times 1 + 2^4 \times 3 + 2^7 \times 1 + 2^8 \times 1 + 2^9 \times 2 = 1461$

Pn633	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn634	Hybrid Vibration Suppression Gain						Full closing
Setting range	0 to 30000	Unit	0.1/s	Default setting	0	Data attribute	B

- Set the hybrid vibration suppression gain during full closing control.
- In general, set it to the same value as the position loop gain, and finely adjust it based on the situation.
- Refer to "10-10 Hybrid Vibration Suppression Function (P.10-35)".

Pn635	Hybrid Vibration Suppression Filter						Full closing
Setting range	0 to 6400	Unit	0.01 ms	Default setting	10	Data attribute	B

- Set the hybrid vibration suppression filter.
- Refer to "10-10 Hybrid Vibration Suppression Function (P.10-35)".

Pn636	Unused						All
Setting range	–	Unit	–	Default setting	–	Data attribute	–

Pn637	Vibration Detection Threshold						All
Setting range	0 to 1000	Unit	0.1%	Default setting	0	Data attribute	B

- Set the vibration detection threshold.
- If torque vibration that exceeds this setting is detected, the vibration detection warning occurs.
- Refer to "11-2 Warning (P.11-4)".
- Set the value in units of 0.1% of the rated torque (100%).

Pn638	Warning Mask Setting						All
Setting range	–32768 to 32767	Unit	–	Default setting	4	Data attribute	C

- Set the warning detection mask setting.
- If you set the corresponding bit to 1, the corresponding warning detection is disabled.
- Refer to the General Alarms in "11-2 Warning (P.11-4)".

Warning number	Warning name	Warning occurrence condition	Warning Mask Setting (Pn638)*1
A0	Overload warning	The load ratio is 85% or more of the protection level.	bit7
A1	Excessive regeneration warning	The regeneration load ratio is 85% or more of the protection level.	bit5
A2	Battery warning	Battery voltage is 3.2 V or less.	bit0
A3	Fan warning	The fan stop status continues for 1 second.	bit6
A4	Encoder communications warning	The encoder communications errors occurred in series more frequently than the specified value.	bit4
A5	Encoder overheating warning	The encoder detects the overheat warning.	bit3
A6	Vibration detection warning	Vibration is detected.	bit9
A7	Life expectancy warning	The life expectancy of the capacitor or the fan is shorter than the specified value.	bit2
A8	External encoder error warning	The external encoder detects a warning.	bit8
A9	External encoder communications warning	The external encoder has communications errors in series more than the specified value.	bit10

*1.Each warning detection can be masked by the Warning Mask Setting (Pn638). The table above shows the corresponding bit. When the bit is set to 1, the warning detection is masked.

Pn700	Default Display						All
Setting range	0 to 32767	Unit	–	Default setting	0	Data attribute	A

- Select a data type to display on the 7-segment LED indicator on the front panel.

Explanation of Set Value

Set value	Indicated item	Description
0	Normal state	Indicates "––" during Servo-OFF, and "00" during Servo-ON.
1	Mechanical angle	Indicates a value between 0 and FF hex. The value 0 indicates the zero position of encoder. The value increments when the motor rotates in counter clockwise (CCW) direction. The value returns to 0 when it exceeds FF, but the count continues. When an incremental encoder is used, it indicates "nF" (i.e., not fixed) until the zero position of the encoder is detected after the control power is on.
2	Electric angle	Indicates a value between 0 and FF hex. The value 0 indicates the position when the U-phase electro-motive force shows the positive peak. The value increments when the motor rotates in counter clockwise (CCW) direction. The value returns to 0 when it exceeds FF, but the count continues.
3	Cumulative count of MECHATROLINK-II communications errors*1	Indicates a value between 0 and FF hex. The cumulative count is saturated when it reaches the maximum value (FFFF hex). In this case, only the lowest order byte is shown. The value returns to 00 when it exceeds FF, but the count continues.
4	Rotary switch setting (node address)	Indicates the rotary switch setting (i.e. node address) read at power-on. The indication is in decimal. The value is not altered by any changes on the rotary switch setting after the power-on.
5	Cumulative count of encoder communications errors*1	Indicates a value between 0 and FF hex. The cumulative count is saturated when it reaches the maximum value (FFFF hex). In this case, only the lowest order byte is shown. The value returns to 00 when it exceeds FF, but the count continues.
6	Cumulative count of external encoder communications errors*1	
7	Z-phase counter *2	Indicates the Z-phase count value read from the external encoder when an incremental external encoder is used during full closing control. The value between 0 an FF hex is indicated.
8 or over	Unused	Do not set anything.

*1. The cumulative count of communication errors is cleared when the control power is cut off.

*2. The value read from the encoder is indicated directly, regardless of the External Feedback Pulse Direction Switching on the Pn326.

Pn701	Power ON Address Display Duration Setting						All
Setting range	0 to 1000	Unit	100 ms	Default setting	0	Data Attribute	R

- Set the duration to display the node address when the control power is turned ON.

Pn702	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn703	Torque Limit Flag Output Setting						Torque
Setting range	0 to 1	Unit	–	Default setting	0	Data Attribute	A

- Set the condition for torque limit output during torque control.

Explanation of Set Value

Set value	Description
0	On by the torque limit value including the torque command value.
1	On by the torque limit value excluding the torque command value.

Pn704	Backlash Compensation Selection						Position Full closing
Setting range	0 to 2	Unit	–	Default setting	0	Data Attribute	C

- Select to enable or disable the backlash compensation during position control. Set the compensation direction when the compensation is enabled.
- Refer to "6-4 Backlash Compensation (P.6-12)".

Explanation of Set Value

Set value	Description
0	Disable the backlash compensation.
1	Compensate the backlash at the first forward operation after a Servo-ON.
2	Compensate the backlash at the first reverse operation after a Servo-ON.

Pn705	Backlash Compensation Amount						Position Full closing
Setting range	–32768 to 32767	Unit	Command unit	Default setting	0	Data Attribute	B

- Set the backlash compensation amount during position control.
- Refer to "6-4 Backlash Compensation (P.6-12)".

Pn706	Backlash Compensation Time Constant						Position Full closing
Setting range	0 to 6400	Unit	0.01 ms	Default setting	0	Data Attribute	B

- Set the backlash compensation time constant for position control.
- Refer to "6-4 Backlash Compensation (P.6-12)".

Pn707	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn708	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn709	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn710	MECHATROLINK-II Communication I/O Monitor Setting						All
Setting range	0 to 1	Unit	–	Default setting	0	Data Attribute	A

- Select whether to reflect the inputs to the I/O monitor of MECHATROLINK-II communications, when either the forward or reverse drive prohibition input is assigned to the input signal, and the Drive Prohibition Input Selection (Pn504) is set to 1 (Disabled).

Explanation of Set Value

Set value	Description
0	Disable the one on the I/O monitor of MECHATROLINK-II communications as well.
1	Enable the one on the I/O monitor of MECHATROLINK-II communications.

Pn800	Communications Control						All
Setting range	–32768 to 32767	Unit	–	Default setting	0	Data Attribute	C

- Controls the alarms and warnings over the MECHATROLINK-II communications.
- Alarm setting
  A communications error (Alarm No.83.0) is detected if the data to be received in MECHATROLINK-II communications cycles is not received correctly, and the failures continues in series more often than the detection times set on the Communications Control (Pn800).
- Warning setting
  To mask the warning, set the corresponding bit to 1. Then the warning detection is disabled.
  Refer to " Warnings related to MECHATROLINK-II Communications (P.11-5)".

Warning number	Warning name	Warning occurrence condition	Communications control setting (Pn800) *1
94	Data setting warning	• The set value on the command argument is out of the specified range. • Parameter writing fails. • The command set value is incorrect.	bit4
95	Command warning	• The command transmission conditions are not met. • The sub-command transmission conditions are not met. • A rotation command is given in the prohibited direction after the motor made an emergency stop due to a drive prohibition input.	bit5
96	MECHATROLINK-II communications warning	One or more MECHATROLINK-II communications error occur.	bit6

*1.The MECHATROLINK-II communications warning detections can be masked by the setting on the Communications Control (Pn800). The table above shows the corresponding bits.
The warning detection is masked when you set the corresponding bit to 1.

Pn801	Soft Limit						All
Setting range	0 to 3	Unit	–	Default setting	0	Data Attribute	A

- Select whether to enable or disable the Soft Limit.
- When it is enabled, set the soft limit values on the Forward Software Limit (Pn804) and the Reverse Software Limit (Pn806).

Explanation of Set Value

Set value	Description
0	Enable the soft limits on both directions.
1	Disable the forward soft limit, but enable the reverse soft limit.
2	Enable the forward soft limit, but disable the reverse soft limit.
3	Disable the soft limits on both directions.

Precautions for Correct Use

- The disabled limit signals turn to enable (or in the state of set value 0), during the MECHATROLINK-II communications status or if the origin return is not completed.

Pn802	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn803	Origin Range						All
Setting range	0 to 250	Unit	Command unit	Default setting	10	Data Attribute	A

- Set the threshold for detecting the origin in absolute values.

Pn804	Forward Software Limit						All
Setting range	–1073741823 to 1073741823	Unit	Command unit	Default setting	500000	Data Attribute	A

- Set the forward software limit.

Pn805	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn806	Reverse Software Limit						All
Setting range	–1073741823 to 1073741823	Unit	Command unit	Default setting	–500000	Data Attribute	A

- Set the reverse software limit.

Pn807	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn808	Absolute Encoder Origin Offset						All
Setting range	–1073741823 to 1073741823	Unit	Command units	Default setting	0	Data Attribute	C

- Set the offset volume between the encoder or external encoder position and the mechanical coordinate position, when an absolute encoder or an absolute external encoder is used.

Pn809	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn810	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn811	Linear Acceleration Constant						Position Full closing
Setting range	-32768 to 32767 (0 to 65535)	Unit	10000 command units/s^2	Default setting	100	Data Attribute	B

- Set the acceleration for positioning.
- The set value is converted to unsigned 16-bit data (0 to 65535).
  Example: -32768 → 8000h = 32768, -1 → FFFFh = 65535
  If 0 is set, the internal value is handled as 1.

Pn812	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn813	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn814	Linear Deceleration Constant						Position Full closing
Setting range	-32768 to 32767 (0 to 65535)	Unit	10000 command units/s^2	Default setting	100	Data Attribute	B

- Set the deceleration for positioning.
- The set value is converted to the same type as Pn811.

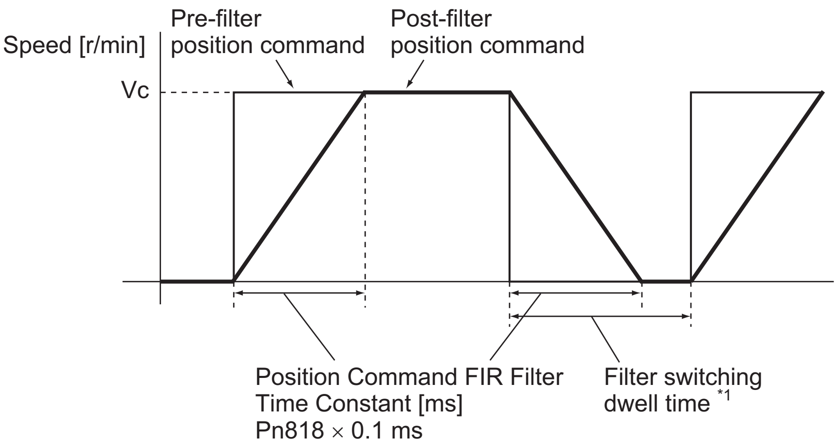
Pn815	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn816	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn817	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn818	Position Command FIR Filter Time Constant					Position Full closing	
Setting range	0 to 10000	Unit	0.1 ms	Default setting	0	Data Attribute	B

- Set the time constant of FIR filter for the position command.
- The Position command FIR filter can be selected to enable or disable, by the position command filer switch input via MECHATROLINK-II communications.
- It sets the time to arrive at the target speed Vc, as shown below, for the square-wave command of Vc.



*1. Change the setting on Pn818 only after you stop the command pulse and the filter switching dwell time elapses. The dwell time is calculated by the following formulas depending on the value set on Pn818.
If Pn818 set value ≤ 10 ms, the set value × 0.1 ms + 0.25 ms.
If Pn818 set value > 10 ms, the set value × 0.1 ms × 1.05.

Precautions for Correct Use

- If the set value on Pn818 is changed during the position command is entered, the change is not reflected immediately. It is updated only after the subsequent state of no position command persists for the filter switching dwell time.
- There is some time lag from when the Pn818 is change and to when the change is applied. If the filter switching dwell time elapses during the lag, the change may be suspended.

Pn819	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn820	Final Distance for External Input Positioning					Position Full closing	
Setting range	–1073741823 to 1073741823	Unit	Command units	Default setting	100	Data Attribute	B

- Sets the distance to travel after the latch signal input position is detected during the external input positioning.

Pn821	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

8

Parameters Details

Pn822	Origin Return Mode Setting					Position Full closing	
Setting range	0 to 1	Unit	–	Default setting	0	Data Attribute	B

- Set the direction for origin return.

Explanation of Set Values

Set value	Description
0	Positive direction
1	Negative direction

Pn823	Origin Return Approach Speed 1					Position Full closing	
Setting range	1 to 32767	Unit	100 command units/s	Default setting	50	Data Attribute	B

- Set the operating speed for origin returns, from when the origin proximity signal turns ON to when it turns OFF and the latch signal is detected.

Reference

The maximum approach speed is limited by the maximum motor rotation speed.

Pn824	Origin Return Approach Speed 2					Position Full closing	
Setting range	1 to 32767	Unit	100 command units/s	Default setting	5	Data Attribute	B

- Set the operating speed for origin returns, from when the latch signal is detected to when the motor reaches the Final Distance for Origin Return (Pn825).

Reference

The maximum approach speed is limited by the maximum motor rotation speed.

Pn825	Final Distance for Origin Return					Position Full closing	
Setting range	–1073741823 to 1073741823	Unit	Command units	Default setting	100	Data Attribute	B

- Set the distance from the position where the latch signal is entered to the origin during origin returns.

Pn826	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn827	Unused					All	
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn828	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn829	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn830	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn831	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn832	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn833	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn834	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn835	Unused						All
Setting range	–	Unit	–	Default setting	–	Data Attribute	–

Pn836	Option Monitor Selection 1						All
Setting range	–32768 to 32767	Unit	–	Default setting	0	Data Attribute	A

- The Monitor Selection Field of MECHATROLINK-II communications displays the monitoring data that is set on this parameter.

Pn837	Option Monitor Selection 2						All
Setting range	–32768 to 32767	Unit	–	Default setting	0	Data Attribute	A

- The Monitor Selection Field of MECHATROLINK-II communications displays the monitoring data that is set on this parameter.

9

Operation

This chapter explains the operating procedures and how to operate in each mode.

9-1 Operational Procedure

Turn ON the power supply after the correct installation and wiring to check the operation of the individual motor and drive.
Then make the function settings as required according to the use of the motor and drive.
If the user parameters are set incorrectly, there is a risk of an unpredictable motor operation, which is dangerous. Set the parameters securely according to the setting methods in this manual.

Item	Contents	Reference
Mounting and installation	Install the motor and drive according to the installation conditions.(Do not connect the motor to the mechanical system before checking the no-load operation.)	Chapter 4, 4-1
↓		
Wiring and connections	Connect the motor and drive to the power supply and peripheral equipment. Specified installation and wiring conditions must be satisfied, particularly for models conforming to the EC directives.	Chapter 4, 4-2
↓		
Preparing for operation	Check the necessary items and then turn ON the power supply. Check on the display to see whether there are any internal errors in the drive. If using a motor with an absolute encoder, first set up the absolute encoder.	Chapter 9, 9-2
↓		
Function settings	By means of the user parameters, set the functions according to the operating conditions.	Chapter 8
↓		
Trial operation	First, check the motor operation with no-load condition. Then turn the power supply OFF and connect the motor to the mechanical system. If using a motor with an absolute encoder, set up the absolute encoder and set the Motion Control Unit's initial parameters. Turn ON the power supply again, and check to see whether protective functions, such as the emergency stop and operational limits, work properly. Check operation at both low speed and high speed using the system without a workpiece, or with dummy workpieces.	Chapter 9, 9-3
↓		
Adjustment	Manually adjust the gain if necessary. Further adjust the various functions to improve the control performance.	Chapter 10
↓		
Operation	Operation can now be started. If any problems should occur, refer to "Chapter 11, Error and Maintenance".	Chapter 11

9-2 Preparing for Operation

This section explains the procedure to prepare the mechanical system for operation following installation and wiring of the motor and drive. It explains items to check both before and after turning ON the power supply.
It also explains the setup procedure required if using a motor with an absolute encoder.

Items to Check Before Turning ON the Power Supply

Checking Power Supply Voltage

- Check to be sure that the power supply voltage is within the ranges shown below.

R88D-KNA5L-ML2/-KN01L-ML2/-KN02L-ML2/-KN04L-ML2 (Single-phase 100-VAC input)
Main circuit power supply: Single-phase 100 to 120 VAC (85 to 132) 50/60 Hz
Control circuit power supply: Single-phase 100 to 120 VAC (85 to 132) 50/60 Hz

R88D-KN01H-ML2/-KN02H-ML2/-KN04H-ML2/-KN08H-ML2/-KN10H-ML2/-KN15H-ML2
Main circuit power supply: Single-phase or single-phase/3-phase 200 to 240 V (170 to 264 V) 50/60 Hz Control circuit power supply: Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz

R88D-KN20H-ML2/-KN30H-ML2/-KN50H-ML2 (3-phase 200-VAC input)
Main circuit power supply: 3-phase 200 to 230 VAC (170 to 253 V)
50/60 Hz Control circuit power supply: Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz

R88D-KN06F-ML2/-KN10F-ML2/-KN15F-ML2/-KN20F-ML2/-KN30F-ML2/-KN50F-ML2
Main circuit power supply: 3-phase 380 to 480 VAC (323 to 528 V)
50/60 Hz Control circuit power supply: 24 VDC ± 15%

Checking Terminal Block Wiring

- The main circuit power supply inputs (L1/L3 or L1/L2/L3) must be properly connected to the terminal block.
- The control circuit power supply inputs (L1C/L2C) must be properly connected to the terminal block.
- The motor's red (U), white (V), and blue (W) power lines and the green/yellow (⏚) must be properly connected to the terminal block.

Checking the Motor

- There should be no load on the motor. (Do not connect the mechanical system.)
- The motor side power lines and the power cables must be securely connected.

Checking the Encoder Wiring

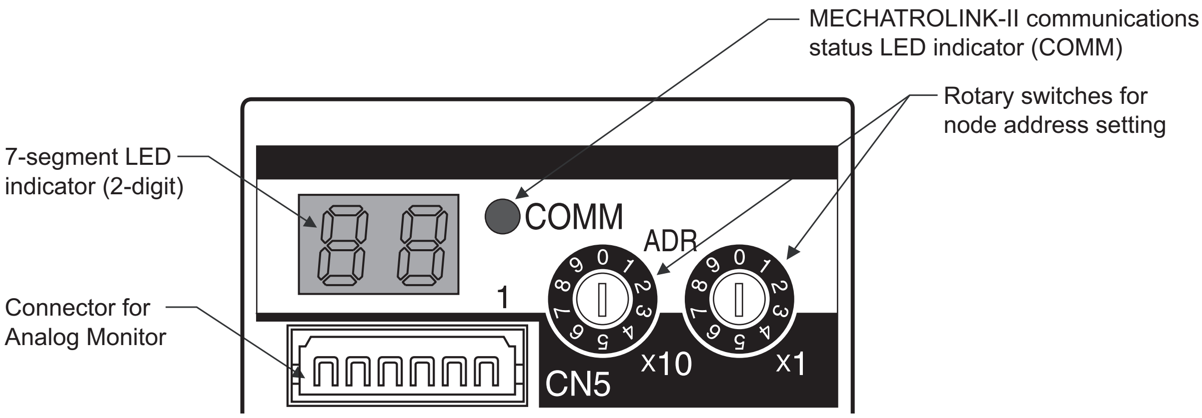
- The encoder cable must be securely connected to the encoder connector (CN2) at the drive side.
- The encoder cable must be securely connected to the encoder connector at the motor side.

Checking the MECHATROLINK-II Communications Connectors

- The MECHATROLINK-II Communications Cables must be connected securely to the MECHATROLINK-II Communications Connectors (ML2A and ML2B).

Display Area and Setting on Drives

This is the display area of R88D-KNx Servo Drive.
There are the rotary switches to set the MECHATROLINK-II communication node address, the Drive alarm indicator, and the MECHATROLINK-II communications status LED indicator.



Note 1. The node address set by the rotary switch is read only once when the control power is turned on. Any changes made by the rotary switches after the power-on are not reflected to the Controller. Such changes become effective only after the subsequent power-on following to a power-off. Do not change the rotary switch setting after the power-on.

Note 2. The settable range for a node address is between 1 and 31. The node address used over the network is the value obtained by adding the offset 40h to the rotary switch set value. If any value over or under the range is set, the Node address setting error (Alarm No.82.0) occurs.

Rotary switch setting	Description
1 to 31	Node address = Set value + 40h (41h≤ Node address ≤ 5Fh)
Others	Node address setting error (Alarm No.82.0) occurs.

MECHATROLINK-II Communications Status LED Indicator

The table below shows the LED indication status and the corresponding conditions of the communications.

LED status	Communications status
Unlit	No communication is established.
Green Flash	Asynchronous communications is established.
Green Light	Synchronous communications is established.
Red Flash	A clearable error occurred in MECHATROLINK-II communications. • Communications error (Alarm No.83.0) • Transmission cycle error (Alarm No.84.0) • SSYNC_SET error (Alarm No.84.4) • Watchdog data error (Alarm No.86.0) • Transmission cycle setting error (Alarm No.90.0) • CONNECT error (Alarm No.90.1) • SYNC command error (Alarm No.91.0)
Red Light	A non-clearable error occurred in MECHATROLINK-II communications. • Node address setting error (Alarm No.82.0) • SYNC process error (Alarm No.84.3)

Note. If any of communication related error occurs while an error that is not related to MECHATROLINK-II communications happens, the MECHATROLINK-II Communications Status LED Indicator follows the corresponding communications status as shown above.

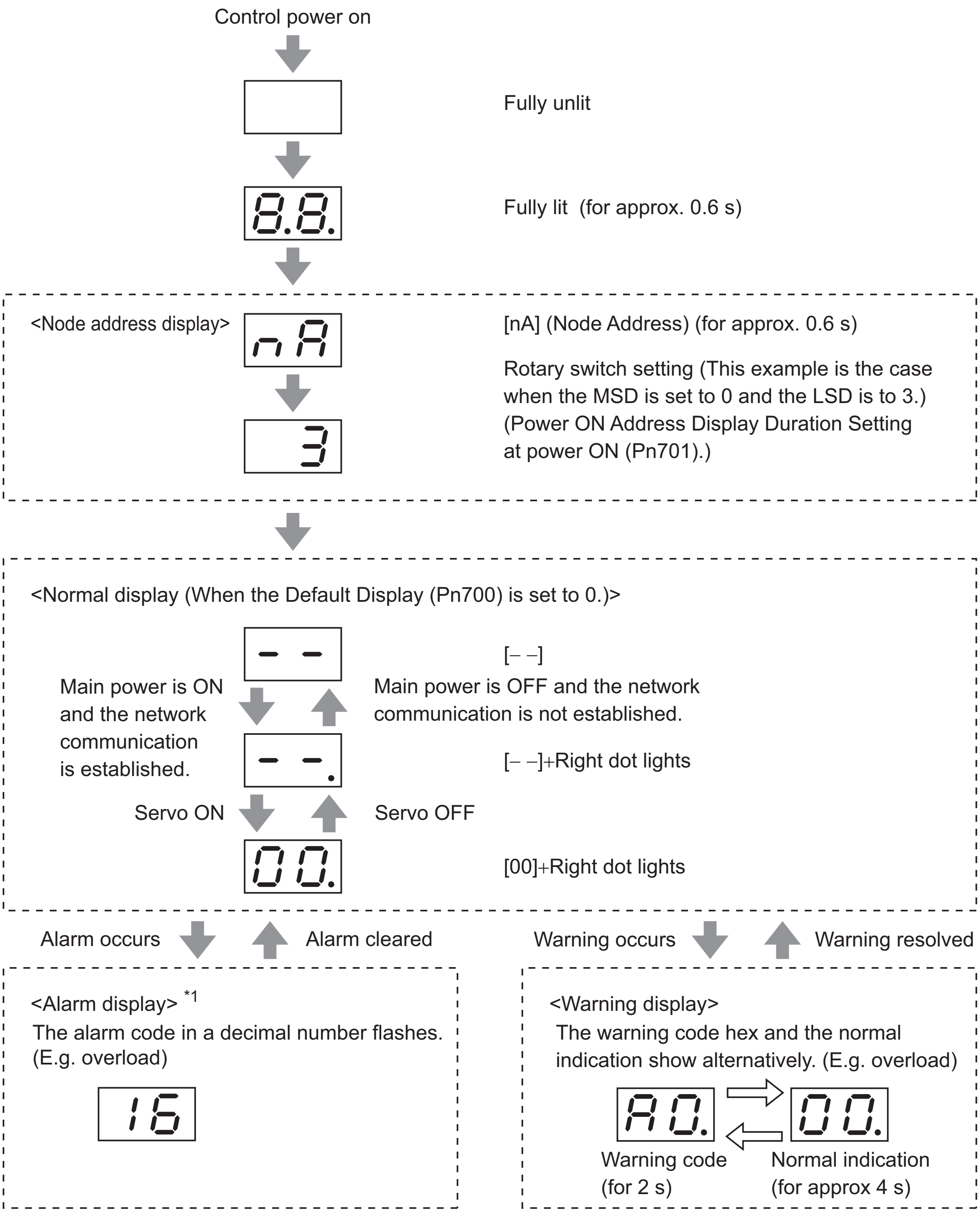
Turning on the Power Supply

- Turn on the control circuit power after you conduct the pre-power-on checking.
  You may turn on the main circuit power, but it is not a requisite.
- It takes approx 2 seconds for the alarm output (/ALM) to turn on since the power-on. Do not attempt to detect an alarm, during this period, by the Host Controller. This precaution relates to the case when the power is turned on while the Host Controller is connected.

Checking the Displays

7-Segment LED Indicator

The 7-segment LED indicator is on the front panel.
When the power is turned on, it shows the node address that is set by the rotary switches. Then the indication changes in accordance with the setting on the Default Display (Pn700).
If any alarming error occurs, it indicates the error number (Alarm No.xx) as the alarm code. If any warning situation occurs, it indicates the warning number as the warning code.



*1. When the Safety input error (Alarm No.33.0) occurs, the alarm code is not shown. Instead, "St" flashes.

9

Operation

Absolute Encoder Setup ABS

You must set up the absolute encoder if using a motor with an absolute encoder. The setup is required when you turn ON the power supply for the first time, when an absolute encoder system down error (Alarm No.40) occurs, or when the encoder cable is disconnected and then connected again.
To use an absolute encoder, set the Operation Switch when Using Absolute Encoder (Pn015) to 0 or 2.

The absolute encoder is set up via communications. Refer to the operation manual of the host controller of CX-Drive (Cat. No. W453).
After the setup, turn off the control power and turn it on again.

9-3 Trial Operation

When you have finished installation, wiring, and switch settings and have confirmed that status is normal after turning ON the power supply, perform trial operation. The main purpose of trial operation is to confirm that the servo system is electrically correct.
If an error occurs during the trial operation, refer to "Chapter 11, Error and Maintenance" to eliminate the cause. Then check for safety, and then retry the trial operation.

Preparation for Trial Operation

Inspections before Trial Operation

Check the following items.

Wiring

- Make sure that there is no error (especially the power supply input and motor output).
- Make sure that there are no short-circuits. (Check the ground for short circuits as well.)
- Make sure that there are no loose connections.

Power Supply Voltage

- Make sure that the voltage corresponds to the rated voltage.

Motor Installation

- Make sure that it is securely installed.

Disconnection from Mechanical System

- If necessary, make sure that the motor has been disconnected from the mechanical system.

Brake Released

- Make sure that the brake has been released.

Trial Operation by Using the CX-Drive

1. **Use the Connector CN1 for connection.**
2. **Supply the power of 12 to 24 VDC to the control signal connector pins +24 VIN and COM.**
3. **Turn on the Servo Drive power.**
4. **Confirm the parameters are set to standard values.**
5. **Connect the USB cable to the CN7 Connector. Write the parameters from the CX-Drive.**
6. **Write the parameters to EEPROM. Turn OFF the power and then turn ON the power again.**
7. **Operate the CX-Drive in jog operation to make the Servo ON state. Keep the motor in servo lock state.**
8. **Operate the CX-Drive in low jog speed.**
9. **Confirm the motor rotation speed.**

10

Adjustment Functions

This chapter explains the functions, setting methods and items to note regarding various gain adjustments.

10-1 Analog Monitor

Two types of analog signals can be output from the Analog Monitor Connector on the front panel.
They are used when the monitoring is required for adjustment.
A monitor type and a scale (output gain) can be set by the following parameters.
The refresh period of the analog monitor is 1 ms.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn416	Analog Monitor 1 Selection	Set the monitoring item for the analog monitor 1.	P.8-32
Pn417	Analog Monitor 1 Scale Setting	Set the output gain for the analog monitor 1.	P.8-32
Pn418	Analog Monitor 2 Selection	Select the monitoring item for the analog monitor 2.	P.8-32
Pn419	Analog Monitor 2 Scale Setting	Set the output gain for the analog monitor 2.	P.8-33
Pn421	Analog Monitor Output Setting	Select the analog monitor output method.	P.8-33

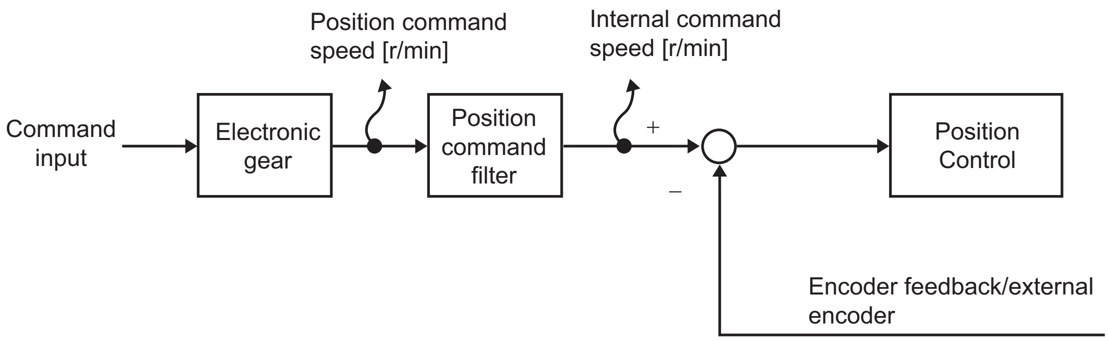
Analog Monitor Parameters (Pn416, Pn417, Pn418 and Pn419)

The analog monitor scales (Pn417 and Pn419) are set in units for 1 V. When the parameters are set to 0, the values shown in the table below are automatically set.

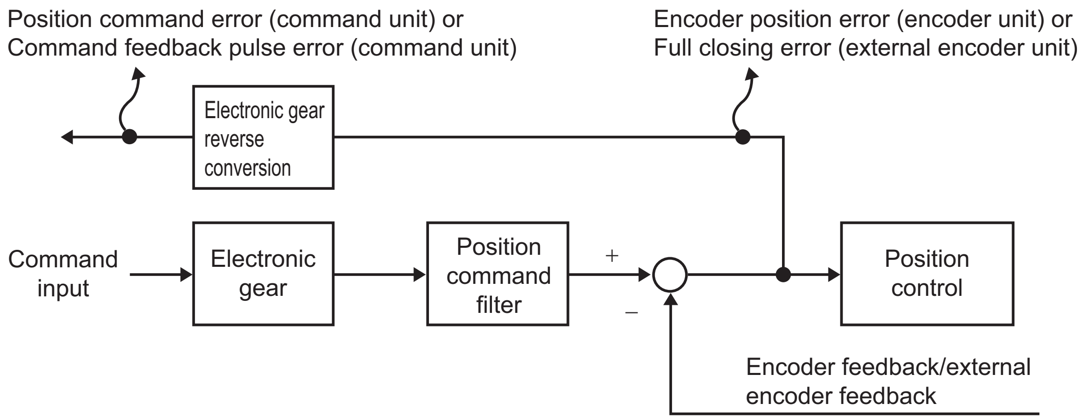
Pn416 and Pn418 set value	Description		
	Monitoring item	Unit	Output gain when Pn417 and Pn419 are set to 0
0	Motor speed	r/min	500
1	Position command speed *1	r/min	500
2	Internal position command speed *1	r/min	500
3	Speed control command	r/min	500
4	Torque command	% (rated torque ratio)	33
5	Command position error *2	pulse (command unit)	3000
6	Encoder position error *2	pulse (encoder unit)	3000
7	Full closing error *2	pulse (external encoder unit)	3000
8	Hybrid Error	pulse (command unit)	3000
9	P-N voltage	V	80
10	Regeneration load ratio	%	33
11	Overload load ratio	% (rated torque ratio)	33
12	Forward direction torque limit	% (rated torque ratio)	33

Pn416 and Pn418 set value	Description		
	Monitoring item	Unit	Output gain when Pn417 and Pn419 are set to 0
13	Reverse direction torque limit	%	33
14	Speed limit value	r/min	500
15	Inertia ratio	%	500
16 to 18	Reserved	–	–
19	Encoder temperature*3	°C	10
20	Servo Drive temperature	°C	10
21	Encoder 1-rotation data *4	pulse (encoder unit)	110000

*1.The Position command speed is the speed before the command input passes through the command filter (the position command filter time constant and the smoothing filter time constant). The internal command speed is the speed after the command input passes through the command filter.



*2.The position command error is an error on the command input. The encoder position error and the full closing position error are the error of the input section of the position control.
Each of position error and feedback pulse error is expressed in 2 types of units: Encoder unit and command unit for position errors, and external encoder unit and command unit for feed back pulse errors. The encoder unit and the external encoder unit are for the errors of the position control input sections, while the command unit is for the error of command pulse inputs.



*3.The encoder temperature is indicated only for the 20-bit incremental encoder. The value is not settled for other types of encoders.
*4.Directions of monitor data, either forward or reverse, is the direction set in the Rotation Direction Switching (Pn000). However, CCW is the forward direction for the absolute encoder 1-rotation data. A normal value is output from the incremental encoder after the first phase Z.

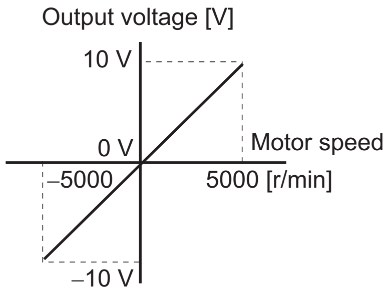
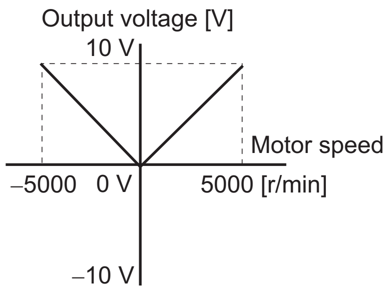
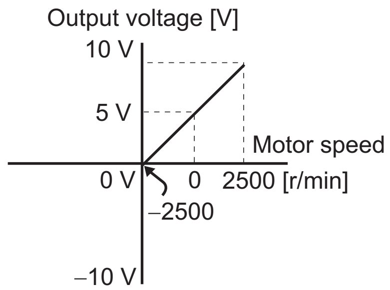
10

Adjustment Functions

Analog Monitor Output Setting (Pn421)

Select the direction for analog monitor output voltage.

These are the output voltage range and the output direction when the Analog Monitor 1 Selection (Pn416) or the Analog Monitor 2 Selection (Pn418) is set to 0 (i.e., motor speed), and the Analog Monitor 1 Scale Setting (Pn417) or the Analog Monitor 2 Scale Setting (Pn419) is set to 0 (i.e., 1V = 500 r/min).

Set value	Output range	Data output
0	–10 to 10 V	
1	0 to 10 V	
2	0 to 10 V (5 V as the center)	

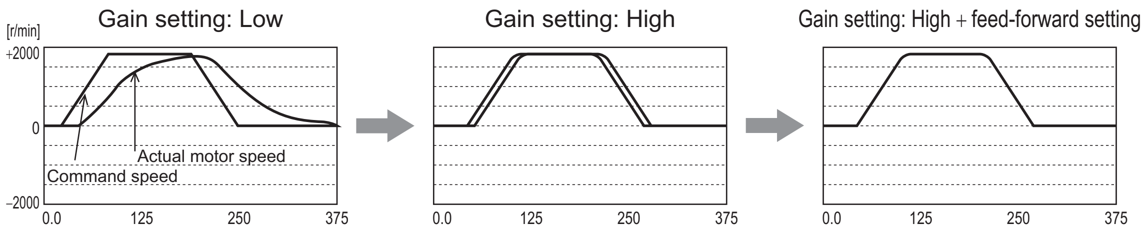
10-2 Gain Adjustment

OMNUC G5-Series Servo Drives provide the realtime autotuning function.
With this function, gain adjustments can be made easily even by those who use a servo system for the first time. If you cannot obtain desired responsiveness with autotuning, use manual tuning.

Purpose of the Gain Adjustment

The Servo Drive must operate the motor in response to commands from the host system with minimal time delay and maximum reliability. The gain is adjusted to bring the actual operation of the motor as close as possible to the operations specified by the commands, and to maximize the performance of the machine.

Example: Ball screw



	Gain setting: Low	Gain setting: High	Gain setting: High + feed-forward setting
Position loop gain	3.0	251.0	251.0
Speed loop gain	2.5	140.0	180.0
Speed loop integral time constant	190.0	6.0	6.0
Speed feed-forward	30	30	100
Inertia ratio	300	300	300

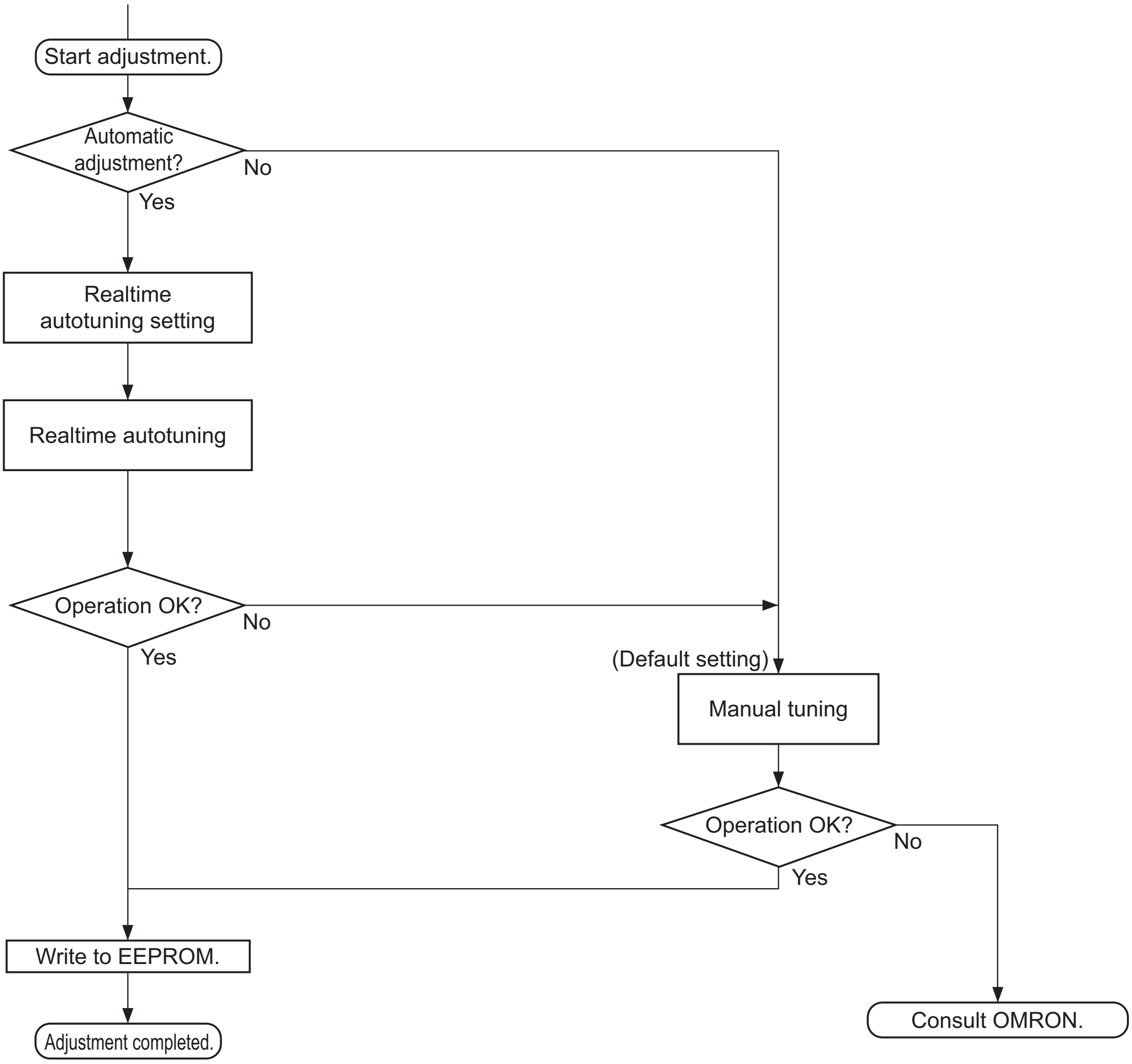
Gain Adjustment Methods

Function			Description	Reference page
Automatic adjustment	Realtime autotuning		Realtime autotuning estimates the load inertia of the machine in realtime and automatically sets the optimal gain according to the estimated load inertia.	P.10-6
Manual adjustment	Manual tuning		Manual adjustment is performed if autotuning cannot be executed due to restrictions on the CONTROL mode or load conditions or if ensuring the maximum responsiveness to match each load is required.	P.10-13
		Basic procedure	POSITION CONTROL/FULL CLOSING CONTROL mode adjustment	P.10-14
			SPEED CONTROL mode adjustment	P.10-15
			TORQUE CONTROL mode adjustment	P.10-20

Precautions for Safe Use

- Take sufficient care for safety.
- If vibration occurs (unusual noise or vibration), immediately turn OFF the power supply or let the servo OFF status occur.

Gain Adjustment Procedure



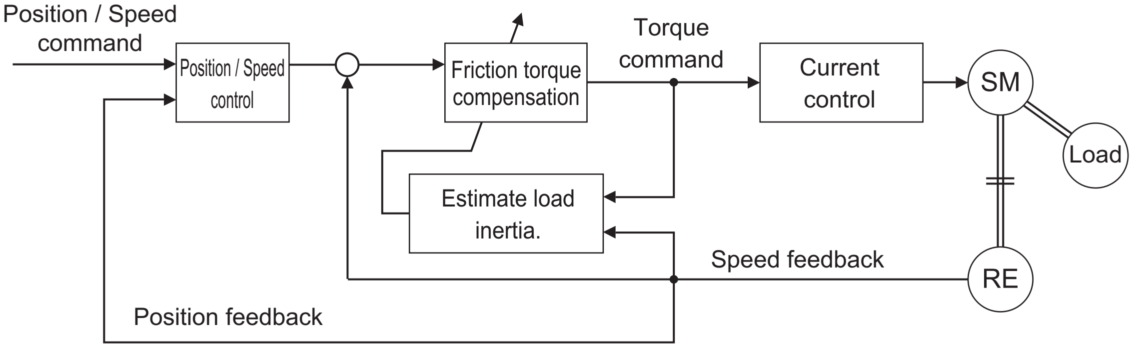
Gain Adjustment and Machine Rigidity

To improve machine rigidity:

- Install the machine on a secure base so that it does not cause any play.
- Use couplings that have a high rigidity, and that are designed for servo systems.
- Use a wide timing belt. And use a tension within the range of allowable axial load for the motor or Decelerator output.
- Use gears with small backlash.
  The specific vibration (resonance frequency) of the mechanical system has a large impact on the gain adjustment of the servo. The servo system responsiveness cannot be set high for machines with a low resonance frequency (low machine rigidity).

10-3 Realtime Autotuning

Realtime autotuning estimates the load inertia of the machine in realtime and operates the machine by automatically setting the gain according to the estimated load inertia. At the same time, it can lower the resonance and vibration if operated with the adaptive filter enabled.
Refer to "10-6 Adaptive Filter" (P.10-25) for details about adaptive filters.
Realtime autotuning is enabled for any control to adjust the speed loop PI control.



Precautions for Correct Use

- Realtime autotuning may not function properly under the conditions described in the following table.In such cases, use manual tuning.

	Conditions under which realtime autotuning does not operate properly
Load inertia	• If the load inertia is small or large compared with the rotor inertia. (less than 3 times, more than 20 times, or more than the applicable load inertia ratio) • If the load inertia changes quickly. (in less than 10 s)
Load	• If the machine rigidity is extremely low. • If there is backlash or play in the system.
Operation pattern	• If the speed is continuously run at a low speed below 100 r/min. • If the acceleration/deceleration gradually changes at less than 2,000 r/min in 1 s. • If the acceleration/deceleration torque is too small compared with the unbalanced load and the viscous friction torque. • If a speed of 100 r/min or an acceleration/deceleration of 2,000 r/min/s does not continue for at least 50 ms.

- With realtime autotuning, each parameter is fixed to the value in the machine rigidity table at the time the machine rigidity is set. By estimating the load inertia from the operation pattern, the operation coefficient for the speed loop gain and the integration time constant are altered. Doing this for each pattern can cause vibration, so the estimation value is set conservatively.

Parameters Requiring Settings

Parameter number	Parameter name	Explanation	Reference
Pn002	REALTIME AUTOTUNING mode Selection	Set the operation mode for the realtime autotuning.	P.8-2
Pn003	Realtime Autotuning Machine Rigidity Setting	Set the responsiveness when the realtime autotuning is enabled.	P.8-2
Pn631	Realtime Autotuning Estimated Speed Selection	Set the load characteristic estimated speed, when the realtime autotuning is enabled.	P.8-56
Pn632	REALTIME AUTOTUNING CUSTOMIZATION mode Setting	Make the detailed setting for the autotuning function, when the customized mode (6) is selected on the REALTIME AUTOTUNING mode Selection (Pn002).	P.8-56

Setting Realtime Autotuning

1. When setting realtime autotuning, turn the servo OFF.

2. Set REALTIME AUTOTUNING mode Selection (Pn002) depending on the load.

Normally, set the parameter to 1 or 2. When using a vertical axis, set the parameter to 3 or 4. A setting of 5 is used in combination with a software tool. Do not set the parameter to 5 for normal operation.
The gain switching function is enabled for set values 2 to 4. If Pn002 is set to 2 to 4, the Switching Mode in Position Control (Pn115) must be set to 10 (Combination of position command input and rotation speed). The gain is switched according to this switching condition setting. Refer to page " Gain Switching Setting for Each CONTROL mode" (P.6-28) for details on setting the Switching Mode in Position Control (Pn115).

Set value	Realtime autotuning	Description
0	Disabled	Realtime autotuning is disabled.
1	Focus on stability (default setting)	No unbalanced load or friction compensation, nor gain switching.
2	Focus on positioning *1	Used for a horizontal axis or others which has no unbalanced load, or for a ball screw drive with little friction.
3	Vertical axis *2	Used when unbalanced load is present to vertical axis, etc.
4	Friction compensation *3	Used when friction is large. Used for a belt driving shaft with large friction. Variations in finalizing the positioning are narrowed.
5	Friction compensation and Vertical axis	Used when unbalanced load is present on the vertical axis or the like and when friction is large.
6	Customization *4	Detailed customization can be set on the REALTIME AUTOTUNING CUSTOMIZATION mode Setting (Pn632).

*1.In speed controls or torque controls, this will be 1: Focus on stability.
*2. In torque controls, this will be 1: Focus on stability.
*3.In speed controls, this will be 3: Vertical axis. In torque controls, this will be 1: Focus on stability.
*4.In some control modes, some functions are not available. Refer to the Realtime Autotuning Customization Mode Selection (Pn632) in “8-7 Special Parameters”.

Setting Machine Rigidity

1. Set the Realtime Autotuning Machine Rigidity Selection (Pn003) according to the table below.

Start from the lower machine rigidity number and check the operation.

Machine configuration and drive method	Realtime Autotuning Machine Rigidity Selection (Pn003)
Ball screw direct coupling	12 to 24
Ball screw and timing belt	8 to 20
Timing belt	4 to 16
Gears, rack and pinion drives	4 to 16
Machines with low rigidity, etc.	1 to 8
Stacker crane	Perform manual tuning.

2. Turn the servo ON and operate the machine with a normal pattern.

To increase responsiveness, increase the machine rigidity number, and check the response. If vibration occurs, enable the adaptive filter and operate. If already enabled, adjust by lowering the machine rigidity number.

3. If there are no issues with the operation, turn the servo OFF and set REALTIME AUTOTUNING mode Selection (Pn002) to 0 (disabled).

In this case, the adaptive filter can remain enabled. To disable the adaptive filter, read the frequency from the adaptive filter table number display, and set to notch filter 1 frequency.

Precautions for Correct Use

- Unusual noise or vibration may occur until the load inertia is estimated or the adaptive filter stabilizes after startup, immediately after the first servo ON, or when the Realtime Autotuning Machine Rigidity Selection (Pn003) is increased. This is not an error if it disappears right away. If the unusual noise or vibration, however, continues for 3 or more reciprocating operations, take the following measures in any order you can.
  - Write the parameters used during normal operation to the EEPROM.
  - Lower the Realtime Autotuning Machine Rigidity Selection (Pn003).
  - Manually set the notch filter.
- Once unusual noise or vibration occurs, Inertia Ratio (Pn004), Torque Command Value Offset (Pn607), Forward Direction Torque Offset (Pn608), and Reverse Direction Torque Offset (Pn609) may have changed to an extreme value. In this case, also take the measures described above.
- Out of the results of realtime autotuning, the Inertia Ratio (Pn004), Torque Command Value Offset (Pn607), Forward Direction Torque Offset (Pn608) and Reverse Direction Torque Offset (Pn609) are automatically saved to the EEPROM every 30 minutes. Realtime autotuning uses this saved data as the default setting when the power supply is turned OFF and turned ON again.
- The parameter is automatically set based on the Realtime Autotuning Machine Rigidity Setting (Pn003) if realtime autotuning is enabled.

Realtime Autotuning (RTAT) Parameter Table

Parameter number	Parameter name	AT Machine Rigidity Setting (Pn003)							
		0	1	2	3	4	5	6	7
Pn004	Inertia Ratio	Estimated load inertia ratio							
Pn100	Position Loop Gain 1	20	25	30	40	45	55	75	95
Pn101	Speed Loop Gain 1	15	20	25	30	35	45	60	75
Pn102	Speed Loop Integral Time Constant 1	3700	2800	2200	1900	1600	1200	900	700
Pn103	Speed Feedback Filter Time Constant 1	0	0	0	0	0	0	0	0
Pn104	Torque Command Filter Time Constant 1*1	1500	1100	900	800	600	500	400	300
Pn105	Position Loop Gain 2	25	30	40	45	55	70	95	120
Pn106	Speed Loop Gain 2	15	20	25	30	35	45	60	75
Pn107	Speed Loop Integral Time Constant 2*2	10000	10000	10000	10000	10000	10000	10000	10000
Pn108	Speed Feedback Filter Time Constant 2	0	0	0	0	0	0	0	0
Pn109	Torque Command Filter Time Constant 2*1	1500	1100	900	800	600	500	400	300
Pn110	Speed Feed-forward Amount	300	300	300	300	300	300	300	300
Pn111	Speed Feed-forward Command Filter	50	50	50	50	50	50	50	50
Pn112	Torque Feed-forward Amount	0	0	0	0	0	0	0	0
Pn113	Torque Feed-forward Command Filter	0	0	0	0	0	0	0	0
Pn114	GAIN SWITCHING INPUT OPERATING mode Selection	1	1	1	1	1	1	1	1
Pn115	SWITCHING mode in Position Control	GAIN SWITCHING ENABLE mode: 10 GAIN SWITCHING DISABLE mode: 0							
Pn116	Gain Switching Delay Time in Position Control	30	30	30	30	30	30	30	30
Pn117	Gain Switching Level in Position Control	50	50	50	50	50	50	50	50
Pn118	Gain Switching Hysteresis in Position Control	33	33	33	33	33	33	33	33
Pn119	Position Gain Switching Time	33	33	33	33	33	33	33	33
Pn120	SWITCHING mode in Speed Control	0	0	0	0	0	0	0	0
Pn121	Gain Switching Delay Time in Speed Control	0	0	0	0	0	0	0	0
Pn122	Gain Switching Level in Speed Control	0	0	0	0	0	0	0	0
Pn123	Gain Switching Hysteresis in Speed Control	0	0	0	0	0	0	0	0
Pn124	SWITCHING mode in Torque Control	0	0	0	0	0	0	0	0
Pn125	Gain Switching Delay Time in Torque Control	0	0	0	0	0	0	0	0
Pn126	Gain Switching Level in Torque Control	0	0	0	0	0	0	0	0
Pn127	Gain Switching Hysteresis in Torque Control	0	0	0	0	0	0	0	0
Pn607	Torque Command Value Offset	Estimated torque command additional value							
Pn608	Forward Direction Torque Offset	Estimated forward direction torque compensation							
Pn609	Reverse Direction Torque Offset	Estimated reverse direction torque compensation							
Pn610.0, Pn610.1	Function Expansion Setting	0	0	0	0	0	0	0	0
Pn623	Disturbance Torque Compensation Gain	0	0	0	0	0	0	0	0
Pn624	Disturbance Observer Filter Setting	0	0	0	0	0	0	0	0

*1. This is limited at the minimum value of 10 if a 17-bit absolute encoder is used.

*2. If realtime autotuning is performed in vertical axis mode or friction compensation and vertical axis mode, the value will be 9999 until load characteristic estimation (estimation of the inertia ratio, torque command value offset, and forward/reverse direction torque offset) is completed. The value will change to 10000 after the load characteristic estimation is completed.

Parameter number	Parameter name	AT Machine Rigidity Setting (Pn003)							
		8	9	10	11	12	13	14	15
Pn004	Inertia Ratio	Estimated load inertia ratio							
Pn100	Position Loop Gain 1	115	140	175	320	390	480	630	720
Pn101	Speed Loop Gain 1	90	110	140	180	220	270	350	400
Pn102	Speed Loop Integral Time Constant 1	600	500	400	310	250	210	160	140
Pn103	Speed Feedback Filter Time Constant 1	0	0	0	0	0	0	0	0
Pn104	Torque Command Filter Time Constant 1*1	300	200	200	126	103	84	65	57
Pn105	Position Loop Gain 2	140	175	220	380	460	570	730	840
Pn106	Speed Loop Gain 2	90	110	140	180	220	270	350	400
Pn107	Speed Loop Integral Time Constant 2*2	10000	10000	10000	10000	10000	10000	10000	10000
Pn108	Speed Feedback Filter Time Constant 2	0	0	0	0	0	0	0	0
Pn109	Torque Command Filter Time Constant 2*1	300	200	200	126	103	84	65	57
Pn110	Speed Feed-forward Amount	300	300	300	300	300	300	300	300
Pn111	Speed Feed-forward Command Filter	50	50	50	50	50	50	50	50
Pn112	Torque Feed-forward Amount	0	0	0	0	0	0	0	0
Pn113	Torque Feed-forward Command Filter	0	0	0	0	0	0	0	0
Pn114	GAIN SWITCHING INPUT OPERATING mode Selection	1	1	1	1	1	1	1	1
Pn115	SWITCHING mode in Position Control	GAIN SWITCHING ENABLE mode: 10 GAIN SWITCHING DISABLE mode: 0							
Pn116	Gain Switching Delay Time in Position Control	30	30	30	30	30	30	30	30
Pn117	Gain Switching Level in Position Control	50	50	50	50	50	50	50	50
Pn118	Gain Switching Hysteresis in Position Control	33	33	33	33	33	33	33	33
Pn119	Position Gain Switching Time	33	33	33	33	33	33	33	33
Pn120	SWITCHING mode in Speed Control	0	0	0	0	0	0	0	0
Pn121	Gain Switching Delay Time in Speed Control	0	0	0	0	0	0	0	0
Pn122	Gain Switching Level in Speed Control	0	0	0	0	0	0	0	0
Pn123	Gain Switching Hysteresis in Speed Control	0	0	0	0	0	0	0	0
Pn124	SWITCHING mode in Torque Control	0	0	0	0	0	0	0	0
Pn125	Gain Switching Delay Time in Torque Control	0	0	0	0	0	0	0	0
Pn126	Gain Switching Level in Torque Control	0	0	0	0	0	0	0	0
Pn127	Gain Switching Hysteresis in Torque Control	0	0	0	0	0	0	0	0
Pn607	Torque Command Value Offset	Estimated torque command additional value							
Pn608	Forward Direction Torque Offset	Estimated forward direction torque compensation							
Pn609	Reverse Direction Torque Offset	Estimated reverse direction torque compensation							
Pn610.0, Pn610.1	Function Expansion Setting	0	0	0	0	0	0	0	0
Pn623	Disturbance Torque Compensation Gain	0	0	0	0	0	0	0	0
Pn624	Disturbance Observer Filter Setting	0	0	0	0	0	0	0	0

*1. This is limited at the minimum value of 10 if a 17-bit absolute encoder is used.

*2. If realtime autotuning is performed in vertical axis mode or friction compensation and vertical axis mode, the value will be 9999 until load characteristic estimation (estimation of the inertia ratio, torque command value offset, and forward/reverse direction torque offset) is completed. The value will change to 10000 after the load characteristic estimation is completed.

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Adjustment Functions

Parameter number	Parameter name	AT Machine Rigidity Setting (Pn003)							
		16	17	18	19	20	21	22	23
Pn004	Inertia Ratio	Estimated load inertia ratio							
Pn100	Position Loop Gain 1	900	1080	1350	1620	2060	2510	3050	3770
Pn101	Speed Loop Gain 1	500	600	750	900	1150	1400	1700	2100
Pn102	Speed Loop Integral Time Constant 1	120	110	90	80	70	60	50	40
Pn103	Speed Feedback Filter Time Constant 1	0	0	0	0	0	0	0	0
Pn104	Torque Command Filter Time Constant 1*1	45	38	30	25	20	16	13	11
Pn105	Position Loop Gain 2	1050	1260	1570	1880	2410	2930	3560	4400
Pn106	Speed Loop Gain 2	500	600	750	900	1150	1400	1700	2100
Pn107	Speed Loop Integral Time Constant 2*2	10000	10000	10000	10000	10000	10000	10000	10000
Pn108	Speed Feedback Filter Time Constant 2	0	0	0	0	0	0	0	0
Pn109	Torque Command Filter Time Constant 2*1	45	38	30	25	20	16	13	11
Pn110	Speed Feed-forward Amount	300	300	300	300	300	300	300	300
Pn111	Speed Feed-forward Command Filter	50	50	50	50	50	50	50	50
Pn112	Torque Feed-forward Amount	0	0	0	0	0	0	0	0
Pn113	Torque Feed-forward Command Filter	0	0	0	0	0	0	0	0
Pn114	GAIN SWITCHING INPUT OPERATING mode Selection	1	1	1	1	1	1	1	1
Pn115	SWITCHING mode in Position Control	GAIN SWITCHING ENABLE mode: 10 GAIN SWITCHING DISABLE mode: 0							
Pn116	Gain Switching Delay Time in Position Control	30	30	30	30	30	30	30	30
Pn117	Gain Switching Level in Position Control	50	50	50	50	50	50	50	50
Pn118	Gain Switching Hysteresis in Position Control	33	33	33	33	33	33	33	33
Pn119	Position Gain Switching Time	33	33	33	33	33	33	33	33
Pn120	SWITCHING mode in Speed Control	0	0	0	0	0	0	0	0
Pn121	Gain Switching Delay Time in Speed Control	0	0	0	0	0	0	0	0
Pn122	Gain Switching Level in Speed Control	0	0	0	0	0	0	0	0
Pn123	Gain Switching Hysteresis in Speed Control	0	0	0	0	0	0	0	0
Pn124	SWITCHING mode in Torque Control	0	0	0	0	0	0	0	0
Pn125	Gain Switching Delay Time in Torque Control	0	0	0	0	0	0	0	0
Pn126	Gain Switching Level in Torque Control	0	0	0	0	0	0	0	0
Pn127	Gain Switching Hysteresis in Torque Control	0	0	0	0	0	0	0	0
Pn607	Torque Command Value Offset	Estimated torque command additional value							
Pn608	Forward Direction Torque Offset	Estimated forward direction torque compensation							
Pn609	Reverse Direction Torque Offset	Estimated reverse direction torque compensation							
Pn610.0, Pn610.1	Function Expansion Setting	0	0	0	0	0	0	0	0
Pn623	Disturbance Torque Compensation Gain	0	0	0	0	0	0	0	0
Pn624	Disturbance Observer Filter Setting	0	0	0	0	0	0	0	0

*1. This is limited at the minimum value of 10 if a 17-bit absolute encoder is used.

*2. If realtime autotuning is performed in vertical axis mode or friction compensation and vertical axis mode, the value will be 9999 until load characteristic estimation (estimation of the inertia ratio, torque command value offset, and forward/reverse direction torque offset) is completed. The value will change to 10000 after the load characteristic estimation is completed.

Parameter number	Parameter name	AT Machine Rigidity Setting (Pn003)							
		24	25	26	27	28	29	30	31
Pn004	Inertia Ratio	Estimated load inertia ratio							
Pn100	Position Loop Gain 1	4490	5000	5600	6100	6600	7200	8100	9000
Pn101	Speed Loop Gain 1	2500	2800	3100	3400	3700	4000	4500	5000
Pn102	Speed Loop Integral Time Constant 1	40	35	30	30	25	25	20	20
Pn103	Speed Feedback Filter Time Constant 1	0	0	0	0	0	0	0	0
Pn104	Torque Command Filter Time Constant 1*1	9	8	7	7	6	6	5	5
Pn105	Position Loop Gain 2	5240	5900	6500	7100	7700	8400	9400	10500
Pn106	Speed Loop Gain 2	2500	2800	3100	3400	3700	4000	4500	5000
Pn107	Speed Loop Integral Time Constant 2*2	10000	10000	10000	10000	10000	10000	10000	10000
Pn108	Speed Feedback Filter Time Constant 2	0	0	0	0	0	0	0	0
Pn109	Torque Command Filter Time Constant 2*1	9	8	7	7	6	6	5	5
Pn110	Speed Feed-forward Amount	300	300	300	300	300	300	300	300
Pn111	Speed Feed-forward Command Filter	50	50	50	50	50	50	50	50
Pn112	Torque Feed-forward Amount	0	0	0	0	0	0	0	0
Pn113	Torque Feed-forward Command Filter	0	0	0	0	0	0	0	0
Pn114	GAIN SWITCHING INPUT OPERATING mode Selection	1	1	1	1	1	1	1	1
Pn115	SWITCHING mode in Position Control	GAIN SWITCHING ENABLE mode: 10 GAIN SWITCHING DISABLE mode: 0							
Pn116	Gain Switching Delay Time in Position Control	30	30	30	30	30	30	30	30
Pn117	Gain Switching Level in Position Control	50	50	50	50	50	50	50	50
Pn118	Gain Switching Hysteresis in Position Control	33	33	33	33	33	33	33	33
Pn119	Position Gain Switching Time	33	33	33	33	33	33	33	33
Pn120	SWITCHING mode in Speed Control	0	0	0	0	0	0	0	0
Pn121	Gain Switching Delay Time in Speed Control	0	0	0	0	0	0	0	0
Pn122	Gain Switching Level in Speed Control	0	0	0	0	0	0	0	0
Pn123	Gain Switching Hysteresis in Speed Control	0	0	0	0	0	0	0	0
Pn124	SWITCHING mode in Torque Control	0	0	0	0	0	0	0	0
Pn125	Gain Switching Delay Time in Torque Control	0	0	0	0	0	0	0	0
Pn126	Gain Switching Level in Torque Control	0	0	0	0	0	0	0	0
Pn127	Gain Switching Hysteresis in Torque Control	0	0	0	0	0	0	0	0
Pn607	Torque Command Value Offset	Estimated torque command additional value							
Pn608	Forward Direction Torque Offset	Estimated forward direction torque compensation							
Pn609	Reverse Direction Torque Offset	Estimated reverse direction torque compensation							
Pn610.0, Pn610.1	Function Expansion Setting	0	0	0	0	0	0	0	0
Pn623	Disturbance Torque Compensation Gain	0	0	0	0	0	0	0	0
Pn624	Disturbance Observer Filter Setting	0	0	0	0	0	0	0	0

*1. This is limited at the minimum value of 10 if a 17-bit absolute encoder is used.

*2. If realtime autotuning is performed in vertical axis mode or friction compensation and vertical axis mode, the value will be 9999 until load characteristic estimation (estimation of the inertia ratio, torque command value offset, and forward/reverse direction torque offset) is completed. The value will change to 10000 after the load characteristic estimation is completed.

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Adjustment Functions

10-4 Manual Tuning

As described before, the OMNUC G5 Series have a realtime autotuning function. However, when the gain cannot be properly adjusted due to restrictions such as load conditions even if realtime autotuning is performed, or when the optimum responsiveness or stability is required to match each load, readjustment maybe required.
This section describes how to perform manual tuning for each CONTROL mode and function.

Basic Settings

Before Manual Setting

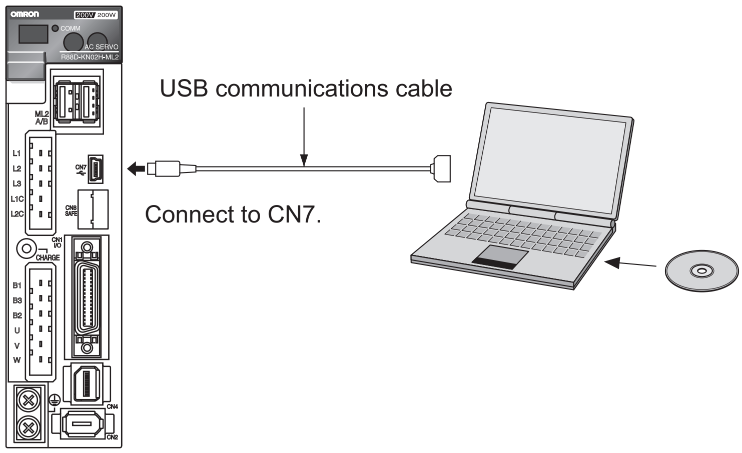
More reliable adjustment can be performed quickly by using waveform monitoring with the data tracing function of CX-Drive or by measuring the analog voltage waveform with the monitor function.

Analog Monitor Output

The actual motor speed, command speed, torque, and number of accumulated pulses can be measured in the analog voltage level using an oscilloscope or other device. The type of signal to output and the output voltage level are set with Analog Monitor 1 Selection (Pn416) and Analog Monitor 2 Selection (Pn418) settings. For details, refer to "A-1 Parameter List" (P.A-1).

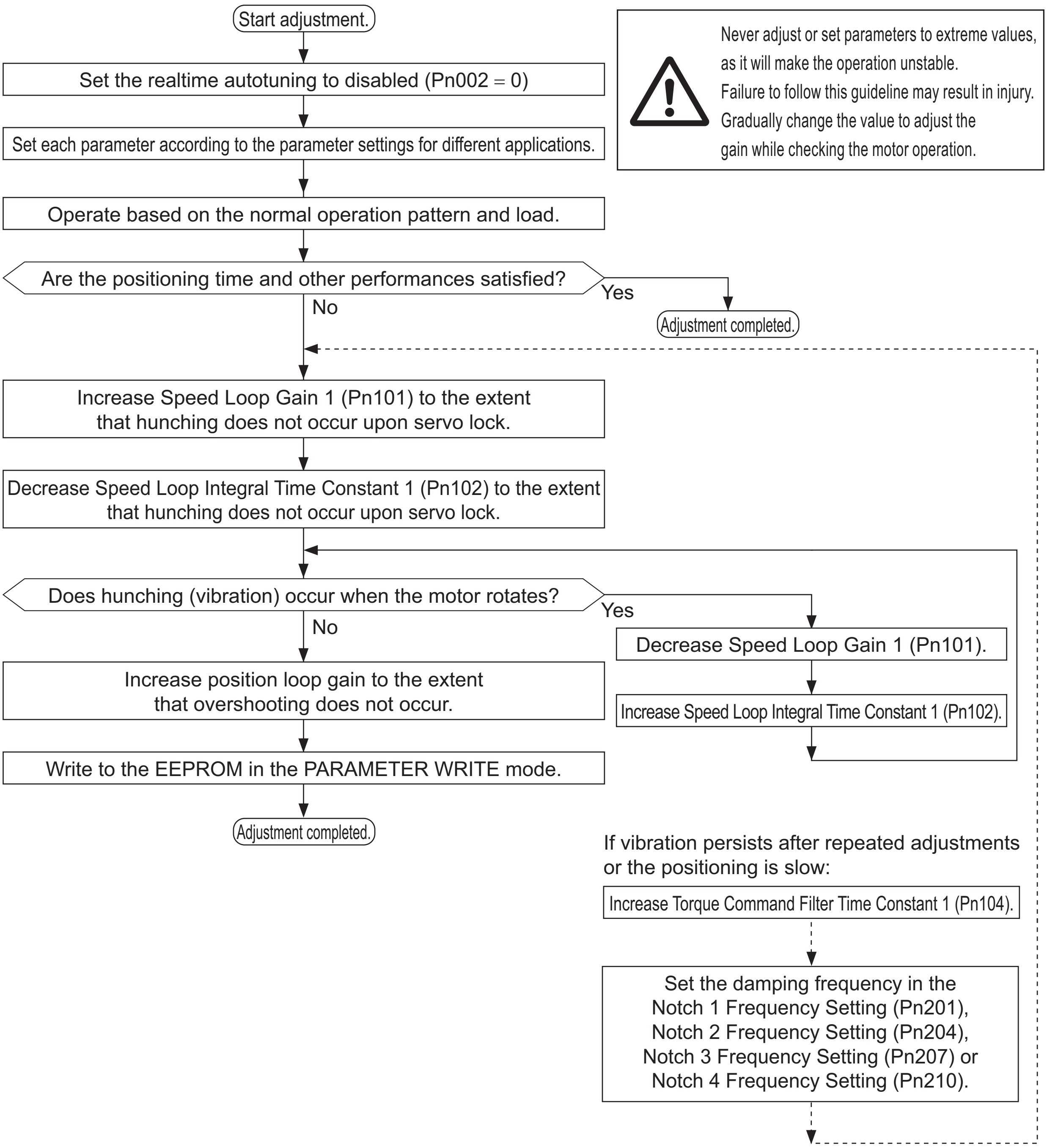
CX-Drive Data Tracing Function

Commands to the motor and motor operation (speed, torque command, and position error) can be displayed on a computer as waveforms. Refer to the CX-Drive Operation Manual (Cat.No.W453).



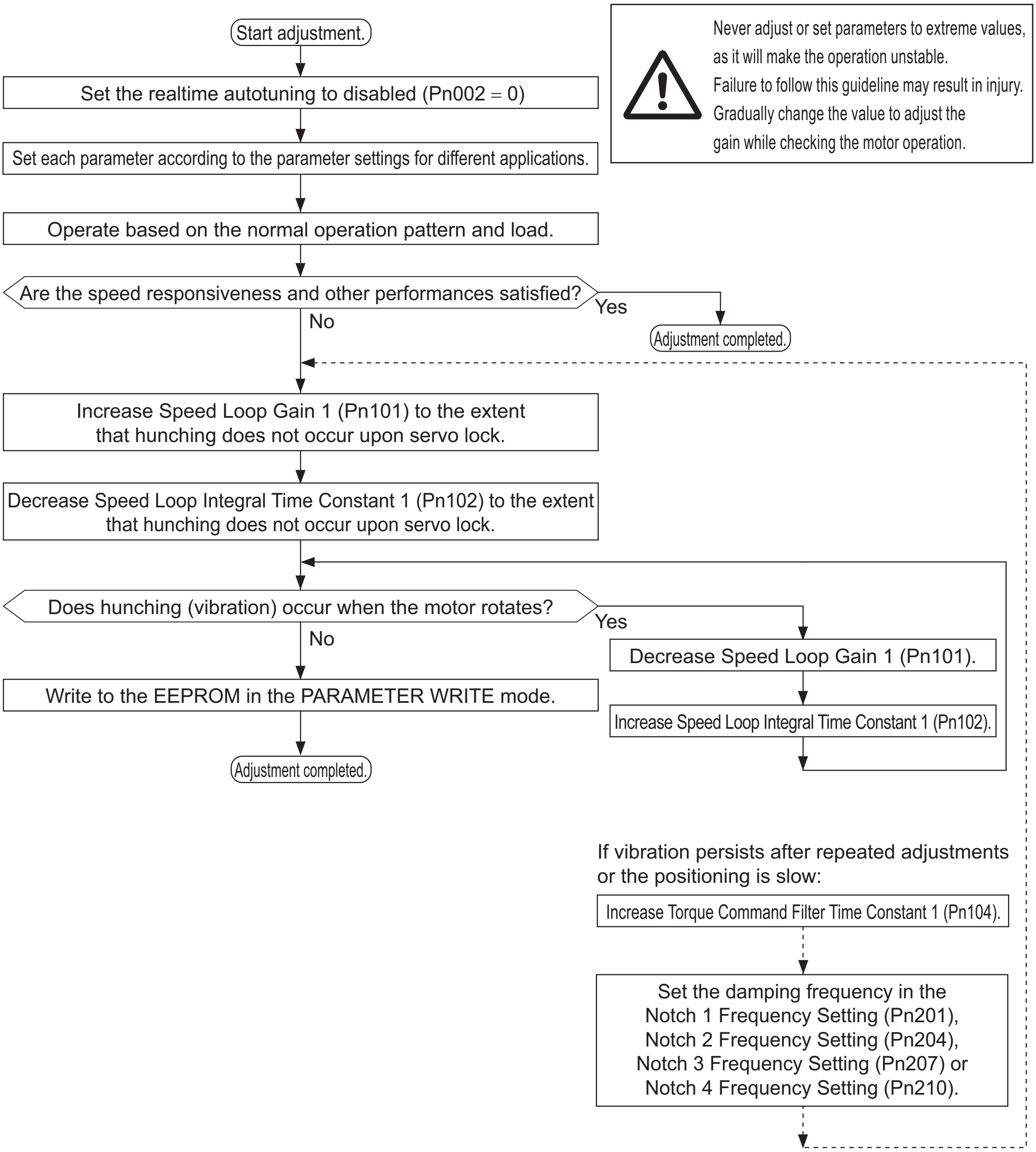
POSITION CONTROL/FULL CLOSING CONTROL Mode Adjustment

Use the following procedure to perform the adjustment in position control for the OMNUC G5 Series.



SPEED CONTROL Mode Adjustment

Adjustments in speed control for the OMNUC G5 Series are very similar to POSITION CONTROL mode adjustment.
Use the following procedure to perform the adjustment.



Servo Manual Tuning Method

The following 4 parameters are the basic servo adjustment parameters.
If desired operation characteristics are obtained by adjusting the following 4 parameters, the adjustments of other parameters are not necessary.

Parameter number	Parameter name	Default setting	Parameter number 2
Pn100	Position Loop Gain 1	40.0 [1/s]	Pn105
Pn101	Speed Loop Gain 1	50.0 Hz	Pn106
Pn102	Speed Loop Integral Time Constant 1	20.0 ms	Pn107
Pn104	Torque Command Filter Time Constant 1	0.80 ms	Pn109

Adjustment of Each Parameter

The control loop for the servo consists of, from the outside, a position loop, speed loop and current loop.
The inner loop is affected by the outer loop, and the outer loop is affected by the inner loop.
What determines the default setting includes the structure and the rigidity of the machine, and the inertia ratio.
Guide of each parameter for different applications is as follows.

Parameter Settings for Different Applications

Application name	Inertia	Rigidity	Position loop gain [1/s]	Speed loop gain [Hz]	Speed loop integration time constant	Torque command filter time constant [x 0.01 ms]
Ball screw horizontal	Large	Low	20	140	35	160
Ball screw horizontal	Medium	Medium	40	80	20	100
Ball screw horizontal	Small	High	80	60	15	80
Ball screw vertical	Large	Low	20	160	45	160
Ball screw vertical	Medium	Medium	40	80	30	120
Ball screw vertical	Small	High	60	60	20	100
Ball screw nut rotation horizontal	Large	Low	20	140	40	160
Ball screw nut rotation horizontal	Medium	Medium	40	100	30	120
Ball screw nut rotation vertical	Large	Low	20	160	45	160
Ball screw nut rotation vertical	Medium	Medium	40	120	25	120
Timing belt	Large	Low	20	160	60	160
Timing belt	Medium	Medium	30	120	40	120
Rack and pinion drives	Large	Low	20	160	60	160
Rack and pinion drives	Large	Medium	30	120	40	120
Rack and pinion drives	Medium	Medium	40	100	20	100
Index table	Large	Medium	40	120	25	120
Index table	Small	High	80	120	20	100
Robot arm cylinder	Large	Low	15	160	60	160
Robot arm cylinder	Medium	Medium	25	120	40	120
Other general-purpose	Medium	Medium	30	100	30	150

- Inertia Ratio (Pn004) is when fixed at 300%.

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Adjustment Functions

Inertia guide

The inertia is small.	5 times the rotor inertia max.
The inertia is medium.	5 to 10 times the rotor inertia max.
The inertia is large.	10 to 20 times the rotor inertia max.

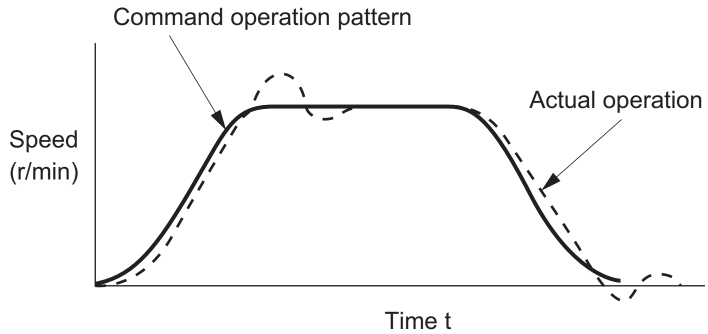
Pn100, Pn105 Position Loop Gain

This loop controls the number of pulses from encoder to be the designated number of pulses. This is called an error counter, and when the pulse is equal to or lower than the specified value, positioning is completed and the signal is output.
The ratio of maximum speed used and error counter is called a position loop gain.

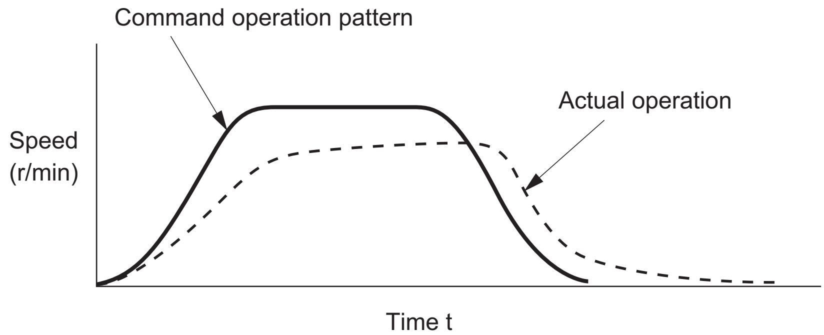
$$\text{Position loop gain [1/s]} = \frac{\text{Command maximum speed [pps]}}{\text{Error counter accumulated pulse (P)}}$$

For the position loop gain, use the inverse of Speed Loop Integral Time Constant 1 (Pn102) as a guide for setting. Setting Pn102 to 100 ms results in 10 [1/s].
There will be no overshooting under this condition. To quicken positioning, increase the value of position loop gain. If the value is too large, overshooting or vibration will occur. In such cases, set the value smaller.
If the speed loop or the current loop is vibrating, adjusting the position loop does not eliminate the vibration.
Response to the position loop gain adjustment is illustrated below.

- If the position loop gain is high, an overshooting occurs.



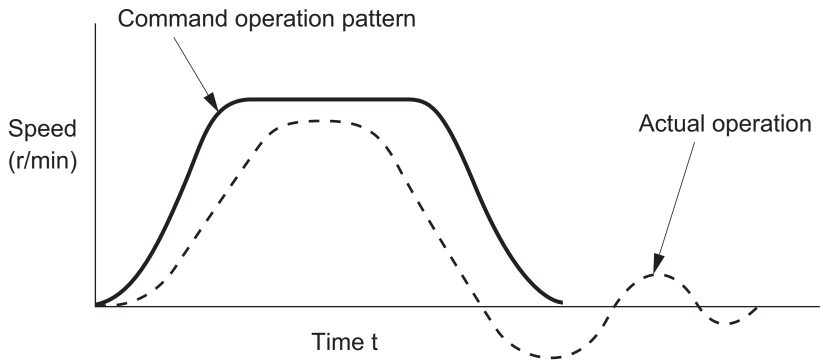
- If the position loop gain is low, positioning completion speed becomes slow.



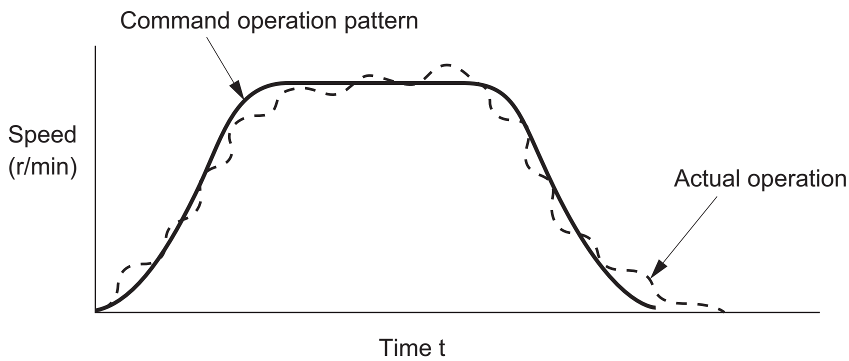
Pn101, Pn106 Speed Loop Gain

The speed loop gain determines the responsiveness of the servo.
This value becomes the response frequency if the Inertia Ratio (Pn004) is set correctly.
Increasing the value of the speed loop gain improves the responsiveness and quickens positioning, but vibration is more likely to occur. Adjustment must be made so vibration will not occur.
This is related to Speed Loop Integral Time Constant 1 (Pn102), and by increasing the integration time constant, the speed loop gain value can be increased.

- If the speed loop gain is low, the speed response becomes slow and a large overshooting occurs. In such case, increase the speed loop gain.



- If the speed loop gain is high, vibrations are more likely to occur. Vibration or resonance may not disappear.
  In such case, decrease the speed loop gain.



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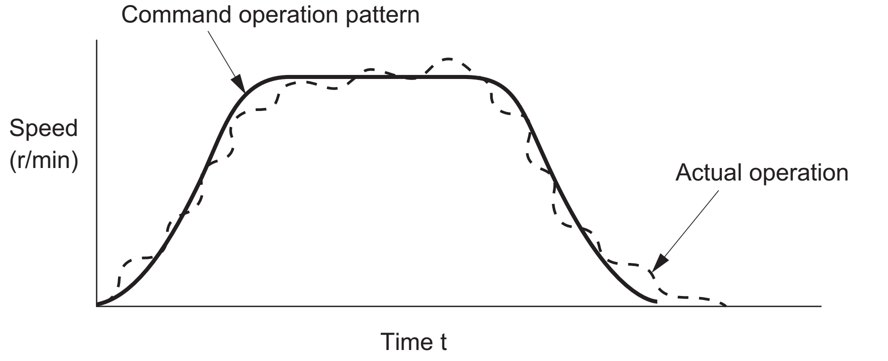
Adjustment Functions

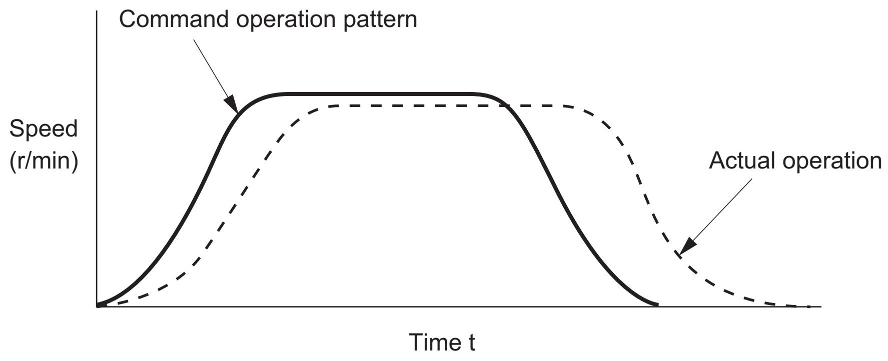
Pn102, Pn107 Speed Loop Integral Time Constant

The speed loop integral time constant also determines the responsiveness of the servo.

- If the speed loop integral time constant is low, vibration or resonance occur.
  In such case, increase the speed loop integral time constant.



- If the speed loop integral time constant is high, the response is delayed. The servo rigidity becomes weak.
  In such case, decrease the speed loop integral time constant.

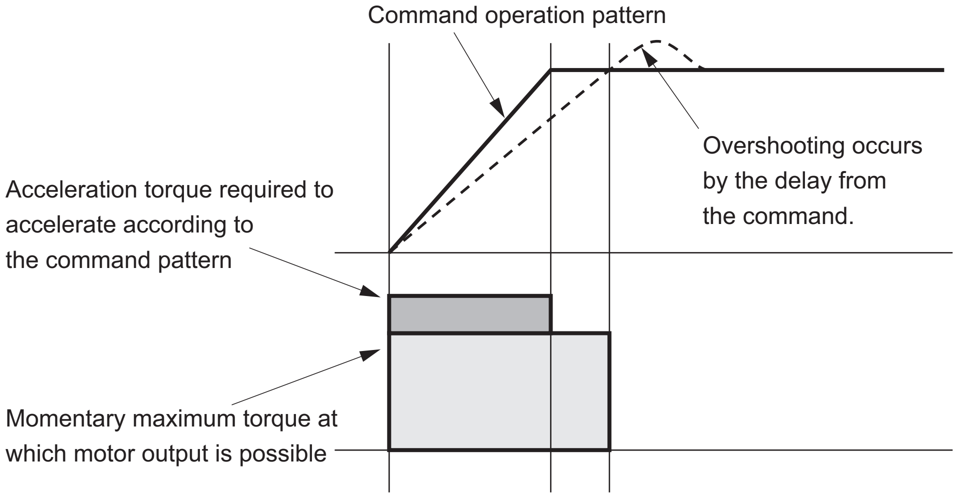


Pn104, Pn109 Torque Command Filter Time Constant (Current Loop Input Adjustment)

The torque command filter applies a filter so the current command from the speed loop becomes smooth. The result is a smooth current flow which suppresses vibration.
The default setting of the filter time constant is 80 (0.8 ms).
Increase the value to reduce vibration. Increasing the value slows the response.
As a guide, aim for about 1/25 of the Speed Loop Integral Time Constant 1 (Pn102).
Also, the torque command filter reduces vibration due to the machine rigidity.
This is related to Speed Loop Gain 1 (Pn101), and if Pn101 is too large, increasing the torque command filter time constant does not reduce vibration.
If there is machine resonance such as with the ball screw, vibration is reduced by using notch filters such as Pn201, Pn204, Pn207 and Pn210. Or, enable the adaptive filter.

Other Adjustments

If the torque loop is saturated because the acceleration time is short or the load torque is large, an overshooting occurs for the speed response. In such case, increase the acceleration time to prevent the torque from saturating.



TORQUE CONTROL Mode Adjustment

This is a torque control based on the speed control loop where the speed limit is the speed limit value from Speed Limit (Pn304, Pn305, Pn306 or Pn307). This section describes the settings for these speed limit values.

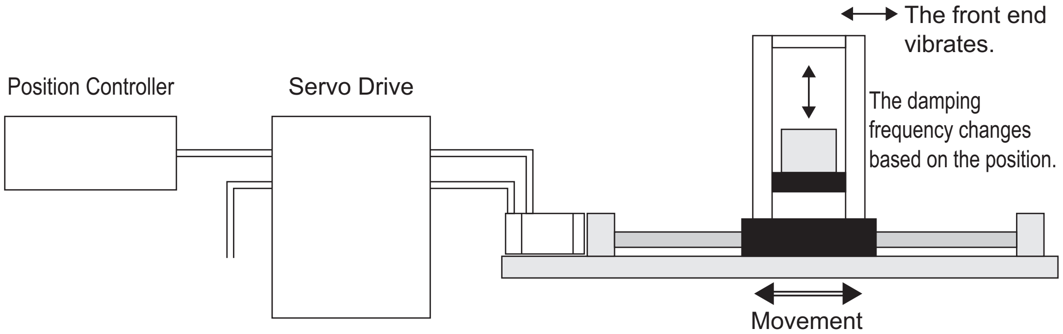
Setting Speed Limit Values

- If Speed Limit Selection (Pn317) is 0, speed limit is the value set by Speed Limit Value Setting (Pn321). If Speed Limit Selection (Pn317) is 1, the speed limit is the value obtained by converting the voltage applied to analog input 1 with Torque Command Scale (Pn319).
- When the motor speed approaches the speed limit value, the speed control switches to that using Speed Limit Value Setting (Pn321) as commands.
- To have a stable operation while the speed is limited, the parameter should be set according to "SPEED CONTROL Mode Adjustment".
- The torque may not be produced as specified by the torque command because the input to the torque limit section is small, when the speed limit value in Speed Limit Value Setting (Pn321) is too low, when the speed loop gain is too low, or when the speed loop integral time constant is 10,000 (disabled).

10-5 Damping Control

Outline of Operation

If the tip of the mechanical unit vibrates, you can use the damping control function to reduce vibration.
This is effective on vibration generated by a machine of low rigidity. The applicable frequencies are from 1 to 200 Hz.
You can set four frequencies, and use two of them at the same time.
Since damping control is performed using position commands, it cannot be used with speed or torque control.



Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn001	CONTROL mode Selection	Set to the POSITION or FULL CLOSING CONTROL mode. 0 to 5: Switch control 6: Full closing control	P.8-1
Pn213	Damping Filter Selection	Select the DAMPING FILTER SWITCHING mode according to the condition of the unit. 0: Damping filter 1 or 2 enabled 3: Switching with command direction	P.8-21
Pn214	Damping Frequency 1	Set damping frequency 1 to suppress vibration at the end of the load in damping control. If the damping control function is not used, set 0.	P.8-21
Pn215	Damping Filter 1 Setting	When the Damping Frequency 1 (Pn214) is set, reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally 0 is set. If the damping filter 1 is disabled, this parameter is also disabled.	P.8-22
Pn216	Damping Frequency 2	The function is the same with Pn214.	P.8-22
Pn217	Damping Filter 2 Setting	The function is the same with Pn215.	P.8-22
Pn218	Damping Frequency 3	The function is the same with Pn214.	P.8-22
Pn219	Damping Filter 3 Setting	The function is the same with Pn215.	P.8-22
Pn220	Damping Frequency 4	The function is the same with Pn214.	P.8-23
Pn221	Damping Filter 4 Setting	The function is the same with Pn215.	P.8-23

Precautions for Correct Use

- Stop operation before changing the parameters or switching with DFSEL.
- It may not function properly or the effect may not be apparent under the following conditions.

Item	Conditions under which the effect of damping control is inhibited
CONTROL mode	• SPEED or TORQUE CONTROL mode
Load condition	• If forces other than position commands, such as external forces, cause vibration. • If the damping frequency is outside the range of 1.0 to 200 Hz. • If the ratio of the resonance frequency to anti-resonance frequency is large.

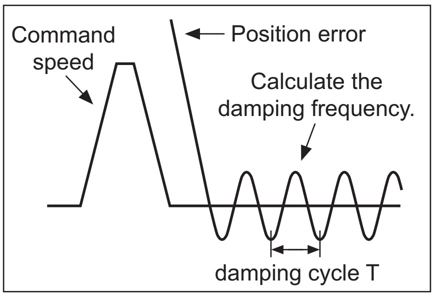
Operating Procedure

1. Adjust the position loop gain and speed loop gain.

Adjust Position Loop Gain 1 (Pn100), Speed Loop Gain 1 (Pn101), Speed Loop Integral Time Constant 1 (Pn102) and Torque Command Filter Time Constant 1 (Pn104).
If no problem occurs in realtime autotuning, you can continue to use the settings.

2. Measure the damping frequency at the tip of the mechanical unit.

Measure the damping frequency using a laser displacement sensor, servo acceleration meter, acceleration pick-up, etc.
Set the damping frequency in one of Damping Frequency 1 to Damping Frequency 4 (1: Pn214, 2: Pn216, 3: Pn218, 4: Pn220) according to the operation.
Also set the SWITCHING mode using Damping Filter Selection (Pn213).
If the measurement device cannot be used, use CX-Drive tracing function, and read the residual damping frequency (Hz) from the position error waveform as shown in the following figure.



- The following gives the damping frequency in the figure.

$$f\ (\text{Hz}) = \frac{1}{T\ (\text{s})}$$

Since the parameter unit is 0.1 Hz:
(Pn214, Pn216, Pn218, Pn220) = 10 $\times$ f

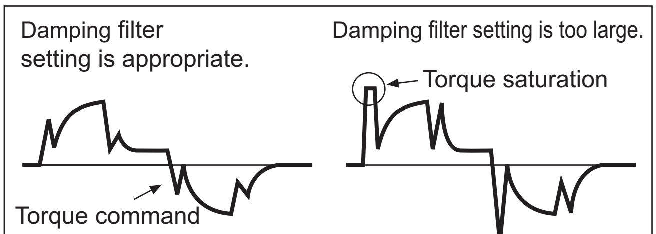
- Application example

If the damping cycle is 100 ms or 20 ms, set 100 or 500 in the parameter so that the damping frequency becomes 10 Hz or 50 Hz.

If vibration persists after setting the frequency, increase or decrease the resonance frequency to find the frequency at which vibration decreases.

3. Set damping filter setting.

Set damping filter setting (1: Pn215, 2: Pn217, 3: Pn219, 4: Pn221).
First, set to 0.
The stabilization time can be reduced by setting a large value; however, torque ripple will increase at the command change point as shown in the following figure. Set a range that will not cause torque saturation under actual operation conditions. The effects of vibration suppression will be lost if torque saturation occurs.



When the Damping Frequency 1 (Pn214) is set, reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally 0 is set.
If the damping filter 1 is enabled, use the following setting range.
Setting range: 100 $\leq$ Pn214 + Pn215 $\leq$ Pn214 $\times$ 2 or 2,000

Precautions for Correct Use

- Note: If the damping filter 1 is disabled under Damping Filter Selection (Pn213), Damping Filter 1 Setting (Pn215) is also disabled.

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Adjustment Functions

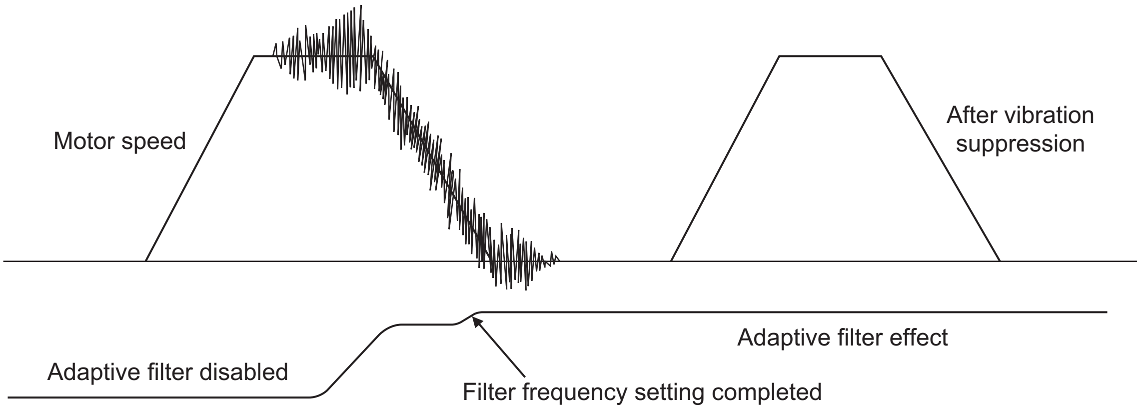
4. Set the Damping Filter Selection (Pn213).

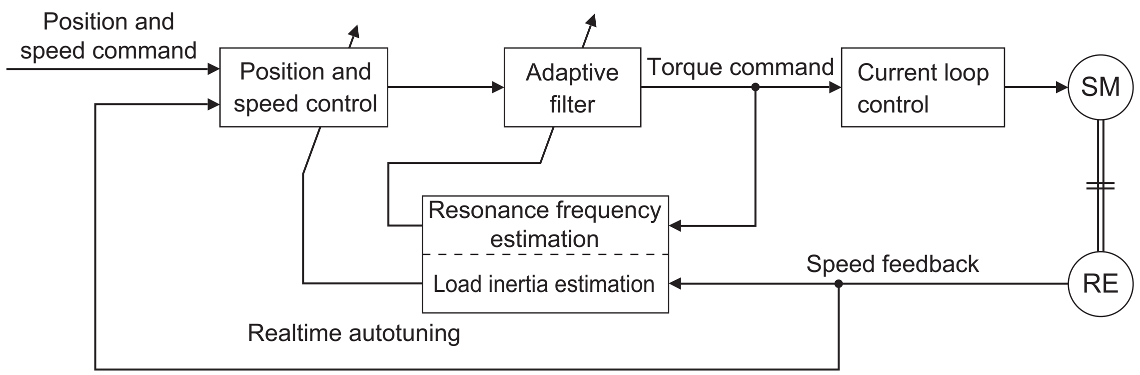
Damping filters 1 to 4 can be switched according to the conditions of the machine vibration.

Set value	SWITCHING mode
0	Damping filter 1 or 2 enabled
1	Switching by external input (DFSEL1) Open: Damping filter 1 or 3 enabled Shorted: Damping filter 2 or 4 enabled
2	Switching by external input (DFSEL1, DFSEL2) When DFSEL1 and DFSEL2 are both open: Damping filter 1 enabled When DFSEL1 is shorted and DFSEL2 is open: Damping filter 2 enabled When DFSEL1 is open and DFSEL2 is shorted: Damping filter 3 enabled When DFSEL1 and DFSEL2 are both shorted: Damping filter 4 enabled
3	Switching with command direction Forward direction: Damping filter 1 or 3 enabled Reverse direction: Damping filter 2 or 4 enabled

10-6 Adaptive Filter

The adaptive filter reduces resonance point vibration by estimating the resonance frequency from the vibration component that appears in the motor speed during actual operation and automatically sets the frequency of the notch filter, which removes the resonance component from the torque command.
The automatically set notch filter frequency is set in Notch 3 (Pn207 to Pn209) or Notch 4 (Pn210 to Pn212).
Refer to "10-7 Notch Filter" (P.10-28) for information on notch filter.





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Adjustment Functions

Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn200	Adaptive Filter Selection	Set the number of resonance frequencies to be estimated by the adaptive filter and the operation to be performed after estimation. 0: Adaptive filter disabled 1: One adaptive filter enabled 2: Two adaptive filters enabled 3: RESONANCE FREQUENCY MEASUREMENT mode If the motor speed is affected by a resonance point, the Notch Filter 3 or Notch Filter 4 parameter is automatically set according to the number of adaptive filters. 4: Adaptive result clear The notch filter 3 and notch filter 4 parameters are disabled, and adaptive result is cleared.	P.8-19

Precautions for Correct Use

- Adaptive filter may not operate correctly under the following conditions.

Item	Conditions under which the adaptive filter operates
CONTROL mode	• TORQUE CONTROL mode
Resonance points	• If the resonance frequency is 300 Hz or lower. • If the resonance peak or control gain is low, and the motor speed is not affected by it. • If there are three or more resonance points.
Load	• If the motor speed with high-frequency components changes due to backlash or other non-linear elements.
Command pattern	• The acceleration/deceleration is sudden, i.e., 3,000 r/min in 1 s.

- If the adaptive filter does not operate properly, use Notch 1 (Pn201 to Pn203) or Notch 2 (Pn204 to Pn206) to implement resonance measures according to the manual adjustment procedure. Refer to "10-7 Notch Filter" (P.10-28) for information on notch filter.
- The adaptive filter is disabled when torque control is performed, but the adaptive filter frequency used in the CONTROL mode before switching is held if torque control has been selected by setting the CONTROL mode Selection (Pn001) to 5 or 6.

Operating Procedure

1. **Set the Adaptive Filter Selection (Pn200).**
   Select an adaptive filter from 1 to 4 on the Adaptive Filter Selection (Pn200).
2. **Start an actual operation.**
   Enter an operation command and start the actual operation.
3. **The Notch Filters 3 and 4 are automatically set.**
   When the influence of resonance point appears in the motor speed, the parameters for the Notch Filters 3 and 4 are set automatically in accordance with the number of adaptive filters.

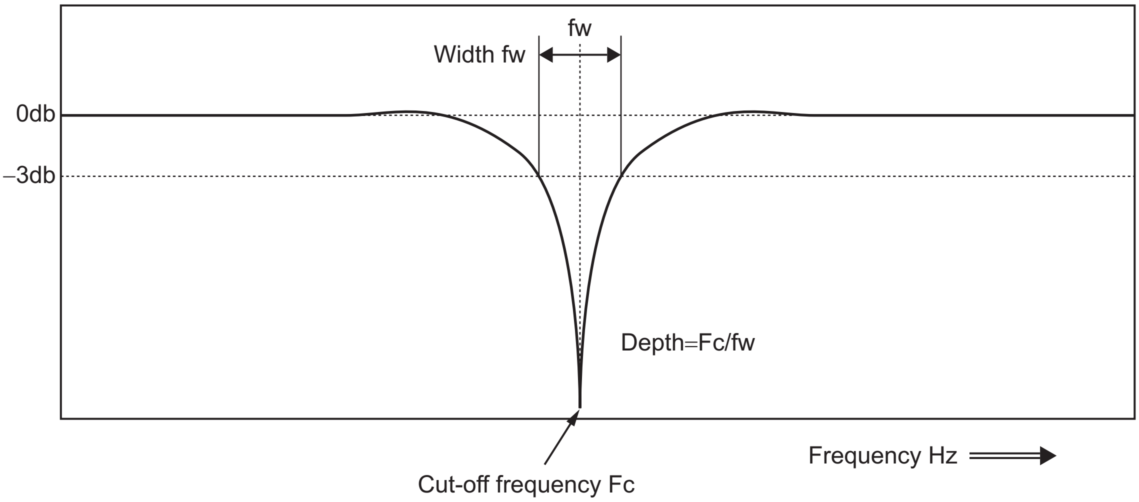
Precautions for Correct Use

- An unusual noise or vibration may occur until the adaptive filter stabilizes after startup, immediately after the first servo ON, or when the Realtime Autotuning Machine Rigidity Selection (Pn003) is increased, but this is not a problem if it disappears right away. If the vibration or unusual noise, however, continues for three or more reciprocating operations, take the following measures in the possible order.
  - Write the parameters used during normal operation to the EEPROM.
  - Lower the Realtime Autotuning Machine Rigidity Selection (Pn003).
  - Disable the adaptive filter by setting the Adaptive Filter Selection (Pn200) to 0. (Resetting of inertial estimation and adaptive operation)
  - Manually set the notch filter.
- If unusual noise or vibration occurred, the setting of Notch 3 (Pn207 to Pn209) or Notch 4 (Pn210 to Pn212) may have changed to an extreme value. In this case, set Adaptive Filter Selection (Pn200) to 0 to disable the parameter and then set Notch 3 Frequency Setting (Pn207) and Notch 4 Frequency Setting (Pn210) to 5,000 (disabled). Next, enable Adaptive Filter Selection again.
- Notch 3 Frequency Setting (Pn207) and Notch 4 Frequency Setting (Pn210) are written to the EEPROM every 30 minutes. When the power supply is turned OFF and then turned ON again, this data is used as the default settings to perform adaptive operation.

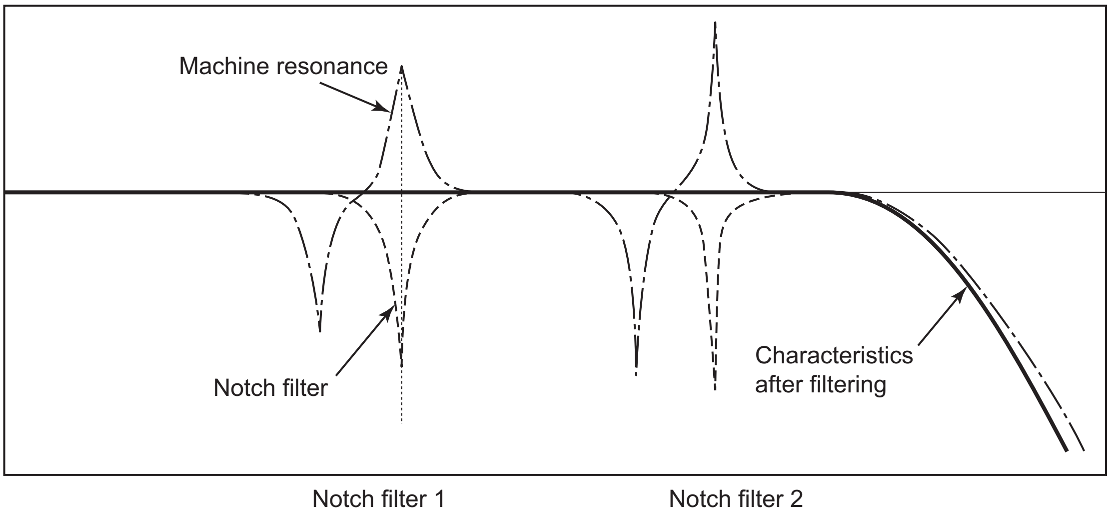
10-7 Notch Filter

When the machine rigidity is low, axis torsion may produce resonance which results in vibration and noise. Thus you may not be able to set a high gain.
The notch filter can restrict the resonance peak, and allows a high gain setting and vibration reduction.

The OMNUG G5-series Servo Drives provide four notch filters that can be used for adjusting frequency, width and depth.
If the ball screw, etc. cause resonation at the specific location, you can set the resonance frequency using a notch filter to eliminate resonance.
A notch filter is used to eliminate a specified frequency component.



If machine resonance occurs, use this notch filter to eliminate resonance.



Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn201	Notch 1 Frequency Setting	Set the center frequency of the notch filter 1. The notch filter is enabled at 50 to 4,999 Hz, and disabled at 5,000 Hz.	P.8-19
Pn202	Notch 1 Width Setting	Select the width of the notch filter 1 frequency. Increasing the value widens the notch width. (Setting range: 0 to 20)	P.8-19
Pn203	Notch 1 Depth Setting	Select the depth of the notch filter 1 center frequency. Increasing the value decreases the notch depth and thereby reduce the phase delay. The notch filter is disabled if 100 is set. (Setting range: 0 to 99)	P.8-19
Pn204	Notch 2 Frequency Setting	Set the center frequency of the notch filter 2. The details are the same with the notch filter 1 frequency.	P.8-19
Pn205	Notch 2 Width Setting	Select the width of the notch filter 2 frequency. The details are the same with the notch filter 1 width.	P.8-20
Pn206	Notch 2 Depth Setting	Select the depth of the notch filter 2 center frequency. The details are the same with the notch filter 1 depth.	P.8-20
Pn207	Notch 3 Frequency Setting *1	Set the center frequency of the notch filter 3. The details are the same with the notch filter 1 frequency.	P.8-20
Pn208	Notch 3 Width Setting *1	Select the width of the notch filter 3 frequency. The details are the same with the notch filter 1 width.	P.8-20
Pn209	Notch 3 Depth Setting *1	Select the depth of the notch filter 3 center frequency. The details are the same with the notch filter 1 depth.	P.8-20
Pn210	Notch 4 Frequency Setting *1	Set the center frequency of the notch filter 4. The details are the same with the notch filter 1 frequency.	P.8-20
Pn211	Notch 4 Width Setting *1	Select the width of the notch filter 4 frequency. The details are the same with the notch filter 1 width.	P.8-21
Pn212	Notch 4 Depth Setting *1	Select the depth of the notch filter 4 center frequency. The details are the same with the notch filter 1 depth.	P.8-21

*1 If an adaptive filter is used, these are set automatically.

Precautions for Correct Use

- Identify the resonance frequency using the frequency characteristics measurement function, resonance frequency monitor or operation waveform of the waveform graphics function of CX-Drive and set the identified frequency as the notch filter frequency.

Notch Filter Width and Depth

Width Setting

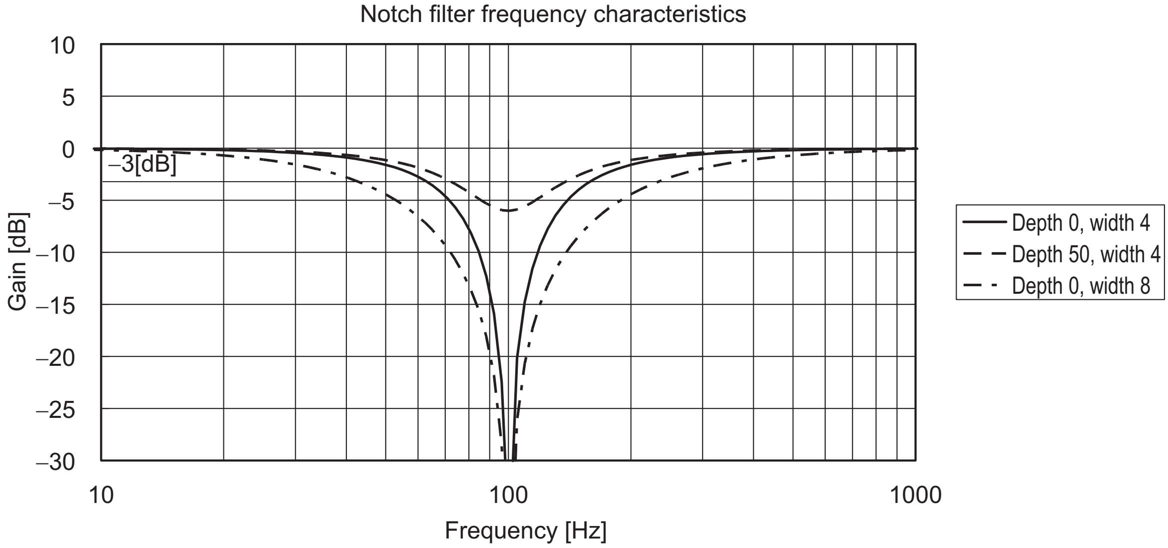
Ratio of the frequency bandwidth at a damping factor of -3 [dB] relative to the center frequency when the depth is 0. This value should conform to the left column in the table below.

Depth Setting

I/O ratio at which the center frequency input is completely cut off at a set value of 0 and completely passed at a set value of 100. If the indication unit is [dB], this value should conform to the right column in the table below.

Width	
Set value	**Bandwidth/center frequency**
0	0.50
1	0.59
2	0.71
3	0.84
4	1.00
5	1.19
6	1.41
7	1.68
8	2.00
9	2.38
10	2.83
11	3.36
12	4.00
13	4.76
14	5.66
15	6.73
16	8.00
17	9.51
18	11.31
19	13.45
20	16.00

Depth		
Set value	**I/O ratio (%)**	**Damping factor (dB)**
0	0 (Cut off)	–∞
1	1	–40.0
2	2	–34.0
3	3	–30.5
4	4	–28.0
5	5	–26.0
10	10	–20.0
15	15	–16.5
20	20	–14.0
25	25	–12.0
30	30	–10.5
35	35	–9.1
40	40	–8.0
45	45	–6.9
50	50	–6.0
60	60	–4.4
70	70	–3.1
80	80	–1.9
90	90	–0.9
100	100 (Passed)	0.0

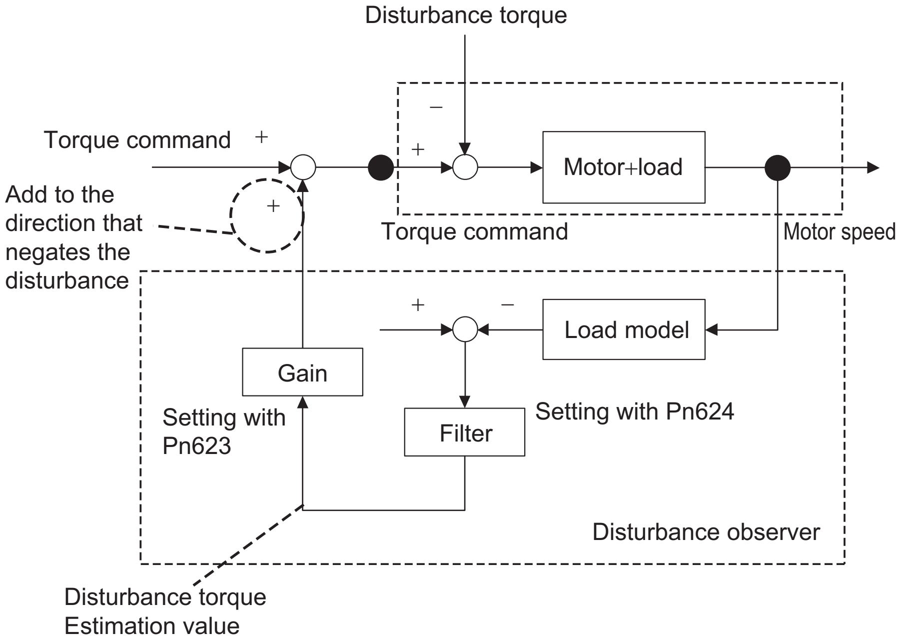


10

Adjustment Functions

10-8 Disturbance Observer Function

You can lower the effect of the disturbance torque and reduce the vibration using the estimated disturbance torque value.



Operating Conditions

You can use the disturbance observer in the following situations.

	Conditions
Operating mode	POSITION CONTROL mode, SPEED CONTROL mode
Others	• Servo-ON state. • The factors other than control parameters are set correctly. This includes the torque limit. The motor operates normally without any failures. • The REALTIME AUTOTUNING mode Selection (Pn002) is set to 0 or disable. • The Instantaneous Speed Observer function is disabled (Pn610, bit0=0).

Precautions for Correct Use

- If there is a resonance point below the cut-off frequency estimated by the disturbance observer, or if a large amount of high-frequency elements are found in the disturbance torque, the disturbance observer may not be enabled.

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Adjustment Functions

Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn610	Function Expansion Setting	Set the bits related to the disturbance observer.	P.8-53
Pn623	Disturbance Torque Compensation Gain	Set the compensation gain for disturbance torque.	P.8-55
Pn624	Disturbance Observer Filter Setting	Set the filter time constant for disturbance torque compensation.	P.8-55

Operating Procedure

1. **Set the Function Expansion Setting (Pn610).**
   Set whether to enable or disable the disturbance observer in bit 1.
   0: Disabled
   1: Enabled
   Set the operating conditions to be enabled in bit 2.
   0: Enabled at all time
   1: Enabled only when gain 1 is selected
2. **Set the Disturbance Observer Filter Setting (Pn624).**
   Set a small value to the Disturbance Torque Compensation Gain (Pn623).
   Change the value on the Disturbance Observer Filter Setting (Pn624) from a large value gradually to a smaller one.
   The smaller the value set on the Disturbance Observer Filter Setting (Pn624) is, the lesser disturbance torque lag can be estimated, and the more effective the disturbance influence can be controlled. But the smaller the value is, the larger the operation noise can be. You must consider the balance of these advantage and disadvantage to set a value.
3. **Set the Disturbance Torque Compensation Gain (Pn623).**
   After you set the Disturbance Observer Filter Setting (Pn624), return the value on the Disturbance Torque Compensation Gain (Pn623) from the small value to a large value. The larger the value set on the Disturbance Torque Compensation Gain (Pn623) is, the more effective the disturbance influence can be controlled. But the larger the value is, the larger the operation noise can be. You must consider the balance of these advantage and disadvantage to set a value.

10-9 Friction Torque Compensation Function

Two types of friction torque compensations can be set to reduce influence of mechanical frictions. One is the unbalanced load compensation that offsets the constantly applied unbalance torque. The other is the dynamic friction compensation that changes the offset direction in accordance with the operating direction.

Operating Conditions

You can use the function under the following conditions:

Conditions
• Servo-ON state. • The factors other than control parameters are set correctly. This includes the torque limit. The motor operates normally without any failures.

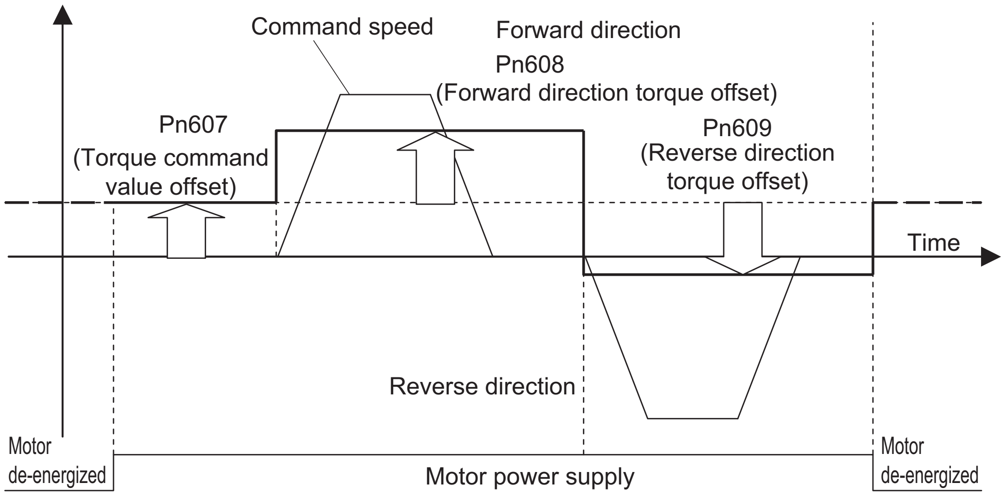
Parameters Requiring Settings

The torque compensation function needs the combined settings of following three parameters.

Parameter number	Parameter name	Description	Reference
Pn607	Torque Command Value Offset	Set the unbalanced load compensation value that is always added to the torque command in the CONTROL mode other than torque control.	P.8-52
Pn608	Forward Direction Torque Offset	Set the dynamic friction compensation value that is added to the torque command when a forward direction position command is input for position control or full closing control.	P.8-52
Pn609	Reverse Direction Torque Offset	Set the dynamic friction compensation value that is added to the torque command when a reverse direction position command is input for position control or full closing control.	P.8-53

Operation Example

The friction torque compensation is applied to the input direction of the position command as shown in the drawing below.



The Torque Command Value Offset (Pn607) reduces the variations of positioning operations due to the movement directions when a certain amount of unbalanced load torque is always applied to the motor at the vertical axis by setting the torque command.
The Forward Direction Torque Offset (Pn608) and Reverse Direction Torque Offset (Pn609) are loads that require a large amount of dynamic friction torque due to the radial load, such as the belt drive axis. By setting the friction torque for each rotation direction for all parameters, you can reduce the deterioration and inconsistencies of positioning stabilization time due to dynamic friction.

Precautions for Correct Use

You can use the unbalanced load compensation and the dynamic friction compensation together or separately. Take note that the following use limit is applied upon CONTROL mode switching or servo ON.

- During torque control
  The unbalanced load compensation and the dynamic friction compensation will be 0 regardless of the parameter setting.
- During speed control with Servo-OFF state
  The load compensation is enabled based on Pn607 when the servo is turned OFF.The dynamic friction compensation will be 0 regardless of the parameter setting.
- When the servo is turned ON during position control or full closing control
  The unbalanced load compensation and the dynamic friction compensation values is held until the first position command is input.When the position command is input, the unbalanced load compensation is updated based on Pn607. Also, based on the command direction, the dynamic friction compensation value is updated according to parameters Pn608 or Pn609.

10-10 Hybrid Vibration Suppression Function

This function suppresses the vibrations that are caused by the amount of the torsion between the motor and the load in the FULL CLOSING CONTROL mode.You can use this function to raise the gain setting.

Operating Conditions

The hybrid vibration suppression function can be used in the following situations.

	Conditions
Operating mode	FULL CLOSING CONTROL mode
Others	• Servo-ON state. • The factors other than control parameters are set correctly. This includes the torque limit. The motor operates normally without any failures.

Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn634	Hybrid Vibration Suppression Gain	Set the hybrid vibration suppression gain. In general, set it to the same value as the position loop gain, and finely adjust it based on the situation.	P.8-57
Pn635	Hybrid Vibration Suppression Filter	Set the hybrid vibration suppression filter.	P.8-58

Operating Procedure

1. **Set the Hybrid Vibration Suppression Gain (Pn634) to the same value as the position loop gain.**
2. **Gradually increase the set value of the Hybrid Vibration Suppression Filter (Pn635) while driving with full closing control and check the changes in the response.**
   If the response improves, find the combination of Pn634 and Pn635 that result in the optimal response by adjusting them.

Precautions for Correct Use

- This function is effective when the amount of torsion between the motor shaft and the load is large.This may be less effective when the amount of torsion is small.

10-11 Feed-forward Function

The feed-forward function come in 2 types: speed feed forward and torque feed forward.
The speed feed forward can minimize the position error and increase the responsiveness by calculating the speed control command that is required for the operation based on the internal positioning command during position or full closing control, and adding it to the speed command that is calculated based on the comparison with the position feedback.
The torque feed forward can increase the responsiveness during speed control by calculating the torque command that is required for the operation based on the speed control command, and adding it to the torque command that is calculated based on the comparison with the speed feedback.

Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn110	Speed Feed-forward Amount	Use this parameter to add the speed control command calculated from the internal positioning command that is multiplied by this parameter's ratio to the speed command from the position control process.	P.8-10
Pn111	Speed Feed-forward Command Filter	Set the time constant for the first-order lag filter that is applied to speed feed-forward inputs.	P.8-10
Pn112	Torque Feed-forward Amount	Use this parameter to add the torque command calculated from the speed control command that is multiplied by this parameter's ratio to the torque command from the speed control process.	P.8-10
Pn113	Torque Feed-forward Command Filter	Set the time constant for the first-order lag filter that is applied to torque feed-forward inputs.	P.8-10
Pn610	Function Expansion Setting	Set the bits related to inertia ratio switching.	P.8-53

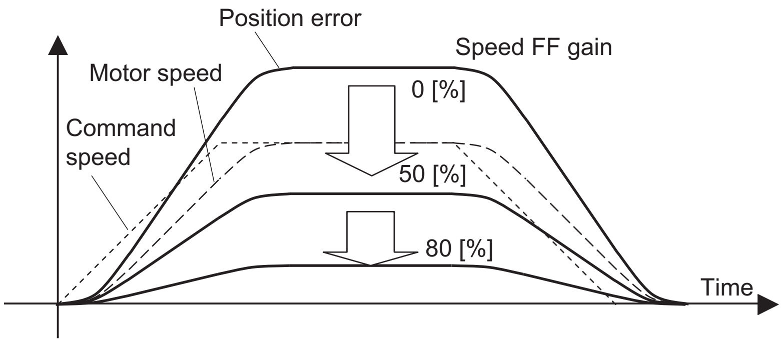
Operating Procedure

Speed Feed-forward Operating Method

1. **Set the Speed Feed-forward Command Filter (Pn111).**
   Set it to 50 (0.5 ms) or so.
2. **Adjust the Speed Feed-forward Amount (Pn110).**
   Gradually increase the value of Speed Feed-forward Amount (Pn110) and finely adjust it to avoid overshooting during acceleration/deceleration.
   If the speed feed-forward amount is set to 100%, the position error is 0 in calculation. However, a large overshooting will occur during acceleration/deceleration.

   The position error during an operation at a certain speed can be smaller based on the following formula according to the speed feed-forward gain value.

Position error [command unit] = command speed [command unit/s] / position loop gain [1/s] × (100 - speed feed-forward amount [%]) / 100



The position error in the range of constant speed becomes smaller as the speed feed-forward gain increases.

Precautions for Correct Use

- If the updating cycle of the position command inputs is longer than the Servo Drive control cycle, or if the input command frequency is not uniform, the operating noise while the speed feed-forward is enabled may increase. Apply the position command filter (first-order lag or FIR smoothing) or raise the speed feed-forward filter setting.

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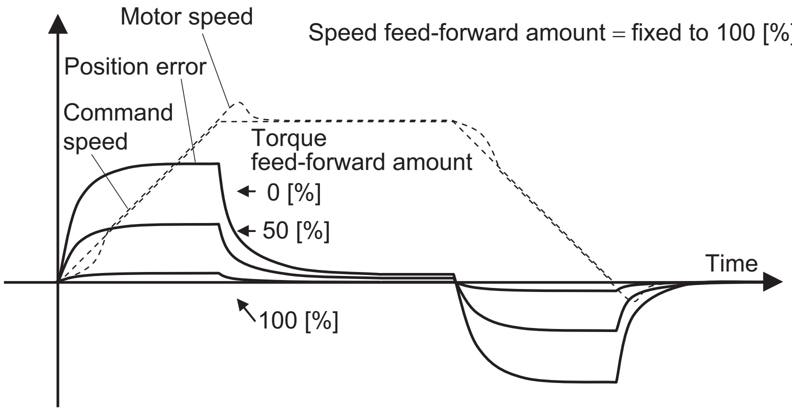
Adjustment Functions

Torque Feed-forward Operating Method

1. **Set the Inertia Ratio (Pn004).**
   Set the inertia ratio as correctly as possible.
   - If the inertia ratio is calculated for the selected motor, input the calculated value.
   - If the inertia ratio is not known, perform autotuning and set the inertia ratio.
2. **Set the Torque Feed-forward Command Filter (Pn113).**
   Set it to 50 (0.5 ms) or so.
3. **Adjust the Torque Feed-forward Amount (Pn112).**
   Gradually increase the value of Torque Feed-forward Amount (Pn112).
   Since the position error during acceleration/deceleration at a certain speed can be brought close to 0, it can be controlled almost to 0 throughout the entire operation range during a trapezoidal speed pattern drive under ideal conditions where no disturbance torque is working.
   In reality, disturbance torque is always applied and, therefore, the position error cannot be completely 0.



Torque feed forward can reduce the position error in a range of acceleration/deceleration specified.

Precautions for Correct Use

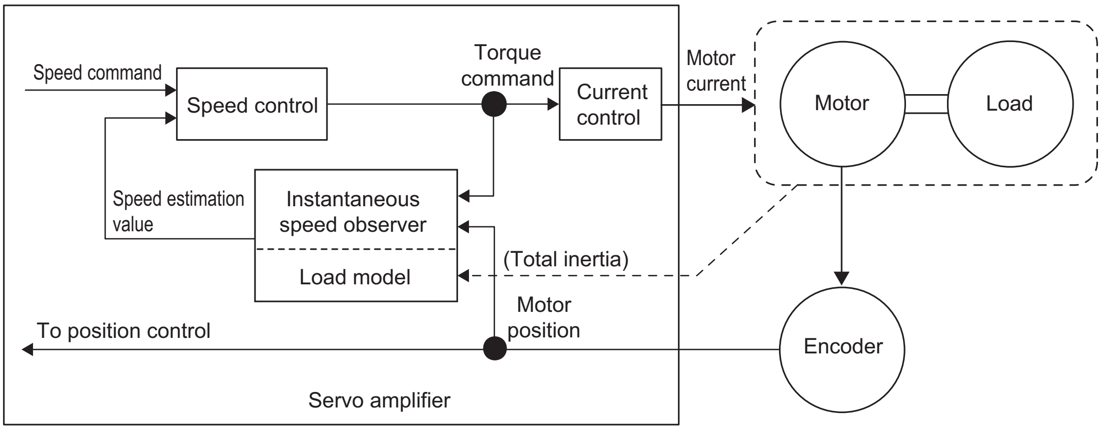
- If you raise the torque feed-forward filter time constant, the operation noise will become smaller. However, the position error at the point of change in acceleration will become larger.

10

Adjustment Functions

10-12 Instantaneous Speed Observer Function

Estimating the motor speed using a load inertia increases responsiveness and reduces vibration at stopping and improves the speed detection accuracy.



Operating Conditions

The instantaneous speed observer function can be used in the following situations.

	Conditions
Operating mode	POSITION CONTROL mode*1 , SPEED CONTROL mode
Others	• Servo-ON state. • The factors other than control parameters are set correctly. This includes the torque limit. The motor operates normally without any failures. • Realtime autotuning is disabled (Pn002=0).

*1.This function cannot be used in FULL CLOSING CONTROL mode.

Parameters Requiring Settings

Parameter number	Parameter name	Description	Reference
Pn610	Function Expansion Setting	Set whether to enable or disable the instantaneous observer function.	P.8-53
Pn004	Inertia Ratio	Set the inertia ratio 1.	P.8-3
Pn100	Position Loop Gain 1	Set the position loop gain.	P.8-7
Pn101	Speed Loop Gain 1	Set the speed loop gain.	P.8-8

Operating Procedure

1. **Set the Inertia Ratio (Pn004).**
   Set the inertia ratio as correctly as possible.
   - If the Inertia Ratio (Pn004) is obtained in a realtime auto gain tuning, use the set value.
   - If the inertia ratio is calculated for the selected motor, input the calculated value.
   - If the inertia ratio is not known, perform autotuning and set the inertia ratio.
2. **Adjust the position loop gain and speed loop gain.**
   Adjust Position Loop Gain 1 (Pn100), Speed Loop Gain 1 (Pn101), Speed Loop Integral Time Constant 1 (Pn102) and Torque Command Filter Time Constant 1 (Pn104).
   If no problem occurs in realtime autotuning, you can continue to use the settings.
3. **Set the Function Expansion Setting (Pn610).**
   Set whether to enable or disable the instantaneous speed observer function in bit 0.
   If you set this to 1 (enabled), the speed detection method switches to instantaneous speed observer.
   - If the machine operation noise or vibration, or a change in the torque monitor waveform is significant enough to cause any problem, return the setting to 0 and make sure that the inertia ratio or the adjustment parameters are correct.
   - If the machine operation noise or vibration, or a change in the torque monitor waveform is small, make small adjustments to the Inertia Ratio (Pn004) to find the setting that makes the smallest change while monitoring the position error waveform and the actual speed waveform.
   - If Position Loop Gain 1 (Pn100), Speed Loop Gain 1 (Pn101) or Speed Loop Integral Time Constant 1 (Pn102) is changed, the optimal value for the Inertia Ratio (Pn004) may change, so make small adjustments on the value for the Inertia Ratio (Pn004) again to set a value that makes the smallest change.

Precautions for Correct Use

- It may not function properly or the effect may not be apparent under the following conditions.
  - If the margin of error with the actual device is large for the inertia load.
  - If there are multiple resonance points.
  - If there is a large resonance point at the frequency of 300 Hz or lower.
  - If there is a non-linear element (play), such as a large backlash.
  - If the load inertia changes.
  - If a large disturbance torque with high-frequency elements is applied.
  - If the setting range for positioning is small.

11

Error and Maintenance

This chapter explains the items to check when problems occur, error diagnosis using the alarm LED display and measures, error diagnosis based on the operating condition and measures, and periodic maintenance.

11-1 Error Processing

Preliminary Checks When a Problem Occurs

This section explains the preliminary checks required to determine the cause of a problem if one occurs.

Checking the Power Supply Voltage

- Check the voltage at the power supply input terminals.
  Main circuit power supply input terminal (L1, L2, L3)

R88D-KNxL-ML2	(50 to 400 W)	: Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz
R88D-KNxH-ML2	(100 W to 1.5 kW)	: Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz
	(750 W to 1.5 kW)	: 3-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz
	(2 to 5 kW)	: 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz
R88D-KNxF-ML2	(750 W to 5 kW)	: 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz

  Control circuit power supply input terminal (L1C, L2C)

R88D-KNxL-ML2	(50 to 400 W)	: Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz
R88D-KNxH-ML2	(100 W to 1.5 kW)	: Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz
	(2 to 5 kW)	: Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz
R88D-KNxF-ML2	(750 W to 5 kW)	: 24 VDC (21.6 to 26.4 V)

  If the voltage is out of this range, there is a risk of operation failure, so be sure that the power supply is correct.
- Check the voltage of the sequence input power supply. (+24 VIN terminal (CN1 pin 7))
  Within the range of 11 to 25 VDC.
  If the voltage is out of this range, there is a risk of operation failure. Be sure that the power supply is correct.

Checking Whether an Alarm Has Occurred

- Make an analysis using the 7-segment LED display area in the front of the Servo Drive and using the Operation keys.
- When an alarm has occurred
  … Check the alarm display that displays (xx) and make an analysis based on the alarm that is indicated.
- When an alarm has not occurred
  … Make an analysis according to the error conditions.
- In either case, refer to "11-4 Troubleshooting (P.11-14)" for details.

Precautions When a Problem Occurs

When checking and verifying I/O after a problem has occurred, the Servo Drive may suddenly start to operate or suddenly stop, so always take the following precautions.
You should assure that anything not described in this manual is not possible with this product.

Precautions

- Disconnect the wire before checking for cable breakage. Even if you test conduction with the cable connected, test results may not be accurate due to conduction via bypassing circuit.
- If the encoder signal is lost, the motor may run away, or an error may occur. Be sure to disconnect the motor from the mechanical system before checking the encoder signal.
- When performing tests, first check that there are no persons in the vicinity of the equipment, and that the equipment will not be damaged even if the motor runs away.
  Before performing the tests, verify that you can immediately stop the machine using an emergency stop even if it runs away.

Replacing the Servomotor and Servo Drive

Use the following procedure to replace the Servomotor or Servo Drive.

Replacing the Servomotor

1. **Replace the motor.**
2. **Perform origin adjustment (for position control).**
   - When the motor is replaced, the motor's origin position (phase Z) may deviate, so origin adjustment must be performed.
   - Refer to the Position Controller's manual for details on performing origin adjustment.
3. **Set up the absolute encoder.**
   - If a motor with an absolute encoder is used, the absolute value data in the absolute encoder is cleared when the motor is replaced, so setup is again required.
     The multi-rotation data will be different from before it was replaced, so reset the initial Motion Control Unit parameters.
   - For details, refer to "Absolute Encoder Setup" (P.9-6).

Replacing the Servo Drive

1. **Copy the parameters.**
   Use a software tool such as the CX-Drive to read and save all parameter settings from the Servo Drive.
2. **Replace the Servo Drive.**
3. **Reset the parameters.**
   Use a software tool such as the CX-Drive to set and transfer all parameter settings to the Servo Drive.
4. **Set up the absolute encoder.**
   - If a motor with an absolute encoder is used, the absolute value data in the absolute encoder is cleared when the Servo Drive is replaced, so setup is again required.
   - The multi-rotation data will be different from before it was replaced, so initialize the Motion Control Unit settings.
   - For details, refer to "Absolute Encoder Setup" (P.9-6).

11-2 Warning

This function outputs a warning signal and notifies the erroneous state such as overload before an alarm starts to operate.
Set the warning output type to Warning Output Selection 1 (Pn440) and Waning Output Selection 2 (Pn441).
Refer to the description about the Warning Output Selection 1 (Pn440) and the Warning Output Selection 2 (Pn441) in Section 8-5 Interface Monitor Setting Parameter, and those about the Warning Mask Setting (Pn638) and the Communications Control (Pn800) in "8-7 Special Parameters".

Precautions for Correct Use

- All warnings are retained. To reset the retained warnings, take the same procedures as resetting the usual alarms.

Warning List

General Warnings

Warning number	Warning name	Warning occurrence condition	Warning Output Selection (Pn440, Pn441) *1	Warning Mask Setting (Pn638)*2
A0	Overload warning	The load ratio is 85% or more of the protection level.	1	bit7
A1	Excessive regeneration warning	The regeneration load ratio is 85% or more of the protection level.	2	bit5
A2	Battery warning	Battery voltage is 3.2 V or less.	3	bit0
A3	Fan warning	The fan stop status continues for 1 second.	4	bit6
A4	Encoder communications warning	The encoder communications errors occurred in series more frequently than the specified value.	5	bit4
A5	Encoder overheating warning	The encoder detects the overheat warning.	6	bit3
A6	Vibration detection warning	Vibrating is detected.	7	bit9
A7	Life expectancy warning	The life expectancy of the capacitor or the fan is shorter than the specified value.	8	bit2
A8	External encoder error warning	The external encoder detects a warning.	9	bit8
A9	External encoder communications warning	The external encoder has communications errors in series more than the specified value.	10	bit10

*1. Set the Warning Output Selection 1 (Pn440) by the warning type to output to the Warning Output 1 (WARN1), and the Warning Output Selection 2 (Pn441) by the type to output to the Warning Output 2 (WARN2). If you set this to 0, all warning types are output.

*2. Each warning detection can be masked using the Warning Mask Setting (Pn638). The table shows the corresponding bits.
When the bit is set to 1, the warning detection is masked.

Warnings related to MECHATROLINK-II Communications

Warning number	Warning name	Warning occurrence condition	Warning Output Selection (Pn440, Pn441)*1	Communications Control (Pn800)*2
94	Data setting warning	• The set value on the command argument is out of the specified range. • Parameter writing fails. • The command set value is incorrect.	11	bit4
95	Command warning	• The command transmission conditions are not met. • The sub-command transmission conditions are not met. • A rotation command is given in the prohibited direction after the motor made an emergency stop due to a drive prohibition input.	12	bit5
96	MECHATROLINK-II communications warning	One or more MECHATROLINK-II communications error occur.	13	bit6

*1. Set the Warning Output Selection (Pn440) by the warning type to output to the Warning Output 1 (WARN1), and the Warning Output Selection 2 (Pn441) by the type to output to the Warning Output 2 (WARN2).

*2. The MECHATROLINK-II communications warning detections can be masked by the setting on the Communications Control (Pn800). The table above shows the corresponding bits. The warning detection is masked when you set the corresponding bit to 1.

11-3 Alarms

If the Servo Drive detects an error, it outputs an alarm (ALM), turns off the power drive circuit, and displays the error number on the front panel.

Precautions for Correct Use

- Refer to "Error Diagnosis Using the Alarm Displays" (P.11-14) for appropriate alarm measures.
- Reset the alarm using one of the following methods. Remove the cause of the alarm first.
  - Turn OFF the power supply, then turn it ON again.
  - Reset the alarm via MECHATROLINK-II communications or on CX-Drive.

  However, some alarms can only be reset by turning the power supply OFF then ON again. Refer to the "Alarm List" (P.11-6).
- If you reset an alarm while the operation command (RUN) is turned ON, the Servo Drive starts operation as soon as the alarm is released, which is dangerous. Be sure to turn OFF the RUN before clearing the alarm.
  If the RUN is always ON, first check safety sufficiently before clearing the alarm.
- The Overload (Alarm No.16) cannot be reset for 10 seconds once it occurs.
- Any displays such as hh, ꟻꟻ, and HH on the error number mean internal malfunction on the MPU. Cut off the power immediately when you encounter such a case.

Alarm List

Alarm number		Error detection function	Detection details and probable cause	Attribute		
Main	Sub			History	Can be reset	Emergency stop *1
11	0	Control power supply undervoltage	The DC voltage of the control circuit is below the specified value.	–	√	–
12	0	Overvoltage	The DC voltage in the main circuit is abnormally high.	√	√	–
13	0	Main power supply undervoltage (Insufficient voltage between P and N)	The DC voltage of the main circuit is low.	–	√	–
	1	Main power supply undervoltage (AC cut-off detection)	A location was detected where the main circuit AC power supply is cut off.	–	√	–
14	0	Overcurrent	Overcurrent flowed to the IGBT.	√	–	–
	1	IPM error	Motor power line ground fault or short circuit.	√	–	–
15	0	Servo Drive overheat	The temperature of the Servo Drive radiator exceeded the specified value.	√	–	√
16	0	Overload	Operation was performed with torque significantly exceeding the rating for several seconds to several tens of seconds.	√	√ *2	–

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Error and Maintenance

Alarm number		Error detection function	Detection details and probable cause	Attribute		
Main	Sub			History	Can be reset	Emergency stop *1
18	0	Regeneration overload	The regenerative energy exceeds the processing capacity of the Regeneration Resistor.	√	–	√
	1	Regeneration Tr error	An error was detected in a Servo Drive regeneration drive Tr.	√	–	–
21	0	Encoder communications disconnection error	The encoder wiring is disconnected.	√	–	–
	1	Encoder communications error	An encoder communications error was detected.	√	–	–
23	0	Encoder communications data error	Communications cannot be performed between the encoder and the Servo Drive.	√	–	–
24	0	Error counter overflow	The error counter accumulated pulse exceeds the set value for the Error Counter Overflow Level (Pn014).	√	√	√
25	0	Excessive hybrid error	During full closing control, difference between the load position from external encoder and the motor position from to encoder was larger than the pulse set by the Internal/ External Feedback Pulse Error Counter Overflow Level (Pn328).	√	–	√
26	0	Overspeed	The motor rotation speed exceeded the value set on the Overspeed Detection Level Setting (Pn513).	√	√	√
	1	Overspeed 2	The motor rotation speed exceeded the value set on the Overspeed Detection Level Setting at Emergency Stop (Pn615).	√	√	–
27	1	Absolute value cleared	The multi-turn counter for the absolute encoder was cleared by the CX-Drive.	√	–	–
	4	Command error	The position command variation after the electronic gear is higher than the specified value.	√	–	–
	5	Command generation error	During the position command processing, an error such as the "over the calculation range" occurred.	√	–	–
	6	Operation command duplicated	During a trial operation of CX-Drive, MECHATROLINK-II communication was established.	√	√	–

Alarm number		Error detection function	Detection details and probable cause	Attribute		
Main	Sub			History	Can be reset	Emergency stop *1
29	1	Internal error counter overflow 1	During the initialization of position data, after the control power is turned on in absolute value mode or after CONFIG operation, the value that is obtained by dividing the Absolute encoder position (pulse unit) by the Electronic gear ratio exceeded $\pm 2^{31}$ or 2147483648.	√	–	–
	2	Internal error counter overflow 2	The position error in units of pulse exceeded $\pm 2^{29}$ or 536870912. Alternatively, the position command in command units exceeded $\pm 2^{30}$ or 1073741824.	√	–	–
	3	Internal error counter overflow 3	The value that is obtained by multiplying the Final Distance for Origin Return (Pn825) by the Electronic gear ratio exceeded $\pm 2^{31}$ or 2147483648.	√	–	–
30 (st)	0	Safety input error	Safety input signal turned OFF.	–	√	–
33	0	Interface input duplicate allocation error 1	Detected a duplicated setting among the interface input signals (IN1, IN2, IN3 and IN4).	√	–	–
	1	Interface input duplicate allocation error 2	Detected a duplicated setting among the interface input signals (IN5, IN6, IN7 and IN8).	√	–	–
	2	Interface input function number error 1	Detected that a non-defined number was assigned to the interface input signals (IN1, IN2, IN3 or IN4). Alternatively, a setting error was detected.	√	–	–
	3	Interface input function number error 2	Detected that a non-defined number was assigned to the interface input signals (IN5, IN6, IN7 or IN8). Alternatively, a setting error was detected.	√	–	–
	4	Interface output function number error 1	Detected that a non-defined number was assigned to the interface output signal (OUTM1).	√	–	–
	5	Interface output function number error 2	Detected that a non-defined number was assigned to the interface output signal (OUTM2).	√	–	–
	8	Latch input allocation error	Detected an error on the latch input allocation.	√	–	–
34	0	Overrun limit error	The motor exceeded the allowable operating range set in the Overrun Limit Setting (Pn514) with respect to the position command input.	√	√	–
36	0 to 2	Parameter error	Data in the Parameter Save area was corrupted when the power supply was turned ON and data was read from the EEPROM.	–	–	–
37	0 to 2	Parameters destruction	The checksum for the data read from the EEPROM when the power supply was turned ON does not match.	–	–	–

Alarm number		Error detection function	Detection details and probable cause	Attribute		
Main	Sub			History	Can be reset	Emergency stop *1
38	0	Drive prohibition input error 1	Both the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT) were turned on while the Drive Prohibition Input Selection (Pn504) was set to 0. Alternatively, either the Forward Drive Prohibition Input (POT) or the Reverse Drive Prohibition Input (NOT) was turned on while the Drive Prohibition Input Selection (Pn504) was set to 2.	–	√	–
	1	Drive prohibition input error 2	An operation command such as jog was made by CX-Drive, while the Drive Prohibition Input Selection (Pn504) was set to 0, the MECHATROLINK-II communications was cut off, and either the Forward Drive Prohibition Input (POT) or the Reverse Drive Prohibition Input (NOT) was turned on. Both the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT) were turned on. Alternatively, either the Forward Drive Prohibition Input (POT) or the Reverse Drive Prohibition Input (NOT) was turned on while an operation command is given by CX-Drive.	–	√	–
40	0	Absolute encoder system down error ABS	The voltage supplied to the absolute encoder is lower than the specified value.	√	√ *3	–
41	0	Absolute encoder counter overflow error ABS	The multi-rotation counter of the absolute encoder exceeds the specified value.	√	–	–
42	0	Absolute encoder overspeed error ABS	The motor rotation speed exceeds the specified value when only the battery power supply of the absolute encoder is used.	√	√ *3	–
43	0	Encoder initialization error	An encoder initialization error was detected.	√	–	–
44	0	Absolute encoder 1-rotation counter error ABS	A 1-turn counter error was detected.	√	–	–
45	0	Absolute encoder multi-rotation counter error ABS	A multi-rotation counter error or phase-AB signal error was detected.	√	–	–
47	0	Absolute encoder status error ABS	The rotation of the absolute encoder is higher than the specified value.	√	–	–
48	0	Encoder phase-Z error	A serial incremental encoder phase Z pulse irregularity was detected.	√	–	–
49	0	Encoder CS signal error	A logic error was detected in the CS signal for serial incremental encoder.	√	–	–

Alarm number		Error detection function	Detection details and probable cause	Attribute		
Main	Sub			History	Can be reset	Emergency stop *1
50	0	External encoder connection error	An error was detected in external encoder connection.	√	–	–
	1	External encoder communications data error	An error was detected in external encoder communications data.	√	–	–
51	0	External encoder status error 0	An external encoder error code was detected.	√	–	–
	1	External encoder status error 1		√	–	–
	2	External encoder status error 2		√	–	–
	3	External encoder status error 3		√	–	–
	4	External encoder status error 4		√	–	–
	5	External encoder status error 5		√	–	–
55	0	Phase-A connection error	An error was detected in the external encoder phase A connection.	√	–	–
	1	Phase-B connection error	An error was detected in the external encoder phase B connection.	√	–	–
	2	Phase-Z connection error	An error was detected in the external encoder phase Z connection.	√	–	–
82	0	Node address setting error	The node address set by the rotary switches on the Drive exceeded the setting range, when the control power was turned on.	√	–	–
83	0	Communications error	Failures to correctly receive the data to receive during the MECHATROLINK-II communication cycles continued in series more often than the value set on the Communications Control (Pn800).	√	√	√
84	0	Transmission cycle error	Failed to receive synchronization frames (SYNC) according to transmission cycle while the MECHATROLINK-II communication connection is being established.	√	√	√
	3	Synchronization error	An error occurred while synchronization is established.	√	–	–
	4	SYNC_SET error	In the asynchronous MECHATROLINK-II communications state, a communication error occurs while SYNC_SET command is executed.	√	√	–
86	0	Watchdog data error	An error occurred in the synchronization data that is exchanged between Master and Slave nodes for every MECHATROLINK-II communications cycle.	√	√	√
87	0	Forced alarm input error	The forced alarm input signal was input.	–	√	–

Alarm number		Error detection function	Detection details and probable cause	Attribute		
Main	Sub			History	Can be reset	Emergency stop *1
90	0	Transmission cycle setting error	Transmission cycle has a setting error when the MECHATROLINK-II CONNECT command is received.	√	√	–
	1	CONNECT error	In the standby state for a MECHATROLINK-II communications CONNECT command, a communications error occurred when the CONNECT command is received.	√	√	–
91	0	SYNC command error	During asynchronous MECHATROLINK-II communications, a synchronous type of command is issued.	√	√	√
92	0	Encoder data restoration error	In semi-closing control mode and absolute value mode as well, initialization of internal position data is not processed correctly.	√	–	–
	1	External encoder data restoration error	In FULL CLOSING CONTROL mode and absolute value mode as well, initialization of internal position data is not processed correctly.	√	–	–
93	0	Parameter setting error 1	Electronic gear ratio exceeded the allowable range.	√	–	–
	2	Parameter setting error 2	External encoder ratio exceeded the allowable range.	√	–	–
	3	External encoder connection error	The value set on the External Feedback Pulse Type Selection (Pn323) differs from the external encoder type that is connected for serial communications.	√	–	–
95	0 to 4	Motor non-conformity	The combination of the Servomotor and Servo Drive is not appropriate.	–	–	–
99	0	Other errors	• The control circuit malfunctioned due to excess noise or some other problem. • An alarm clear operation was performed when safety input 1 or safety input 2 was not in the normal status (i.e., when the input photocoupler was not ON).	√	–	–
Other numbers						

*1. An emergency stop means that there is an error causing an immediate stop when the Stop Selection for Alarm Detection (Pn510) is set to a value between 4 and 7. Refer to the description about the Stop Selection for Alarm Detection (Pn510) in “8-6 Extended parameters”.

*2. The alarm is not reset for 10 seconds once it occurs.

*3. The alarm cannot be reset unless the absolute value is cleared.

Note 1. If an unresettable alarm occurs, remove the error factor, cut off the control power to reset the alarm.

2. If a resettable alarm occurs, reset the alarm via MECHATROLINK-II communications or on the CX-Drive.

3. Any displays such as hh, ᆿᆿ, and HH on the error number mean internal malfunction on the MPU. Cut off the power immediately when you encounter such a case.

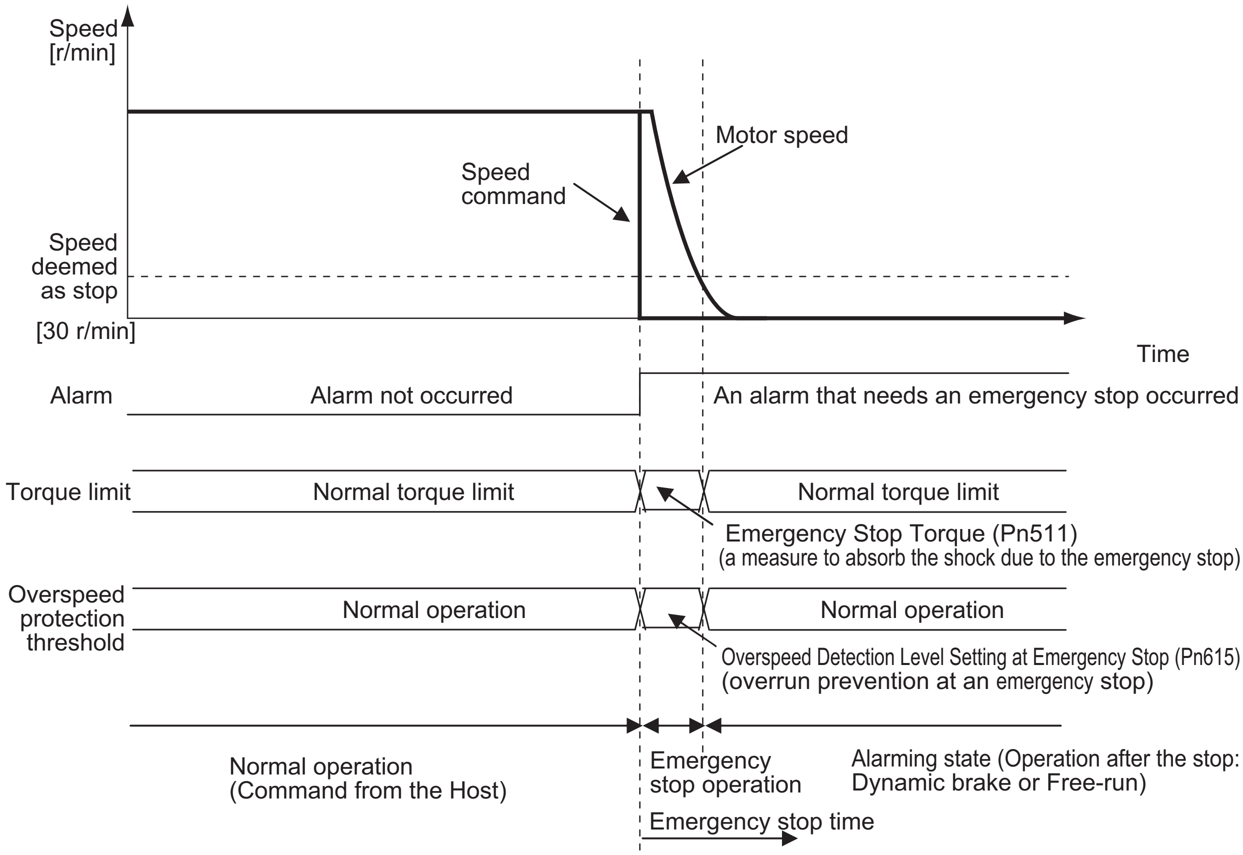
Emergency Stop Operation at Alarms

The emergency stop function controls the motor and stop it immediately, if an alarm that supports for emergency stop occurs.

Related Parameters

Parameter number	Parameter name	Explanation	Reference
Pn510	Stop Selection for Alarm Detection	Set the states during deceleration and after stop, when an alarm occurs.	P.8-46
Pn511	Emergency Stop Torque	Set the torque limit for emergency stops.	P.8-46
Pn513	Overspeed Detection Level Setting	If the motor rotation speed exceeds the set value, the Overspeed (Alarm No.26.0) occurs.	P.8-47
Pn614	Alarm Detection Allowable Time Setting	Set the allowable time required until the motor stops by an emergency stop due to an alarm.	P.8-54
Pn615	Overspeed Detection Level Setting at Emergency Stop	If the motor speed exceeds the set value during an emergency stop due to an alarm, the Overspeed 2 (Alarm No.26.1) occurs.	P.8-54

Emergency Stop Operation



Precautions for Correct Use

- As the prevention of overrun at an emergency stop, set the allowable overspeed level on the Overspeed Detection Level Setting at Emergency Stop (Pn615). The Overspeed 2 (Alarm No.26.1) is the alarm that does not support emergency stop. If it occurs, error trip occurs immediately.
- Set a higher value on the Overspeed Detection Level Setting at Emergency Stop (Pn615) than one on the Overspeed Detection Level Setting (Pn513). Otherwise, the Overspeed 2 (Alarm No.26.1) occurs earlier than the Overspeed (Alarm No.26.0). Thus an emergency stop does not happen. If the Overspeed (Alarm No.26.0) and the Overspeed 2 (Alarm No.26.1) occur at the same time, the emergency stop does not happen, either.
- If the actual rotation speed is not lower than 30 r/min after the time set on the Alarm Detection Allowable Time Setting (Pn614) elapses since an alarm that support an emergency stop occurs, it will be an alarming state immediately.
- If an alarm which is not supported by emergency stop operation occurs while in emergency stop, Alarming state occurs immediately.

11-4 Troubleshooting

If an error occurs in the machine, determine the error conditions from the alarm displays and operation status, identify the cause of the error, and take appropriate measures.

Error Diagnosis Using the Alarm Displays

Alarm number		Name	Cause	Measures
Main	Sub			
11	0	Control power supply undervoltage	The voltage between the positive and negative terminals in the control power supply converter dropped below the specified value. 100-V products: Approx. 70 VDC (Approx. 50 VAC) 200-V products: Approx. 145 VDC (Approx. 100 VAC) 400-V products: Approx. 15 VDC	Measure the voltage between the L1C and L2C lines on the connectors and the terminal block.
			• The power supply voltage is low. A momentary power interruption occurred.	• Increase the power supply voltage. Change the power supply.
			• Insufficient power supply capacity: the power supply voltage dropped because there was inrush current when the main power supply was turned ON.	• Increase the power supply capacity.
			• The Servo Drive is faulty (circuit fault).	• Replace the Servo Drive.
12	0	Overvoltage	The power supply voltage exceeded the allowable input voltage range, causing the voltage between the positive and negative terminals in the converter to exceed the specified value. The power supply voltage is high. The voltage was suddenly increased by the phase advance capacitor or the uninterruptible power supply (UPS). 100-V products: Approx. 200 VDC (Approx. 140 VAC) 200-V products: Approx. 400 VDC (Approx. 280 VAC) 400-V products: Approx. 800 VDC (Approx. 560 VAC)	Measure the voltage between the connector (L1, L2, and L3) lines. Input the correct voltage. Remove the phase advance capacitor.
			• The Regeneration Resistor wiring is broken.	• Use a tester to measure the resistance of the external resistor between the B1 and B2 terminals on the Servo Drive. If the resistance is infinite, the wiring is broken. Replace the external resistor.
			• The External Regeneration Resistor is inappropriate and cannot absorb all of the regenerative energy. The load inertia is too large, gravitational torque on the vertical axis is too large, or there is some other problem to absorb the regenerative energy.	• Change the regeneration resistance and wattage to the specified values. (Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity. Reduce the descent speed.)
			• The Servo Drive is faulty (circuit fault).	• Replace the Servo Drive.

Alarm number		Name	Cause	Measures
Main	Sub			
13	0	Main power supply undervoltage (Insufficient voltage between P and N)	If the Undervoltage Alarm Selection (Pn508) is set to 1, a momentary power interruption occurred between L1 and L3 for longer than the value specified for the Momentary Hold Time (Pn509). Alternatively, the voltage between the positive and negative terminals in the main power supply converter dropped below the specified value while the servo was ON. 100-V products: Approx. 80 VDC (Approx. 55 VAC) 200-V products: Approx. 110 VDC (Approx. 75 VAC) 400-V products: Approx. 180 VDC (Approx. 125 VAC)	Measure the voltage between the connector (L1, L2, and L3) lines.
	1	Main power supply undervoltage (AC cut-off detection)	• The power supply voltage is low.	• Increase the power supply voltage. Change the power supply. Eliminate the cause of the failure of the electromagnetic contactor on the main circuit power supply, and then turn ON the power again.
			• A momentary power interruption occurred.	• Check the setting of the Momentary Hold Time (Pn509). Set each phase of the power supply correctly.
			• Insufficient power supply capacity: the power supply voltage dropped because there was inrush current when the main power supply was turned ON.	• Increase the power supply capacity. Refer to 2-3-1 Servo Drive Model List on page 2-5 for information on the power supply capacity.
			• Phase-failure: a Servo Drive with 3-phase input specifications was operated with single-phase power supply.	• Connect each phase (L1, L2, and L3) of the power supply correctly. Use L1 and L3 for single-phase 100 V and single-phase 200 V.
			• The Servo Drive is faulty (circuit fault).	• Replace the Servo Drive.

Alarm number		Name	Cause	Measures
Main	Sub			
14	0	Overcurrent	The current flowing through the converter exceeded the specified value. • The Servo Drive is faulty (faulty circuit, faulty IGBT part, etc.).	• Disconnect the Servomotor cable, and turn ON the servo. If the problem immediately occurs, replace the Servo Drive with a new one.
			• The Servomotor cable is short-circuited between phases U, V, and W.	• Check to see if the Servomotor cable is short-circuited between phases U, V and W by checking for loose wire strands on the connector lead. Connect the Servomotor cable correctly.
	1	IPM error	• The Servomotor cable is ground-faulted.	• Check the insulation resistance between phases U, V, and W of the Servomotor cable and the grounding wire of the Servomotor. If the insulation is faulty, replace the Servomotor.
			• Motor windings are burned out.	• Check the balance between the resistance of each wire of the Servomotor. If resistance is unbalanced, replace the Servomotor.
			• The Servomotor wiring contacts are faulty.	• Check for missing connector pins in Servomotor connections U, V, and W. If any loose or missing connector pins are found, secure them firmly.
			• The relay for the dynamic brake has been welded due to frequent servo ON/OFF operations. • The Servomotor is not suitable for the Servo Drive.	• Replace the Servo Drive. Do not turn the servo ON for 3 minutes after using the dynamic brake. • Check model (capacity) of the Servomotor and the Servo Drive on the nameplates. Replace the Servomotor with a Servomotor that matches the Servo Drive.
			• The command input timing is the same as or earlier than the Servo ON timing. • The resistance of the connected External Regeneration Resistor is less than the minimum allowable value.	• Wait at least 100 ms after the servo has been turned ON, then input commands. • Connect an External Regeneration Resistor whose resistance is more than the minimum allowable value.
15	0	Servo Drive overheat	The temperature of the Servo Drive radiator or power elements exceeded the specified value. • The ambient temperature of the Servo Drive exceeded the specified value. • Overload	• Improve the ambient temperature and the cooling conditions of the Servo Drive. • Increase the capacities of the Servo Drive and the Servomotor. Set longer acceleration and deceleration times. Reduce the load.

Alarm number		Name	Cause	Measures
Main	Sub			
16	0	Overload	When the feedback value for torque command exceeds the overload level specified in the Overload Detection Level Setting (Pn512), overload protection is performed according to the overload characteristics.	Check if torque (current) waveforms oscillate or excessively oscillates vertically during analog output or communications. Check the overload warning display and the load rate through communications.
			• The load was heavy, the effective torque exceeded the rated torque, and operation continued too long.	• Increase the capacities of the Servo Drive and the Servomotor. Set longer acceleration and deceleration times. Reduce the load.
			• Vibration or hunting occurred due to faulty gain adjustment. The Servomotor vibrates or makes unusual noise. The Inertia Ratio (Pn004) setting is faulty.	• Readjust the gain.
			• The Servomotor wiring is incorrect or broken.	• Connect the Servomotor cable as shown in the wiring diagram. Replace the cable.
			• The machine was hit by an object, or the machine load suddenly became heavy. The machine was distorted.	• Remove the distortion from the machine. Reduce the load.
			• The electromagnetic brake remains ON.	• Measure the voltage at the brake terminals. Turn OFF the brake.
			• When multiple machines were wired, the wiring was incorrect and the Servomotor cable was connected to a Servomotor for another axis.	• Wire the Servomotor and the encoder correctly so that the wiring matches the axes.
			Refer to *3-2 Overload Characteristics (Electronic Thermal Function)* on page 3-32 for information on overload characteristics.	

Alarm number Main	Alarm number Sub	Name	Cause	Measures
18	0	Regeneration overload	The regenerative energy exceeds the processing capacity of the Regeneration Resistor.	Check the load rate of the Regeneration Resistor through communications. This Regeneration Resistor cannot be used for continuous regenerative braking.
			• The regenerative energy during deceleration caused by a large load inertia increased the converter voltage, and then insufficient energy absorption by the Regeneration Resistor further increased the voltage.	• Check the operation pattern (speed monitor). Check the load rate of the Regeneration Resistor and check for the excessive regeneration warning display. Increase the capacities of the Servo Drive and the Servomotor, and lengthen the deceleration time. Use an External Regeneration Resistor.
			• The Servomotor rotation speed is too high to absorb the regenerative energy within the specified deceleration time.	• Check the operation pattern (speed monitor). Check the load rate of the Regeneration Resistor and the excessive regeneration warning display. Increase the capacities of the Servo Drive and the Servomotor, and lengthen the deceleration time. Reduce the Servomotor rotation speed. Use an External Regeneration Resistor.
			• The operating limit of the external resistor is limited to a 10% duty.	• Set the Regeneration Resistor Selection (Pn016) to 2.
			Precautions for Correct Use Always provide a temperature fuse or other protective measure when setting the Regeneration Resistor Selection (Pn016) to 2. Otherwise, the Regeneration Resistor will not be protected, generate excessive heat, and be burnt.	
	1	Regeneration Tr error	The Servo Drive regeneration drive Tr is faulty.	Replace the Servo Drive.
21	0	Encoder communications disconnection error	A disconnection was detected because communications between the encoder and the Servo Drive were stopped more frequently than the specified value.	Wire the encoder correctly as shown in the wiring diagram. Correct the connector pin connections.
	1	Encoder communications error	There was a communications error in data from the encoder. There was a data error mainly due to noise. The encode cable is connected, but a communications data error occurred.	• Provide the required encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). Be careful especially when the encode cable is long. • If the Servomotor cable and the encoder cable are bundled together, separate them. • Connect the shield to FG.
23	0	Encoder communications data error	No communications error occurred with the data from the encoder, but there is an error in the contents of the data. There was a data error mainly due to noise. The encode cable is connected, but a communications data error occurred.	• Provide the required encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). Be careful especially when the encode cable is long. • If the Servomotor cable and the encoder cable are bundled together, separate them. • Connect the shield to FG.

Alarm number		Name	Cause	Measures
Main	Sub			
24	0	Error counter overflow	Position error pulses exceeded the setting of the Error Counter Overflow Level (Pn014). • Motor operation does not follow the command. • The value of the Error Counter Overflow Level (Pn014) is small.	• Check to see if the Servomotor rotates according to the position command pulse. Check on the torque monitor to see if the output torque is saturated. Adjust the gain. Maximize the set values on the No.1 Torque Limit (Pn013) and the No.2 Torque Limit (Pn522). Wire the encoder as shown in the wiring diagram. Lengthen the acceleration and deceleration times. Reduce the load and the speed. • Increase the set value of object Pn014.
25	0	Excessive hybrid error	During fully-closed control, the difference between the load position from the external encoder and the Servomotor position from the encoder was larger than the number of pulses set for the Internal/External Feedback Pulse Error Counter Overflow Level (Pn328).	• Check the Servomotor and load connection. • Check the external encoder and Servo Drive connection. • When moving the load, check to see if the change in the Servomotor position (encoder feedback value) has the same sign as the change in the load position (external encoder feedback value). Check to see if the External Feedback Pulse Dividing Numerator and Denominator (Pn324 and Pn325), and External Feedback Pulse Direction Switching (Pn326) are set correctly.
26	0	Overspeed	The Servomotor rotation speed exceeded the value set on the Overspeed Detection Level Setting (Pn513).	• Do not give excessive speed commands. • Check the input frequency, dividing ratio, and multiplication ratio of the command pulse. • If overshooting occurred due to faulty gain adjustment, adjust the gain. • Wire the encoder as shown in the wiring diagram.
	1	Overspeed 2	The Servomotor rotation speed exceeded the value set for the Overspeed Detection Level Setting at Emergency Stop (Pn615).	

Alarm number Main	Alarm number Sub	Name	Cause	Measures
27	1	Absolute value cleared ABS	The multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive.	• Check to see if the multi-rotation counter for the absolute encoder was cleared during USB communications by the CXDrive. Note This operation is performed for safety and is not an error.
	4	Command error	The position command variation after the electronic gear is higher than the specified value.	• Check to see if the position command variation is large. • Check the electronic gear ratio. • Check to see if the backlash compensation amount is too large.
	5	Command generation error	During position command processing, an error such as an “over the calculation range” error occurred.	Check to see if the electronic gear ratio, and the acceleration and deceleration rates meet the restrictions.
	6	Operation command duplicated	MECHATROLINK-II communications were established during execution of FFT that operates with the Servo Drive alone or a trial run.	Check to see if MECHATROLINK-II communications are established during execution of FFT or a trial run.
29	1	Internal error Counter Overflow 1 ABS	The value that is obtained by dividing the absolute encoder position (in pulses) by the electronic gear ratio exceeded $\pm 2^{31}$ (2,147,483,648) during the initialization of position data, after the control power was turned ON in absolute value mode, after a Config operation, after FFT was executed, or after a trial run was executed.	Review the operation range of the absolute external encoder position and the electronic gear ratio.
	2	Internal error Counter Overflow 2	The position error in pulses exceeded $\pm 2^{29}$ (536,870,912). Alternatively, the position error in command units exceeded $\pm 2^{30}$ (1,073,741,824).	• Check to see if the Servomotor rotates according to the position command. • Check on the torque monitor to see if the output torque is saturated. • Adjust the gain. • Set the No. 1 Torque Limit (Pn013) and No. 2 Torque Limit (Pn522) to the maximum value. • Wire the encoder as shown in the wiring diagram.
	3	Internal error Counter Overflow 3	The value that is obtained by multiplying the Final Distance for Origin Return (Pn825) by the electronic gear ratio exceeded $\pm 2^{31}$(2,147,483,648).	Review the Final Distance for Origin Return (Pn825) and electronic gear ratio.
30 (st)	0	Safety input error	At least one of the input photocouplers for safety inputs 1 and 2 turned OFF.	Check the input wiring of safety inputs 1 and 2.

Alarm number		Name	Cause	Measures
Main	Sub			
33	0	Interface input duplicate allocation error 1	There is a duplicate setting in the input signal (IN1, IN2, IN3, and IN4) function allocations.	Allocate the functions to the connector pins correctly.
	1	Interface input duplicate allocation error 2	There is a duplicate setting in the input signal (IN5, IN6, IN7, and IN8) function allocations.	
	2	Interface input function number error 1	There is an undefined number specification in the input signal (IN1, IN2, IN3, and IN4) function allocations. Alternatively, a logic setting error was detected.	
	3	Interface input function number error 2	There is an undefined number specification in the input signal (IN5, IN6, IN7, and IN8) function allocations. Alternatively, a logic setting error was detected.	
	4	Interface output function number error 1	There is an undefined number specification in the output signal (OUTM1) function allocation.	
	5	Interface output function number error 2	There is an undefined number specification in the output signal (OUTM2) function allocation.	
	8	Latch input allocation error	There is an error in the latch input function allocation. • The function was allocated to input signals other than IN5, IN6, or IN7. • The function was allocated to NC. • The function was not allocated for all control modes.	
34	0	Overrun limit error	The Servomotor exceeded the allowable operating range set in the Overrun Limit Setting (Pn514) with respect to the position command input range. • The gain is not suitable. • The set value of Pn514 is too small.	Check the gain (the balance between position loop gain and speed loop gain) and the inertia ratio. • Increase the set value of Pn514. Alternatively, set Pn514 to 0 to disable the protection function.
36	0	Parameter error	Data in the Parameter Save area was corrupted when the power supply was turned ON and data was read from the EEPROM.	• Reset all parameters. • If this error occurs repeatedly, the Servo Drive may be faulty. In this case, replace the Servo Drive. Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair.
	1			
	2			
37	0	Parameters destruction	EEPROM write verification data was corrupted when the power supply was turned ON and data was read from the EEPROM.	The Servo Drive is faulty. Replace the Servo Drive. Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair.
	1			
	2			

Alarm number		Name	Cause	Measures
Main	Sub			
38	0	Drive prohibition input error 1	When the Drive Prohibition Input Selection (Pn504) was set to 0, both the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT) turned ON. When object Pn504 was set to 2, either the Forward Drive Prohibition input or the Reverse Drive Prohibition input turned ON.	Check for any problems with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. In particular, check to see if the control signal power supply (12 to 24 VDC) turned ON too slowly.
	1	Drive prohibition input error 2	When object Pn504 was set to 0, MECHATROLINK-II communications were interrupted and either POT or NOT was ON, an operation command (such as a trial run or FFT) was received from the CX-Drive. Conversely, POT or NOT turned ON while operation was being performed for a CX-Drive operation command.	
40	0	Absolute encoder system down error ABS	The voltage of the built-in capacitor dropped below the specified value because the power supply to the encoder or the battery power supply was down.	Connect the battery power supply, and then set up the absolute encoder. Unless the absolute encoder is set up, the alarm cannot be cleared.
41	0	Absolute encoder counter overflow error ABS	The multi-rotation counter of the encoder exceeded the specified value.	• Set the Operation Switch when Using Absolute Encoder (Pn015) to an appropriate value. • Make sure that the traveling distance from the origin of the machine is no more than 32,767 revolutions.
42	0	Absolute encoder overspeed error ABS	The Servomotor rotation speed exceeded the specified value when only the battery power supply was used during a power interruption.	• Check the power supply voltage (5 VDC ± 5%) at the encoder. • Check the connections to connector CN2. Unless the absolute encoder is set up, the alarm cannot be cleared.
43	0	Encoder initialization error	An encoder initialization error was detected.	Replace the Servomotor.
44	0	Absolute encoder 1-rotation counter error ABS	The encoder detected a 1-rotation counter error.	Replace the Servomotor.
45	0	Absolute encoder multi-rotation counter error ABS	The encoder detected a multi-rotation counter error.	Replace the Servomotor.
47	0	Absolute encoder status error ABS	The rotation of the encoder was higher than the specified value when the power supply was turned ON.	Do not let the Servomotor move when the power supply is turned ON.
48	0	Encoder phase-Z error	A missing incremental encoder phase-Z pulse was detected. The encoder is faulty.	Replace the Servomotor.
49	0	Encoder CS signal error	A logic error was detected in the CS signal for incremental encoder. The encoder is faulty.	Replace the Servomotor.

Alarm number Main	Alarm number Sub	Name	Cause	Measures
50	0	External encoder connection error	A disconnection was detected because communications between the external encoder and the Servo Drive were interrupted more than the specified number of times.	Wire the external encoder correctly as shown in the connection diagram. Correct the connector pin connections.
	1	External encoder communications data error	There was a communications error in data from external encoder. There was a data error mainly due to noise. The external encoder connection cable is connected, but a communications data error occurred.	• Provide the required external encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). Be careful especially when the external encoder connection cable is long. • If the Servomotor cable and the external encoder connection cable are bundled together, separate them. • Connect the shield to FG. Refer to the external encoder connection diagram.
51	0	External encoder status error 0	Bit 0 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications.	Eliminate the cause of the error and then clear the external encoder error. Then, temporarily turn OFF the control power supply to reset.
	1	External encoder status error 1	Bit 1 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications.	
	2	External encoder status error 2	Bit 2 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications.	
	3	External encoder status error 3	Bit 3 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications.	
	4	External encoder status error 4	Bit 4 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications.	
	5	External encoder status error 5	Bit 5 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications.	
55	0	Phase-A connection error	An error such as broken wiring was detected in the external encoder phase-A connection.	Check the external encoder phase A connection.
	1	Phase-B connection error	An error such as broken wiring was detected in the external encoder phase-B connection.	Check the external encoder phase-B connection.
	2	Phase-Z connection error	An error such as broken wiring was detected in the external encoder phase-Z connection.	Check the external encoder phase-Z connection.
82	0	Node address setting error	The node address set by the rotary switches on the Servo Drive exceeded the setting range, when the control power was turned ON.	• Check the value of the rotary switches for node address setting. • Set the rotary switch correctly (set to 1 to 31), and then turn OFF the control power supply for the Servo Drive and turn it ON again.

Alarm number Main	Alarm number Sub	Name	Cause	Measures
83	0	Communications error	Failures to correctly receive the data to be received in the MECHATROLINK-II communications cycle continued in series more often than the value set on the Communications Control (Pn800).	• Check if there is a broken MECHATROLINK-II communications cable or a wiring problem. • Check if the Terminating Resistor is connected correctly. • Check if there is excessive noise on the MECHATROLINK-II communications cable. Review the routing of the MECHATROLINK-II communications cable and the FG wiring. Attach a ferrite core to the MECHATROLINK-II communications cable. • Set a larger value for the continuous communications error detection times in Communications Control (Pn800).
84	0	Transmission cycle error	Failed to receive synchronization frames (SYNC) according to the transmission cycle while the MECHATROLINK-II communications connection was established. • An error occurred in the synchronization frames. • The transmission cycle of the synchronization frames does not accord with the setting (including missing frames).	• Check if the transmission cycle of the synchronization frames sent from the host controller is normal, not changed, and accords with the setting. • Check if there is a broken communications cable or a wiring problem. • Check if there is excessive noise on the communications cable. • Check if the Terminating Resistor is connected correctly. • Review the routing of the communications cable and the FG wiring. • Attach a ferrite core to the communications cable.
	4	SYNC_SET error	In the asynchronous MECHATROLINK-II communications state (PHASE2), a communications error occurred while the SYNC_SET command was executed.	
	3	Synchronization error	An error occurred while synchronization was established.	• Turn OFF the power once, and turn it ON again. • If the alarm is displayed even after the power is turned ON again, the system may be faulty. Stop using the system, and replace the Servomotor and/or the Servo Drive. • Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair.

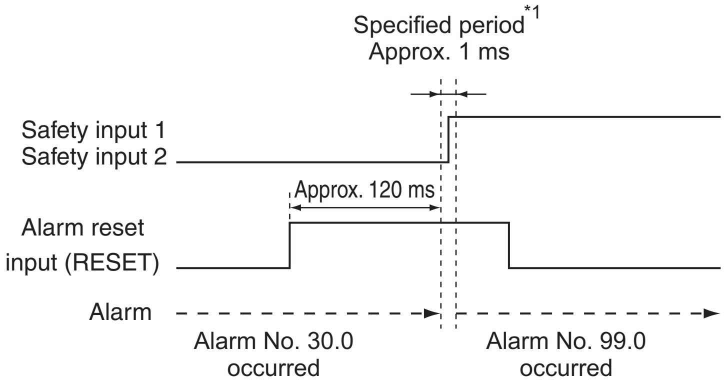
Alarm number Main	Alarm number Sub	Name	Cause	Measures
86	0	Watchdog data error	An error occurred in the synchronization data that was exchanged between the host controller and Servo Drive every MECHATROLINK-II communications cycle.	• Check if there is excessive noise on the MECHATROLINK-II communications cable. Review the routing of the MECHATROLINK-II communications cable and the FG wiring. Attach a ferrite core to the MECHATROLINK-II communications cable. • Transfer the communications settings and axis settings to the host controller again. • Replace the host controller and Servo Drive.
87	0	Forced alarm input error	An emergency stop input (STOP) was input.	Check the emergency stop input (STOP) wiring.
90	0	Transmission cycle setting error	The transmission cycle has a setting error when the MECHATROLINK-II CONNECT command is received.	• Check if there is a broken MECHATROLINK-II communications cable or a wiring problem. • Check if the Terminating Resistor is connected correctly. • Check if there is excessive noise on the MECHATROLINK-II communications cable. Review the routing of the MECHATROLINK-II communications cable and the FG wiring. Attach a ferrite core to the MECHATROLINK-II communications cable.
	1	CONNECT error	In the standby state for a MECHATROLINK-II CONNECT command (PHASE1), a communications error occurred when the CONNECT command was received.	
91	0	SYNC command error	During asynchronous MECHATROLINK-II communications, a synchronous type of command was issued.	Check the command that is sent from the host controller.
92	0	Encoder data restoration error ABS	Initialization of internal position data was not processed correctly in semi-closed control mode and absolute value mode.	• Provide the required encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). Be careful especially when the encode cable is long. • If the Servomotor cable and the encoder cable are bundled together, separate them. • Connect the shield to FG.
	1	External encoder data restoration error ABS	Initialization of internal position data was not processed correctly in fully-closed control mode and absolute value mode.	• Provide the required external encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). Be careful especially when the external encoder connection cable is long. • If the Servomotor cable and the external encoder connection cable are bundled together, separate them. • Connect the shield to FG. Refer to the external encoder connection diagram.

Alarm number Main	Alarm number Sub	Name	Cause	Measures
93	0	Parameter setting error 1	Electronic gear ratio exceeded the allowable range.	Check the Parameter settings. The electronic gear ratio must be set between 1/1000 and 1000.
	2	Parameter setting error 2	External encoder ratio exceeded the allowable range.	Check the Parameter settings. The external encoder ratio must be set between 1/40 and 160.
	3	External encoder connection error	The set value of the External Feedback Pulse Type Selection (Pn323) differs from the external encoder type that is actually connected for serial communications. Electronic gear ratio exceeded the allowable range.	Set object Pn323 to conform with the external encoder type that is actually connected.
95	0 to 4	Motor non-conformity	The Servomotor does not match the Servo Drive.	Replace the Servomotor with a Servomotor that matches the Servo Drive.
99	0	Other errors	• An error signal was detected due to excess noise or some other problem. • An alarm was cleared when safety input 1 or 2 was not in a normal state (one of the input photocouplers is not ON).	• Turn OFF the power once, and turn it ON again. • If the alarm is displayed even after the power is turned ON again, the system may be faulty. Stop using the system, and replace the Servomotor and/or the Servo Drive. • Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair. • Clear the alarm when both safety input 1 and 2 are in a normal state (the both input photocouplers are ON).
Other numbers			• The control circuit malfunctioned due to excess noise or some other problem. • The self-diagnosis function of the Servo Drive was activated, and an error occurred in the Servo Drive.	• Turn OFF the power once, and turn it ON again. • If the alarm is displayed even after the power is turned ON again, the system may be faulty. Stop using the system, and replace the Servomotor and/or the Servo Drive. • Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair.

Alarm No. 99.0

Alarm No. 99.0 may occur due to the timing between safety input 1/2 and alarm clear input. This alarm will occur if both of the following conditions are met:

- An alarm was cleared when at least one of the input photocouplers for safety inputs 1 and 2 was OFF (which means that a Safety Input Error (Alarm No. 30.0) had occurred).
- At least one of the input photocouplers for safety inputs 1 and 2 was turned from OFF to ON in a specific period during the alarm clear process (See below).



*1. Alarm No. 99.0 will occur if at least one of the input photocouplers for safety inputs 1 and 2 is turned from OFF to ON.

Precautions for Correct Use

Be sure to clear the alarm after turning ON the photocouplers for safety inputs 1 and 2 again.

Error Diagnosis Using the Operation Status

Symptom	Probable cause	Items to check	Measures
The 7-segment LED indicator does not light.	The control power is not supplied.	Check whether the power supply input is within the allowed power supply voltage range.	Supply the correct power supply voltage.
		Check whether the power supply input is wired correctly.	Wire correctly.
The LED (COM) is unlit.	The MECHATROLINK-II communications is not established.	Check that the communications cable is connected correctly.	Check that the host controller has started up.
		Check that the Terminating Resistor is connected correctly.	Check the connector and its connection.
The LED (COM) flashes in green.	Asynchronous MECHATROLINK-II communications is established.	Controllable by the host controller. (normal state)	Normal state
The LED (COM) lights in green.	Synchronous MECHATROLINK-II communications is established.	Controllable (normal state)	Normal state
The LED (COM) flashes in red.	A recoverable alarm occurs in MECHATROLINK-II communications.	• Reset the network by the host controller, and establish the communications again. • Check that the communications cable has no error.	Check the wiring and noise condition.
The LED (COM) lights in red.	An unresettable alarm occurs in MECHATROLINK-II communications.	Check that no node address duplication occurs on the network, and that the number of connected nodes is not over the specification.	Correct the network address.
An alarm occurs.	Read the Error No. and the alarm log.	Check the cause listed in Error Diagnosis Using the Alarm Display in previous pages.	Take appropriate measures against the cause of the alarm that are listed in Error Diagnosis Using the Alarm Display in previous pages.

Symptom	Probable cause	Items to check	Measures
Servo Lock state does not occur.	The power cable is not connected correctly.	Check that the motor power cable is connected properly.	Wire the cable correctly.
	The motor power is not on.	Check the main circuit wiring and power voltage.	Input the correct power and voltage for the main circuit.
	The Forward or Reverse Drive Prohibition (POT or NOT) signal is OFF.	• Check that the input for Forward or Reverse Drive Prohibition (POT or NOT) is not OFF. • Check the input of +24 VIN to CN1.	• Turn on the POT and NOT. • Input +24 VIN to CN1.
	The torque limit is set to 0.	Check that the torque limits on No.1 Torque Limit (Pn013) and the No.2 Torque Limit (Pn522) are not set to 0.	Set the maximum torque to be used for each of these parameters.
	The torque command value is set to 0 while the host controller commands the torque control.	Check the control mode set by the host controller and the given torque command.	Change the setting of control mode by the host controller to position. Check for the servo lock.
	The Servo Drive breaks down.	–	Replace the Servo Drive with a new one.

Symptom	Probable cause	Items to check	Measures
The Servomotor does not rotate in the Servo lock state.	The host controller does not give a command.	If it is the position command, check that the speed and position are not set to 0.	Enter a position and speed data. Start up the Servomotor.
	The torque command value is too small, while the host controller commands the torque control.	Check the control mode set by the host controller and the given torque command.	Change the setting of control mode by the host controller to position. Check for the servo lock.
	Hard to determine that the motor rotates.	Check that the speed command given by the host controller is not too small.	Check the speed command from the host controller.
	The holding brake works.	Check the brake interlock output (BKIR) signal and the +24 VDC power supply.	Check that the holding brake on a Servomotor with brake is released by Servo lock.
	The torque limits on No.1 Torque Limit (Pn013) and the No.2 Torque Limit (Pn522) are too small.	Check that the torque limits on Pn013 and Pn522 are not set to a value close to 0.	Set the maximum torque to be used for each of these parameters.
	In torque control mode, the Speed Limit Value Setting (Pn321) is set to 0.	Check the value set on the Pn321.	Set a larger value on the Pn321.
	The Servo Drive breaks down.	–	Replace the Servo Drive with a new one.
	The Forward or Reverse Drive Prohibition (POT or NOT) signal is OFF.	Check the ON-OFF status of POT and NOT signals in the monitor mode.	• Turn on the POT and NOT signals. • Set to disable, when the POT and NOT signals are not used.
	The control mode does not conform with the command.	Check the value set on the Control Mode Selection (Pn001).	Set the Pn001 in accordance with the command.
	The motor power cable is wired incorrectly.	Check the wiring.	Wire correctly.
	The encoder cable is wired incorrectly.		
	The power is not supplied.	Check the power supply and the 7-segment LED state.	Turn on the power.
		Check the voltage between the power terminals.	Wire the power-on circuits correctly.
	The Servo Drive breaks down.	–	Replace the Servo Drive with a new one.
The motor operates momentarily, but then it does not operate after that.	The position commands given are too little.	Check the position data and the electronic gear ratio on the host controller.	Set the correct data.
	The motor power cable is wired incorrectly.	Check the wiring of the motor power cable's phases U, V, and W.	Wire correctly.
	The encoder cable is wired incorrectly.	Check the encoder cable's wiring.	Wire correctly.

Symptom	Probable cause	Items to check	Measures
The motor rotates without a command.	There are inputs of small values in speed control mode.	Check if there is any inputs in speed control mode.	Set the speed command to 0. Alternatively, change the mode to position control.
	There are inputs of small values in torque control mode.	Check if there is any inputs in torque control mode.	Change the mode from torque control to position control.
	The Servo Drive breaks down.	–	Replace the Servo Drive with a new one.
The motor rotates in the reverse direction from the command.	The value set on the Rotation Direction Switching (Pn000) is incorrect.	Check the value set on the Pn000.	Chang the setting on the Pn000.
	The command given by the host controller is incorrect.	• The absolute command is set improperly in size. • The incremental command is set improperly in polarity.	• Check the present and target values. • Check the rotation direction.
The holding brake does not work.	Power is supplied to the holding brake.	Check whether power is supplied to the holding brake.	• Check the brake interlock output (BKIR) signal and the relay circuit. • Check that the holding brake is not worn down.
Motor rotation is unstable.	The motor power cable or encoder cable is wired incorrectly.	Check the wiring of the motor power cable's phases U, V, and W and check the encoder cable's wiring.	Wire correctly.
	Low rigidity. It causes vibration.	Measure the vibration frequency of the load.	Enable the damping control. Set the damping filter frequency.
	The load's moment of inertia exceeds the Servo Drive's allowable value.	Calculate the load inertia.	• Check if the manual tuning can make a proper adjustment. • Increase the Servomotor capacity.
	Loose joint and/or large clearance with the machine	Check the joint with the machine.	Remove the joint looseness with the machine.
	The pulse signal line's connections are loose.	Check the pulse signal line's wiring at the controller and Servo Drive.	Wire correctly.
		Check the controller's command pulse type and the Servo Drive's commands pulse type.	Set the Servo Drive's pulse type to match the controller's command pulse type.
	The load and gain do not conform.	Check the response waveforms for speed and torque.	Adjust the speed loop gain to stabilize the rotation.

Symptom	Probable cause	Items to check	Measures
The motor is overheating.	The ambient temperature is too high.	Check the ambient temperature around the motor is not over 40°C.	• Lower the ambient temperature around the motor to 40°C or less. (Use a fan or air conditioner.) • Lower the load rate.
	The heat radiation condition for the motor is inappropriate.	• Check that the specified radiation condition is observed. • Check the load ratio for the servomotor with brake.	• Improve the radiation condition. • Reduce the load. • Improve ventilation.
	The motor is overloaded.	Measure the torque on the analog monitor on the front panel or by the CX-Drive.	• Decrease the acceleration and deceleration speed. • Lower the speed and check the load.
	The motor vibrates during rotation.		
The machine position is misaligned.	The coupling of the servomotor axis and the machine is abnormal.	Check that the coupling of the servomotor and the machine is not misaligned.	• Tighten the coupling again. • Replace with a coupling which has no looseness.
	The host controller gives a deceleration stop command.	Check the control ladder on the host controller.	Review the control on the host controller.
The motor does not stop or is hard to stop even if the operation command (RUN) is turned OFF while the motor is rotating.	The load inertia is too large.	• Check the load inertia. • Check the motor rotation speed. • The dynamic brake resistance is disconnected.	• Review the load inertia. • Replace the motor and drive with appropriate ones.
	The dynamic brake is disabled.	Check if the dynamic brake is not disabled or broken.	• Enable, if it is disabled. • Replace the brake with a new one, if it is broken or resistor disconnection is detected.

Symptom	Probable cause	Items to check	Measures
The Servomotor or the load generates abnormal noise or vibration.	Vibration occurs due to improper mechanical installation.	Check whether the Servomotor's mounting screws are loose.	Retighten the mounting screws.
		Check the load for eccentricity.	Eliminate the eccentricity, which results in torque fluctuation and noise.
		Check that the coupling with the load is not unbalanced.	Balance the rotation.
		Check that the decelerator does not generate any abnormal noise.	Check the decelerator specification. Investigate the decelerator for breakage.
	Vibration occurs due to low mechanical rigidity.	Check that the vibration frequency is not 100 Hz or lower.	If the frequency is 100 Hz or lower, set the correct damping frequency on the damping filter to eliminate the vibration.
	Vibration occurs due to machine resonance.	Check if the resonance frequency is high or low.	If the frequency is high, set the adaptive filter in a manner that stops the resonance. Alternatively, measure the resonance frequency and set the Notch Filter 1 and 2.
	There is a problem with the bearings.	Check for noise or vibration around the bearings.	Contact your OMRON dealer or sales office.
	The gain is wrong.	–	Check if the manual tuning can make a proper adjustment.
	The Speed Feedback Filter Time Constant 1 (Pn103) is wrong.	Check the value set on the Pn103. Normally set 0 to Pn103.	Return the setting to the initial 0. Alternatively, set a large value and operate the motor.
	The Torque Command Filter Time Constant 1 (Pn104) does not match the load.	Review the setting on the Pn104.	Set a larger value on the Pn104 and eliminate the vibration.
	The Position Loop Gain 1 (Pn100) is too large.	Review the setting on the Pn100.	By the CX-Drive or the analog monitor, measure the response and adjust the gain.
	The Speed Loop Gain 1 (Pn101) and the Speed Loop Integration Time Constant 1 (Pn102) are balanced incorrectly.	Review the settings on the Pn101 and Pn102.	
	Noise is applied to the control I/O signal cable because the cable does not meet specifications.	Check that it is a twisted-pair wire or twisted-pair shielded cable with core wires that are at least 0.08 mm^2.	Use control I/O signal cable that meets specifications.

Symptom	Probable cause	Items to check	Measures
	Noise is applied to the control I/O signal cable because the cable is longer than the specified length.	Check the length of the control I/O signal cable.	Shorten the control I/O signal cable to 3 m or less.
	Noise is applied to the cable because the encoder cable does not meet specifications.	Check that it is a twisted-pair shielded cable with core wires that are at least 0.12 mm^2.	Use encoder cable that meets specifications.
	Noise is applied to the encoder cable because the cable is longer than the specified length.	Check the length of the encoder cable.	Shorten the encoder cable to less than 50 m.
	Noise is applied to the signal lines because the encoder cable is stuck or the sheath is damaged.	Check the encoder cable for damage.	Correct the encoder cable's pathway.
	Too much noise is applied to the encoder cable.	Check whether the encoder cable is bound together with or too close to high-current lines.	Install the encoder cable where it won't be subjected to surges.
	The FG's potential is fluctuating due to devices near the Servomotor, such as welding machines.	Check for ground problems (loss of ground or incomplete ground) at equipment such as welding machines near the Servomotor.	Ground the equipment properly and prevent currents from flowing to the encoder FG.
	Errors are being caused by excessive vibration or shock on the encoder.	There are problems with mechanical vibration or motor installation (such as the precision of the mounting surface, attachment, or axial offset).	Reduce the mechanical vibration or correct the Servomotor's installation.
Overshooting at a startup or stop	The Position Loop Gain 1 (Pn100) is too large.	Review the Pn100.	Adjust the gain in a manner that prevents overshoots.
	The Speed Loop Gain 1 (Pn101) and the Speed Loop Integral Time Constant 1 (Pn102) are balanced incorrectly.	Review the settings on the Pn101 and Pn102.	By the CX-Drive or the analog monitor, measure the response and adjust the gain.
	The machine rigidity set by the realtime autotuning is incorrect.	Review the setting of machine rigidity.	Match the machine rigidity setting to the load rigidity.
	The set inertia ratio differs from the load.	Review the Inertial Ratio (Pn004).	Align the setting on the Pn004 with the load.
Vibration is occurring at the same frequency as the power supply.	Inductive noise is occurring.	Check whether the drive control signal lines are too long.	Shorten the control signal lines.
		Check whether the control signal lines and power supply lines are not bound together.	• Separate control signal lines from power supply lines. • Use a low-impedance power supply for control signals.

Symptom	Probable cause	Items to check	Measures
The position is misaligned. (Position misalignment occurs without an alarm being output.)	There is an error in the coupling of the mechanical system and the Servomotor.	Check whether the coupling of the mechanical system and the Servomotor is misaligned.	Correct the coupling between the mechanical system and the Servomotor.
	The gain is wrong.	–	Check if the manual tuning can make a proper adjustment.
	The load inertia is too large.	• Check the load inertia. • Check the motor rotation speed. • The dynamic brake resistance is disconnected.	• Review the load inertia. • Replace the motor and drive with proper ones.

11-5 Periodic Maintenance

Caution

After replacing the unit, transfer to the new unit all data needed to resume operation, before restarting the operation. Equipment damage may result.

Never repair the product by disassembling it.
Electric shock or injury may result.

Servomotors and Servo Drives contain many components and will operate properly only when each of the individual components is operating properly.
Some of the electrical and mechanical components require maintenance depending on application conditions. Periodic inspection and replacement are necessary to ensure proper long-term operation of Servomotors and Servo Drives. (Quotes from The Recommendation for Periodic Maintenance of a General-purpose Inverter published by JEMA.)

The periodic maintenance cycle depends on the installation environment and application conditions of the Servomotors and Servo Drives.
Recommended maintenance times are listed below for Servomotors and Servo Drives. Use these for reference in periodic maintenance.

Servomotor Life Expectancy

- The life expectancy for units is listed below.
  Bearings: 20,000 hours
  Oil seal: 5,000 hours
  Encoder: 30,000 hours
  These values presume an ambient motor operating temperature of 40°C, within the allowable axial load, rated operation (rated torque and rated rotation speed), and proper installation as described in this manual.
  The bearings, oil seal, and encoder can be replaced for repair work.
- The radial load during operation (rotation) on timing pulleys and other components contacting belts is twice or more the still load. Consult with the belt and pulley manufacturers and adjust designs and system settings so that the motor allowable axial load is not exceeded even during operation. If a motor is used under a shaft load exceeding the allowable limit, the motor shaft can break, and the bearings can burn out.

Servo Drive Life Expectancy

- The life expectancy for units is listed below.
  Aluminum electrolytic capacitors: 28,000 hours
  (at an ambient drive operating temperature of 55°C, constant output of rated torque, constant output of rated rotation speed, and installation as described in this manual)
  Axial-flow fan: 10,000 to 30,000 hours (The limit depends on the operating conditions.)
  Inrush current prevention relay: Approx. 20,000 operations (The limit depends on the operation conditions.)
- When using the Servo Drive in continuous operation, use fans or air conditioners to maintain an ambient temperature below 40°C.
- We recommend that ambient temperature and the power supply ON time be reduced as much as possible to lengthen the service life of the drive.
- The limit of aluminum electrolytic capacitors is greatly affected by the ambient operating temperature. Generally, an increase of 10°C in the operating ambient temperature will reduce capacitor service life by 50%.
- For example, when the ambient operating temperature is 25°C, the life expectancy will be as follows:

$$\text{Life Expectacy (at 25°C)} = \text{Life Expectacy (at 55°C)} \times 2^{\frac{55-25}{10}}$$
$$= 224{,}000 \text{ hours}$$

- The aluminum electrolytic capacitors deteriorate even when the Servo Drive is stored with no power supplied. If the Servo Drive is not used for a long time, we recommend a periodic inspection and replacement schedule of 5 years.
- If the Servomotor or Servo Drive is not to be used for a long time, or if they are to be used under conditions worse than those described above, a periodic inspection schedule of 5 years is recommended.
- Upon request, OMRON will examine the Servo Drive and Servomotor and determine if a replacement is required.

Replacing the Absolute Encoder Battery ABS

Replace the absolute encoder backup battery if it has been used for more than 3 years or if an absolute encoder system down error (Alarm No.40) has occurred.

Replacement Battery Model and Specifications

Item	Specifications
Name	Absolute Encoder Backup Battery Unit
Model	R88A-BAT01G
Battery model	ER6V (Toshiba)
Battery voltage	3.6 V
Current capacity	2,000 mA • h

Mounting the Backup Battery

Mounting the Battery Unit for the First Time

Connect the Absolute Encoder Backup Battery Unit to the motor, then set up the absolute encoder. Refer to "Absolute Encoder Setup" (P.9-6).
After the Absolute Encoder Battery Unit is attached, it is recommended that the control power supply be turned ON and OFF once a day to refresh the battery.
If you neglect to refresh the battery, battery warning will occur due to voltage delays in the battery.

Replacing the Battery Unit

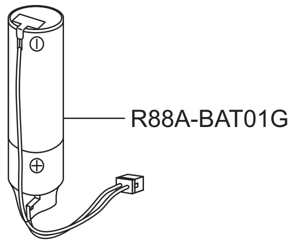
If a battery warning occurs, the Absolute Encoder Backup Battery Unit must be replaced.
Replace the Battery Unit with the control power supply of the Servo Drive turned ON. If the Battery Unit is replaced with the control power supply of the Servo Drive turned OFF, data held in the encoder will be lost.
The Battery Warning will occur after you replace the Absolute Encoder Backup Battery Unit. Use one of the following methods to clear it.

- Use the alarm reset input signal of CN1 control inputs.
- Use the absolute encoder setting in the CX-Drive.

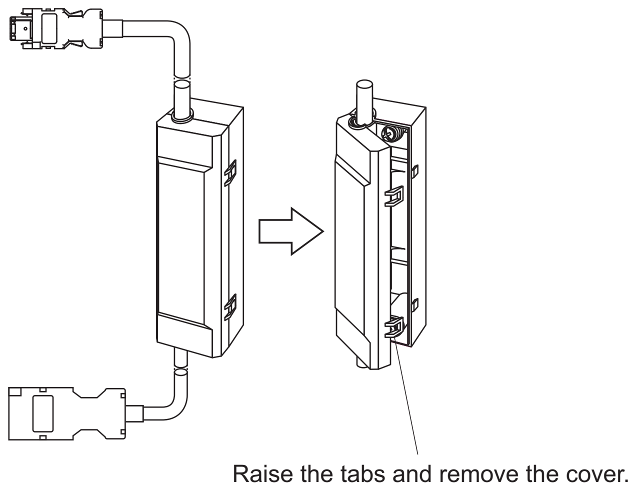
Note: If the absolute encoder is cleared using communications, all alarms and multi-rotation data will be lost and the absolute encoder must be set up again. Refer to "Absolute Encoder Setup" (P.9-6).

Battery Mounting Method

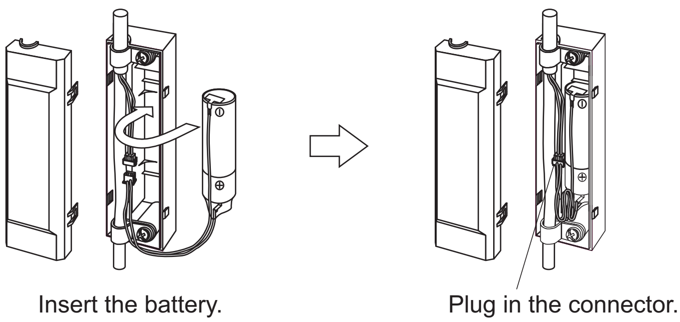
1. Prepare the replacement battery (R88A-BAT01G).



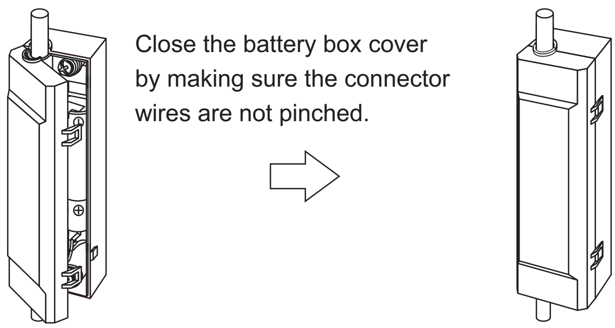
2. Remove the battery box cover.



3. Put the battery into the battery box.



4. Close the cover to the battery box.



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Appendix

This chapter provides connection examples using OMRON's PLC and Position Controller, as well as a list of parameters.

A-1 Parameter List

- Some parameters are enabled by turning the power supply OFF and then ON again. After changing these parameters, turn OFF the power supply, confirm that the power supply indicator has gone OFF, and then turn ON the power supply again.
- Do not change the parameters marked "Reserved".
- See below for the data attributes.

A : Always enabled

B : Prohibited to change during motor rotation or commanding.
If it is changed during motor rotation or commanding, the reflection timing is unknown.

C : Enabled after a power reset, or after the CONFIG command is executed via MECHATROLINK-II communications.

R : Enabled after a power reset.
It is not enabled by the CONFIG command via MECHATROLINK-II communications.

Basic Parameters

Pn No.	Parameter name	Explanation	Default setting	Unit	Setting range	Data attribute
000	Rotation Direction Switching	Set the relation between the command direction and the motor rotation direction. 0: A forward direction command sets the direction to CW as viewed from the shaft end. 1: A forward direction command sets the direction to CCW as viewed from the shaft end.	1	–	0 to 1	C
001	CONTROL mode Selection	Select the Servo Drive CONTROL mode. 0 to 5: Switch function 6: Full closing control	0	–	0 to 6	R
002	REALTIME AUTOTUNING mode selection	Set the OPERATION mode for realtime autotuning. 0: Disabled 1: Emphasizes stability 2: Emphasizes positioning 3: If there is an unbalanced load on the vertical axis or the like. 4: When friction is large. 5: If there is an unbalanced load on the vertical axis or the like and friction is too large. 6: When the realtime autotuning is customized.	1	–	0 to 6	B
003	Realtime Autotuning Machine Rigidity Setting	Set the machine rigidity for executing realtime autotuning.	11 / 13*1	–	0 to 31	B
004	Inertia Ratio	Set the load inertia as a percentage of the motor rotor inertia.	250	%	0 to 10000	B

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Pn No.	Parameter name	Explanation	Default setting	Unit	Setting range	Data attribute
009	Electronic Gear Ratio Numerator	Set the electronic gear ratio. If Pn009 = 0, the encoder resolution is set as the numerator. $\frac{\text{Electronic gear ratio numerator (Pn009)}}{\text{Electronic gear ratio denominator (Pn010)}}$	1	–	0 to 2^{30}	C
010	Electronic Gear Ratio Denominator		1	–	1 to 2^{30}	C
013	No. 1 Torque Limit	Set the No. 1 limit value for the output torque of the motor.	500	%	0 to 500	B
014	Error Counter Overflow Level	Set the range of the error counter overflow level. Detection of error counter overflow level error is disabled if the set value is 0.	100000	Command unit	0 to 2^{27}	A
015	Operation Switch when Using Absolute Encoder	Select the absolute encoder usage method. 0: Used as absolute encoder. 1: Used as an incremental encoder. 2: Used as absolute encoder. (Multi-rotation counter overflows are ignored.)	1	–	0 to 2	C
016	Regeneration Resistor Selection	Select the Regeneration Resistor used. 0: Use the Built-in Resistor. Triggering of regeneration overload protection (Alarm No.18) depends on the Built-in Resistor (with approx. 1% duty). 1: Use an External Resistor. The regeneration processing circuit operates and regeneration overload protection (Alarm No.18) is triggered when the operating rate of the Regeneration Resistor exceeds 10%. 2: Use an External Resistor. Regeneration overload protection (Alarm No.18) does not operate. 3: No Regeneration Resistor All regeneration power is processed with built-in capacitors.	0 / 3*2	–	0 to 3	C
017	External Regeneration Resistor Setting	Select the type of load ratio calculation for the External Regeneration Resistor. 0: Regeneration load ratio is 100% when operating rate of the External Regeneration Resistor is 10%. 1 to 4: Reserved	0	–	0 to 4	C

*1. It is set to 11 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 13 for other types of Servo Drives.

*2. It is set to 0 when the Servo Drive capacity is 100 V and 400 W or over, 200 V and 750 W or over, or 400 V.
It is set to 3 for other types of Servo Drives.

Gain Parameters

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
100	Position Loop Gain 1	Set the position loop gain 1.	320/ 480*1	0.1/s	0 to 30000	B
101	Speed Loop Gain 1	Set the speed loop gain 1.	180/ 270*2	0.1 Hz	1 to 32767	B
102	Speed Loop Integral Time Constant 1	Set the speed loop integration time constant 1.	210/ 310*3	0.1 ms	1 to 10000	B
103	Speed Feedback Filter Time Constant 1	The speed feedback filter 1 can be set to one of 6 values.	0	–	0 to 5	B
104	Torque Command Filter Time Constant 1	Set the time constant for the torque filter 1.	84/ 126*4	0.01 ms	0 to 2500	B
105	Position Loop Gain 2	Set the position loop gain 2.	380/ 570*5	0.1/s	0 to 30000	B
106	Speed Loop Gain 2	Set the speed loop gain 2.	180/ 270*6	0.1 Hz	1 to 32767	B
107	Speed Loop Integration Time Constant 2	Set the speed loop integration time constant 2.	10000	0.1 ms	1 to 10000	B
108	Speed Feedback Filter Time Constant 2	The speed feedback filter 2 can be set to one of 6 values.	0	–	0 to 5	B
109	Torque Command Filter Time Constant 2	Set the time constant for the torque filter 2.	84/ 126*7	0.01 ms	0 to 2500	B
110	Speed Feed-forward Amount	Set the speed feed-forward amount.	300	0.1%	0 to 1000	B
111	Speed Feed-forward Command Filter	Set the speed feed-forward filter time constant.	50	0.01 ms	0 to 6400	B
112	Torque Feed-forward Amount	Set the torque feed-forward amount.	0	0.1%	0 to 1000	B
113	Torque Feed-forward Command Filter	Set the torque feed-forward filter.	0	0.01 ms	0 to 6400	B
114	GAIN SWITCHING INPUT OPERATING mode Selection	Execute optimum tuning using the gain switching function. 0: Gain 1 (PI/P switching enabled) 1: Gain 1 and gain 2 switching available	1	–	0 to 1	B

*1. It is set to 320 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 480 for other types of Serve Drives.

*2. It is set to 180 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 270 for other types of Serve Drives

*3. It is set to 310 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 210 for other types of Serve Drive

*4. It is set to 126 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 84 for other types of Serve Drives

*5. It is set to 380 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 570 for other types of Serve Drives.

*6. It is set to 180 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 270 for other types of Serve Drives.

*7. It is set to 126 when the Servo Drive capacity is 200 V and 1 kW or over, or 400 V.
It is set to 84 for other types of Serve Drives.

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
115	SWITCHING mode in Position Control	Select the gain switching condition for position control. It is necessary that Pn114 be set to 1. 0: Always gain 1 1: Always gain 2 2: Gain switching command input via MECHATROLINK-II communications 3: Torque command change amount 4: Always gain 1 5: Command speed 6: Amount of position error 7: When the position command is received. 8: Positioning completion signal (INP) OFF 9: Actual motor speed 10: Combination of position command input and rotation speed	0	–	0 to 10	B
116	Gain Switching Delay Time in Position Control	Set the delay time for switching from gain 2 to gain 1.	50	0.1 ms	0 to 10000	B
117	Gain Switching Level in Position Control	Set the gain switching level.	50	–	0 to 20000	B
118	Gain Switching Hysteresis in Position Control	Set the hysteresis for gain switching.	33	–	0 to 20000	B
119	Position Gain Switching Time	Set the position gain switching time for gain switching.	33	0.1 ms	0 to 10000	B
120	SWITCHING mode in Speed Control	Select the gain switching condition for speed control. It is necessary that Pn114 be set to 1. 0: Always gain 1 1: Always gain 2 2: Gain switching command input via MECHATROLINK-II communications 3: Torque command change amount 4: Speed command change amount 5: Command speed	0	–	0 to 5	B
121	Gain Switching Delay Time in Speed Control	Set the delay time for switching from gain 2 to gain 1.	0	0.1 ms	0 to 10000	B
122	Gain Switching Level in Speed Control	Set the gain switching level.	0	–	0 to 20000	B
123	Gain Switching Hysteresis in Speed Control	Set the hysteresis for gain switching.	0	–	0 to 20000	B
124	SWITCHING mode in Torque Control	Select the gain switching condition for torque control. It is necessary that Pn114 be set to 1. 0: Always gain 1 1: Always gain 2 2: Gain switching command input via MECHATROLINK-II communications 3: Torque command change amount	0	–	0 to 3	B

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
125	Gain Switching Delay Time in Torque Control	Set the delay time for switching from gain 2 to gain 1.	0	0.1 ms	0 to 10000	B
126	Gain Switching Level in Torque Control	Set the gain switching level.	0	–	0 to 20000	B
127	Gain Switching Hysteresis in Torque Control	Set the hysteresis for gain switching.	0	–	0 to 20000	B

Damping Control Parameters

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
200	Adaptive Filter Selection	Set the operation of the adaptive filter. 0: Disabled 1: One enabled. Frequency limited after adaptation. 2: Two enabled. Frequency limited after adaptation. 3: One enabled. Adaptation performed at all times. 4: Two enabled. Adaptation performed with 1 filter at all times.	0	–	0 to 4	B
201	Notch 1 Frequency Setting	Set the notch frequency of resonance suppression notch filter 1.	5000	Hz	50 to 5000	B
202	Notch 1 Width Setting	Set the notch width of the resonance suppression notch filter 1.	2	–	0 to 20	B
203	Notch 1 Depth Setting	Set the notch depth of resonance suppression notch filter 1.	0	–	0 to 99	B
204	Notch 2 Frequency Setting	Set the notch frequency of resonance suppression notch filter 2.	5000	Hz	50 to 5,000	B
205	Notch 2 Width Setting	Set the notch width of the resonance suppression notch filter 2.	2	–	0 to 20	B
206	Notch 2 Depth Setting	Set the notch depth of resonance suppression notch filter 2.	0	–	0 to 99	B
207	Notch 3 Frequency Setting	Set the notch frequency of resonance suppression notch filter 3. This is set automatically when an adaptive notch is enabled.	5000	Hz	50 to 5000	B
208	Notch 3 Width Setting	Set the notch width of the resonance suppression notch filter 3. This is set automatically when an adaptive notch is enabled.	2	–	0 to 20	B
209	Notch 3 Depth Setting	Set the notch depth of resonance suppression notch filter 3. This is set automatically when an adaptive notch is enabled.	0	–	0 to 99	B

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
210	Notch 4 Frequency Setting	Set the notch frequency of resonance suppression notch filter 4. This is set automatically when an adaptive notch is enabled.	5000	Hz	50 to 5000	B
211	Notch 4 Width Setting	Set the notch width of the resonance suppression notch filter 4. This is set automatically when an adaptive notch is enabled.	2	–	0 to 20	B
212	Notch 4 Depth Setting	Set the notch depth of resonance suppression notch filter 4. This is set automatically when an adaptive notch is enabled.	0	–	0 to 99	B
213	Damping Filter Selection	Select the damping filter switching method. 0:Damping filter 1 or 2 is enabled. 1: Reserved for manufacturer use 2: Reserved for manufacturer use 3: Switch by the position command direction. • Forward direction: Damping filter 1 or 3 is enabled. • Reserve direction: Damping filter 2 or 4 is enabled.	0	–	0 to 3	B
214	Damping Frequency 1	Set the damping frequency 1. The function is enabled if the set value is 10 (= 1 Hz) or greater.	0	0.1 Hz	0 to 2000	B
215	Damping Filter 1 Setting	Finely adjust damping control function 1. If torque saturation occurs, lower this setting; to increase responsiveness, raise this setting.	0	0.1 Hz	0 to 1000	B
216	Damping Frequency 2	Set the damping frequency 2. The function is enabled if the set value is 10 (= 1 Hz) or greater.	0	0.1 Hz	0 to 2000	B
217	Damping Filter 2 Setting	Finely adjust damping control function 2. If torque saturation occurs, lower this setting; to increase responsiveness, raise this setting.	0	0.1 Hz	0 to 1000	B
218	Damping Frequency 3	Set the damping frequency 3. The function is enabled if the set value is 10 (= 1 Hz) or greater.	0	0.1 Hz	0 to 2000	B
219	Damping Filter 3 Setting	Finely adjust damping control function 3. If torque saturation occurs, lower this setting; to increase responsiveness, raise this setting.	0	0.1 Hz	0 to 1000	B
220	Damping Frequency 4	Set the damping frequency 4. The function is enabled if the set value is 10 (= 1 Hz) or greater.	0	0.1 Hz	0 to 2000	B
221	Damping Filter 4 Setting	Finely adjust damping control function 4. If torque saturation occurs, lower this setting; to increase responsiveness, raise this setting.	0	0.1 Hz	0 to 1000	B
222	Position Command Filter Time Constant	Set the time constant of the first-order lag filter for the position command.	0	0.1 ms	0 to 10000	B

Analog Control Parameters

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
312	Soft Start Acceleration Time	Set the acceleration processing acceleration time for speed commands.	0	ms/Motor Max. rotation speed	0 to 10000	B
313	Soft Start Deceleration Time	Set the deceleration processing deceleration time for speed commands.	0	ms/Motor Max. rotation speed	0 to 10000	B
314	S-curve Acceleration/ Deceleration Time Setting	Set the acceleration/deceleration processing S-curve time for speed commands.	0	ms	0 to 1000	B
317	Speed Limit Selection	Select the torque command and speed limit value. 0: Limit the speed by the value set on the Speed Limit Value Setting (Pn321). 1: Limit the speed by the speed limit value (VLIM) via MECHATROLINK-II communications or by the value set by the Speed Limit Value Setting (Pn321), whichever is smaller.	0	–	0 to 1	B
321	Speed Limit Value Setting	Set the speed limit value.	50	r/min	0 to 20000	B
323	External Feedback Pulse Type Selection	Select the external feedback pulse type. 0: 90° phase difference output type 1: Serial communications type (incremental encoder specifications) 2: Serial communications type (absolute encoder specifications)	0	–	0 to 2	R
324	External Feedback Pulse Dividing Numerator	Set the external feedback pulse dividing numerator.	0	–	0 to 2^{20}	R
325	External Feedback Pulse Dividing Denominator	Set the external feedback pulse dividing denominator.	10000	–	1 to 2^{20}	R
326	External Feedback Pulse Direction Switching	Reverse the direction to count the external encoder feed back. 0: Count direction not reversed 1: Count direction reversed	0	–	0 to 1	R
327	External Feedback Pulse Phase-Z Setting	Set to enable or disable the Phase-Z disconnection detection when an external encoder of 90° phase difference output type is used. 0: Phase-Z disconnection detection enabled 1: Phase-Z disconnection detection disabled	0	–	0 to 1	R
328	Internal/External Feedback Pulse Error Counter Overflow Level	Set the threshold for feedback pulse deviation errors.	16000	Command unit	1 to 2^{27}	C

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
329	Internal/External Feedback Pulse Error Counter Reset	Clear to 0 the feedback pulse error value for each set rotation speed.	0	Rotation	0 to 100	C

Interface Monitor Setting Parameters

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
400	Input Signal Selection 1	Set the function and logic for the general-purpose input 1 (IN1).	00949494h	–	0 to 00FFFFFFh	C
401	Input Signal Selection 2	Set the function and logic for the general-purpose input 2 (IN2).	00818181h	–	0 to 00FFFFFFh	C
402	Input Signal Selection 3	Set the function and logic for the general-purpose input 3 (IN3).	00828282h	–	0 to 00FFFFFFh	C
403	Input Signal Selection 4	Set the function and logic for the general-purpose input 4 (IN4).	00222222h	–	0 to 00FFFFFFh	C
404	Input Signal Selection 5	Set the function and logic for the general-purpose input 5 (IN5).	002B2B2Bh	–	0 to 00FFFFFFh	C
405	Input Signal Selection 6	Set the function and logic for the general-purpose input 6 (IN6).	00212121h	–	0 to 00FFFFFFh	C
406	Input Signal Selection 7	Set the function and logic for the general-purpose input 7 (IN7).	00202020h	–	0 to 00FFFFFFh	C
407	Input Signal Selection 8	Set the function and logic for the general-purpose input 8 (IN8).	002E2E2Eh	–	0 to 00FFFFFFh	C
410	Output Signal Selection 1	Set the function assignment for the general-purpose output 1 (OUTM1).	00030303h	–	0 to 00FFFFFFh	C
411	Output Signal Selection 2	Set the function assignment for the general-purpose output 2 (OUTM2).	00020202h	–	0 to 00FFFFFFh	C
416	Analog Monitor 1 Selection	Select the type for analog monitor 1. 0: Motor speed 1: Position command speed 2: Internal position command speed 3: Speed Control Command 4: Torque command 5: Command position error 6: Encoder Position Error 7: Full closing Error 8: Hybrid Error 9: P-N voltage 10: Regeneration load ratio 11: Motor load ratio 12: Forward direction torque limit 13: Reverse direction torque limit 14: Speed limit value 15: Inertia Ratio 16 to 18: Reserved 19: Encoder temperature 20: Servo Drive temperature 21: Encoder 1-rotation data	0	*1	0 to 21	A

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Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
417	Analog Monitor 1 Scale Setting	Set the output gain for analog monitor 1.	0	–	0 to 214748364	A
418	Analog Monitor 2 Selection	Select the type for analog monitor 2. The set values for this parameter are the same as Analog Monitor 1 Type (Pn416).	4	–	0 to 21	A
419	Analog Monitor 2 Scale Setting	Select the output gain for analog monitor 2.	0	–	0 to 214748364	A
421	Analog Monitor Output Setting	Select the analog monitor output voltage method. 0: Output range from –10 to 10 V 1: Output range from 0 to 10 V 2: Output range from 0 to 10 V (5 V as the center)	0	–	0 to 2	A
431	Positioning Completion Range 1	Set the allowed number of pulses for the positioning completion range.	10	Command unit	0 to 262144	A
432	Positioning Completion Condition Selection	Set the judgment conditions for positioning completion output. 0: The Positioning completion output 1 becomes on when the positional error is lower than the value set on the Pn431. 1: The Positioning completion output 1 becomes on when there is no position command, and the positional error is lower than the value set on the Pn431. 2: The Positioning completion output 1 becomes on when there is no position command, the zero-speed detection signal is on, and the positional error is lower than the value set on the Pn431. 3. The Positioning completion output 1 becomes on when there is no position command, and the positional error is lower than the value set on the Pn431. The ON-state is retained until the Positioning Completion Hold Time (Pn433) elapses. After that, it is turned off or kept to be on, depending on the positional error then.	0	–	0 to 3	A
433	Positioning Completion Hold Time	Set the positioning completion hold time.	0	1 ms	0 to 30000	A
434	Zero Speed Detection	Set the output timing of the Zero speed detection output (ZSP) in rotation speed [r/min].	50	r/min	10 to 20000	A

*1. Refer to the description about the Pn416 in "8-5 Interface Monitor Setting Parameters" (P.8-30).

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
435	Speed Conformity Detection Range	Set the detection range for the speed conformity output (VCMP). Set the difference between the speed command and the actual speed.	50	r/min	10 to 20000	A
436	Rotation Speed for Motor Rotation Detection	Set the number of motor rotation for the Motor rotation speed detection output (TGON).	1000	r/min	10 to 20000	A
437	Brake Timing when Stopped	Set the operation time for the mechanical brake at stop.	0	1 ms	0 to 10000	B
438	Brake Timing during Operation	Set the operation time for the mechanical brake during operation.	0	1 ms	0 to 10000	B
439	Brake Release Speed Setting	Set the number of motor rotation to determine a mechanical brake output during rotation.	30	r/min	30 to 3000	B
440	Warning Output Selection 1	Select the warning type for warning output 1. 0: Output by all types of warnings. 1: Overload warning 2: Excessive regeneration warning 3: Battery warning 4: Fan warning 5: Encoder communications warning 6: Encoder overheating warning 7: Vibration warning 8: Life expectancy warning 9: External encoder error warning 10: External encoder communications error warning 11: Data setting warning 12: Command warning 13: MECHATROLINK-II communications warning	0	–	0 to 13	A
441	Warning Output Selection 2	Select the warning type for warning output 2. The relationships among the set values for this parameter are the same as for Warning Output Selection 1 (Pn440).	0	–	0 to 13	A
442	Positioning Completion Range 2	Set the allowable number of pulses for the second positioning completion range.	10	Command unit	0 to 262144	A

Expansion Parameters

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
504	Drive Prohibition Input Selection	Set the operation to be performed upon forward/reverse direction drive prohibition input. 0: Enable the Forward and Reverse drive prohibition inputs. 1: Disable the Forward and Reverse drive prohibition inputs. 2: Enable the Forward and Reverse drive prohibition inputs.	1	–	0 to 2	C
505	Stop Selection for Drive Prohibition Input	Set the drive conditions during deceleration and after stopping, when the Forward or Reverse Drive Prohibition Inputs are enabled. 0: The torque in the drive prohibit direction is disabled, and the dynamic brake is activated. 1: The torque in the drive prohibit direction is disabled, and free-run deceleration is performed. 2: The torque in the drive prohibit direction is disabled, and an emergency stop is performed.	0	–	0 to 2	C
506	Stop Selection with Servo OFF	Set the stop operation when the servo is turned OFF. 0, 4: During deceleration: Dynamic brake After stopping: Dynamic brake Error counter: Clear 1, 5: During deceleration: Free-run After stopping: Dynamic brake Error counter: Clear 2, 6: During deceleration: Dynamic brake After stopping: Servo free Error counter: Clear 3, 7: During deceleration: Free-run After stopping: Servo free Error counter: Clear 8: During deceleration: Emergency stop After stopping: Dynamic brake Error counter: Clear 9: During deceleration: Emergency stop After stopping: Servo free Error counter: Clear	0	–	0 to 9	B
507	Stop Selection with Main Power Supply OFF	Set the stop operation when the main power supply is turned OFF. The settable values are the same as those on the Pn506.	0	–	0 to 9	B
508	Undervoltage Alarm Selection	Select either to let the servo off or to stop the alarm when a main power alarm occurs. 0: Bring the Servo-OFF state in accordance with the Pn507 setting. Return to Servo on state by turning on the main power. 1: Main power supply undervoltage (Alarm No.13.1) occurs. Stop the alarm.	1	–	0 to 1	B
509	Momentary Hold Time	Set the main power supply alarm detection time.	70	1 ms	70 to 2000	C

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
510	Stop Selection for Alarm Detection	Select the stopping method at an alarm. 0: During deceleration: Dynamic brake After stopping: Dynamic brake 1: During deceleration: Free-run After stopping: Dynamic brake 2: During deceleration: Dynamic brake After stopping: Servo free 3: During deceleration: Free-run After stopping: Servo free 4: During deceleration due to emergency stop alarm: Emergency stop During deceleration: Dynamic brake After stopping: Dynamic brake 5: During Emergency stop alarm deceleration: Emergency stop During deceleration: Free-run After stopping: Dynamic brake 6: During Emergency stop alarm deceleration: Emergency stop During deceleration: Dynamic brake After stopping: Servo free 7: During Emergency stop alarm deceleration: Emergency stop During deceleration: Free-run After stopping: Servo free	0	–	0 to 7	B
511	Emergency Stop Torque	Set the torque limit for emergency stops.	0	%	0 to 500	B
512	Overload Detection Level Setting	Set the overload detection level.	0	%	0 to 500*	A
513	Overspeed Detection Level Setting	Set the overspeed error detection level.	0	r/min	0 to 20000	A
514	Overrun Limit Setting	Set the motor over-travel distance for position commands.	10	0.1 Rotation	0 to 1000	A
515	Control Input Signal Read Setting	Select the cycle to read the control input signals from the four levels. 0: 0.166 ms 1: 0.333 ms 2: 1 ms 3: 1.666 ms	0	–	0 to 3	C
520	Position Setting Unit Selection	Select the setting units of Positioning Completion Range 1 and 2 (Pn431 and Pn442) and of the Error Counter Overflow Level (Pn014). 0: Command unit 1: Encoder unit	0	–	0 to 1	C
521	Torque Limit Selection	Select the method to set the forward and reverse torque limits, and the torque feed forward function during speed control.	1	–	0 to 6	B
522	No. 2 Torque Limit	Set the No. 2 limit value for the motor output torque.	500	%	0 to 500	B
525	Forward External Torque Limit	Set the forward external toque limit when the torque limit switch input is given.	500	%	0 to 500	B

* For example, if you set 115 or higher, the resolution will be 115%.

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
526	Reverse External Torque Limit	Set the reverse external toque limit when the torque limit switch input is given.	500	%	0 to 500	B
531	Axis Number	Set the axis number for USB communications. Normally, do not change the set value.	1	–	0 to 127	C

Special Setting Parameters 1

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
605	Gain 3 Effective Time	Set effective time of gain 3 of three-step gain switching.	0	0.1 ms	0 to 10000	B
606	Gain 3 Ratio Setting	Set gain 3 as a multiple of gain 1.	100	%	50 to 1000	B
607	Torque Command Value Offset	Set offset torque to add to torque command.	0	%	–100 to 100	B
608	Forward Direction Torque Offset	Set the value to add to a torque command for forward direction operation.	0	%	–100 to 100	B
609	Reverse Direction Torque Offset	Set the value to add to a torque command for reverse direction operation.	0	%	–100 to 100	B
610	Function Expansion Setting	Set the function expansion. The setting contents vary depending on the function.	0	–	0 to 63	B
611	Electric Current Response Setting	Make fine adjustment on electric current response with default setting as 100%.	100	%	50 to 100	B
614	Alarm Detection Allowable Time Setting	Set the allowable time until stopping when an emergency stop is actuated upon alarm detection.	200	ms	0 to 1000	B
615	Overspeed Detection Level Setting at Emergency Stop	During an emergency stop upon alarm detection, if the motor speed excess this set value, this is an overspeed 2 error.	0	r/min	0 to 20000	A
618	Power Supply ON Initialization Time	Set initialization time after power supply ON to the standard 1.5 s plus some.	0	0.1 s	0 to 100	R
623	Disturbance Torque Compensation Gain	Set the compensation gain for disturbance torque.	0	%	–100 to 100	B
624	Disturbance Observer Filter Setting	Set the filter time constant for disturbance torque compensation.	53	0.01 ms	10 to 2500	B

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
631	Realtime Autotuning Estimated Speed Selection	Set the load characteristics estimated speed when realtime autotuning is enabled. 0: Fixes estimated results at the time load estimation becomes stable. 1: Estimates in every minute from the load characteristic changes. 2: Estimates in every second from the load characteristic changes. 3: Estimates the optimum from the load characteristic changes.	1	–	0 to 3	B
632	REALTIME AUTOTUNING CUSTOMIZATI ON mode Setting	Set the CUSTOMIZATION mode detail for realtime autotuning.	0	–	–32,768 to 32767	B
634	Hybrid Vibration Suppression Gain	Set the hybrid vibration suppression gain during full closing control.	0	0.1/s	0 to 30000	B
635	Hybrid Vibration Suppression Filter	Set the hybrid vibration suppression filter time constant during full closing control.	10	0.01 ms	0 to 6400	B
637	Vibration Detection Threshold	Set the vibration detection threshold. If torque vibration that exceeds this setting is detected, the vibration detection warning occurs.	0	0.1%	0 to 1000	B
638	Warning Mask Setting	Set the warning detection mask setting.If you set the corresponding bit to 1, the corresponding warning detection is disabled.	4	–	–32768 to 32767	C

Special Setting Parameters 2

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
700	Default Display	Select a data type to display on the 7-segment LED indicator on the front panel. 0: Normal state 1: Mechanical angle 2: Electric angle 3: Cumulative count of MECHATROLINK-II communications errors 4 Rotary switch setting value 5: Cumulative count of encoder communications errors 6: Cumulative count of external encoder communications errors 7: Z-phase counter 8 or over: Unused	0	–	0 to 32767	A
701	Power-ON Address Display Duration Setting	Set the time to indicate the node address when the control power is turned on.	0	100 ms	0 to 1000	R

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
703	Torque Limit Flag Output Setting	Set the condition for torque limit output during torque control. 0: On by the torque limit value including the torque command value. 1: On by the torque limit value excluding the torque command value.	0	–	0 to 1	A
704	Backlash Compensation Selection	Select to enable or disable the backlash compensation during position control. Set the compensation direction when the compensation is enabled. 0: Disable the backlash compensation. 1: Compensate the backlash at the first forward operation after a Servo ON. 2: Compensate the backlash at the first reverse operation after a Servo ON.	0	–	0 to 2	C
705	Backlash Compensation Amount	Set the backlash compensation amount during position control.	0	Command unit	–32768 to 32767	B
706	Backlash Compensation Time Constant	Set the time constant to apply a backlash compensation during position control.	0	0.01 ms	0 to 6400	B
710	MECHATROLINK-II Communication I/O Monitor Setting	Select whether to reflect the inputs to the I/O monitor of MECHATROLINK-II communications, when either the forward or reverse drive prohibition input is assigned to the input signal and the Drive Prohibition Input Selection (Pn504) is set to 1 (i.e. Disable). 0: Disable the one on the I/O monitor of MECHATROLINK-II communications as well. 1: Enable the one on the I/O monitor of MECHATROLINK-II communications.	0	–	0 to 1	A

Special Setting Parameters 3

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
800	Communications Control	Controls the alarms and warnings over the MECHATROLINK-II communications.	0	–	–32768 to 32767	C
801	Soft Limit	Select whether to enable or disable the Soft Limit Function. 0: Enable the soft limits on both directions. 1: Disable the forward soft limit, but enable the reverse soft limit. 2: Enable the forward soft limit, but disable the reverse soft limit. 3: Disable the soft limits on both directions.	0	–	0 to 3	A
803	Origin Range	Set the threshold for detecting the origin in absolute values.	10	Command unit	0 to 250	A
804	Forward Software Limit	Set the forward soft limit.	500000	Command unit	–1073741823 to 1073741823	A

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Appendix

Pn No.	Parameter name	Function and description	Default setting	Unit	Setting range	Data attribute
806	Reverse Software Limit	Set the reverse soft limit.	–500000	Command unit	–1073741823 to 1073741823	A
808	Absolute Encoder Origin Offset	Set the offset volume between the encoder or external encoder position and the mechanical coordinate position, when an absolute encoder or an absolute external encoder is used.	0	Command unit	–1073741823 to 1073741823	C
811	Linear Acceleration Constant	Set the acceleration for positioning.	100	*1	-32768 to 32767 (0 to 65535)	B
814	Linear Deceleration Constant	Set the deceleration for positioning.	100	*1	-32768 to 32767 (0 to 65535)	B
818	Position Command FIR Filter Time Constant	Set the time constant of FIR filter for the position command.	0	0.1ms	0 to 10000	B
820	Final Distance for External Input Positioning	Sets the distance to travel after the latch signal input position is detected during the external input positioning.	100	Command unit	–1073741823 to 1073741823	B
822	Origin Return Mode Settings	Set the direction for origin return. 0: Positive direction 1: Negative direction	0	–	0 to 1	B
823	Origin Return Approach Speed 1	Set the operating speed for origin returns, from when the origin proximity signal turns on to when it turns off and the latch signal is detected.	50	*2	1 to 32767	B
824	Origin Return Approach Speed 2	Set the operating speed for origin returns, from when the latch signal is detected to when the motor stops at the position after travelling the distance set by Final Distance for Origin Return (Pn825).	5	*2	1 to 32767	B
825	Final Distance for Origin Return	Set the distance from the position where the latch signal is entered to the origin during origin returns.	100	Command unit	–1073741823 to 1073741823	B
836	Option Monitor Selection 1	The Monitor Selection Field of MECHATROLINK-II communications displays the monitoring data that is set on this parameter.	0	–	–32768 to 32767	A
837	Option Monitor Selection 2	The Monitor Selection Field of MECHATROLINK-II communications displays the monitoring data that is set on this parameter.	0	–	–32768 to 32767	A

*1. 10000 command units / s^2

*2. 100 command units / s

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