# Accurax G5 servo system
with Analogue/Pulse control
Model:
R88D-KT_ Servo Drives
R88M-K_ Servomotors

# USER'S MANUAL

**OMRON**

# Introduction

Thank you for purchasing the Accurax G5. This user's manual explains how to install and wire the Accurax G5, set parameters needed to operate the G5, 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 Accurax G5 and peripheral equipment.
Before using the Accurax G5, 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 get to the end-user.

# Items Requiring Acknowledgment

## 1. Terms of Warranty

(1) Warranty period

The warranty period of this product is 1 year after its purchase or delivery to the specified location.

(2) Scope of warranty

If the product fails during the above warranty period due to design, material or workmanship, we will provide a replacement unit or repair the faulty product free of charge at the location where you purchased the product.

Take note, however, that the following failures are excluded from the scope of warranty.

a) Failure due to use or handling of the product in any condition or environment not specified in the catalog, operation manual, etc.

b) Failure not caused by this product

c) Failure caused by any modification or repair not carried out by OMRON

d) Failure caused by any use not intended for this product

e) Failure that could not be predicted with the level of science and technology available when the product was shipped from OMRON

f) Failure caused by a natural disaster or any other reason for which OMRON is not held responsible

Take note that this warranty applies to the product itself, and losses induced by a failure of the product are excluded from the scope of warranty.

## 2. Limited Liability

(1) OMRON shall not assume any responsibility whatsoever for any special damage, indirect damage or passive damage arising from this product.

(2) OMRON shall not assume any responsibility for programming done by individuals not belonging to OMRON, if the product is programmable, or outcomes of such programming.

## 3. Conditions for Intended Application

(1) If this product is combined with other product, the customer must check the standards and regulations applicable to such combination. The customer must also check the compatibility of this product with any system, machinery or device used by the customer. If the above actions are not taken, OMRON shall not assume any responsibility regarding the compatibility of this product.

(2) If the product is used in the following applications, consult your OMRON sales representative to check the necessary items according to the specification sheet, etc. Also make sure the product is used within the specified ratings and performance ranges with an ample margin and implement safety measures, such as designing a safety circuit, to minimize danger should the product fail.

a) Used in any outdoor application, application subject to potential chemical contamination or electrical interference, or in any condition or environment not specified in the catalog, operation manual, etc.

b) Nuclear power control equipment, incineration equipment, railway, aircraft and vehicle equipment, medical machinery, entertainment machinery, safety system or any other device controlled by an administrative agency or industry regulation

c) System, machinery or device that may threaten human life or property

d) Gas, water or electricity supply system, system operated continuously for 24 hours or any other equipment requiring high reliability

e) Any other application where a high level of safety corresponding to a) to d) above is required

(3) If the customer wishes to use this product in any application that may threaten human life or property, be sure to confirm beforehand that the entire system is designed in

such a way to notify dangers or ensure the necessary level of safety via design redundancy, and that the product is wired and installed appropriately in the system according to the intended application.

(4) Sample applications explained in the catalog, etc. are provided for reference purposes only. When adopting any of these samples, check the function and safety of each equipment or device.

(5) Understand all prohibited items and notes on use provided herein, so that this product will be used correctly and that customers or third parties will not suffer unexpected losses.

## 4. Specification Change

The product specifications and accessories explained in the catalog, operation manual, etc. are subject to change, if necessary, for the reasons of improvement, etc. Contact your OMRON sales representative to check the actual specifications of this product.

## 5. Scope of Service

The price of this product excludes costs of service such as dispatching engineers.
If you have any request regarding service, consult your OMRON sales representative.

## 6. Scope of Application

The above paragraphs are based on the assumption that this product is traded and used in Japan.
If you wish to trade or use this product outside Japan, consult your OMRON sales representative.

# Safety Precautions Document

■So that the Accurax G5 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.

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

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

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.<br><br>The specific instruction is described using an illustration or text inside or near △.<br>The symbol shown to the left indicates "beware of electric shock". |
| 🚫 | ⊘ This symbol indicates a prohibited item (item you must not do).<br><br>The specific instruction is described using an illustration or text inside or near ⊘.<br>The symbol shown to the left indicates "disassembly prohibited". |
| ⏚ | ⬤ This symbol indicates a compulsory item (item that must be done).<br><br>The specific instruction is described using an illustration or text inside or near ⬤.<br>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** |
|---|---|
| | Be sure to ground the frame ground terminals of the driver and motor to 100 $\Omega$ or less.<br>Electric shock may result. |
| | Never touch the parts inside the driver.<br>Electric shock may result. |
| | While the power is supplied, do not remove the front cover, terminal covers, cables and options.<br>Electric shock may result. |
| | Installation, operation and maintenance or inspection by unauthorized personnel is prohibited.<br>Electric shock or injury may result. |
| | Before carrying out wiring or inspection, turn OFF the power supply and wait for at least 15 minutes.<br>Electric shock may result. |
| | Do not damage, pull, stress strongly or pinch the cables or place heavy articles on them.<br>Electric shock, stopping of product operation or burn damage may result. |
| | Never touch the rotating part of the motor during operation.<br>Injury may result. |
| | Never modify the product.<br>Injury or equipment damage may result. |
| | Install a stopping device on the machine side to ensure safety.<br>* The holding brake is not a stopping device to ensure safety.<br>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.<br>Injury may result. |
| | When the power is restored after a momentary power interruption, the machine may restart suddenly. Never come close to the machine.<br>* Implement remedies to ensure safety of people nearby even when the machine is restarted.<br>Injury may result. |
| | After an earthquake, be sure to conduct safety checks.<br>Electric shock, injury or fire may result. |
| | Never drive the motor using an external drive source.<br>Fire may result. |

# ⚠ Danger

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

⚠ Install the motor, driver 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 driver 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 driver 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.<br>Injury or failure may result. |
|---|---|
| ⚠ | Do not overload the products. (Follow the instruction on the product label.)<br>Injury or failure may result. |
| ⚠ | Use the motor eye-bolts only when transporting the motor.<br>Do not use them to transport the machine.<br>Injury or failure may result. |

## Installation and Wiring

| ⚠ | **Caution** |
|---|---|

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

## Operation and Adjustment

**⚠ Caution**

| | |
|---|---|
| ⚠ | Conduct a test operation after confirming that the equipment is not affected.<br>Equipment damage may result. |
| ⚠ | Before operating the product in an actual environment, check if it operates correctly based on the parameters you have set.<br>Equipment damage may result. |
| ⚠ | Never adjust or set parameters to extreme values, as it will make the operation unstable.<br>Injury may result. |
| ⚠ | Separate the motor from the mechanical system and check its operation before installing the motor to the machine.<br>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.<br>Injury may result. |
| ⚠ | Do not use the built-in brake of the motor for normal braking operation.<br>Failure may result. |
| ⚠ | Do not operate the Servomotor when an excessive load inertia is installed.<br>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.<br>Injury, damage or taint damage may result. |
| ⚠ | If the driver fails, cut off the power supply to the driver on the power supply side.<br>Fire may result. |
| ⚠ | Do not turn ON and OFF the main driver power supply frequently.<br>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.<br>Equipment damage may result. |
| 🚫 | Never repair the product by disassembling it.<br>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.<br>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.

Warning label display location ────
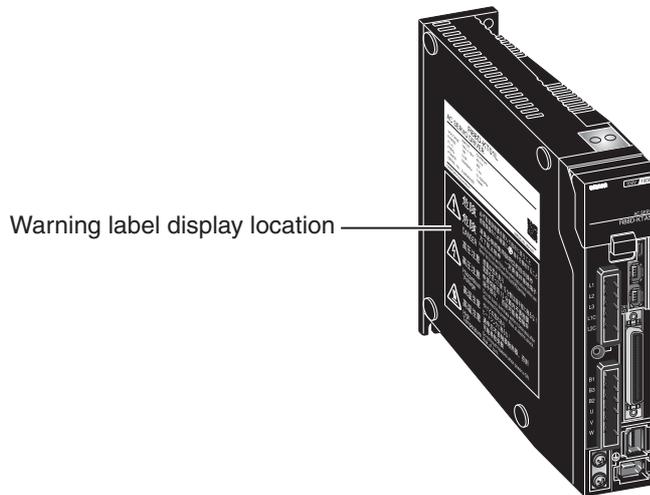
(R88D-KTA5L)

## Instructions on Warning Label

| 危険 / 危险 / DANGER | 必ず取扱説明書を読んで指示に従うこと<br>感電保護のため確実に ⏚ 端子を接地すること<br>请务必按照使用说明书的指示操作<br>为了防止触电，一定要接好接地端子<br>Read the manual and follow the safety instructions before use.<br>Never fail to connect Protective Earth(PE) terminal. |
| 高圧注意 / 高压注意 / Hazardous Voltage | 感電の恐れあり<br>電源を切った後15分間は端子部に触るな！<br>电源切断后15分钟内不要触摸<br>端子部分，否则可能导致触电<br>Do not touch terminals within 15 minutes after<br>disconnect the power. Risk of electric shock. |
| 高温注意 / 高温注意 / High Temperature | やけどの恐れあり<br>ヒートシンクに触るな！<br>通电后不要触摸散热器，否则<br>可能导致受伤<br>Do not touch heatsink when power is ON.<br>Risk of burn. |

## 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, etc. other than those in the table below are not supplied. They must be prepared by the customer.

⬥ 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.

| Specifications | | Main power supply connector | Control power supply connector | Motor connector | Regeneration Resistor connector | Open software | Safety bypass connector |
|---|---|---|---|---|---|---|---|
| Single-phase 100 VAC | 50 W | | | | | | |
| | 100 W | | | | | | |
| | 200 W | | | | | | |
| | 400 W | | | | | | |
| Single-phase/3-phase 200 VAC | 100 W | Included | | | | | |
| | 200 W | | | | | | |
| | 400 W | | | | | | |
| | 750 W | | | | | | |
| | 1 kW | | | | | | |
| | 1.5 kW | | | | | | |
| 3-phase 200 VAC | 2 kW | | | | | | |
| | 3 kW | – | | | | | Included |
| | 5 kW | | | | | | |
| | 7.5 kW | | | | | | |
| | 15 kW | | | | | | |
| 3-phase 400 VAC | 600 W | Included | | | | | |
| | 1 kW | | | | | | |
| | 1.5 kW | | | | | | |
| | 2 kW | | | | | | |
| | 3 kW | – | | | | | Included |
| | 5 kW | | | | | | |
| | 7.5 kW | | | | | | |
| | 15 kW | | | | | | |

# 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. I571-E2-03

↑ Revision symbol

| Revision symbol | Revision date | Description of revision and revised page |
|---|---|---|
| 01 | February 2010 | First Print. European version |
| 02 | April 2011 | Second Print. European version |
| 03 | August 2011 | Third Print. European version |

# 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 damping control, electronic gears, gain switching and disturbance observer, and explains the contents of setting. |
| 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. |
| Chapter 12 | Appendix | This chapter provides connection examples using OMRON's PLC and Position Controller, as well as a list of parameters. |

# Table Of Contents

**Table Of Contents**

# 1

# Features and System Configuration

**1**

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

# 1-1   Outline

**Features and System Configuration**

**1**

## Outline of the Accurax G5

With the Accurax G5, you can perform full closing control in addition to position control, speed control and torque control.

Various models are available supporting wide-ranging motor capacities from 50 W to 5 kW and input power supplies from 100 to 400 V. You will surely find a model that best suits your application.

Motors with high-resolution 20-bit incremental encoders and 17-bit absolute/incremental encoders are available as standard models.

The Accurax G5 features realtime autotuning function and adaptive filter function that automatically perform complicated gain adjustments. A notch filter can also be automatically set to suppress machine vibration by reducing machine resonance during operation.

The damping control function of the Servomotor and Servo Drive realizes stable stopping performance in a mechanism which vibrates because of the low rigidity of the load.

## Features of the Accurax G5

The Accurax G5 has the following features.

### 7 Possible CONTROL modes Switching

You can switch among 7 CONTROL modes including the following: (1) position control, (2) speed control, (3) torque control, (4) position and speed control, (5) position and torque control, (6) speed and torque control, (7) full closing control. Desired modes can be selected with the flexible driver according to your need. A single driver supports various applications.

### Achievement of Accurate Positioning by Full Closing Control

Feedbacks from the external scale 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 Accurax G5 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 immediate stop button or other safety equipment. In addition to the conventional stop method based on a control signal, the STO function that permits direct stopping without a need to involve the control circuit provides the immediate stop from 2 systems, thereby enhancing safety.

### 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.

2 vibration filters are provided to enable switching the vibration 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 vibration frequency and filter values, and you are assured of stable operation even if the set values are inappropriate.

# 1-2 System Configuration



**Controller (Voltage Output Type)**

Programmable Controller SYSMAC CS

Motion Control Unit CS1W-MC221/421 (-V1)

Analog voltage

'Accurax G5 AC Servomotor R88D-KTx

**SYSMAC + Position Control Unit (Pulse Train Output Type)**

Programmable Controller SYSMAC CJ/CS

Position Control Unit
CJ1W-NC113/213/413
CJ1W-NC133/233/433
CJ1W-NC214/414
CJ1W-NC234/434
CS1W-NC113/213/413
CS1W-NC133/233/433
C200HW-NC113/213/413

Pulse train

INC   ABS

'Accurax G5 AC Servomotor R88M-Kx

♦The following units support a motor with absolute encoder:
 CJ1W-NC214/414
 CJ1W-NC234/434
 CS1W-MC221/421 (-V1)

**Features and System Configuration**

**1**

# 1-3   Names and Functions

## Driver Part Names

**1**

**Features and System Configuration**

Display area

Monitor connector (CN5)

Operation area

USB connector (CN7)

Expansion connector (CN3)

Main circuit
power supply terminals
(L1, L2, and L3)

L1
L2
L3

Safety connector (CN8)

Control circuit
power supply terminals
(L1C and L2C)

L1C
L2C

CN1
I/O

Charge lamp

CHARGE

Control I/O connector (CN1)

External Regeneration
Resistor connection
terminals (B1, B2 and B3)

B1
B3
B2

Motor connection
terminals (U, V and W)

U
V
W

External scale connector (CN4)

Protective ground terminals

Encoder connector (CN2)

CN4

CN2

## Driver Functions

### Display Area

A 6-digit 7-segment LED display shows the driver status, alarm codes, parameters, and other information.

### Operation Area

Monitors the parameter setting and driver condition.

### Charge Lamp

Lits when the main circuit power supply is turned ON.

### 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.

### Expansion Connector (CN3)

A spare connector for expansion. Do not connect anything.

### External Scale Connector (CN4)

Connector for an encoder signal used during full closing control.

### Monitor Connector (CN5)

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

### 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

**Size A: R88D-KTA5L/-01L/-02H**
**Size B: R88D-KT02L/-04H**
**Size C: R88D-KT04L/KT08H**

**Size D: R88D-KT10H/-15H**

**Features and System Configuration**

**Size D: R88D-KT06F/-10F/-15F**



Features and System Configuration

**1**

**Size E: R88D-KT20H**
**Size F: R88D-KT30H/-50H**
**Size G: R88D-KT75H**
**Size H: R88D-KT150H**



**1**
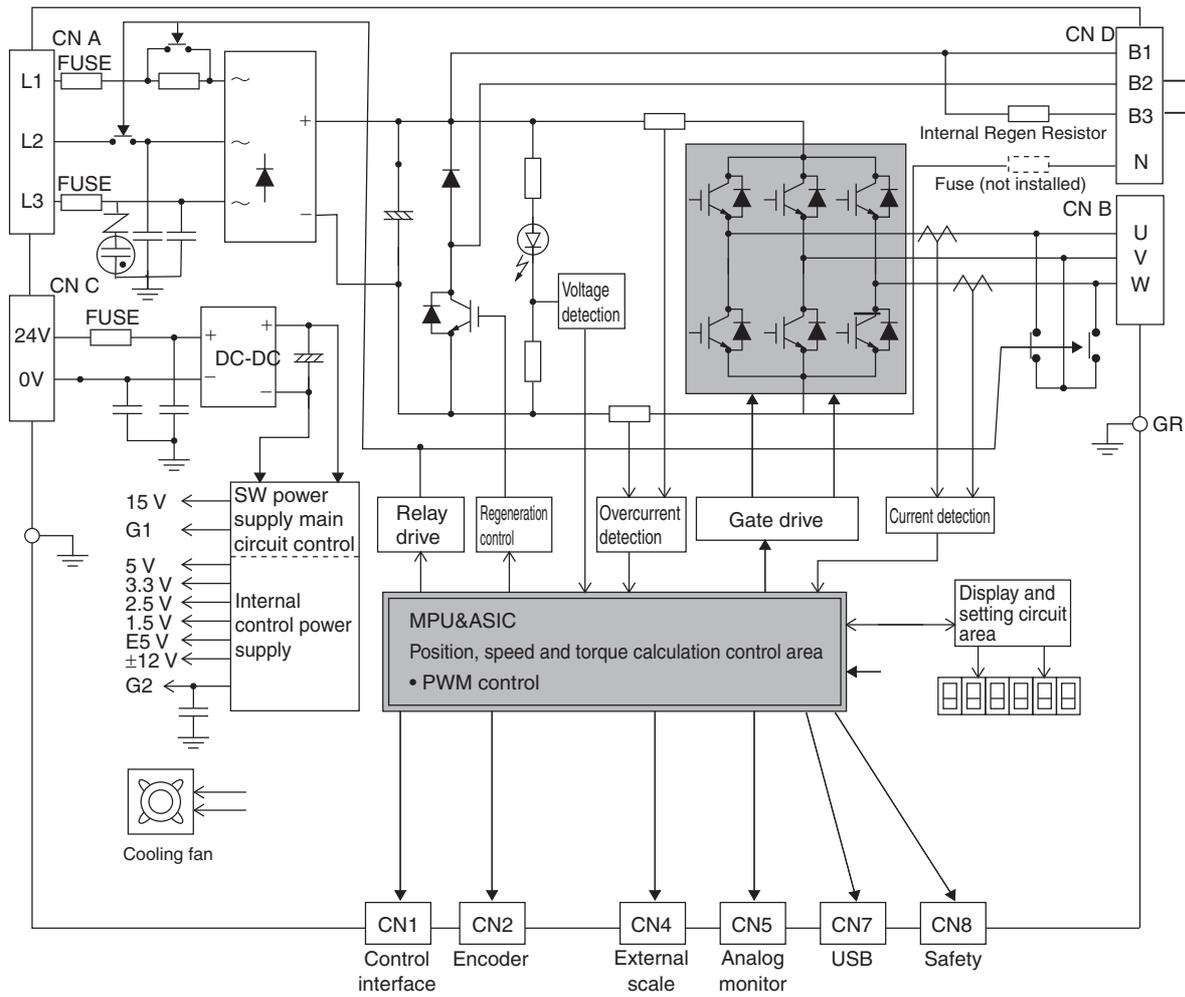
**Features and System Configuration**
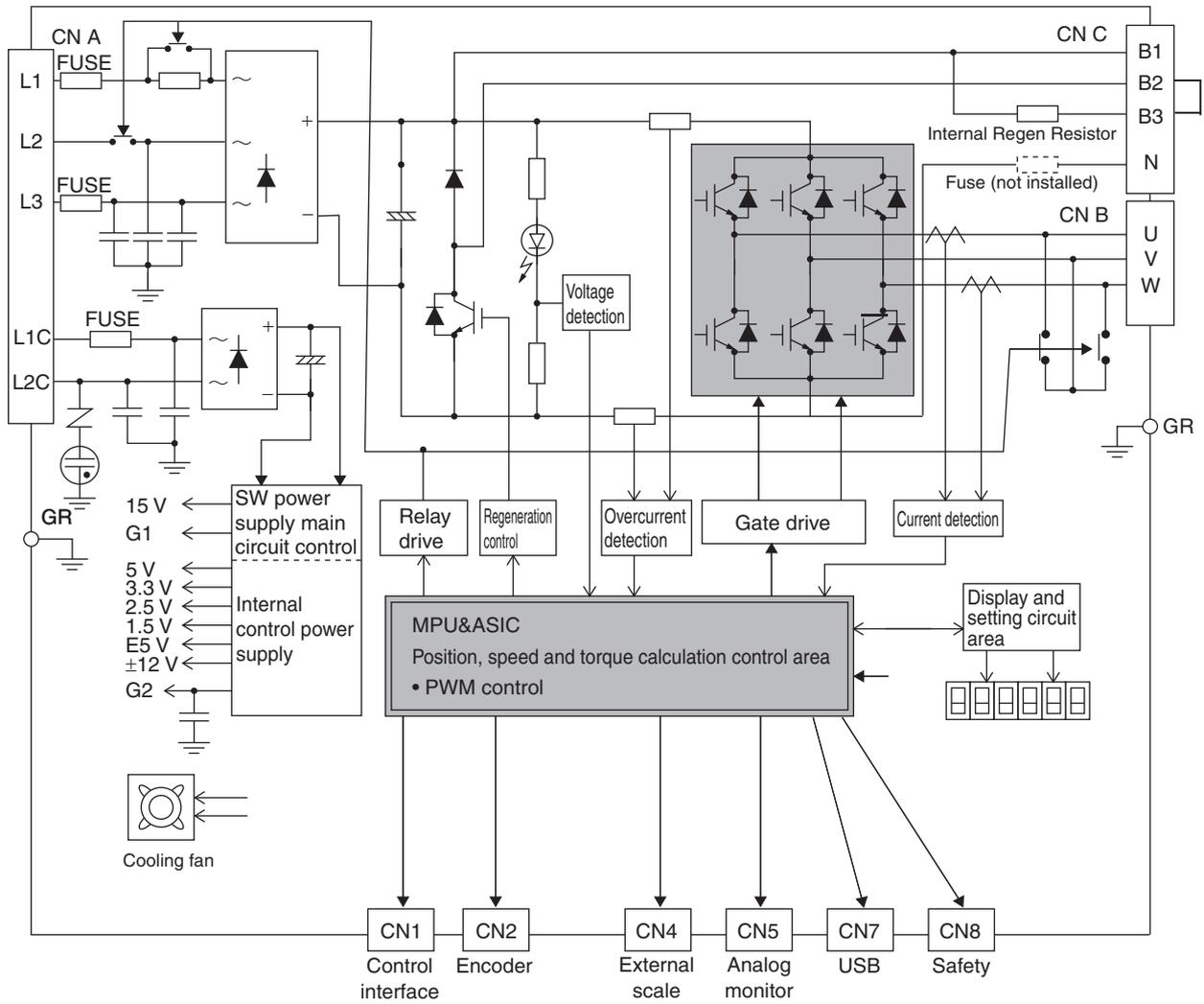
**Size E: R88D-KT20F**
**Size F: R88D-KT30F/-50F**
**Size G: R88D-KT75F**
**Size H: R88D-KT150F**



**1**

**Features and System Configuration**
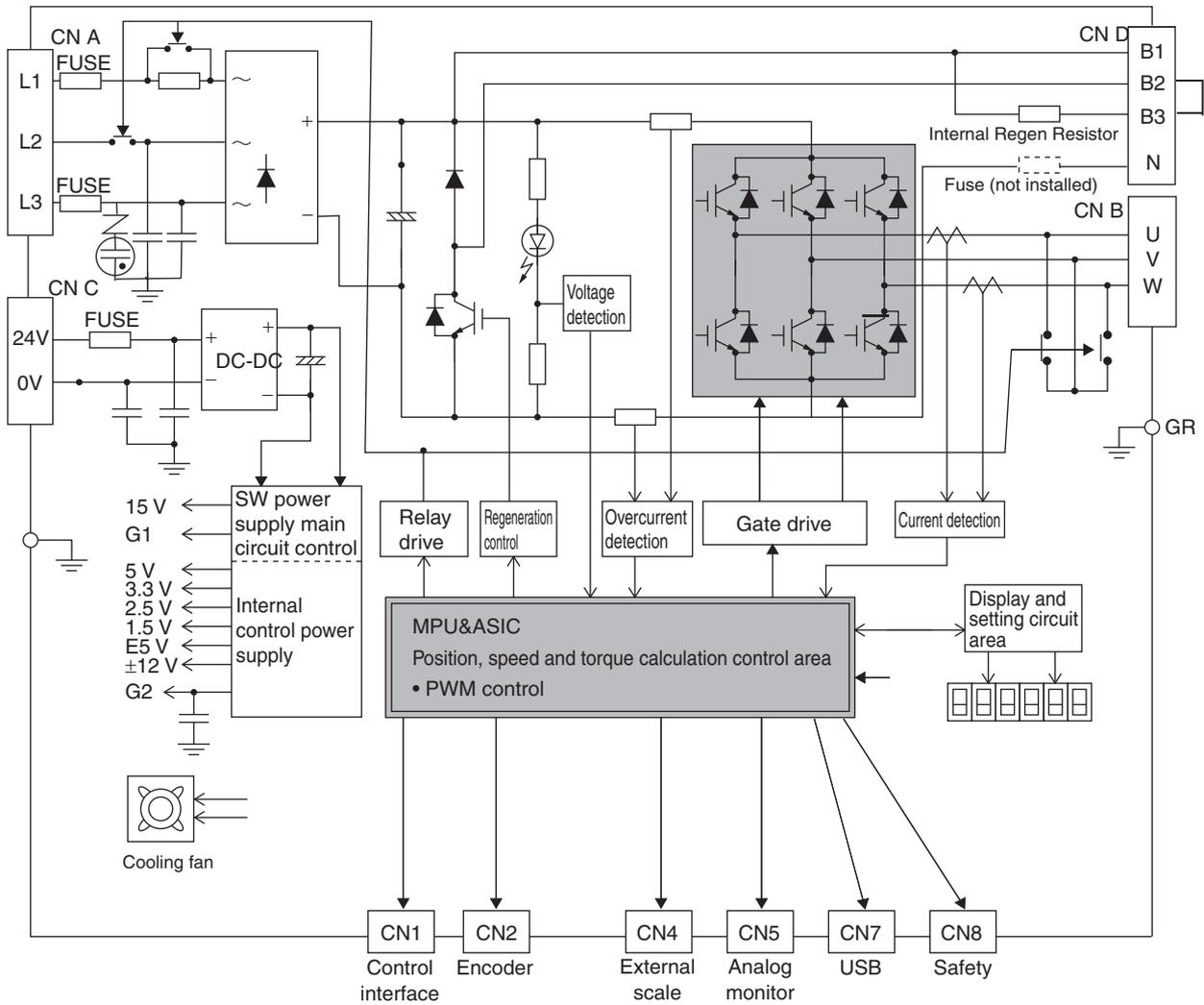
# 1-5   Applicable Standards

## 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 AC Servomotor | EN 55011 class A group 1 |
| | | IEC61800-3 |
| | | EN61000-6-2 |

Note. To conform to EMC directives, the Servo Motor and Servo Drive must be installed under the conditions described in "4-3 Wiring Conforming to EMC Directives" (P.4-32).

## UL and cUL Standards

| Standard | Product | Applicable standards | File number |
|---|---|---|---|
| UL standards | AC Servo Drive | UL508C | E179149 |
| | AC Servomotor | UL1004-1 [100 V, 200 V] 3,000 r/min 50 to 750 W | E331224 |
| | | UL1004 | E179189 |
| CSA standards | AC Servo Drive | CSA22.2 No. 14 | E179149 |
| | AC Servomotor | CSA22.2 No. 100 [100 V, 200 V] 3,000 r/min 50 to 750 W | E331224 |
| | | CSA22.2 No. 100 | E179189 |

## Functional Safety

| Standard | Product | Applicable standards |
|---|---|---|
| Functional safety | AC Servo Drive | EN954-1 (Category 3) ISO13849-1 (Performance level D) EN61508 (SIL2) EN62061 (SIL2) EV61800-5-2 (STO) IEC61326-3-1 (SIL2) |

**Features and System Configuration**

**1**

# 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

**Standard Models and External Dimensions**

**2**

**Pulse Train Commands**

**Analog Commands**

**Controller**

**Position Control Unit**

**CPU Unit**

**Support Software**
- CX-One Software Package (Including CX-Drive, CX-MotionPro, CX-Motion, CX-Programmer)

High-speed type

Programmable Controller SYSMAC CJ2

Position Control Unit (NC) CJ1W-NC214/414 CJ1W-NC234/434

**ABS**

**Direct connection cable for CJ1W-NC□□4**
XW2Z-□□□J-G□

**Pulse Train Commands/Feedback Signals**

**Position Control Unit Cable**
XW2Z-□X

**Connector Terminal Block Conversion Unit**
XW2□-20G□

**External Signal**

Standard type

Programmable Controller SYSMAC CJ1/CS1

Position Control Unit (NC) CJ1W-NC□□3  CS1W-NC□□3 C200HW-NC□□3

**Position Control Unit Cable (NC)**
XW2Z-□-A□

**Servo Relay Unit**
XW2B-□

**Servo Drive Cable**
XW2Z-□-B□

**External Signal**

Built-in pulse I/O function type

CJ1M-CPU2□

Built-in pulse I/O function type

CP1H/CP1L

**Connector-Terminal Block Conversion Units and Cable**
XW2□-50G□     XW2Z-□□□J-B24

**Pulse Train Commands**

**SYSMAC + Controller (Analog output type)**

Programmable Controller SYSMAC CS1

Motion Control Unit (MC) CS1W-MC221/421 (-V1)

**ABS**

**Control Cables (for Motion Control Unit)**
R88A-CPG

**Analog Commands/Feedback Signals**

**ABS** Available to build the Absolute System.

**2**

**Standard Models and External Dimensions**

| | Servo Drive | | | AC Servomotors |
|---|---|---|---|---|
| USB communications | | Motor power signals | | |

**Power Cables**

- Standard Cables
  · Without Brake
    R88A-CA□□□□□SR-E
  · With Brake
    R88A-CA□□□□□BR-E

**Brake Cables (50 to 750 W max.)**

- Standard Cables
  R88A-CAKA□□□BR-E

- Accurax G5 drive
  R88D-KT

  100 VAC
  200 VAC
  400 VAC

**Feedback Signals**

**Encoder Cables**

- Standard Cables
  R88A-CRK□□□□□R-E

- Accurax G5 motor
  R88M-K

  3,000 r/min
  2,000 r/min
  1,000 r/min

INC  ABS/INC

**Peripheral Devices**

External encoder | External Regeneration Resistors R88A-RR

**Absolute Encoder Battery Cable**

R88A-CRGD0R3C (-BS)
(A battery is included with model numbers ending in "BS").

* Not required if a battery is connected to the control connector (CN1).

# 2-2   How to Read Model

## Servo Drive

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

R88D-KT01H

Accurax G5 Series Servomotor

Driver Type
  T  : Pulse/analog type

Capacity
  A5 : 50 W
  01 : 100 W
  02 : 200 W
  04 : 400 W
  06 : 600 W
  08 : 750 W
  10 : 1 kW
  15 : 1.5 kW
  20 : 2 kW
  30 : 3 kW
  50 : 5 kW
  75 : 7.5 kW
  150 : 15 kW

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

**2**

**Standard Models and External Dimensions**

## Servomotor

# R88M-K10030H-BOS2

Accurax G5 Series Servomotor

**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
4K5 : 4.5 kW
5K0 : 5 kW
6K0 : 6 kW
7K5 : 7.5 kW
11K0 : 11 kW
15K0 : 15 kW

**Rated Rotation Speed**
10  : 1,000 r/min
15  : 1,500 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**
Blank : Straight shaft, no key
B  : With brake
O  : With oil seal
S2  : Straight, key, tapped

**2**

**Standard Models and External Dimensions**

# 2-3 Standard Model List

## Servo Drive Model List

| Specifications | | Model |
|---|---|---|
| Single-phase 100 VAC | 50 W | R88D-KTA5L |
| | 100 W | R88D-KT01L |
| | 200 W | R88D-KT02L |
| | 400 W | R88D-KT04L |
| Single-phase/3-phase 200 VAC | 100 W | R88D-KT01H |
| | 200 W | R88D-KT02H |
| | 400 W | R88D-KT04H |
| | 750 W | R88D-KT08H |
| | 1 kW | R88D-KT10H |
| | 1.5 kW | R88D-KT15H |
| 3-phase 200 VAC | 2 kW | R88D-KT20H |
| | 3 kW | R88D-KT30H |
| | 5 kW | R88D-KT50H |
| | 7.5 kW | R88D-KT75H |
| | 15 kW | R88D-KT150H |
| 3-phase 400 VAC | 600 W | R88D-KT06F |
| | 1 kW | R88D-KT10F |
| | 1.5 kW | R88D-KT15F |
| | 2 kW | R88D-KT20F |
| | 3 kW | R88D-KT30F |
| | 5 kW | R88D-KT50F |
| | 7.5 kW | R88D-KT75F |
| | 15 kW | R88D-KT150F |

## Servomotor Model List

### 3,000-r/min motors

| 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-K05030L | R88M-K05030L-S2 | R88M-K05030S | R88M-K05030S-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 |

**Standard Models and External Dimensions**

**2**

| 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-K05030L-B | R88M-K05030L-BS2 | R88M-K05030S-B | R88M-K05030S-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.

## 1,500-r/min and 2,000-r/min Motors

| 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 |
| | | 7.5 kW | --- | --- | R88M-K7K515T | R88M-K7K515T-S2 |
| | | 11 kW | --- | --- | R88M-K11K015T | R88M-K11K015T-S2 |
| | | 15 kW | --- | --- | R88M-K15K015T | R88M-K15K015T-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 |
| | | 7.5 kW | --- | --- | R88M-K7K515C | R88M-K7K515C-S2 |
| | | 11 kW | --- | --- | R88M-K11K015C | R88M-K11K015C-S2 |
| | | 15 kW | --- | --- | R88M-K15K015C | R88M-K15K015C-S2 |

**2**

**Standard Models and External Dimensions**

| 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 | 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 |
| | | 7.5 kW | --- | --- | R88M-K7K515T-B | R88M-K7K515T-BS2 |
| | | 11 kW | --- | --- | R88M-K11K015T-B | R88M-K11K015T-BS2 |
| | | 15 kW | --- | --- | R88M-K15K015T-B | R88M-K15K015T-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 |
| | | 7.5 kW | --- | --- | R88M-K7K515C-B | R88M-K7K515C-BS2 |
| | | 11 kW | --- | --- | R88M-K11K015C-B | R88M-K11K015C-BS2 |
| | | 15 kW | --- | --- | R88M-K15K015C-B | R88M-K15K015C-BS2 |

Note 1. Models with oil seals are also available.

Note 2. The rated rotation speed of Servomotors of 7.5 to 15 kW is 1,500 r/min.

**2** 

**Standard Models and External Dimensions**

## 1,000-r/min Motors

| 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 W | 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 |
| | | 4.5 kW | --- | --- | R88M-K4K510T | R88M-K4K510T-S2 |
| | | 6 kW | --- | --- | R88M-K6K010T | R88M-K6K010T-S2 |
| | 400 V | 900 W | 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 |
| | | 4.5 kW | --- | --- | R88M-K4K510C | R88M-K4K510C-S2 |
| | | 6 kW | --- | --- | R88M-K6K010C | R88M-K6K010C-S2 |
| With brakes | 200 V | 900 W | 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 |
| | | 4.5 kW | --- | --- | R88M-K4K510T-B | R88M-K4K510T-BS2 |
| | | 6 kW | --- | --- | R88M-K6K010T-B | R88M-K6K010T-BS2 |
| | 400 V | 900 W | 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 |
| | | 4.5 kW | --- | --- | R88M-K4K510C-B | R88M-K4K510C-BS2 |
| | | 6 kW | --- | --- | R88M-K6K010C-B | R88M-K6K010C-BS2 |

Note. Models with oil seals are also available.

**Standard Models and External Dimensions**

**2**

## Servo Drive and Servomotor Combination List

The tables in this section show the possible combinations of Accurax G5 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 Motors and Drivers

| Voltage | Servomotor | | | Servo Drive |
|---|---|---|---|---|
| | Rated output | With incremental encoder | With absolute encoder | |
| Single-phase 100 V | 50 W | R88M-K05030L-x | R88M-K05030S-x | R88D-KTA5L |
| | 100 W | R88M-K10030L-x | R88M-K10030S-x | R88D-KT01L |
| Single-phase/ 3-phase 100 V | 200 W | R88M-K20030L-x | R88M-K20030S-x | R88D-KT02L |
| | 400 W | R88M-K40030L-x | R88M-K40030S-x | R88D-KT04L |
| Single-phase/ 3-phase 200 V | 50 W | R88M-K05030H-x | R88M-K05030T-x | R88D-KT01H |
| | 100 W | R88M-K10030H-x | R88M-K10030T-x | R88D-KT01H |
| | 200 W | R88M-K20030H-x | R88M-K20030T-x | R88D-KT02H |
| | 400 W | R88M-K40030H-x | R88M-K40030T-x | R88D-KT04H |
| | 750 W | R88M-K75030H-x | R88M-K75030T-x | R88D-KT08H |
| | 1 kW | R88M-K1K030H-x | R88M-K1K030T-x | R88D-KT15H |
| | 1.5 kW | R88M-K1K530H-x | R88M-K1K530T-x | R88D-KT15H |
| 3-phase 200 V | 2 kW | R88M-K2K030H-x | R88M-K2K030T-x | R88D-KT20H |
| | 3 kW | R88M-K3K030H-x | R88M-K3K030T-x | R88D-KT30H |
| | 4 kW | R88M-K4K030H-x | R88M-K4K030T-x | R88D-KT50H |
| | 5 kW | R88M-K5K030H-x | R88M-K5K030T-x | R88D-KT50H |
| 3-phase 400 V | 750 W | R88M-K75030F-x | R88M-K75030C-x | R88D-KT10F |
| | 1 kW | R88M-K1K030F-x | R88M-K1K030C-x | R88D-KT15F |
| | 1.5 kW | R88M-K1K530F-x | R88M-K1K530C-x | R88D-KT15F |
| | 2 kW | R88M-K2K030F-x | R88M-K2K030C-x | R88D-KT20F |
| | 3 kW | R88M-K3K030F-x | R88M-K3K030C-x | R88D-KT30F |
| | 4 kW | R88M-K4K030F-x | R88M-K4K030C-x | R88D-KT50F |
| | 5 kW | R88M-K5K030F-x | R88M-K5K030C-x | R88D-KT50F |

**2**

**Standard Models and External Dimensions**

## 1,500-r/min and 2,000-r/min Motors and Drivers

| 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-KT10H |
| | 1.5 kW | R88M-K1K520H-x | R88M-K1K520T-x | R88D-KT15H |
| 3-phase 200 V | 2 kW | R88M-K2K020H-x | R88M-K2K020T-x | R88D-KT20H |
| | 3 kW | R88M-K3K020H-x | R88M-K3K020T-x | R88D-KT30H |
| | 4 kW | R88M-K4K020H-x | R88M-K4K020T-x | R88D-KT50H* |
| | 5 kW | R88M-K5K020H-x | R88M-K5K020T-x | R88D-KT50H |
| | 7.5 kW | --- | R88M-K7K515T-x | R88D-KT75H |
| | 11 kW | --- | R88M-K11K015T-x | R88D-KT150H* |
| | 15 kW | --- | R88M-K15K015T-x | R88D-KT150H |
| 3-phase 400 V | 400 W | R88M-K40020F-x | R88M-K40020C-x | R88D-KT06F* |
| | 600 W | R88M-K60020F-x | R88M-K60020C-x | R88D-KT06F |
| | 1 kW | R88M-K1K020F-x | R88M-K1K020C-x | R88D-KT10F |
| | 1.5 kW | R88M-K1K520F-x | R88M-K1K520C-x | R88D-KT15F |
| | 2 kW | R88M-K2K020F-x | R88M-K2K020C-x | R88D-KT20F |
| | 3 kW | R88M-K3K020F-x | R88M-K3K020C-x | R88D-KT30F |
| | 4 kW | R88M-K4K020F-x | R88M-K4K020C-x | R88D-KT50F* |
| | 5 kW | R88M-K5K020F-x | R88M-K5K020C-x | R88D-KT50F |
| | 7.5 kW | --- | R88M-K7K515C-x | R88D-KT75F |
| | 11 kW | --- | R88M-K11K015C-x | R88D-KT150F* |
| | 15 kW | --- | R88M-K15K015C-x | R88D-KT150F |

* Use these combination with caution beacuse the Servo Drive and Servomotor have different capacities.

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**Standard Models and External Dimensions**

## 1,000-r/min Motors and Drivers

| 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-KT15H* |
| 3-phase 200 V | 2 kW | R88M-K2K010H-x | R88M-K2K010T-x | R88D-KT30H* |
|               | 3 kW | R88M-K3K010H-x | R88M-K3K010T-x | R88D-KT50H* |
|               | 4.5 kW | --- | R88M-K4K510T-x | R88D-KT50H* |
|               | 6 kW | --- | R88M-K6K010T-x | R88D-KT75H* |
| 3-phase 400 V | 900 W | R88M-K90010F-x | R88M-K90010C-x | R88D-KT15F* |
|               | 2 kW | R88M-K2K010F-x | R88M-K2K010C-x | R88D-KT30F* |
|               | 3 kW | R88M-K3K010F-x | R88M-K3K010C-x | R88D-KT50F* |
|               | 4.5 kW | --- | R88M-K4K510C-x | R88D-KT50F* |
|               | 6 kW | --- | R88M-K6K010C-x | R88D-KT75F* |

* Use these combination with caution beacuse the Servo Drive and Servomotor have different capacities.

## Peripheral Equipment and Cable Model List

### Encoder Cables (European Flexible Cables)

| Specifications | | Model |
|---|---|---|
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W<br>(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]<br>3,000-r/min motors of 1.0 kW or more<br>For 2,000-r/min motors<br>For 1,000-r/min motors<br>(for both absolute encoders and incremental encoders)<br><br>[400 V]<br>For 3,000-r/min motors<br>For 2,000-r/min motors<br>For 1,000-r/min motors<br>(for both absolute encoders and incremental encoders) | 1.5 m | R88A-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 |

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**Standard Models and External Dimensions**

## Motor Power Cables (European 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 | It requires both, the power cable R88A-CAKAxxxSR-E and the separate brake cable R88A-CAKAxxxBR-E (1) |
| | 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 |
| [200 V and 400 V] 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 |
| [200 V and 400 V] For 1,500-r/min motors of 7.5 kW For 1,000-r/min motors of 6 kW | 1.5 m | R88A-CAKE001-5SR-E | - |
| | 3 m | R88A-CAKE003SR-E | - |
| | 5 m | R88A-CAKE005SR-E | - |
| | 10 m | R88A-CAKE010SR-E | - |
| | 15 m | R88A-CAKE015SR-E | - |
| | 20 m | R88A-CAKE020SR-E | - |
| [200 V and 400 V] For 1,500-r/min motors of 11 to 15 kW | 1.5 m | R88A-CAKG001-5SR-E | - |
| | 3 m | R88A-CAKG003SR-E | - |
| | 5 m | R88A-CAKG005SR-E | - |
| | 10 m | R88A-CAKG010SR-E | - |
| | 15 m | R88A-CAKG015SR-E | - |
| | 20 m | R88A-CAKG020SR-E | - |

(1)Note: For the separate brake cable selection, see brake cables table in page 2-17

## Brake Cables (European Flexible Cables)

| Specifications | | Model |
|---|---|---|
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W | 1.5 m | R88A-CAKA001-5BR-E |
| | 3 m | R88A-CAKA003BR-E |
| | 5 m | R88A-CAKA005BR-E |
| | 10 m | R88A-CAKA010BR-E |
| | 15 m | R88A-CAKA015BR-E |
| | 20 m | R88A-CAKA020BR-E |
| [400 V]<br>For 1,500-r/min motors of 7.5 kW to 15 kW<br>For 1,000-r/min motors of 6 kW | 1.5 m | R88A-CAGE001-5BR-E |
| | 3 m | R88A-CAGE003BR-E |
| | 5 m | R88A-CAGE005BR-E |
| | 10 m | R88A-CAGE010BR-E |
| | 15 m | R88A-CAGE015BR-E |
| | 20 m | R88A-CAGE020BR-E |

## Encoder Cables (Japanese Non-Flexible Cables)

| Specifications | | Model |
|---|---|---|
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W<br>(for both absolute encoders and incremental encoders) | 3 m | R88A-CRKA003C |
| | 5 m | R88A-CRKA005C |
| | 10 m | R88A-CRKA010C |
| | 15 m | R88A-CRKA015C |
| | 20 m | R88A-CRKA020C |
| | 30 m | R88A-CRKA030C |
| | 40 m | R88A-CRKA040C |
| | 50 m | R88A-CRKA050C |
| [100 V and 200 V]<br>3,000-r/min motors of 1.0 kW or more<br>For 2,000-r/min motors<br>For 1,500-r/min motors<br>For 1,000-r/min motors<br>(for both absolute encoders and incremental encoders)<br>[400 V]<br>For 3,000-r/min motors<br>For 2,000-r/min motors<br>For 1,500-r/min motors<br>For 1,000-r/min motors<br>(for both absolute encoders and incremental encoders) | 3 m | R88A-CRKC003N |
| | 5 m | R88A-CRKC005N |
| | 10 m | R88A-CRKC010N |
| | 15 m | R88A-CRKC015N |
| | 20 m | R88A-CRKC020N |
| | 30 m | R88A-CRKC030N |
| | 40 m | R88A-CRKC040N |
| | 50 m | R88A-CRKC050N |

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**Standard Models and External Dimensions**

## Motor Power Cables (Japanese Non-Flexible Cables)

| Specifications | | Model | |
|---|---|---|---|
| | | **For motor without brake** | **For motor with brake** |
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W | 3 m | R88A-CAKA003S | It requires both, the power cable R88A-CAKAxxxS and the separate brake cable R88A-CAKAxxxB (1) |
| | 5 m | R88A-CAKA005S | |
| | 10 m | R88A-CAKA010S | |
| | 15 m | R88A-CAKA015S | |
| | 20 m | R88A-CAKA020S | |
| | 30 m | R88A-CAKA030S | |
| | 40 m | R88A-CAKA040S | |
| | 50 m | R88A-CAKA050S | |
| [200 V]<br>For 3,000-r/min motors of 1 to 2 kW<br>For 2,000-r/min motors of 1 to 2 kW<br>For 1,000-r/min motors of 900 W | 3 m | R88A-CAGB003S | R88A-CAGB003B |
| | 5 m | R88A-CAGB005S | R88A-CAGB005B |
| | 10 m | R88A-CAGB010S | R88A-CAGB010B |
| | 15 m | R88A-CAGB015S | R88A-CAGB015B |
| | 20 m | R88A-CAGB020S | R88A-CAGB020B |
| | 30 m | R88A-CAGB030S | R88A-CAGB030B |
| | 40 m | R88A-CAGB040S | R88A-CAGB040B |
| | 50 m | R88A-CAGB050S | R88A-CAGB050B |
| [400 V]<br>For 3,000-r/min motors of 750 W to 2 kW<br>For 2,000-r/min motors of 400 W to 2 kW<br>For 1,000-r/min motors of 900 W | 3 m | R88A-CAGB003S | R88A-CAKF003B |
| | 5 m | R88A-CAGB005S | R88A-CAKF005B |
| | 10 m | R88A-CAGB010S | R88A-CAKF010B |
| | 15 m | R88A-CAGB015S | R88A-CAKF015B |
| | 20 m | R88A-CAGB020S | R88A-CAKF020B |
| | 30 m | R88A-CAGB030S | R88A-CAKF030B |
| | 40 m | R88A-CAGB040S | R88A-CAKF040B |
| | 50 m | R88A-CAGB050S | R88A-CAKF050B |
| [400 V]<br>For 3,000-r/min motors of 3 to 5 kW<br>For 2,000-r/min motors of 3 to 5 kW<br>For 1,000-r/min motors of 2 to 3 kW | 3 m | R88A-CAGD003S | R88A-CAGD003B |
| | 5 m | R88A-CAGD005S | R88A-CAGD005B |
| | 10 m | R88A-CAGD010S | R88A-CAGD010B |
| | 15 m | R88A-CAGD015S | R88A-CAGD015B |
| | 20 m | R88A-CAGD020S | R88A-CAGD020B |
| | 30 m | R88A-CAGD030S | R88A-CAGD030B |
| | 40 m | R88A-CAGD040S | R88A-CAGD040B |
| | 50 m | R88A-CAGD050S | R88A-CAGD050B |
| [400 V]<br>For 2,000-r/min motors of 7.5 kW<br>For 1,000-r/min motors of 6 kW | 3 m | R88A-CAGE003S | - |
| | 5 m | R88A-CAGE005S | - |
| | 10 m | R88A-CAGE010S | - |
| | 15 m | R88A-CAGE015S | - |
| | 20 m | R88A-CAGE020S | - |
| | 30 m | R88A-CAGE030S | - |
| | 40 m | R88A-CAGE040S | - |
| | 50 m | R88A-CAGE050S | - |

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**Standard Models and External Dimensions**

(1)Note: For the separate brake cable selection, see brake cables table in page 2-16

## Brake Cables (Japanese Non-Flexible Cables)

| Specifications | | Model |
|---|---|---|
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W | 3 m | R88A-CAKA003B |
| | 5 m | R88A-CAKA005B |
| | 10 m | R88A-CAKA010B |
| | 15 m | R88A-CAKA015B |
| | 20 m | R88A-CAKA020B |
| | 30 m | R88A-CAKA030B |
| | 40 m | R88A-CAKA040B |
| | 50 m | R88A-CAKA050B |
| For 2,000-r/min motors of 7.5 to 15 kW<br>For 1,000-r/min motors of 6 kW | 3 m | R88A-CAGE003B |
| | 5 m | R88A-CAGE005B |
| | 10 m | R88A-CAGE010B |
| | 15 m | R88A-CAGE015B |
| | 20 m | R88A-CAGE020B |
| | 30 m | R88A-CAGE030B |
| | 40 m | R88A-CAGE040B |
| | 50 m | R88A-CAGE050B |

## Encoder Cables (Japanese Flexible Cables)

| Specifications | | Model |
|---|---|---|
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W<br>(for both absolute encoders and incremental encoders) | 3 m | R88A-CRKA003CR |
| | 5 m | R88A-CRKA005CR |
| | 10 m | R88A-CRKA010CR |
| | 15 m | R88A-CRKA015CR |
| | 20 m | R88A-CRKA020CR |
| | 30 m | R88A-CRKA030CR |
| | 40 m | R88A-CRKA040CR |
| | 50 m | R88A-CRKA050CR |
| [100 V and 200 V]<br>3,000-r/min motors of 1.0 kW or more<br>For 2,000-r/min motors<br>For 1,500-r/min motors<br>For 1,000-r/min motors<br>(for both absolute encoders and incremental encoders)<br>[400 V]<br>For 3,000-r/min motors<br>For 2,000-r/min motors<br>For 1,500-r/min motors<br>For 1,000-r/min motors<br>(for both absolute encoders and incremental encoders) | 3 m | R88A-CRKC003NR |
| | 5 m | R88A-CRKC005NR |
| | 10 m | R88A-CRKC010NR |
| | 15 m | R88A-CRKC015NR |
| | 20 m | R88A-CRKC020NR |
| | 30 m | R88A-CRKC030NR |
| | 40 m | R88A-CRKC040NR |
| | 50 m | R88A-CRKC050NR |

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**Standard Models and External Dimensions**

## Motor Power Cables (Japanese Flexible Cables)

| Specifications | | Model | |
|---|---|---|---|
| | | **For motor without brake** | **For motor with brake** |
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W | 3 m | R88A-CAKA003SR | It requires both, the power cable R88A-CAKAxxxSR and the separate brake cable R88A-CAKAxxxBR [1] |
| | 5 m | R88A-CAKA005SR | |
| | 10 m | R88A-CAKA010SR | |
| | 15 m | R88A-CAKA015SR | |
| | 20 m | R88A-CAKA020SR | |
| | 30 m | R88A-CAKA030SR | |
| | 40 m | R88A-CAKA040SR | |
| | 50 m | R88A-CAKA050SR | |
| [200 V]<br>For 3,000-r/min motors of 1 to 2 kW<br>For 2,000-r/min motors of 1 to 2 kW<br>For 1,000-r/min motors of 900 W | 3 m | R88A-CAGB003SR | R88A-CAGB003BR |
| | 5 m | R88A-CAGB005SR | R88A-CAGB005BR |
| | 10 m | R88A-CAGB010SR | R88A-CAGB010BR |
| | 15 m | R88A-CAGB015SR | R88A-CAGB015BR |
| | 20 m | R88A-CAGB020SR | R88A-CAGB020BR |
| | 30 m | R88A-CAGB030SR | R88A-CAGB030BR |
| | 40 m | R88A-CAGB040SR | R88A-CAGB040BR |
| | 50 m | R88A-CAGB050SR | R88A-CAGB050BR |
| [400 V]<br>For 3,000-r/min motors of 750 W to 2 kW<br>For 2,000-r/min motors of 400 W to 2 kW<br>For 1,000-r/min motors of 900 W | 3 m | R88A-CAGB003SR | R88A-CAKF003BR |
| | 5 m | R88A-CAGB005SR | R88A-CAKF005BR |
| | 10 m | R88A-CAGB010SR | R88A-CAKF010BR |
| | 15 m | R88A-CAGB015SR | R88A-CAKF015BR |
| | 20 m | R88A-CAGB020SR | R88A-CAKF020BR |
| | 30 m | R88A-CAGB030SR | R88A-CAKF030BR |
| | 40 m | R88A-CAGB040SR | R88A-CAKF040BR |
| | 50 m | R88A-CAGB050SR | R88A-CAKF050BR |
| [400 V]<br>For 3,000-r/min motors of 3 to 5 kW<br>For 2,000-r/min motors of 3 to 5 kW<br>For 1,000-r/min motors of 2 to 3 kW | 3 m | R88A-CAGD003SR | R88A-CAGD003BR |
| | 5 m | R88A-CAGD005SR | R88A-CAGD005BR |
| | 10 m | R88A-CAGD010SR | R88A-CAGD010BR |
| | 15 m | R88A-CAGD015SR | R88A-CAGD015BR |
| | 20 m | R88A-CAGD020SR | R88A-CAGD020BR |
| | 30 m | R88A-CAGD030SR | R88A-CAGD030BR |
| | 40 m | R88A-CAGD040SR | R88A-CAGD040BR |
| | 50 m | R88A-CAGD050SR | R88A-CAGD050BR |

[1]Note: For the separate brake cable selection, see brake cables table in page 2-18

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## Brake Cables (Japanese Flexible Cables)

| Specifications | | Model |
|---|---|---|
| [100 V and 200 V]<br>For 3,000-r/min motors of 50 to 750 W | 3 m | R88A-CAKA003BR |
| | 5 m | R88A-CAKA005BR |
| | 10 m | R88A-CAKA010BR |
| | 15 m | R88A-CAKA015BR |
| | 20 m | R88A-CAKA020BR |
| | 30 m | R88A-CAKA030BR |
| | 40 m | R88A-CAKA040BR |
| | 50 m | R88A-CAKA050BR |

## 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 |

## Analog Monitor Cable

| Specifications | | Model |
|---|---|---|
| Analog monitor cable | 1 m | R88A-CMK001S |

## Absolute Encoder Backup Battery

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

**Standard Models and External Dimensions**

**2**

## Connectors

| Specifications | | Model |
|---|---|---|
| Motor connector for encoder cable | [100 V and 200 V]<br>For 3,000-r/min of 50 to 750 W | R88A-CNK02R |
| | [100 V and 200 V]<br>For 3,000-r/min of 1 to 5 kW<br>For 2,000 r/min, 1,000 r/min<br>[400 V]<br>For 3,000 r/min, 2,000 r/min and<br>1,000 r/min | R88A-CNK04R |
| Control I/O connector (CN1) | | R88A-CNU11C |
| 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 |

## Servo Relay Units (for CN1)

| Specifications | | Model |
|---|---|---|
| Servo Relay Unit | For CS1W-NC113/-NC133<br>For CJ1W-NC113/-NC133<br>For C200HW-NC113 | XW2B-20J6-1B |
| | For CS1W-NC213/-NC413/-NC233/-NC433<br>For CJ1W-NC213/-NC413/-NC233/-NC433<br>For C200HW-NC213/-NC413 | XW2B-40J6-2B |
| | For CJ1M-CPU21/-CPU22/-CPU23 | XW2B-20J6-8A<br>XW2B-40J6-9A |
| | For CQM1-CPU43-V1<br>For CQM1H-PLB21 | XW2B-20J6-3B |

## Servo Relay Unit Cables for Servo Drives

| Specifications | | | Model |
|---|---|---|---|
| Servo Drive cables | For CS1W-NC113/-NC133, CJ1W-NC113/-NC133, C200HW-NC113 (XW2B-20J6-1B)<br>For CS1W-NC213/-NC413/-NC233/-NC433, CJ1W-NC213/-NC413/-NC233/-NC433, C200HW-NC213/-NC413 (XW2B-40J6-2B)<br>For CQM1-CPU43-V1 or CQM1H-PLB21 (XW2B-20J6-3B) | 1 m | XW2Z-100J-B25 |
| | | 2 m | XW2Z-200J-B25 |
| | For CJM1-CPU21/-CPU22/-CPU23 (XW2B-20J6-8A/XW2B-40J6-9A) | 1 m | XW2Z-100J-B31 |
| | | 2 m | XW2Z-200J-B31 |

## Servo Relay Unit Cables for Position Control Units

| Specifications | | | Model |
|---|---|---|---|
| Position Control Unit cables | For CQM1H-PLB21 (XW2B-20J6-3B) | 0.5 m | XW2Z-050J-A3 |
| | | 1 m | XW2Z-100J-A3 |
| | For CS1W-NC113, C200HW-NC113 (XW2B-20J6-1B) | 0.5 m | XW2Z-050J-A6 |
| | | 1 m | XW2Z-100J-A6 |
| | For CS1W-NC213/-NC413, C200HW-NC213/-NC413 (XW2B-20J6-2B) | 0.5 m | XW2Z-050J-A7 |
| | | 1 m | XW2Z-100J-A7 |
| | For CS1W-NC133 (XW2B-20J6-1B) | 0.5 m | XW2Z-050J-A10 |
| | | 1 m | XW2Z-100J-A10 |
| | For CS1W-NC233/-NC433 (XW2B-20J6-2B) | 0.5 m | XW2Z-050J-A11 |
| | | 1 m | XW2Z-100J-A11 |
| | For CJ1W-NC113 (XW2B-20J6-1B) | 0.5 m | XW2Z-050J-A14 |
| | | 1 m | XW2Z-100J-A14 |
| | For CJ1W-NC213/-NC413 (XW2B-20J6-2B) | 0.5 m | XW2Z-050J-A15 |
| | | 1 m | XW2Z-100J-A15 |
| | For CJ1W-NC133 (XW2B-20J6-1B) | 0.5 m | XW2Z-050J-A18 |
| | | 1 m | XW2Z-100J-A18 |
| | For CJ1W-NC233/-NC433 (XW2B-20J6-2B) | 0.5 m | XW2Z-050J-A19 |
| | | 1 m | XW2Z-100J-A19 |
| | For CJ1M-CPU21/-CPU22/-CPU23 (XW2B-20J6-8A/XW2B-40J6-9A) | 0.5 m | XW2Z-050J-A33 |
| | | 1 m | XW2Z-100J-A33 |

## Control Cables

| Specifications | | Model |
|---|---|---|
| Specified cables for Position Control Unit (line-driver output for 1 axis) CJ1W-NC234/-NC434 | 1 m | XW2Z-100J-G9 |
| | 5 m | XW2Z-500J-G9 |
| | 10 m | XW2Z-10MJ-G9 |
| Specified cables for Position Control Unit (open collector output for 1 axis) CJ1W-NC214/-NC414 | 1 m | XW2Z-100J-G13 |
| | 3 m | XW2Z-300J-G13 |
| Specified cables for Position Control Unit (line-driver output for 2 axes) CJ1W-NC234/-NC434 | 1 m | XW2Z-100J-G13 |
| | 5 m | XW2Z-500J-G1 |
| | 10 m | XW2Z-10MJ-G1 |
| Specified cables for Position Control Unit (open collector output for 2 axes) CJ1W-NC214/-NC414 | 1 m | XW2Z-100J-G5 |
| | 3 m | XW2Z-300J-G5 |
| Specified cables for Motion Control Unit (for 1 axis) CS1W-MC221-V1/-MC421-V1 | 1 m | R88A-CPG001M1 |
| | 2 m | R88A-CPG002M1 |
| | 3 m | R88A-CPG003M1 |
| | 5 m | R88A-CPG005M1 |
| Specified cables for Motion Control Unit (for 2 axes) CS1W-MC221-V1/-MC421-V1 | 1 m | R88A-CPG001M2 |
| | 2 m | R88A-CPG002M2 |
| | 3 m | R88A-CPG003M2 |
| | 5 m | R88A-CPG005M2 |
| General control cables (with connector on one end) | 1 m | R88A-CPG001S |
| | 2 m | R88A-CPG002S |
| Connector-terminal block cables | 1 m | XW2Z-100J-B24 |
| | 2 m | XW2Z-200J-B24 |
| Connector-terminal block | M3 screw and for pin terminals | XW2B-50G4 |
| | M3.5 screw and for fork/round terminals | XW2B-50G5 |
| | M3 screw and for fork/round terminals | XW2D-50G6 |

## 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 170°C thermal sensor) | R88A-RR22047S |
| Regeneration process capacity: 180 W, 20 Ω (with 200°C thermal sensor) | R88A-RR50020S |

**2**

**Standard Models and External Dimensions**

## Mounting Brackets (L-Brackets for Rack Mounting)

| Specifications | Model |
|---|---|
| R88D-KTA5L/-KT01L/-KT01H/-KT02H | R88A-TK01K |
| R88D-KT02L/-KT04H | R88A-TK02K |
| R88D-KT04L/-KT08H | R88A-TK03K |
| R88D-KT10H/-KT15H/-KT06F/-KT10F/-KT15F | R88A-TK04K |

# 2-4 External and Mounting Dimensions

## Servo Drive Dimensions

**Single-phase 100 VAC: R88D-KTA5L/-KT01L (50 to 100 W)**
**Single-phase/3-phase 200 VAC: R88D-KT01H/-KT02H (100 to 200 W)**

**Wall Mounting**

External dimensions

Mounting dimensions

**2**

**Standard Models and External Dimensions**

**Front Mounting (Using Front Mounting Brackets)**
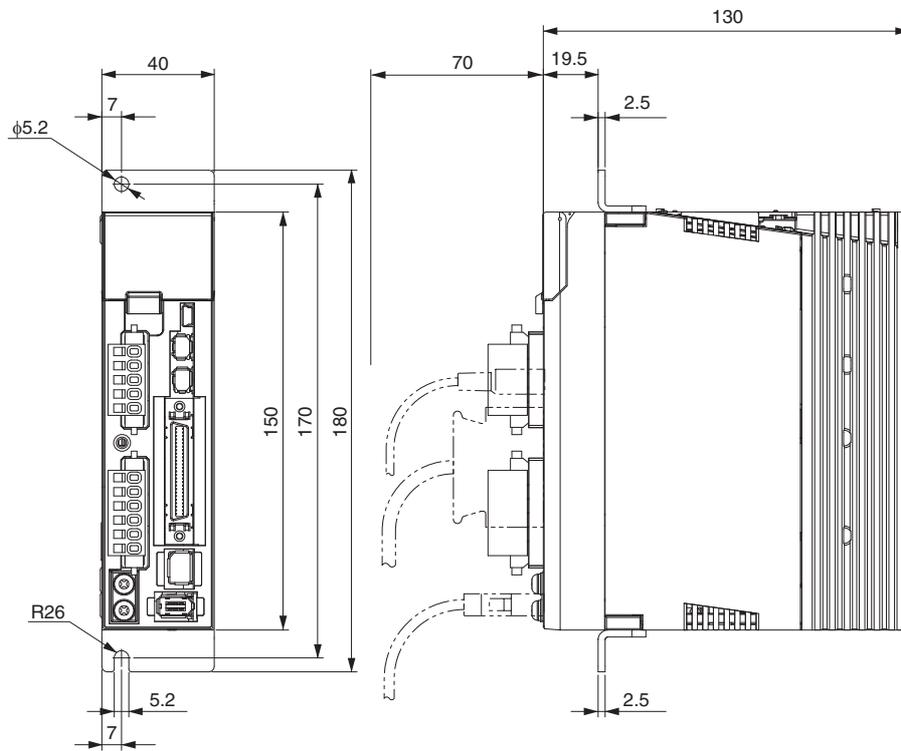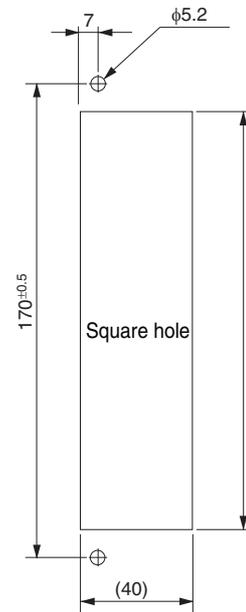
<u>External dimensions</u>                                    <u>Mounting dimensions</u>

**Single-phase/3-phase 100 VAC: R88D-KT02L (200 W)**
**Single-phase/3-phase 200 VAC: R88D-KT04H (400 W)**

### Wall Mounting

External dimensions

Mounting dimensions

### Front Mounting (Using Front Mounting Brackets)
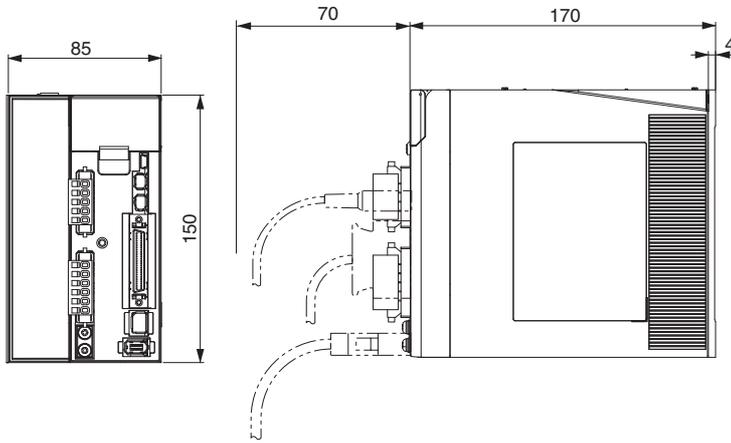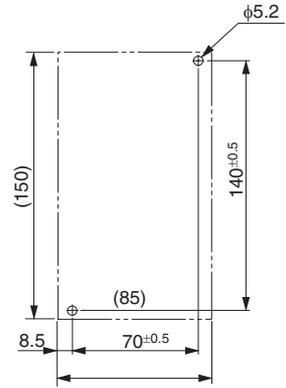
External dimensions

Mounting dimensions

**Standard Models and External Dimensions**

**2**

## Single-phase/3-phase 100 VAC: R88D-KT04L (400 W)
## Single-phase/3-phase 200 VAC: R88D-KT08H (800 W)

### Wall Mounting

External dimensions

Mounting dimensions

### Front Mounting (Using Front Mounting Brackets)

External dimensions

Mounting dimensions

Square hole

**Standard Models and External Dimensions**

**2**
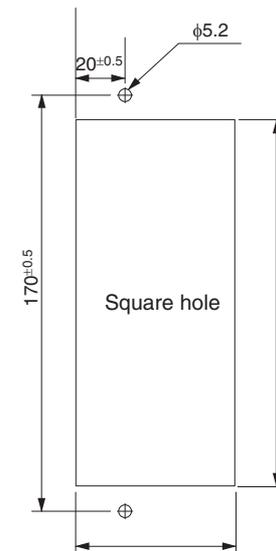
### Single-phase/3-phase 200 VAC: R88D-KT10H/-KT15H (900 W to 1.5 kW)
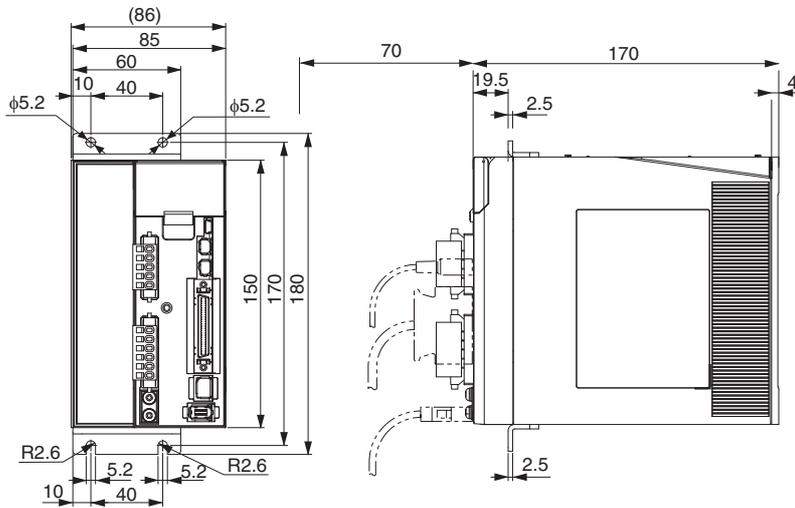
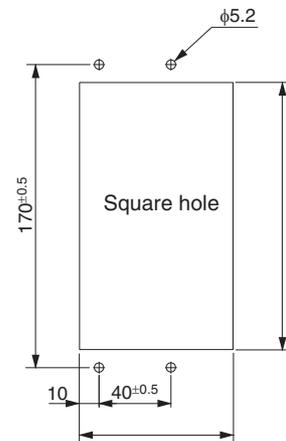#### Wall Mounting

External dimensions

Mounting dimensions



#### Front Mounting (Using Front Mounting Brackets)
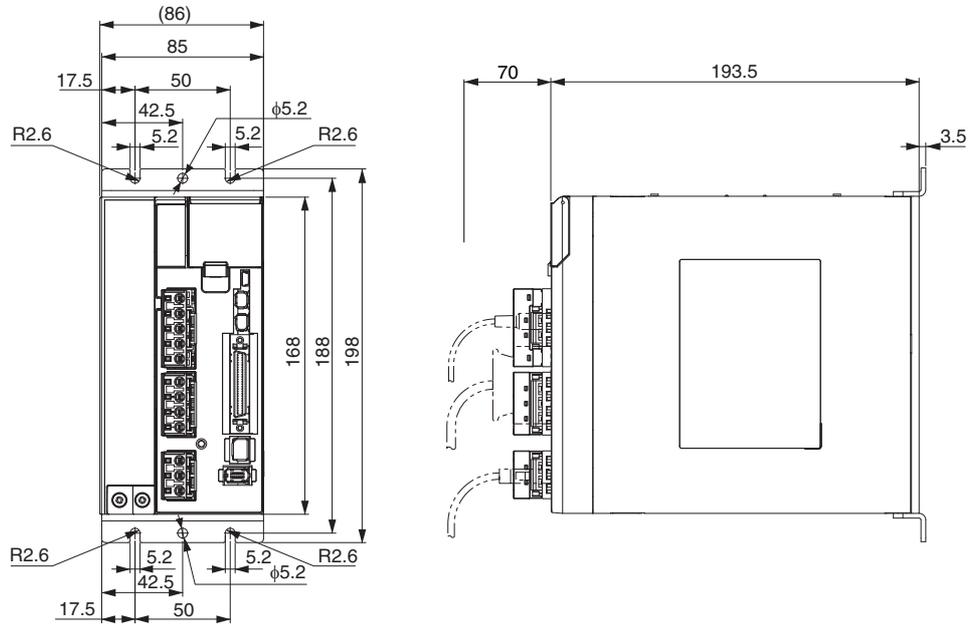
External dimensions

Mounting dimensions



**2**

**Standard Models and External Dimensions**
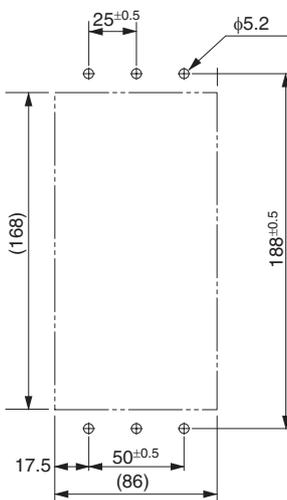
**Standard Models and External Dimensions**

**2**

### 3-phase 200 VAC: R88D-KT20H (2 kW)

**Wall Mounting**

External dimensions

Mounting dimensions

**Front Mounting (Using Front Mounting Brackets)**

External dimensions

**2**

Mounting dimensions

**Standard Models and External Dimensions**

### 3-phase 200 VAC: R88D-KT30H/-KT50H (3 kW to 5 kW)
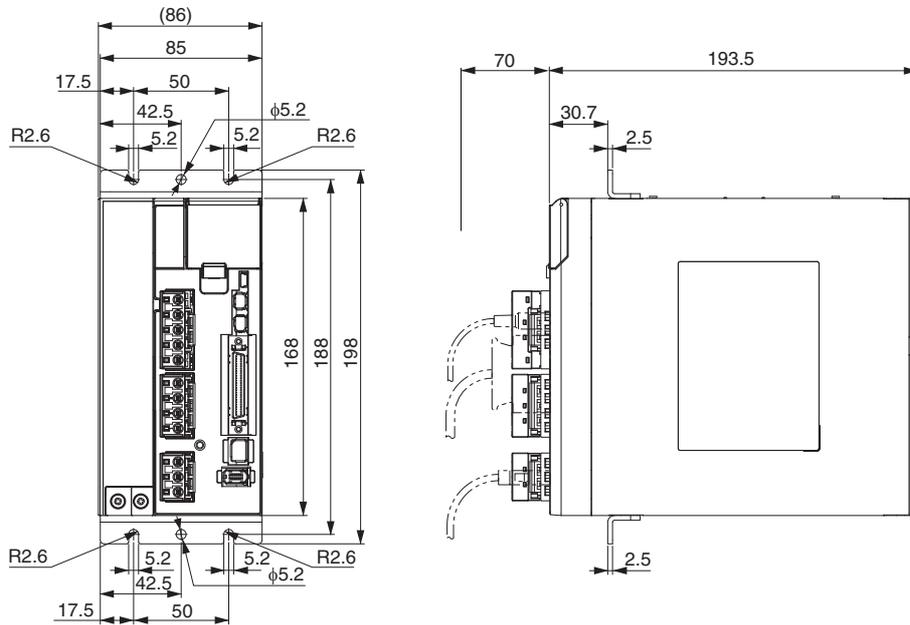
**Wall Mounting**

<u>External dimensions</u>

<u>Mounting dimensions</u>

**Front Mounting (Using Front Mounting Brackets)**

External dimensions

Mounting dimensions

Square hole

**2**

**Standard Models and External Dimensions**
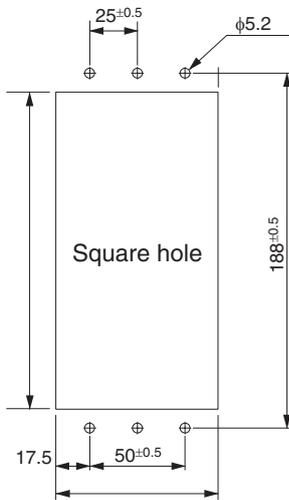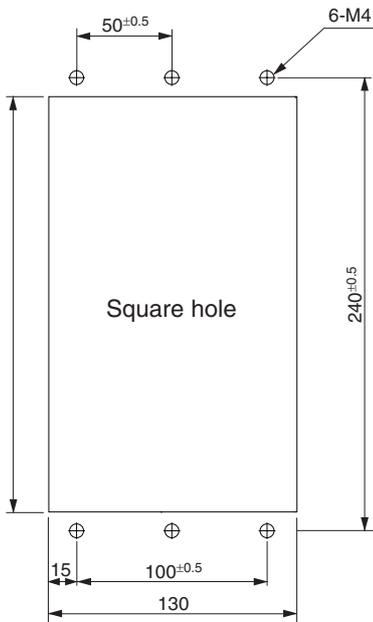
### 3-phase 200 VAC: R88D-KT75H (7.5 kW)

**Wall Mounting**

<u>External dimensions</u>

<u>Mounting dimensions</u>

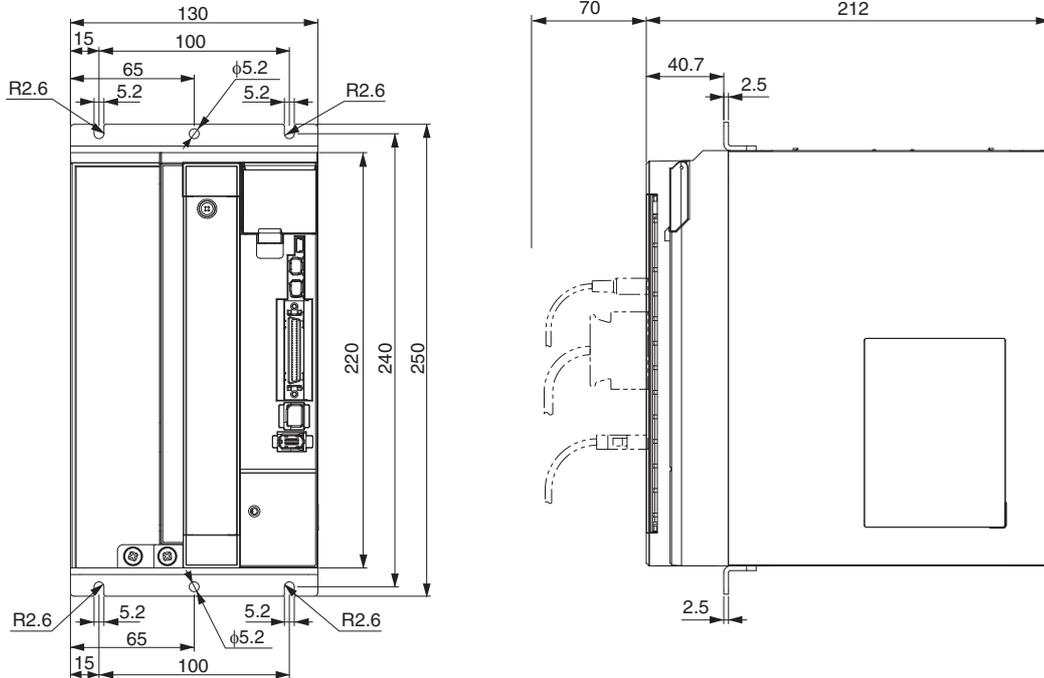## Front Mounting (Using Front Mounting Brackets)

<u>External dimensions</u>

<u>Mounting dimensions</u>

Rectangular hole

10-M4

\* Rectangular hole dimensions are reference values.

**2**

**Standard Models and External Dimensions**

**2**

**Standard Models and External Dimensions**

### 3-phase 200 VAC: R88D-KT150H (15 kW)

**Wall Mounting**

<u>External dimensions</u>

<u>Mounting dimensions</u>

## 3-phase 400 VAC: R88D-KT06F/-KT10F/-KT15F (600 W to 1.5 kW)

### Wall Mounting
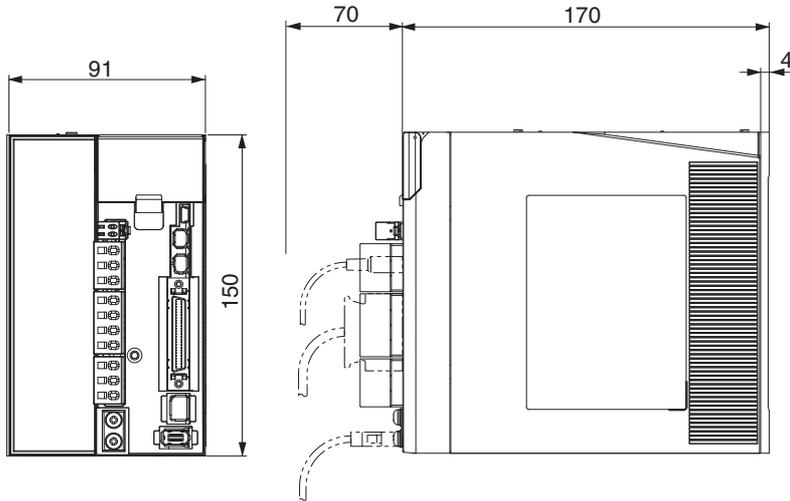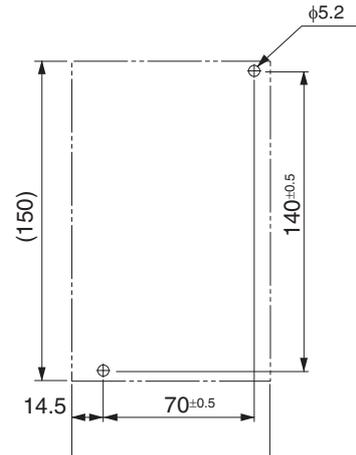
External dimensions

Mounting dimensions



### Front Mounting (Using Front Mounting Brackets)
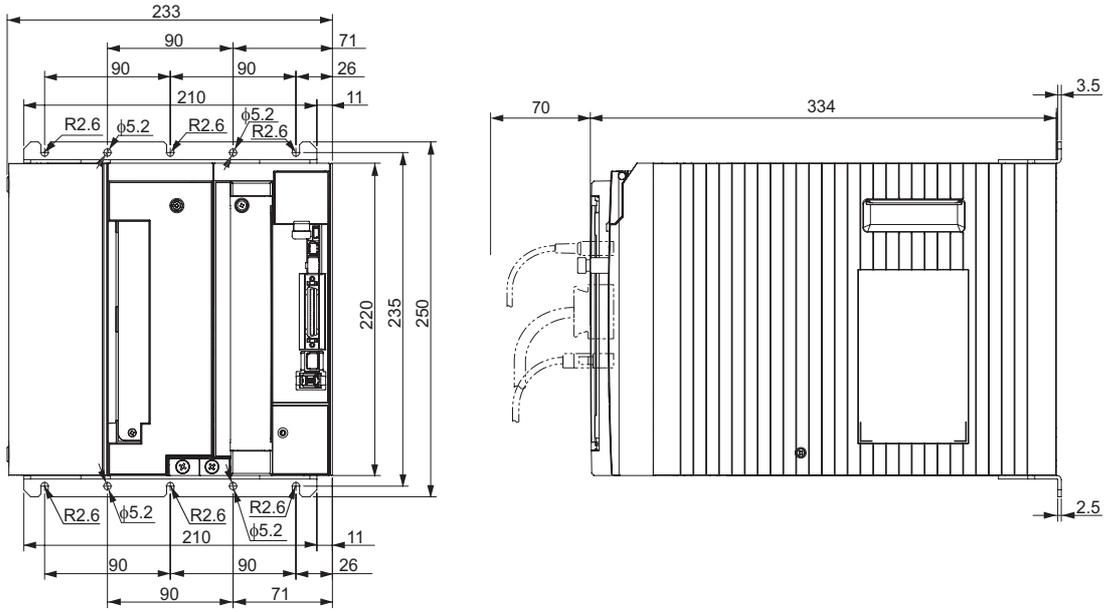
External dimensions

Mounting dimensions
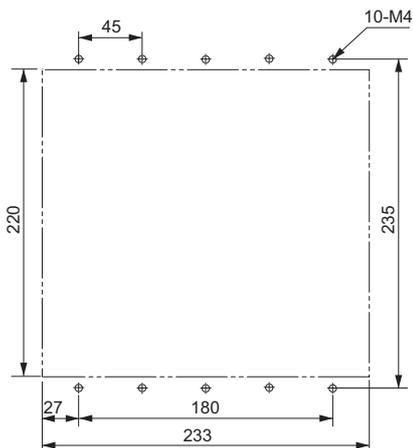
**Standard Models and External Dimensions**

**2**

### 3-phase 400 VAC: R88D-KT20F (2 kW)

#### Wall Mounting

External dimensions
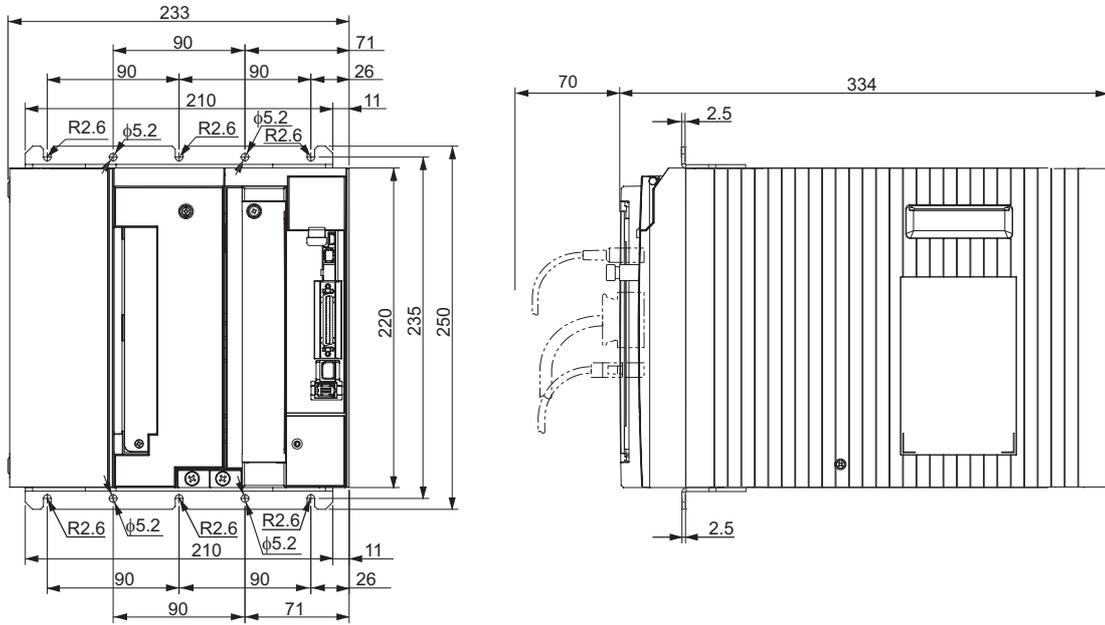
Mounting dimensions



#### Front Mounting (Using Front Mounting Brackets)

External dimensions

Mounting dimensions

**Standard Models and External Dimensions**

**2**
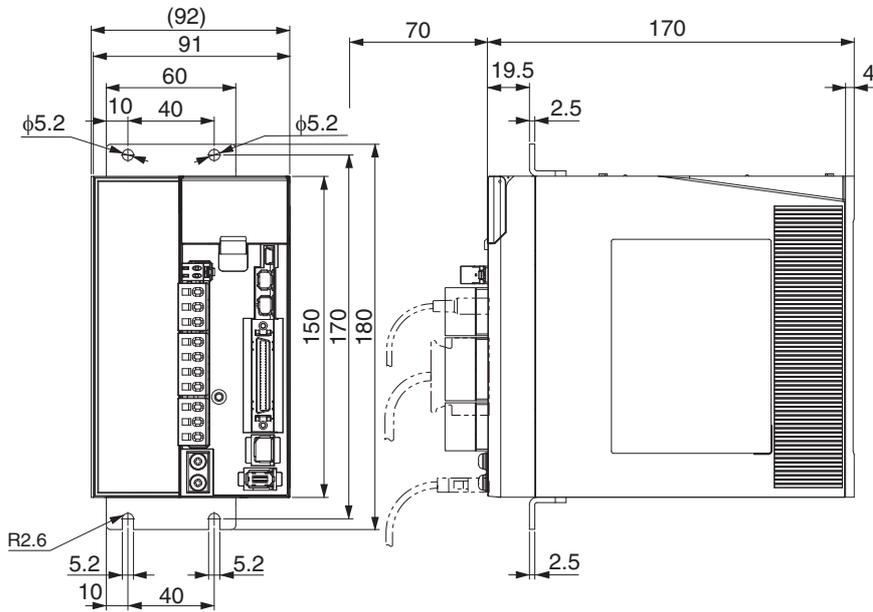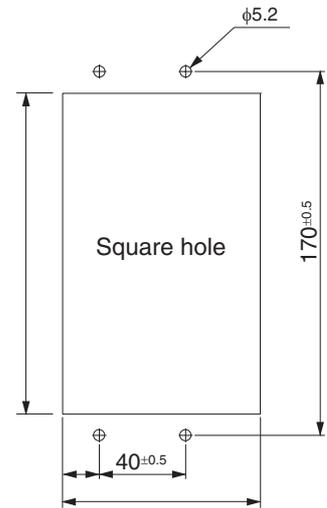
## 3-phase 400 VAC: R88D-KT30F/-KT50F (3 kW to 5 kW)

### Wall Mounting
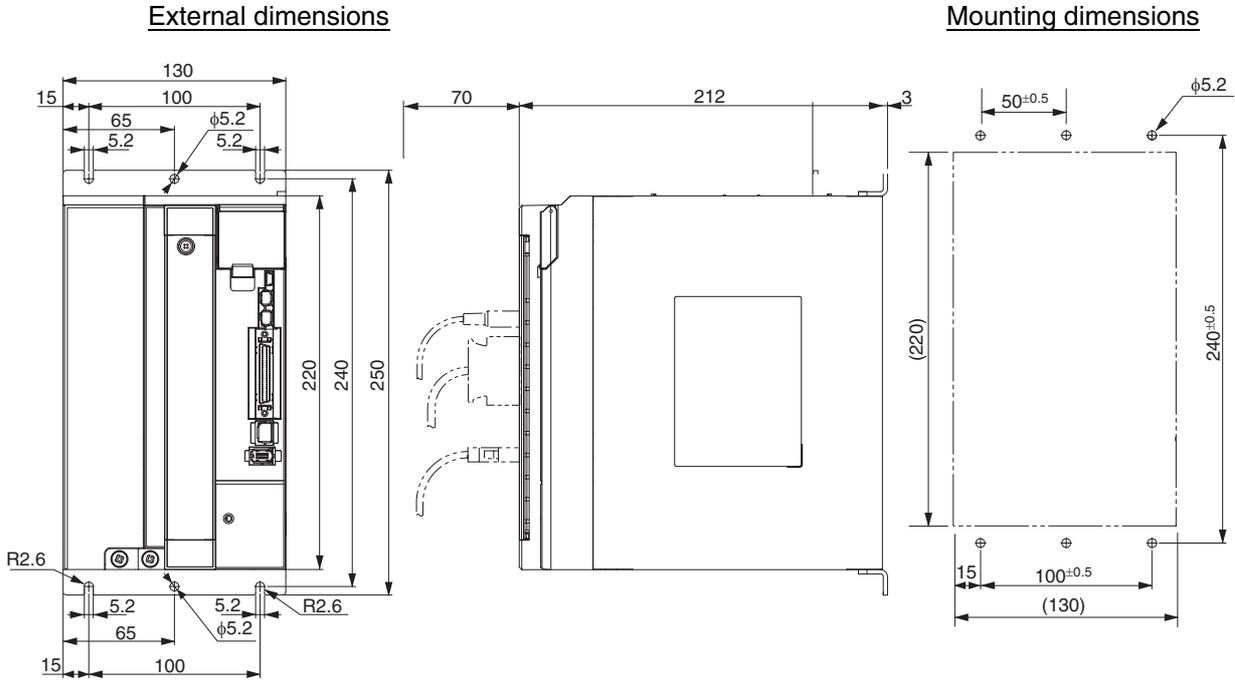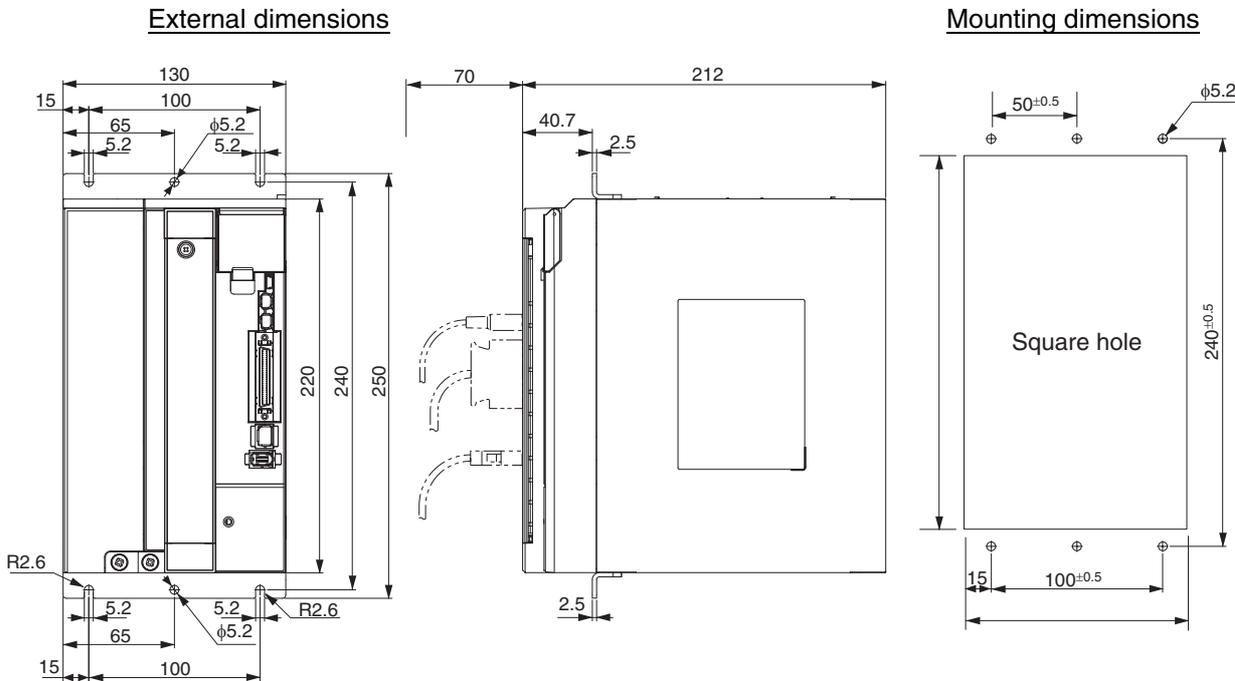
<u>External dimensions</u>

<u>Mounting dimensions</u>

### Front Mounting (Using Front Mounting Brackets)

<u>External dimensions</u>

<u>Mounting dimensions</u>

Square hole

**Standard Models and External Dimensions**

**2**

**2**

**Standard Models and External Dimensions**

### 3-phase 400 VAC: R88D-KT75F (7.5 kW)

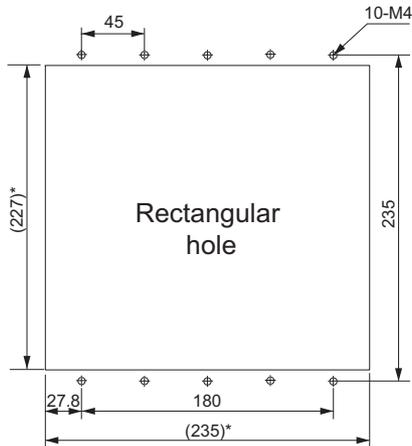**Wall Mounting**

External dimensions



Mounting dimensions

**Front Mounting (Using Front Mounting Brackets)**
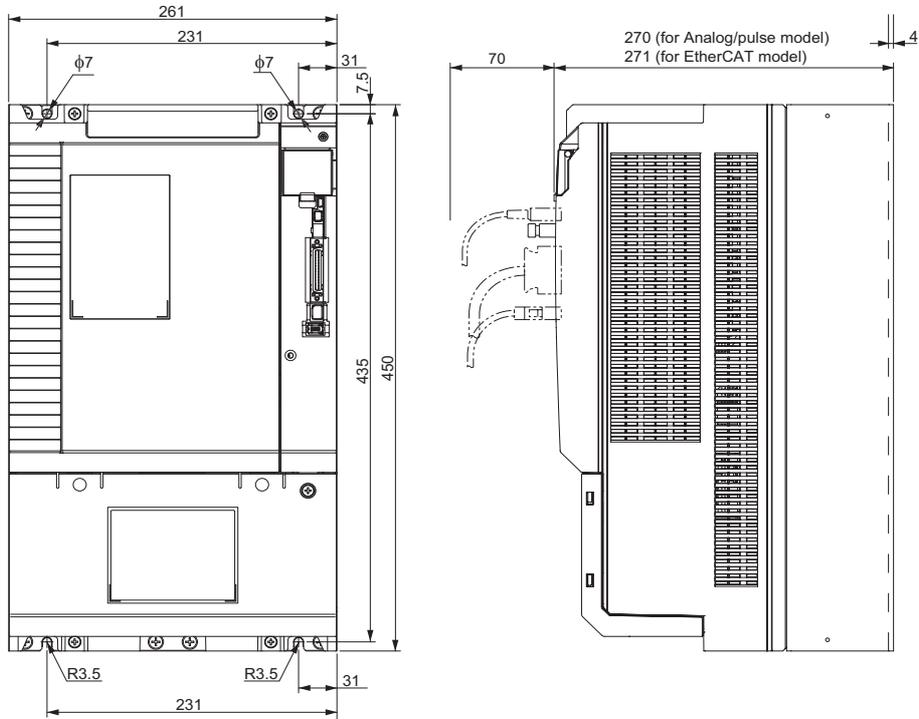
External dimensions

Mounting dimensions

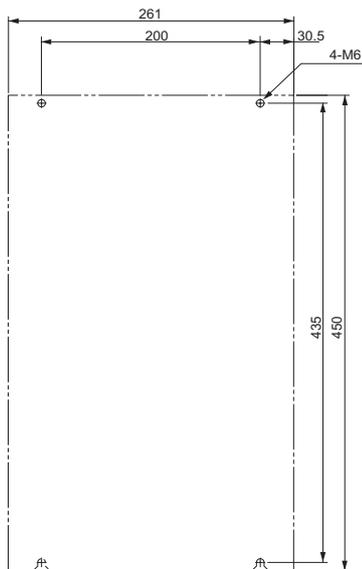* Rectangular hole dimensions are reference values.

**2**

**Standard Models and External Dimensions**
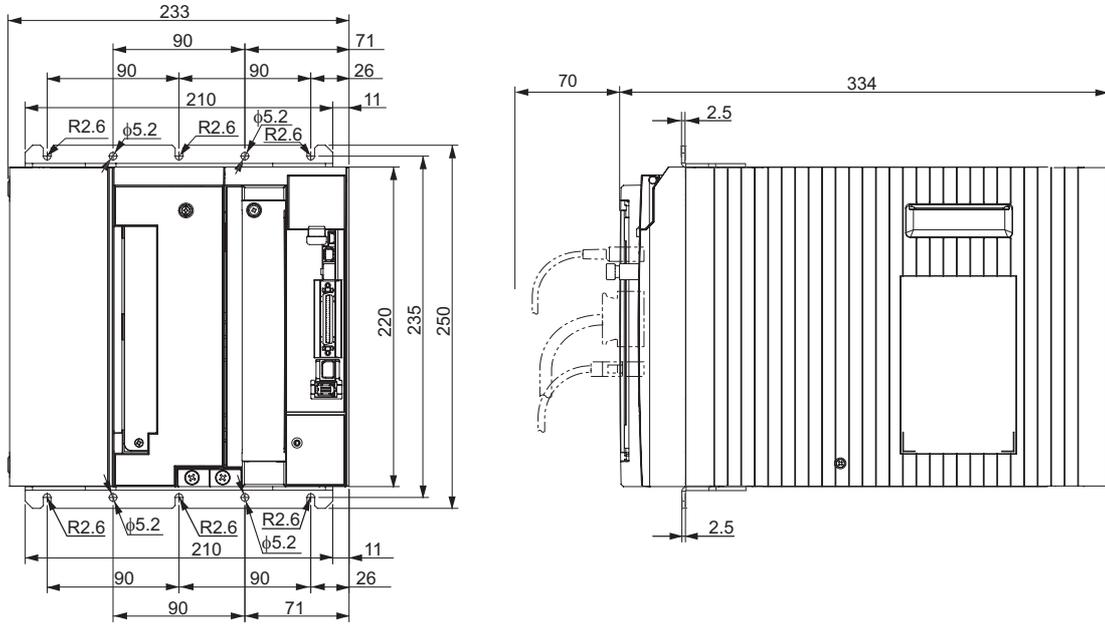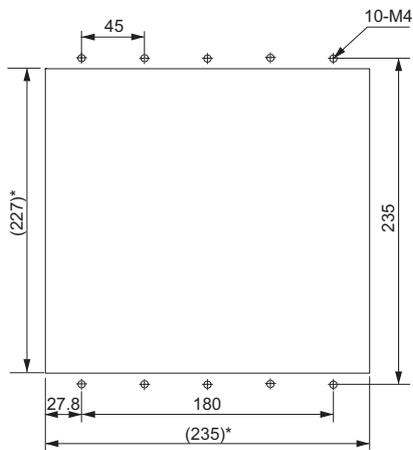
**3-phase 400 VAC: R88D-KT150F (15 kW)**

**Wall Mounting**

External dimensions



Mounting dimensions

Accurax G5 AC SERVOMOTOR AND SERVO DRIVE USER'S MANUAL
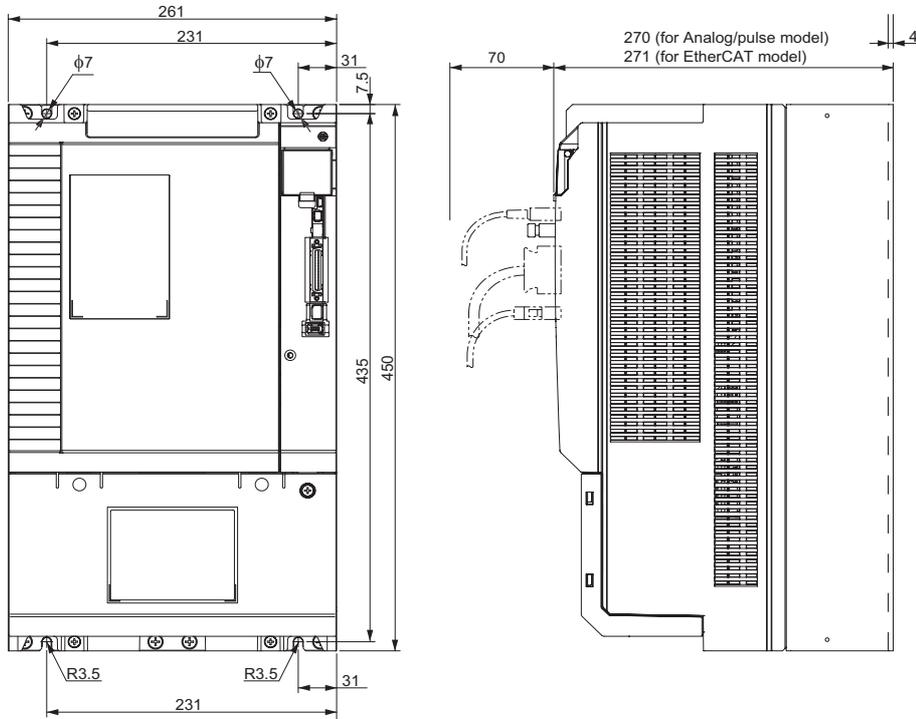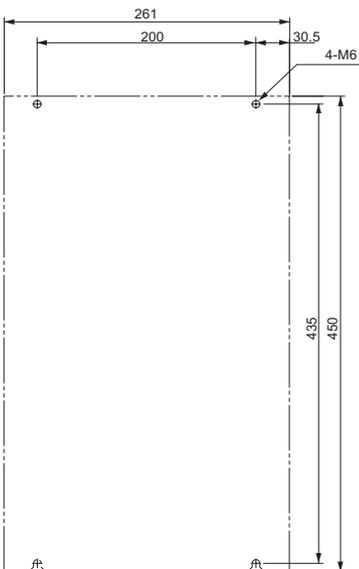
## Servomotor Dimensions

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

#### 50 W/100 W (without Brake)

R88M-K05030x (-S2)/-K10030x (-S2)  **INC**

R88M-K05030x (-S2)/-K10030x (-S2)  **ABS**
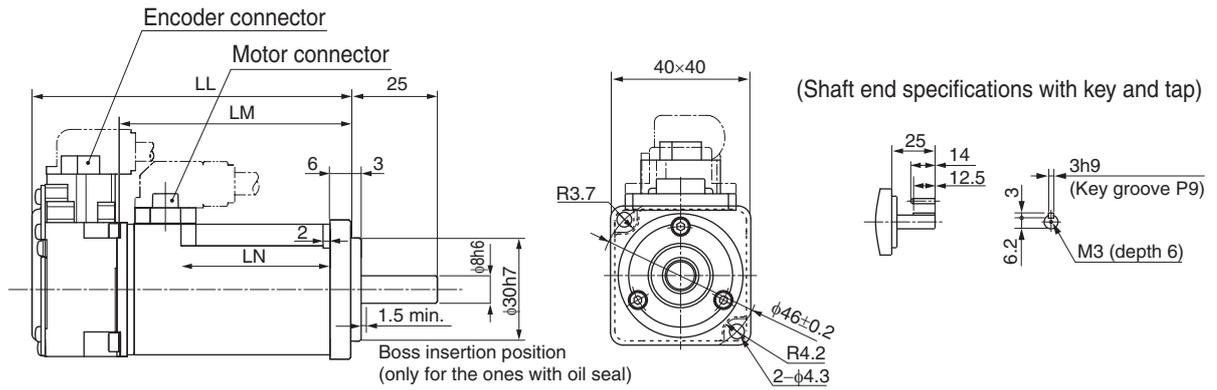


| Model | Dimensions (mm) | | |
|---|---|---|---|
| | LL | LM | LN |
| R88M-K05030x | 72 | 48 | 23 |
| R88M-K10030x | 92 | 68 | 43 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

**2**

### 50 W/100 W (with Brake)

R88M-K05030x-B (S2)/-K10030x-B (S2)    **INC**

R88M-K05030x-B (S2)/-K10030x-B (S2)    **ABS**

Encoder connector
Brake connector
Motor connector

LL
LM
25

6 3

2

LN

φ8h6
φ30h7

1.5 min.
Boss insertion position
(only for the ones with oil seal)

40×40

R3.7

φ46±0.2
R4.2
2−φ4.3

(Shaft end specifications with key and tap)

25
14
12.5

3h9
(Key groove P9)
3

6.2

M3 (depth 6)
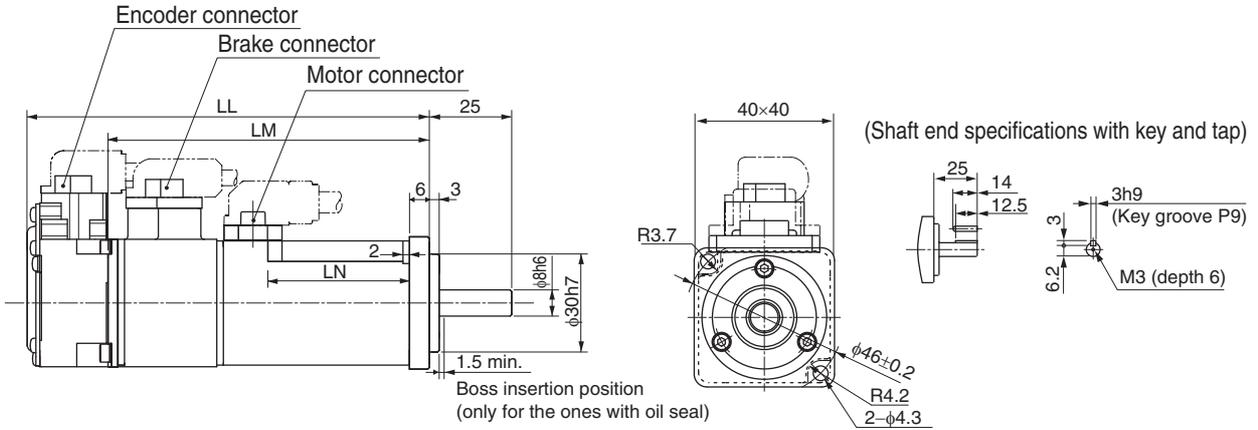
| Model | Dimensions (mm) | | |
|---|---|---|---|
| | LL | LM | LN |
| R88M-K05030x-Bx | 102 | 78 | 23 |
| R88M-K10030x-Bx | 122 | 98 | 43 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

## 200 W/400 W (without Brake)

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

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



(Shaft end specifications with key and tap)

Boss insertion position
(only for the ones with oil seal)
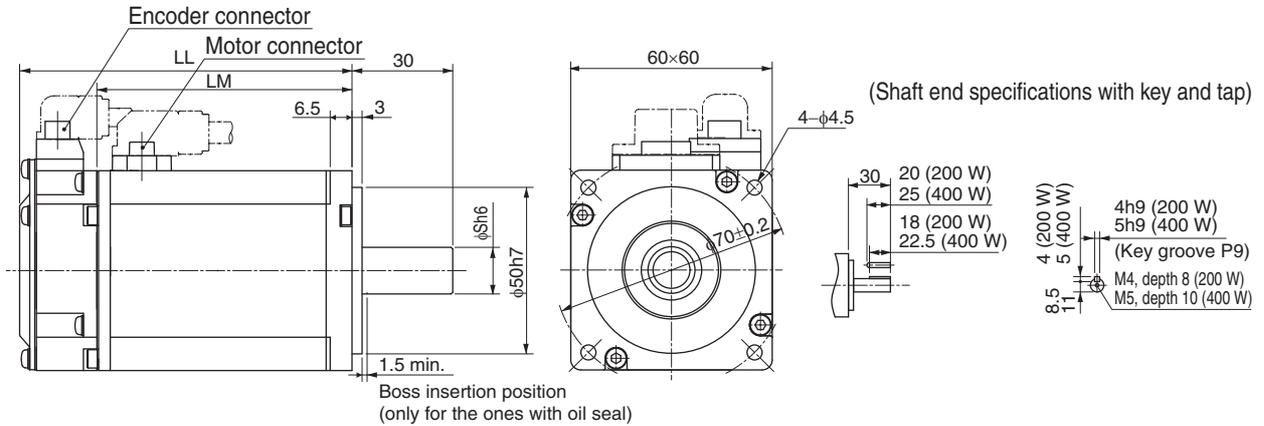
| Model | Dimensions (mm) | | |
|---|---|---|---|
| | LL | LM | S |
| R88M-K20030x | 79.5 | 56.5 | 11 |
| R88M-K40030x | 99 | 76 | 14 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

## 200 W/400 W (with Brake)

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

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



(Shaft end specifications with key and tap)

Boss insertion position
(only for the ones with oil seal)
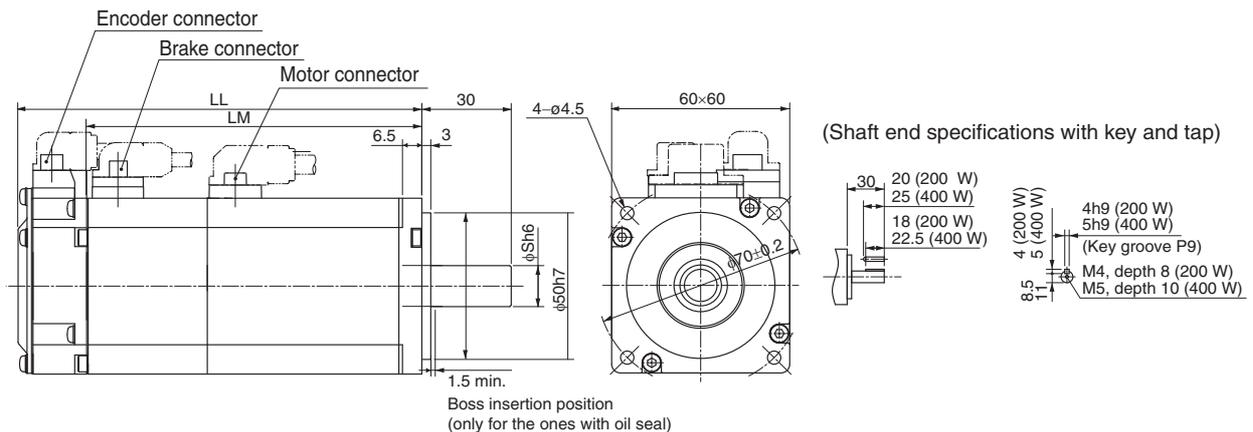
| Model | Dimensions (mm) | | |
|---|---|---|---|
| | LL | LM | S |
| R88M-K20030x-Bx | 116 | 93 | 11 |
| R88M-K40030x-Bx | 135.5 | 112.5 | 14 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**Standard Models and External Dimensions**

**2**

### 750 W (without Brake)

R88M-K75030H (-S2)  `INC`

R88M-K75030T (-S2)  `ABS`

Encoder connector
Motor connector

112.2
86.2
35
8  3
80×80
(Shaft end specifications with key and tap)
4–φ6
φ90±0.2
35
25
22
φ19h6
φ70h7
6
6h9
15.5
M5 (depth 10)
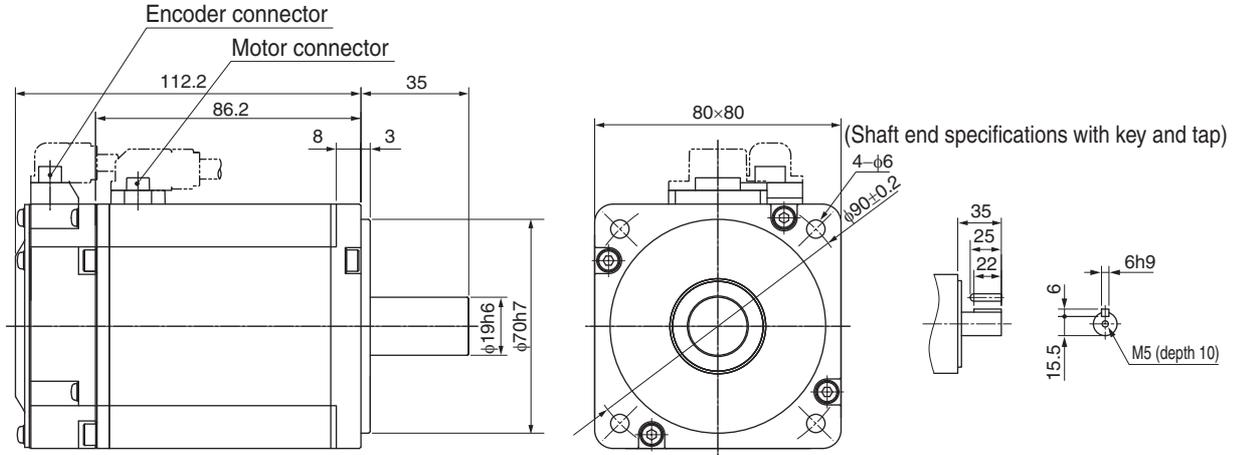
Note. Models with a key and tap are indicated with S2 at the end of the model number.

### 750 W (with Brake)

R88M-K75030H-B (S2)  `INC`

R88M-K75030T-B (S2)  `ABS`
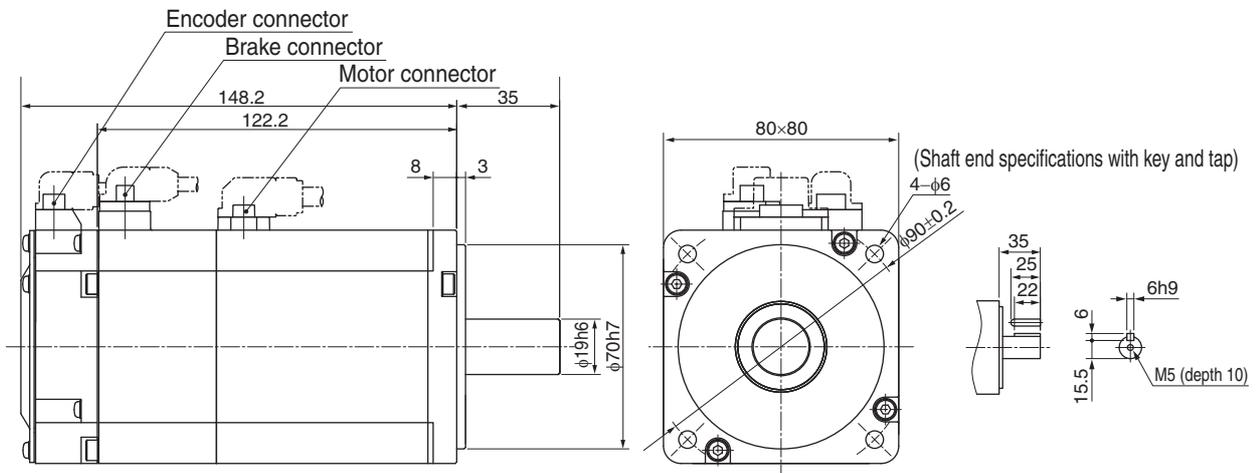
Encoder connector
Brake connector
Motor connector

148.2
122.2
35
8  3
80×80
(Shaft end specifications with key and tap)
4–φ6
φ90±0.2
35
25
22
φ19h6
φ70h7
6
6h9
15.5
M5 (depth 10)

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

### 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**

Motor and brake connector

Encoder connector

LL
LM
KB2
KB1
55
10   3
101
60
$\phi$19h6
$\phi$95h7

100×100
4−$\phi$9
$\phi$135
$\phi$115

(Shaft end specifications with key and tap)

55
45
42
M3, through
$\phi$19h6
$\phi$95h7
15.5
6h9
6
M5 (depth 12)

| 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. Models with a key and tap are indicated with S2 at the end of the model number.

**Standard Models and External Dimensions**

### 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. Models with a key and tap are indicated with S2 at the end of the model number.

**Standard Models and External Dimensions**

**2**

## 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`
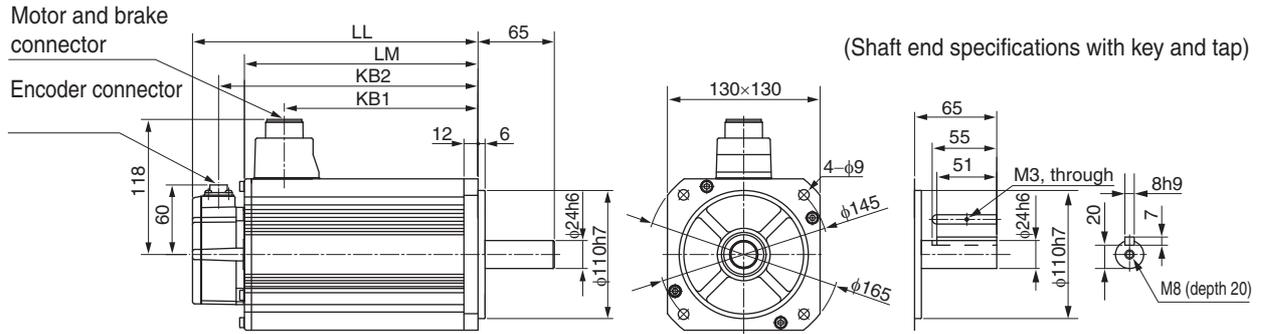


(Shaft end specifications with key and tap)

| 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. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

## 3,000-r/min Motors (400 V)
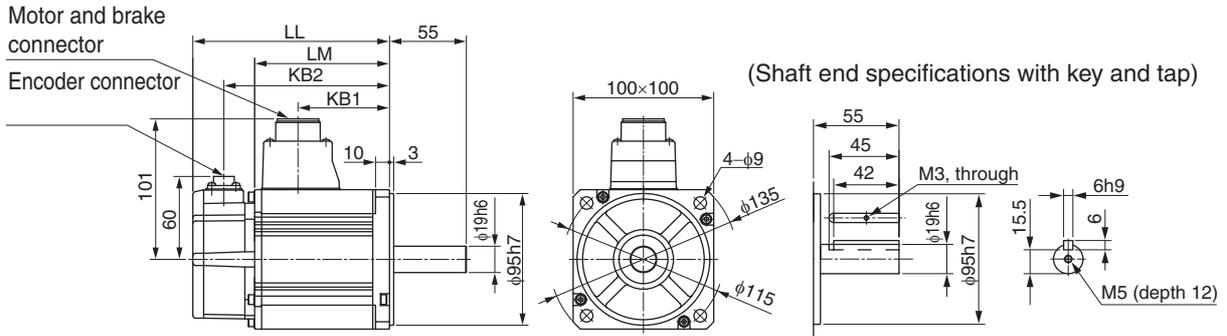
### 750 W/1 kW/1.5 kW/2 kW (without Brake)

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**
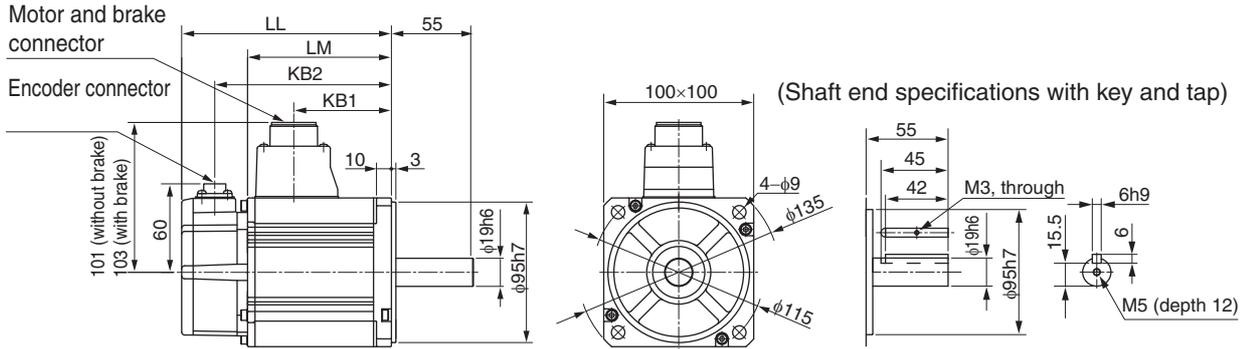


| Model | Dimensions (mm) | | | |
|-------|------|------|------|------|
| | LL | LM | KB1 | KB2 |
| R88M-K75030x | 131.5 | 87.5 | 56.5 | 109.5 |
| R88M-K1K030x | 141 | 97 | 66 | 119 |
| R88M-K1K530x | 159.5 | 115.5 | 84.5 | 137.5 |
| R88M-K2K030x | 178.5 | 134.5 | 103.5 | 156.5 |
| R88M-K75030x-Bx | 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. Models with a key and tap are indicated with S2 at the end of the model number.
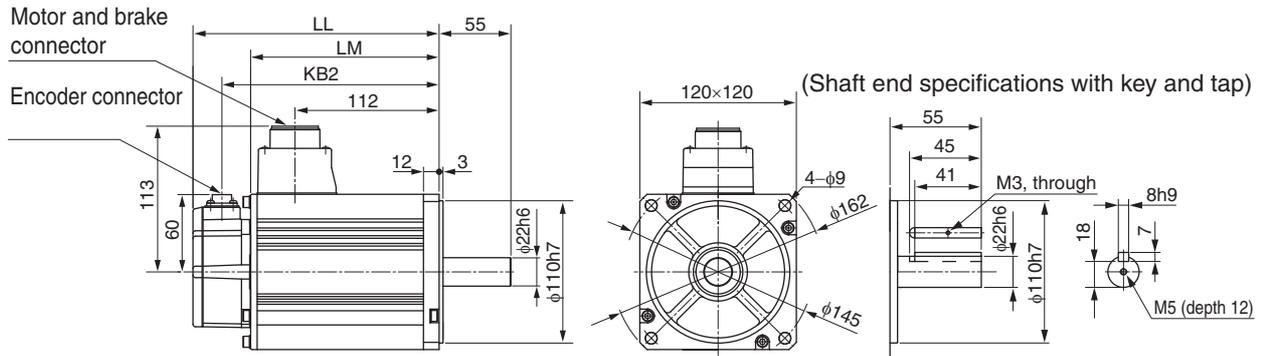
## 3 kW (without Brake)

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

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

## 3 kW (with Brake)

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

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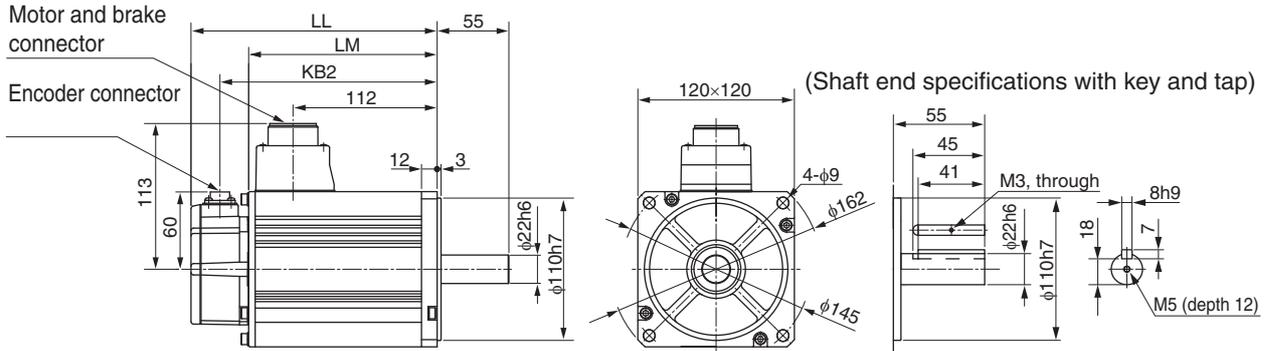


(Shaft end specifications with key and tap)

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

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

## 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**
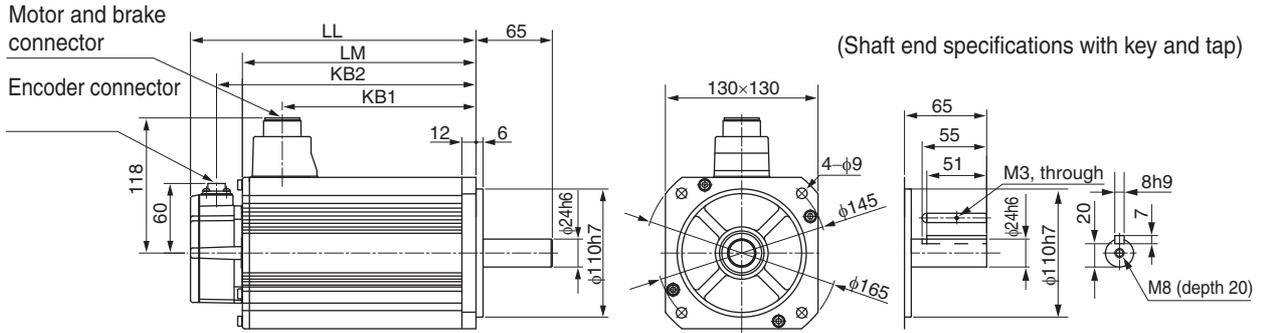


| Model | Dimensions (mm) | | | |
|---|---|---|---|---|
| | LL | LM | KB1 | KB2 |
| R88M-K4K030x | 208 | 164 | 127 | 186 |
| R88M-K5K030x | 243 | 199 | 162 | 221 |
| R88M-K4K030x-Bx | 233 | 189 | 127 | 211 |
| R88M-K5K030x-Bx | 268 | 224 | 162 | 246 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**Standard Models and External Dimensions**

**2**

## 1,500-r/min and 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**
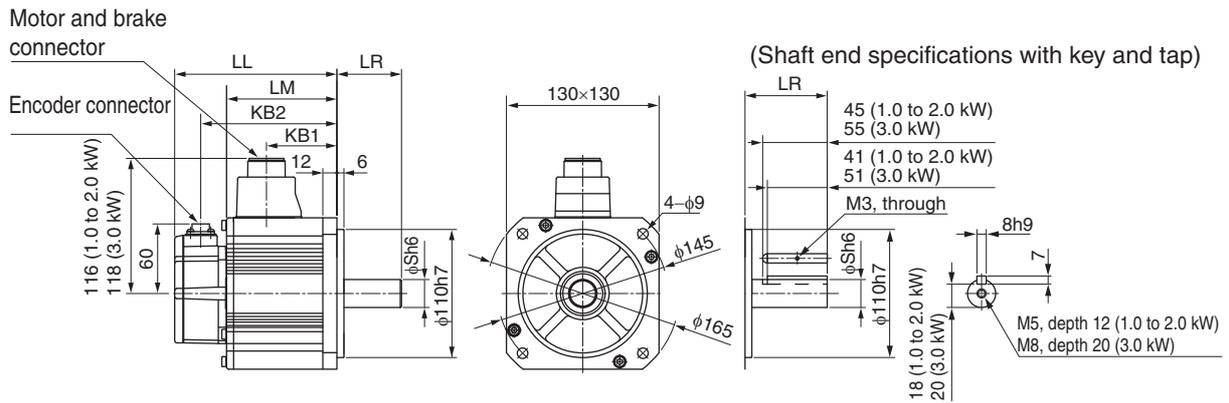
| Model | Dimensions (mm) | | | | | |
|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 |
| R88M-K1K020x | 138 | 55 | 94 | 22 | 60 | 116 |
| R88M-K1K520x | 155.5 | 55 | 111.5 | 22 | 77.5 | 133.5 |
| R88M-K2K020x | 173 | 55 | 129 | 22 | 95 | 151 |
| R88M-K3K020x | 208 | 65 | 164 | 24 | 127 | 186 |
| R88M-K1K020x-Bx | 163 | 55 | 119 | 22 | 60 | 141 |
| R88M-K1K520x-Bx | 180.5 | 55 | 136.5 | 22 | 77.5 | 158.5 |
| R88M-K2K020x-Bx | 198 | 55 | 154 | 22 | 95 | 176 |
| R88M-K3K020x-Bx | 233 | 65 | 189 | 24 | 127 | 211 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

### 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 | 202 | 158 | 96 | 180 |
| R88M-K5K020x-Bx | 221 | 177 | 115 | 199 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

Standard Models and External Dimensions

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### 7.5 kW (without Brake)

R88M-K7K515T (-S2)  **ABS**

### 7.5 kW (with Brake)

R88M-K7K515T-B (S2)  **ABS**
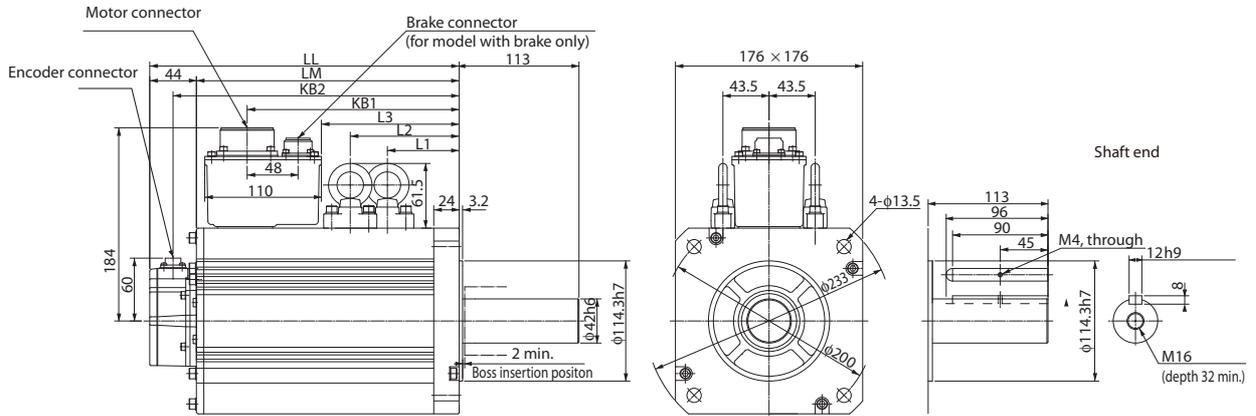
| Model | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 | L3 |
| R88M-K7K515Tx | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K7K515T-Bx | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

### 11 kW/15 kW (without Brake)

R88M-K11K015T (-S2)/-K15K015T (-S2) **ABS**

### 11 kW/15 kW (with Brake)

R88M-K11K015T-B (S2)/-K15K015T-B (S2) **ABS**
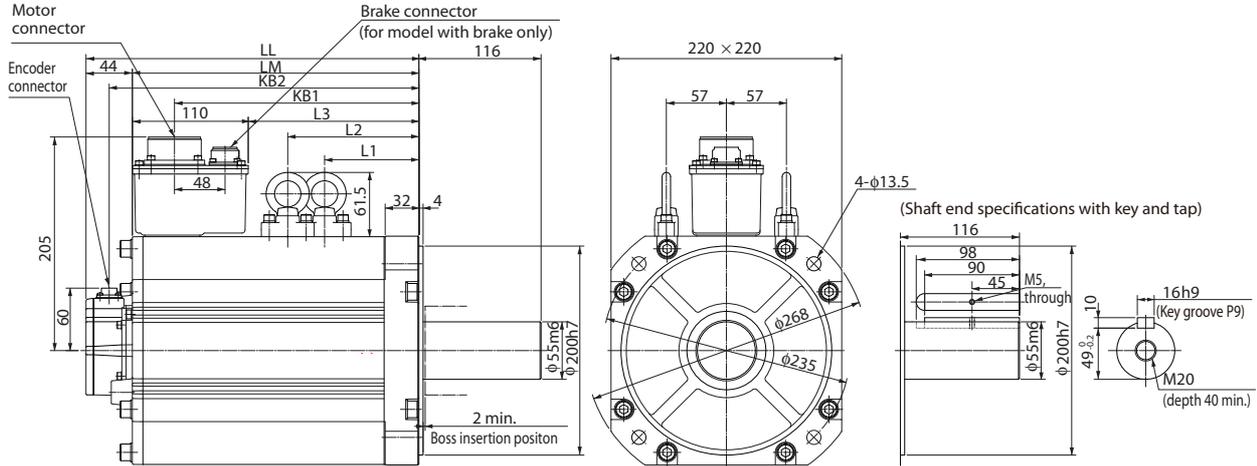


| Model | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 | L3 |
| R88M-K11K015Tx | 316 | 116 | 272 | 55 | 232 | 294 | 124.5 | 124.5 | 162 |
| R88M-K15K015Tx | 384 | 116 | 340 | 55 | 300 | 362 | 158.5 | 158.5 | 230 |
| R88M-K11K015T-Bx | 364 | 116 | 320 | 55 | 266 | 342 | 124.5 | 159.5 | 196 |
| R88M-K15K015T-Bx | 432 | 116 | 388 | 55 | 334 | 410 | 158.5 | 193.5 | 264 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

## 1,500-r/min and 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
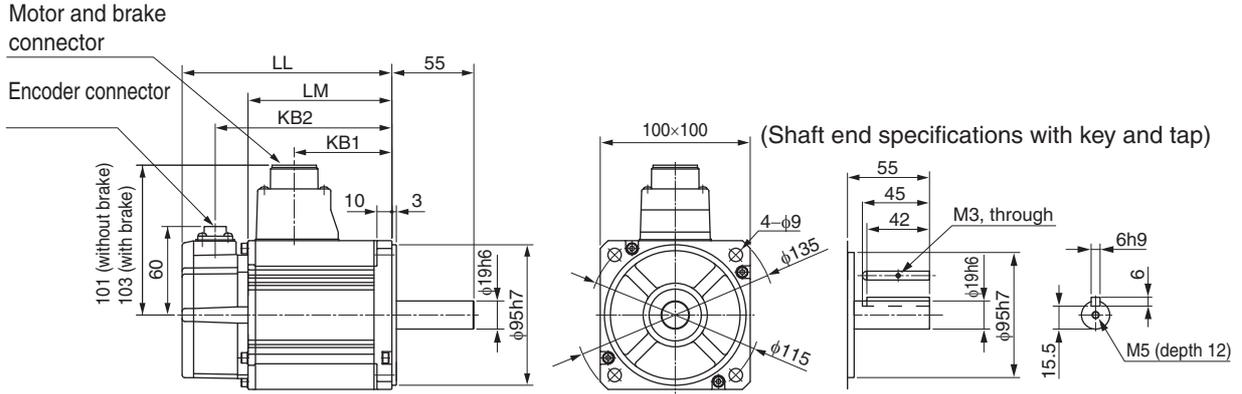


| Model | Dimensions (mm) | | | |
|---|---|---|---|---|
| | LL | LM | KB1 | KB2 |
| R88M-K40020x | 131.5 | 87.5 | 56.5 | 109.5 |
| R88M-K60020x | 141 | 97 | 66 | 119 |
| R88M-K40020x-Bx | 158.5 | 114.5 | 53.5 | 136.5 |
| R88M-K60020x-Bx | 168 | 124 | 63 | 146 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

### 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`
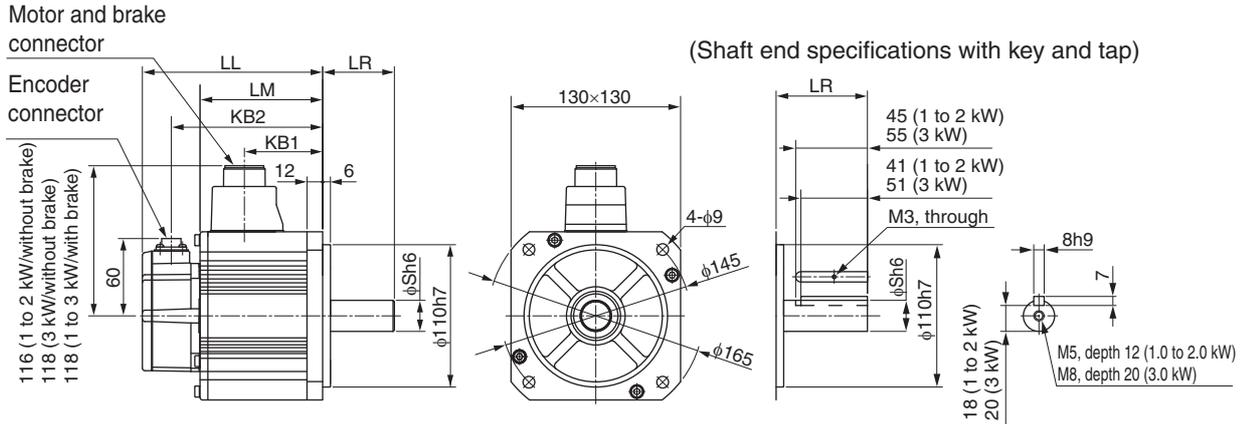


| Model | Dimensions (mm) | | | | | |
|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 |
| R88M-K1K020x | 138 | 55 | 94 | 22 | 60 | 116 |
| R88M-K1K520x | 155.5 | 55 | 111.5 | 22 | 77.5 | 133.5 |
| R88M-K2K020x | 173 | 55 | 129 | 22 | 95 | 151 |
| R88M-K3K020x | 208 | 65 | 164 | 24 | 127 | 186 |
| R88M-K1K020x-Bx | 163 | 55 | 119 | 22 | 57 | 141 |
| R88M-K1K520x-Bx | 180.5 | 55 | 136.5 | 22 | 74.5 | 158.5 |
| R88M-K2K020x-Bx | 198 | 55 | 154 | 22 | 92 | 176 |
| R88M-K3K020x-Bx | 233 | 65 | 189 | 24 | 127 | 211 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.
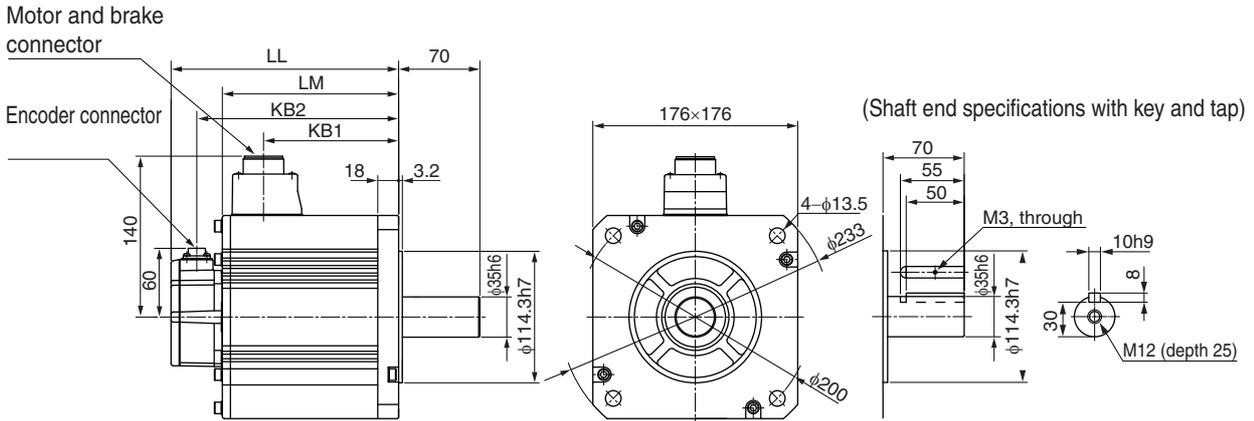
### 4 kW/5 kW (without Brake)

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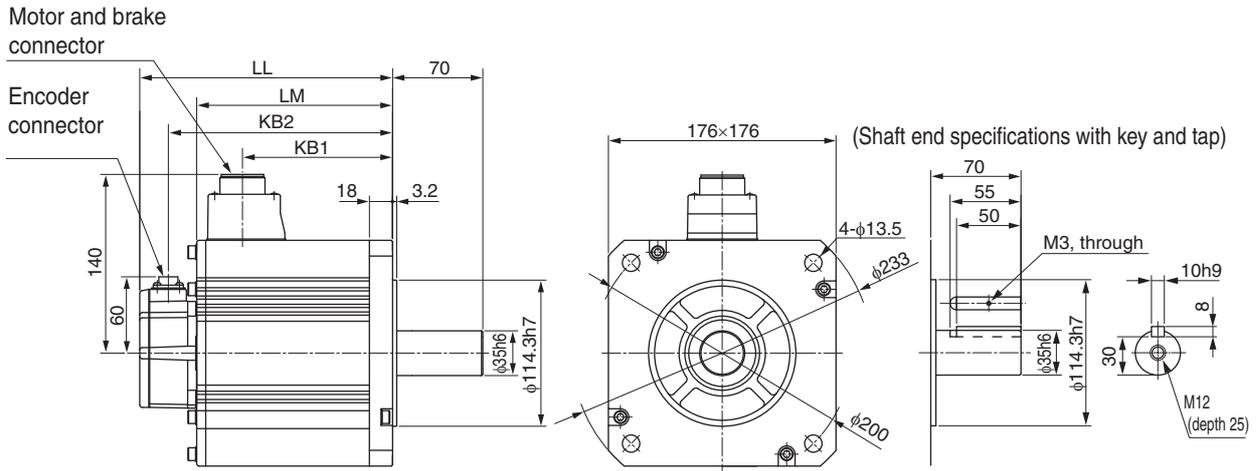
| Model | Dimensions (mm) | | | |
|---|---|---|---|---|
| | **LL** | **LM** | **KB1** | **KB2** |
| R88M-K4K020x | 177 | 133 | 96 | 155 |
| R88M-K5K020x | 196 | 152 | 115 | 174 |
| R88M-K4K020x-Bx | 202 | 158 | 96 | 180 |
| R88M-K5K020x-Bx | 221 | 177 | 115 | 199 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

Standard Models and External Dimensions

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### 7.5 kW (without Brake)

R88M-K7K515C (-S2)    **ABS**

### 7.5 kW (with Brake)

R88M-K7K515C-B (S2)    **ABS**
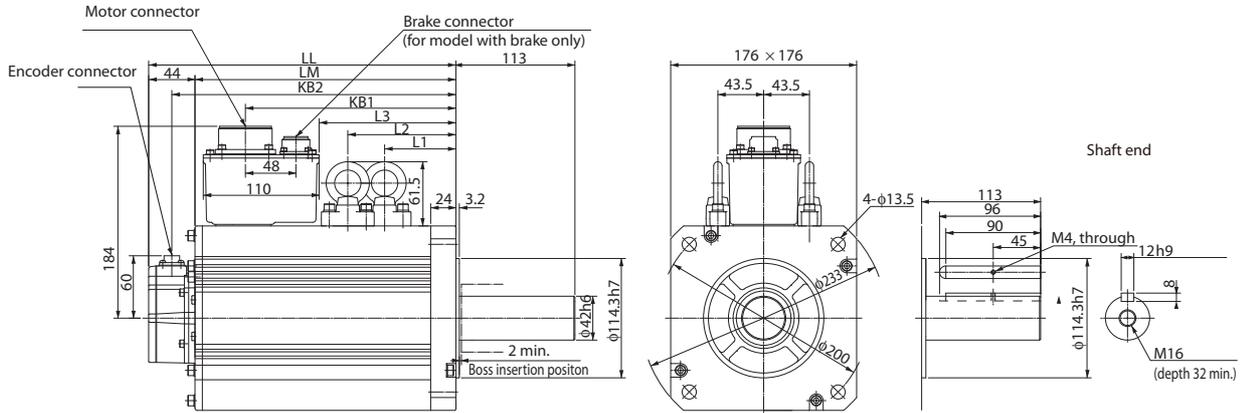


| Model | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 | L3 |
| R88M-K7K515Cx | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K7K515C-Bx | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

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**Standard Models and External Dimensions**

### 11 kW/15 kW (without Brake)

R88M-K11K015C (-S2)/-K15K015C (-S2)  **ABS**

### 11 kW/15 kW (with Brake)

R88M-K11K015C-B (S2)/-K15K015C-B (S2)  **ABS**
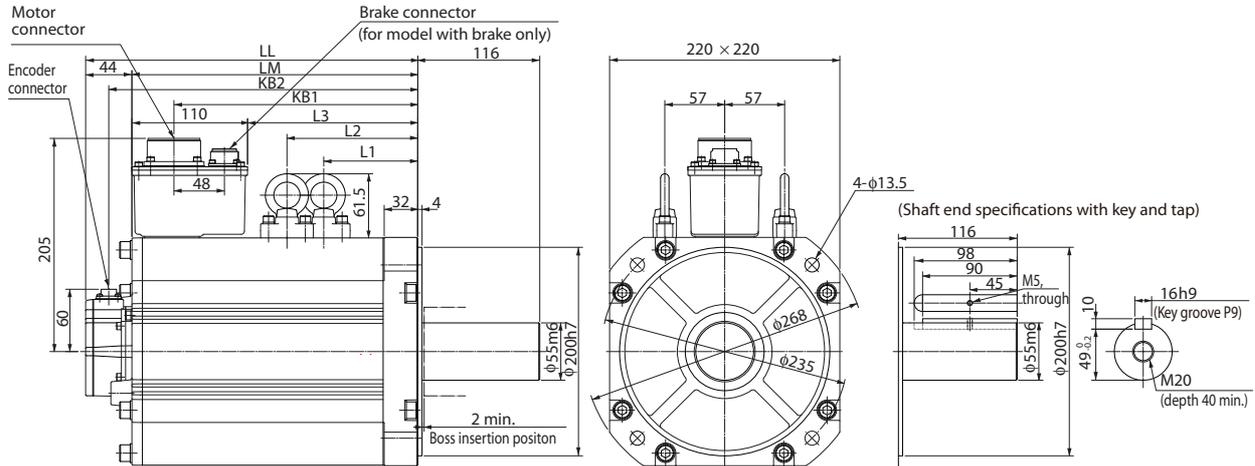


| Model | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **LL** | **LR** | **LM** | **S** | **KB1** | **KB2** | **L1** | **L2** | **L3** |
| R88M-K11K015Cx | 316 | 116 | 272 | 55 | 232 | 294 | 124.5 | 124.5 | 162 |
| R88M-K15K015Cx | 384 | 116 | 340 | 55 | 300 | 362 | 158.5 | 158.5 | 230 |
| R88M-K11K015C-Bx | 364 | 116 | 320 | 55 | 266 | 342 | 124.5 | 159.5 | 196 |
| R88M-K15K015C-Bx | 432 | 116 | 388 | 55 | 334 | 410 | 158.5 | 193.5 | 264 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

## 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**

Motor and brake connector

Encoder connector

(Shaft end specifications with key and tap)

| Model | Dimensions (mm) | | |
|---|---|---|---|
| | **LL** | **LM** | **KB2** |
| R88M-K90010x | 155.5 | 111.5 | 133.5 |
| R88M-K90010x-Bx | 180.5 | 136.5 | 158.5 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**Standard Models and External Dimensions**

**2**

**2**

**Standard Models and External Dimensions**

## 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 | 188.5 | 144.5 | 82.5 | 166.5 |
| R88M-K3K010x-Bx | 234.5 | 190.5 | 128.5 | 212.5 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

### 4.5 kW (without Brake)

R88M-K4K510T (-S2)  **ABS**

### 4.5 kW (with Brake)

R88M-K4K510T-B (S2)  **ABS**
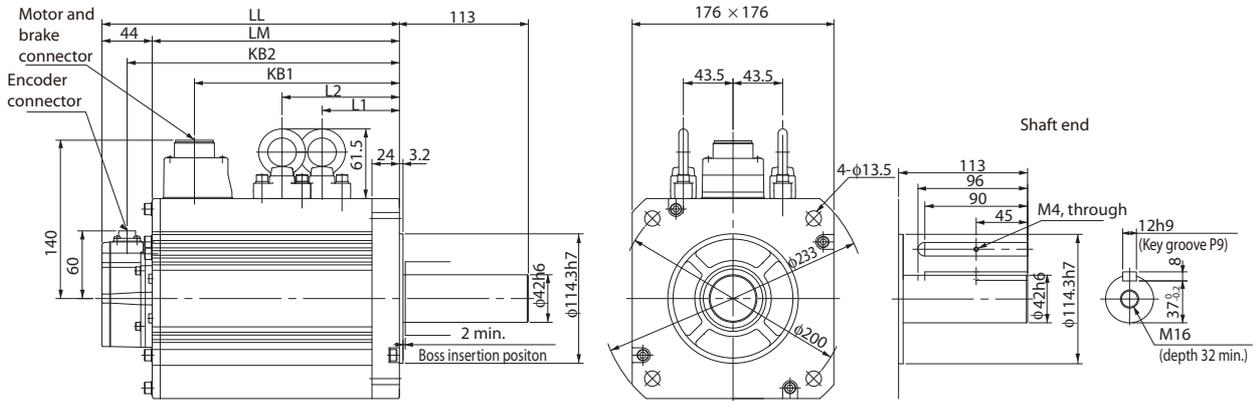


| Model | Dimensions (mm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 |
| R88M-K4K510Tx | 266 | 113 | 222 | 42 | 185 | 244 | 98 | 98 |
| R88M-K4K510T-Bx | 291 | 113 | 247 | 42 | 185 | 269 | 98 | 133 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

### 6 kW (without Brake)

R88M-K6K010T (-S2)　**ABS**

### 6 kW (with Brake)

R88M-K6K010T-B (S2)　**ABS**
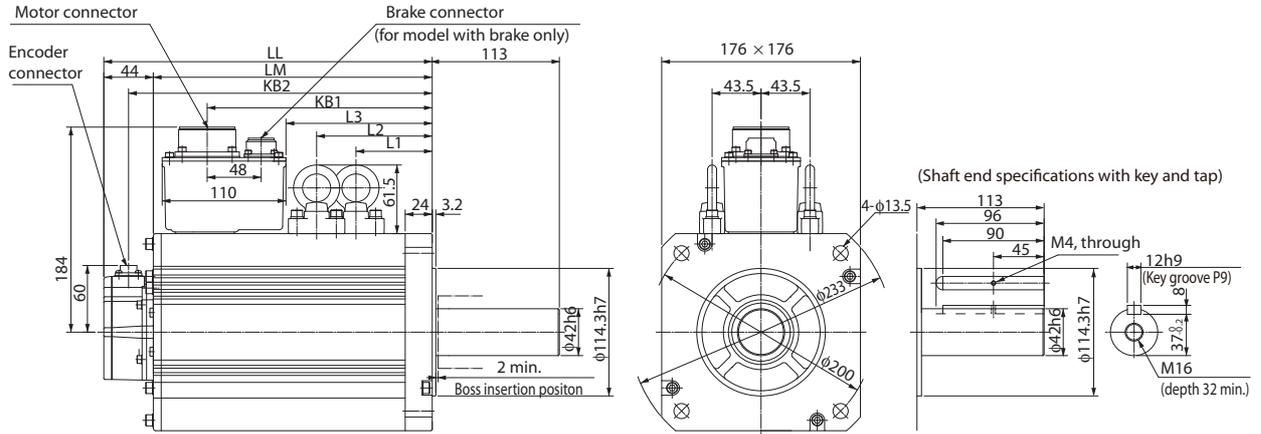
| Model | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 | L3 |
| R88M-K6K010Tx | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K6K010T-Bx | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

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**Standard Models and External Dimensions**

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

### 900 W (without Brake)

R88M-K90010F (-S2)  **INC**
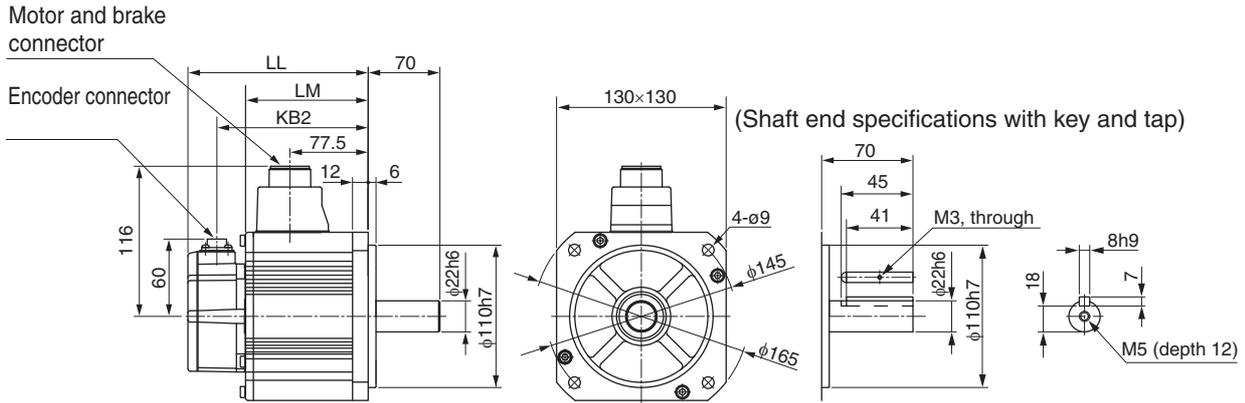
R88M-K90010C (-S2)  **ABS**

### 900 W (with Brake)

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

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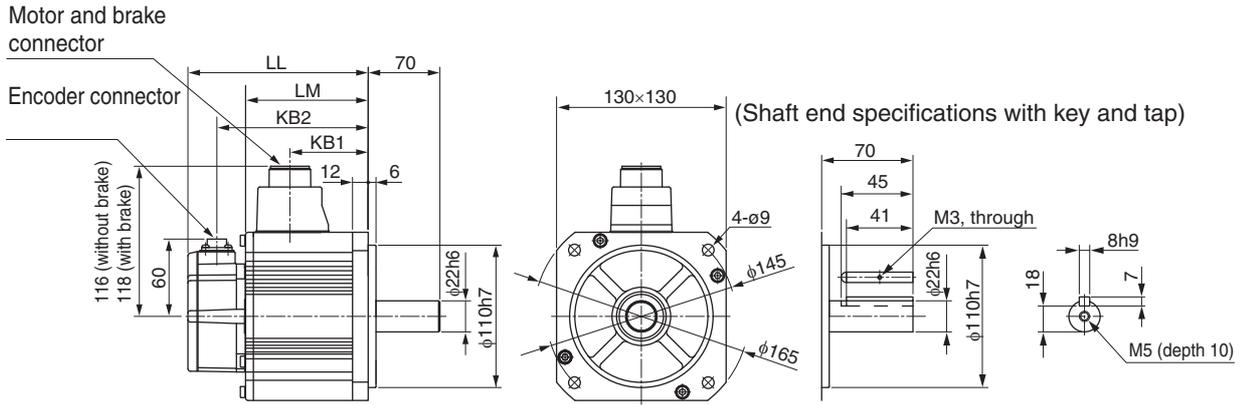


| Model | Dimensions (mm) | | | |
|---|---|---|---|---|
| | LL | LM | KB1 | KB2 |
| R88M-K90010x | 155.5 | 111.5 | 77.5 | 133.5 |
| R88M-K90010x-Bx | 180.5 | 136.5 | 74.5 | 158.5 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

## 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**
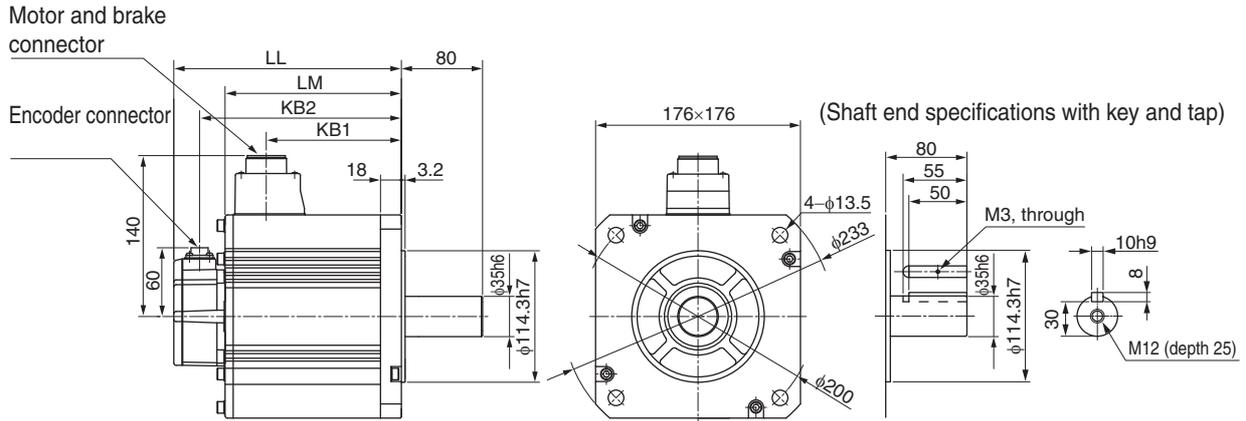
| Model | Dimensions (mm) | | | |
|---|---|---|---|---|
| | **LL** | **LM** | **KB1** | **KB2** |
| R88M-K2K010x | 163.5 | 119.5 | 82.5 | 141.5 |
| R88M-K3K010x | 209.5 | 165.5 | 128.5 | 187.5 |
| R88M-K2K010x-Bx | 188.5 | 144.5 | 82.5 | 166.5 |
| R88M-K3K010x-Bx | 234.5 | 190.5 | 128.5 | 212.5 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

**2**

**Standard Models and External Dimensions**

### 4.5 kW (without Brake)

R88M-K4K510C (-S2)    **ABS**

### 4.5 kW (with Brake)

R88M-K4K510C-B (S2)    **ABS**
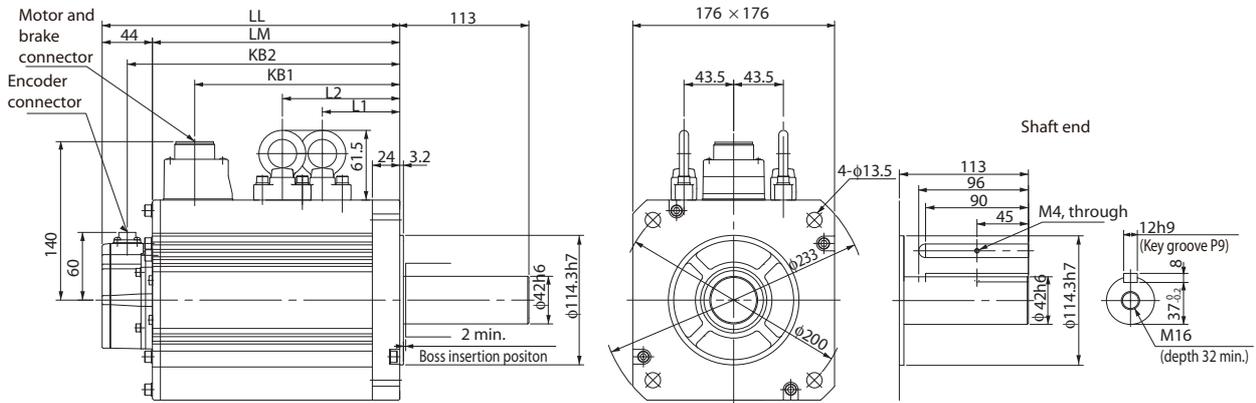


| Model | Dimensions (mm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 |
| R88M-K4K510Cx | 266 | 113 | 222 | 42 | 185 | 244 | 98 | 98 |
| R88M-K4K510C-Bx | 291 | 113 | 247 | 42 | 185 | 269 | 98 | 133 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

## 6 kW (without Brake)

R88M-K6K010C (-S2)  **ABS**

## 6 kW (with Brake)

R88M-K6K010C-B (S2)  **ABS**
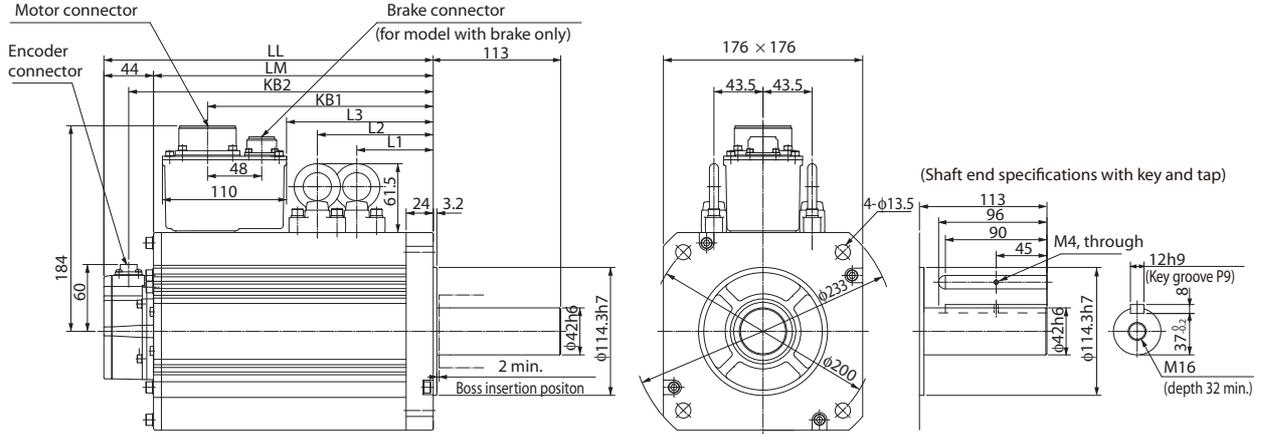


| Model | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LL | LR | LM | S | KB1 | KB2 | L1 | L2 | L3 |
| R88M-K6K010Cx | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K6K010C-Bx | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

Note. Models with a key and tap are indicated with S2 at the end of the model number.

## External Regeneration Resistor Dimensions

### External Regeneration Resistor

**R88A-RR08050S/-RR080100S**
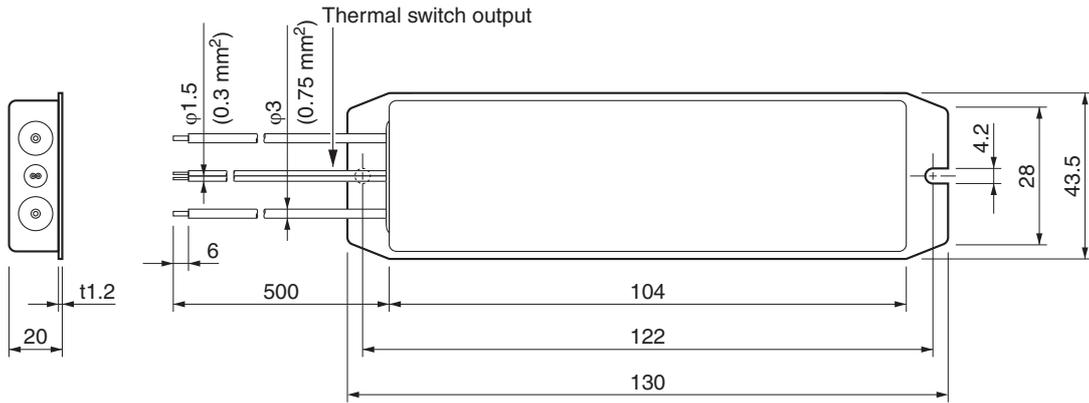


**R88A-RR22047S**
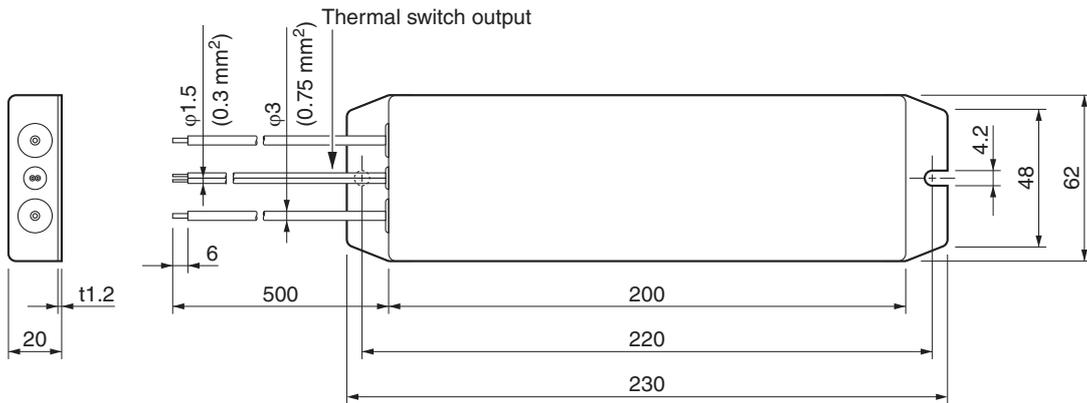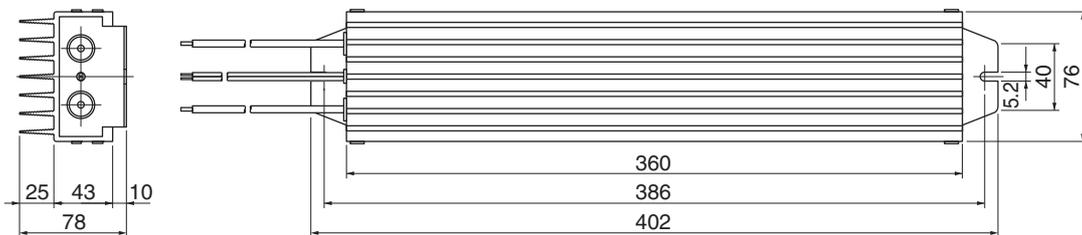


**R88A-RR50020S**

# 2-5  EMC Filter Dimensions
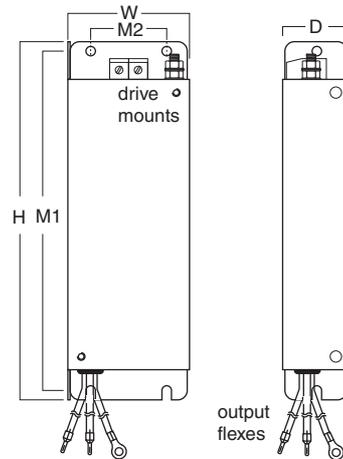


| Filter model | External dimensions | | | Mount dimensions | |
|---|---|---|---|---|---|
| | **H** | **W** | **D** | **M1** | **M2** |
| R88A-FIK102-RE | 190 | 42 | 44 | 180 | 20 |
| R88A-FIK104-RE | 190 | 57 | 30 | 180 | 30 |
| R88A-FIK107-RE | 190 | 64 | 35 | 180 | 40 |
| R88A-FIK114-RE | 190 | 86 | 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 |

**2**

**Standard Models and External Dimensions**

# 3

# Specifications

This chapter explains the general specifications, characteristics, connector specifications and I/O circuits of the Servo Drive, Servomotor and peripheral devices.

# 3-1   Driver Specifications

Select the Servo Drive matching the Servomotor to be used. Refer to "Servo Drive and Servomotor Combination List"(P.2-12).

The same Accurax G5 AC Servo Drive can be used for either a pulse train input or analog input. You can change the CONTROL mode according to the controller. (The default setting is for position control with pulse train commands.)

## 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 |
| | UL standards | | UL 508C |
| | CSA standards | | CSA22.2 No. 14 |
| | Functional safety | | EN ISO13849-1:2008 (Performance Level d), IEC61800-5-2:2007 (STO), EN61508:2001 (SIL2),EN954-1:1996 (CAT3) |

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

Note 2. Never perform dielectric strength or other megameter tests 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.11-22).

## Characteristics

### 100-VAC Input Type

| Item | | | R88D-KTA5L | R88D-KT01L | R88D-KT02L | R88D-KT04L |
|---|---|---|---|---|---|---|
| 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 115 VAC (85 to 127 V) 50/60 Hz | | | |
| | | Rated current | 1.4 A | 2.6 A | 4.3 A | 7.6 A |
| | Control circuit | Power supply voltage | Single-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz | | | |
| 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** | K05030L | K10030L | K20030L | K40030L |
| | | **ABS** | K05030S | K10030S | K20030S | K40030S |
| | 2,000-r/min type | **ABS** | – | – | – | – |
| | 1,000-r/min type | **ABS** | – | – | – | – |

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**Specifications**

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**Specifications**

## 200-VAC Input Type

| Item | | | R88D-KT01H | R88D-KT02H | R88D-KT04H | R88D-KT08H | R88D-KT10H | R88D-KT15H |
|---|---|---|---|---|---|---|---|---|
| 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 | 1.3 A | 2.4/1.3 [1] A | 4.1/2.4 [1] A | 6.6/3.6 [1] A | 9.1/5.9 [1] A | 14.2/8.1 [1] A |
| | Control circuit | Power supply voltage | Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz | | | | | |
| PWM frequency | | | 12.0 kHz | | 6.0 kHz | | | |
| Weight | | | Approx. 0.8 kg | Approx. 0.8 kg | Approx. 1.1 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.

| Item | | | R88D-KT20H | R88D-KT30H | R88D-KT50H | R88D-KT75H | R88D-KT150H |
|---|---|---|---|---|---|---|---|
| Continuous output current (rms) | | | 13.4 A | 18.7 A | 33.0 A | 44.0 A | 66.1 A |
| Input power supply | Main circuit | Power supply capacity | 3.3 KVA | 4.5 KVA | 7.5 KVA | 9.0 KVA | 11.0 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 | 32.0 A | 58.0 A |
| | Control circuit | Power supply voltage | Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz | | | | |
| PWM frequency | | | 6.0 kHz | | | | |
| Weight | | | Approx. 2.7 kg | Approx. 4.8 kg | Approx. 4.8 kg | Approx. 13.5 kg | Approx. 21.0 kg |
| Maximum applicable motor capacity | | | 2 kW | 3 kW | 5 kW | 7.5 kW | 15 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 | K7K515T | K11K015T K15K015T |
| | 1,000-r/min type | **INC** | – | K2K010H | K3K010H | – | – |
| | | **ABS** | – | K2K010T | K3K010T K4K510T | K6K010T | – |
| Control method | | | All-digital servo | | | | |
| Inverter method | | | IGBT-driven PWM method | | | | |

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**Specifications**

## 400-VAC Input Type

| Item | | | R88D-KT06F | R88D-KT10F | R88D-KT15F | R88D-KT20F | R88D-KT30F | R88D-KT50F | R88D-KT75F | R88D-KT150F |
|---|---|---|---|---|---|---|---|---|---|---|
| Continuous output current (rms) | | | 2.9 A | 2.9 A | 4.7 A | 6.7 A | 9.4 A | 16.5 A | 22.0 A | 33.4 A |
| Input power supply | Main circuit | Power supply voltage | 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz | | | | | | | |
| | | Rated current | 2.8 A | 2.8 A | 4.7 A | 5.9 A | 7.6 A | 12.1 A | 16.0 A | 29.0 |
| | Control circuit | Power supply voltage | 24 VDC (20.4 to 27.6 V) | | | | | | | |
| 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 | Approx. 13.5 kg | Approx. 21.0 kg |
| Maximum applicable motor capacity | | | 600 W | 1 kW | 1.5 kW | 2 kW | 3 kW | 5 kW | 7.5 kW | 15 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 | K7K510C | K11K015C K15K015C |
| | 1,000-r/min type | INC | – | – | K90010F | – | K2K010F | K3K010F | – | – |
| | | ABS | – | – | K90010C | – | K2K010C | K3K010C | K6K010C | – |
| Control method | | | All-digital servo | | | | | | | |
| Inverter method | | | IGBT-driven PWM method | | | | | | | |

## Protective Functions

| Error detection | Description |
|---|---|
| Control power supply undervoltage | The DC voltage of the main circuit fell below the specified value while the operation command (RUN) input was ON. |
| 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. |
| Driver overheat | The temperature of the driver 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 driver. |
| 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 scale 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, Pn500 to Pn503) is not appropriate. |
| Error counter overflow | Error counter value based on the encoder pulse reference exceeded $2^{29}$ (536870912). |
| 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. |
| Excessive analog input | A current exceeding the Excessive Analog Input (Pn424, Pn427 or Pn430) was applied to the analog command input (pin 14). |
| 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 1-rotation counter error **ABS** | A 1-turn counter error was detected. |

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**Specifications**

| Error detection | Description |
|---|---|
| Absolute encoder multi-rotation counter error **ABS** | A multi-rotation counter error or phase-AB signal error was detected. |
| 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 scale communications error | An error was detected in external scale connection and communications data. |
| External scale status error | An external scale error code was detected. |
| Phases-A, B and Z connection error | An error was generated for connection of phases A, B, and Z of external scale. |
| 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. |

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**Specifications**

## Main Circuit and Motor Connections

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

### R88D-KTA5L/-KT01L/-KT02L/-KT04L
### R88D-KT01H/-KT02H/-KT04H/-KT08H/-KT10H/-KT15H

#### Main Circuit Connector Specifications (CNA)

| Symbol | Name | Function |
|--------|------|----------|
| L1 | Main circuit power supply input | R88D-KTxL |
| L2 | | (50 to 400 W) : Single-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz |
| | | (200 to 400 W) : 3-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| | | R88D-KTxH |
| | | (50 W to 1.5 kW) : Single-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| L3 | | (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 or L3. |
| L1C | Control circuit power supply input | R88D-KTxL : Single-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz |
| L2C | | R88D-KTxH : Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz |

#### Motor Connector Specifications (CNB)

| 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. (Models from 750 W) | |
| 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 | |

☑ Precautions for Correct Use

• 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).

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### R88D-KT20H

#### Main Circuit Connector Specifications (CNA)

| Symbol | Name | Function |
|---|---|---|
| L1 | Main circuit power supply input | R88D-KTxH (2 kW) : 3-phase: 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| L2 | | |
| L3 | | |
| L1C | Control circuit power supply input | R88D-KTxH : 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 Regenerative Resistor (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 to the torque of 0.7 to 0.8 N•m (M4) or 1.4 to 1.6 N•m (M5).

### R88D-KT30H/-KT50H

#### Terminal Block Specifications

| Symbol | Name | Function | |
|---|---|---|---|
| L1 | Main circuit power supply input | R88D-KTxH (3 to 5 kW):<br>3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| L1C | Control circuit power supply input | R88D-KTxH : 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.<br>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).

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**Specifications**

### R88D-KT75H

### Terminal Block Specifications

| Symbol | Name | Function | | |
|--------|------|----------|---|---|
| L1 | Main circuit power supply input | R88D-KTxH (7.5 kW): 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz | | |
| L2 | | | | |
| L3 | | | | |
| L1C | Control circuit power supply input | R88D-KTxH : Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz | | |
| L2C | | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | | |
| B2 | | | | |
| NC | | Do not connect. | | |
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. | | |
| DB2 | | | | |
| DB3 | | Normally DB3 and DB4 are connected. When using an externally connected Dynamic Brake Unit, remove the short bar from between DB3 and DB4. | | |
| DB4 | | | | |
| 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 1.5 N•m (M5).
- If the torque for terminal block screws exceeds 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 1.4 to 1.6 N•m (M5).

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**Specifications**

### R88D-KT150H

**Terminal Block Specifications**

| Symbol | Name | Function | |
|--------|------|----------|---|
| L1 | Main circuit power supply input | R88D-KTxH (15 kW):<br>3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| L1C | Control circuit power supply input | R88D-KTxH : Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz | |
| L2C | | | |
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. | |
| DB2 | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | |
| B2 | | | |
| 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 1.5 N•m (M5) or 2.5 N•m (M6).
- If the torque for terminal block screws exceeds 2.0 N•m (M5) or 3.0 N•m (M6), the terminal block may be damaged.
- Tighten the fixing screw of the terminal block cover to the torque of 0.4 N•m (M5).
- Tighten the ground screws to the torque of 2.4 to 2.6 N•m (M6).

### R88D-KT06F/-KT10F/-KT15F/-KT20F

#### Main Circuit Connector Specifications (CNA)

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

#### External Regenerative Resistor (CNC)

| Symbol | Name | Function |
|--------|------|----------|
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are short-circuited. |
| B2 | | 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. |
| B3 | | |
| NC | | Do not connect. |

#### Control Circuit Connector Specifications (CND)

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

Precautions for Correct Use

• 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-KT30F/-KT50F

### Terminal Block Specifications (TB1)

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

### Terminal Block Specifications (TB2)

| Symbol | Name | Function | |
|--------|------|----------|---|
| L1 | Main circuit power supply input | R88D-KTxF (3 to 5 kW):<br>3-phase 380 to 400 VAC (323 to 528 V) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are short-circuited.<br>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).

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**Specifications**

### R88D-KT75F

### Terminal Block Specifications (TB1)

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

### Terminal Block Specifications (TB2)

| Symbol | Name | Function | | |
|--------|------|----------|---|---|
| L1 | Main circuit power supply input | R88D-KTxF (7.5 kW): 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz | | |
| L2 | | | | |
| L3 | | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | | |
| B2 | | | | |
| NC | | Do not connect. | | |
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. | | |
| DB2 | | | | |
| DB3 | | Normally DB3 and DB4 are connected. When using an externally connected Dynamic Brake Unit, remove the short bar from between DB3 and DB4. | | |
| DB4 | | | | |
| 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 1.5 N•m (M5).
- If the torque for terminal block screws exceeds 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 1.4 to 1.6 N•m (M5).

### R88D-KT150F

#### Terminal Block Specifications (TB1)

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

#### Terminal Block Specifications (TB2)

| Symbol | Name | Function | |
|--------|------|----------|---|
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. | |
| DB2 | | | |
| L1 | Main circuit power supply input | R88D-KTxF (15 kW): 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | |
| B2 | | | |
| 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 1.5 N•m (M5) or 2.5 N•m (M6).
- If the torque for terminal block screws exceeds 2.0 N•m (M5) or 3.0 N•m (M6), the terminal block may be damaged.
- Tighten the fixing screw of the terminal block cover to the torque of 0.4 N•m (M5).
- Tighten the ground screws to the torque of 2.4 to 2.6 N•m (M6).

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**Specifications**

## Control I/O Connector Specifications (CN1)

### Control I/O Signal Connections and External Signal Processing for Position Control
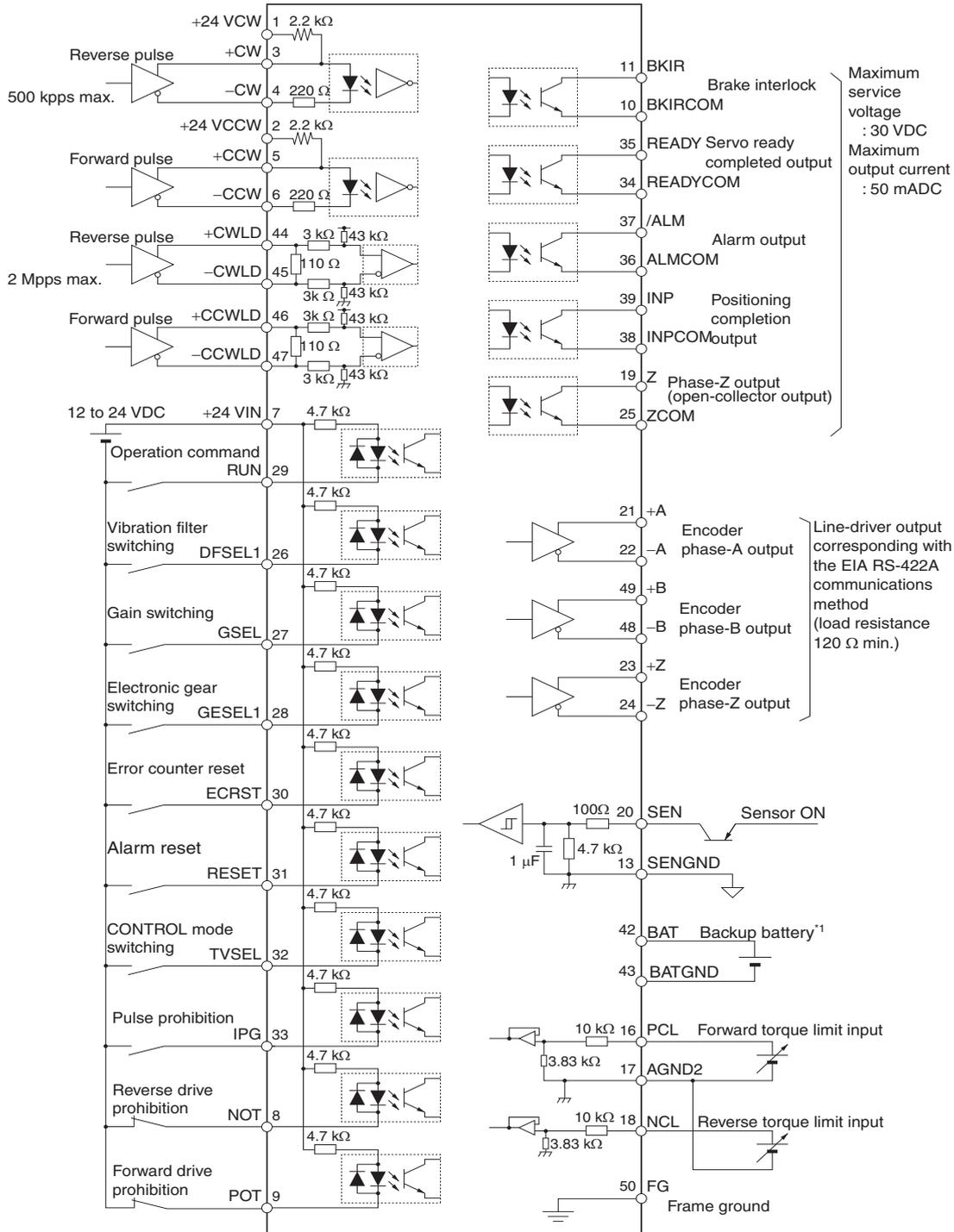


*1. If a backup battery is connected, a cable with a battery is not required.

Note 1. The inputs of pins 8, 9 and 26 to 33, and outputs of pins 10, 11, 34, 35, 38 and 39, can be changed via parameter settings.

Note 2. Pins 13, 20, 42 and 43 represent signals which are applicable when an absolute encoder is used.

## Control I/O Signal Connections and External Signal Processing for Speed Control
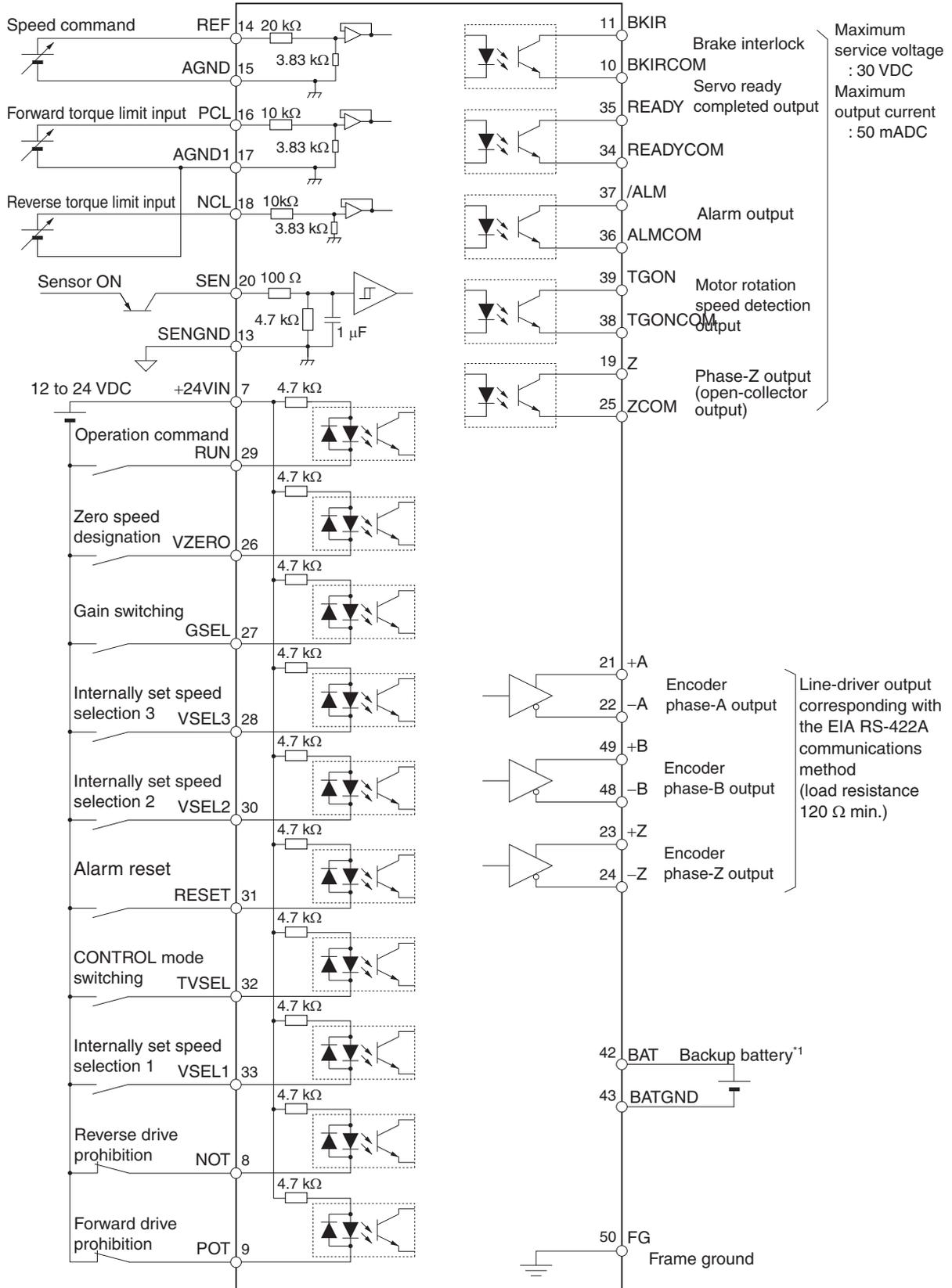


*1. If a backup battery is connected, a cable with a battery is not required.

Note 1. The inputs of pins 8, 9 and 26 to 33, and outputs of pins 10, 11, 34, 35, 38 and 39, can be changed via parameter settings.

Note 2. Pins 13, 20, 42 and 43 represent signals which are applicable when an absolute encoder is used.

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Specifications

## Control I/O Signal Connections and External Signal Processing for Torque Control



*1. If a backup battery is connected, a cable with a battery is not required.

Note 1. The inputs of pins 8, 9 and 26 to 33, and outputs of pins 10, 11, 34, 35, 38 and 39, can be changed via parameter settings.

Note 2. Pins 13, 20, 42 and 43 represent signals which are applicable when an absolute encoder is used.

## Control I/O Signal List

### CN1 Control Inputs

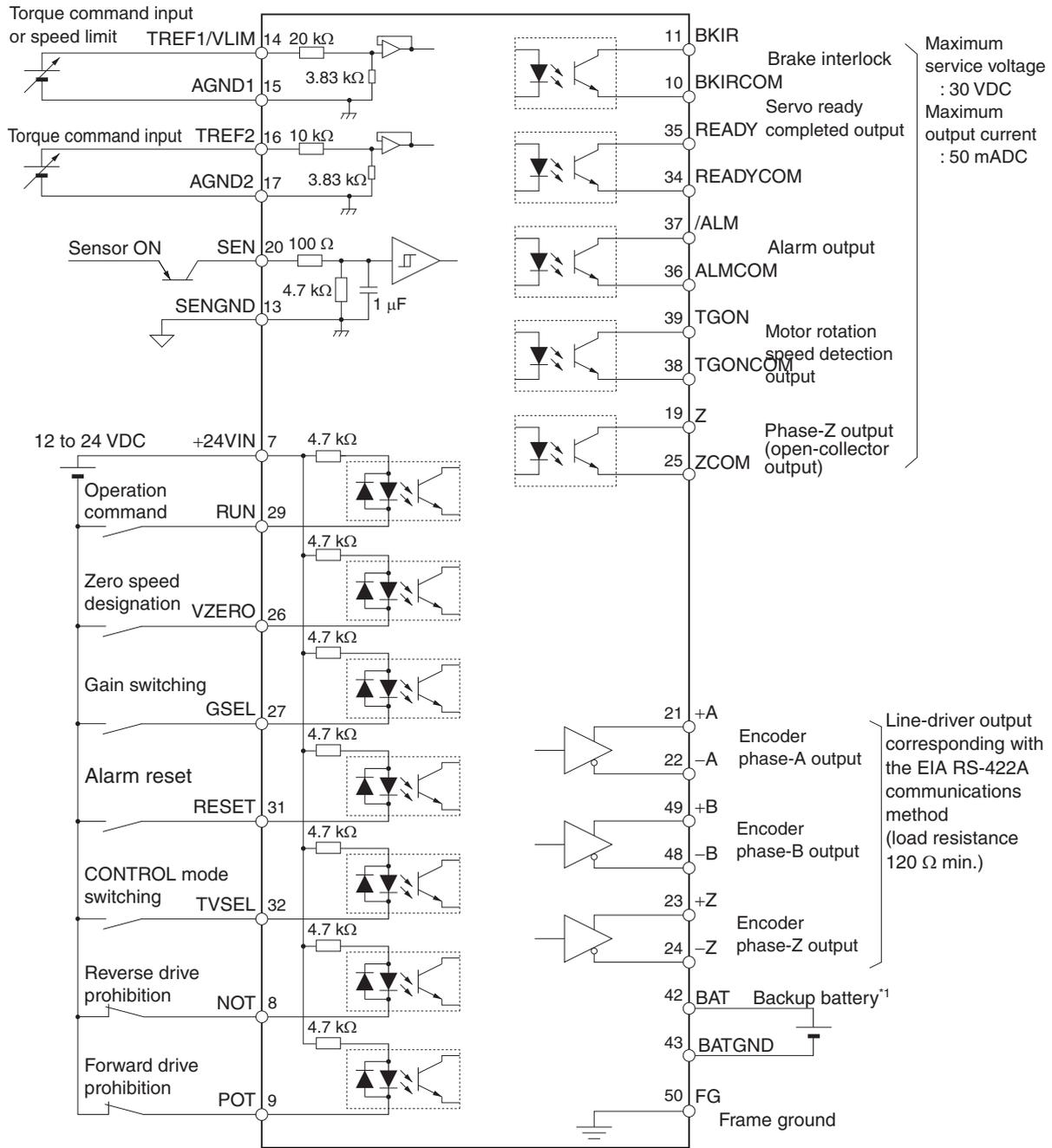| Pin number | Symbol | Name | Function and interface | Position | Speed | Torque | Full closing |
|---|---|---|---|---|---|---|---|
| | | | | CONTROL mode | | | |
| 1 | +24VCW | 24-V open-collector input for command pulse | Input terminals for position command pulses for both line driver and open collector.<br>Changes to enable (set value: 0<default setting>) according to the setting of Command Pulse Input Selection (Pn005). | √ | | | √ |
| 3 | +CW/+puls/+FA | Reverse pulse, feed pulse, or 90° phase difference signal (phase A) | | | | | |
| 4 | -CW/-puls/-FA | | | | | | |
| 2 | +24VCW | 24-V open-collector input for command pulse | | | | | |
| 5 | +CW/+puls/+FA | Forward pulse, direction signal, or 90° phase difference signal (phase B) | | | | | |
| 6 | -CW/-puls/-FA | | | | | | |
| 44 | +CWLD | Reverse pulse (input for line driver only) | Input terminals for position command pulses dedicated to the line-driver output.<br>Changes to enable (set value: 1) according to the setting of Command Pulse Input Selection (Pn005). | √ | | | √ |
| 45 | -CWLD | | | | | | |
| 46 | +CCWLD | Forward pulse (input for line driver only) | | | | | |
| 47 | -CCWLD | | | | | | |
| 20 | SEN | Sensor ON Input **ABS** | This performs serial transmission of multi-rotation data of the absolute encoder and also outputs 1-rotation data as the initial incremental pulses.<br>This input changes to enable (set value: 1) according to the setting of Absolute Interface Function Selection (Pn616). | √ | √ | √ | |
| 13 | SENGND | Signal ground | This is a sensor ON signal ground. | | | | |
| 42 | BAT | Backup battery input | 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.) | √ | √ | √ | √ |
| 43 | BATGND | **ABS** | | | | | |
| 14 | REF | Speed command input | This is an analog input terminal for speed command.<br>Use the Speed Command Scale (Pn302) to change the rotation speed scale for the command input. | | √ | | |
| | TREF1 | Torque command input 1 | Provides a torque command input (set value: 0 or 2) according to the setting of Torque Command/Speed Limit Selection (Pn317).<br>Use the Torque Command Scale (Pn319) to change the rotation speed scale for the command input. | | | √ | |

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**Specifications**

| Pin number | Symbol | Name | Function and interface | CONTROL mode | | | |
|---|---|---|---|---|---|---|---|
| | | | | Position | Speed | Torque | Full closing |
| 14 | VLIM | Speed limit input | Provides a speed limit input (set value: 1) according to the setting of Torque Command/Speed Limit Selection (Pn317). Use the Speed Command Scale (Pn302) to change the limit speed scale for the analog input. | | | √ | |
| 15 | AGND1 | Analog ground 1 | This is an analog signal ground. | | | | |
| 16 | PCL | Forward torque limit input | Provides a forward torque limit input (set value: 0 or 4) or forward/reverse torque limit input (set value: 5) according to the setting of Torque Limit Selection (Pn521). | √ | √ | | √ |
| | TREF2 | Torque command input 2 | Provides a torque command input (set value: 1) according to the setting of Torque Command/Speed Limit Selection (Pn317). Use the Torque Command Scale (Pn319) to change the rotation speed scale for the command input. | | | √ | |
| 17 | AGND1 | Analog ground 1 | This is an analog signal ground. | | | | |
| 18 | NCL | Reverse torque limit input | Provides a reverse torque limit input (set value: 0 or 4) according to the setting of Torque Limit Selection (Pn521). | √ | √ | | √ |
| 7 | +24VIN | 12 to 24-VDC power supply input | This is the positive input terminal of the external DC power supply for sequence input (12 to 24 V). | √ | √ | √ | √ |
| 8, 9, 26 to 33 | SI1 to SI10 | Sequence input signal | These allocate the following function and logics according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409). | | | | |
| | NOT [8] | Reverse drive prohibition input | This performs the drive prohibition input in the reverse direction. Changes to enable (set value: 0 or 2) according to the setting of Drive Prohibition Input Selection (Pn504). | √ | √ | √ | √ |
| | POT [9] | Forward drive prohibition input | This performs the drive prohibition input in the forward direction. Changes to enable (set value: 0 or 2) according to the setting of Drive Prohibition Input Selection (Pn504). | √ | √ | √ | √ |
| | DFSEL1 [26] | Vibration filter switching 1 | Changes to enable (set value: 1 or 2) according to the setting of Vibration Filter Selection (Pn213). If the set value of Vibration Filter Selection (Pn213) is 2, switching between 4 settings is possible by combining this with the vibration filter switching input 2 (DFSEL2). | √ | | | √ |

| Pin number | Symbol | Name | Function and interface | CONTROL mode | | | |
|---|---|---|---|---|---|---|---|
| | | | | Position | Speed | Torque | Full closing |
| 8, 9, 26 to 33 | GSEL [27] | Gain switching | This changes to enable (set value: 2) according to the setting of GAIN SWITCHING mode (Pn115 for position control, Pn120 for speed control, or Pn124 for torque control). When the signal is OFF and ON, gain 1 and gain 2 change to enable, respectively. | √ | √ | √ | √ |
| | GESEL1 [28] | Electronic gear switching 1 | Switches the numerator for electronic gear ratio. You can switch maximum 4 electronic gear ratio numerators by combining with electronic gear switching input 2 (GESEL2). | √ | | | √ |
| | RUN [29] | Operation command input | This turns ON the servo (motor power supply starts). | √ | √ | √ | √ |
| | ECRST [30] | Error counter reset input | Resets the position error counter. An edge (set value: 0) or level (set value: 1) can be selected according to the setting of Error Counter Reset Condition Selection (Pn517). | √ | | | √ |
| | RESET [31] | Alarm reset input | Release the alarm status. The error counter is reset when the alarm is reset. Some alarms cannot be reset with this input. | √ | √ | √ | √ |
| | TVSEL [32] | CONTROL mode switching input | This signal switches the CONTROL mode for Servo Drive. Changes to enable (set value: 3 to 5) according to the setting of CONTROL mode Selection (Pn001). | √ | √ | √ | |
| | IPG [33] | Pulse prohibition input | Prohibits the position command pulse. Changes to enable (set value: 0) according to the setting of Command Pulse Prohibition Input Setting (Pn518). | √ | | | |
| | VSEL1 [33] | Internally set speed selection 1 | Use this input to select a desired Speed Setting (Pn304 to 311) during the internally set speed operation. | | √ | | |
| | VSEL2 [30] | Internally set speed selection 2 | | | | | |
| | VSEL3 [28] | Internally set speed selection 3 | | | | | |
| | TLSEL | Torque limit switching | Switches the torque limit value via ON/OFF. Changes to enable (set value: 3 or 6) according to the setting of Torque Limit Selection (Pn521). The torque limit value and operating direction vary according to the set value. | √ | √ | | √ |
| | DFSEL2 | Vibration filter switching 2 | Changes to enable (set value: 2) according to the setting of Vibration Filter Selection (Pn213). Switching between 4 settings is possible by combining this with the vibration filter switching input 1 (DFSEL1). | √ | | | √ |

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**Specifications**

| Pin number | Symbol | Name | Function and interface | CONTROL mode | | | |
|---|---|---|---|---|---|---|---|
| | | | | Position | Speed | Torque | Full closing |
| 8, 9, 26 to 33 | GESEL2 | Electronic gear switching 2 | You can switch maximum 4 electronic gear ratio numerators by combining with electronic gear switching input 1 (GESEL1). | √ | | | √ |
| | VZERO | Zero speed designation input | This signal forcibly sets the speed command to 0. Changes to enable (set value: 1 to 3) according to the setting of Zero Speed Designation Selection (Pn315). | | √ | √ | |
| | VSING | Speed command sign input | Designates the motor rotation direction for speed commands. Changes to enable (set value: 1) according to the setting of Speed Command Direction Selection (Pn301). | | √ | | |
| | TSIGN | Torque command sign input | This signal designates the motor rotation direction for torque commands. Changes to enable (set value: 1) according to the setting of Torque Command Direction Selection (Pn318). | | | √ | √ |
| | EMG-STOP | Emergency stop input | This is an emergency stop input. When input, this becomes an emergency stop input error and thereby stop the motor. | √ | √ | √ | √ |
| | JSEL | Inertia ratio switching input | This signal switches between inertia ratio 1 and inertia ratio 2. | √ | √ | √ | √ |

⬥ Be cautious that allocatable pin numbers are fixed for the following functions.
   Error counter reset input (ECRST): Pin 30 only
   Command pulse input prohibition input (IPG): Pin 33 only

⬥ The number in brackets indicates the pin number (allocation) at default setting. (The allocations vary according to each CONTROL mode.)

## CN1 Control Outputs

| Pin number | Symbol | Name | Function and interface | CONTROL mode | | | |
|---|---|---|---|---|---|---|---|
| | | | | Position | Speed | Torque | Full closing |
| 21 | +A | Encoder phase A +output | Encoder signals (or external scale signals during full closing control) are output according to the setting of Encoder Dividing Numerator (Pn011). This is the line-driver output (equivalent to RS-422). The maximum output frequency is 4 Mpps. Phase Z is output for encoder signals (or external scale signals during full closing control). This is the line-driver output (equivalent to RS-422). | √ | | | √ |
| 22 | -A | Encoder phase A - output | | | | | |
| 48 | +B | Encoder phase B +output | | | | | |
| 49 | -B | Encoder phase B - output | | | | | |
| 23 | +Z | Encoder phase Z +output | | | | | |
| 24 | -Z | Encoder phase Z - output | | | | | |

| Pin number | Symbol | Name | Function and interface | CONTROL mode | | | |
|---|---|---|---|---|---|---|---|
| | | | | Position | Speed | Torque | Full closing |
| 19 | -Z | Encoder phase-Z output | Phase Z is output for encoder signals (or external scale signals during full closing control). Open-collector output | √ | | | √ |
| 25 | ZCOM | Encoder phase-Z output common | | | | | |
| 10, 11, 34 to 39 | SO1 to SO4 | Sequence output signal | These signals allocate the following functions according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413). | | | | |
| | BKIR [11] | Brake interlock output | Outputs the timing signal for operating the electromagnetic brake on a motor. | √ | √ | √ | √ |
| | BKIRCOM [10] | | | | | | |
| | READY [35] | Servo ready completed | This output signal indicates that the driver is turned ON and ready to start operation. It is turned ON when the control and main power supply is established and not in alarm status. | √ | √ | √ | √ |
| | READYCOM [34] | | | | | | |
| | /ALM [37] | Servo alarm | The output is OFF when an alarm is generated for the Servo Drive. | √ | √ | √ | √ |
| | ALMCOM [36] | | | | | | |
| | INP1 [39] | Positioning completion output 1 | If the position error is equal to Positioning Completion Range 1 (Pn431) or less, this output turns ON according to the setting condition of Positioning Completion Condition Selection (Pn432). | √ | | | √ |
| | INP1COM [38] | | | | | | |
| | TGON [39] | Motor rotation speed detection output | This output turns ON when the motor rotation speed reaches the speed set in Rotation Speed for Motor Rotation Detection (Pn436). | | √ | √ | |
| | TGONCOM [38] | | | | | | |
| | TLIMT | Torque limiting output | This output turns ON while the torque is limited. | √ | √ | | √ |
| | TLIMTCOM | | | | | | |
| | ZSP | Zero speed detection signal | This output turns ON when the motor rotation speed is equal to Zero Speed Detection (Pn434) or less. | √ | √ | √ | √ |
| | ZSPCOM | | | | | | |
| | VCMP | Speed conformity output | This output turns ON when the command speed corresponds to the motor rotation speed. This output turns ON when the difference between the command speed and motor rotation speed is inside the setting range of Speed Conformity Detection Width (Pn435). | | √ | √ | |
| | VCMPCOM | | | | | | |
| | INP2 | Positioning completion output 2 | If the position error is equal to Positioning Completion Range 2 (Pn442) or less, this output turns ON according to the setting condition of Positioning Completion Condition Selection (Pn432). | √ | | | √ |
| | INP2COM | | | | | | |
| | WARN1 | Warning output 1 | This output turns ON according to the setting condition of Warning Output Selection 1 (Pn440). | √ | √ | √ | √ |
| | WARN1COM | | | | | | |

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**Specifications**

## 3-1 Driver Specifications

| Pin number | Symbol | Name | Function and interface | CONTROL mode | | | |
|---|---|---|---|---|---|---|---|
| | | | | Position | Speed | Torque | Full closing |
| 10, 11, 34 to 39 | WARN2 / WARN2COM | Warning output 2 | This output turns ON according to the setting condition of Warning Output Selection 1 (Pn440). | √ | √ | √ | √ |
| | P-CMD / P-CMDCOM | Position command status output | This output turns ON when a positioning command is input. | √ | | | √ |
| | V-LIMIT / V-LIMITCOM | Speed limiting output | This turns ON during torque control or speed limit status. | | | √ | |
| | ALM-ATB / ALM-ATBCOM | Alarm clear attribute output | This output turns ON when an alarm occurs or the alarm can be cleared. | √ | √ | √ | √ |
| | V-CMD / V-CMDCOM | Speed command status output | This output turns ON during speed control or when a speed command is input. | | √ | | |

 • You cannot change the allocation for servo alarm output (/ALM). (The allocation is fixed.)

 • The number in brackets indicates the pin number (allocation) at default setting. (The allocations vary according to each CONTROL mode.)

## CN1 Pin Arrangement

| Pin | Signal | Description |
|---|---|---|
| 1 | +24VCW | 24-V open-collector input for command pulse |
| 2 | +24VCCW | 24-V open-collector input for command pulse |
| 3 | +CW/+PULS/+FA | Reverse pulses, feed pulses, or 90° phase difference signal (phase A) |
| 4 | −CW/−PULS/−FA | Reverse pulses, feed pulses, or 90º phase difference signal (phase A) |
| 5 | +CCW/+SIGN/+FB | Forward pulse, direction signal, or 90°phase difference signal (phase B) |
| 6 | −CCW/−SIGN/−FB | Forward pulse, direction signal, or 90ª phase difference signal (phase B) |
| 7 | +24VIN | 12 to 24-VDC power supply input |
| 8 | SI1 | General-purpose input 1 |
| 9 | SI2 | General-purpose input 2 |
| 10 | SO1COM | General-purpose output 1 common |
| 11 | SO1 | General-purpose input 1 |
| 12 | | * |
| 13 | SENGND | Signal ground |
| 14 | REF/TREF1/VLIM | Speed command input, torque command input 1, speed limit input |
| 15 | AGND1 | Analog ground 1 |
| 16 | PCL/TREF2 | Forward torque limit input, torque command input 2 |
| 17 | AGND2 | Analog ground 2 |
| 18 | NCL | Reverse torque limit input |
| 19 | Z | Phase-Z output (open collector) |
| 20 | SEN | Sensor ON undefined |
| 21 | +A | Encoder phase A+output |
| 22 | −A | Encoder phase A−output |
| 23 | +Z | Encoder phase Z+output |
| 24 | −Z | Encoder phase Z−output |
| 25 | ZCOM | Phase-Z (open collector) common |
| 26 | SI3 | General-purpose input 3 |
| 27 | SI4 | General-purpose input 4 |
| 28 | SI5 | General-purpose input 5 |
| 29 | SI6 | General-purpose input 6 |
| 30 | SI7 | General-purpose input 7 |
| 31 | SI8 | General-purpose input 8 |
| 32 | SI9 | General-purpose input 9 |
| 33 | SI10 | General-purpose input10 |
| 34 | SO2COM | General-purpose output 2 common |
| 35 | SO2 | General-purpose output 2 |
| 36 | ALMCOM (SO3COM) | Alarm output common (general-purpose output 3 common) |
| 37 | /ALM (SO3) | Alarm output (general-purpose output 3) |
| 38 | SO4COM | General-purpose output 4 common |
| 39 | SO4 | General-purpose output 4 |
| 40 | | * |
| 41 | | * |
| 42 | BAT | Absolute encoder backup battery input |
| 43 | BATGND | Absolute encoder backup battery input |
| 44 | +CWLD | Reverse pulse (input for line driver only) |
| 45 | −CWLD | Reverse pulse (input for line driver only) |
| 46 | +CCWLD | Forward pulse (input for line driver only) |
| 47 | −CCWLD | Forward pulse (input for line driver only) |
| 48 | −B | Encoder phase B−output |
| 49 | +B | Encoder phase B+output |
| 50 | | * |

Note. Do not wire anything to unused pins (*).

For general-purpose inputs 1 to 10 (SI1 to 10) and general-purpose outputs (SO1, SO2 and SO4), use user parameters Pn400 to Pn409 (Input Signal Selections 1 to 10) and Pn410 to Pn413 (Output Signal Selections 1 to 4) to set the function allocations.

The alarm output (/ALM) is fixed to general-purpose output 3.

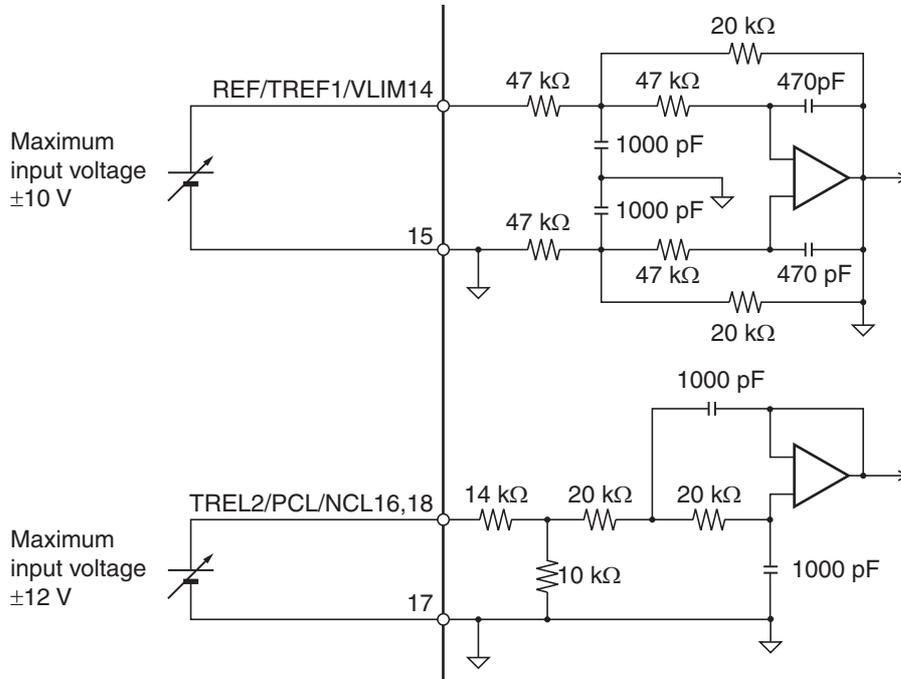To use an absolute encoder, connect a battery to either Pin 42 which is the backup battery input, or 43 which is the battery holder for absolute encoder cable. (Never connect to both.)

## Connectors for CN1 (Pin 50)

| Name | Model | Manufacturer |
|---|---|---|
| Driver connector | 52986-3679 | Molex Japan |
| Cable plug | 10150-3000PE | Sumitomo 3M |
| Cable case (shell kit) | 10350-52A0-008 | |

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**Specifications**

## Control Input Circuits

### Speed Command Input, Torque Command Input and Speed Limit Input

REF/TREF1/VLIM14

Maximum input voltage ±10 V

15

20 kΩ

47 kΩ    47 kΩ    470pF

1000 pF

1000 pF

47 kΩ

47 kΩ    470 pF

20 kΩ

TREL2/PCL/NCL16,18

Maximum input voltage ±12 V

17

1000 pF

14 kΩ    20 kΩ    20 kΩ

10 kΩ

1000 pF

⬩ The maximum allowable input voltage is ± 10 V for each input. The VR must be 2 kΩ with B characteristics and 1/2 W minimum. R must be 200 Ω and 1/2 W minimum.

### Position Command Pulse (Line Receiver Input)

When connecting with a line driver and a line receiver, up to 4 Mpps will be available. (+CWLD: 44, −CWLD: 45, +CCWLD: 46, −CCWLD: 47)

Controller

+    44,46

−    45,47

Applicable line driver AM26LS31A or equivalent

13

2 kΩ    20 kΩ

120 Ω

2 kΩ

20 kΩ

Applicable line driver AM26C32 or equivalent
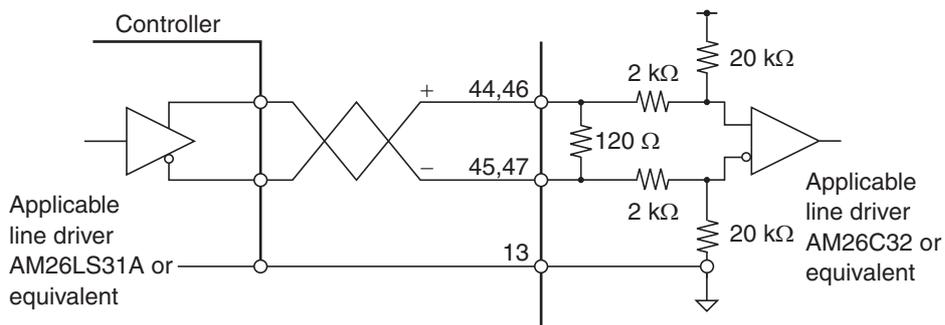
⬩ The shielded twisted-pair cable should not exceed 20 m in length.

## Position Command Pulse (Photocoupler Input)

**Line Driver Input (500 kpps Maximum)**

(+CW: 3, −CW: 4, +CCW: 5, −CCW: 6)



**Precautions for Correct Use**

⬩ The twisted-pair cable should not exceed 10 m in length.

### Open Collector Input

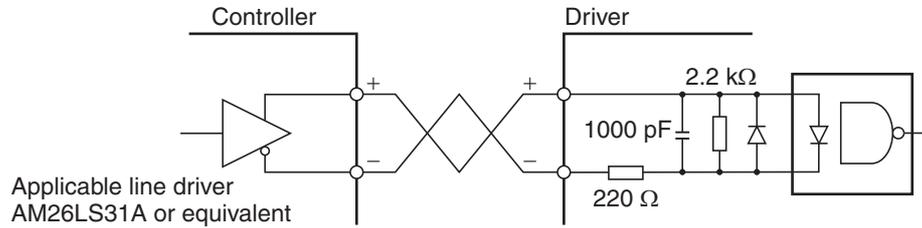• External 24-V power supply without a Current Limit Resistor (200 kpps maximum) (+24 VCW: 1, −CW: 4, +24 VCCW: 2, −CCW: 6)

Controller                     Driver

Vcc 24 V          +    2.2 kΩ

2.2 kΩ

1000 pF    220 Ω

−
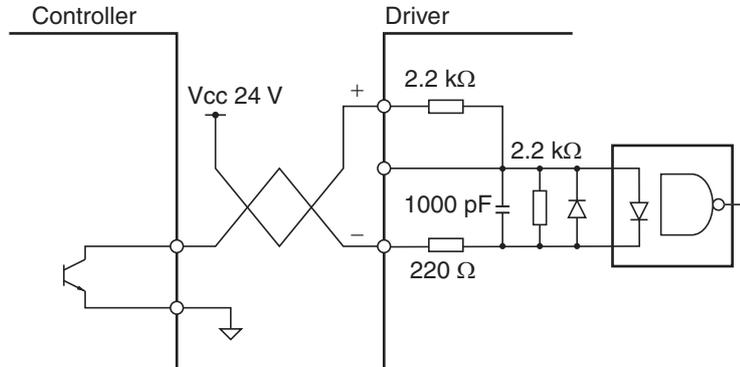
• External control power supply (200 kpps maximum) (+CW: 3, −CW: 4, +CCW: 5, −CCW: 6)

Controller                     Driver

Vcc                2.2 kΩ

R

+        2.2 kΩ

1000 pF

−    220 Ω
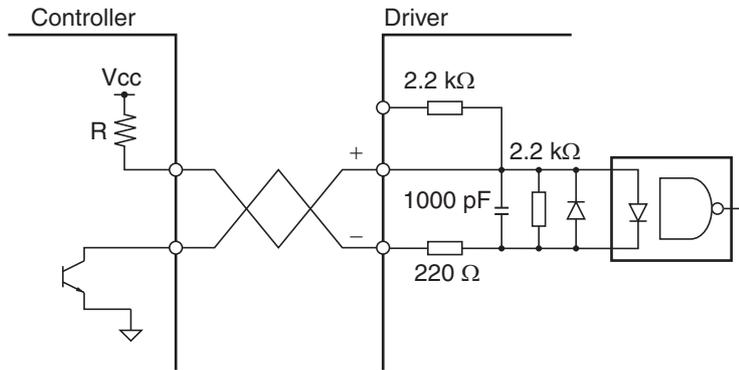
Select a Current Limit Resistor (R) appropriate for Vcc.32

$$\frac{Vcc - 1.5}{R + 220} \approx 10mA$$
(7 to 15 mA)

| VCC | R |
|-----|---|
| 24 V | 2 kΩ (1/2 W) |
| 12 V | 1 kΩ (1/2 W) |
| 5 V | 0 Ω (short) |

Precautions for Correct Use

• The open collector wiring should not exceed 2 m in length.

## General-purpose Input

External power supply
  12 VDC ± 5% to
  24 VDC ± 5%

Power supply capacity
50 mA or more
 (per unit)

Signal level
  ON level: 10 V or more
  OFF level: 3 V or less

Minimum ON time 40 ms

+24VIN 7    4.7 kΩ

SI1 8    1.0 kΩ    Photocoupler input

    4.7 kΩ

SI2 9    1.0 kΩ    Photocoupler input

To another input circuit GND common    To other input circuit
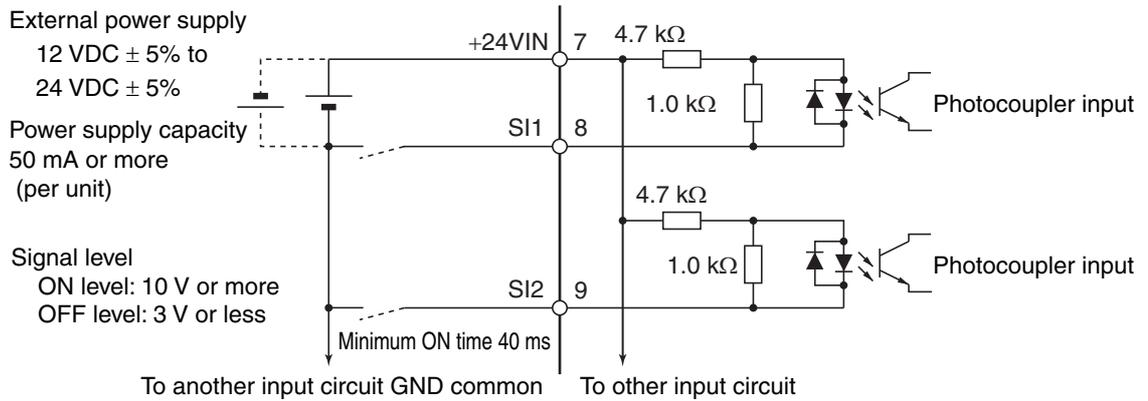
## Sensor Input

### Sensor ON Input  ABS

+5 V

7406 or equivalent

At high level
Approx. 1 mA

SEN  20    100 Ω

4.7 KΩ    1 μF

SENGND  13

SENGND
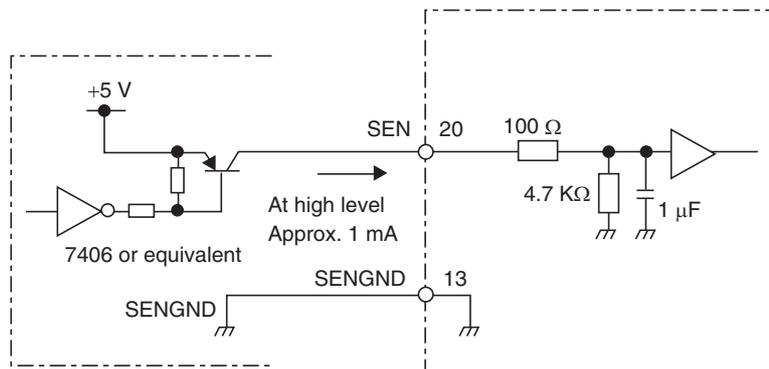
 • A PNP transistor is recommended.

 • The signal level is as follows.
   H level: 2.0 V or more, L level: 0.8 V or less

**3**

**Specifications**

## Control Input Details

Details on the input pins for the CN1 connector are described here.

### High-speed Photocoupler Input

Pin 3: +Reverse pulse (+CW), +feed pulse (+PULS), or +phase A (+FA)
Pin 4: −Reverse pulse (−CW), −feed pulse (−PULS), or −phase A (−FA)
Pin 5: +Forward pulse (+CCW), +direction signal (+SIGN), or +phase B (+FB)
Pin 6: −Forward pulse (−CCW), −direction signal (−SIGN), or −phase B (−FB)

**Function**

- The functions of these signals depend on the settings of the Command Pulse Rotation Direction Switching Selection (Pn006) and the COMMAND PULSE mode Selection (Pn007).

| Pn005 Set value | Pn006 Set value | Pn007 Set value | COMMAND PULSE mode | Input pins | Motor forward command | Motor reverse command |
|---|---|---|---|---|---|---|
| 0 | 0 | 0/2 | 90° phase difference signals (quadruple multiplier) | 3: +FA<br>4: −FA<br>5: +FB<br>6: −FB | | |
| | | 1 | Reverse pulse/forward pulse | 3: +CW<br>4: −CW<br>5: +CCW<br>6: −CCW | L | L |
| | | 3 | Feed pulse/ direction signal | 3: +PULS<br>4: −PULS<br>5: +SIGN<br>6: −SIGN | H | L |

Note 1. If the Command Pulse Rotation Direction Switching Selection (Pn006) is set to 1, the rotation direction will be reversed.
Note 2. If the photocoupler LED is turned ON, each signal will go high as shown above.

### Command Pulse Timing for Photocoupler Inputs

| COMMAND PULSE mode | Timing |
|---|---|
| Feed pulse/direction signal<br><br>Maximum input frequency<br>  Line driver:<br>  500 kpps<br>  Open collector:<br>  200 kpps | Forward command — Reverse command<br><br>Direction signal / Feed pulse<br>t1, t2, τ, T<br><br>At 200 kpps<br>$t1 \leq 0.5\ \mu s$<br>$t2 > 2.5\ \mu s$<br>$\tau \geq 2.5\ \mu s$<br>$T \geq 5.0\ \mu s$<br>$(\tau/T) \times 100 \leq 50\ (\%)$<br><br>At 500 kpps<br>$t1 \leq 0.1\ \mu s$<br>$t2 > 1.0\ \mu s$<br>$\tau \geq 1.0\ \mu s$<br>$T \geq 2.0\ \mu s$<br>$(\tau/T) \times 100 \leq 50\ (\%)$ |
| Reverse pulse/forward pulse<br><br>Maximum input frequency<br>  Line driver:<br>  500 kpps<br>  Open collector:<br>  200 kpps | Forward command — Reverse command<br><br>Reverse pulse / Forward pulse<br>t1, t2, τ, T<br><br>At 200 kpps<br>$t1 \leq 0.5\ \mu s$<br>$t2 > 2.5\ \mu s$<br>$\tau \geq 2.5\ \mu s$<br>$T \geq 5.0\ \mu s$<br>$(\tau/T) \times 100 \leq 50\ (\%)$<br><br>At 500 kpps<br>$t1 \leq 0.1\ \mu s$<br>$t2 > 1.0\ \mu s$<br>$\tau \geq 1.0\ \mu s$<br>$T \geq 2.0\ \mu s$<br>$(\tau/T) \times 100 \leq 50\ (\%)$ |
| 90° phase difference signals<br><br>Maximum input frequency<br>  Line driver:<br>  500 kpps<br>  Open collector:<br>  200 kpps | Forward command — Reverse command<br><br>Phase-A pulse / Phase-B pulse<br>t1, τ, T<br><br>At 200 kpps<br>$t1 \leq 0.5\ \mu s$<br>$\tau \geq 10\ \mu s$<br>$T \geq 20\ \mu s$<br>$(\tau/T) \times 100 \leq 50\ (\%)$<br><br>At 500 kpps<br>$t1 \leq 0.1\ \mu s$<br>$\tau \geq 4.0\ \mu s$<br>$T \geq 8.0\ \mu s$<br>$(\tau/T) \times 100 \leq 50\ (\%)$ |

**3**

**Specifications**

## Line Receiver Input

Pin 44: +Reverse pulse (+CW), +feed pulse (+PULS), or +phase A (+FA)
Pin 45: −Reverse pulse (−CW), −feed pulse (−PULS), or −phase A (−FA)
Pin 46: +Forward pulse (+CCW), +direction signal (+SIGN), or +phase B (+FB)
Pin 47: −Forward pulse (−CCW), −direction signal (−SIGN), or −phase B (−FB)

### Function

⬥ The functions of these signals depend on the settings of the Command Pulse Rotation Direction Switching Selection (Pn006) and the COMMAND PULSE mode Selection (Pn007).
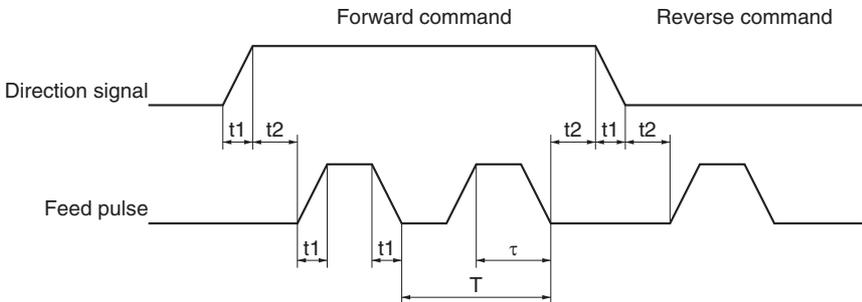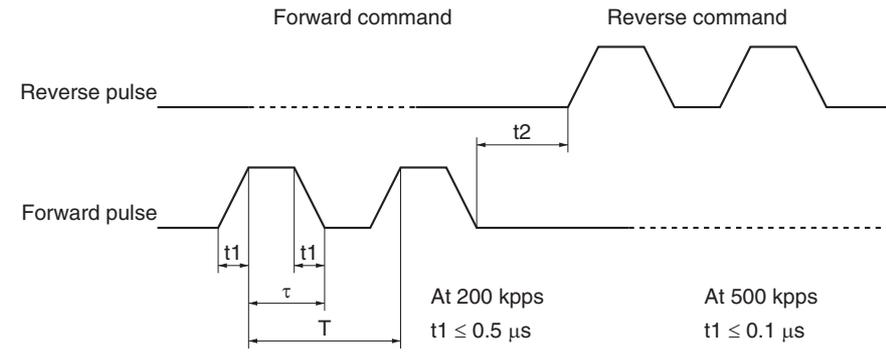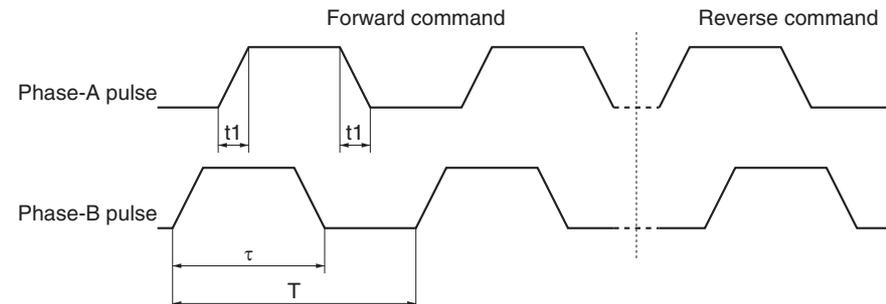
| Pn005 Set value | Pn006 Set value | Pn007 Set value | COMMAND PULSE mode | Input pins | Motor forward command | Motor reverse command |
|---|---|---|---|---|---|---|
| 1 | 0 | 0/2 | 90° phase difference signals (quadruple multiplier) | 44: +FA<br>45: −FA<br>46: +FB<br>47: −FB | | |
| | | 1 | Reverse pulse/ forward pulse | 44: +CW<br>45: −CW<br>46: +CCW<br>47: −CCW | | |
| | | 3 | Feed pulse/ direction signal | 44: +PULS<br>45: −PULS<br>46: +SIGN<br>47: −SIGN | | |

Note 1. If the Command Pulse Rotation Direction Switching Selection (Pn006) is set to 1, the rotation direction will be reversed.

### Command Pulse Timing for Line Receiver Inputs

| COMMAND PULSE mode | Timing |
|---|---|
| Feed pulse/direction signal<br><br>Maximum input frequency<br>Line driver:<br>4 Mpps | Forward command — Reverse command<br>Direction signal / Feed pulse<br><br>$t1 \leq 20$ ns<br>$t2 > 500$ ns<br>$\tau \geq 250$ ns<br>$T \geq 500$ ns<br>$(\tau/T) \times 100 \leq 50$ (%) |
| Reverse pulse/forward pulse<br><br>Maximum input frequency<br>Line driver:<br>4 Mpps | Forward command — Reverse command<br>Reverse pulse / Forward pulse<br><br>$t1 \leq 20$ ns<br>$t2 > 500$ ns<br>$\tau \geq 250$ ns<br>$T \geq 500$ ns<br>$(\tau/T) \times 100 \leq 50$ (%) |
| 90° phase difference signals<br><br>Maximum input frequency<br>Line driver:<br>4 Mpps | Forward command — Reverse command<br>Phase-A pulse / Phase-B pulse<br><br>$t1 \leq 20$ ns<br>$\tau \geq 4.0$ μs<br>$T \geq 8.0$ μs<br>$(\tau/T) \times 100 \leq 50$ (%) |
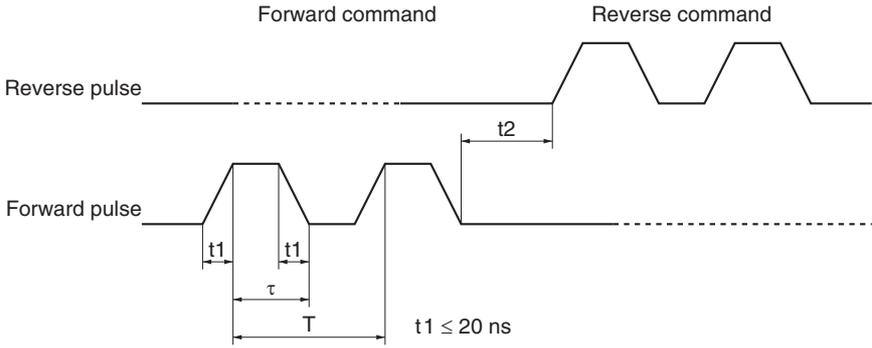
3

Specifications
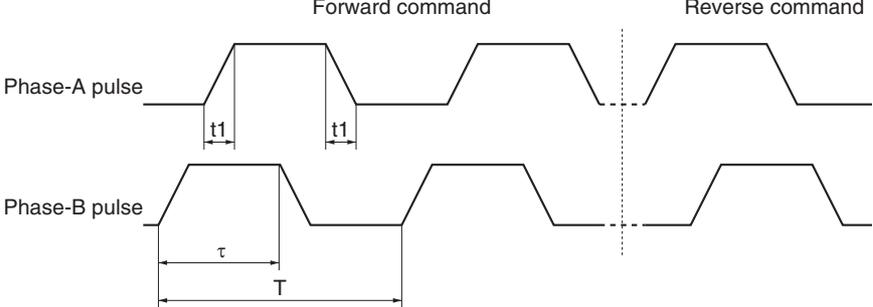
## Sensor ON Input (SEN)

Pin 20: Sensor ON input (SEN)
Pin 13: Signal ground (SENGND)

### Function

This input changes to enable (set value: 1) according to the setting of Absolute Interface Function Selection (Pn616).
When the SEN signal turns ON, this performs serial transmission of multi-rotation data of the absolute encoder and also outputs 1-rotation data as the initial incremental pulses.
If the SEN signal is OFF, motor power supply is not possible even when the RUN signal (Operation command) is input. The RUN signal changes to enable after the SEN signal turns ON and the normal operation of encoder becomes ready.

## Backup Battery Input (BAT)

Pin 42: Backup battery +input (BAT)
Pin 43: Backup battery −input (BATGND)

### Function

Backup battery connection terminals when the absolute encoder power is interrupted.
Normally do not connect anything to this terminal, because a battery is connected to the battery holder for absolute encoder battery cable. (Never connect to both. Failure may result.)

## Speed Command Input (REF), Torque Command Input (TREF1) and Speed Limit Input (VLIM)

Pin 14: Speed command input (REF), torque command Input (TREF1) and speed limit input (VLIM)
Pin 15: Analog input ground (AGND1)

### Function

⬥ During speed control
Speed command is input. Use the Speed Command Scale (Pn302) to change the rotation speed scale for the command input.
⬥ During torque control
This signal provides either a torque command input (set value: 0 or 2) or speed limit input (set value: 1) according to the setting of Torque Command/Speed Limit Selection (Pn317).
In the case of torque command input 1 (TREF1), you can use Torque Command Scale (Pn319) to change the rotation speed scale relative to the command input.
In the case of speed limit input (VLIM), you can use the Speed Command Scale (Pn302) to change the limit speed scale relative to the analog input.

## Torque Command Input 2 (TREF2) and Forward Torque Limit Input (PCL)

Pin 16: Torque command input 2 (TREF2) and forward torque limit input (PCL)
Pin 17: Analog input ground 2 (AGND2)

### Function

⬩ During position control, speed control or full closing control
This signal provides a forward torque limit input (set value: 0 or 4) or forward/reverse torque limit input (set value: 5) according to the setting of Torque Limit Selection (Pn521).
You can use Analog Torque Limit Scale (Pn527) to change the torque limit scale relative to the analog input.

⬩ During torque control
This signal provides a torque command input (set value: 1) according to the setting of Torque Command/Speed Limit Selection (Pn317).
In the case of torque command input 2 (TREF2), you can use Torque Command Scale (Pn319) to change the rotation speed scale relative to the command input.

## Reverse Torque Limit Input (NCL)

Pin 18: Reverse torque limit input (NCL)
Pin 17: Analog input ground 2 (AGND2)

### Function

⬩ During position control, speed control or full closing control
This signal provides a reverse torque limit input (set value: 0 or 4) according to the setting of Torque Limit Selection (Pn521).
You can use Analog Torque Limit Scale (Pn527) to change the torque limit scale relative to the analog input.

## Operation command (RUN)

Pin 29: Operation command (RUN)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).
You must always allocate the Operation command (RUN). If not, the servo does not turn ON.

### Function

This input turns ON the power drive circuit for the main circuit of the Servo Drive. If this signal is not input (servo OFF), the motor cannot drive.

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

Pin 9: Forward drive prohibition input (POT)
Pin 8: Reverse drive prohibition input (NOT)
This is the allocation at default setting. Note, however, that both signals are set to disable (drive prohibition is disabled). You can use Drive Prohibition Input Setting (Pn504) to change these settings. Also, you can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

These 2 signals are drive prohibition (overtravel) inputs in forward and reverse directions.
If Drive Prohibition Input Setting (Pn504) is 1, you can use the setting of Stop Selection (Pn505) to select the operation to be taken upon input of each prohibit signal.
If Drive Prohibition Input Setting (Pn504) is 2, drive prohibition input protection (E380) actuates upon input of a drive prohibition.

**3**

**Specifications**

## Alarm Reset Input (RESET)

Pin 31: Alarm reset input (RESET)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).
The input logic for the alarm reset input (RESET) is always contact a. (You cannot set contact b.)

### Function

It is the external reset input for servo alarm. (A reset occurs at the rising edge of this input.)
Inputting for 120 ms or more releases an alarm condition.
An alarm reset also resets the content of the error counter, upon which the position loop becomes no longer effective.
Eliminate the cause of the alarm before resuming operation. To prevent danger, turn OFF the Operation command (RUN) first, then input the alarm reset signal.
Some alarms cannot be reset with this input.

## Error Counter Reset Input (ECRST)

Pin 30: Error counter reset input (ECRST)
This is the allocation at default setting. You can change the functions for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).
You can only allocate the error counter reset input (ECRST) to pin 30 (SI7). Allocating to any other terminal generates an error counter reset signal allocation error (A332).
The input logic for the error counter reset input (ECRST) is always contact a. (You cannot set contact b.)

### Function

Inputting the error counter reset resets the content of the error counter, upon which the position loop becomes no longer effective.
You can use Error Counter Reset Condition Selection (Pn517) to set the status (level) signal (ON) or differential (rising edge) signal (from OFF to ON).
Input the differential signal for at least 100 μs, or status signal for at least 1 ms. A reset may not occur if the time is shorter.

## CONTROL mode Switching (TVSEL)

Pin 32: CONTROL mode switching (TVSEL)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

If the CONTROL mode Selection (Pn001) is set to 3 to 5, the CONTROL mode can be switched as given in the following table.

| Pn001 set value | OFF (FIRST CONTROL mode) | ON (SECOND CONTROL mode) |
|---|---|---|
| 3 | Position control | Speed control |
| 4 | Position control | Torque control |
| 5 | Speed control | Torque control |

## Gain Switching (GSEL)

Pin 27: Gain switching (GSEL)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

This signal changes to enable (set value: 2) according to the setting of GAIN SWITCHING mode (Pn115 for position control, Pn120 for speed control, or Pn124 for torque control).
When the signal is OFF and ON, gain 1 and gain 2 change to enable, respectively.

## Vibration Filter Switching 1 (DFSEL1) and Vibration Filter Switching 2 (DFSEL2)

Pin 26: Vibration filter switching 1 (DFSEL1)
No allocation: Vibration filter switching 2 (DFSEL2)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

Use the sequence signal to switch among the 4 filters for use in damping control when the setting of Vibration Filter Selection (Pn213) is enable (set value: 1 or 2).

| Pn213 set value | DFSEL1 | DFSEL2 | Vibration filter 1 | Vibration filter 2 | Vibration filter 3 | Vibration filter 4 |
|---|---|---|---|---|---|---|
| 1 | OFF | – | Enabled | | Enabled | |
| | ON | – | | Enabled | | Enabled |
| 2 | OFF | OFF | Enabled | | | |
| | ON | OFF | | Enabled | | |
| | OFF | ON | | | Enabled | |
| | ON | ON | | | | Enabled |

## Electronic Gear Switching 1 (GESEL1) and Electronic Gear Switching 2 (GESEL2)

Pin 28: Electronic gear switching 1 (GESEL1)
No allocation: Electronic gear switching 2 (GESEL2)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

Use these 2 signals to switch among up to 4 electronic gear ratio numerators.

| GESEL1 | GESEL2 | Electronic Gear 1 | Electronic Gear 2 | Electronic Gear 3 | Electronic Gear 4 |
|---|---|---|---|---|---|
| OFF | OFF | Pn009 valid | | | |
| ON | OFF | | Pn500 valid | | |
| OFF | ON | | | Pn501 valid | |
| ON | ON | | | | Pn502 valid |

⬩ Electronic Gear Ratio Denominator (Pn010) is a common setting.

## Pulse Prohibition Input (IPG)

Pin 33: Pulse prohibition input (IPG)
This is the allocation at default setting. However, Command Pulse Prohibition Input (Pn518) is set to disable (set value: 1). To use this, change Pn518 to enable (set value: 0). You can change the functions for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).
You can only allocate the pulse prohibition input (ECRST) to pin 33 (SI10). Allocating this input to any other terminal generates a pulse prohibition input allocation error (A337).

### Function

You can use this input to forcibly stop the command pulse input.
When this input is ON, the driver ignores the command pulse input and does not count pulses.

## Internally Set Speed Selection 1, 2 and 3 (VSEL1, 2 and 3)

Pin 33: Internally set speed selection 1 (VSEL1) Pin 30: Internally set speed selection 2 (VSEL2)
Pin 28: Internally set speed selection 3 (VSEL3)
This is the allocation at default setting. However, Command Speed Selection (Pn300) is set to disable (set value: 0). To use this, change Command Speed Selection (Pn300) to enable (set value: 1 to 3). You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

Perform speed control according to the internal speed set value in the parameter.
You can select from up to 8 internal speed set values.

| Pn300 set value | VSEL1 | VSEL2 | VSEL3 | Speed command selection |
|---|---|---|---|---|
| 1 | OFF | OFF | – | No. 1 Internally Set Speed (Pn304) |
| | ON | OFF | – | No. 2 Internally Set Speed (Pn305) |
| | OFF | ON | – | No. 3 Internally Set Speed (Pn306) |
| | ON | OFF | – | No. 4 Internally Set Speed (Pn307) |
| 2 | OFF | OFF | – | No. 1 Internally Set Speed (Pn304) |
| | ON | OFF | – | No. 2 Internally Set Speed (Pn305) |
| | OFF | ON | – | No. 3 Internally Set Speed (Pn306) |
| | ON | OFF | – | Analog speed command input (REF) |
| 3 | OFF | OFF | OFF | No. 1 Internally Set Speed (Pn304) |
| | ON | OFF | OFF | No. 2 Internally Set Speed (Pn305) |
| | OFF | ON | OFF | No. 3 Internally Set Speed (Pn306) |
| | ON | OFF | OFF | No. 4 Internally Set Speed (Pn307) |
| | OFF | OFF | ON | No. 5 Internally Set Speed (Pn308) |
| | ON | OFF | ON | No. 6 Internally Set Speed (Pn309) |
| | OFF | ON | ON | No. 7 Internally Set Speed (Pn310) |
| | ON | OFF | ON | No. 8 Internally Set Speed (Pn311) |

To use the internally set speed, use the zero speed designation input (VZERO) as contact b.(If this is OFF, the speed command becomes 0.)The zero speed designation input (VZERO) is set to disable (set value: 0) by default. To use this, change Zero Speed Designation Selection (Pn315) to enable (set value: 1 to 2).
(If the zero speed designation input is not used, the motor turns at No. 1 Internally Set Speed (Pn304) when the servo turns ON.)

## Zero Speed Designation (VZERO)

No allocation: Zero speed designation (VZERO)
There is no allocation at default setting. Also, Zero Speed Designation Selection (Pn315) is set to disable (set value: 1). You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

You can use this input to forcibly change the speed command to 0.
This signal changes to enable (set value: 1 to 3) according to the setting of Zero Speed Designation Selection (Pn315).

| Pn300 set value | Operation when ON |
|---|---|
| 0 | Zero speed designation is disabled. |
| 1 | The speed command becomes 0. |
| 2 | The speed command becomes 0, and a position lock occurs at a motor rotation speed equal to Position Lock Level Setting (Pn316) or less. |
| 3 | A position lock occurs at a command speed equal to Position Lock Level Setting (Pn316) or less. |

## Speed Command Sign Input (VSIGN)

No allocation: Speed command sign designation (VSIGN)
There is no allocation at default setting. Also, Speed Command Direction Selection (Pn301) is set to disable (set value: 0). You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

You can use this input to designate the rotation direction relative to the speed command.
If Speed Command Direction Selection (Pn301) is enable (set value: 1), the polarity of analog command input and rotation direction at internal command speed become disabled.

| Pn301 set value | Pn303 set value | VSIGN | Analog speed command input (REF) | Motor rotation direction |
|---|---|---|---|---|
| 0 | 0 | Operation Disabled | +Voltage (0 to +10 V) | Forward operation |
| | | | −Voltage (−10 to 0 V) | Reverse operation |
| | 1 | | +Voltage (0 to +10 V) | Reverse operation |
| | | | −Voltage (−10 to 0 V) | Forward operation |
| 1 | Setting Disabled | OFF | +Voltage (0 to +10 V) | Forward operation |
| | | | −Voltage (−10 to 0 V) | |
| | | ON | +Voltage (0 to +10 V) | Reverse operation |
| | | | −Voltage (−10 to 0 V) | |

| Pn301 set value | VSIGN | Internal command speed | Motor rotation direction |
|---|---|---|---|
| 0 | OFF | + (Forward command: 0 to +20,000 r/min) | Forward operation |
| | | − (Reverse command: −20,000 to 0 r/min) | Reverse operation |
| | ON | + (Forward command: 0 to +20,000 r/min) | Forward operation |
| | | − (Reverse command: −20,000 to 0 r/min) | Reverse operation |
| 1 | OFF | + (Forward command: 0 to +20,000 r/min) | Forward operation |
| | | − (Reverse command: −20,000 to 0 r/min) | |
| | ON | + (Forward command: 0 to +20,000 r/min) | Reverse operation |
| | | − (Reverse command: −20,000 to 0 r/min) | |

## Torque Limit Switching (TLSEL)

No allocation: Torque Limit Switching (TLSEL)
There is no allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

This input is used for switching the torque limit value.
This signal changes to enable (set value: 3 or 6) according to the setting of Torque Limit Selection (Pn521).

| Pn521 set value | TLSEL | Forward | Reverse |
|---|---|---|---|
| 3 | OFF | Pn013 (No. 1 Torque Limit) | Pn013 (No. 1 Torque Limit) |
| | ON | Pn522 (No. 2 Torque Limit) | Pn522 (No. 2 Torque Limit) |
| 6 | OFF | Pn013 (No. 1 Torque Limit) | Pn522 (No. 2 Torque Limit) |
| | ON | Pn525 (Forward External Torque Limit) | Pn526 (Reverse External Torque Limit) |

## Torque Command Sign Input (TSIGN)

No allocation: Torque command sign input (TSIGN)
There is no allocation at default setting. Also, Torque Command Direction Selection (Pn318) is set to disable (set value: 0). You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

You can use this input to designate the rotation direction relative to the torque command.
If Torque Command Direction Selection (Pn301) is enable (set value: 1), the polarity of torque command input is disabled.

| Pn318 Set value | Pn320 Set value | TSIGN | Torque command input (TREF) | Motor rotation direction |
|---|---|---|---|---|
| 0 | 0 | Operation Disabled | +Voltage (0 to +10 V) | Forward operation |
| | | | −Voltage (−10 to 0 V) | Reverse operation |
| | 1 | | +Voltage (0 to +10 V) | Reverse operation |
| | | | −Voltage (−10 to 0 V) | Forward operation |
| 1 | Setting Disabled | OFF | +Voltage (0 to +10 V) | Forward operation |
| | | | − Voltage (−10 to 0 V) | |
| | | ON | +Voltage (0 to +10 V) | Reverse operation |
| | | | − Voltage (−10 to 0 V) | |

## Emergency Stop Input (EMG-STP)

No allocation: Emergency stop input (EMG-STP)
There is no allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

This is an external alarm stop input.
Upon input of an emergency stop, the system stops according to the set value of Stop Selection for Alarm Generation (Pn510).

## Inertia Ratio Switching Input (JSEL)

No allocation: Inertia ratio switching input (JSEL)
This is the allocation at default setting. You can change the logics and allocations for input terminals (CN1 to 8, 9 and 26 to 33) according to the settings of Input Signal Selection 1 to 10 (Pn400 to 409).

### Function

You can switch the inertia ratio between Inertia Ratio 1 (Pn004) and Inertia Ratio 2 (Pn613). When this signal is OFF, Inertia Ratio 1 (Pn004) becomes valid. If ON, Inertia Ratio 2 (Pn613) becomes valid.

**3**

**Specifications**

**3**

**Specifications**

## Control Output Circuits

### Position Feedback Output

Servo Drive

Controller

R = 120 to 180 Ω

+5 V

Output line driver
AM26C31 or
equivalent

Phase A

21 +A
22 −A

+A
−A

R

Phase A

Phase B

49 +B
48 −B

+B
−B

R

Phase B

Phase Z

23 +Z
24 −Z

+Z
−Z

R

Phase Z

0 V

25 ZCOM

GND

0 V

0 V

Shell FG

0 V

Applicable line receiver
AM26C32 or equivalent

FG

FG

### Phase-Z Output (Open Collector Output)

Driver

Controller

19 Z

25 ZCOM

Maximum service voltage: 30 VDC or less
Maximum output current: 50 mA or less

Shell FG

0 V

FG

FG

### Sequence Output

Servo Drive

10 Ω

+

X

−

Di

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

### Control Output Sequence

Control power supply (L1C and L2C) — ON / OFF

Approx. 100 to 300 ms

Internal control power supply — ON / OFF

Approx. 1.5 s    Approx. 2 s

MPU initialization completed — ON / OFF    Initialization *3

Main circuit power supply (L1, L2 and L3) — ON / OFF    0 s or more

Approx. 10 ms after initialization and main circuit ON *2

Servo ready completed output (READY) — ON / OFF

Alarm output (ALM) — ON / OFF

Positioning completion output (INP) — ON / OFF

0 ms or more

Operation command input (RUN) — ON / OFF

Approx. 2 ms

Dynamic brake — ON / OFF

Approx. 60 ms    Pn437

Motor power supply — ON / OFF

Approx. 4 ms    1 to 6 ms

Brake interlock output (BKIR) — ON / OFF

100 ms or more *1

Servo position, speed, torque input — ON / OFF

*1. In this section, the hardware inputs the servo ON signal, but the signal is not accepted.

*2. The servo ready completed output turns ON the moment the conditions of MPU initialization completed and main circuit power supply establishment are both satisfied.

*3. Operation of the protective function starts approx. 1.5 seconds after the start of MPU initialization following an establishment of internal control power supply. Make sure all I/O signals which connect to the amplifier (especially forward/reverse direction, drive prohibition input and external scale input) are established before operation of the protective function starts. Also, you can increase this time with Pn618 "Power Supply ON Initialization Time."

## Encoder Outputs (Phases A, B and Z)

Pin 21: +A, 22: -A, 48: -B, 49: +B, 23: +Z, 24: -Z

**Function**

- It outputs the phase A, phase B, and phase Z encoder signals for the Servomotor.
- The encoder outputs conform to the RS-422 communication method.
- You can use External Feedback Pulse Dividing Numerator Setting (Pn324) and External Feedback Pulse Dividing Denominator Setting (Pn325) to set the dividing ratio.
- The logical relation of phase B to the phase A pulse and the output source are set in the External Feedback Pulse Direction Switching (Pn326).
- The ground for the output circuit line driver is connected to the signal ground (SENGND). It is not isolated.
- The maximum output frequency is 4 Mpps (after quadruple multiplier).
- The output frequency = the motor encoder resolution × (Pn324/Pn325) × 4 × motor rotation speed (r/min)/60
- The output phases are as shown below. (They are the same for both incremental and absolute encoders.)

| | |
|---|---|
| Phase A<br>Phase B<br>Phase Z<br>**Synchronous** | Phase A<br>Phase B<br>Phase Z<br>**Asynchronous** |
| • If the motor encoder resolution × Pn324/Pn325 is a multiple of 4, phases Z and A are synchronized. | • In cases except for the one on the left, phases A and Z are not synchronized. |
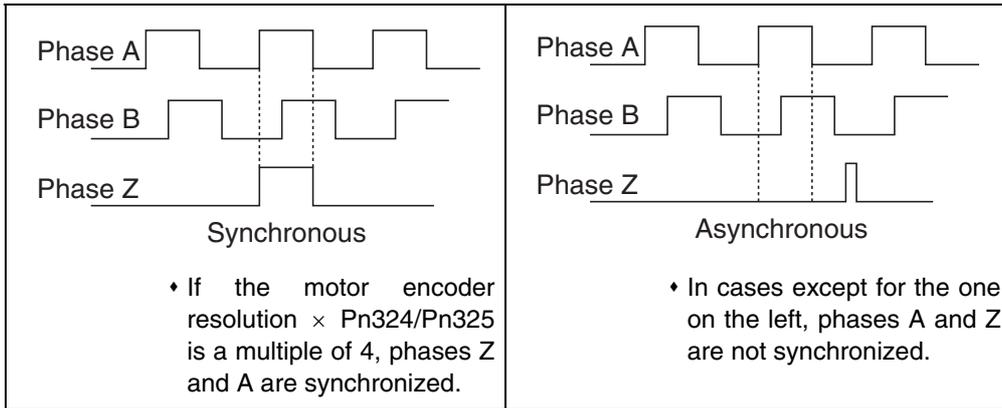
## Brake Interlock Output (BKIR)

Pin 11: Brake interlock output (BKIR)
Pin 10: Brake interlock output common (BKIRCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

This outputs an external brake timing signal according to the settings of the Brake Timing when Stopped (Pn437) and Brake Timing during Operation (Pn438).

## Servo Ready Completed Output (READY)

Pin 35: Servo ready completed output (READY)
Pin 34: Servo ready completed output common (READYCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

This output signal indicates that the driver is turned ON and ready to start operation.
It is turned ON when the control and main power supply is established and not in alarm status.

## Alarm Output (/ALM)

Pin 37: Alarm Output (/ALM)
Pin 36: Alarm output common (ALMCOM)
The alarm output terminal is fixed to pin 36 or 37.

### Function

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

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

Pin 39: Positioning completion output 1 (INP1)
Pin 38: Positioning completion output common (INP1COM)
No allocation: Positioning completion output 2 (INP2)
No allocation: Positioning completion output 2 (INP2COM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

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).

## Speed Conformity Output (TGON)

Pin 39: Speed conformity output (TGON)
Pin 39: Speed conformity output common (TGONCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

**Function**

It turns ON when the speed of the Servomotor exceeds the set value of the Rotation Speed for Motor Rotation Detection (Pn436).

## Torque Limiting Signal (TLIMT)

No allocation: Torque limiting signal (TLIMT)
No allocation: Torque limiting signal common (TLIMCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

**Function**

This output turns ON while the torque is limited.

## Zero Speed Detection Signal (ZSP)

No allocation: Zero speed detection signal (ZSP)
No allocation: Zero speed detection signal common (ZSPCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

**Function**

This output turns ON when the motor rotation speed is equal to Zero Speed Detection (Pn434) or less.

## Speed Conformity Output Signal (VCMP)

No allocation: Speed conformity output signal (VCMP)
No allocation: Speed conformity output signal common (VCMPCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

**Function**

This output turns ON when the command speed corresponds to the motor rotation speed.
This output turns ON when the difference between the command speed and motor rotation speed is inside the setting range of Speed Conformity Detection Width (Pn435).

## Warning Output 1 (WARN1) and Warning Output 2 (WARN2)

No allocation: Warning output 1 (WARN1) and warning output 2 (WARN2)
No allocation: Warning output 1 common (WARN1COM) and warning output 2 common (WARN2COM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

**Function**

The output turns ON according to the setting conditions of Warning Output Selection 1 (Pn440) and Warning Output Selection 2 (Pn441).

## Position Command Status Output (P-CMD)

No allocation: Position command status output (P-CMD)
No allocation: Position command status output common (P-CMDCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

This output turns ON when a positioning command is input.

## Speed Limiting Output (V-LIMIT)

No allocation: Speed limiting output (V-LIMIT)
No allocation: Speed limiting output common (V-LIMITCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

This turns ON during torque control or speed limit status.

## Alarm Clear Attribute Output (ALM-ATB)

No allocation: Alarm clear attribute output (ALM-ATB)
No allocation: Alarm clear attribute output common (ALM-ATB COM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

This output turns ON when an alarm occurs or the alarm can be cleared.

## Speed Command Status Output (V-CMD)

No allocation: Speed command status output (V-CMD)
No allocation: Speed command status output common (V-CMDCOM)
This is the allocation at default setting. You can change the allocations of output terminals (CN1 to 10, 11, 34, 35, 38 and 39) according to the settings of Output Signal Selections 1 to 4 (Pn410 to 413).

### Function

This output turns ON during speed control or when a speed command is input.

**3**

**Specifications**

## 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 (Pin 6)

| Name | Model | Manufacturer |
|---|---|---|
| Driver connector | 53460-0629 | Molex Japan |
| Cable connector | 55100-0670 | |

## External Encoder Connector Specifications (CN4)

Connects to 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 | PS | External encoder signal I/O (Serial signal) | Performs the serial signal input and output. |
| 4 | /PS | | |
| 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 (Pin 10)

| Name | Model | Manufacturer |
|---|---|---|
| Connector | MUF-PK10K-X | JST Mfg. Co., Ltd. |

**3**

**Specifications**

## Connection of External Encoder Input Signal and Processing of External Signals
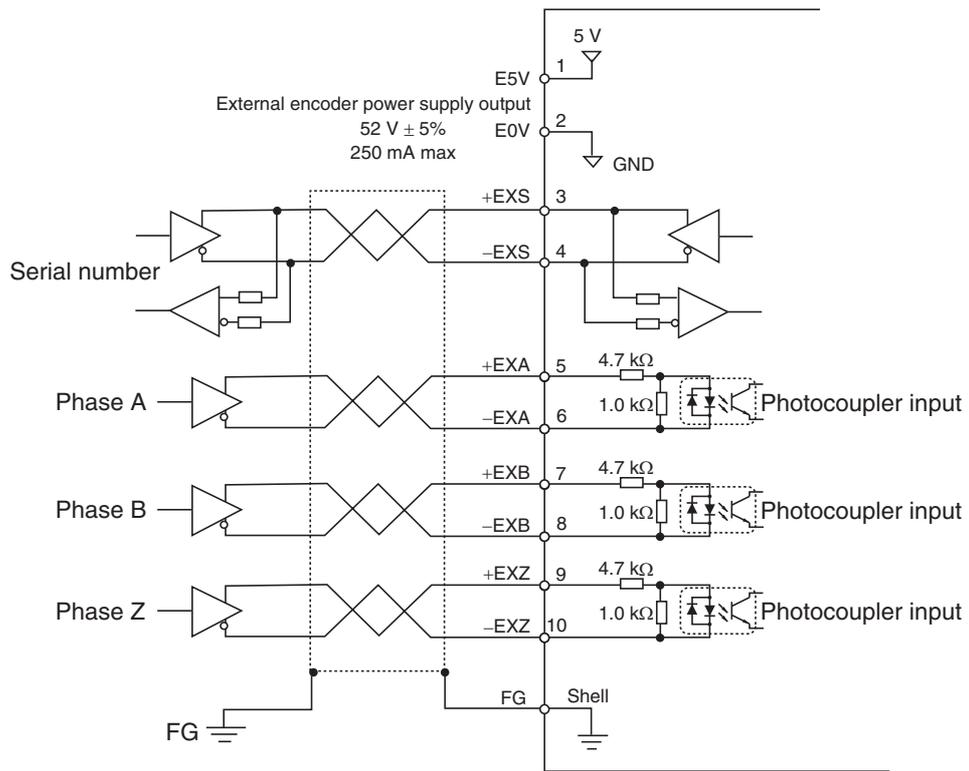


## External Encoder Input Signals List

### 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.*(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.* Maximum response frequency 4 Mpps (quadruple multiplier) |
| 6 | −EXA | | |
| 7 | +EXB | | |
| 8 | −EXB | | |
| 9 | +EXZ | | |
| 10 | −EXZ | | |

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

## Connector for CN4 (Pin 10)

| Name | Model | Manufacturer |
|------|-------|--------------|
| MUF connector | MUF-PK10K-X | JST Mfg. Co., Ltd. |

## Example of Connection with External Encoder

### ■ 90 Phase Difference Input Type (Pn323 = 0)
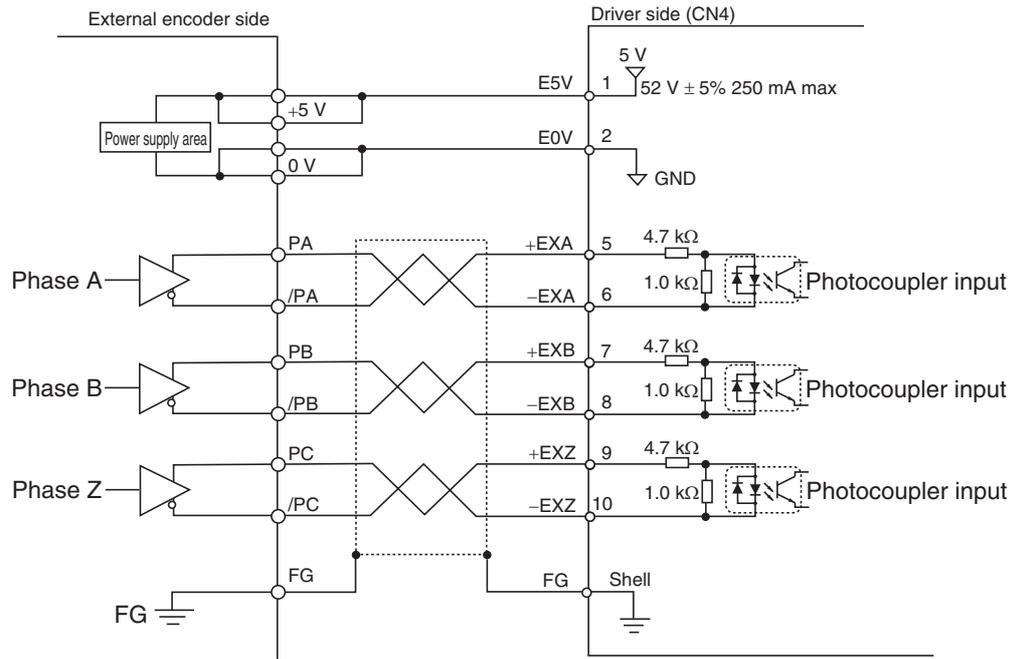


### ■ Serial Communications Type, Incremental Encoder Specifications (Pn323 = 1)
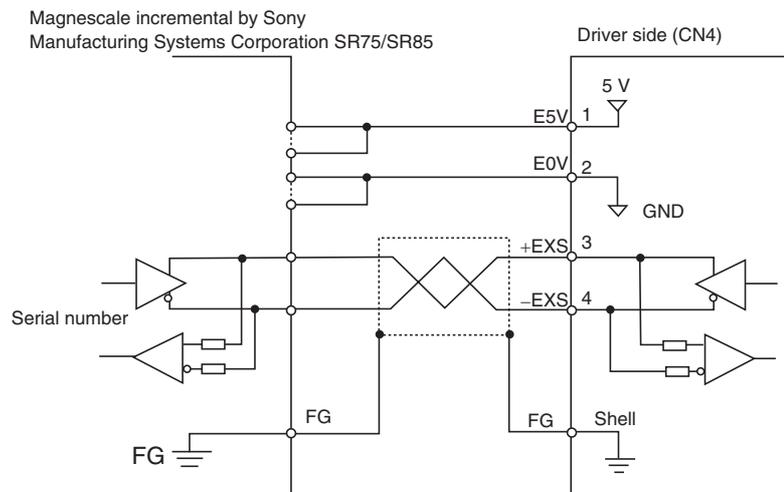
■ **Serial Communications Type, Absolute Encoder Specifications (Pn323 = 2)**

**3**
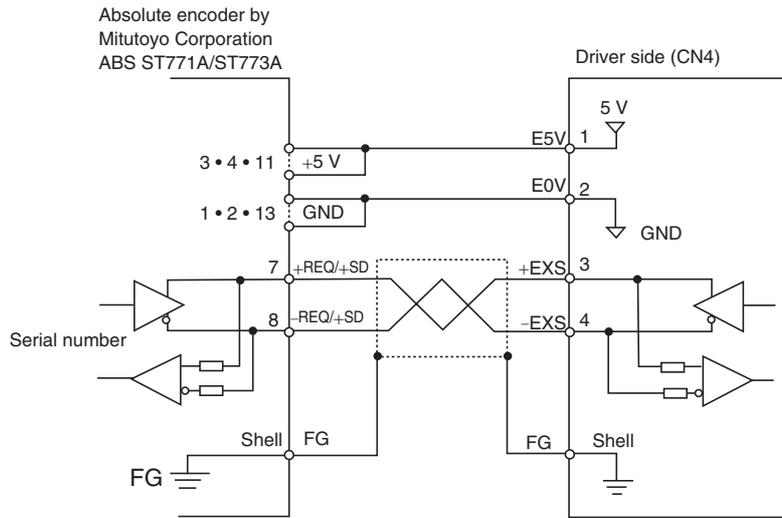
**Specifications**

## 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.<br>Default setting: Motor rotation speed 1 V/(1,000 r/min)<br>You can use Pn416 and Pn417 to change the item and unit.<br>You can use Pn421 to change the output method. |
| 2 | AM2 | Analog monitor output 2 | Outputs the analog signal for the monitor.<br>Default setting: Motor rotation speed 1 V/(1,000 r/min)<br>You can use Pn418 and Pn419 to change the item and unit.<br>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 (Pin 6)

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

### Monitor output circuit
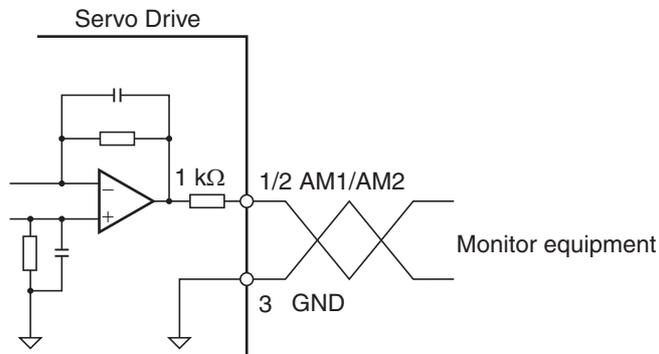
## USB Connector Specifications (CN7)

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 | SENGND | Signal ground | Signal ground |

## Safety Connector Specifications (CN8)

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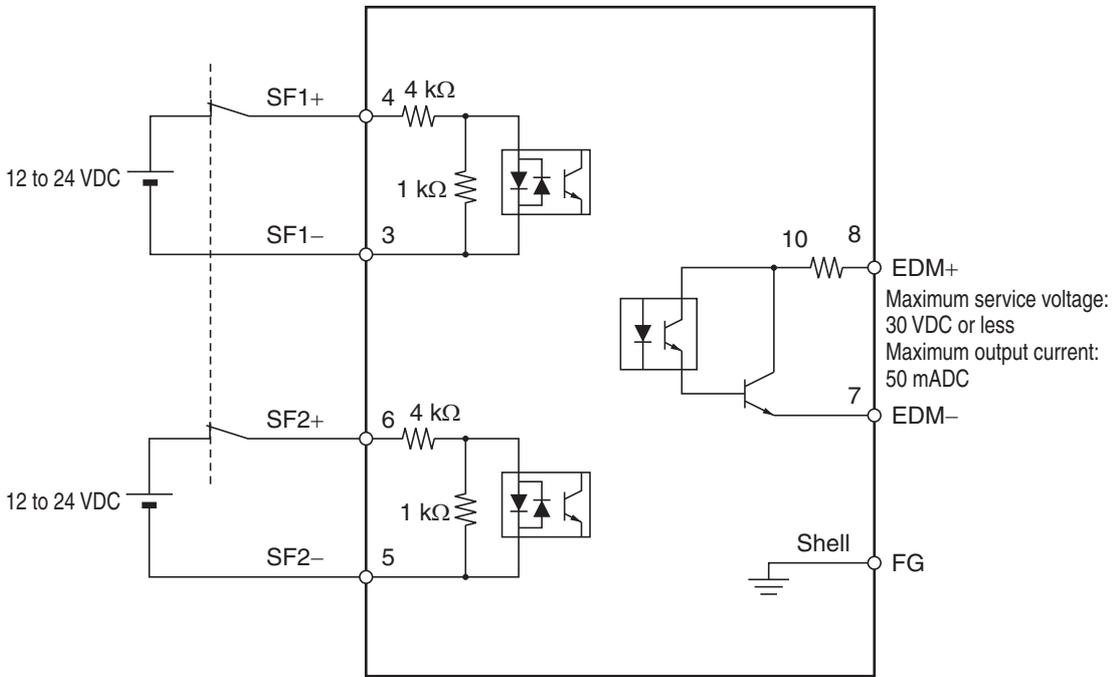


### Safety I/O Signals List

#### 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 (Pin 8)

| Name | Model | Manufacturer |
|---|---|---|
| Industrial Mini I/O Connector (D-SHAPE1) | 2013595-1 | Tyco Electronics AMP KK |

## Safety Input Circuit



## EDM Output Circuit



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

**3**

**Specifications**
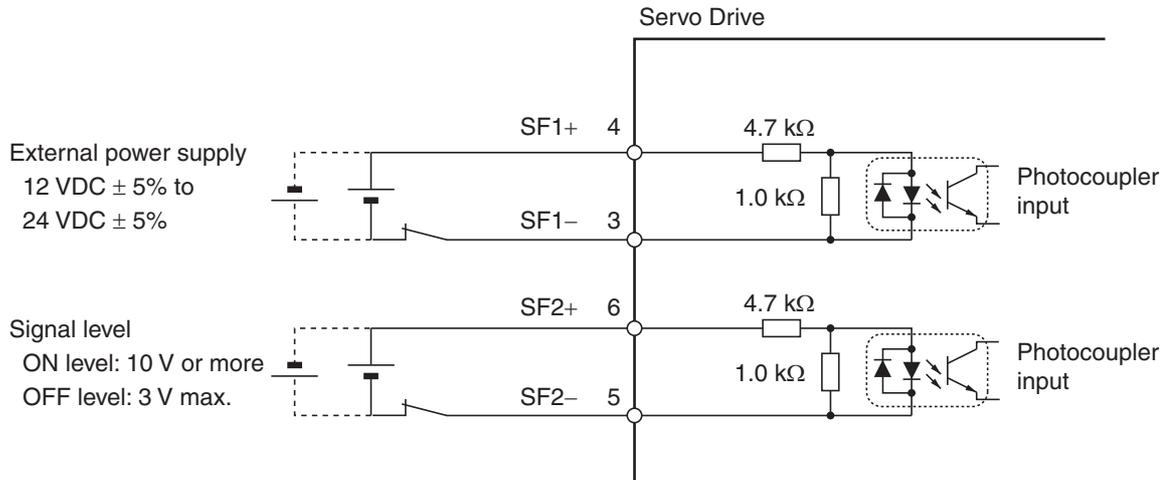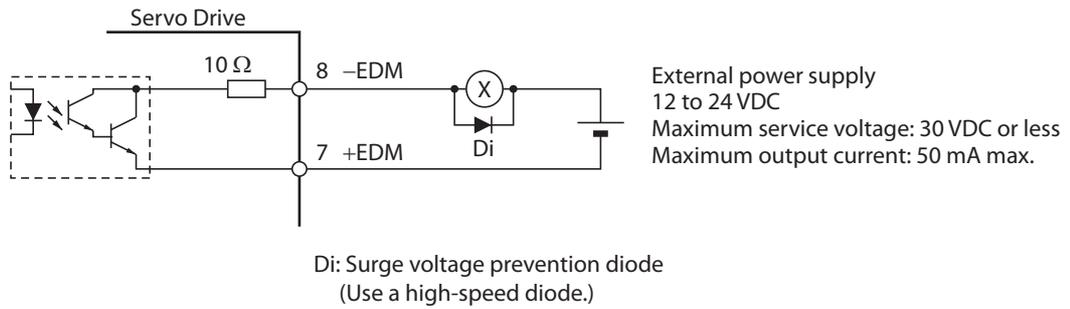
# 3-2 Overload Characteristics (Electronic Thermal Function)

An overload protection function (electronic thermal) is built into the driver to protect the driver 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.
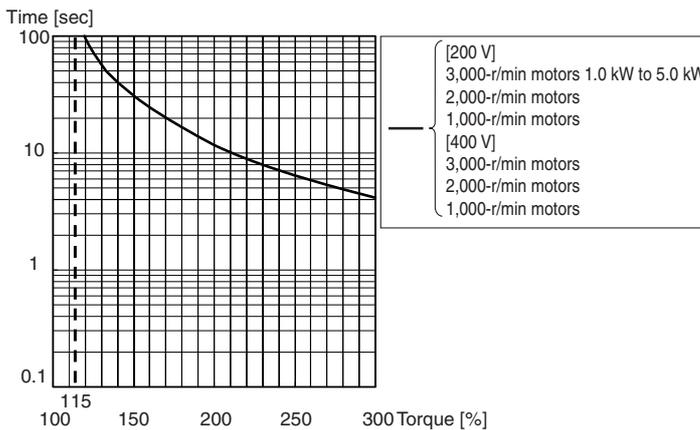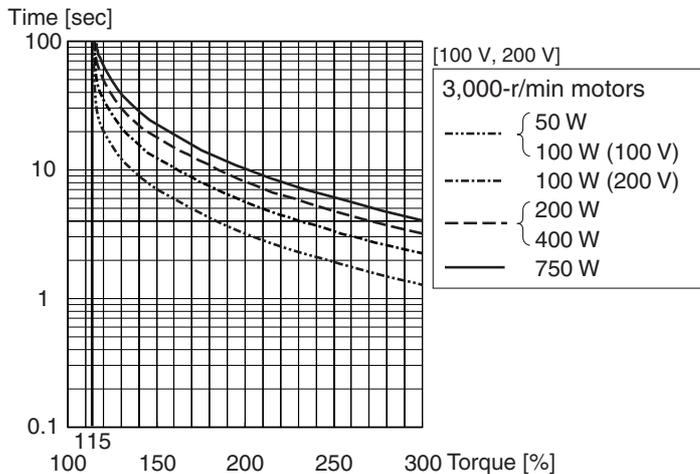
When the torque command = 0, and a constant torque command is continuously applied after 3 or more times the overload time constant has elapsed, the overload time t [s] will be:

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 Motor Specifications

The following Accurax G5 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, Decelerators, 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 15 kW |
| Ambient operating temperature and operating humidity | | 0 to +40°C, 20% to 80% RH (with no condensation) | 0 to +40°C, 20% to 85% RH (with no condensation) | |
| Storage ambient temperature and humidity | | −20 to +65°C, 20% to 80% RH (with no condensation) Guaranteed maximum temperature of 80°C (72 hours at normal temperature) | −20 to +65°C, 20% to 85% RH (with no condensation) Guaranteed maximum temperature of 80°C (72 hours at normal temperature) | |
| 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 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 | | |
| Protective structure | | IP67 (except for through-shaft parts and motor and encoder connector pins) | | |
| International standard | EC directive — EMC directive | EN 55011 class A group 1 | | |
| | | EN61000-6-2, IEC61800-3 and IEC61326-3-1 | | |
| | EC directive — Low voltage directive | EN60034-1/-5 | | |
| | UL standards | 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.

3

Specifications

## Characteristics

### 3,000-r/min Motors

| Model (R88M-) | | | 100 VAC | | | |
|---|---|---|---|---|---|---|
| | | | K05030H | K10030L | K20030L | K40030L |
| Item | | Unit | K05030T | K10030S | K20030S | 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) | 1.2 | 1.6 | 2.5 | 4.6 |
| Momentary maximum current [1] | | A (rms) | 5.1 | 6.9 | 10.6 | 19.5 |
| Rotor inertia | Without brake | kg • m$^2$ | $0.025 \times 10^{-4}$ | $0.051 \times 10^{-4}$ | $0.14 \times 10^{-4}$ | $0.26 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $0.027 \times 10^{-4}$ | $0.054 \times 10^{-4}$ | $0.16 \times 10^{-4}$ | $0.28 \times 10^{-4}$ |
| Applicable load inertia | | – | 30 times the rotor inertia max. [2] | | | |
| Torque constant [1] | | N • m/A | 0.11±10% | 0.13±10% | 0.19±10% | 0.21±10% |
| Power rate [1] | Without brake | kW/s | 10.1 | 19.8 | 29.0 | 62.4 |
| | With brake | kW/s | 9.4 | 18.8 | 25.4 | 58.0 |
| Mechanical time constant | Without brake | ms | 1.37 | 1.07 | 0.65 | 0.46 |
| | With brake | ms | 1.48 | 1.13 | 0.74 | 0.50 |
| Electrical time constant | | ms | 0.80 | 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. 0.32 | Approx. 0.47 | Approx. 0.82 | Approx. 1.2 |
| | With brake | kg | Approx. 0.53 | Approx. 0.68 | Approx. 1.3 | Approx. 1.7 |
| Radiator plate dimensions (material) | | | $100 \times 80 \times$ t10 (Al) | | $130 \times 120 \times$ t12 (Al) | |
| Applicable drivers (R88D-) | | | KTA5L | KT01L | KT02L | KT04L |
| Brake specifications | Brake inertia | kg • m$^2$ | $2 \times 10^{-7}$ | $2 \times 10^{-7}$ | $1.8 \times 10^{-6}$ | $1.8 \times 10^{-6}$ |
| | Excitation voltage [4] | V | 24 VDC ± 10% | | | |
| | 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. | 20 max. |
| | Backlash | | 1° (reference value) | | | |
| | Allowable work per braking | J | 39.2 | 39.2 | 137 | 137 |
| | Allowable total work | J | $4.9 \times 10^3$ | $4.9 \times 10^3$ | $44.1 \times 10^3$ | $44.1 \times 10^3$ |

| Model (R88M-) | | Unit | 100 VAC | | | |
|---|---|---|---|---|---|---|
| | | | K05030H | K10030L | K20030L | K40030L |
| **Item** | | **Unit** | K05030T | K10030S | K20030S | 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 B | | | |

**3**

**Specifications**

## 3-3 Motor Specifications

| Model (R88M-) | | | 200 VAC | | | |
|---|---|---|---|---|---|---|
| | | | K05030H | K10030H | K20030H | K40030H |
| Item | | Unit | K05030T | K10030T | K20030T | 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) | 1.2 | 1.1 | 1.5 | 2.4 |
| Momentary maximum current [1] | | A (rms) | 5.1 | 4.7 | 6.5 | 10.2 |
| Rotor inertia | Without brake | kg • m$^2$ | $0.025 \times 10^{-4}$ | $0.051 \times 10^{-4}$ | $0.14 \times 10^{-4}$ | $0.26 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $0.027 \times 10^{-4}$ | $0.054 \times 10^{-4}$ | $0.16 \times 10^{-4}$ | $0.28 \times 10^{-4}$ |
| Applicable load inertia | | − | 30 times the rotor inertia max.[2] | | | |
| Torque constant [1] | | N • m/A | 0.11±10% | 0.21±10% | 0.31±10% | 0.39±10% |
| Power rate [1] | Without brake | kW/s | 10.1 | 19.9 | 29.0 | 62.4 |
| | With brake | kW/s | 9.4 | 18.8 | 25.4 | 58.0 |
| Mechanical time constant | Without brake | ms | 1.37 | 1.12 | 0.58 | 0.44 |
| | With brake | ms | 1.48 | 1.20 | 0.66 | 0.47 |
| Electrical time constant | | ms | 0.80 | 0.77 | 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. 0.32 | Approx. 0.47 | Approx. 0.82 | Approx. 1.2 |
| | With brake | kg | Approx. 0.53 | Approx. 0.68 | Approx. 1.3 | Approx. 1.7 |
| Radiator plate dimensions (material) | | | $100 \times 80 \times t10$ (Al) | | $130 \times 120 \times t12$ (Al) | |
| Applicable drivers (R88D-) | | | KT01H | KT01H | KT02H | KT04H |

| Model (R88M-) | | 200 VAC | | | |
|---|---|---|---|---|---|
| | | **K05030H** | **K10030H** | **K20030H** | **K40030H** |
| **Item** | **Unit** | **K05030T** | **K10030T** | **K20030T** | **K40030T** |
| Brake inertia | kg • m$^2$ | $2\times10^{-7}$ | $2\times10^{-7}$ | $1.8\times10^{-6}$ | $1.8\times10^{-6}$ |
| Excitation voltage *4 | V | 24 VDC $\pm$ 10% | | | |
| 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° (reference value) | | | |
| Allowable work per braking | J | 39.2 | 39.2 | 137 | 137 |
| Allowable total work | J | $4.9\times10^3$ | $4.9\times10^3$ | $44.1\times10^3$ | $44.1\times10^3$ |
| 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 B | | | |

*Brake specifications*

*Specifications*

**3**

## 3-3 Motor Specifications

| Model (R88M-) | | | 200 VAC | | |
|---|---|---|---|---|---|
| | | | K75030H | K1K030H | K1K530H |
| Item | | Unit | K75030T | K1K030T | 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 (rms) | 17.4 | 28 | 35 |
| Rotor inertia | Without brake | kg • m$^2$ | $0.87 \times 10^{-4}$ | $2.03 \times 10^{-4}$ | $2.84 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $0.97 \times 10^{-4}$ | $2.35 \times 10^{-4}$ | $3.17 \times 10^{-4}$ |
| Applicable load inertia | | – | 20 times the rotor inertia max. | 15 times the rotor inertia max. [2] | |
| Torque constant [1] | | N • m/A | 0.42±10% | 0.37 | 0.45 |
| Power rate [1] | Without brake | kW/s | 65.6 | 49.8 | 80.1 |
| | With brake | kW/s | 58.8 | 43.0 | 71.8 |
| Mechanical time constant | Without brake | ms | 0.39 | 0.61 | 0.49 |
| | With brake | ms | 0.43 | 0.71 | 0.55 |
| Electrical time constant | | ms | 5.4 | 5.8 | 6.3 |
| Allowable radial load [3] | | N | 490 | 490 | 490 |
| Allowable thrust load [3] | | N | 196 | 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 drivers (R88D-) | | | KT08H | KT15H | KT15H |

| Model (R88M-) | | 200 VAC | | |
|---|---|---|---|---|
| | | K75030H | K1K030H | K1K530H |
| **Item** | **Unit** | K75030T | K1K030T | K1K530T |
| Brake inertia | kg • m$^2$ | $0.33 \times 10^{-4}$ | $0.33 \times 10^{-4}$ | $0.33 \times 10^{-4}$ |
| Excitation voltage *4 | V | 24 VDC ± 10% | | |
| Power consumption (at 20°C) | W | 17 | 19 | 19 |
| Current consumption (at 20°C) | A | 0.70±10% | 0.81±10% | 0.81±10% |
| Static friction torque | N • m | 2.5 min. | 7.8 min. | 7.8 min. |
| Attraction time *5 | ms | 50 max. | 50 max. | 50 max. |
| Release time *5 | ms | 15 max. *6 | 15 max. *6 | 15 max. *6 |
| Backlash | | ±1° (reference value) | | |
| Allowable work per braking | J | 392 | 392 | 392 |
| Allowable total work | J | $4.9 \times 10^5$ | $4.9 \times 10^5$ | $4.9 \times 10^{-5}$ |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | |
| Brake limit | – | 10 million times min. | | |
| Rating | – | Continuous | | |
| Insulation class | – | Type B | Type F | |

(Leftmost vertical label: Brake specifications)

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Specifications

| Model (R88M-) | | 200 VAC | | | |
|---|---|---|---|---|---|
| | | **K2K030H** | **K3K030H** | **K4K030H** | **K5K030H** |
| **Item** | **Unit** | **K2K030T** | **K3K030T** | **K4K030T** | **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 | 3,000 | | | |
| Maximum rotation speed | r/min | 5,000 | | 4,500 | |
| 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 (rms) | 48 | 77 | 83 | 102 |
| Rotor inertia | Without brake | kg • m$^2$ | 3.68x10$^{-4}$ | 6.50x10$^{-4}$ | 12.9x10$^{-4}$ | 17.4x10$^{-4}$ |
| | With brake | kg • m$^2$ | 4.01x10$^{-4}$ | 7.85x10$^{-4}$ | 14.2x10$^{-4}$ | 18.6x10$^{-4}$ |
| 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 | | 784 | |
| Allowable thrust load [3] | N | 196 | | 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 x 350 x t30 (Al) | | | |
| Applicable drives (R88D-) | | KT20H | KT30H | KT50H | KT50H |

| Model (R88M-) | | 200 VAC | | | |
|---|---|---|---|---|---|
| | | K2K030H | K3K030H | K4K030H | K5K030H |
| Item | Unit | K2K030T | K3K030T | K4K030T | K5K030T |
| Brake inertia | kg • m$^2$ | 0.33x10$^{-4}$ | | 1.35x10$^{-4}$ | |
| Excitation voltage [4] | V | 24 VDC $\pm$ 10% | | | |
| Power consumption (at 20ºC) | W | 19 | | 22 | |
| Current consumption (at 20ºC) | A | 0.81 $\pm$ 10% | | 0.90 $\pm$ 10% | |
| Static friction torque | N • m | 7.8 min. | 11.8 min. | 16.1 min. | |
| Attraction time [5] | ms | 50 max. | 80 max. | 110 max. | |
| Release time [5] | ms | 15 max. [6] | | 50 max. [7] | |
| Backlash | - | $\pm$ 1º (reference value) | | | |
| Allowable work per braking | J | 392 | | 1,470 | |
| Allowable total work | J | 4.9x10$^6$ | | 2.2x10$^6$ | |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | | |
| Brake limit | - | 10 million times min. | | | |
| Rating | - | Continuous | | | |
| Insulation class | - | Type F | | | |

Brake specifications

**3**

Specifications

## 3-3 Motor Specifications

| Model (R88M-) | | | 400 VAC | | | |
|---|---|---|---|---|---|---|
| | | | K75030F | K1K030F | K1K530F | K2K030F |
| Item | | Unit | K75030C | K1K030C | K1K530C | 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 (rms) | 10 | 14 | 18 | 24 |
| Rotor inertia | Without brake | kg • m$^2$ | $1.61{\times}10^{-4}$ | $2.03{\times}10^{-4}$ | $2.84{\times}10^{-4}$ | $3.68{\times}10^{-4}$ |
| | With brake | kg • m$^2$ | $1.93{\times}10^{-4}$ | $2.35{\times}10^{-4}$ | $3.17{\times}10^{-4}$ | $4.01{\times}10^{-4}$ |
| 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 drivers (R88D-) | | | KT10F | KT15F | KT15F | KT20F |

| Model (R88M-) | | 400 VAC | | | |
| Item | Unit | K75030F | K1K030F | K1K530F | K2K030F |
| | | K75030C | K1K030C | K1K530C | K2K030C |
| Brake inertia | kg • m$^2$ | $0.33 \times 10^{-4}$ | $0.33 \times 10^{-4}$ | $0.33 \times 10^{-4}$ | $0.33 \times 10^{-4}$ |
| 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° (reference value) | | | |
| Allowable work per braking | J | 392 | 392 | 392 | 392 |
| Allowable total work | J | $4.9 \times 10^5$ | $4.9 \times 10^5$ | $4.9 \times 10^5$ | $4.9 \times 10^5$ |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | | |
| Brake limit | – | 10 million times min. | | | |
| Rating | – | Continuous | | | |
| Insulation class | – | Type F | | | |

(left margin label: Brake specifications)

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**Specifications**

## 3-3 Motor Specifications

| Model (R88M-) | | | 400 VAC | | |
|---|---|---|---|---|---|
| | | | K3K030F | K4K030F | K5K030F |
| Item | | Unit | K3K030C | K4K030C | 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 (rms) | 39 | 42 | 51 |
| Rotor inertia | Without brake | kg • m$^2$ | $6.50 \times 10^{-4}$ | $12.9 \times 10^{-4}$ | $17.4 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $7.85 \times 10^{-4}$ | $14.2 \times 10^{-4}$ | $18.6 \times 10^{-4}$ |
| 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) | | | $380 \times 350 \times t30$ (Al) | | |
| Applicable drivers (R88D-) | | | KT30F | KT50F | KT50F |

**3**

**Specifications**

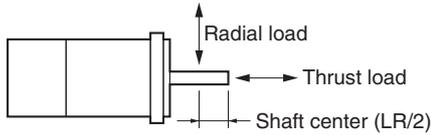| Model (R88M-) | | 400 VAC | | |
| | | K3K030F | K4K030F | K5K030F |
| Item | Unit | K3K030C | K4K030C | K5K030C |
|---|---|---|---|---|
| Brake inertia | kg • m$^2$ | $0.33 \times 10^{-4}$ | $0.33 \times 10^{-4}$ | $1.35 \times 10^{-4}$ |
| Excitation voltage *[4] | V | 24 VDC ± 10% | | |
| Power consumption (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° (reference value) | | |
| Allowable work per braking | J | 392 | 1470 | 1470 |
| Allowable total work | J | $4.9 \times 10^5$ | $2.2 \times 10^6$ | $2.2 \times 10^6$ |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | |
| Brake limit | – | 10 million times min. | | |
| Rating | – | Continuous | | |
| Insulation class | – | Type F | | |

Brake specifications

Specifications

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## 3-3 Motor Specifications

*1. These are the values when the motor is combined with a driver 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.
  - If the dynamic brake is activated frequently with high load inertia, the Dynamic Brake Resistor may burn. Do not repeatedly turn the servo ON/OFF while the dynamic brake is enabled.

*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)
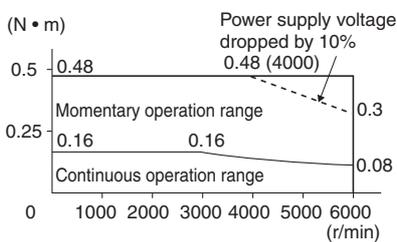


• R88M-K10030L/S (100 W)
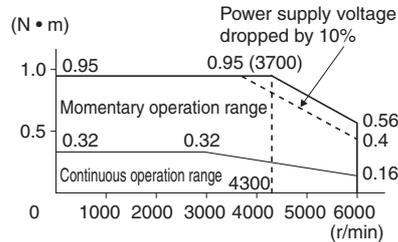


• R88M-K20030L/S (200 W)



• R88M-K40030L/S (400 W)

♦ 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)

(N • m)

Power supply voltage dropped by 10%

0.5 ─ 0.48        0.48 (4000)

Momentary operation range

0.25   0.16        0.16                        0.3

Continuous operation range               0.08

0   1000 2000 3000 4000 5000 6000
(r/min)

• R88M-K10030H/T (100 W)

(N • m)

Power supply voltage dropped by 10%

1.0 ─ 0.95        0.95 (5000)
                                           0.9

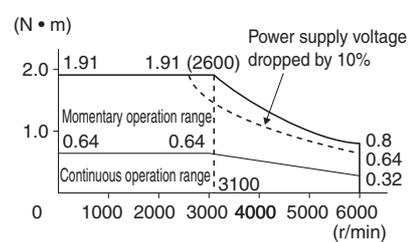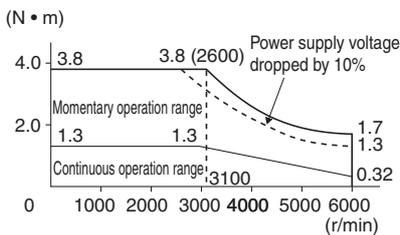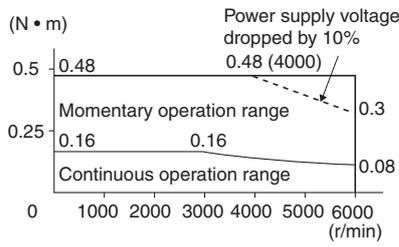Momentary operation range

0.5   0.32        0.32

Continuous operation range        0.16

0   1000 2000 3000 4000 5000 6000
(r/min)

• R88M-K20030H/T (200 W)

(N • m)

Power supply voltage dropped by 10%

2.0 ─ 1.91      (4000)   1.91 (4600)

Momentary operation range                1.3

1.0   0.64        0.64                     1.1

Continuous operation range          0.32

0   1000 2000 3000 4000 5000 6000
(r/min)

• R88M-K40030H/T (400 W)

(N • m)

Power supply voltage dropped by 10%

4.0 ─ 3.8   (3100) 3.8 (3600)

Momentary operation range            2.0

2.0   1.3        1.3                      1.7

Continuous operation range        0.64

0   1000 2000 3000 4000 5000 6000
(r/min)

• R88M-K75030H/T (750 W)

(N • m)

Power supply voltage dropped by 10%

8.0 ─ 7.1   (3200)  7.1 (3600)

Momentary operation range           3.4

4.0   2.4        2.4                     3.0

Continuous operation range        0.60

0   1000 2000 3000 4000 5000 6000
(r/min)

• R88M-K1K030H/T (1 kW)

(N • m)

Power supply voltage dropped by 10%

10 ─ 9.55   (3800) 9.55 (4200)

Momentary operation range           6.0

5   3.18        3.18                     4.0
                                         1.9

Continuous operation range

0   1000 2000 3000 4000 5000
(r/min)

• R88M-K1K530H/T (1.5 kW)

(N • m)

Power supply voltage dropped by 10%

15 ─ 14.3   (3200) 14.3 (3600)

Momentary operation range

7.5   4.77        4.77

Continuous operation range         4.0

0   1000 2000 3000 4000 5000
(r/min)

• R88M-K2K030H/T (2 kW)

(N • m)

Power supply voltage dropped by 10%

20 ─ 19.1   (3300) 19.1 (3700)

Momentary operation range

10   6.37        6.37                   7.0

Continuous operation range

0   1000 2000 3000 4000 5000
(r/min)

• R88M-K3K030H/T (3 kW)

(N • m)

Power supply voltage dropped by 10%

30 ─ 28.6   (3100) 28.7 (3400)

Momentary operation range         12.0

15   9.55        9.55                   8.0
                                        5.7

Continuous operation range

0   1000 2000 3000 4000 5000
(r/min)

• R88M-K4K030H/T (4 kW)

(N • m)

Power supply voltage dropped by 10%

40 ─ 38.2   (2800) 38.2 (3100)

Momentary operation range

20   12.7        12.7

Continuous operation range        10.0

0   1000 2000 3000 4000 5000
(r/min)

• R88M-K5K030H/T (5 kW)

(N • m)

Power supply voltage dropped by 10%

50 ─ 47.7   (2800) 47.8 (3200)

Momentary operation range

25   15.9        15.9

Continuous operation range        15.0

0   1000 2000 3000 4000 5000
(r/min)

**3**

**Specifications**

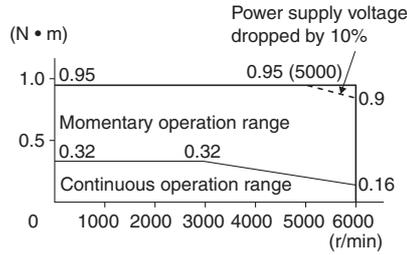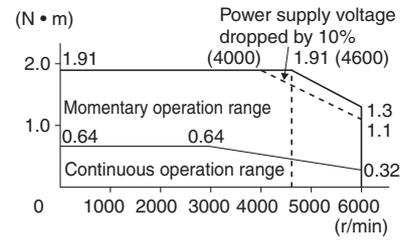◆ 3,000-r/min motor (400 VAC)
The following graphs show the characteristics with a 3-m standard cable and a 400-VAC input.
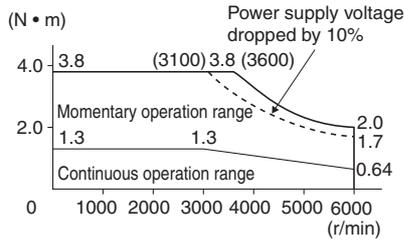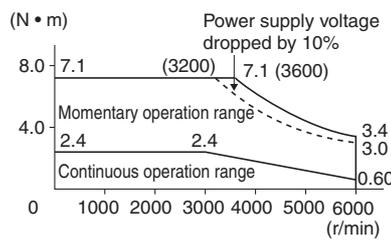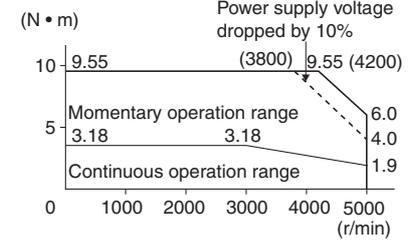
• R88M-K75030F/C (750 W)

(N • m)

Power supply voltage
dropped by 10%

8 ─ 7.16        (3500)  7.16 (3800)

Momentary operation range

4 ─
2.39        2.39        2.6
Continuous operation range        1.6

0    1000 2000 3000 4000 5000
(r/min)

• R88M-K1K030F/C (1 kW)

(N • m)

Power supply voltage
dropped by 10%

10 ─ 9.55        (3800) 9.55 (4200)

Momentary operation range

5 ─        6.0
3.18        3.18        4.0
Continuous operation range        1.9

0    1000 2000 3000 4000 5000
(r/min)

• R88M-K1K530F/C (1.5 kW)

(N • m)

Power supply voltage
dropped by 10%

15 ─ 14.3        (3200) 14.3 (3600)

Momentary operation range

7.5 ─
4.77        4.77        4.0
Continuous operation range

0    1000 2000 3000 4000 5000
(r/min)

• R88M-K2K030F/C (2 kW)

(N • m)

Power supply voltage
dropped by 10%

20 ─ 19.1        (3300) 19.1 (3700)
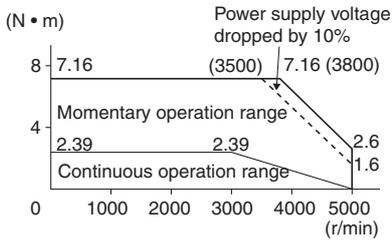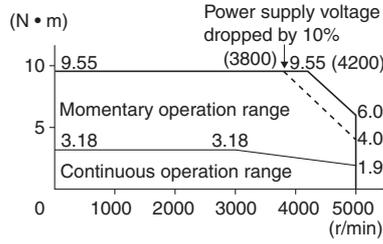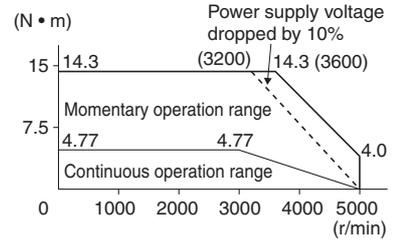
Momentary operation range

10 ─
6.37        6.37        7.0
Continuous operation range        2.0

0    1000 2000 3000 4000 5000
(r/min)

• R88M-K3K030F/C (3 kW)

(N • m)

Power supply voltage
dropped by 10%

30 ─ 28.6        (3100) 28.7 (3400)

Momentary operation range        12.0

15 ─
9.55        9.55        8.0
Continuous operation range        5.7

0    1000 2000 3000 4000 5000
(r/min)

• R88M-K4K030F/C (4 kW)

(N • m)

Power supply voltage
dropped by 10%

40 ─ 38.2        (2800) 38.2 (3100)

Momentary operation range

20 ─
12.7        12.7
Continuous operation range        10

0    1000 2000 3000 4000 5000
(r/min)

• R88M-K5K030F/C (5 kW)

(N • m)

Power supply voltage
dropped by 10%

50 ─ 47.7        (2800) 47.7 (3200)

Momentary operation range

25 ─
15.9        15.9        15
Continuous operation range

0    1000 2000 3000 4000 5000
(r/min)

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)

Rated torque ratio [%]
100% — Without brake / With brake — 70% / 60%
Ambient temperature
0 10 20 30 40 [°C]

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

Rated torque ratio [%]
100% — Without brake / With brake — 75% / 70%
Ambient temperature
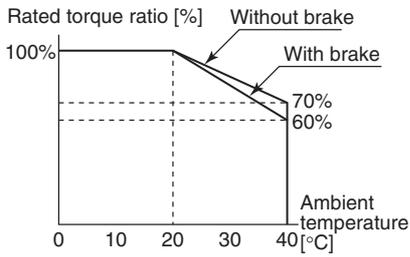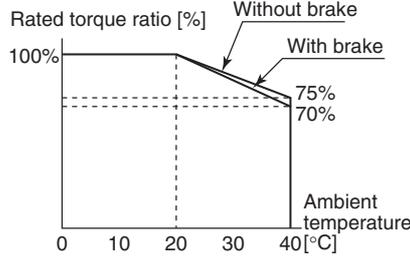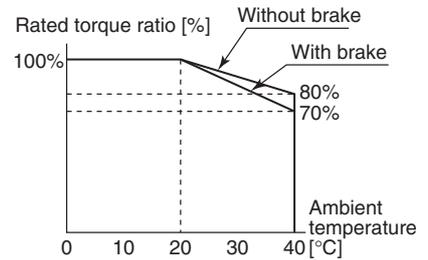0 10 20 30 40 [°C]

- R88M-K20030L/S/H/T
  (200 W: With oil seal)

Rated torque ratio [%]
100% — Without brake / With brake — 80% / 70%
Ambient temperature
0 10 20 30 40 [°C]

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

Rated torque ratio [%]
100% — With brake — 90%
Ambient temperature
0 10 20 30 40 [°C]
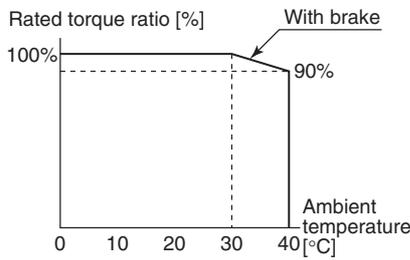
- R88M-K40030L/S/H/T
  (400 W: With oil seal)

Rated torque ratio [%]
100% — With brake — 75%
Ambient temperature
0 10 20 30 40 [°C]

- R88M-K1K530H/T/F/C
  (1.5 kW)

Rated torque ratio [%]
100% — Without brake / With brake — 85%
Ambient temperature
0 10 20 30 40 [°C]

- R88M-K2K030H/T/F/C
  (2 kW)

Rated torque ratio [%]
100% — Without brake / With brake — 85% / 70%
Ambient temperature
0 10 20 30 40 [°C]

- R88M-K3K030H/T/F/C
  (3 kW)

Rated torque ratio [%]
100% — Without brake / With brake — 90% / 85%
Ambient temperature
0 10 20 30 40 [°C]

- R88M-K4K030H/T/F/C
  (4 kW)

Rated torque ratio [%]
100% — Without brake / With brake — 90% / 85%
Ambient temperature
0 10 20 30 40 [°C]

- R88M-K5K030H/T/F/C
  (5 kW)

Rated torque ratio [%]
100% — With brake — 70%
Ambient temperature
0 10 20 30 40 [°C]

**3**

**Specifications**

### 1,500-r/min and 2,000-r/min Motors

| Model (R88M-) | | | 200 VAC | | |
|---|---|---|---|---|---|
| | | | K1K020H | K1K520H | K2K020H |
| Item | | Unit | K1K020T | K1K520T | 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 (rms) | 24 | 40 | 49 |
| Rotor inertia | Without brake | kg • m$^2$ | $4.60 \times 10^{-4}$ | $6.70 \times 10^{-4}$ | $8.72 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $5.90 \times 10^{-4}$ | $7.99 \times 10^{-4}$ | $10.0 \times 10^{-4}$ |
| 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) | | | $275 \times 260 \times t15$ (Al) | | |
| Applicable drivers (R88D-) | | | KT10H | KT15H | KT20H |
| Brake specifications | Brake inertia | kg • m$^2$ | $1.35 \times 10^{-4}$ | $1.35 \times 10^{-4}$ | $1.35 \times 10^{-4}$ |
| | 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 (reference value) | | |
| | Allowable work per braking | J | 588 | 1,176 | 1,176 |

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

(leftmost column label, rotated: Brake specifications)

| Model (R88M-) | | 200 VAC | | |
|---|---|---|---|---|
| | | K3K020H | K4K020H | K5K020H |
| Item | Unit | K3K020T | K4K020T | 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 (rms) | 74 | 89 | 110 |
| Rotor inertia | Without brake kg • m$^2$ | $12.9 \times 10^{-4}$ | $37.6 \times 10^{-4}$ | $48.0 \times 10^{-4}$ |
| | With brake kg • m$^2$ | $14.2 \times 10^{-4}$ | $38.6 \times 10^{-4}$ | $48.8 \times 10^{-4}$ |
| 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) | | $380 \times 350 \times t30$ (Al) | $470 \times 440 \times t30$ (Al) | |
| Applicable drivers (R88D-) | | KT30H | KT50H | KT50H |

| Model (R88M-) | | 200 VAC | | |
|---|---|---|---|---|
| | | K3K020H | K4K020H | K5K020H |
| **Item** | **Unit** | K3K020T | K4K020T | K5K020T |
| Brake inertia | kg • m$^2$ | $1.35{\times}10^{-4}$ | $4.7{\times}10^{-4}$ | $4.7{\times}10^{-4}$ |
| Excitation voltage *4 | V | 24 VDC $\pm$ 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 (reference value) | | |
| Allowable work per braking | J | 1470 | 1372 | 1372 |
| Allowable total work | J | $2.2{\times}10^6$ | $2.9{\times}10^6$ | $2.9{\times}10^6$ |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | |
| Brake limit | – | 10 million times min. | | |
| Rating | – | Continuous | | |
| Insulation class | – | Type F | | |

*Brake specifications*

**3** **Specifications**

| Model (R88M-) | | 200 VAC | | |
|---|---|---|---|---|
| | | - | - | - |
| Item | Unit | K7K515T | K11K015T | K15K015T |
| Rated output [1] | W | 7,500 | 11,000 | 15,000 |
| Rated torque [1] | N • m | 47.8 | 70.0 | 95.0 |
| Rated rotation speed | r/min | 1,500 | | |
| Maximum rotation speed | r/min | 3,000 | 2,000 | |
| Momentary maximum torque [1] | N • m | 119.0 | 175.0 | 224.0 |
| Rated current [1] | A (rms) | 44.0 | 54.2 | 66.1 |
| Momentary maximum current [1] | A (rms) | 165 | 203 | 236 |
| Rotor inertia | Without brake | kg • m$^2$ | $101 \times 10^{-4}$ | $212 \times 10^{-4}$ | $302 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $107 \times 10^{-4}$ | $220 \times 10^{-4}$ | $311 \times 10^{-4}$ |
| Applicable load inertia | - | 10 times the rotor inertia max.[4] | | |
| Torque constant [1] | N • m/A | 0.77 | 0.92 | 1.05 |
| Power rate[1] | Without brake | kW/s | 226 | 231 | 302 |
| | With brake | kW/s | 213 | 223 | 293 |
| Mechanical time constant | Without brake | ms | 0.58 | 0.80 | 0.71 |
| | With brake | ms | 0.61 | 0.83 | 0.74 |
| Electrical time constant | ms | 21 | 31 | 32 |
| Allowable radial load [3] | N | 1,176 | 2,254 | |
| Allowable thrust load [3] | N | 490 | 686 | |
| Weight | Without brake | kg | Approx. 36.4 | Approx. 52.7 | Approx. 70.2 |
| | With brake | kg | Approx. 40.4 | Approx. 58.9 | Approx. 76.3 |
| Radiator plate dimensions (material) | | 550 x 520 x t30 (Al) | 670 x 630 x t35 (Al) | |
| Applicable drives (R88D-) | | KT75H | KT150H | KT150H |

**3**

**Specifications**

| Model (R88M-) | | 200 VAC | | |
|---|---|---|---|---|
| | | - | - | - |
| Item | Unit | K7K515T | K11K015T | K15K015T |
| Brake inertia | kg • m$^2$ | $4.7 \times 10^{-4}$ | $7.1 \times 10^{-4}$ | |
| Excitation voltage [4] | V | 24 VDC $\pm$ 10% | | |
| Power consumption (at 20ºC) | W | 34 | 26 | |
| Current consumption (at 20ºC) | A | 1.4±10% | 1.08±10% | |
| Static friction torque | N • m | 58.8 min. | 100 min. | |
| Attraction time [5] | ms | 150 max. | 300 max. | |
| Release time [5] | ms | 50 max. | 140 max. | |
| Backlash | - | 1 (reference value) | | |
| Allowable work per braking | J | 1,372 | 2,000 | |
| Allowable total work | J | $2.9 \times 10^6$ | $4.0 \times 10^6$ | |
| Allowable angular acceleration | rad/s$^2$ | 5,000 | 3,000 | |
| Brake limit | - | 10 million times min. | | |
| Rating | - | Continuous | | |
| Insulation class | - | Type F | | |

*Brake specifications*

| Model (R88M-) | | | 400 VAC | | | |
|---|---|---|---|---|---|---|
| | | | K40020F | K60020F | K1K020F | K1K520F |
| Item | | Unit | K40020C | K60020C | K1K020C | 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 (rms) | 4.9 | 6.5 | 12 | 20 |
| Rotor inertia | Without brake | kg • m$^2$ | $1.61{\times}10^{-4}$ | $2.03{\times}10^{-4}$ | $4.60{\times}10^{-4}$ | $6.70{\times}10^{-4}$ |
| | With brake | kg • m$^2$ | $1.90{\times}10^{-4}$ | $2.35{\times}10^{-4}$ | $5.90{\times}10^{-4}$ | $7.99{\times}10^{-4}$ |
| 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 |
| | 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 |
| | 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 |
| | 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 drivers (R88D-) | | | KT06F | KT06F | KT10F | KT15F |

**3**

**Specifications**

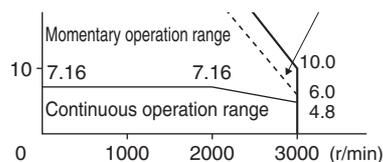| Model (R88M-) | | 400 VAC | | | |
|---|---|---|---|---|---|
| | | K40020F | K60020F | K1K020F | K1K520F |
| Item | Unit | K40020C | K60020C | K1K020C | K1K520C |
| Brake specifications — Brake inertia | kg • m² | $1.35 \times 10^{-4}$ | $1.35 \times 10^{-4}$ | $1.35 \times 10^{-4}$ | $1.35 \times 10^{-4}$ |
| Excitation voltage [4] | V | 24 VDC ± 10% | | | |
| Power consumption (at 20°C) | W | 17 | 17 | 14 | 19 |
| Current consumption (at 20°C) | A | 0.70±10% | 0.70±10% | 0.59±10% | 0.79±10% |
| Static friction torque | N • m | 2.5 min. | 2.5 min. | 4.9 min. | 13.7 min. |
| Attraction time [5] | ms | 50 max. | 50 max. | 80 max. | 100 max. |
| Release time [5] | ms | 15 max. [7] | 15 max. [7] | 70 max. [6] | 50 max. [6] |
| Backlash | | 1 (reference value) | | | |
| Allowable work per braking | J | 392 | 392 | 588 | 1176 |
| Allowable total work | J | $4.9 \times 10^{5}$ | $4.9 \times 10^{5}$ | $7.8 \times 10^{5}$ | $1.5 \times 10^{6}$ |
| Allowable angular acceleration | rad/s² | 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 driver 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.
  ♦ If the dynamic brake is activated frequently with high load inertia, the Dynamic Brake Resistor may burn. Do not repeatedly turn the servo ON/OFF while the dynamic brake is enabled.

*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.).

3 — Specifications

| Model (R88M-) | | | 400 VAC | | | |
|---|---|---|---|---|---|---|
| | | | K2K020F | K3K020F | K4K020F | K5K020F |
| Item | | Unit | K2K020C | K3K020C | K4K020C | 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 (rms) | 25 | 37 | 45 | 55 |
| Rotor inertia | Without brake | kg • m$^2$ | $8.72 \times 10^{-4}$ | $12.9 \times 10^{-4}$ | $37.6 \times 10^{-4}$ | $48.0 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $10.0 \times 10^{-4}$ | $14.2 \times 10^{-4}$ | $38.6 \times 10^{-4}$ | $48.8 \times 10^{-4}$ |
| 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) | | | $275 \times 260 \times t15$ (Al) | $380 \times 350 \times t30$ (Al) | $470 \times 440 \times t30$ (Al) | |
| Applicable drivers (R88D-) | | | KT20F | KT30F | KT50F | KT50F |

**3**

**Specifications**

## 3-3 Motor Specifications

| Model (R88M-) | | 400 VAC | | | |
|---|---|---|---|---|---|
| | | **K2K020F** | **K3K020F** | **K4K020F** | **K5K020F** |
| **Item** | **Unit** | **K2K020C** | **K3K020C** | **K4K020C** | **K5K020C** |
| Brake inertia | kg • m$^2$ | $1.35 \times 10^{-4}$ | $1.35 \times 10^{-4}$ | $4.7 \times 10^{-4}$ | $4.7 \times 10^{-4}$ |
| 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 (reference value) | | | |
| Allowable work per braking | J | 1176 | 1470 | 1372 | 1372 |
| Allowable total work | J | $1.5 \times 10^6$ | $2.2 \times 10^6$ | $2.9 \times 10^6$ | $2.9 \times 10^6$ |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | | |
| Brake limit | − | 10 million times min. | | | |
| Rating | − | Continuous | | | |
| Insulation class | − | Type F | | | |

(left margin: Brake specifications)

(left margin: 3 / Specifications)

| Model (R88M-) | | 400 VAC | | |
|---|---|---|---|---|
| | | - | - | - |
| Item | Unit | K7K515C | K11K015C | K15K015C |
| Rated output *[1] | W | 7,500 | 11,000 | 15,000 |
| Rated torque *[1] | N • m | 47.8 | 70.0 | 95.9 |
| Rated rotation speed | r/min | 1,500 | | |
| Maximum rotation speed | r/min | 3,000 | 2,000 | |
| Momentary maximum torque *[1] | N • m | 119.0 | 175.0 | 224.0 |
| Rated current *[1] | A (rms) | 22.0 | 27.1 | 33.1 |
| Momentary maximum current *[1] | A (rms) | 83 | 101 | 118 |
| Rotor inertia | Without brake | kg • m$^2$ | $101 \times 10^{-4}$ | $212 \times 10^{-4}$ | $302 \times 10^{-4}$ |
| | With brake | kg • m$^2$ | $107 \times 10^{-4}$ | $220 \times 10^{-4}$ | $311 \times 10^{-4}$ |
| Applicable load inertia | - | 10 times the rotor inertia max. *[2] | | |
| Torque constant *[1] | N • m/A | 1.54 | 1.84 | 2.10 |
| Power rate*[1] | Without brake | kW/s | 226 | 231 | 302 |
| | With brake | kW/s | 213 | 223 | 293 |
| Mechanical time constant | Without brake | ms | 0.58 | 0.80 | 0.71 |
| | With brake | ms | 0.61 | 0.83 | 0.74 |
| Electrical time constant | ms | 21 | 31 | 32 |
| Allowable radial load *[3] | N | 1,176 | 2,254 | |
| Allowable thrust load *[3] | N | 490 | 686 | |
| Weight | Without brake | kg | Approx. 36.4 | Approx. 52.7 | Approx. 70.2 |
| | With brake | kg | Approx. 40.4 | Approx. 58.9 | Approx. 76.3 |
| Radiator plate dimensions (material) | | 550 x 520 x t30 (Al) | 670 x 630 x t35 (Al) | |
| Applicable drives (R88D-) | | KT75F | KT150F | KT150F |

**3**

**Specifications**

| Model (R88M-) | | 400 VAC | | |
| Item | Unit | - | - | - |
| | | K7K515C | K11K015C | K15K015C |
| Brake inertia | kg • m$^2$ | $4.7 \times 10^{-4}$ | $7.1 \times 10^{-4}$ | |
| Excitation voltage [*4] | V | 24 VDC ± 10% | | |
| Power consumption (at 20ºC) | W | 34 | 26 | |
| Current consumption (at 20ºC) | A | 1.4±10% | 1.08±10% | |
| Static friction torque | N • m | 58.8 min. | 100 min. | |
| Attraction time [*5] | ms | 150 max. | 300 max. | |
| Release time [*5] | ms | 50 max. | 140 max. | |
| Backlash | - | 1 (reference value) | | |
| Allowable work per braking | J | 1,372 | 2,000 | |
| Allowable total work | J | $2.9 \times 10^6$ | $4.0 \times 10^6$ | |
| Allowable angular acceleration | rad/s$^2$ | 5,000 | 3,000 | |
| Brake limit | - | 10 million times min. | | |
| Rating | - | Continuous | | |
| Insulation class | - | Type F | | |

*(Left vertical label: Brake specifications)*

## Torque-Rotation Speed Characteristics for 1,500-r/min and 2,000-r/min Motors

⬥ 1,500-r/min and 2,000-r/min motor (200 VAC)
The following graphs show the characteristics with a 3-m standard cable and a 200-VAC input.
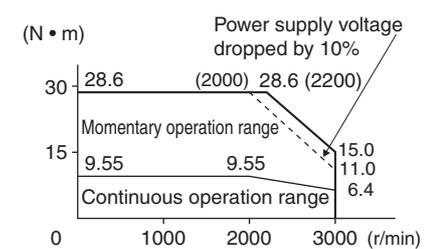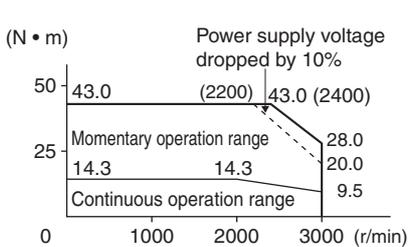
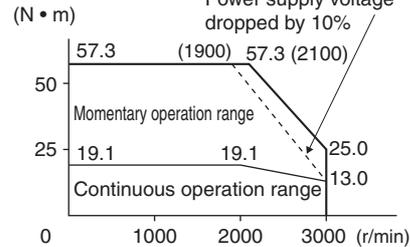• R88M-K1K020H/T (1 kW)
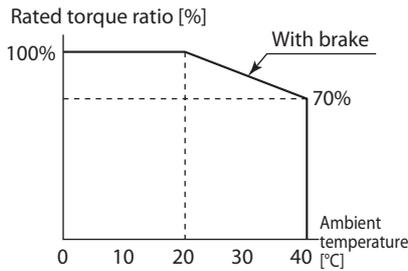


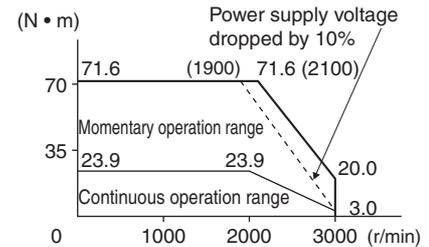• R88M-K1K520H/T (1.5 kW)
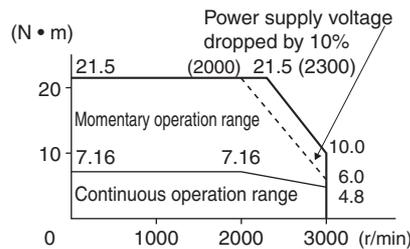


• R88M-K2K020H/T (2 kW)
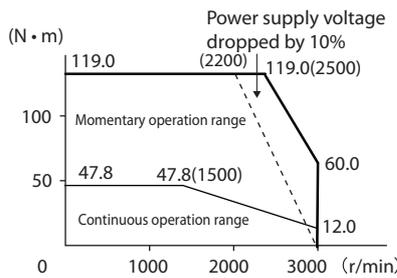


• R88M-K3K020H/T (3 kW)
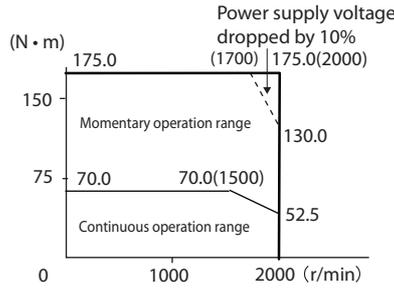


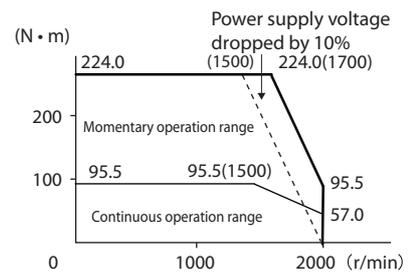• R88M-K4K020H/T (4 kW)



• R88M-K5K020H/T (5 kW)

• R88M-K7K515T (7.5 kW)
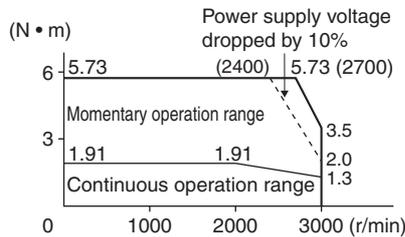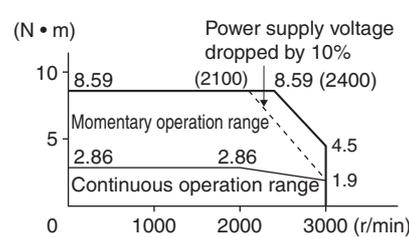


• R88M-K11K015T (11 kW)



• R88M-K15K015T (15 kW)



⋄ 1,500-r/min and 2,000-r/min motor (400 VAC)
The following graphs show the characteristics with a 3-m standard cable and a 400-VAC input.
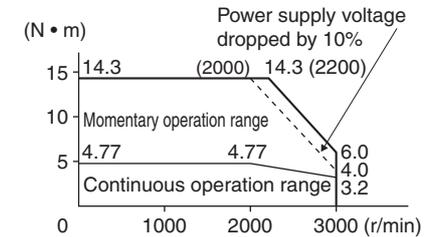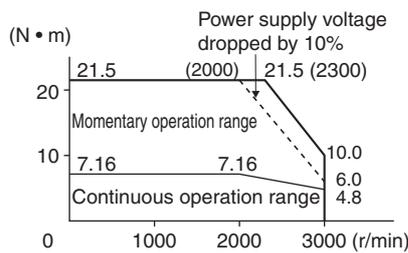
• R88M-K40020F/C (400 W)



• R88M-K60020F/C (600 W)



• R88M-K1K020F/C (1 kW)



• R88M-K1K520F/C (1.5 kW)



• R88M-K2K020F/C (2 kW)
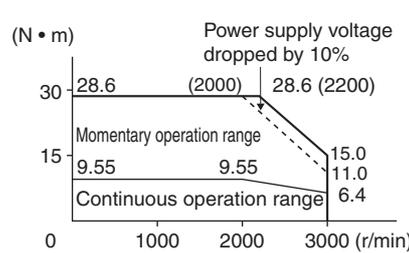


• R88M-K3K020F/C (3 kW)
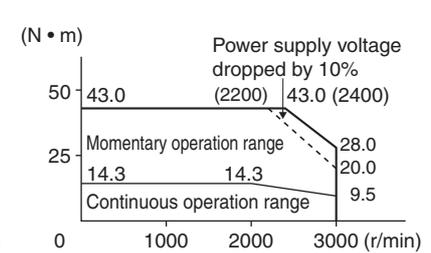


• R88M-K4K020F/C (4 kW)
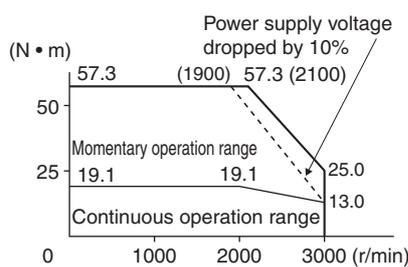


• R88M-K5K020F/C (5 kW)
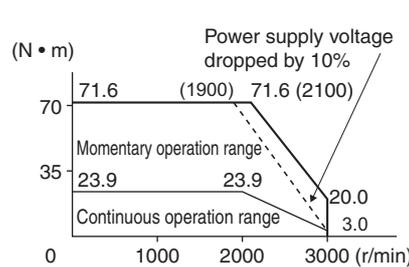


• R88M-K7K515C (7.5 kW)
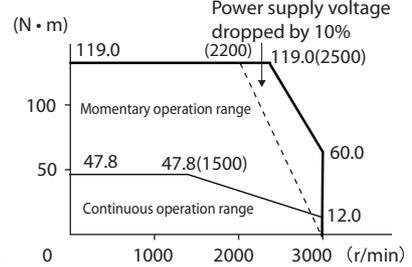


• R88M-K11K015C (11 kW)
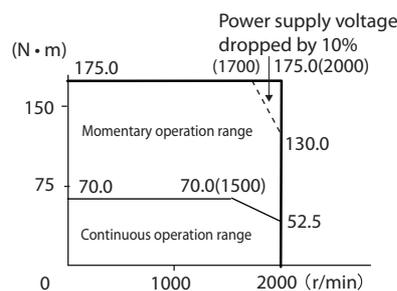


• R88M-K15K015C (15 kW)
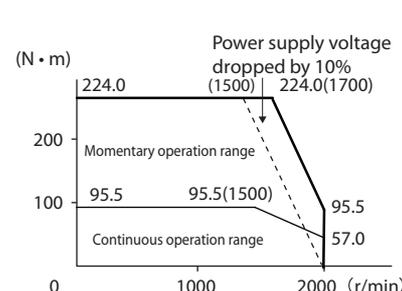


**3**

**Specifications**

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)   • R88M-K7K515T/C (7.5 kW)   • R88M-K15K015T/C (15 kW)
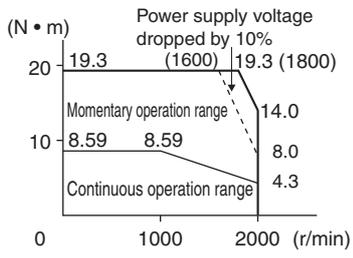
(N • m)
Power supply voltage dropped by 10%
20 — 19.3        (1600)  19.3 (1800)
Momentary operation range   14.0
10 — 8.59        8.59            8.0
Continuous operation range   4.3
0        1000        2000  (r/min)

Rated torque ratio [%]
100%
90%
Ambient temperature [°C]
0    10    20    30    40

Rated torque ratio [%]
100%
90%
Ambient temperature [°C]
0    10    20    30    40
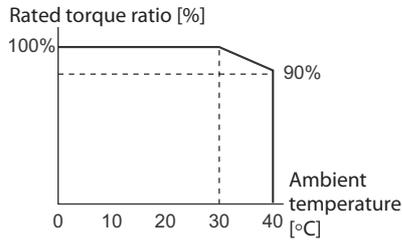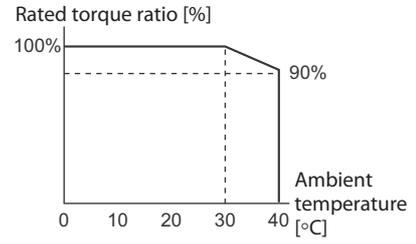
## 1,000-r/min Motors

| Model (R88M-) | | Unit | 200 VAC | | | | |
|---|---|---|---|---|---|---|---|
| | | | K90010H | K2K010H | K3K010H | - | - |
| Item | | | K90010T | K2K010T | K3K010T | K4K510T | K6K010T |
| Rated output *1 | | W | 900 | 2,000 | 3,000 | 4,500 | 6,000 |
| Rated torque *1 | | N • m | 8.59 | 19.1 | 28.7 | 43.0 | 57.0 |
| 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 | 107.0 | 143.0 |
| Rated current *1 | | A (rms) | 7.6 | 17.0 | 22.6 | 29.7 | 38.8 |
| Momentary maximum current *1 | | A (rms) | 24 | 60 | 80 | 110 | 149 |
| Rotor inertia | Without brake | kg • m$^2$ | $6.70{\times}10^{-4}$ | $30.3{\times}10^{-4}$ | $48.4{\times}10^{-4}$ | $79.1{\times}10^{-4}$ | $101{\times}10^{-4}$ |
| | With brake | kg • m$^2$ | $7.99{\times}10^{-4}$ | $31.4{\times}10^{-4}$ | $49.2{\times}10^{-4}$ | $84.4{\times}10^{-4}$ | $107{\times}10^{-4}$ |
| Applicable load inertia | | – | 10 times the rotor inertia max. *2 | | | | |
| Torque constant *1 | | N • m/A | 0.86 | 0.88 | 0.96 | 1.02 | 1.04 |
| Power rate *1 | Without brake | kW/s | 110 | 120 | 170 | 233 | 325 |
| | With brake | kW/s | 92.4 | 116 | 167 | 219 | 307 |
| Mechanical time constant | Without brake | ms | 0.66 | 0.75 | 0.63 | 0.55 | 0.54 |
| | With brake | ms | 0.78 | 0.78 | 0.64 | 0.63 | 0.57 |
| Electrical time constant | | ms | 11 | 18 | 21 | 20 | 23 |
| Allowable radial load *3 | | N | 686 | 1176 | 1470 | | 1764 |
| Allowable thrust load *3 | | N | 196 | 490 | | | 588 |
| Weight | Without brake | kg | Approx. 6.7 | Approx. 14.0 | Approx. 20.0 | Approx. 29.4 | Approx. 36.4 |
| | With brake | kg | Approx. 8.2 | Approx. 17.5 | Approx. 23.5 | Approx. 33.3 | Approx. 40.4 |
| Radiator plate dimensions (material) | | | 270 × 260 × t15 (Al) | | | 470 x 440 x t30 (Al) | 550 x 520 x t30 (Al) |
| Applicable drivers (R88D-) | | | KT15H | KT30H | KT50H | KT75H | KT75H |
| Brake specifications | Brake inertia | kg • m$^2$ | $1.35{\times}10^{-4}$ | $4.7{\times}10^{-4}$ | | | |
| | 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 (reference value) | | | | |

## 3-3 Motor Specifications

| | | | 200 VAC | | | | |
|---|---|---|---|---|---|---|---|
| **Model (R88M-)** | | | **K90010H** | **K2K010H** | **K3K010H** | **-** | **-** |
| **Item** | | **Unit** | **K90010T** | **K2K010T** | **K3K010T** | **K4K510T** | **K6K010T** |
| Brake specifications | Allowable work per braking | J | 1176 | 1372 | | | |
| | Allowable total work | J | $1.5{\times}10^6$ | $2.9{\times}10^6$ | | | |
| | Allowable angular acceleration | rad/s$^2$ | 10,000 | | | 5,000 | |
| | Brake limit | – | 10 million times min. | | | | |
| | Rating | – | Continuous | | | | |
| | Insulation class | – | Type F | | | | |

| | | | 400 VAC | | | | |
|---|---|---|---|---|---|---|---|
| **Model (R88M-)** | | | **K90010F** | **K2K010F** | **K3K010F** | **-** | **-** |
| **Item** | | **Unit** | **K90010C** | **K2K010C** | **K3K010C** | **K4K510C** | **K6K010C** |
| Rated output *1 | | W | 900 | 2,000 | 3,000 | 4,500 | 6,000 |
| Rated torque *1 | | N • m | 8.59 | 19.1 | 28.7 | 43.0 | 57.3 |
| 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 | 107.0 | 143.0 |
| Rated current *1 | | A (rms) | 3.8 | 8.5 | 11.3 | 14.8 | 19.4 |
| Momentary maximum current *1 | | A (rms) | 12 | 30 | 40 | 55 | 74 |
| Rotor inertia | Without brake | kg • m$^2$ | $6.70{\times}10^{-4}$ | $30.3{\times}10^{-4}$ | $48.4{\times}10^{-4}$ | $79.1{\times}10^{-4}$ | $101{\times}10^{-4}$ |
| | With brake | kg • m$^2$ | $7.99{\times}10^{-4}$ | $31.4{\times}10^{-4}$ | $49.2{\times}10^{-4}$ | $84.4{\times}10^{-4}$ | $107{\times}10^{-4}$ |
| Applicable load inertia | | – | 10 times the rotor inertia max. *2 | | | | |
| Torque constant *1 | | N • m/A | 1.72 | 1.76 | 1.92 | 2.05 | 2.08 |
| Power rate *1 | Without brake | kW/s | 110 | 120 | 170 | 233 | 325 |
| | With brake | kW/s | 92.4 | 116 | 167 | 219 | 307 |
| Mechanical time constant | Without brake | ms | 0.66 | 0.76 | 0.61 | 0.55 | 0.54 |
| | With brake | ms | 0.79 | 0.78 | 0.62 | 0.63 | 0.57 |
| Electrical time constant | | ms | 11 | 18 | 22 | 20 | 23 |
| Allowable radial load *3 | | N | 686 | 1176 | 1470 | | 1764 |
| Allowable thrust load *3 | | N | 196 | 490 | | | 588 |
| Weight | Without brake | kg | Approx. 6.7 | Approx. 14.0 | Approx. 20.0 | Approx. 29.4 | Approx. 36.4 |
| | With brake | kg | Approx. 8.2 | Approx. 17.5 | Approx. 23.5 | Approx. 33.3 | Approx. 40.4 |
| Radiator plate dimensions (material) | | | $270 \times 260 \times$ t15 (Al) | $470 \times 440 \times$ t30 (Al) | | | 550 x 520 x t30 (Al) |
| Applicable drivers (R88D-) | | | KT15F | KT30F | KT50F | KT50F | KT75F |

**3**

**Specifications**

| Model (R88M-) | | 400 VAC | | | | |
|---|---|---|---|---|---|---|
| | | K90010F | K2K010F | K3K010F | - | - |
| **Item** | **Unit** | K90010C | K2K010C | K3K010C | K4K510C | K6K010C |
| Brake inertia | kg • m$^2$ | $1.35 \times 10^{-4}$ | $4.7 \times 10^{-4}$ | | | |
| 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 (reference value) | | | | |
| Allowable work per braking | J | 1176 | 1372 | | | |
| Allowable total work | J | $1.5 \times 10^6$ | $2.9 \times 10^6$ | | | |
| Allowable angular acceleration | rad/s$^2$ | 10,000 | | | 5,000 | |
| Brake limit | – | 10 million times min. | | | | |
| Rating | – | Continuous | | | | |
| Insulation class | – | Type F | | | | |

(left side vertical label: Brake specifications)

*1. These are the values when the motor is combined with a driver 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.
   - If the dynamic brake is activated frequently with high load inertia, the Dynamic Brake Resistor may burn. Do not repeatedly turn the servo ON/OFF while the dynamic brake is enabled.

*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 (100 W)
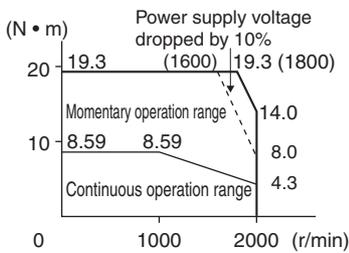
- R88M-K2K010H/T/F/C (2 kW)
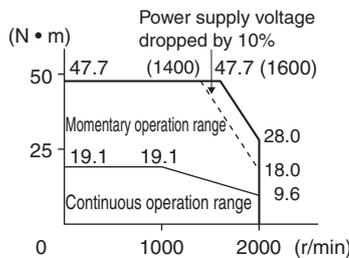
- R88M-K3K010H/T/F/C (3 kW)
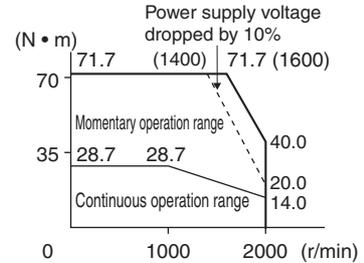
- R88M-K4K510T/C (4.5 kW)
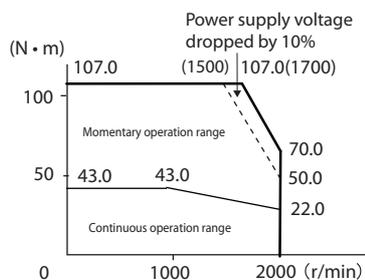
- R88M-K6K010T/C (6 kW)
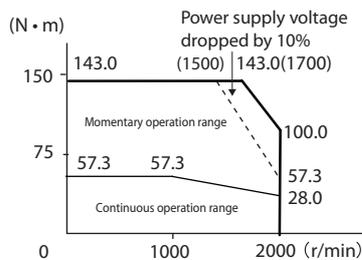
## Temperature Characteristics of the Motor and Mechanical System

♦ Accurax 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 gearbox, 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 driver 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<br>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<br>Phase Z:　　　 1 pulse/rotation |
| Maximum rotations | −32,768 to +32,767 rotations or 0 to 65,534 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)<br>100 μA (for operation during power interruption)<br>3.6 μA (when power is supplied to driver) |
| Output signals | +S, −S |
| Output interface | RS485 compliance |

# 3-4 Cable and Connector Specifications

## Encoder Cable Specifications

These cables are used to connect the encoder between the servo drive and the servomotor. Select the cable matching the servomotor. The cables listed are flexible, shielded and have IP67 protection.

### Encoder Cables (European 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 |
|---|---|---|
| R88A-CRKA001-5CR-E | 1.5 m | |
| R88A-CRKA003CR-E | 3 m | |
| R88A-CRKA005CR-E | 5 m | 6.9 dia. |
| R88A-CRKA010CR-E | 10 m | |
| R88A-CRKA015CR-E | 15 m | |
| R88A-CRKA020CR-E | 20 m | |

Connection configuration and external dimensions



Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

| Symbol | Number | | |
|---|---|---|---|
| E5V | 1 | Red | |
| E0V | 2 | Black | |
| BAT+ | 3 | Orange | |
| BAT− | 4 | Orange/White | |
| S+ | 5 | Blue | |
| S− | 6 | Blue/White | |
| FG | Shell | | |
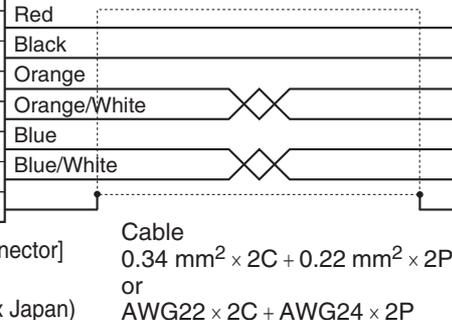
Motor side

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

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

Cable
$0.34 \text{ mm}^2 \times 2C + 0.22 \text{ mm}^2 \times 2P$
or
$AWG22 \times 2C + AWG24 \times 2P$

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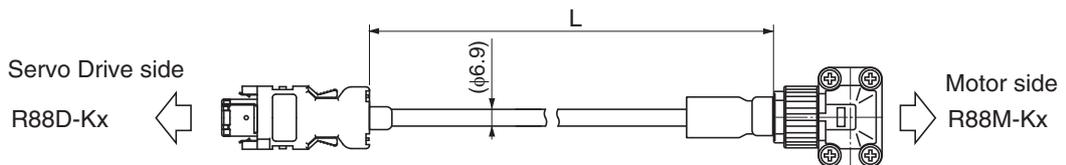Connector pin model
LY10-C1-A1-1000 (Japan Aviation Electronics)

### 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 |
|---|---|---|
| R88A-CRKC001-5NR-E | 1.5 m | |
| R88A-CRKC003NR-E | 3 m | |
| R88A-CRKC005NR-E | 5 m | 7.6 dia. |
| R88A-CRKC010NR-E | 10 m | |
| R88A-CRKC015NR-E | 15 m | |
| R88A-CRKC020NR-E | 20 m | |

Connection configuration and external dimensions
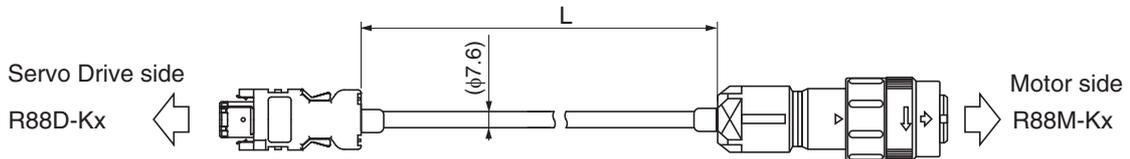


Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

| Symbol | Number | | Motor side Number | Symbol |
|---|---|---|---|---|
| E5V | 1 | Red | 4 | E5V |
| E0V | 2 | Black | 1 | E0V |
| BAT+ | 3 | Orange | 6 | BAT+ |
| BAT− | 4 | Orange/White | 5 | BAT− |
| S+ | 5 | Blue | 3 | S+ |
| S− | 6 | Blue/White | 7 | S− |
| FG | Shell | | 9 | FG |

[Servo Drive side connector]
Connector model
55100-0670 (Molex Japan)
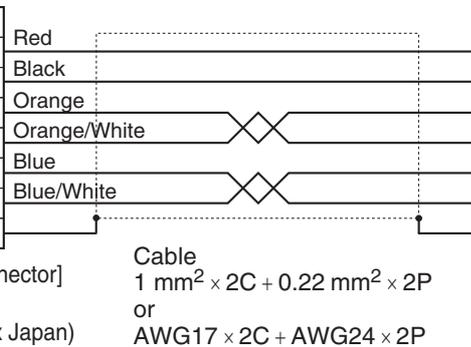
Cable
1 mm² × 2C + 0.22 mm² × 2P
or
AWG17 × 2C + AWG24 × 2P

[Motor side connector]
Straight plug model
JN2DS10SL2-R (Japan Aviation Electronics)
Cable clamp model
JN1-22-22S-10000 (Japan Aviation Electronics)

**3** **Specifications**

## Absolute Encoder Battery Cable Specifications

Use the following cable when using an absolute encoder.

### Cable Model

| Model | Length (L) | Weight |
|---|---|---|
| R88A-CRGD0R3C | 0.3 m | Approx. 0.1 kg |

### Connection Configuration and External Dimensions



### Wiring



Connector plug: 55100-0670 (Molex Japan)
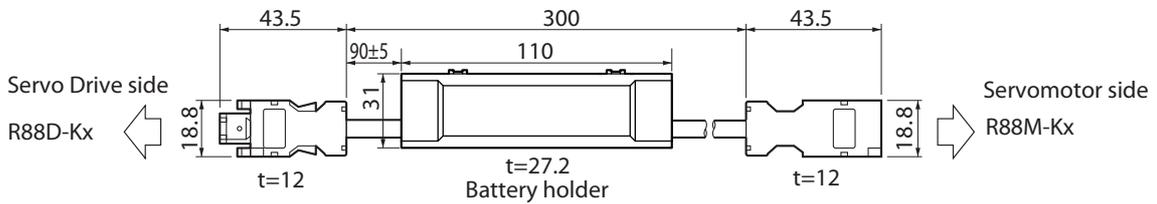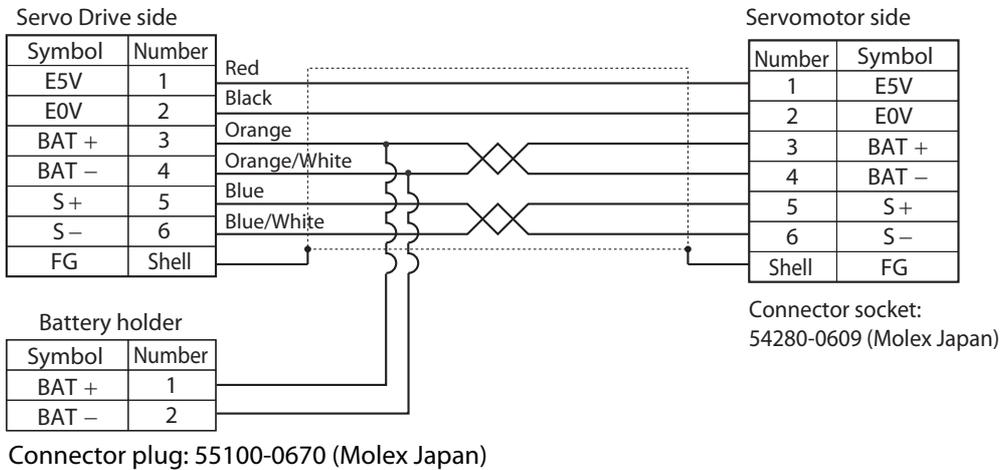
## Motor Power Cable Specifications

These cables connect the servo drive and the servomotor. Select the cable matching the servomotor.

The cables listed are flexible, shielded and have IP67 protection.

### Power Cables without Brakes (European 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 |
|---|---|---|
| R88A-CAKA001-5SR-E | 1.5 m | |
| R88A-CAKA003SR-E | 3 m | |
| R88A-CAKA005SR-E | 5 m | 6.7 dia. |
| R88A-CAKA010SR-E | 10 m | |
| R88A-CAKA015SR-E | 15 m | |
| R88A-CAKA020SR-E | 20 m | |

Connection configuration and external dimensions



Wiring

Servo Drive side

Red
White
Blue
Green/Yellow

M4 crimp terminal

Motor side

| Number | Symbol |
|---|---|
| 1 | Phase U |
| 2 | Phase V |
| 3 | Phase W |
| 4 | FG |

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)
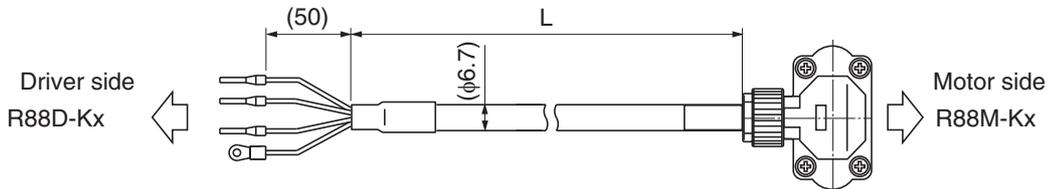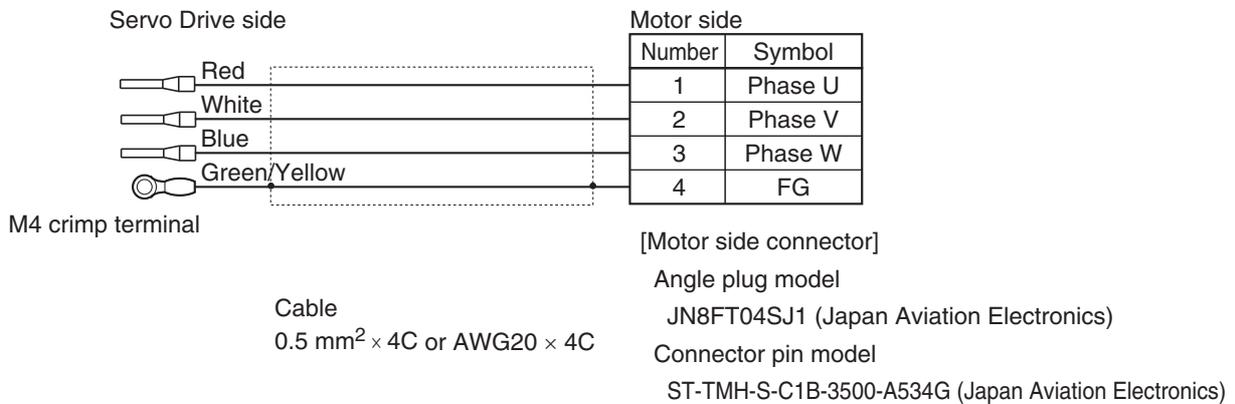
**Note:** for servomotors with brake a separate cable R88A-CAKAxxxBR-E is needed.

### 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 |
|---|---|---|
| R88A-CAGB001-5SR-E | 1.5 m | |
| R88A-CAGB003SR-E | 3 m | |
| R88A-CAGB005SR-E | 5 m | 12.7 dia. |
| R88A-CAGB010SR-E | 10 m | |
| R88A-CAGB015SR-E | 15 m | |
| R88A-CAGB020SR-E | 20 m | |

Connection configuration and external dimensions



Wiring

Servo Drive side

Black-1
Black-2
Black-3
Green/Yellow

M4 crimp terminal

Cable
2.5 mm$^2$ × 4C or AWG14 × 4C

| Number | Symbol |
|---|---|
| A | Phase U |
| B | Phase V |
| C | Phase W |
| D | FG |

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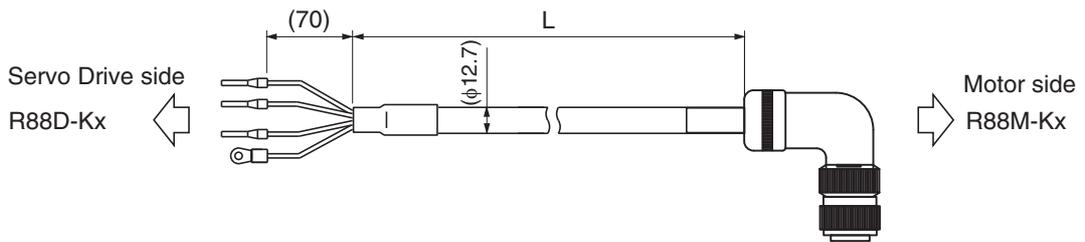
[Motor side connector]
Right angle plug model
N/MS3108B20-4S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-12A (Japan Aviation Electronics)

### 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 |
|---|---|---|
| R88A-CAGD001-5SR-E | 1.5 m | |
| R88A-CAGD003SR-E | 3 m | |
| R88A-CAGD005SR-E | 5 m | 13.2 dia. |
| R88A-CAGD010SR-E | 10 m | |
| R88A-CAGD015SR-E | 15 m | |
| R88A-CAGD020SR-E | 20 m | |

Connection configuration and external dimensions

Servo Drive side
R88D-Kx

Motor side
R88M-Kx

(70)     L     (φ13.2)

Wiring

Servo Drive side

Black-1
Black-2
Black-3
Green/Yellow

M5 crimp terminal

Cable
4 mm² × 4C or AWG11 × 4C

Motor side

| Number | Symbol |
|---|---|
| A | Phase U |
| B | Phase V |
| C | Phase W |
| D | FG |

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

### R88A-CAKExSR-E

Cable types
(For 1,500-r/min motors of 7.5 kW, 1,000-r/min motors of 6 kW)

| Model | Length (L) |
|---|---|
| R88A-CAKE001-5SR-E | 1.5 m |
| R88A-CAKE003SR-E | 3 m |
| R88A-CAKE005SR-E | 5 m |
| R88A-CAKE010SR-E | 10 m |
| R88A-CAKE015SR-E | 15 m |
| R88A-CAKE020SR-E | 20 m |

Connection configuration and external dimensions

Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

Black-1
Black-2
Black-3
Green/Yellow

M5 crimp terminal

Cable
6 mm$^2$ × 4C or AWG11 × 4C

Motor side

| Number | Symbol |
|---|---|
| A | Phase U |
| B | Phase V |
| C | Phase W |
| D | FG |
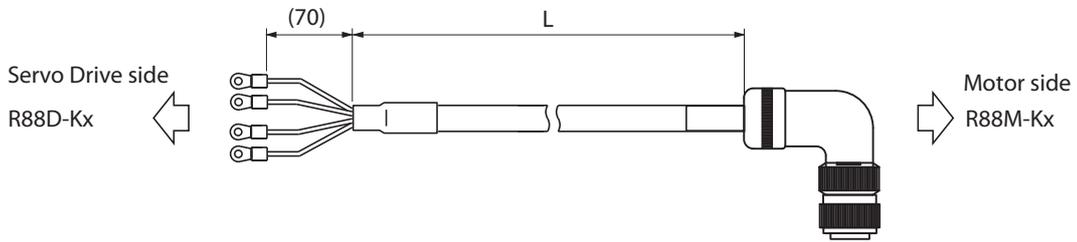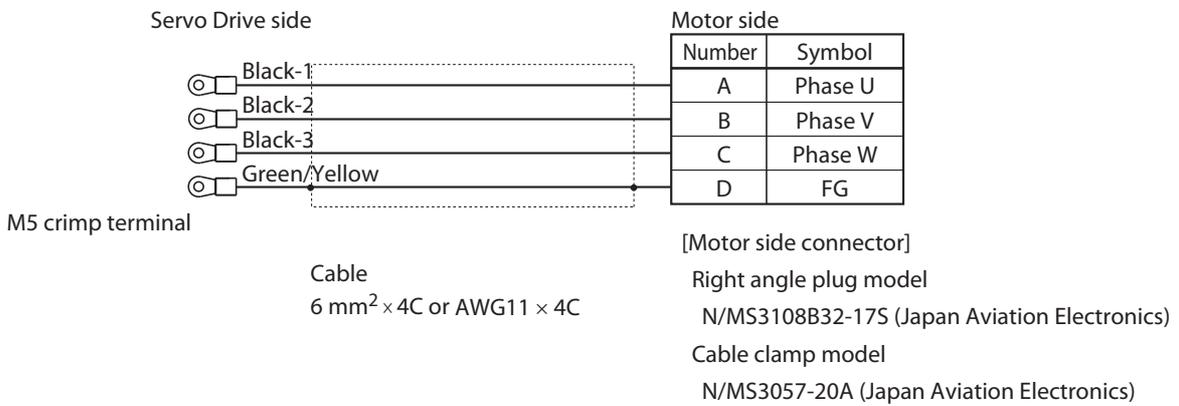
[Motor side connector]
Right angle plug model
N/MS3108B32-17S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-20A (Japan Aviation Electronics)

**R88A-CAKGxSR-E**

Cable types
(For 1,500-r/min motors of 11 kW to 15 kW)

| Model | Length (L) |
|-------|-----------|
| R88A-CAKG001-5SR-E | 1.5 m |
| R88A-CAKG003SR-E | 3 m |
| R88A-CAKG005SR-E | 5 m |
| R88A-CAKG010SR-E | 10 m |
| R88A-CAKG015SR-E | 15 m |
| R88A-CAKG020SR-E | 20 m |

Connection configuration and external dimensions



Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

Black-1
Black-2
Black-3
Green/Yellow

M5 crimp terminal

Cable
10 mm² × 4C or AWG11 × 4C

Motor side

| Number | Symbol |
|--------|--------|
| A | Phase U |
| B | Phase V |
| C | Phase W |
| D | FG |

[Motor side connector]
Right angle plug model
N/MS3108B32-17S (Japan Aviation Electronics)
Cable clamp model
N/MS3057-20A (Japan Aviation Electronics)
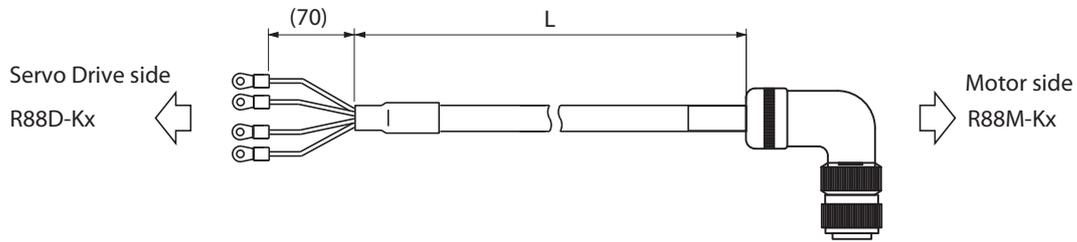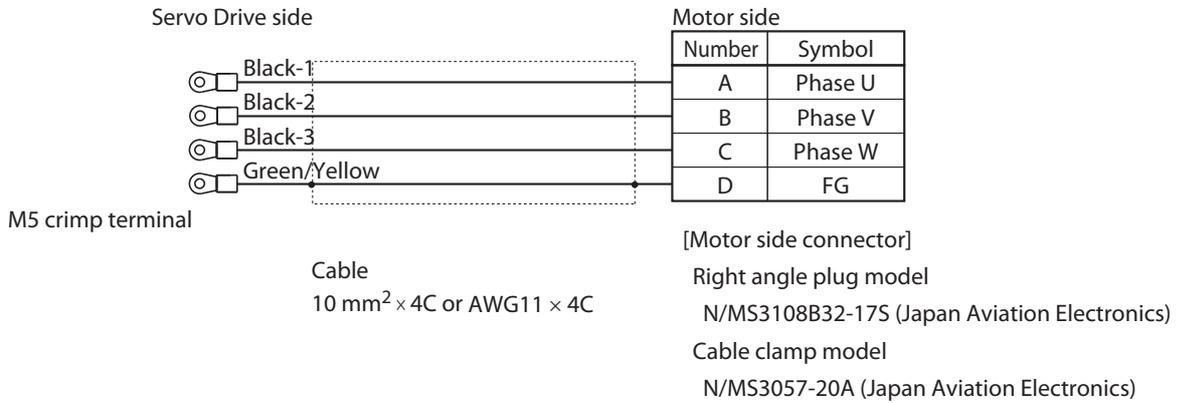
## Power Cables with Brakes (European Flexible Cables)

### 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)

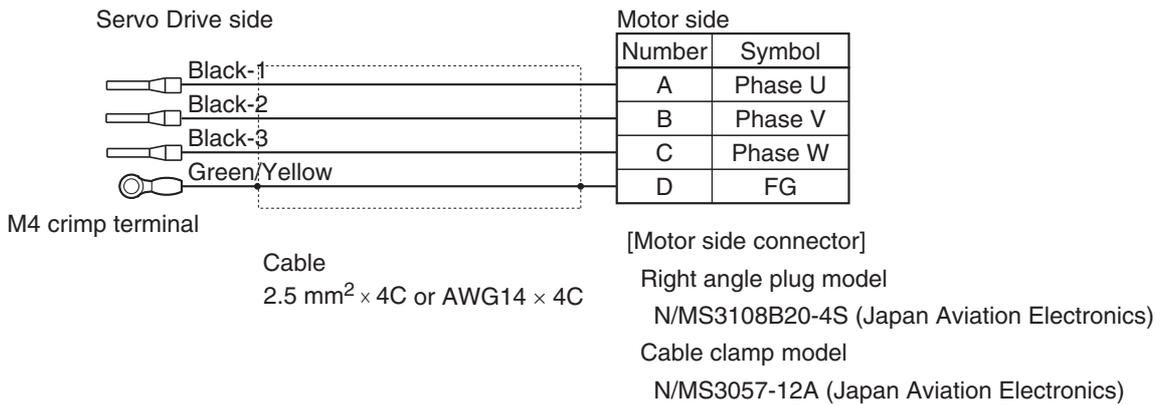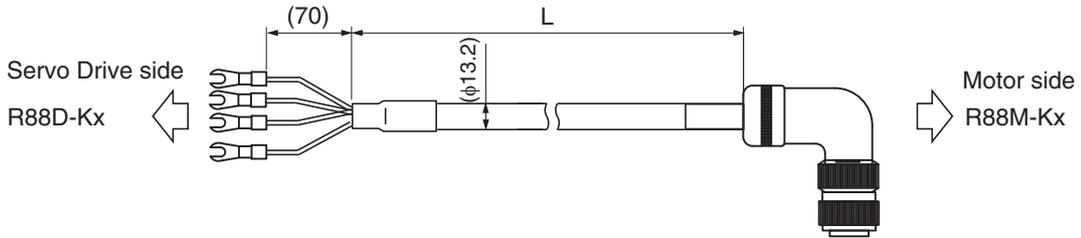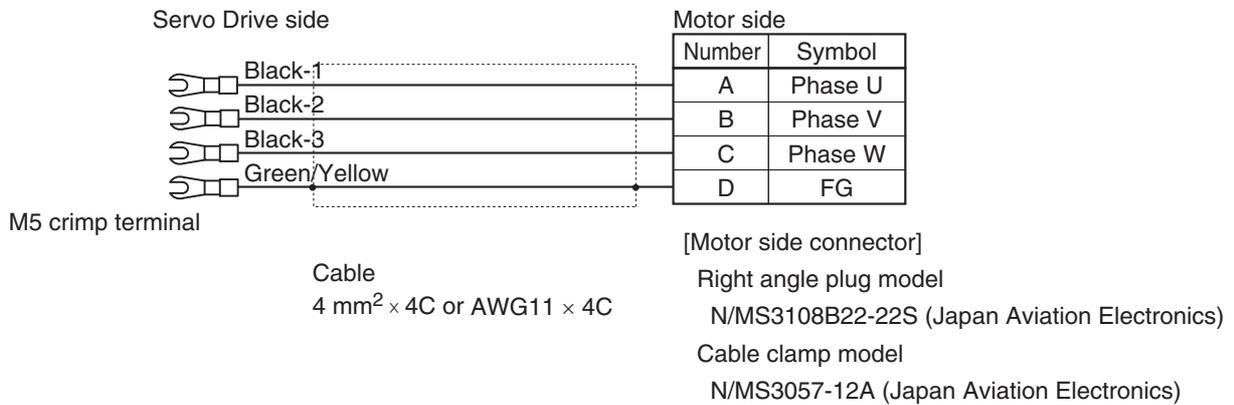| Model | Length (L) | Outer diameter of sheath |
|-------|-----------|--------------------------|
| R88A-CAGB001-5BR-E | 1.5 m | |
| R88A-CAGB003BR-E | 3 m | |
| R88A-CAGB005BR-E | 5 m | 12.5 dia. |
| R88A-CAGB010BR-E | 10 m | |
| R88A-CAGB015BR-E | 15 m | |
| R88A-CAGB020BR-E | 20 m | |

Connection configuration and external dimensions

Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

Black-5    0.5
Black-6    0.5

Black-1    2.5
Black-2    2.5
Black-3    2.5
Green/Yellow    2.5

M4 crimp terminal

Cable
2.5 mm$^2$ × 4C + 0.5 mm$^2$ × 2C
or
AWG14 × 4C + AWG20 × 2C

Motor side

| 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 |
|---|---|---|
| R88A-CAKF001-5BR-E | 1.5 m | |
| R88A-CAKF003BR-E | 3 m | |
| R88A-CAKF005BR-E | 5 m | 12.5 dia. |
| R88A-CAKF010BR-E | 10 m | |
| R88A-CAKF015BR-E | 15 m | |
| R88A-CAKF020BR-E | 20 m | |

Connection configuration and external dimensions



Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

Black-5 — 0.5
Black-6 — 0.5

Black-1 — 2.5
Black-2 — 2.5
Black-3 — 2.5
Green/Yellow — 2.5

M4 crimp terminal

Cable
2.5 mm$^2$ × 4C + 0.5 mm$^2$ × 2C
or
AWG14 × 4C + AWG20 × 2C

| Motor side | |
|---|---|
| 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)
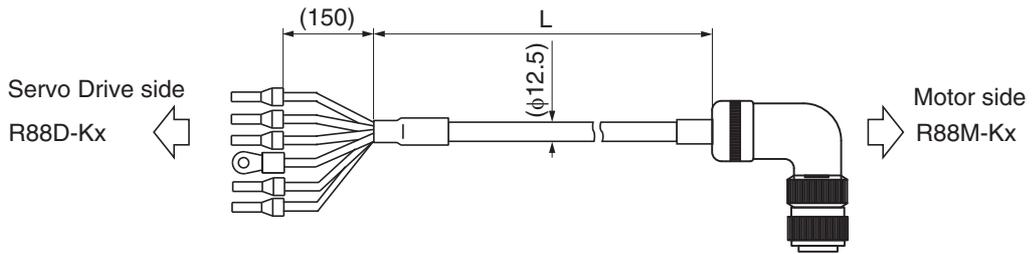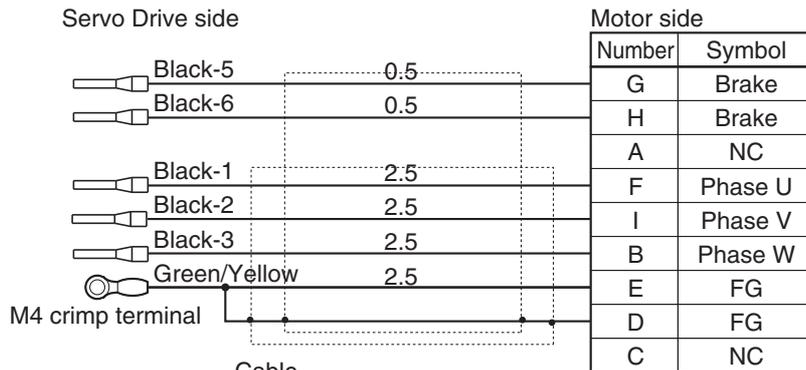
**R88A-CAGDxBR-E**

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 |
|-------|-----------|--------------------------|
| R88A-CAGD001-5BR-E | 1.5 m | |
| R88A-CAGD003BR-E | 3 m | |
| R88A-CAGD005BR-E | 5 m | 13.5 dia. |
| R88A-CAGD010BR-E | 10 m | |
| R88A-CAGD015BR-E | 15 m | |
| R88A-CAGD020BR-E | 20 m | |

Connection configuration and external dimensions

Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

| | | |
|---|---|---|
| Black-5 | 0.5 | |
| Black-6 | 0.5 | |
| Black-1 | 4 | |
| Black-2 | 4 | |
| Black-3 | 4 | |
| Green/Yellow | 4 | |

M4 crimp terminal

Cable
4 mm² × 4C + 0.5 mm² × 2C
or
AWG11 × 4C + AWG20 × 2C

Motor side

| 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
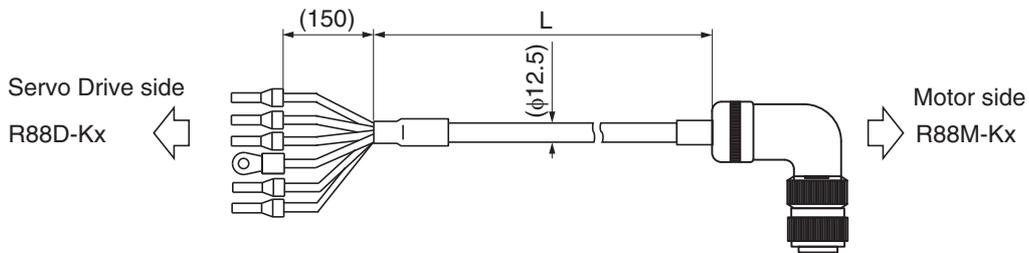
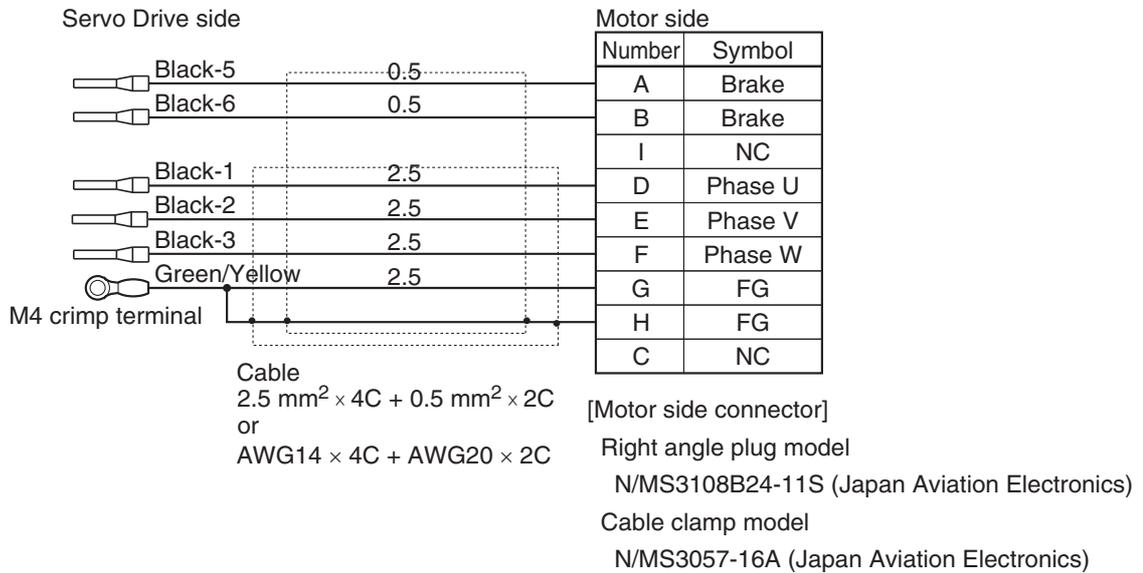N/MS3057-16A (Japan Aviation Electronics)
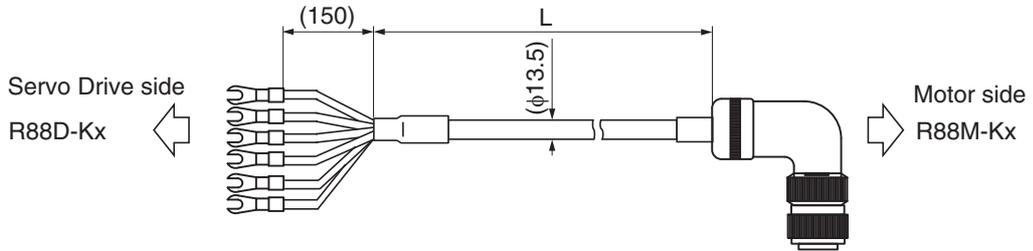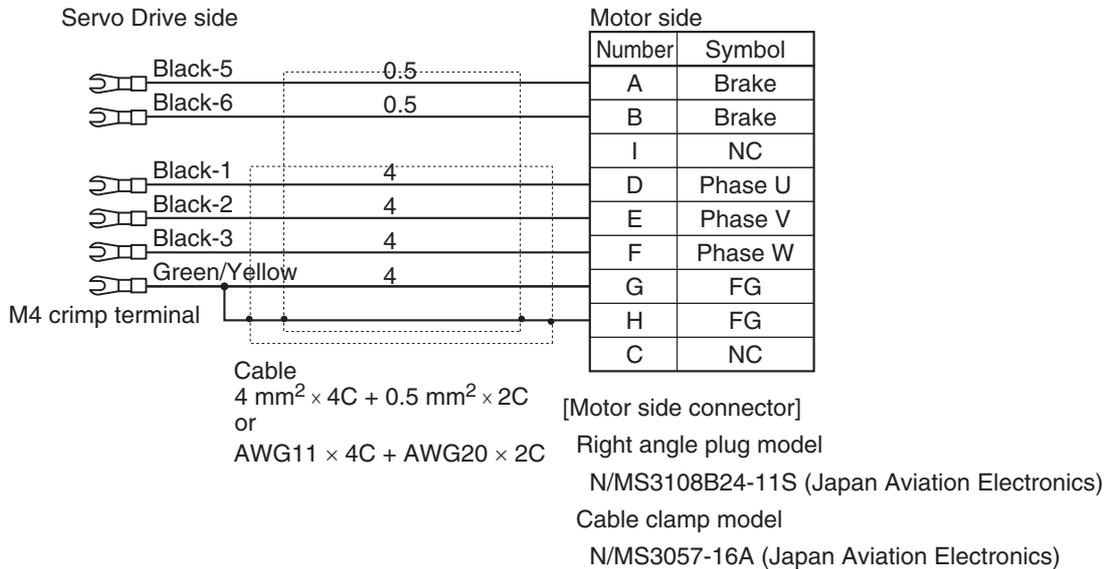
## Brake Cables (European Flexible Cables)

### R88A-CAKAxBR-E

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

| Model | Length (L) | Outer diameter of sheath |
|-------|-----------|--------------------------|
| R88A-CAKA001-5BR-E | 1.5 m | |
| R88A-CAKA003BR-E | 3 m | |
| R88A-CAKA005BR-E | 5 m | 6.0 dia. |
| R88A-CAKA010BR-E | 10 m | |
| R88A-CAKA015BR-E | 15 m | |
| R88A-CAKA020BR-E | 20 m | |

Connection configuration and external dimensions
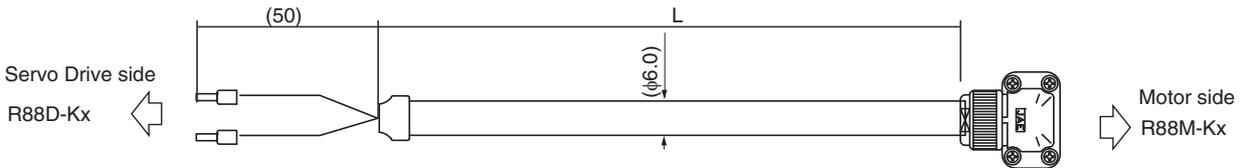


Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

Black-1    0.5
Black-2    0.5

Cable
0.5 mm² × 2C
or
AWG20 × 2C
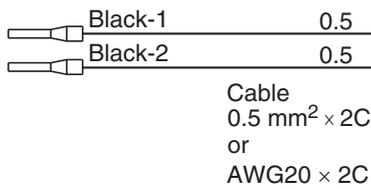
Motor side

| Number | Symbol |
|--------|--------|
| 1 | Brake |
| 2 | Brake |

[Motor side connector]

Connector model
   JN4FT02SJ1-R (Japan Aviation Electronics)
Contact model
   ST-TMH-S-C1B (Japan Aviation Electronics)

### R88A-CAGExBR-E

Cable types
400 V:
(For 1,500-r/min motors of 7.5 kW to 15 kW, 1,000-r/min motors of 6 kW)

| Model | Length (L) |
|---|---|
| R88A-CAGE001-5BR-E | 1.5 m |
| R88A-CAGE003BR-E | 3 m |
| R88A-CAGE005BR-E | 5 m |
| R88A-CAGE010BR-E | 10 m |
| R88A-CAGE015BR-E | 15 m |
| R88A-CAGE020BR-E | 20 m |

Connection configuration and external dimensions



Servo Drive side
R88D-Kx

Motor side
R88M-Kx

Wiring

Servo Drive side

Black-1          0.5
Black-2          0.5

Cable
0.5 mm$^2$ × 2C
or
AWG20 × 2C

Motor side

| Number | Symbol |
|---|---|
| 1 | Brake |
| 2 | Brake |

[Motor side connector]

Connector model

N/MS3108B32-17S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-6A (Japan Aviation Electronics)
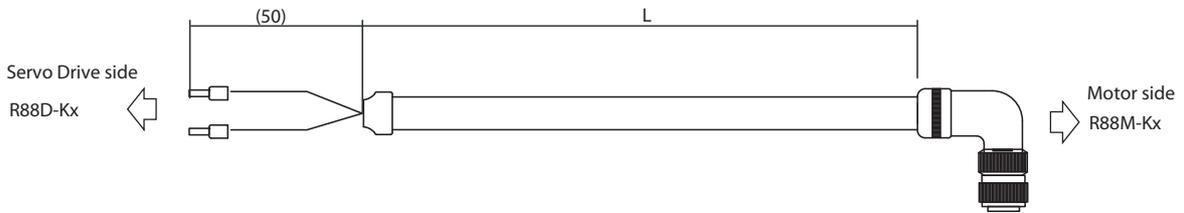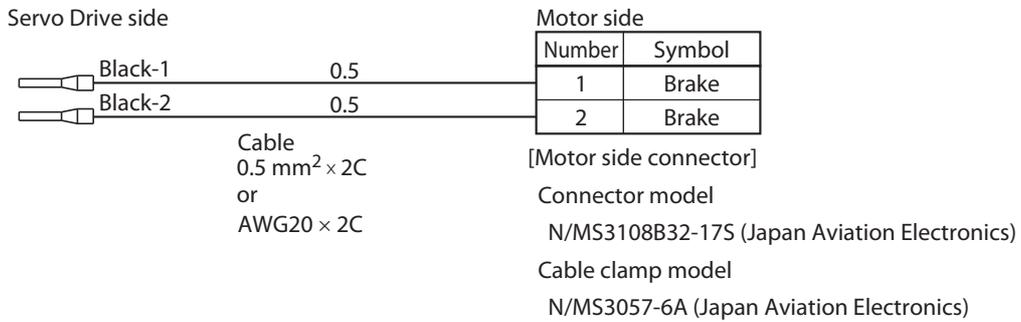
## Connector Specifications

### Control I/O Connector (R88A-CNU11C)

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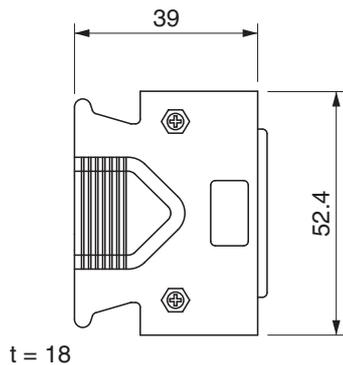
**Dimensions**

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

39

52.4

t = 18

### Encoder Connectors

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

**Dimensions**

R88A-CNW01R (driver'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.

43.5

18.8
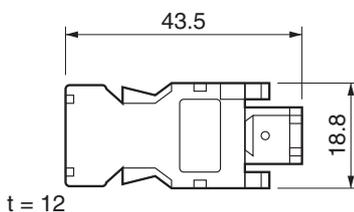
Connector plug model
    55100-0670 (Molex Japan)

t = 12

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

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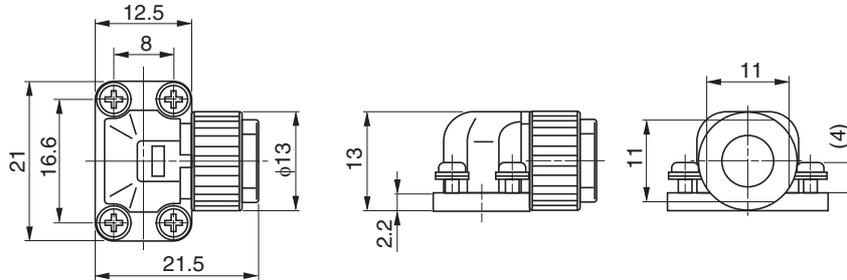
• Applicable wire: AWG22 max.
• Insulating cover outer diameter: 1.3 mm dia. max.
• Outer diameter of sheath: 5 ± 0.5 mm dia.

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

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

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

• Applicable wire: AWG20 max.
• Outer diameter of sheath: 6.5 to 8.0 dia.
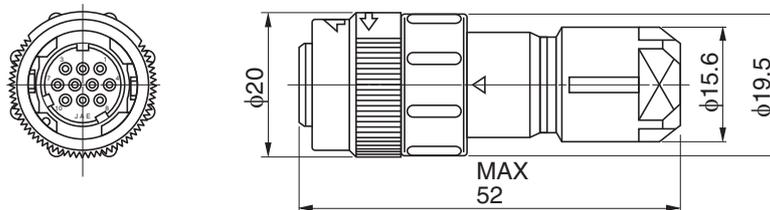
Straight plug model JN2DS10SL2-R
    (Japan Aviation Electronics)
Contact model JN1-22-22S-R-PKG100
    (Japan Aviation Electronics)

**3**

**Specifications**

## Power Cable Connector (R88A-CNK11A)

This connector is used for power cables.
Use it when preparing a power cable by yourself.
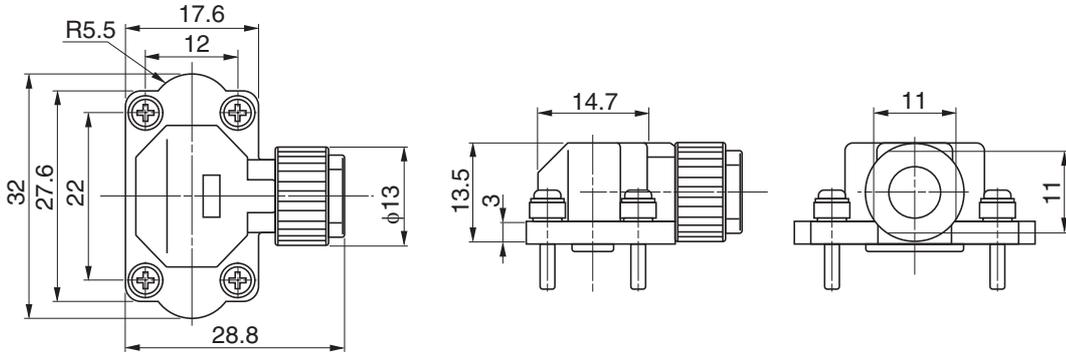
Angle plug model JN8FT04SJ1
    (Japan Aviation Electronics)
Socket contact model ST-TMH-S-C1B-3500-(A534G)
    (Japan Aviation Electronics)

## Brake Cable Connector (R88A-CNK11B)

This connector is used for brake cables.
Use it when preparing a brake cable by yourself.
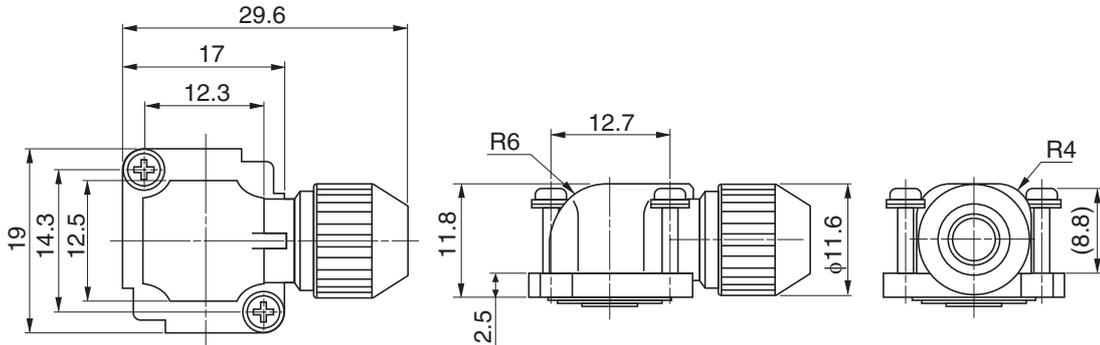
Angle plug model JN4FT02SJ1-R
    (Japan Aviation Electronics)
Socket contact model ST-TMH-S-C1B-3500-(A534G)
    (Japan Aviation Electronics)

## Analog Monitor Cable Specifications

### Analog Monitor Cable (R88A-CMK001S)

**Connection configuration and external dimensions**

| Symbol | No. | |
|--------|-----|--|
| SP | 1 | Red |
| IM | 2 | Black |
| GND | 3 | White |
| | 4 | |
| | 5 | |
| | 6 | Cable: AWG24 × 3C  UL1007 |

Connector housing: 51004-0600 (Molex Japan)
Connector terminal: 50011-8100 (Molex Japan)

1,000 mm (1 m)

**3**

**Specifications**
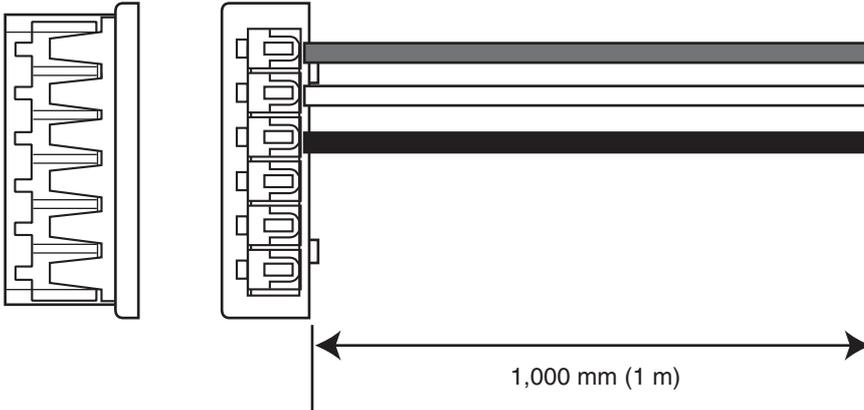
## External Scale Connector (R88A-CNK41L)

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

13.6
10.4
7.1
11.9
18.5
7.2
(42.5)
(10.5)
φ6.8 MAX
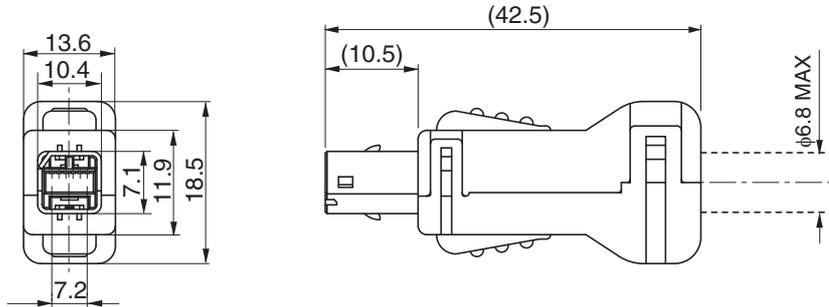
Connector plug model
MUF-PK10K-X (J.S.T. Mfg. Co., Ltd.)

### Pin Arrangement

View from Inserted Portion

10 9 8 7 6 5 4 3 2 1
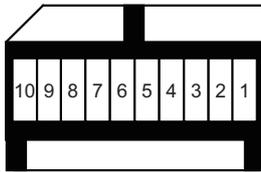
View from Soldered Housing Surface

1 3 5 7 9
2 4 6 8 10
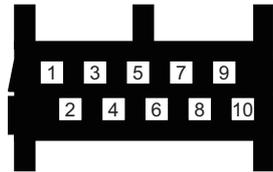
## Safety I/O Signal Connector (R88A-CNK81S)

Use this connector to connect to safety devices.

11
11
7.3
10.7
33
φ6.7

Pin arrangement

8
7

1.5
5.2
8
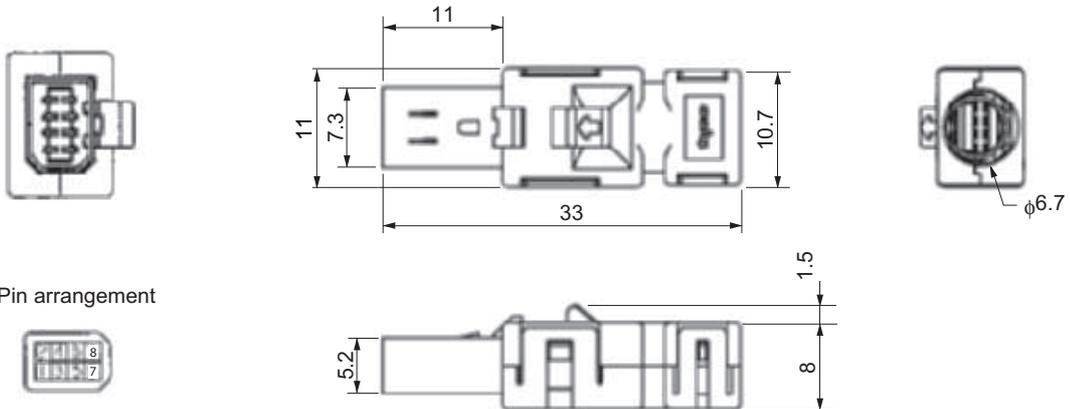
## Control Cable Specifications

### Specified Cables for Motion Control Unit (R88A-CPGxMx)

Use this cable to connect to the Motion Control Units for OMRON Programmable Controllers (SYSMAC). Cables are available for either 1 axis or 2 axes.
The following Motion Control Units can be used.
CS1W-MC221/421(-V1)

#### Cable types

• Cables for 1 axis

| Model | Length (L) | Outer diameter of sheath | Weight |
|-------|-----------|--------------------------|--------|
| R88A-CPG001M1 | 1 m | | Approx. 0.2 kg |
| R88A-CPG002M1 | 2 m | 8.3 dia. | Approx. 0.3 kg |
| R88A-CPG003M1 | 3 m | | Approx. 0.4 kg |
| R88A-CPG005M1 | 5 m | | Approx. 0.6 kg |

• Cables for 2 axes

| Model | Length (L) | Outer diameter of sheath | Weight |
|-------|-----------|--------------------------|--------|
| R88A-CPG001M2 | 1 m | | Approx. 0.3 kg |
| R88A-CPG002M2 | 2 m | 8.3 dia. | Approx. 0.5 kg |
| R88A-CPG003M2 | 3 m | | Approx. 0.7 kg |
| R88A-CPG005M2 | 5 m | | Approx. 1.0 kg |

#### Connection configuration and external dimensions

• Cables for 1 axis

Motion Control Unit side
CS1W-MC221/421(-V1)

39    L    39
43.5    t = 18    52.4    t = 18

Driver side
R88D-Kx

• Cables for 2 axes

Motion Control Unit side
CS1W-MC221/421(-V1)

39    L    39
43.5    t = 18    52.4    t = 18

Driver side
R88D-Kx

Driver side
R88D-Kx

52.4    t = 18

### Wiring

• Cables for 1 axis

Motion Control Unit side

| Symbol | Number | | Number | Symbol | |
|---|---|---|---|---|---|
| +24V | 1 | AWG20 Red | | | |
| DCGND | 2 | AWG20 Black | | | |
| XALM | 3 | White/Black (1) | 37 | /ALM | |
| XRUN | 4 | Pink/Black (1) | 29 | RUN | |
| XALMRS | 5 | Yellow/Black (1) | 31 | RESET | |
| XSGND | 8 | Gray/Black (1) | 13 | SENGND | * |
| XSOUT | 9 | Gray/Red (1) | 20 | SEN | * |
| X–GND | 10 | Orange/Black (2) | 25 | ZCOM | |
| X–A | 11 | White/Red (1) | 21 | +A | |
| X–Ā | 12 | White/Black (1) | 22 | –A | |
| X–B | 13 | Yellow/Red (1) | 49 | +B | |
| X–B̄ | 14 | Yellow/Black (1) | 48 | –B | |
| X–Z | 15 | Pink/Red (1) | 23 | +Z | |
| X–Z̄ | 16 | Pink/Black (1) | 24 | –Z | |
| XOUT | 17 | Orange/Red (1) | 14 | REF/TREF1/VLIM | Connector plug model |
| XAGND | 18 | Orange/Black (1) | 15 | AGND | 10150-3000PE |
| | | | Shell | FG | (Sumitomo 3M) |
| +F24V | 19 | Orange/Black (1) | 7 | +24VIN | Connector case model |
| FDC GND | 20 | Gray/Black (1) | 36 | ALMCOM | 10350-52A0-008 |
| YALM | 21 | Cable: AWG26 × 5P + AWG26 × 6C | | | (Sumitomo 3M) |
| YRUN | 22 | | | | |
| YALMRS | 23 | | | | |
| YSGND | 26 | | | | |
| YSOUT | 27 | | | | |
| Y–GND | 28 | | | | |
| Y–A | 29 | | | | |
| Y–Ā | 30 | | | | |
| Y–B | 31 | | | | |
| Y–B̄ | 32 | | | | |
| Y–Z | 33 | Connector plug model | | | |
| Y–Z̄ | 34 | 10136-3000PE (Sumitomo 3M) | | | |
| YOUT | 35 | Connector case model | | | |
| YAGND | 36 | 10336-52A0-008 (Sumitomo 3M) | | | |

Driver side

• The symbols on the controller side are the DRVX and DRVY connector symbols. For the DRVZ and DRVU connectors, X and Y are indicated as Z and U, respectively.
• Terminals marked with asterisks are for absolute encoders.
• Connect 24 VDC to the 2 lines (red and black) extending from the connector on the controller side. (red: +24 V, black: -)

⬧ Cables for 2 axes

Motion Control Unit side — Driver side

AWG20 Red / AWG20 Black

| Symbol | Number | Wire color | Number | Symbol | |
|---|---|---|---|---|---|
| +24V | 1 | | | | |
| DCGND | 2 | | | | |
| XALM | 3 | White/Black (1) | 37 | /ALM | |
| XRUN | 4 | Pink/Black (1) | 29 | RUN | |
| XALMRS | 5 | Yellow/Black (1) | 31 | RESET | |
| XSGND | 8 | Gray/Black (1) | 13 | SENGND | * |
| XSOUT | 9 | Gray/Red (1) | 20 | SEN | * |
| X−GND | 10 | Orange/Black (2) | 25 | ZCOM | |
| X−A | 11 | White/Red (1) | 21 | +A | |
| X−Ā | 12 | White/Black (1) | 22 | −A | |
| X−B | 13 | Yellow/Red (1) | 49 | +B | |
| X−B̄ | 14 | Yellow/Black (1) | 48 | −B | |
| X−Z | 15 | Pink/Red (1) | 23 | +Z | |
| X−Z̄ | 16 | Pink/Black (1) | 24 | −Z | |
| XOUT | 17 | Orange/Red (1) | 14 | REF/TREF1/VLIM | |
| XAGND | 18 | Orange/Black (1) | 15 | AGND | |
| | | | Shell | FG | |
| +F24V | 19 | Orange/Black (1) | 7 | +24VIN | |
| FDC GND | 20 | Gray/Black (1) | 36 | ALMCOM | |

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

Cable AWG26 × 5P + AWG26 × 6C

| Symbol | Number | Wire color | Number | Symbol | |
|---|---|---|---|---|---|
| | | | 7 | +24VIN | |
| | | | 36 | ALMCOM | |
| YALM | 21 | White/Black (1) | 37 | /ALM | |
| YRUN | 22 | Pink/Black (1) | 29 | RUN | |
| YALMRS | 23 | Yellow/Black (1) | 31 | RESET | |
| YSGND | 26 | Gray/Black (1) | 13 | SENGND | * |
| YSOUT | 27 | Gray/Red (1) | 20 | SEN | * |
| Y−GND | 28 | Orange/Black (2) | 25 | ZCOM | |
| Y−A | 29 | White/Red (1) | 21 | +A | |
| Y−Ā | 30 | White/Black (1) | 22 | −A | |
| Y−B | 31 | Yellow/Red (1) | 49 | +B | |
| Y−B̄ | 32 | Yellow/Black (1) | 48 | −B | |
| Y−Z | 33 | Pink/Red (1) | 23 | +Z | |
| Y−Z̄ | 34 | Pink/Black (1) | 24 | −Z | |
| YOUT | 35 | Orange/Red (1) | 14 | REF/TREF1/VLIM | |
| YAGND | 36 | Orange/Black (1) | 15 | AGND | |
| | | | Shell | FG | |

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

Connector plug model 10136-3000PE (Sumitomo 3M)
Connector case model 10336-52A0-008 (Sumitomo 3M)

Cable AWG26 × 5P + AWG26 × 6C

⬧ The symbols on the controller side are the DRVX and DRVY connector symbols. For the DRVZ and DRVU connectors, X and Y are indicated as Z and U, respectively.
⬧ Terminals marked with asterisks are for absolute encoders.
⬧ Connect 24 VDC to the 2 lines (red and black) extending from the connector on the controller side. (red: +24 V, black: -)

**3**

**Specifications**

## Specified Cables for Position Control Unit (for CJ1W-NCxx4 - high-speed type -)

This cable is for connecting Position Control Units (CJ1W-NCxx4) for OMRON Programmable Controller SYSMAC CJ Series. Cables are available for either 1 axis or 2 axes.
The following types of Position Control Units are supported.
CJ1W-NC214/-NC414/-NC234/-NC434

### Cable types

• Cable for line-driver output for 1 axis

| Model | Length |
|---|---|
| XW2Z-100J-G9 | 1 m |
| XW2Z-500J-G9 | 5 m |
| XW2Z-10MJ-G9 | 10 m |

• Cable for open collector output for 1 axis

| Model | Length |
|---|---|
| XW2Z-100J-G3 | 1 m |
| XW2Z-300J-G3 | 3 m |

• Cable for line-driver output for 2 axes

| Model | Length |
|---|---|
| XW2Z-100J-G1 | 1 m |
| XW2Z-500J-G1 | 5 m |
| XW2Z-10MJ-G1 | 10 m |

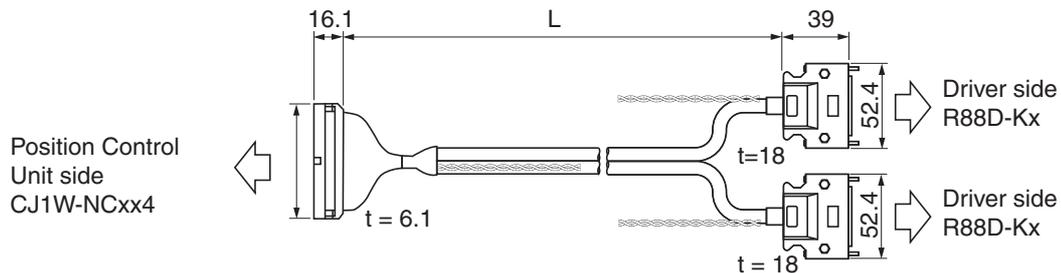• Cable for open collector output for 2 axes

| Model | Length |
|---|---|
| XW2Z-100J-G5 | 1 m |
| XW2Z-300J-G5 | 3 m |

### Connection configuration and external dimensions

• Cables for 1 axis



• Cables for 2 axes

## Wiring

⬥ Cable for line-driver output for 1 axis

AWG18 twisted pair 1 m

Red: 24 VDC
Black: 24 VDC GND

PCU side
XG4M-5030-T (OMRON)

AWG18 twisted pair 1 m

Blue: BKIRCOM
Black: BKIR

Servo Drive side (for axis 1 or 3)
10150-3000PE (Sumitomo 3M)

| PCU side | Pin | | Servo pin | Signal | Description |
|---|---|---|---|---|---|
| 24-V power supply for output | 1 | | 11 | BKIR | Brake interlock output |
| 24-V GND for output | 3 | | 10 | BKIRCOM | |
| Input common | 5 | | 44 | +CWLD | Reverse pulse (*1) |
| Forward direction pulse output (+) | 17 | | 45 | −CWLD | (input for line driver only) |
| Forward direction pulse output (-) | 16 | | 46 | +CCWLD | Forward pulse (*1) |
| Reverse direction pulse output (+) | 19 | | 47 | −CCWLD | (input for line driver only) |
| Reverse direction pulse output (-) | 18 | | 21 | +A | Encoder phase A+output |
| Encoder phase A+ | 21 | | 22 | −A | Encoder phase A−output |
| Encoder phase A− | 20 | | 49 | +B | Encoder phase B+output |
| Encoder phase B+ | 23 | | 48 | −B | Encoder phase B−output |
| Encoder phase B− | 22 | | 23 | +Z | Encoder phase Z+output |
| Encoder phase Z+ | 25 | | 24 | −Z | Encoder phase Z−output |
| Encoder phase Z− | 24 | | 7 | +24VIN | +24-V power supply for controls |
| Error counter reset output | 15 | | 30 | ECRST | Error counter reset input |
| RUN output | 11 | | 29 | RUN | Operation command input |
| General-purpose output | 10 | | 26 | DFSEL | Vibration filter switching |
| Alarm reset output | 12 | | 31 | RESET | Alarm reset |
| Torque limit output | 13 | | 27 | TLSEL | Torque limit switching |
| Positioning completed input | 7 | | 39 | INP | Positioning completion output 1 |
| | | | 38 | INPCOM | |
| General-purpose input | 6 | | 35 | READY | Servo ready completed output |
| | | | 34 | REDYCOM | |
| Alarm input | 9 | | 37 | /ALM | Alarm output |
| | | | 36 | ALMCOM | |
| SEN output | 26 | | 20 | SEN | Sensor ON input |
| Signal ground | 27 | | 13 | SENGND | |
| | | | Shell | FG | Frame ground |

| PCU side | Pin |
|---|---|
| 24-V power supply for output | 2 |
| 24-V GND for output | 4 |
| Input common | 50 |
| Forward direction pulse output (+) | 39 |
| Forward direction pulse output (−) | 38 |
| Reverse direction pulse output (+) | 37 |
| Reverse direction pulse output (−) | 36 |
| Encoder phase A+ | 35 |
| Encoder phase A− | 34 |
| Encoder phase B+ | 33 |
| Encoder phase B− | 32 |
| Encoder phase Z+ | 31 |
| Encoder phase Z− | 30 |
| Error counter reset output | 41 |
| RUN output | 45 |
| General-purpose output | 44 |
| Alarm reset output | 42 |
| Torque limit output | 43 |
| Positioning completed input | 49 |
| General-purpose input | 48 |
| Alarm input | 47 |
| SEN output | 29 |
| Signal ground | 28 |

*1 Since the PCU handles forward direction commands as CW-direction/phase-A advance pulses (selectable by the output pulse direction selection parameter), connect the wires as shown here.
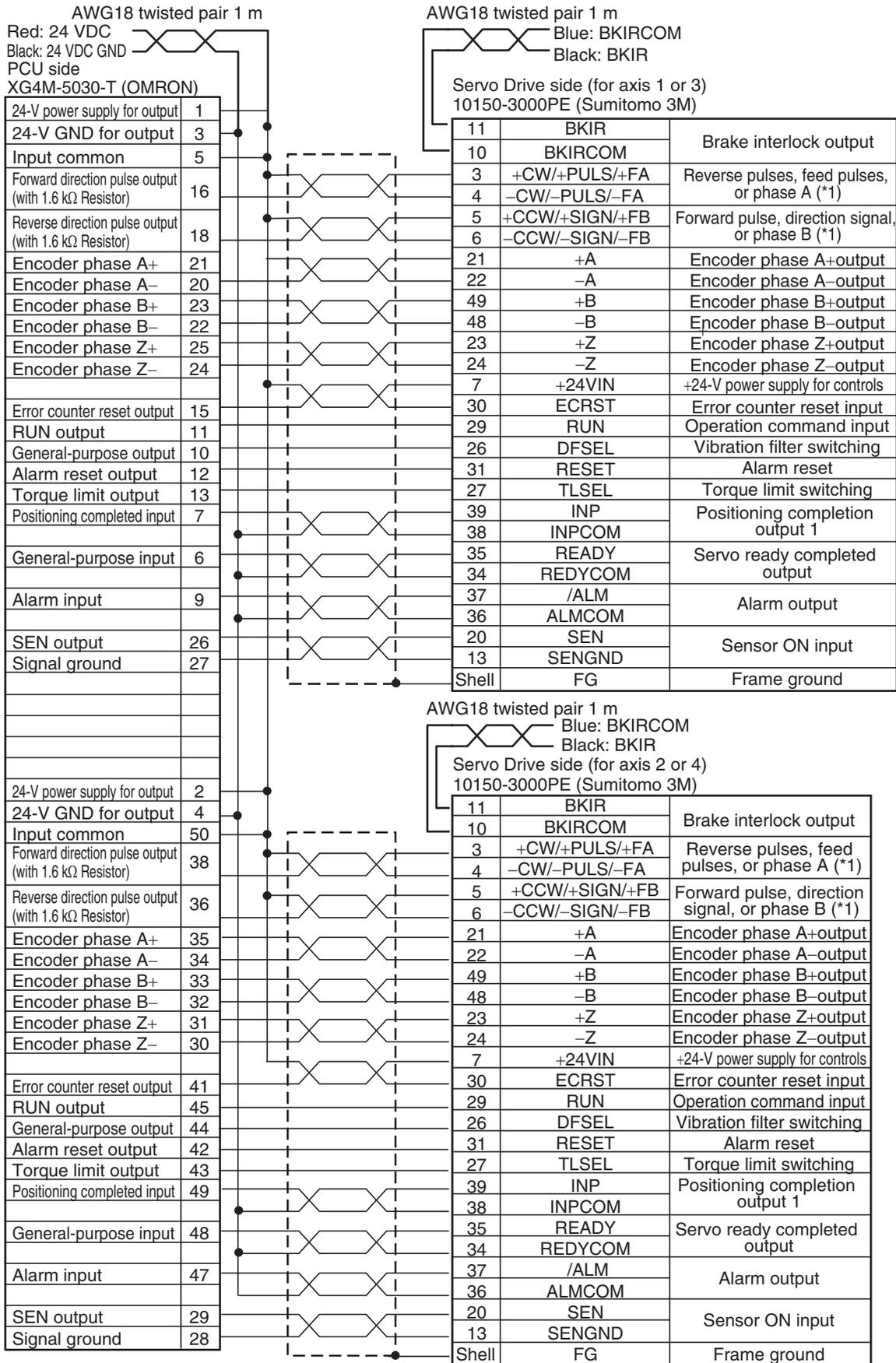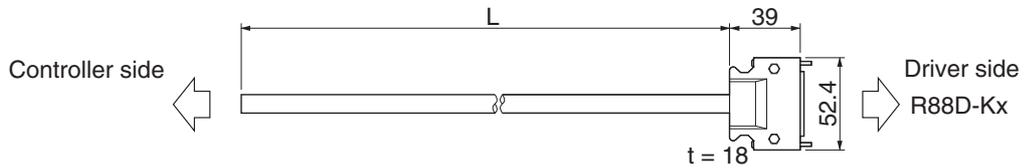
**3**

**Specifications**

♦ Cable for open collector output for 1 axis

AWG18 twisted pair 1 m
Red: 24 VDC
Black: 24 VDC GND
PCU side
XG4M-5030-T (OMRON)

AWG18 twisted pair 1 m
Blue: BKIRCOM
Black: BKIR

Servo Drive side (for axis 1 or 3)
10150-3000PE (Sumitomo 3M)

| | |
|---|---|
| 24-V power supply for output | 1 |
| 24-V GND for output | 3 |
| Input common | 5 |
| Forward direction pulse output (with 1.6 kΩ Resistor) | 16 |
| Reverse direction pulse output (with 1.6 kΩ Resistor) | 18 |
| Encoder phase A+ | 21 |
| Encoder phase A− | 20 |
| Encoder phase B+ | 23 |
| Encoder phase B− | 22 |
| Encoder phase Z+ | 25 |
| Encoder phase Z− | 24 |
| Error counter reset output | 15 |
| RUN output | 11 |
| General-purpose output | 10 |
| Alarm reset output | 12 |
| Torque limit output | 13 |
| Positioning completed input | 7 |
| General-purpose input | 6 |
| Alarm input | 9 |
| SEN output | 26 |
| Signal ground | 27 |
| 24-V power supply for output | 2 |
| 24-V GND for output | 4 |
| Input common | 50 |
| Forward direction pulse output (with 1.6 kΩ Resistor) | 38 |
| Reverse direction pulse output (with 1.6 kΩ Resistor) | 36 |
| Encoder phase A+ | 35 |
| Encoder phase A− | 34 |
| Encoder phase B+ | 33 |
| Encoder phase B− | 32 |
| Encoder phase Z+ | 31 |
| Encoder phase Z− | 30 |
| Error counter reset output | 41 |
| RUN output | 45 |
| General-purpose output | 44 |
| Alarm reset output | 42 |
| Torque limit output | 43 |
| Positioning completed input | 49 |
| General-purpose input | 48 |
| Alarm input | 47 |
| SEN output | 29 |
| Signal ground | 28 |

| | | |
|---|---|---|
| 11 | BKIR | Brake interlock output |
| 10 | BKIRCOM | |
| 3 | +CW/+PULS/+FA | Reverse pulses, feed pulses, or phase A (*1) |
| 4 | −CW/−PULS/−FA | |
| 5 | +CCW/+SIGN/+FB | Forward pulse, direction signal, or phase B (*1) |
| 6 | −CCW/−SIGN/−FB | |
| 21 | +A | Encoder phase A+output |
| 22 | −A | Encoder phase A−output |
| 49 | +B | Encoder phase B+output |
| 48 | −B | Encoder phase B−output |
| 23 | +Z | Encoder phase Z+output |
| 24 | −Z | Encoder phase Z−output |
| 7 | +24VIN | +24-V power supply for controls |
| 30 | ECRST | Error counter reset input |
| 29 | RUN | Operation command input |
| 26 | DFSEL | Vibration filter switching |
| 31 | RESET | Alarm reset |
| 27 | TLSEL | Torque limit switching |
| 39 | INP | Positioning completion output 1 |
| 38 | INPCOM | |
| 35 | READY | Servo ready completed output |
| 34 | REDYCOM | |
| 37 | /ALM | Alarm output |
| 36 | ALMCOM | |
| 20 | SEN | Sensor ON input |
| 13 | SENGND | |
| Shell | FG | Frame ground |

*1 Since the PCU handles forward direction commands as CW-direction/phase-A advance pulses (selectable by the output pulse direction selection parameter), connect the wires as shown here.

**3**

**Specifications**

◆ Cable for line-driver output for 2 axes

AWG18 twisted pair 1 m
Red: 24 VDC
Black: 24 VDC GND

PCU side
XG4M-5030-T (OMRON)

AWG18 twisted pair 1 m
Blue: BKIRCOM
Black: BKIR

Servo Drive side (for axis 1 or 3)
10150-3000PE (Sumitomo 3M)

| PCU side | Pin | Pin | Servo Drive side | Description |
|---|---|---|---|---|
| 24-V power supply for output | 1 | 11 | BKIR | Brake interlock output |
| 24-V GND for output | 3 | 10 | BKIRCOM | |
| Input common | 5 | 44 | +CWLD | Reverse pulse (*1) |
| Forward direction pulse output (+) | 17 | 45 | −CWLD | (input for line driver only) |
| Forward direction pulse output (−) | 16 | 46 | +CCWLD | Forward pulse (*1) |
| Reverse direction pulse output (+) | 19 | 47 | −CCWLD | (input for line driver only) |
| Reverse direction pulse output (−) | 18 | 21 | +A | Encoder phase A+output |
| Encoder phase A+ | 21 | 22 | −A | Encoder phase A−output |
| Encoder phase A− | 20 | 49 | +B | Encoder phase B+output |
| Encoder phase B+ | 23 | 48 | −B | Encoder phase B−output |
| Encoder phase B− | 22 | 23 | +Z | Encoder phase Z+output |
| Encoder phase Z+ | 25 | 24 | −Z | Encoder phase Z−output |
| Encoder phase Z− | 24 | 7 | +24VIN | +24-V power supply for controls |
| Error counter reset output | 15 | 30 | ECRST | Error counter reset input |
| RUN output | 11 | 29 | RUN | Operation command input |
| General-purpose output | 10 | 26 | DFSEL | Vibration filter switching |
| Alarm reset output | 12 | 31 | RESET | Alarm reset |
| Torque limit output | 13 | 27 | TLSEL | Torque limit switching |
| Positioning completed input | 7 | 39 | INP | Positioning completion output 1 |
| | | 38 | INPCOM | |
| General-purpose input | 6 | 35 | READY | Servo ready completed output |
| | | 34 | REDYCOM | |
| Alarm input | 9 | 37 | /ALM | Alarm output |
| | | 36 | ALMCOM | |
| SEN output | 26 | 20 | SEN | Sensor ON input |
| Signal ground | 27 | 13 | SENGND | |
| | | Shell | FG | Frame ground |

AWG18 twisted pair 1 m
Blue: BKIRCOM
Black: BKIR

Servo Drive side (for axis 2 or 4)
10150-3000PE (Sumitomo 3M)

| PCU side | Pin | Pin | Servo Drive side | Description |
|---|---|---|---|---|
| 24-V power supply for output | 2 | 11 | BKIR | Brake interlock output |
| 24-V GND for output | 4 | 10 | BKIRCOM | |
| Input common | 50 | 44 | +CWLD | Reverse pulse (*1) |
| Forward direction pulse output (+) | 39 | 45 | −CWLD | (input for line driver only) |
| Forward direction pulse output (−) | 38 | 46 | +CCWLD | Forward pulse (*1) |
| Reverse direction pulse output (+) | 37 | 47 | −CCWLD | (input for line driver only) |
| Reverse direction pulse output (−) | 36 | 21 | +A | Encoder phase A+output |
| Encoder phase A+ | 35 | 22 | −A | Encoder phase A−output |
| Encoder phase A− | 34 | 49 | +B | Encoder phase B+output |
| Encoder phase B+ | 33 | 48 | −B | Encoder phase B−output |
| Encoder phase B− | 32 | 23 | +Z | Encoder phase Z+output |
| Encoder phase Z+ | 31 | 24 | −Z | Encoder phase Z−output |
| Encoder phase Z− | 30 | 7 | +24VIN | +24-V power supply for controls |
| Error counter reset output | 41 | 30 | ECRST | Error counter reset input |
| RUN output | 45 | 29 | RUN | Operation command input |
| General-purpose output | 44 | 26 | DFSEL | Vibration filter switching |
| Alarm reset output | 42 | 31 | RESET | Alarm reset |
| Torque limit output | 43 | 27 | TLSEL | Torque limit switching |
| Positioning completed input | 49 | 39 | INP | Positioning completion output 1 |
| | | 38 | INPCOM | |
| General-purpose input | 48 | 35 | READY | Servo ready completed output |
| | | 34 | REDYCOM | |
| Alarm input | 47 | 37 | /ALM | Alarm output |
| | | 36 | ALMCOM | |
| SEN output | 29 | 20 | SEN | Sensor ON input |
| Signal ground | 28 | 13 | SENGND | |
| | | Shell | FG | Frame ground |

*1 Since the PCU handles forward direction commands as CW-direction/phase-A advance pulses (selectable by the output pulse direction selection parameter), connect the wires as shown here.

♦ Cable for open collector output for 2 axes

AWG18 twisted pair 1 m
Red: 24 VDC
Black: 24 VDC GND
PCU side
XG4M-5030-T (OMRON)

AWG18 twisted pair 1 m
Blue: BKIRCOM
Black: BKIR
Servo Drive side (for axis 1 or 3)
10150-3000PE (Sumitomo 3M)

| PCU signal | Pin | Drive pin | Drive signal | Description |
|---|---|---|---|---|
| 24-V power supply for output | 1 | | | |
| 24-V GND for output | 3 | 11 | BKIR | Brake interlock output |
| Input common | 5 | 10 | BKIRCOM | |
| Forward direction pulse output (with 1.6 kΩ Resistor) | 16 | 3 | +CW/+PULS/+FA | Reverse pulses, feed pulses, or phase A (*1) |
| | | 4 | −CW/−PULS/−FA | |
| Reverse direction pulse output (with 1.6 kΩ Resistor) | 18 | 5 | +CCW/+SIGN/+FB | Forward pulse, direction signal, or phase B (*1) |
| | | 6 | −CCW/−SIGN/−FB | |
| Encoder phase A+ | 21 | 21 | +A | Encoder phase A+output |
| Encoder phase A− | 20 | 22 | −A | Encoder phase A−output |
| Encoder phase B+ | 23 | 49 | +B | Encoder phase B+output |
| Encoder phase B− | 22 | 48 | −B | Encoder phase B−output |
| Encoder phase Z+ | 25 | 23 | +Z | Encoder phase Z+output |
| Encoder phase Z− | 24 | 24 | −Z | Encoder phase Z−output |
| | | 7 | +24VIN | +24-V power supply for controls |
| Error counter reset output | 15 | 30 | ECRST | Error counter reset input |
| RUN output | 11 | 29 | RUN | Operation command input |
| General-purpose output | 10 | 26 | DFSEL | Vibration filter switching |
| Alarm reset output | 12 | 31 | RESET | Alarm reset |
| Torque limit output | 13 | 27 | TLSEL | Torque limit switching |
| Positioning completed input | 7 | 39 | INP | Positioning completion output 1 |
| | | 38 | INPCOM | |
| General-purpose input | 6 | 35 | READY | Servo ready completed output |
| | | 34 | REDYCOM | |
| Alarm input | 9 | 37 | /ALM | Alarm output |
| | | 36 | ALMCOM | |
| SEN output | 26 | 20 | SEN | Sensor ON input |
| Signal ground | 27 | 13 | SENGND | |
| | | Shell | FG | Frame ground |

AWG18 twisted pair 1 m
Blue: BKIRCOM
Black: BKIR
Servo Drive side (for axis 2 or 4)
10150-3000PE (Sumitomo 3M)

| PCU signal | Pin | Drive pin | Drive signal | Description |
|---|---|---|---|---|
| 24-V power supply for output | 2 | | | |
| 24-V GND for output | 4 | 11 | BKIR | Brake interlock output |
| Input common | 50 | 10 | BKIRCOM | |
| Forward direction pulse output (with 1.6 kΩ Resistor) | 38 | 3 | +CW/+PULS/+FA | Reverse pulses, feed pulses, or phase A (*1) |
| | | 4 | −CW/−PULS/−FA | |
| Reverse direction pulse output (with 1.6 kΩ Resistor) | 36 | 5 | +CCW/+SIGN/+FB | Forward pulse, direction signal, or phase B (*1) |
| | | 6 | −CCW/−SIGN/−FB | |
| Encoder phase A+ | 35 | 21 | +A | Encoder phase A+output |
| Encoder phase A− | 34 | 22 | −A | Encoder phase A−output |
| Encoder phase B+ | 33 | 49 | +B | Encoder phase B+output |
| Encoder phase B− | 32 | 48 | −B | Encoder phase B−output |
| Encoder phase Z+ | 31 | 23 | +Z | Encoder phase Z+output |
| Encoder phase Z− | 30 | 24 | −Z | Encoder phase Z−output |
| | | 7 | +24VIN | +24-V power supply for controls |
| Error counter reset output | 41 | 30 | ECRST | Error counter reset input |
| RUN output | 45 | 29 | RUN | Operation command input |
| General-purpose output | 44 | 26 | DFSEL | Vibration filter switching |
| Alarm reset output | 42 | 31 | RESET | Alarm reset |
| Torque limit output | 43 | 27 | TLSEL | Torque limit switching |
| Positioning completed input | 49 | 39 | INP | Positioning completion output 1 |
| | | 38 | INPCOM | |
| General-purpose input | 48 | 35 | READY | Servo ready completed output |
| | | 34 | REDYCOM | |
| Alarm input | 47 | 37 | /ALM | Alarm output |
| | | 36 | ALMCOM | |
| SEN output | 29 | 20 | SEN | Sensor ON input |
| Signal ground | 28 | 13 | SENGND | |
| | | Shell | FG | Frame ground |

*1 Since the PCU handles forward direction commands as CW-direction/phase-A advance pulses (selectable by the output pulse direction selection parameter), connect the wires as shown here.

## General-purpose Control Cables (R88A-CPGxS)

This is a cable to connect the Servo drive I/O signals (CN1 connector) to a general purpose controller. All servo drive I/O signals are wired. The connector for the controller is not provided.

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| R88A-CPG001S | 1 m | 12.8 dia. | Approx. 0.3 kg |
| R88A-CPG002S | 2 m | | Approx. 0.6 kg |

### Connection configuration and external dimensions

### Wiring

| Number | Wire/Mark color | Symbol | Number | Wire/Mark color | Symbol |
|--------|-----------------|--------|--------|-----------------|--------|
| 1 | Orange/Red (1) | +24VCW | 27 | Pink/Black (3) | SI4 |
| 2 | Orange/Black (1) | +24VCCW | 28 | White/Black (3) | SI5 |
| 3 | Gray/Red (1) | +CW/+PULS/+FA | 29 | Yellow/Red (3) | SI6 |
| 4 | Gray/Black (1) | −CW/−PULS/−FA | 30 | Pink/Red (3) | SI7 |
| 5 | White/Red (1) | +CCW/+SIGN/+FB | 31 | Yellow/Black (3) | SI8 |
| 6 | White/Black (1) | −CCW/−SIGN/−FB | 32 | Gray/Black (4) | SI9 |
| 7 | Yellow/Red (1) | +24VIN | 33 | Orange/Red (4) | SI10 |
| 8 | Pink/Red (1) | SI1 | 34 | White/Red (4) | S02− |
| 9 | Pink/Black (1) | SI2 | 35 | White/Black (4) | S02+ |
| 10 | Orange/Red (2) | SO1− | 36 | Yellow/Red (4) | ALMCOM |
| 11 | Orange/Black (2) | SO1+ | 37 | Yellow/Black (4) | /ALM |
| 12 | Yellow/Black (1) | ––– | 38 | Pink/Red (4) | S03− |
| 13 | Gray/Black (2) | SENGND | 39 | Pink/Black (4) | S03+ |
| 14 | White/Red (2) | REF/TREF1/VLIM | 40 | Gray/Red (4) | ––– |
| 15 | White/Black (2) | AGND1 | 41 | Orange/Black (4) | ––– |
| 16 | Yellow/Red (2) | PCL/TREF2 | 42 | Gray/Red (5) | BAT |
| 17 | Yellow/Black (2), Pink/Black (2) | AGND2 | 43 | Gray/Black (5) | BATGND |
| 18 | Pink/Red (2) | NCL | 44 | White/Red (5) | +CWLD |
| 19 | Orange/Red (5) | Z | 45 | White/Black (5) | −CWLD |
| 20 | Gray/Red (2) | SEN | 46 | Yellow/Red (5) | +CCWLD |
| 21 | Orange/Red (3) | +A | 47 | Yellow/Black (5) | −CCWLD |
| 22 | Orange/Black (3) | −A | 48 | Pink/Black (5) | −B |
| 23 | Gray/Red (3) | +Z | 49 | Pink/Red (5) | +B |
| 24 | Gray/Black (3) | −Z | 50 | ––– | ––– |
| 25 | Orange/Black (5) | ZCOM | Shell | ––– | FG |
| 26 | White/Red (3) | SI3 | | | |

Connector plug model: 10150-3000PE (Sumitomo 3M)

Connector case model: 10350-52A0-008 (Sumitomo 3M)

Cable: AWG24 × 25P UL20276

• Wires with the same wire color and the same number of marks form a twisted pair.

  Example: Wires with respective wire and mark colors of orange/red (1) and orange/black (1) form a twisted pair.

## Terminal Block Cables (XW2Z-xJ-B24)

This is a cable to connect the Servo drive I/O signals (CN1 connector) to a terminal block for general-purpose. All servo drive I/O signals are wired.

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-100J-B24 | 1 m | 11.2 dia. | Approx. 0.2 kg |
| XW2Z-200J-B24 | 2 m | | Approx. 0.4 kg |

### Connection configuration and external dimensions

**3**
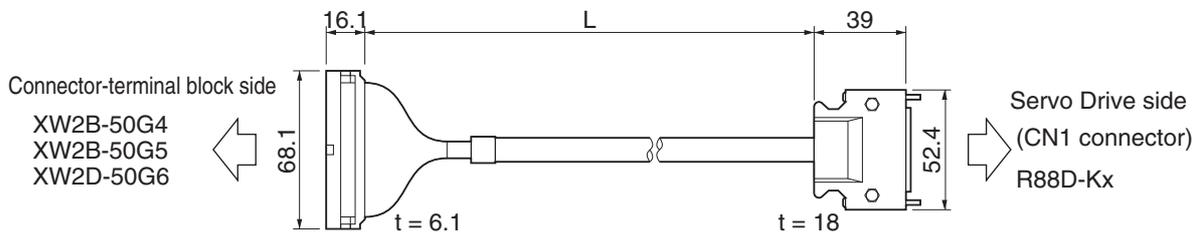
**Specifications**

| Terminal block | Connector | | Driver side | | |
|---|---|---|---|---|---|
| Number | Number | | Number | Wire and mark color | Symbol |
| 1 | 1 | | 1 | Blue/Red (1) | +24VCW |
| 2 | 2 | | 2 | Blue/Black (1) | +24VCCW |
| 3 | 3 | | 3 | Pink/Red (1) | +CW/+PULS/+FA |
| 4 | 4 | | 4 | Pink/Black (1) | −CW/−PULS/−FA |
| 5 | 5 | | 5 | Green/Red (1) | +CCW/+SIGN/+FB |
| 6 | 6 | | 6 | Green/Black (1) | −CCW/−SIGN/−FB |
| 7 | 7 | | 7 | Orange/Red (1) | +24VIN |
| 8 | 8 | | 8 | Gray/Red (1) | SI1 |
| 9 | 9 | | 9 | Gray/Black (1) | SI2 |
| 10 | 10 | | 10 | Blue/Red (2) | SO1− |
| 11 | 11 | | 11 | Blue/Black (2) | SO1+ |
| 13 | 13 | | 13 | Pink/Red (2) | SENGND |
| 20 | 20 | | 20 | Pink/Black (2) | SEN |
| 14 | 14 | | 14 | Green/Red (2) | REF/TREF1/VLIM |
| 15 | 15 | | 15 | Green/Black (2) | AGND1 |
| 16 | 16 | | 16 | Orange/Red(2) | PCL/TREF2 |
| 17 | 17 | | 17 | Orange/Black (2) | AGND2 |
| 18 | 18 | | 18 | Gray/Red (1) | NCL |
| 12 | 12 | | 12 | Gray/Black(2) | ―― |
| 19 | 19 | | 19 | Blue/Red (3) | Z |
| 25 | 25 | | 25 | Blue/Black (3) | ZCOM |
| 21 | 21 | | 21 | Pink/Red (3) | +A |
| 22 | 22 | | 22 | Pink/Black(3) | −A |
| 23 | 23 | | 23 | Green/Red (3) | +Z |
| 24 | 24 | | 24 | Green/Black (3) | −Z |
| 26 | 26 | | 26 | Orange/Red(3) | SI3 |
| 27 | 27 | | 27 | Orange/Black(3) | SI4 |
| 28 | 28 | | 28 | Gray/Red (3) | SI5 |
| 29 | 29 | | 29 | Gray/Black(3) | SI6 |
| 30 | 30 | | 30 | Blue/Red (4) | SI7 |
| 31 | 31 | | 31 | Blue/Black (4) | SI8 |
| 32 | 32 | | 32 | Pink/Red (4) | SI9 |
| 33 | 33 | | 33 | Pink/Black (4) | SI10 |
| 34 | 34 | | 34 | Green/Red (4) | SO2− |
| 35 | 35 | | 35 | Green/Black (4) | SO2+ |
| 36 | 36 | | 36 | Orange/Red(4) | ALMCOM |
| 37 | 37 | | 37 | Orange/Black (4) | /ALM |
| 38 | 38 | | 38 | Gray/Red(4) | SO3− |
| 39 | 39 | | 39 | Gray/Black(4) | SO3+ |
| 40 | 40 | | 40 | Blue/Red (5) | ―― |
| 41 | 41 | | 41 | Blue/Black (5) | ―― |
| 42 | 42 | | 42 | Pink/Red (5) | BAT |
| 43 | 43 | | 43 | Pink/Black (5) | BATGND |
| 44 | 44 | | 44 | Green/Red (5) | +CWLD |
| 45 | 45 | | 45 | Green/Black (5) | −CWLD |
| 46 | 46 | | 46 | Orange/Red (5) | +CCWLD |
| 47 | 47 | | 47 | Orange/Black (5) | −CCWLD |
| 48 | 48 | | 48 | Gray/Red (5) | −B |
| 49 | 49 | | 49 | Gray/Black(5) | +B |
| 50 | 50 | | 50 | Orange/Red(1) | − |
| | | | Shell | | FG |

• 1 Wires with the same wire color and the same number of marks form a twisted pair

Example: Wires with respective wire and mark colors of Yellow/Black (1) and Pink/Black (1) form a twisted pair

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

Connector-terminal Block Connector:
  Connector socket model
    XG4M-5030 (OMRON)
  Strain relief model  XG4T-5004 (OMRON)

Cable: AWG28 × 25P UL2464

## Terminal Block Unit

The Terminal Block Unit connects the servo drive I/O signals (CN1 connector ) for general purpose. Use the cable (XW2Z-xJ-B24) to connect the Terminal Block Unit to the CN1 connector.

### XW2B-50G4 (M3 Screw Terminal Block)

• Dimensions

Flat cable connector (MIL type plug)
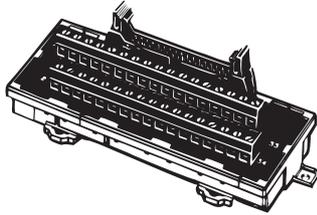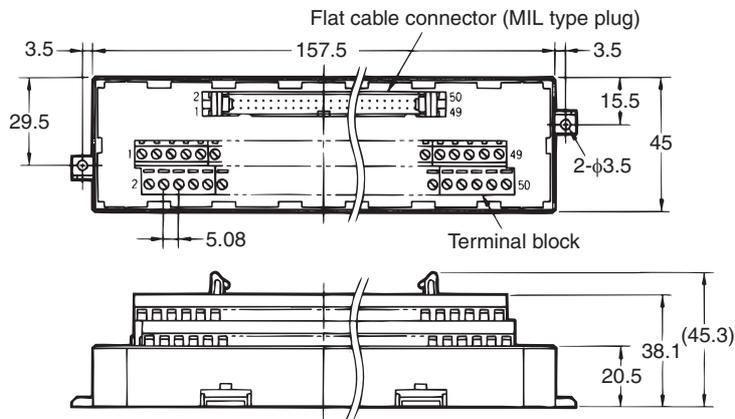
Terminal block

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

6 mm

**3**

**Specifications**
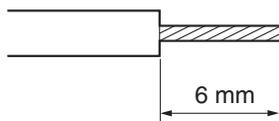
**XW2B-50G5 (M3.5 Screw Terminal Block)**
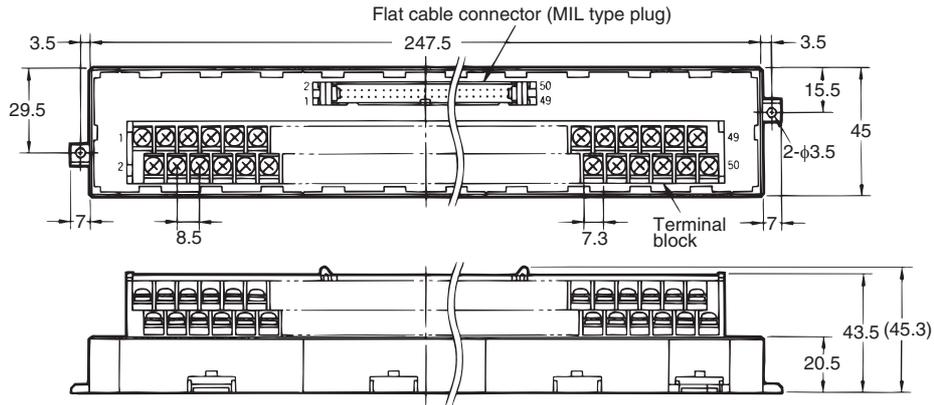
* Dimensions

Flat cable connector (MIL type plug)

* When using crimp terminals, use crimp terminals with the following dimensions.
* When connecting wires and crimp terminals to a terminal block, tighten them with a tightening torque of 0.59 N•m.

Round terminal          Fork terminal

φ3.2mm

6.8 mm max.          3.7mm          6.8 mm max.

| Applicable crimp terminals | | Applicable wires |
|---|---|---|
| Round terminals | 1.25–3 | AWG22-16 (0.3 to 1.25 mm$^2$) |
| | 2–3.5 | AWG16-14 (1.25 to 2.0 mm$^2$) |
| Fork terminals | 1.25Y–3 | AWG22-16 (0.3 to 1.25 mm$^2$) |
| | 2–3.5 | AWG16-14 (1.25 to 2.0 mm$^2$) |

## XW2D-50G6 (M3 Screw Terminal Block)
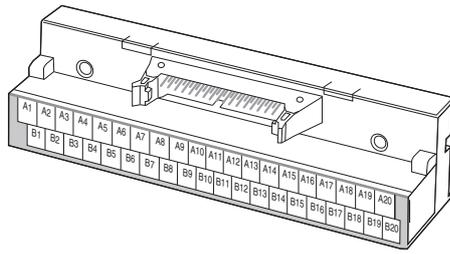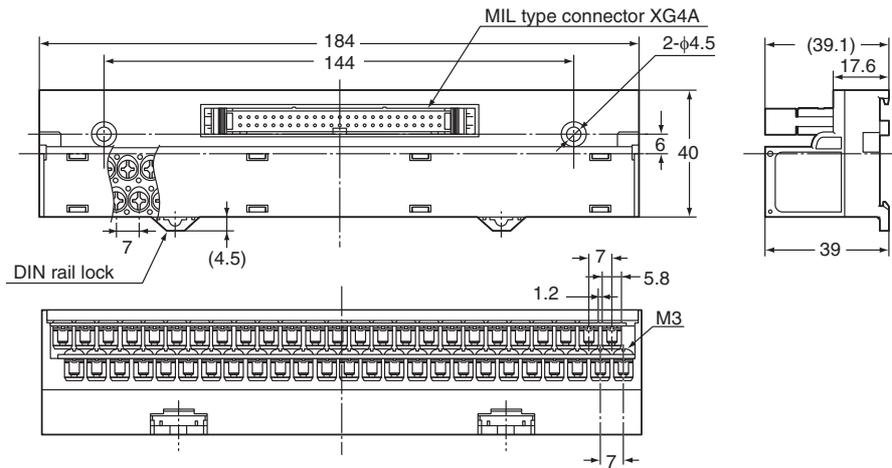


⬧ Dimensions



⬧ When using crimp terminals, use crimp terminals with the following dimensions.
⬧ When connecting wires and crimp terminals to a terminal block, tighten them with a tightening torque of 0.7 N•m.

Round terminal          Fork terminal
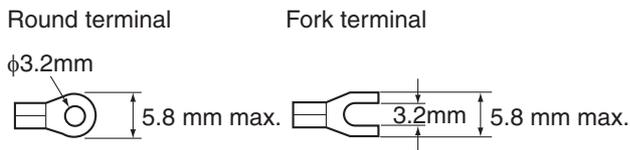


| Applicable crimp terminals | | Applicable wires |
|---|---|---|
| Round terminals | 1.25−3 | AWG22-16 (0.3 to 1.25 mm$^2$) |
| Fork terminals | 1.25Y−3 | AWG22-16 (0.3 to 1.25 mm$^2$) |

# 3-5 Servo Relay Units and Cable Specifications

This section provides the specifications for the Servo Relay Unit and cables used for connecting to Position Control Units for OMRON Programmable Controllers (SYSMAC). Select the models that match the Position Control Unit to be used.

## Servo Relay Units Specifications

### XW2B-20J6-1B

This Servo Relay Unit connects to the following OMRON Position Control Units.

♦ CJ1W-NC113/-NC133
♦ CS1W-NC113/-NC133
♦ C200HW-NC113

**Dimensions**

♦ Terminal block pitch: 7.62 mm

**Wiring**



*1. The XB contacts are used to turn ON/OFF the electromagnetic brake.

Note 1. Do not connect unused terminals.

Note 2. The 0 V terminal is internally connected to the common terminals.

Note 3. The applicable crimp terminal is R1.25-3 (round with open end).

## XW2B-40J6-2B

This Servo Relay Unit connects to the following OMRON Position Control Units.
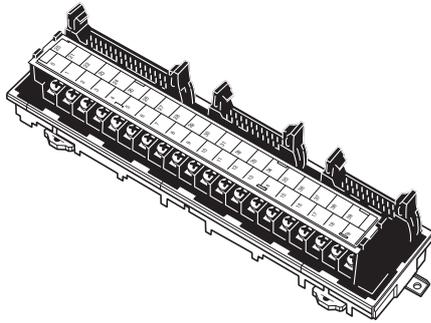


- CJ1W-NC213/-NC233/-NC413/-NC433
- CS1W-NC213/-NC233/-NC413/-NC433
- C200HW-NC213/-NC413

**Dimensions**



- Terminal block pitch: 7.62 mm

**Wiring**

| 20 | +24 V | X/Y-axis emergency stop | X-axis CW limit | X-axis CCW limit | X-axis Origin proximity | X-axis RUN | | | X-axis ALM | X-axis BKIR | | Y-axis CW limit | Y-axis CCW limit | Y-axis Origin proximity | Y-axis RUN | | | Y-axis ALM | Y-axis BKIR | | 39 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 V | Common | Common | Common | X-axis External interrupt | Common | Common | X-axis RESET | X-axis ALMCOM | | Common | Common | Y-axis External interrupt | Common | Common | Y-axis RESET | Y-axis ALMCOM | | FG | | 19 |
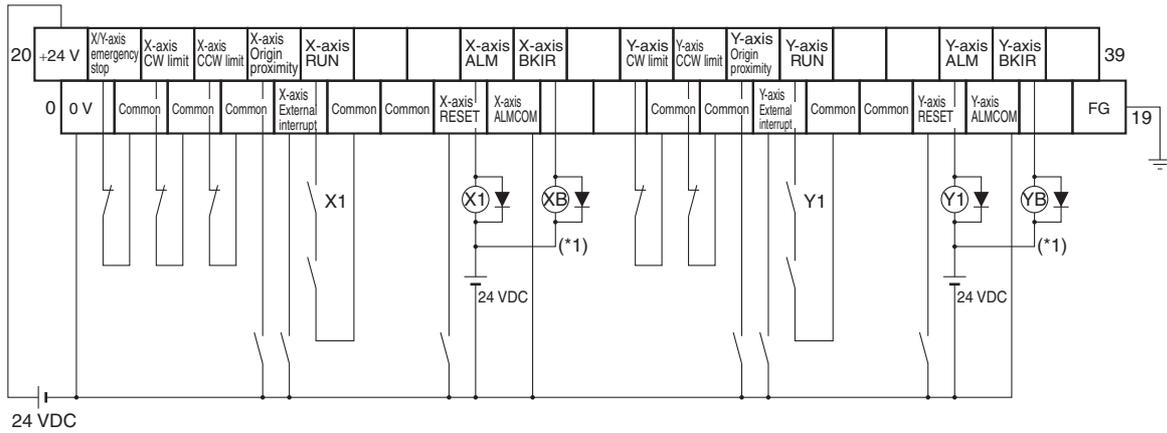
*1. The XB and YB contacts are used to turn ON/OFF the electromagnetic brake.

Note 1. Do not connect unused terminals.

Note 2. The 0 V terminal is internally connected to the common terminals.

Note 3. The applicable crimp terminal is R1.25-3 (round with open end).

## XW2B-20J6-3B

This Servo Relay Unit connects to the following OMRON Programmable Controllers.
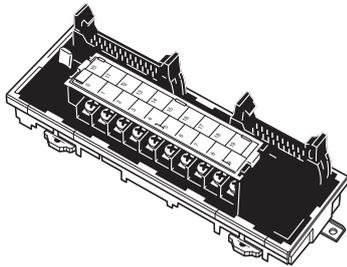
♦ CQM1-CPU43-V1
♦ CQM1-PLB21

**Dimensions**

♦ Terminal block pitch: 7.62 mm

**3**

**Specifications**
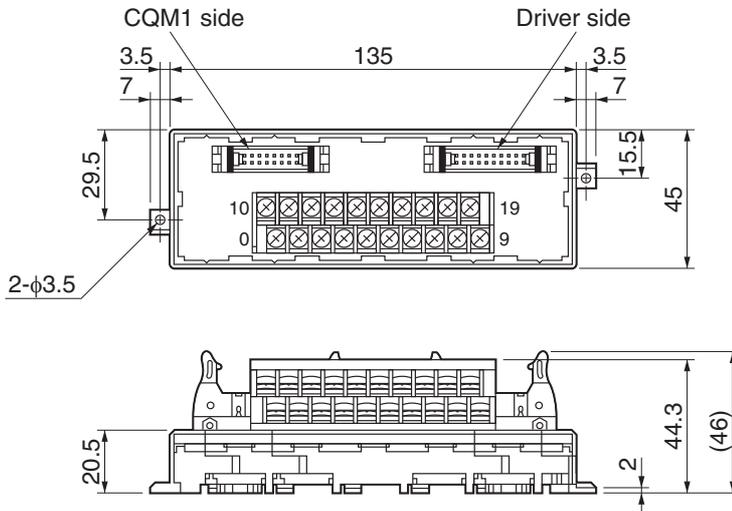
**Wiring**
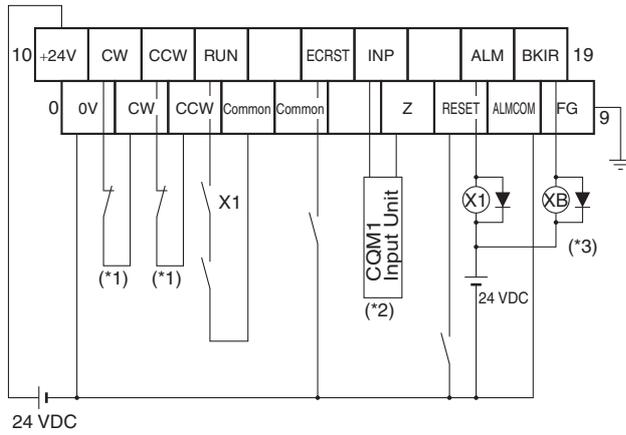


*1. If this signal is input, the output pulse from the CQM1 will be input to the high-speed counter.

*2. Input this output signal to a CQM1 Input Unit.

*3. The XB contacts are used to turn ON/OFF the electromagnetic brake.

Note 1.The phase Z is an open collector.

Note 2.Do not connect unused terminals.

Note 3.The 0 V terminal is internally connected to the common terminals.

Note 4.The applicable crimp terminal is R1.25-3 (round with open end).

**3**

**Specifications**

## XW2B-20J6-8A

This Servo Relay Unit connects to the following OMRON Programmable Controllers.
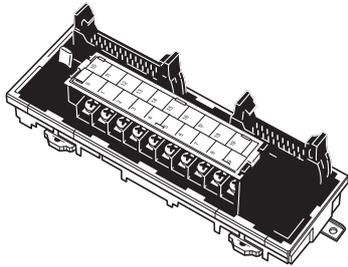
♦ CJ1M-CPU21/-CPU22/-CPU23 (for 1 axis)

### Dimensions
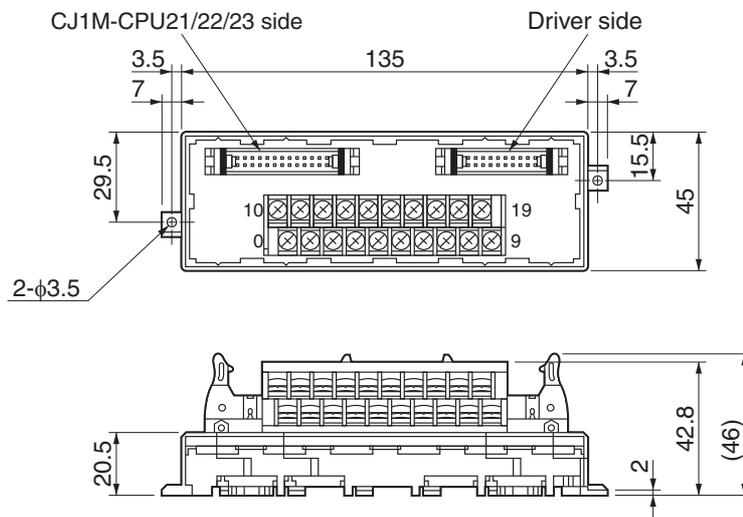
CJ1M-CPU21/22/23 side                    Driver side

3.5                  135                  3.5
7                                          7
29.5                                      15.5

10 ⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠ 19                        45
0  ⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠ 9

2-φ3.5

20.5                                      2    42.8
                                          (46)

♦ Terminal block pitch: 7.62 mm

## Wiring

The Servo Drive phase Z output signal is wired to the origin signal in this terminal block.
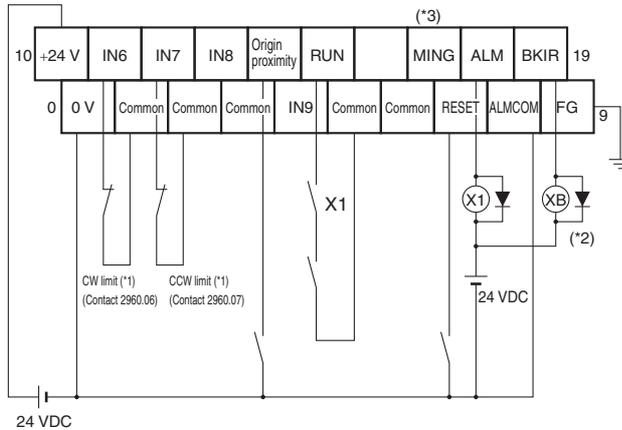


*1. CW and CCW limit input signals can also be input through Input Units. The signal for the CW/CCW limit inputs in the CJ1M are as follows: CW: A540.08, CCW: A540.09 for pulse output 0 and CW: A541.08, CCW: A541.09 for pulse output 1. Accordingly, the actual inputs can be used as the CW/CCW limit by outputting the flags below in the ladder program.

   Example)



*2. The XB contacts are used to turn ON/OFF the electromagnetic brake.

*3. Connection to the MING input terminal is disabled.

Note 1. Do not connect unused terminals.

Note 2. The 0 V terminal is internally connected to the common terminals.

Note 3. The applicable crimp terminal is R1.25-3 (round with open end).

## XW2B-40J6-9A

This Servo Relay Unit connects to the following OMRON Programmable Controllers.



• CJ1M-CPU21/-CPU22/-CPU23 (for 2 axes)
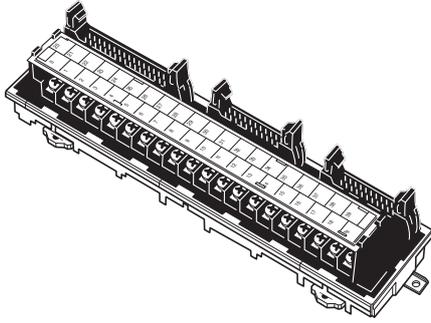
**Dimensions**
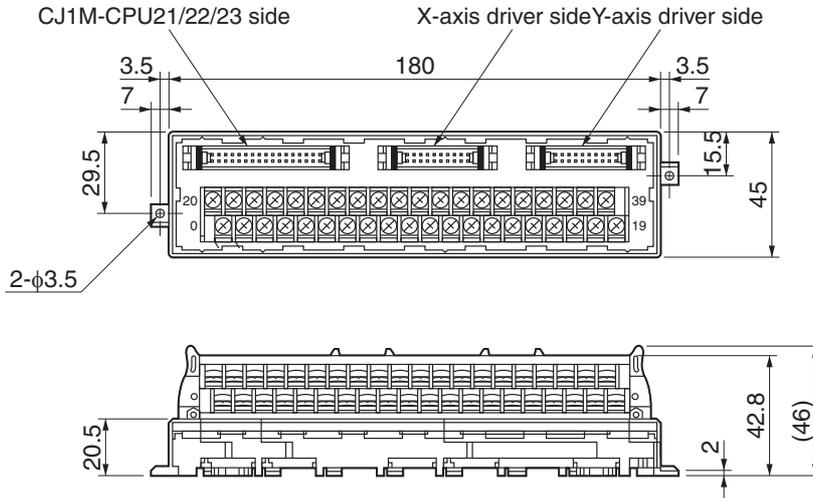


• Terminal block pitch: 7.62 mm

## Wiring

The Servo Drive phase Z output signal is wired to the origin signal in this terminal block.
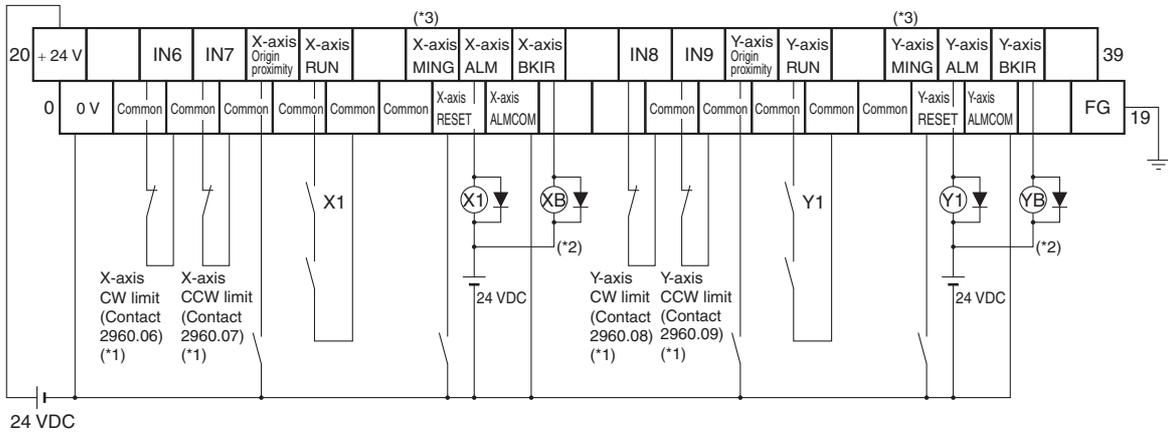


*1. CW and CCW limit input signals can also be input through Input Units. The signal for the CW/CCW limit inputs in the CJ1M are as follows: CW: A540.08, CCW: A540.09 for pulse output 0 and CW: A541.08, CCW: A541.09 for pulse output 1. Accordingly, the actual inputs can be used as the CW/CCW limit by outputting the flags below in the ladder program.

Example)



*2. The XB and YB contacts are used to turn ON/OFF the electromagnetic brake.

*3. Connection to the MING input terminal is disabled.

*4. Do not connect unused terminals.

*5. The 0 V terminal is internally connected to the common terminals.

*6. The applicable crimp terminal is R1.25-3 (round with open end).

### Servo Drive Cable (XW2Z-xJ-B31)

This cable connects the driver to a Servo Relay Unit (XW2B-20J6-8A, XW2B-40J6-9A).

#### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|-------|-----------|--------------------------|--------|
| XW2Z-100J-B31 | 1 m | 8.1 dia. | Approx. 0.1 kg |
| XW2Z-200J-B31 | 2 m | | Approx. 0.2 kg |

#### Connection configuration and external dimensions

Servo Relay Unit side
XW2B-20J6-8A
XW2B-40J6-9A

Driver side
R88D-KTx

#### Wiring

Servo Relay Unit side

| Wire and mark color | Number | Driver side Number |
|---------------------|--------|--------------------|
| Blue/Red (1) | 1 | 7 |
| Blue/Black (1) | 2 | 38 |
| Pink/Red (1) | 3 | 5 |
| Pink/Black (1) | 4 | 6 |
| Green/Red (1) | 5 | 3 |
| Green/Black (1) | 6 | 4 |
| Orange/Red (1) | 7 | |
| – | 8 | 30 |
| – | 9 | 10 |
| Gray/Red (1) | 10 | 23 |
| Gray/Black (1) | 11 | 24 |
| Blue/Red (2) | 12 | 39 |
| Blue/Black (2) | 13 | 29 |
| Orange/Black (1) | 14 | |
| Pink/Red (2) | 15 | 27 |
| Pink/Black (2) | 16 | 31 |
| Orange/Red (2) | 17 | 11 |
| Green/Black (2) | 18 | 37 |
| Orange/Red (2) | 19 | 36 |
| Any | 20 | Shell |
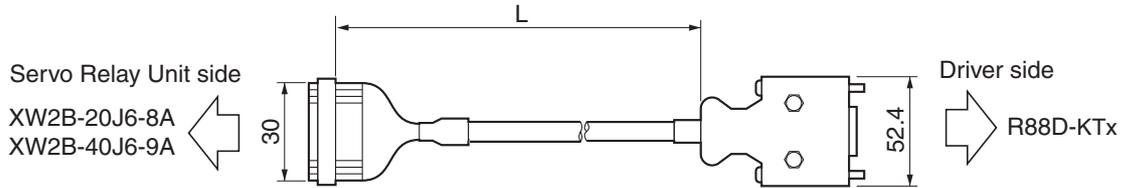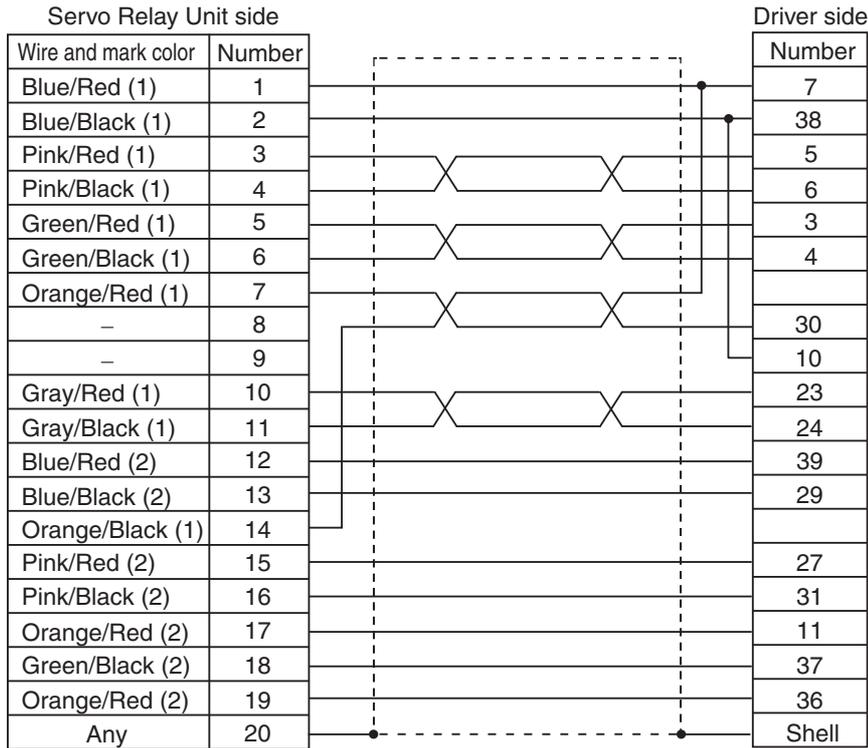
[Servo Relay Unit connector]
   Connector socket model: XG4M-2030
   Strain relief model: XG4T-2004
[Cable]
   AWG28 × 10P UL2464
[Driver connector]
   Connector plug model: 10150-3000PE (Sumitomo 3M)
   Connector case model: 10350-52A0-008 (Sumitomo 3M)

## Position Control Unit-Servo Relay Unit Cable Specifications

### Position Control Unit Cable (XW2Z-xJ-A3)

This cable connects a Programmable Controller (CQM1H-PLB21) to a Servo Relay Unit (XW2B-20J6-3B).

#### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A3 | 50 cm | 7.5 dia. | Approx. 0.1 kg |
| XW2Z-100J-A3 | 1 m | | Approx. 0.1 kg |

#### Connection configuration and external dimensions



#### Wiring



Cable: AWG28 × 4P + AWG28 × 4C
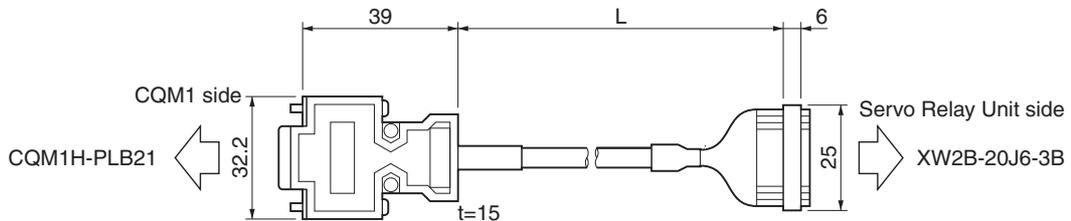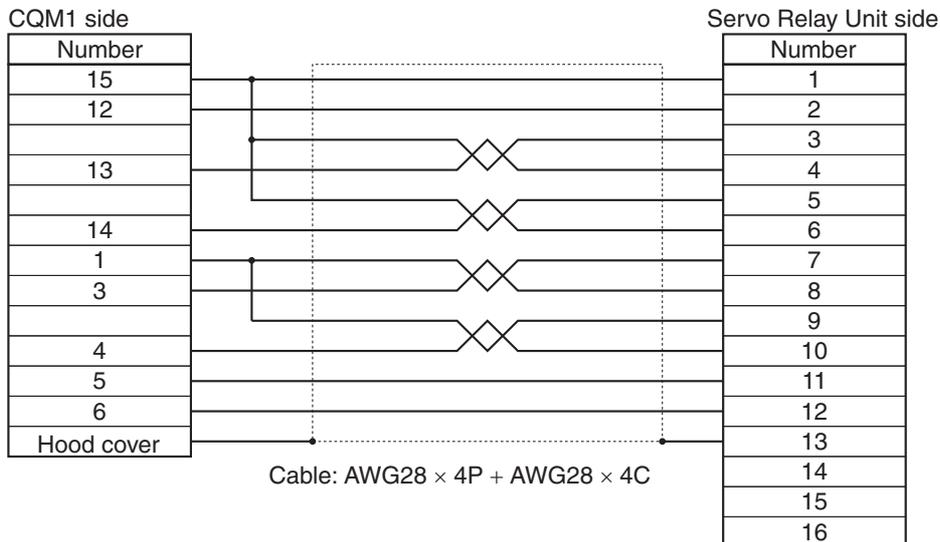
## Position Control Unit Cable (XW2Z-xJ-A6)

This cable connects a Position Control Unit (CS1W-NC113 and C200HW-NC113) to a Servo Relay Unit (XW2B-20J6-1B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A6 | 50 cm | 8.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A6 | 1 m | | Approx. 0.1 kg |

### Connection configuration and external dimensions
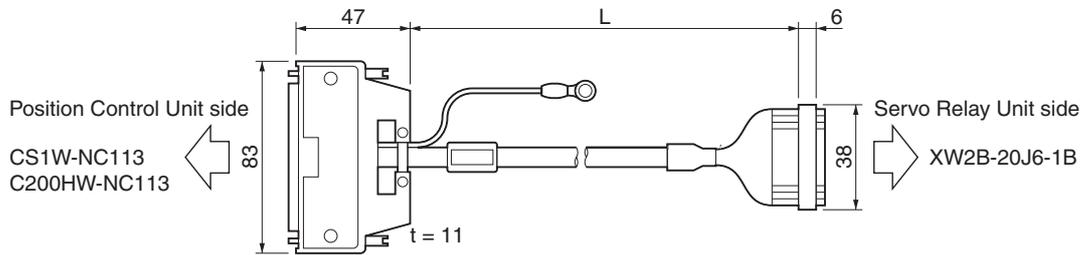


### Wiring
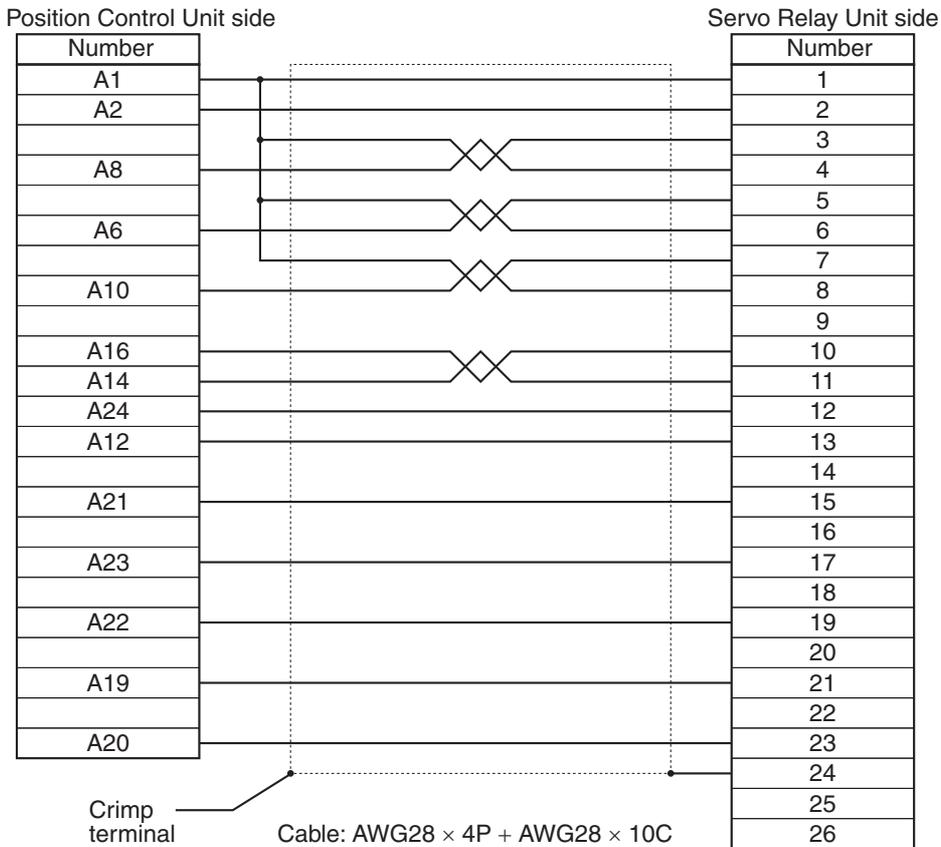
## Position Control Unit Cable (XW2Z-xJ-A7)

This cable connects a Position Control Unit (CS1W-NC213/NC413 and C200HW-NC213/NC413) to a Servo Relay Unit (XW2B-40J6-2B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A7 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A7 | 1 m | | Approx. 0.2 kg |

### Connection configuration and external dimensions

Position Control Unit side

CS1W-NC213
CS1W-NC413
C200HW-NC213
C200HW-NC413

Servo Relay Unit side

XW2B-40J6-2B

### Wiring

| Position Control Unit side | Servo Relay Unit side |
|---|---|
| **Number** | **Number** |
| A1/B1 | 1 |
| A2/B2 | 2 |
| | 3 |
| A8 | 4 |
| | 5 |
| A6 | 6 |
| | 7 |
| A10 | 8 |
| | 9 |
| A16 | 10 |
| A14 | 11 |
| A24/B24 | 12 |
| A19 | 13 |
| A21 | 14 |
| A12 | 15 |
| A23 | 16 |
| A22 | 17 |
| A20/B20 | 18 |
| | 19 |
| B8 | 20 |
| | 21 |
| B6 | 22 |
| | 23 |
| B10 | 24 |
| | 25 |
| B16 | 26 |
| B14 | 27 |
| B23 | 28 |
| B22 | 29 |
| B21 | 30 |
| B19 | 31 |
| B12 | 32 |
| | 33 |
| | 34 |

Crimp terminal

Cable: AWG28 × 6P + AWG28 × 16C

**3**

**Specifications**
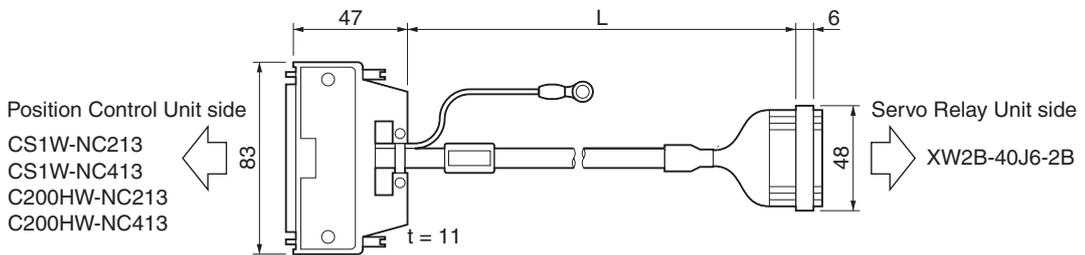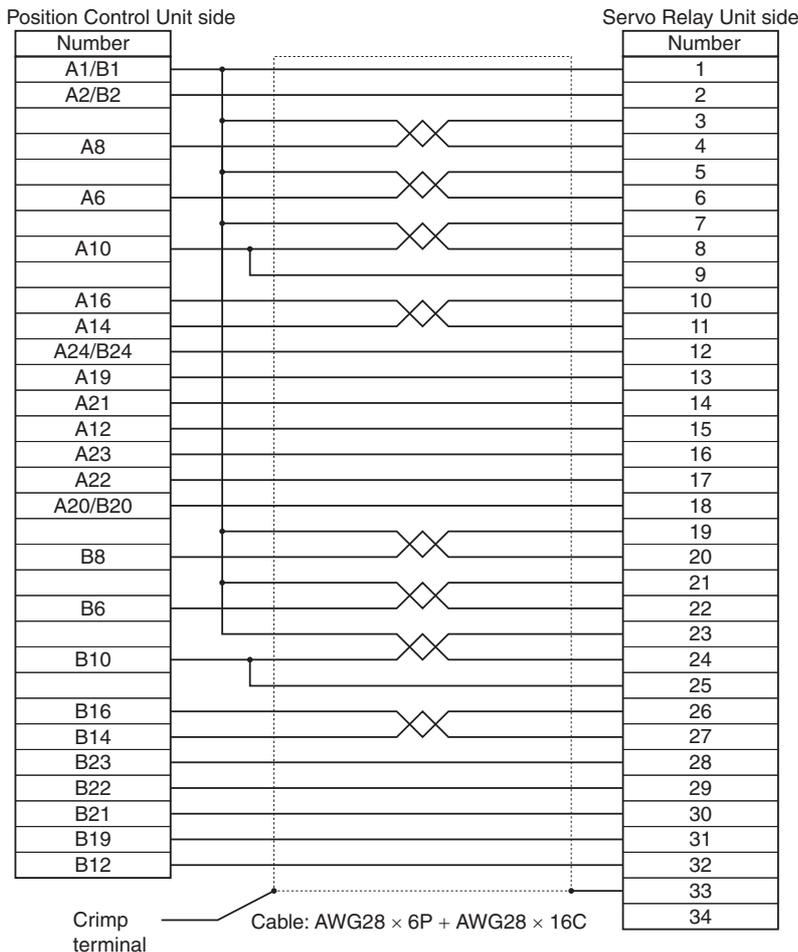
### Position Control Unit Cable (XW2Z-xJ-A10)

This cable connects a Position Control Unit (CS1W-NC133) to a Servo Relay Unit (XW2B-20J6-1B).

#### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A10 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A10 | 1 m | | Approx. 0.2 kg |

#### Connection configuration and external dimensions
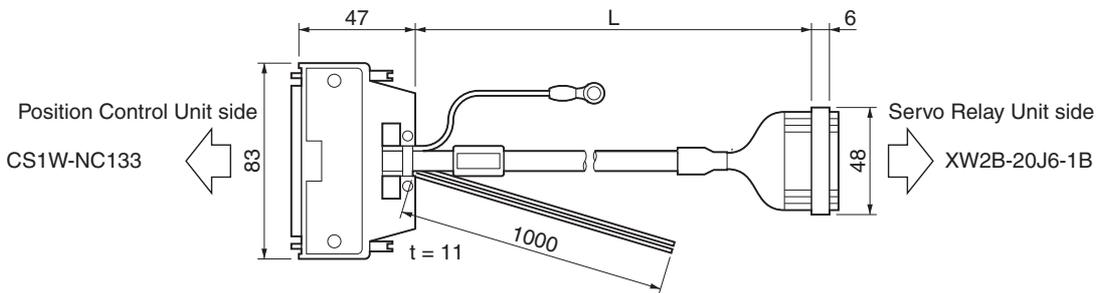


#### Wiring
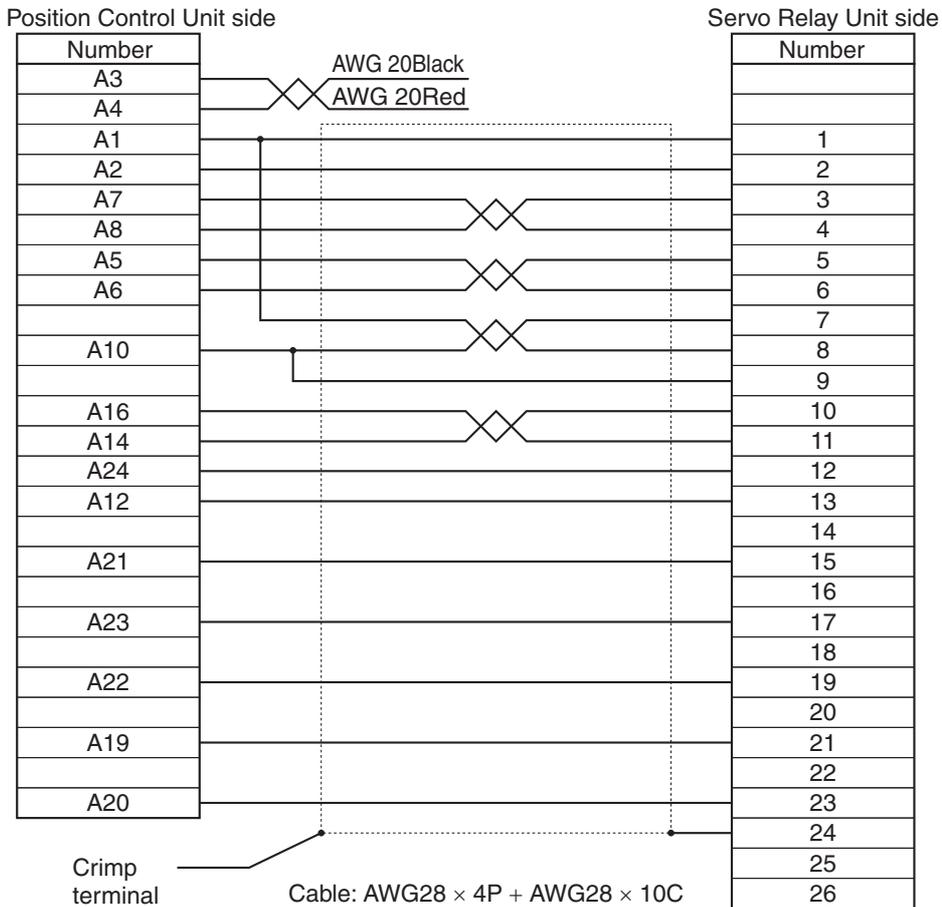
## Position Control Unit Cable (XW2Z-xJ-A11)

This cable connects a Position Control Unit (CS1W-NC233/433) to a Servo Relay Unit (XW2B-40J6-1B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A11 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A11 | 1 m | | Approx. 0.2 kg |

### Connection configuration and external dimensions
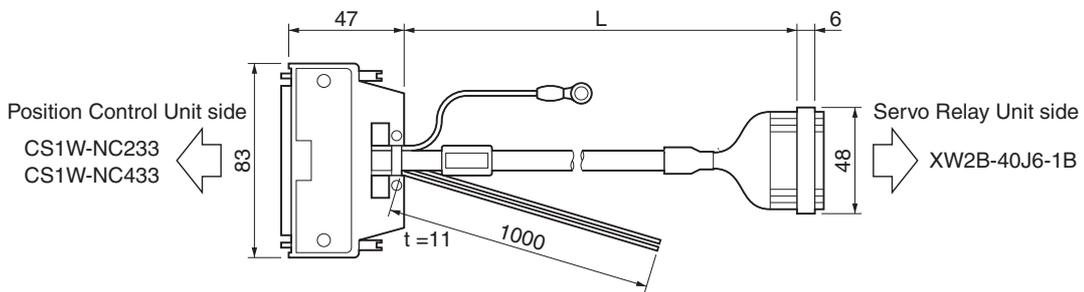


### Wiring
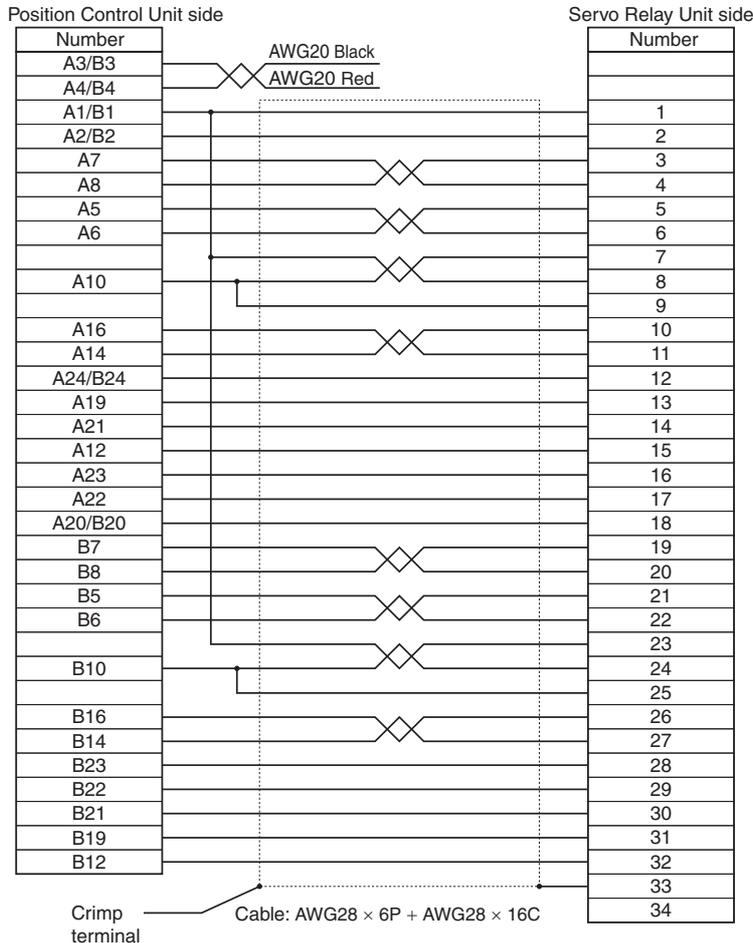
## Position Control Unit Cable (XW2Z-xJ-A14)

This cable connects a Position Control Unit (CJ1W-NC113) to a Servo Relay Unit (XW2B-20J6-1B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A14 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A14 | 1 m | | Approx. 0.2 kg |

### Connection configuration and external dimensions
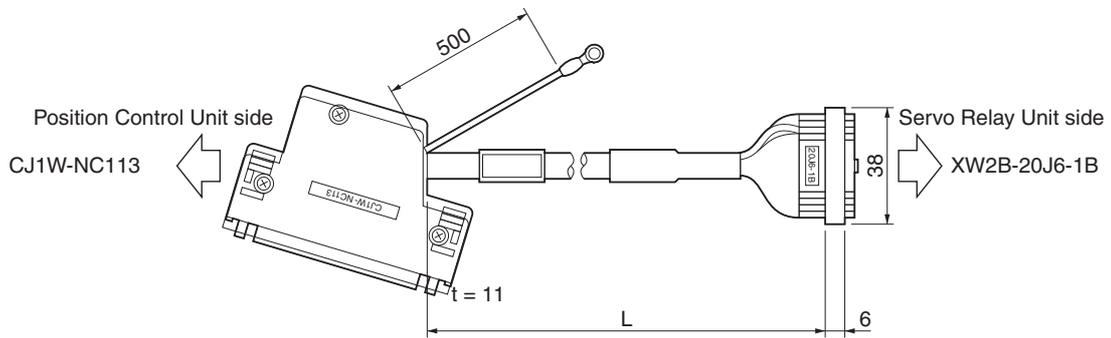


### Wiring
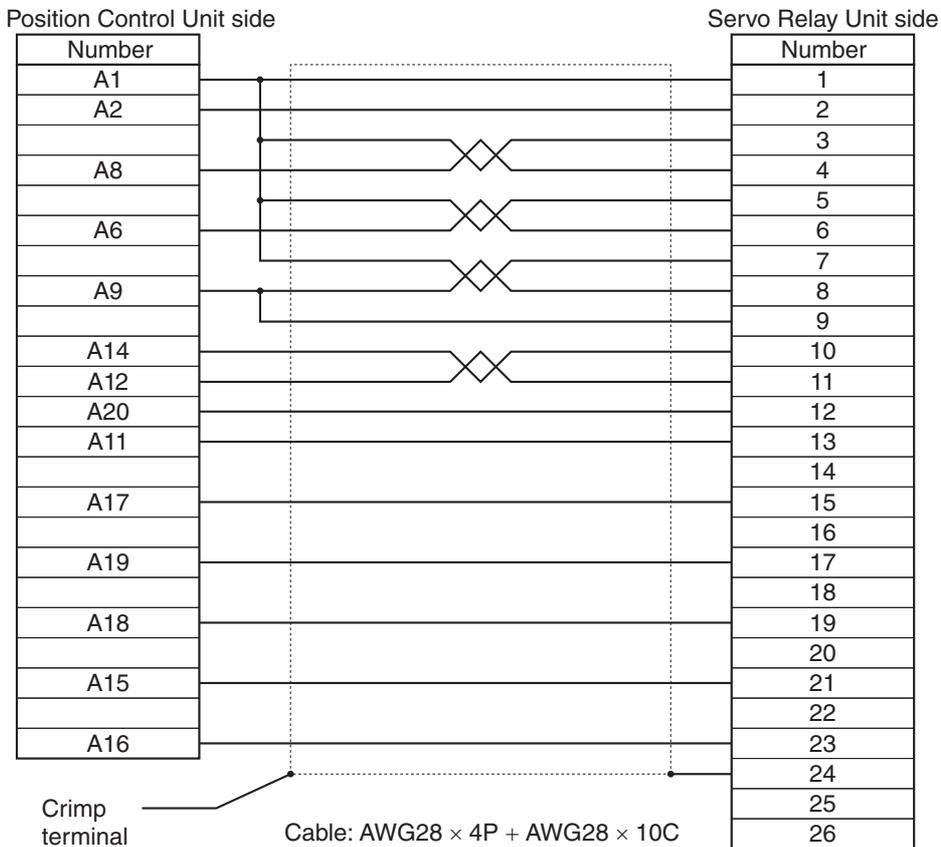
## Position Control Unit Cable (XW2Z-xJ-A15)

This cable connects a Position Control Unit (CJ1W-NC213/NC413) to a Servo Relay Unit (XW2B-40J6-2B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A15 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A15 | 1 m | | Approx. 0.2 kg |

### Connection configuration and external dimensions



### Wiring

| Position Control Unit side | | Servo Relay Unit side |
|---|---|---|
| Number | | Number |
| A1/B1 | | 1 |
| A2/B2 | | 2 |
| | | 3 |
| A8 | | 4 |
| | | 5 |
| A6 | | 6 |
| | | 7 |
| A9 | | 8 |
| | | 9 |
| A14 | | 10 |
| A12 | | 11 |
| A20/B20 | | 12 |
| A15 | | 13 |
| A17 | | 14 |
| A11 | | 15 |
| A19 | | 16 |
| A18 | | 17 |
| A16/B16 | | 18 |
| | | 19 |
| B8 | | 20 |
| | | 21 |
| B6 | | 22 |
| | | 23 |
| B9 | | 24 |
| | | 25 |
| B14 | | 26 |
| B12 | | 27 |
| B19 | | 28 |
| B18 | | 29 |
| B17 | | 30 |
| B15 | | 31 |
| B11 | | 32 |
| | | 33 |
| | | 34 |

Crimp terminal — Cable: AWG28 × 8P + AWG28 × 16C
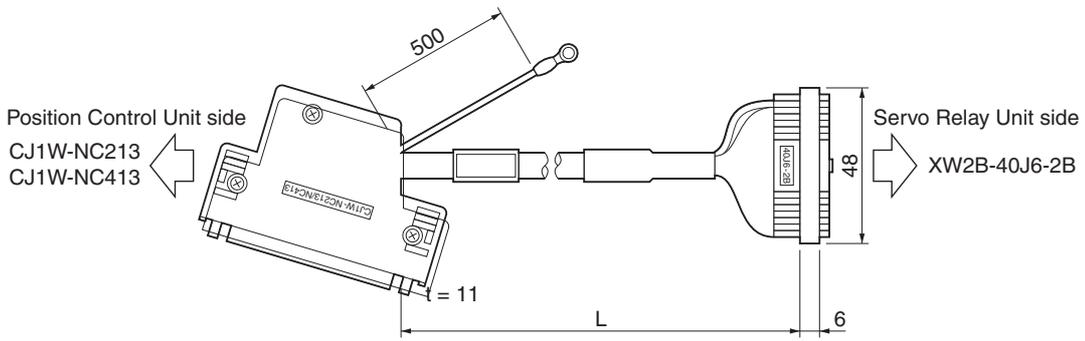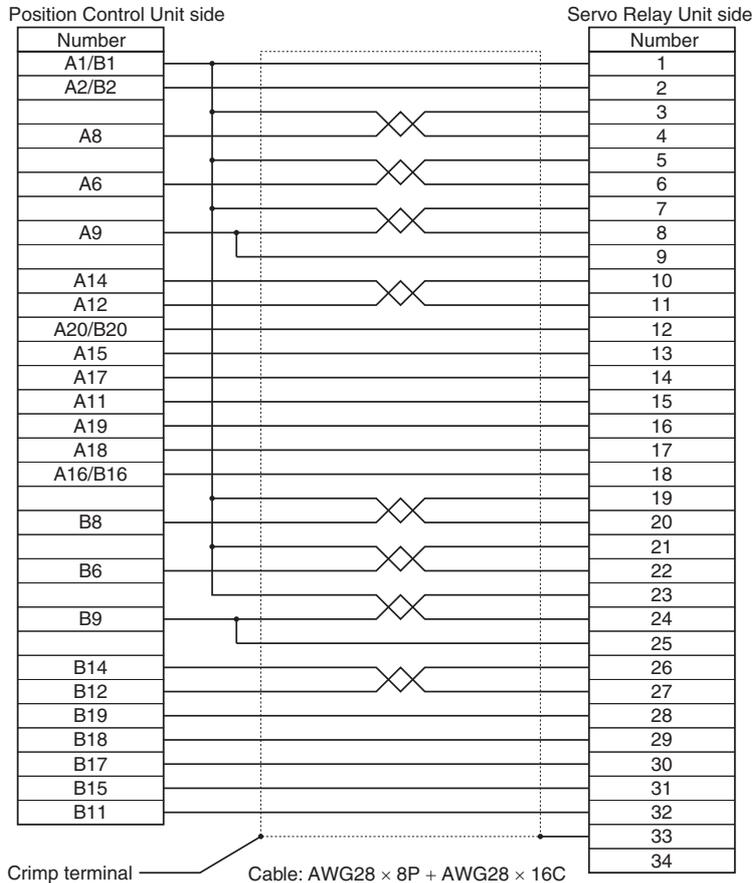
## Position Control Unit Cable (XW2Z-xJ-A18)

This cable connects a Position Control Unit (CJ1W-NC133) to a Servo Relay Unit (XW2B-20J6-1B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A18 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A18 | 1 m | | Approx. 0.2 kg |

### Connection configuration and external dimensions
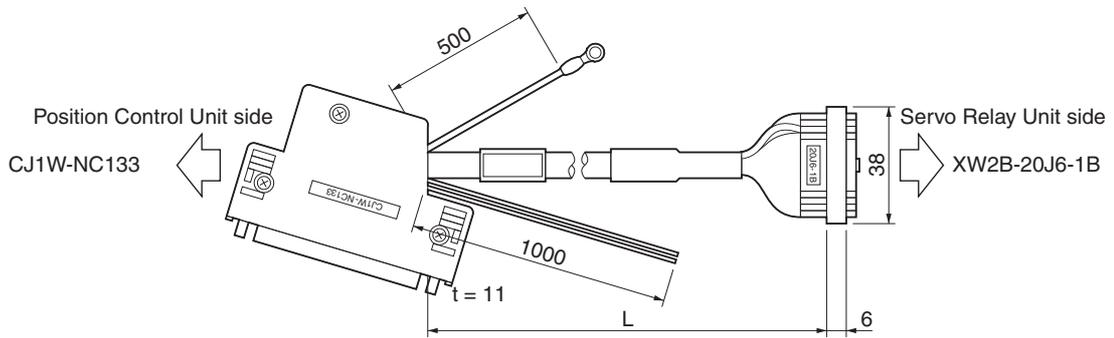


### Wiring
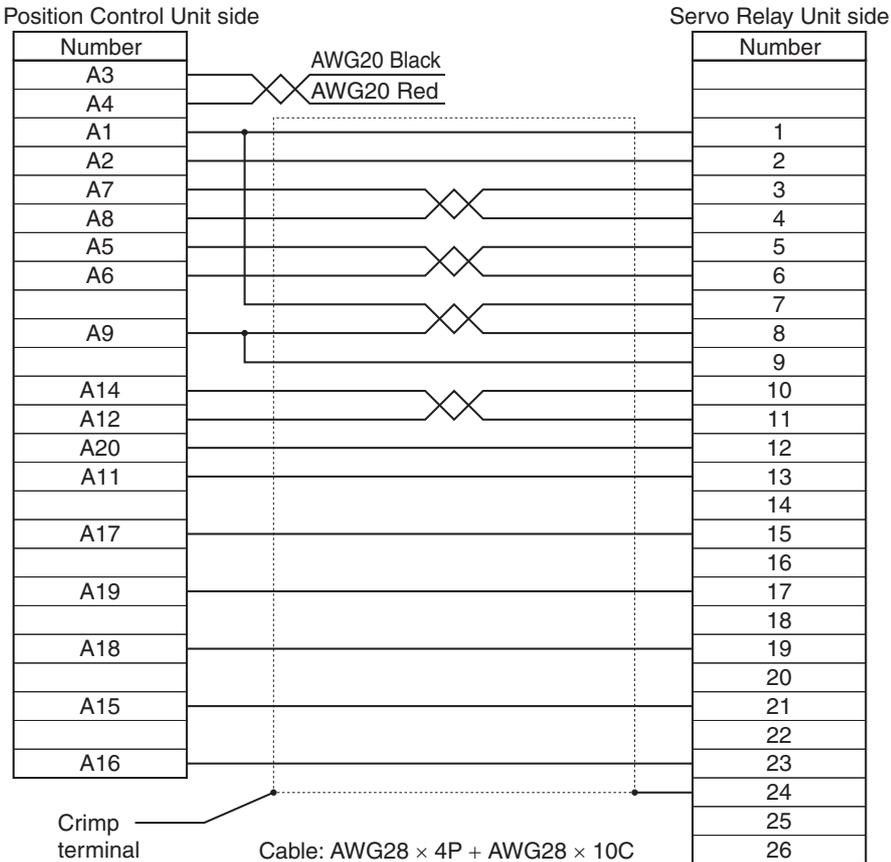
## Position Control Unit Cable (XW2Z-xJ-A19)

This cable connects a Position Control Unit (CJ1W-NC233/433) to a Servo Relay Unit (XW2B-40J6-2B).

### Cable types

| Model | Length (L) | Outer diameter of sheath | Weight |
|---|---|---|---|
| XW2Z-050J-A19 | 50 cm | 10.0 dia. | Approx. 0.1 kg |
| XW2Z-100J-A19 | 1 m | | Approx. 0.2 kg |

### Connection configuration and external dimensions

Position Control Unit side
CJ1W-NC233
CJ1W-NC433

Servo Relay Unit side
XW2B-40J6-2B

### Wiring

Position Control Unit side

Servo Relay Unit side

| Number | | Number |
|---|---|---|
| A3/B3 | AWG20 Black | |
| A4/B4 | AWG20 Red | |
| A1/B1 | | 1 |
| A2/B2 | | 2 |
| A7 | | 3 |
| A8 | | 4 |
| A5 | | 5 |
| A6 | | 6 |
| | | 7 |
| A9 | | 8 |
| | | 9 |
| A14 | | 10 |
| A12 | | 11 |
| A20/B20 | | 12 |
| A15 | | 13 |
| A17 | | 14 |
| A11 | | 15 |
| A19 | | 16 |
| A18 | | 17 |
| A16/B16 | | 18 |
| B7 | | 19 |
| B8 | | 20 |
| B5 | | 21 |
| B6 | | 22 |
| | | 23 |
| B9 | | 24 |
| | | 25 |
| B14 | | 26 |
| B12 | | 27 |
| B19 | | 28 |
| B18 | | 29 |
| B17 | | 30 |
| B15 | | 31 |
| B11 | | 32 |
| | | 33 |
| | | 34 |

Crimp terminal

Cable: AWG28 × 8P + AWG28 × 16C
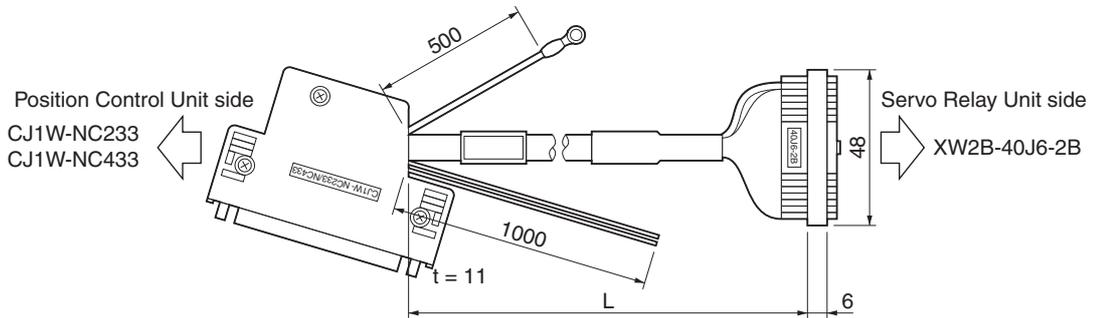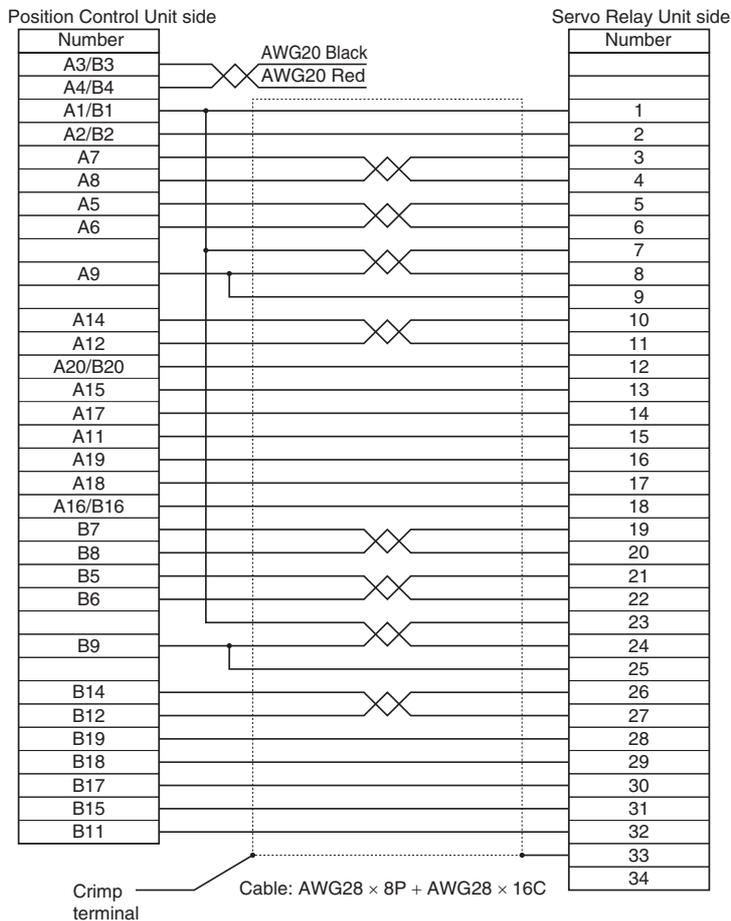
# 3-6 External Regeneration Resistor Specifications

## 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 250 × 250, Thickness: 3.0 | Operating temperature 150°C ± 5% NC contact Rated output: 30 VDC, 50 mA max. |

### 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 250 × 250, Thickness: 3.0 | Operating temperature 150°C ± 5% NC contact Rated output: 30 VDC, 50 mA max. |

### R88A-RR22047S

| Model | Resistance value | Nominal capacity | Regeneration absorption for 120°C temperature rise | Heat radiation condition | Thermal switch output specifications |
|---|---|---|---|---|---|
| R88A-RR22047S | 47 Ω | 220 W | 70 W | Aluminum 350 × 350, Thickness: 3.0 | Operating temperature: 170°C ± 7°C NC contact Rated output: 250 VAC, 0.2 A max. |

## 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: 250 VAC, 0.2 A max. 24 VDC, 0.2 A max. |

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**Specifications**

# 3-7 EMC Filter Specifications

## Specifications

| Applicable servodrive | Filter model | Rated current | Leakage current | Rated voltage |
|---|---|---|---|---|
| R88D-KT01H | R88A-FIK102-RE | 2.4 A | 3.5 mA | 250 VAC single-phase |
| R88D-KT02H | | | | |
| R88D-KT04H | R88A-FIK104-RE | 4.1 A | | |
| R88D-KT08H | R88A-FIK107-RE | 6.6 A | | |
| R88D-KT10H | R88A-FIK114-RE | 14.2 A | | |
| R88D-KT15H | | | | |
| R88D-KT06F | R88A-FIK304-RE | 4 A | | 400 VAC single-phase |
| R88D-KT10F | | | | |
| R88D-KT15F | | | | |
| R88D-KT20F | R88A-FIK306-RE | 6 A | | |
| R88D-KT30F | R88A-FIK312-RE | 12 A | | |
| R88D-KT50F | | | | |

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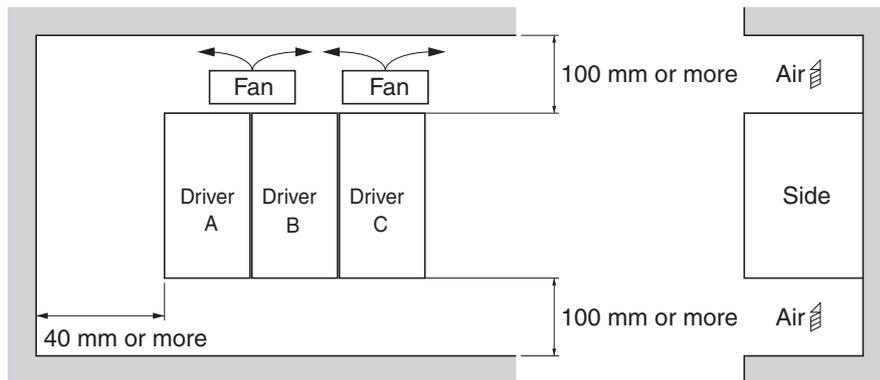


⬥ For side-by-side installation you have to apply next derating for models of 800W or less: Installed in position A, maximum ambient temperature 50°C, installed in position B, maximum ambient temperature 40°C and installed in position C, maximum ambient temperature 45°C.

### Mounting Direction

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

### Environment Operating Conditions

⬥ The environment in which drivers are operated must meet the following conditions. Drivers may malfunction if operated under any other conditions.

   Operating ambient temperature: 0 to +55°C (Take into account temperature rises in the following individual drivers themselves.)
   Operating humidity: 90% RH max. (with no condensation)
   Operating atmosphere: No corrosive gases.
   Altitude: 1,000 m max.
   Derating must be applied for higher altitudes.

### 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 driver is installed in a closed space, such as a box, ambient temperature will rise due to temperature rise in each unit. Use a fan or air conditioner to prevent the driver's ambient temperature from exceeding 55°C.

⬥ Driver 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 limit of a driver is largely determined by the ambient temperature around the internal electrolytic capacitors. When an electrolytic capacitor reaches its limit, electrostatic capacity drops

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**System Design**

⬥ If a driver 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 driver.

$$\text{Lifetime } 25°C = \text{Lifetim } 55°C \times 2 \; \frac{55-25}{10} = 224000 \text{ hour}$$

## Keeping Foreign Objects Out of Units

⬥ Place a cover over the driver or take other preventative measures to prevent foreign objects, such as drill filings, from getting into the driver during installation. Be sure to remove the cover after installation is complete. If the cover is left on during operation, driver'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 drivers.

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**System Design**

## 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.
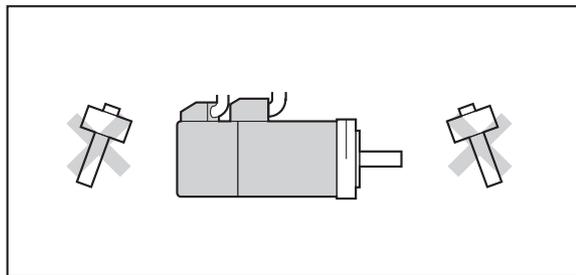
### Connecting to Mechanical Systems

• For the allowable axial loads for motors, refer to "Characteristics"(P.3-3). If an axial load greater than that specified is applied to a motor, it will 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 will be 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.

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**System Design**

Ball screw center line

Axial offset

Motor center line

Backlash

Set a structure in which the distance between axes can be adjusted.

Bevel gear

Set a movable structure.
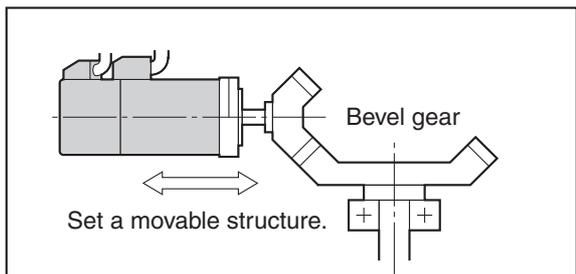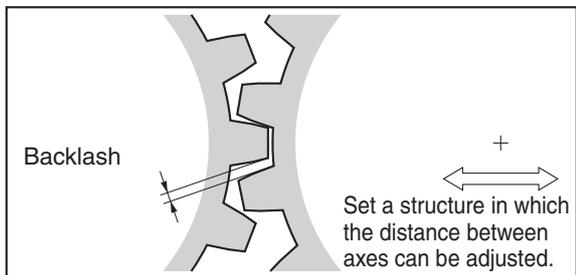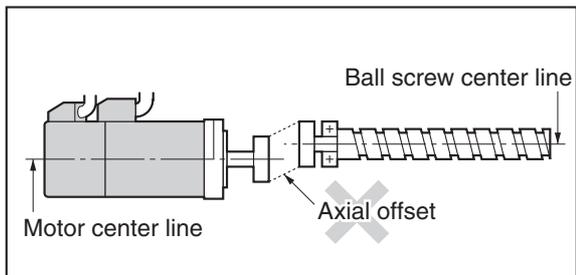
• When connecting to a V-belt or timing belt, consult the manufacturer for belt selection and tension.

• A radial load twice the belt tension will 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.
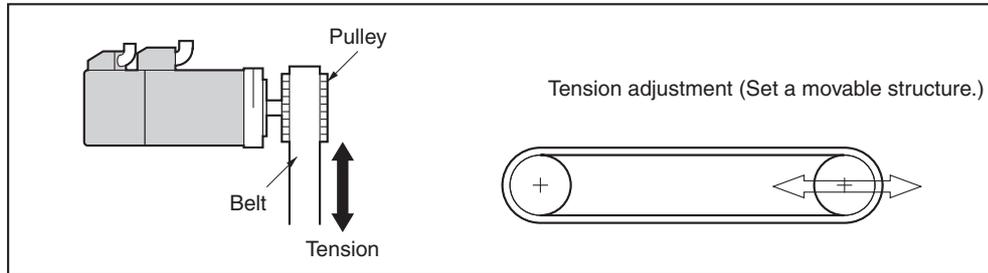


## Water and Drip Resistance

• The protective structure for the motors is as follows.
  IP67 or equivalent (except for through-shaft parts)

## 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 in the axial direction, make sure that no oil accumulates on the lip of the oil seal.

## Radiator Plate Installation Conditions

• Be sure to install a radiator plate on the Servomotor.If a radiator plate is not installed, the Servomotor may be damaged due to temperature rise.Refer to 3-2, "Motor Specifications" for the specifications of the radiator plate.

• When the Servomotor is to be attached to the equipment, the Servomotor temperature may rise if not enough radiation area is provided.Because a rise in temperature can vary depending on the material of the mounting part or the environment, check the temperature on the actual 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.

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**System Design**

## 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.

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**System Design**

## Gearbox Installation Conditions

### Using Another Company's Gearbox (Reference)

If the system configuration requires another company's Gearbox to be used in combination with an Accurax G5 motor, select the Gearbox 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.3-3) for details on the allowable loads for the motors.)

Also, select the Gearbox so that the allowable input rotation speed and allowable input torque of the Gearbox are not exceeded.

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**System Design**

# 4-2 Wiring

## Peripheral Equipment Connection Examples

### R88D-KTA5L/-KT01L/-KT02L/-KT04L
### R88D-KT01H/-KT02H/-KT04H/-KT08H/-KT10H/-KT15H (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 (KT04L, KT08H, KT10H and KT15H) 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 KTA5L to KT02L, and KT01H to KT04H. When the amount of regeneration is large, connect the necessary Regeneration Resistor between B1 and B2.

## R88D-KT01H/-KT02H/-KT04H/-KT08H/-KT10H/-KT15H (3-phase Input)
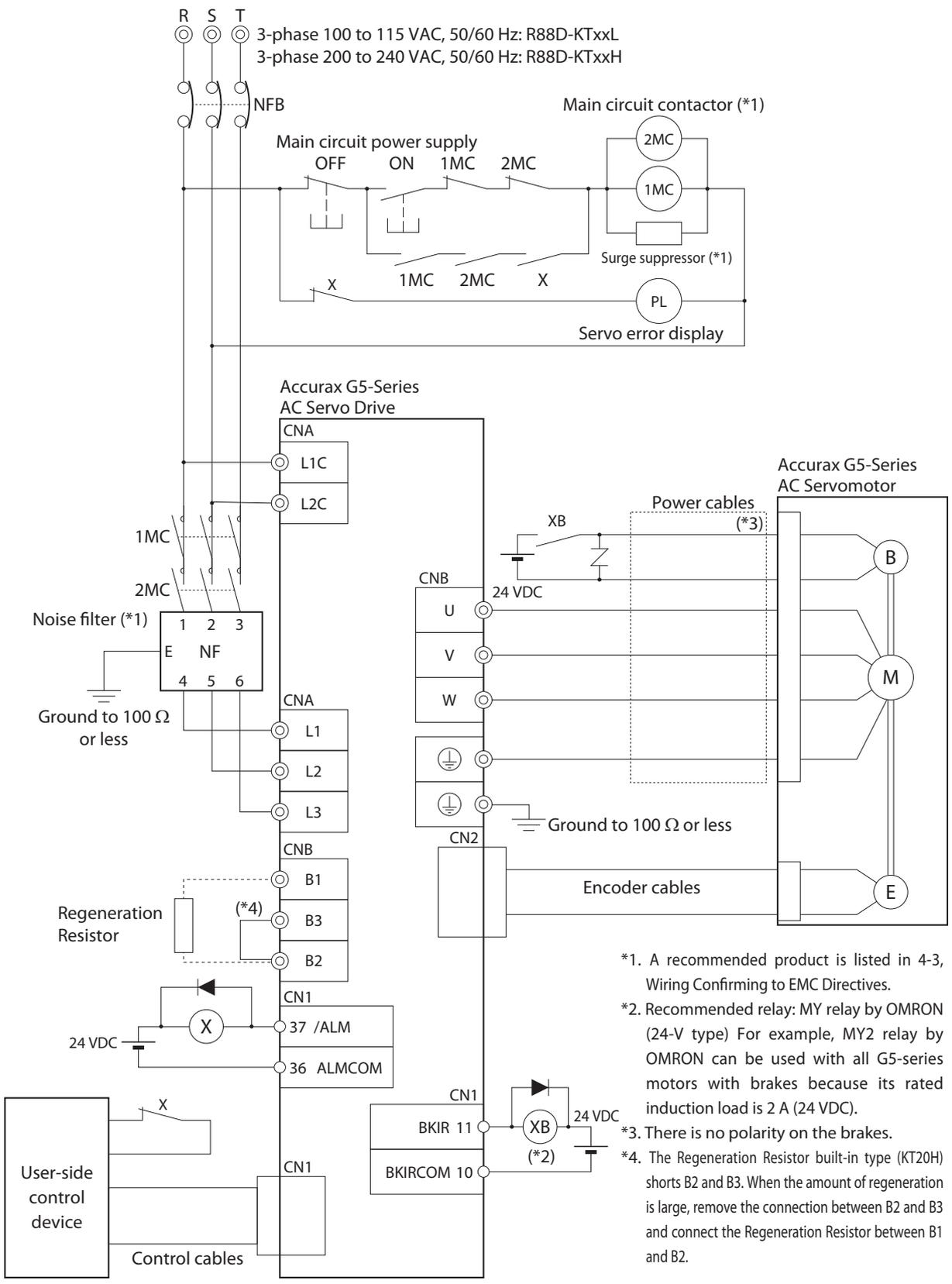


*1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.

*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 (KT20H) 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.

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**System Design**

## R88D-KT20H

**System Design**

**4**

R S T
3-phase 200 to 240 VAC, 50/60 Hz: R88D-KTxxH

NFB

Main circuit power supply

Main circuit contactor (*1)

OFF    ON    1MC    2MC

2MC

1MC

Surge suppressor (*1)

1MC    2MC    X

X

PL

Servo error display

Accurax G5-Series
AC Servo Drive

CNA

L1C

L2C

Accurax G5-Series
AC Servomotor

Power cables
(*3)

XB

24 VDC

1MC

2MC

Noise filter (*1)

1    2    3

E    NF

4    5    6

Ground to 100 Ω
or less

CNA

L1

L2

L3

CNB

U

V

W

B

M

Ground to 100 Ω or less

CNC

B1

Regeneration
Resistor

(*4)    B3

B2

CN2

Encoder cables

E

24 VDC

X

CN1

37  /ALM

36  ALMCOM

CN1

BKIR 11

XB    24 VDC

(*2)

BKIRCOM 10

User-side
control
device

X

CN1

Control cables

*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.
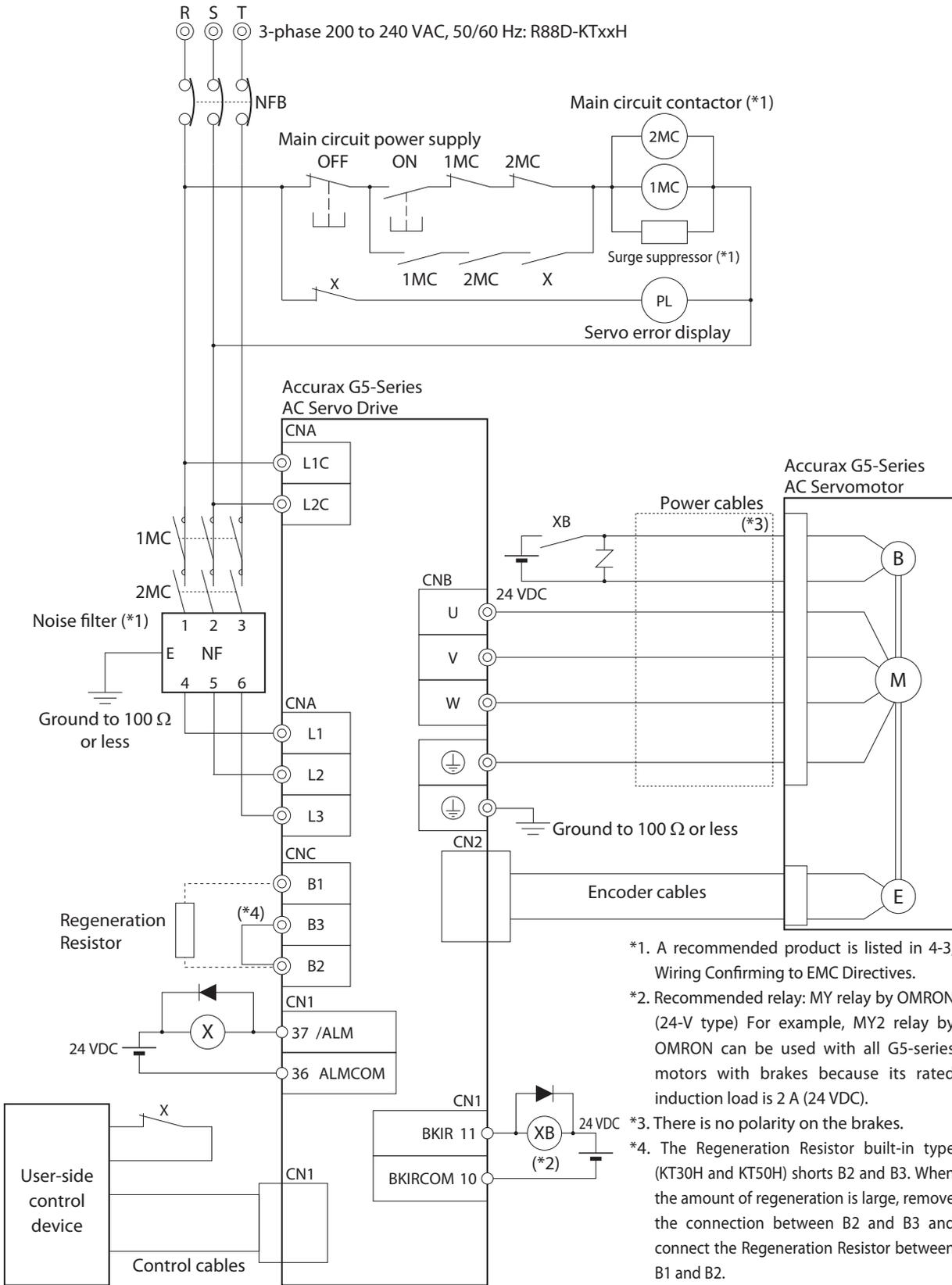
*4. The Regeneration Resistor built-in type
(KT30H and KT50H) shorts B2 and B3. When
the amount of regeneration is large, remove
the connection between B2 and B3 and
connect the Regeneration Resistor between
B1 and B2.

## R88D-KT30H/-KT50H



*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 (KT06F to KT15F) 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-KT75H
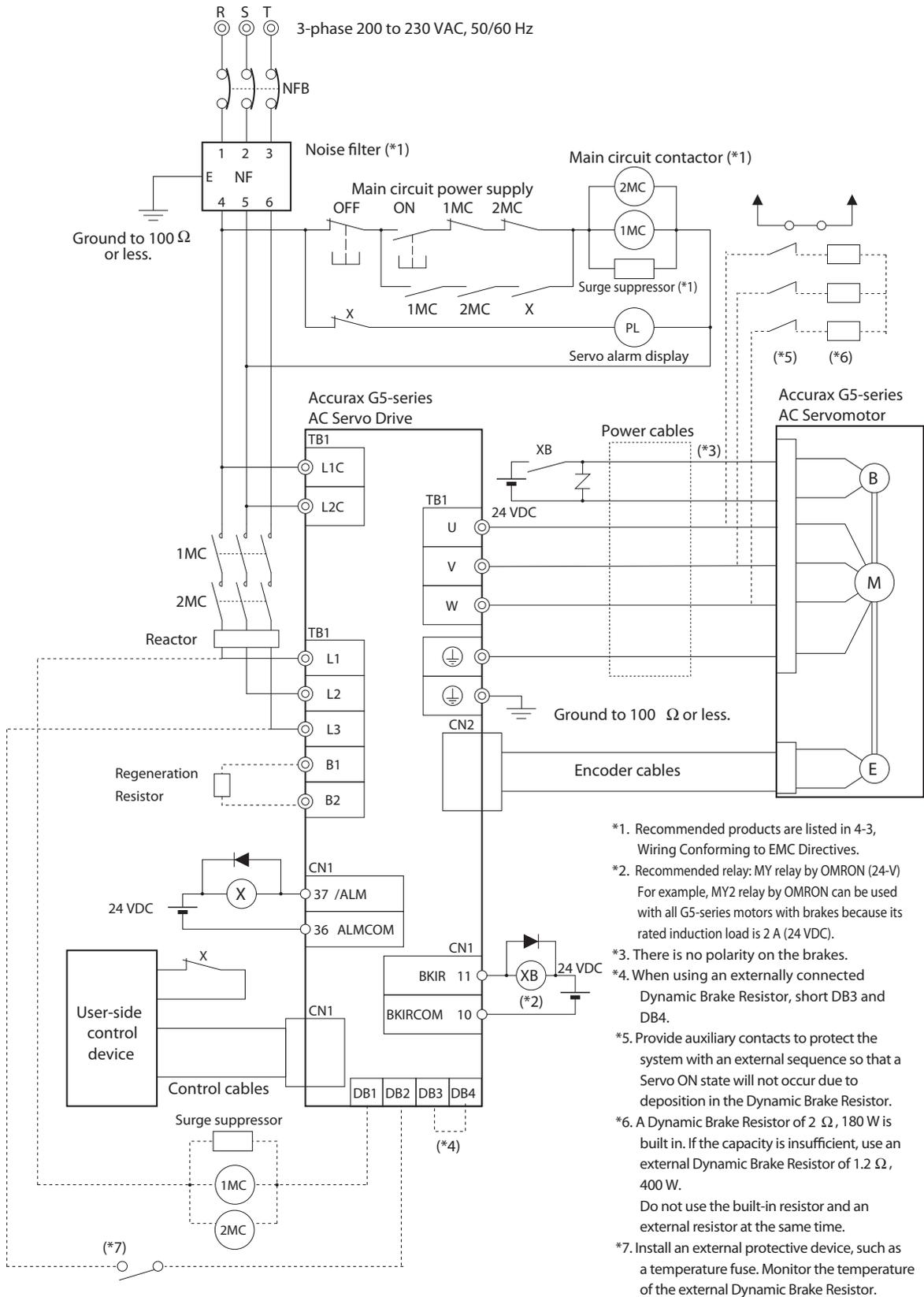


*1. Recommended products are listed in 4-3, Wiring Conforming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V) 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. When using an externally connected Dynamic Brake Resistor, short DB3 and DB4.

*5. Provide auxiliary contacts to protect the system with an external sequence so that a Servo ON state will not occur due to deposition in the Dynamic Brake Resistor.

*6. A Dynamic Brake Resistor of 2 Ω, 180 W is built in. If the capacity is insufficient, use an external Dynamic Brake Resistor of 1.2 Ω, 400 W.
Do not use the built-in resistor and an external resistor at the same time.

*7. Install an external protective device, such as a temperature fuse. Monitor the temperature of the external Dynamic Brake Resistor.

## R88D-KT150H
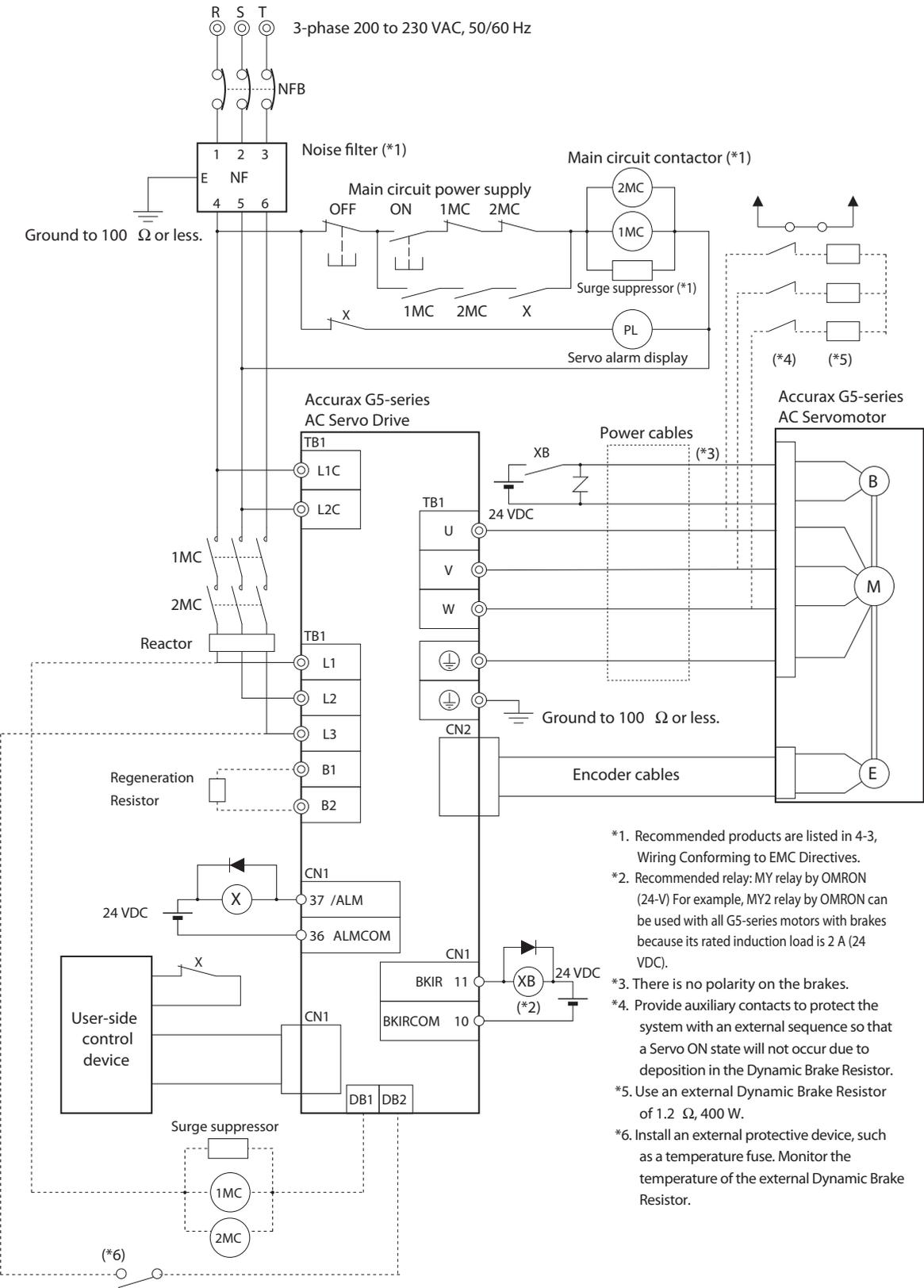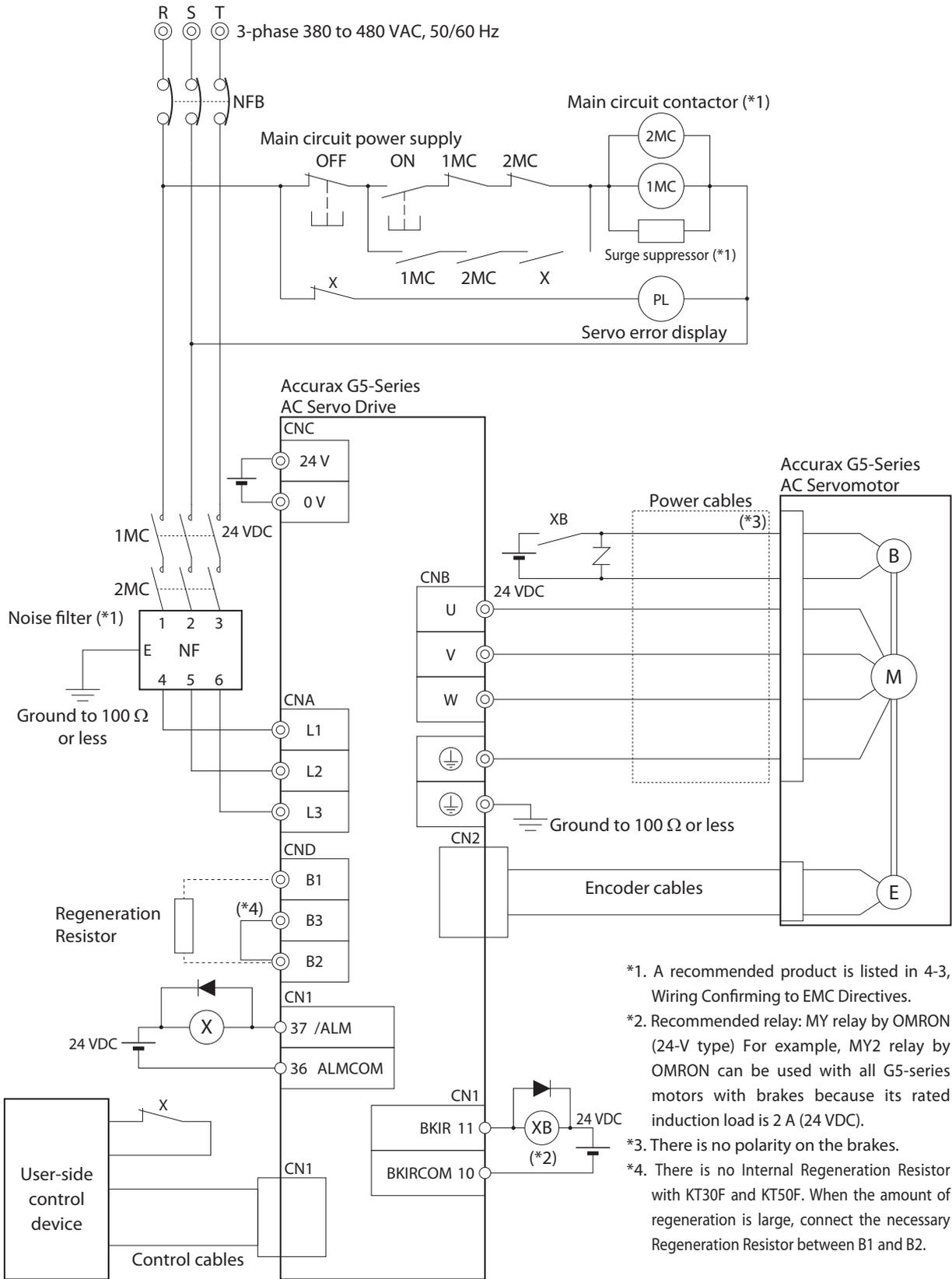


*1. Recommended products are listed in 4-3, Wiring Conforming to EMC Directives.
*2. Recommended relay: MY relay by OMRON (24-V) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).
*3. There is no polarity on the brakes.
*4. Provide auxiliary contacts to protect the system with an external sequence so that a Servo ON state will not occur due to deposition in the Dynamic Brake Resistor.
*5. Use an external Dynamic Brake Resistor of 1.2 Ω, 400 W.
*6. Install an external protective device, such as a temperature fuse. Monitor the temperature of the external Dynamic Brake Resistor.

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**System Design**

## R88D-KT06F/-KT10F/-KT15F/-KT20F



*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 KT30F and KT50F. When the amount of regeneration is large, connect the necessary Regeneration Resistor between B1 and B2.

## R88D-KT30F/-KT50F



R   S   T   3-phase 380 to 480 VAC, 50/60 Hz

NFB

Main circuit power supply

Main circuit contactor (*1)

OFF   ON   1MC   2MC

2MC

1MC

Surge suppressor (*1)

X   1MC   2MC   X

PL

Servo error display

Accurax G5-Series AC Servo Drive

Accurax G5-Series AC Servomotor

TB2

24 V

0 V

24 VDC

Power cables (*3)

XB

24 VDC

TB1

U

V

W

1MC

2MC

Noise filter (*1)

1   2   3

E   NF

4   5   6

Ground to 100 Ω or less

TB1

L1

L2

L3

Ground to 100 Ω or less

CN2

Regeneration Resistor

B1

B2

Encoder cables

*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.

CN1

X

24 VDC

37   /ALM

36   ALMCOM

CN1

BKIR 11

XB   24 VDC

(*2)

BKIRCOM 10

X

User-side contro device

CN1

Control cables

### R88D-KT75F



R S T — 3-phase 380 to 480 VAC, 50/60 Hz

NFB

Noise filter (*1)

E NF
1 2 3
4 5 6

Ground to 100 Ω or less.

Main circuit power supply
OFF ON 1MC 2MC

Main circuit contactor (*1)
2MC
1MC
Surge suppressor (*1)

X 1MC 2MC X
PL
Servo alarm display

(*5) (*6)

Accurax G5-series AC Servo Drive

Accurax G5-series AC Servomotor

TB2
24 V
0V
24 VDC

Power cables (*3)

XB
24 VDC

TB1
U
V
W

(*5) (*6)

B

M

1MC
2MC

Reactor

TB1
L1
L2
L3

CN2

Ground to 100 Ω or less.

Power supply (neutral point)

Regeneration Resistor
B1
B2

Encoder cables

E

24 VDC

CN1
X
37 /ALM
36 ALMCOM

User-side control device
X

CN1
BKIR 11
BKIRCOM 10
XB (*2)
24 VDC

CN1

Control cables

DB1 DB2 DB3 DB4

Surge suppressor
1MC
2MC

(*4)

(*7)

*1. Recommended products are listed in 4-3, Wiring Conforming to EMC Directives.
*2. Recommended relay: MY relay by OMRON (24-V) 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. When using an externally connected Dynamic Brake Resistor, short DB3 and DB4.
*5. Provide auxiliary contacts to protect the system with an external sequence so that a Servo ON state will not occur due to deposition in the Dynamic Brake Resistor.
*6. A Dynamic Brake Resistor of 8 Ω, 180 W is built in. If the capacity is insufficient, use an external Dynamic Brake Resistor of 4.8 Ω, 400 W. Do not use a built-in resistor and an external resistor at the same time.
*7. Wire the circuit so that the voltage between DB1 and DB2 is 400 VAC or less. Install an external protective device, such as a temperature fuse. Monitor the temperature of the external Dynamic Brake Resistor.

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**System Design**

## R88D-KT150F



*1. Recommended products are listed in 4-3, Wiring Conforming to EMC Directives.

*2. Recommended relay: MY relay by OMRON (24-V) 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. Provide auxiliary contacts to protect the system with an external sequence so that a Servo ON state will not occur due to deposition in the Dynamic Brake Resistor.

*5. Use an external Dynamic Brake Resistor of 4.8 Ω, 400 W.

*6. Wire the circuit so that the voltage between DB1 and DB2 is 400 VAC or less. Install an external protective device, such as a temperature fuse. Monitor the temperature of the external Dynamic Brake Resistor.

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**System Design**

## Main Circuit and Motor Connections

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

### R88D-KTA5L/-KT01L/-KT02L/-KT04L
### R88D-KT01H/-KT02H/-KT04H/-KT08H/-KT10H/-KT15H

**Main Circuit Connector Specifications (CNA)**

| Symbol | Name | Function |
|---|---|---|
| L1 | Main circuit power supply input | R88D-KTxL<br>(50 to 400 W) : Single-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz<br>(200 to 400 W): 3-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz<br>R88D-KTxH<br>(100 W to 1.5 kW) : Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz<br>(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-KTxL : Single-phase 100 to 115 VAC (85 to 127 V) 50/60Hz<br>R88D-KTxH : 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 | 50 to 400 W: These terminals normally do not need to be connected. If there is high regenerative energy, connect an External Regeneration Resistor between B1 and B2.<br>750 W to 1.5 kW: Normally B2 and B3 are shorted. 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 | These are the output terminals to the Servomotor.<br>Be sure to wire them correctly. |
| V | | |
| W | | |
| ⏚ | | |
| ⏚ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

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## R88D-KT20H

### Main Circuit Connector Specifications (CNA)

| Symbol | Name | Function |
|---|---|---|
| L1 | Main circuit power supply input | R88D-KTxH (2 kW) :<br>3-phase: 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| L2 | | |
| L3 | | |
| L1C | Control circuit power supply input | R88D-KTxH : 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 | |
| $\bot$ | | Green/Yellow | |
| $\bot$ | Frame ground | This is the ground terminal. Ground to 100 $\Omega$ or less. | |

### External Regeneration Resistor Connector Specifications (CNC)

| Symbol | Name | Function |
|---|---|---|
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are short-circuited.<br>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.<br>When using N terminal, make sure not to exceed the fuse's rated voltage (360 VDC, 60 A). |
| B2 | | |
| B3 | | |
| N | | |

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**System Design**

## R88D-KT30H/-KT50H

### Terminal Block Specifications

| Symbol | Name | Function |
|--------|------|----------|
| L1 | Main circuit power supply input | R88D-KTxH (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-KTxH: 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 | | |
| U | Motor connection terminals | These are the output terminals to the Servomotor. Be sure to wire them correctly. |
| V | | |
| W | | |
| ⏚ | | |
| ⏚ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

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**System Design**

## R88D-KT75H

### Terminal Block Specifications

| Symbol | Name | Function |
|--------|------|----------|
| L1 | Main circuit power supply input | R88D-KTxH (7.5 kW): 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| L2 | | |
| L3 | | |
| L1C | Control circuit power supply input | R88D-KTxH: Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| L2C | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. |
| B2 | | |
| B3 | | Do not connect. |
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. |
| DB2 | | |
| DB3 | | Normally DB3 and DB4 are connected. When using an externally connected Dynamic Brake Unit, remove the short bar from between DB3 and DB4. |
| DB4 | | |
| U | Motor connection terminals | These are the output terminals to the Servomotor. Be sure to wire them correctly. |
| V | | |
| W | | |
| ⏚ | | |
| ⏚ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

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**System Design**

## R88D-KT150H

### Terminal Block Specifications

| Symbol | Name | Function |
|--------|------|----------|
| L1 | Main circuit power supply input | R88D-KTxH (15 kW): 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| L2 | | |
| L3 | | |
| L1C | Control circuit power supply input | R88D-KTxH: Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| L2C | | |
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. |
| DB2 | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. |
| B2 | | |
| B3 | | Do not connect. |
| U | Motor connection terminals | These are the output terminals to the Servomotor. Be sure to wire them correctly. |
| V | | |
| W | | |
| ⏚ | | |
| ⏚ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

## R88D-KT06F/-KT10F/-KT15F/-KT20F

### Main Circuit Connector Specifications (CNA)

| Symbol | Name | Function |
|--------|------|----------|
| L1 | Main circuit power supply input | R88D-KTxF (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 100 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 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. When using N terminal, make sure not to exceed the fuse's rated voltage (660 VDC, 20 A). |
| B2 | | |
| B3 | | |
| N | | |

## R88D-KT30F/-KT50F

### Terminal Block Specifications (TB1)

| Symbol | Name | Function | |
|---|---|---|---|
| L1 | Main circuit power supply input | R88D-KTxF (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. | |
| N | – | Do not connect. | |
| 24 V | Control circuit power supply input | R88D-KTxF: 24 VDC (21.6 to 26.4 V) | |
| 0 V | | | |
| ⏚ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. | |
| NC | – | Do not connect. | |

## R88D-KT75F

### Terminal Block Specifications (TB1)

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

### Terminal Block Specifications (TB2)

| Symbol | Name | Function | |
|--------|------|----------|---|
| L1 | Main circuit power supply input | R88D-KTxF (7.5 kW): 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | |
| B2 | | | |
| NC | | Do not connect. | |
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. | |
| DB2 | | | |
| DB3 | | Normally DB3 and DB4 are connected. When using an externally connected Dynamic Brake Unit, remove the short bar from between DB3 and DB4. | |
| DB4 | | | |
| 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-KT150F

### Terminal Block Specifications (TB1)

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

### Terminal Block Specifications (TB2)

| Symbol | Name | Function | | |
|--------|------|----------|---|---|
| DB1 | Dynamic brake resistance control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. Connect them if required. | | |
| DB2 | | | | |
| L1 | Main circuit power supply input | R88D-KTxF (15 kW): 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz | | |
| L2 | | | | |
| L3 | | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | | |
| B2 | | | | |
| NC | | Do not connect. | | |
| 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. | | |

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**System Design**

## Terminal Block Wire Sizes

**100-VAC Input Type Wire Sizes: R88D-KTxxL**

| Model (R88D-) | | | KTA5L | KT01L | KT02L | KT04L |
|---|---|---|---|---|---|---|
| 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) [*1] | Rated current | A | 1.4 | 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) [*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 | | | |

### 200 VAC Input Type Wire Sizes: R88D-KTxxH

| Model (R88D-) | | | KT01H | KT02H | KT04H | KT08H | KT10H |
|---|---|---|---|---|---|---|---|
| Item | | Unit | | | | | |
| 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) [1] | Rated current | A | 1.3 | 2.4/1.3 [1] | 4.1/2.4 [1] | 6.6/3.6 [1] | 9.1/5.9 [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] | 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 | | | | |

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**System Design**

| Model (R88D-) | | | KT15H | KT20H | KT30H | KT50H | KT75H | KT150H |
|---|---|---|---|---|---|---|---|---|
| **Item** | | **Unit** | | | | | | |
| Power supply capacity | | kVA | 2.3 | 3.3 | 4.5 | 7.5 | 11.0 | 22.0 |
| 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 | 32.0 | 58.0 |
| | Wire size | – | AWG14 | | AWG12 | | AWG 10 | AWG6 |
| | Screw size | – | – | – | M5 | | | M6 |
| | Tightening torque | N·m | – | – | 2.0 | | 2.0 to 2.4 | 2.2 to 2.5 |
| Control circuit power supply input (L1C and L2C) | Wire size | – | AWG18 | | | | | |
| | Screw size | – | – | – | M5 | | | M4 |
| | Tightening torque | N·m | – | – | 2.0 | | 1.3 to 1.5 | 0.7 to 0.8 |
| Motor connection terminals (U, V, W, and FG) [*1] | Rated current | A | 9.4 | 13.4 | 18.6 | 33.0 | 44.0 | 66.7 |
| | Wire size | – | AWG14 | | AWG12 | | AWG6 | AWG4 |
| | Screw size | – | – | – | M5 | | | M6 |
| | Tightening torque | N·m | – | – | 2.0 | | 2.0 to 2.4 | 2.2 to 2.5 |
| Frame ground (FG) | Wire size | – | AWG14 | | AWG12 | | AWG6 | AWG4 |
| | Screw size | – | M4 | | M5 | | | M6 |
| | Tightening torque | N·m | 1.2 | | 2.0 | | 1.4 to 1.6 | 2.4 to 2.8 |
| Dynamic brake resistance control terminals | Screw size | – | | | | | M5 | M4 |
| | Tightening torque | N·m | – | | | | 1.3 to 1.5 | 0.7 to 0.8 |

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

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

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

### 400 VAC Input Type Wire Sizes: R88D-KTxxF

| Model (R88D-) Item | | Unit | KT06F | KT10F | KT15F | KT20F | KT30F | KT50F | KT75F | KT150F |
|---|---|---|---|---|---|---|---|---|---|---|
| Main circuit power supply input (L1 and L3, or L1, L2 and L3) | Rated current | A | 2.8 | 2.8 | 3.9 | 5.9 | 7.6 | 12.1 | 16.0 | 29.0 |
| | Wire size | – | AWG14 | | | | AWG12 | | AWG10 | AWG6 |
| | Screw size | – | – | – | – | – | M5 | | | M6 |
| | Tightening torque | N·m | – | – | – | – | 2.0 | | 2.0 to 2.4 | 2.2 to 2.5 |
| Control circuit power supply input (L1C and L2C) | Wire size | – | AWG20 to 24 | | | | AWG18 | | | |
| | Screw size | – | – | – | – | – | M5 | | | M4 |
| | Tightening torque | N·m | – | – | – | – | 2.0 | | 1.3 to 1.5 | 0.7 to 0.8 |
| Motor connection terminals (U, V, W, and FG) [*1] | Rated current | A | 2.9 | 2.9 | 4.7 | 6.7 | 9.4 | 16.5 | 22.0 | 33.4 |
| | Wire size | – | AWG14 | | | | AWG12 | | AWG6 | AWG4 |
| | Screw size | – | – | – | – | – | M5 | | | M6 |
| | Tightening torque | N·m | – | – | – | – | 2.0 | | 2.0 to 2.4 | 2.2 to 2.5 |
| Frame ground (FG) | Wire size | – | AWG14 | | | | AWG12 | | AWG6 | AWG4 |
| | Screw size | – | M4 | | | | M5 | | | M6 |
| | Tightening torque | N·m | 1.2 | | | | 2.0 | | 1.4 to 1.6 | 2.4 to 2.8 |
| Dynamic brake resistance control terminals | Screw size | – | | | | | | | M5 | M4 |
| | Tightening torque | N·m | – | | | | | | 1.3 to 1.5 | 0.7 to 0.8 |

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

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

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

**4**

**System Design**

## 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 ($\Omega$/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 |

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**System Design**

## Terminal Block Wiring Procedure

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



Connector-type terminal block

(Example of R88D-KT01H)
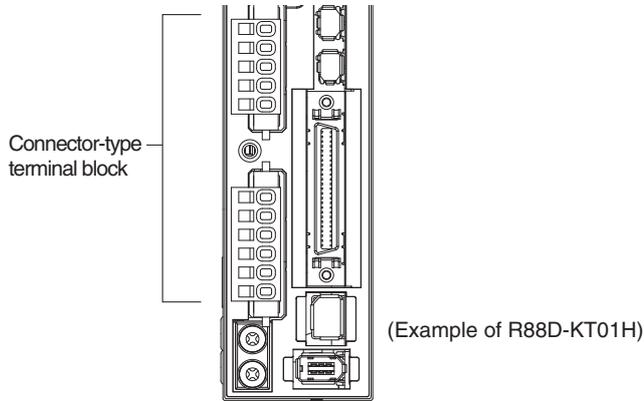
1. **Remove the terminal block from the driver before wiring.**
   The driver will be damaged if the wiring is done with the terminal block in place.
2. **Strip off 8 to 9 mm of the covering from the end of each wire.**
   Refer to "Terminal Block Wire Sizes"(P.4-26) for applicable wire sizes.



8 to 9 mm
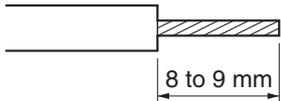
3. **Open the wire insertion slots in the terminal block using a tool.**
   There are 2 ways to open the wire insertion slots, as follows.

   ⬥ 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)
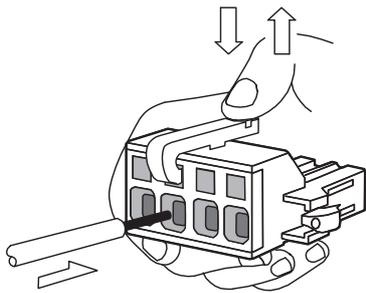


Figure A
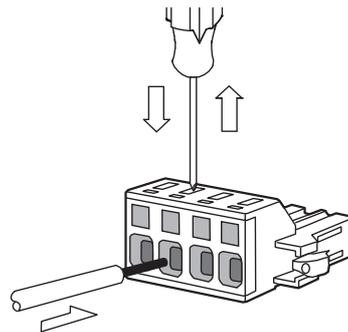
Figure B

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 driver.**
   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 Accurax G5 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 driver 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 I/O signal cables and encoder cables. (Use tin-plated, mild steel wires for the shielding.)
- All cables, I/O wiring, and power lines connected to the driver may have clamp filters installed to improve the noise immunity.
- The shields of all cables must be directly connected to a ground plate.

## Wiring Method

### R88D-KTA5L/-KT01L/-KT02L/-KT04L/-KT01H/-KT02H/-KT04H/-KT08H/-KT10H/-KT15H/-KT20H/-KT30H/-KT50H/-KT75H/-KT150H
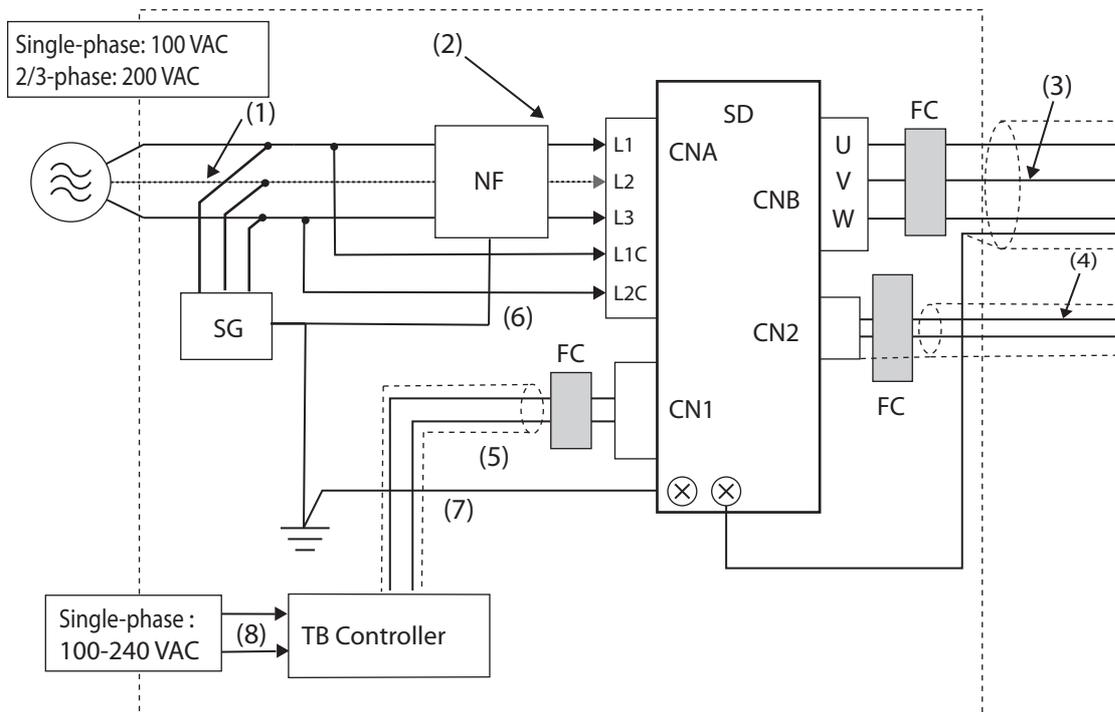


*1. For models with a single-phase power supply input (R88D-KTA5L/-KT01L/-KT02L/-KT04L/-KT01H/-KT02H/-KT04H/-KT08H/-KT10H/-KT15H), the main circuit power supply input terminals are L1 and L3.

- 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.

**R88D-KT06F/-KT10F/-KT15F/-KT20F/-KT30F/-KT50F/-KT75F/-KT150F**
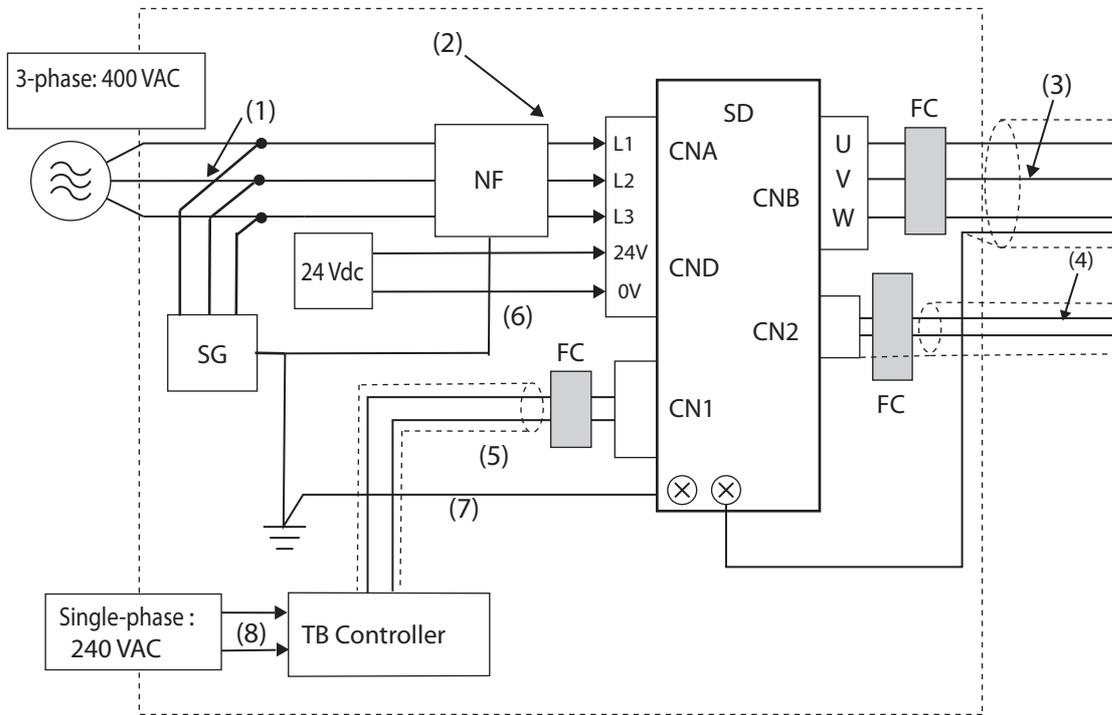


## Unit Details

| Symbol | Name | Manufacturer | Model | Comment |
|---|---|---|---|---|
| SG | Surge absorber (Optional) | Okaya Electric Industries Co., Ltd. | RAV781BWZ-4 | Single-phase 100 VAC |
| | | | RAV781BXZ-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-HQ10-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) |
| | | Rasmi | See chapter 3 | 1-phase 200 VAC 3-phase 400 VAC |
| SD | Servo Drive | OMRON | – | *1 |
| SM | Servomotor | OMRON | – | *1 |
| FC | Clamp core | TDK | ZACT305-1330 | – |
| 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 | 3-phase or single phase | No | No |
| (2) | Noise filter | Servo Drive | Power supply line | 2 m | – | No | Optional |
| (3) | Servo Drive | Servomotor | Power cable | 20 m | – | Yes | Optional |
| (4) | Servo Drive | Servomotor | Encoder cable | 20 m | – | Yes | Optional |
| (5) | Switch box | Servo Drive | I/O cable | 2 m | – | Optional | 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 | Switch box | Power supply line | 1.5 m | – | No | No |

• 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.



○ Separate the input and output.     ✗ The effect of the noise filter is small.
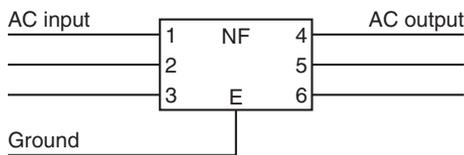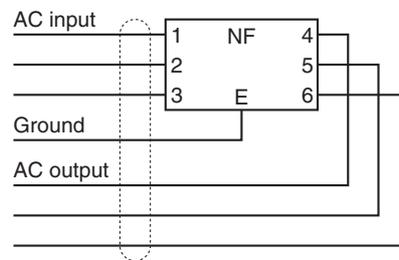
• Use twisted-pair cables for the power supply cables, or bind the cables.



○ Twisted-pair process     ○ Bound cables
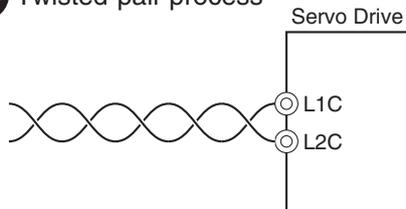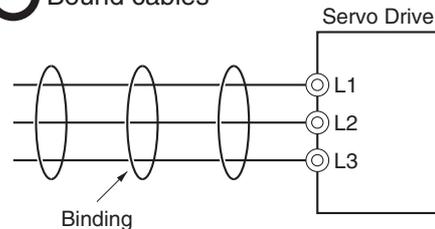
• Separate power supply lines and signal lines when wiring.

## Control Panel Structure

Openings in the control panel, such as holes for cables, operating 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 will be 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 will be electrically conductive.
⋄ The panel may warp and gaps may appear when screws are tightened. Be sure that no gaps appear when tightening screws.

Case

A

Door

B

[Control panel]

Oil-resistant gasket  Conductive gasket
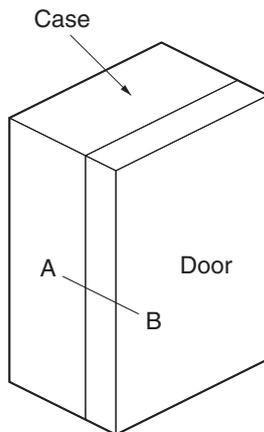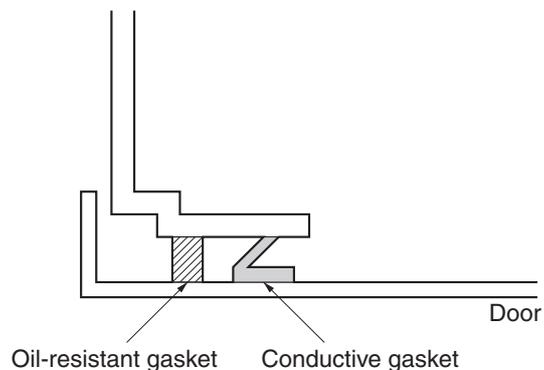
Door

[A-B cross-section diagram]

Oil-resistant gasket

Conductive gasket
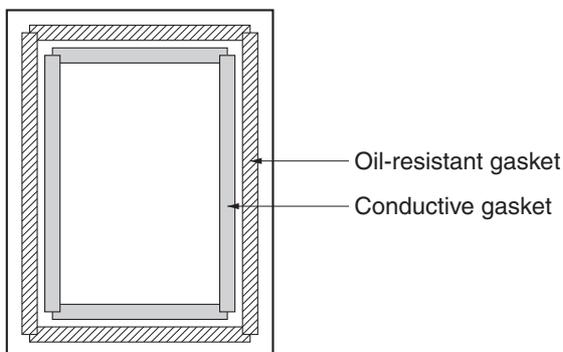
[Door (interior side)]

## 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 driver's momentary maximum output 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 drivers are used). (The rated current of the power supply input for each motor is provided in "Main Circuit and Motor Connections"(P.4-18).)
- Add the current consumption of other controllers, and any other components when selecting.

#### Inrush Current

- The following table lists the driver inrush currents.
- With low-speed no-fuse breakers, an inrush current 10 times the rated current can flow for 0.02 second.
- When multiple drivers 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.

| Driver model | Inrush current (Ao-p) | |
|---|---|---|
| | Main circuit power supply | Control circuit power supply |
| R88D-KTA5L | 7 | 14 |
| R88D-KT01L | 7 | 14 |
| R88D-KT02L | 7 | 14 |
| R88D-KT04L | 15 | 14 |
| R88D-KT01H | 14 | 28 |
| R88D-KT02H | 14 | 28 |
| R88D-KT04H | 14 | 28 |
| R88D-KT08H | 29 | 28 |
| R88D-KT10H | 29 | 28 |
| R88D-KT15H | 29 | 28 |
| R88D-KT20H | 29 | 14 |
| R88D-KT30H | 22 | 14 |
| R88D-KT50H | 22 | 14 |
| R88D-KT75H | 66 | 15 |
| R88D-KT150H | 66 | 15 |

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**System Design**

| Driver model | Inrush current (Ao-p) | |
|---|---|---|
| | Main circuit power supply | Control circuit power supply |
| R88D-KT06F | 28 | 48 |
| R88D-KT10F | 28 | 48 |
| R88D-KT15F | 28 | 48 |
| R88D-KT20F | 32 | 48 |
| R88D-KT30F | 32 | 48 |
| R88D-KT50F | 32 | 48 |
| R88D-KT75F | 32 | 48 |
| R88D-KT150F | 32 | 48 |

## Leakage Breaker

- Select leakage breakers designed for protection against ground faults.
- Because switching takes place inside the drivers, high-frequency current leaks from the SW elements of the driver, 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.
- When selecting leakage breakers, remember to add the leakage current from devices other than the motor, such as machines 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 current values.
- The leakage breaker is activated at 50% of the rated current. Allow leeway when selecting a leakage breaker.
- For details on leakage breakers selection method, refer to the manufacturer's catalog.

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**System Design**

## 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. | RAV-781BWZ-4 | 700 V ± 20% | 2500 A | Block | Single-phase 100/200 VAC |
| Okaya Electric Industries Co., Ltd. | RAV-781BXZ-4 | 700 V ± 20% | 2500 A | | 3-phase 200 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 $\mu$s. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

### External Dimensions
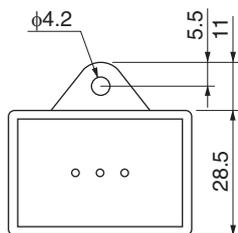
For single-phase (BWZ series)          For 3-phase (BXZ series)
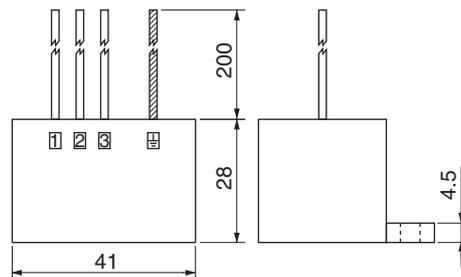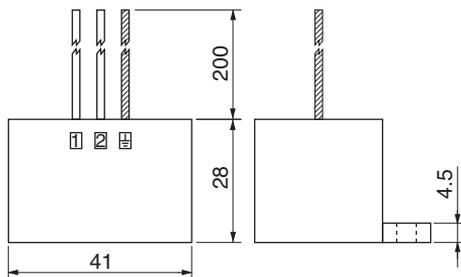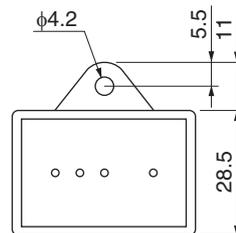


### Equalizing Circuits

For single-phase (BWZ series)    For 3-phase (BXZ series)
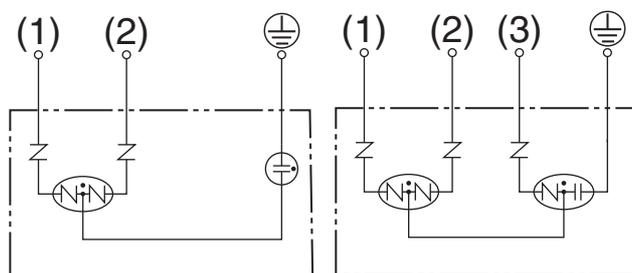
## Noise Filter for the Brake Power Supply

⬩ 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 | Driver output and power cable |
| 3G3AX-ZCL2 [2] | OMRON | Driver output and power cable |
| ESD-R-47B [3] | NEC TOKIN | Driver output and power cable |
| ZCAT3035-1330 [4] | TDK | Encoder cable and I/O cable |

[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 driver 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.

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**System Design**

**External Dimensions**

3G3AX-ZCL1

3G3AX-ZCL2

ESD-R-47B

ZCAT3035-1330

**4**

**System Design**
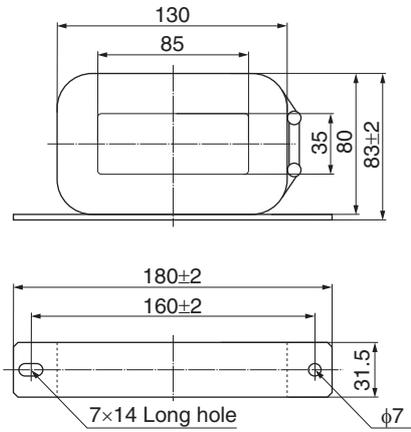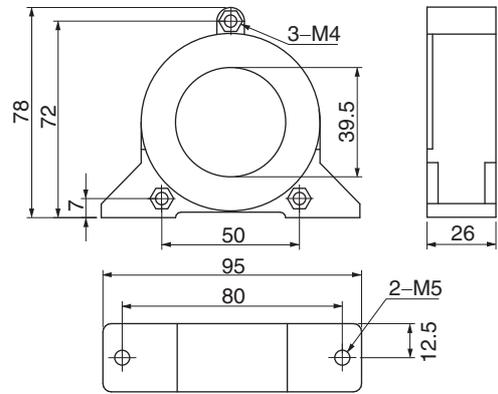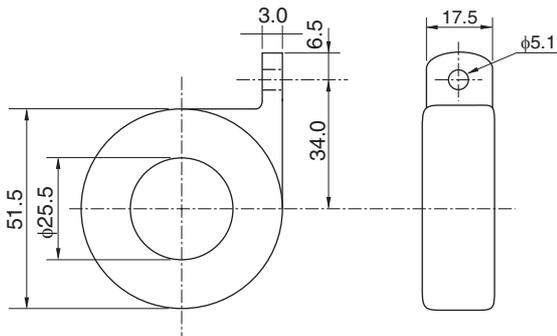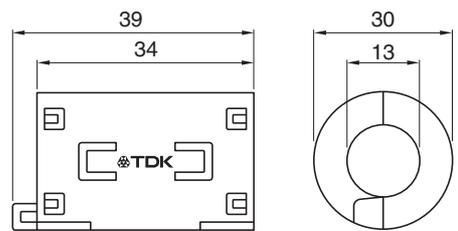
## Impedance Characteristics

3G3AX-ZCL1



3G3AX-ZCL2



ESD-R-47B



ZCAT3035-1330

**4**

**System Design**
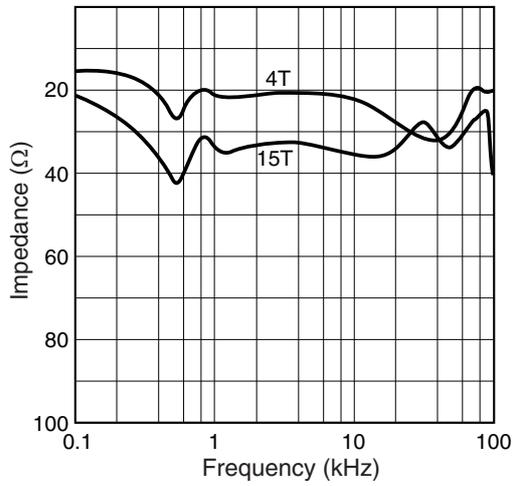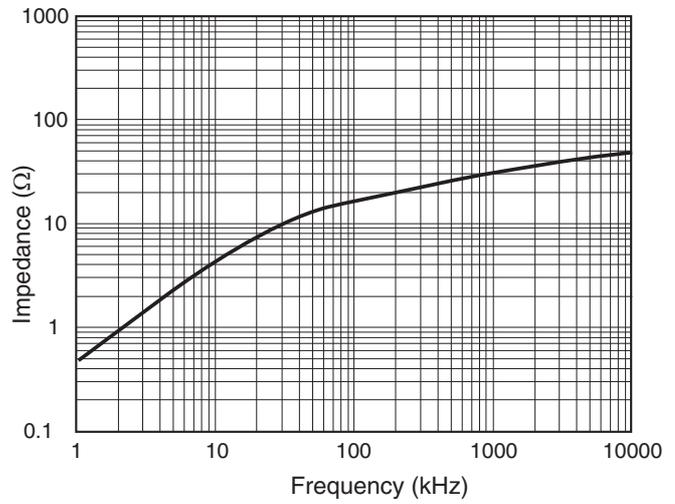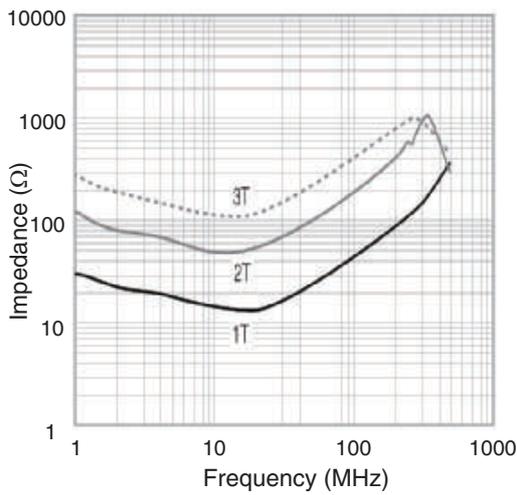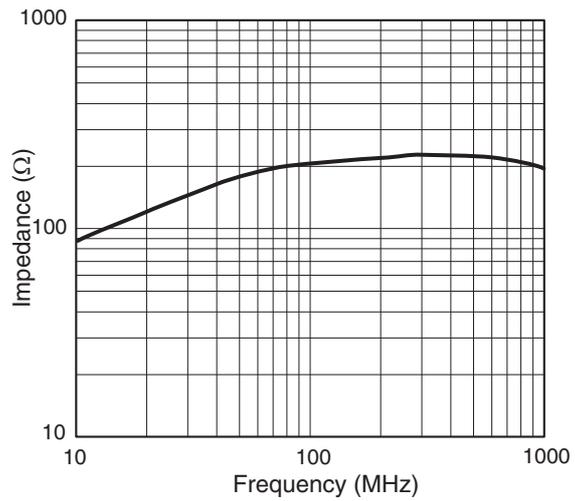
## Surge Suppressor

⬩ 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 when the reset time is not an issue, such as relays.<br>At power shutoff the surge voltage is the lowest, but the rest time takes longer.<br>Used for 24/48-VDC systems. | Use a fast-recovery diode with a short reverse recovery time<br>(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 an issue.<br>The surge voltage at power shutoff is approx. 1.5 times the varistor voltage. | Select the varistor voltage as follows.<br>For 24-VDC systems, varistor voltage 39 V For 100-VDC systems, varistor voltage 200 V For 100-VAC systems, varistor voltage 270 V For 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.<br>The reset time can be shortened by selecting the appropriate capacitance and resistance. | Okaya Electric Industries Co., Ltd.<br>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 driver 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.
⬩ The following table shows the recommended contactors.

| Manufacturer | Model | Rated current | Coil voltage |
|---|---|---|---|
| OMRON | J7L-09-22200 | 11 A | 200 VAC |
| | J7L-12-22200 | 13 A | 200 VAC |
| | J7L-18-22200 | 18 A | 200 VAC |
| | J7L-32-22200 | 26 A | 200 VAC |
| | J7L-40-22200 | 35 A | 200 VAC |
| | J7L-50-22200 | 50 A | 200 VAC |
| | J7L-65-22200 | 65 A | 200 VAC |
| | J7L-75-22200 | 75 A | 200 VAC |

## 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.
⬥ If cables are joined midway, be sure to use connectors. And do not remove more than 50 mm of the cable insulation. In addition, always use shielded cables.
⬥ Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and cause malfunctions. Always use cables fully extended.
⬥ When installing noise filters for encoder cables, use clamp filters.
⬥ The following table shows the recommended clamp filters.

| Manufacturer | Product name | Model | Specifications |
|---|---|---|---|
| NEC TOKIN | Clamp filters | ESD-SR-250 | For cable dia. up to 13 mm |
| TDK | Clamp filters | 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
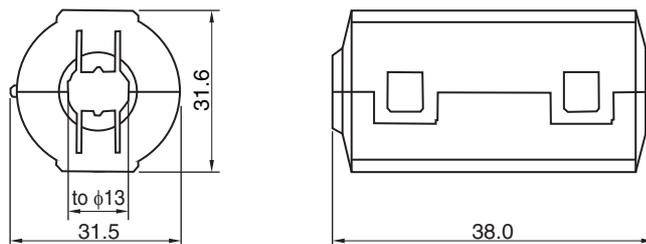
### Impedance Characteristics

ESD-SR-250
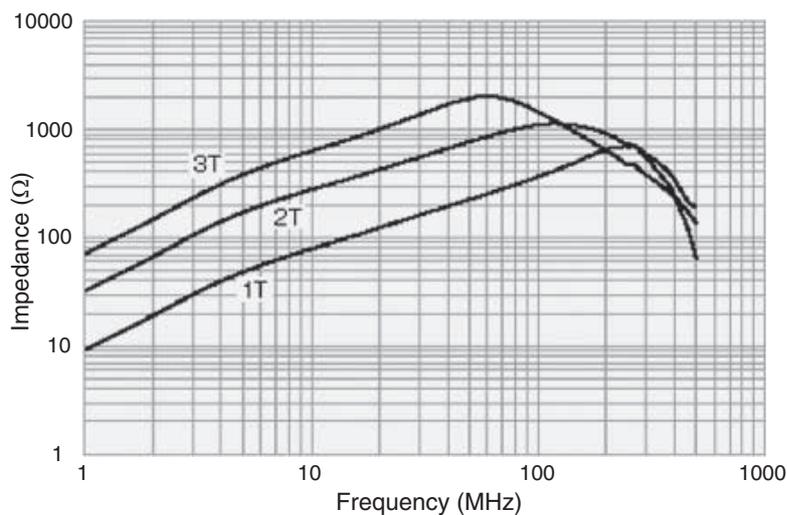
## Improving Control I/O Signal Noise Resistance

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-$\mu$F laminated ceramic capacitors between the control power supply and ground at the driver input section or the controller output section.
- For open collector specifications, keep the length of wires to within 2 m.

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## Reactor to Reduce Harmonic Current

### Harmonic Current Measures

- The Reactor is used for suppressing 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.

| Driver model | Reactor | | |
| --- | --- | --- | --- |
| | Model | Rated current | Inductance |
| R88D-KTA5L<br>R88D-KT01H | 3G3AX-DL2002 | 1.6 A | 21.4 mH |
| R88D-KT01L<br>R88D-KT02H | 3G3AX-DL2004 | 3.2 A | 10.7 mH |
| R88D-KT02L<br>R88D-KT04H | 3G3AX-DL2007 | 6.1 A | 6.75 mH |
| R88D-KT04L<br>R88D-KT08H<br>R88D-KT10H | 3G3AX-DL2015 | 9.3 A | 3.51 mH |
| R88D-KT15H | 3G3AX-DL2022 | 13.8 A | 2.51 mH |
| R88D-KT08H<br>R88D-KT10H<br>R88D-KT15H | 3G3AX-AL2025 | 10.0 A | 2.8 mH |
| R88D-KT20H<br>R88D-KT30H | 3G3AX-AL2055 | 20.0 A | 0.88 mH |
| R88D-KT50H | 3G3AX-AL2110 | 34.0 A | 0.35 mH |
| R88D-KT75H<br>R88D-KT150H | 3G3AX-AL2220 | 67.0 A | 0.18 mH |
| R88D-KT06F<br>R88D-KT10F<br>R88D-KT15F | 3G3AX-AL4025 | 5.0 A | 7.7 mH |
| R88D-KT20F<br>R88D-KT30F | 3G3AX-AL4055 | 10.0 A | 3.5 mH |
| R88D-KT50F | 3G3AX-AL4110 | 17.0 A | 1.3 mH |
| R88D-KT75F<br>R88D-KT150F | 3G3AX-AL4220 | 34.0 A | 0.74 mH |

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**System Design**

# 4-4 Regenerative Energy Absorption

The Servo Drives have internal regeneration process circuitry, which absorbs the regenerative energy produced during motor deceleration and prevents the DC voltage from increasing. An overvoltage error occurs, however, if the amount of regenerative energy from the motor is too large. If this occurs, remedies must be taken to reduce the regenerative energy by changing operating patterns, or to increase the regeneration process capacity by connecting an External Regeneration Unit.

## Calculating the Regenerative Energy

### Horizontal Axis
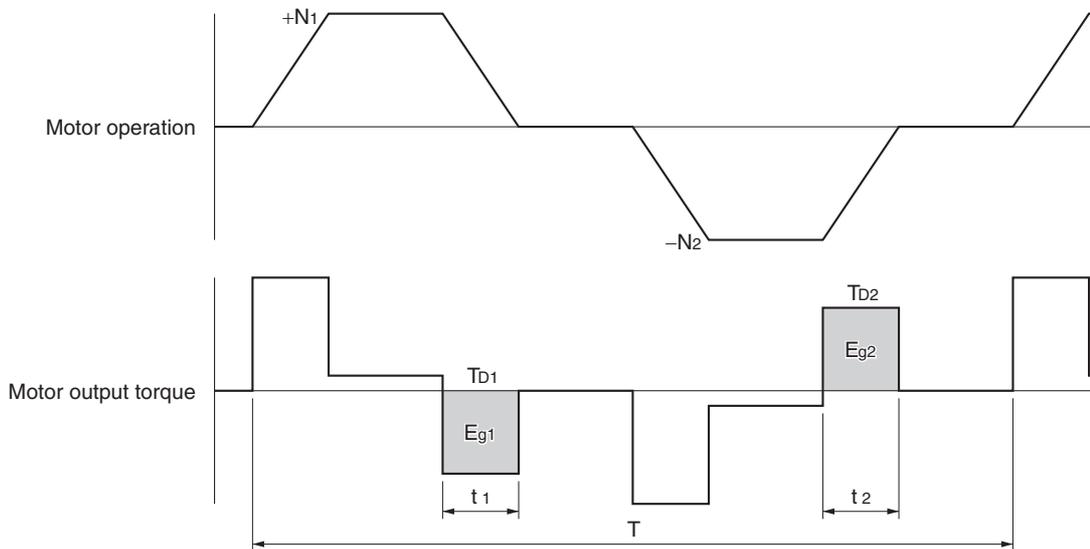


- In the output torque graph, acceleration in the forward direction is shown as positive, and acceleration in the reverse direction is shown as negative.
- The regenerative energy values in each region can be derived from the following equations.

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

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

$N_1$, $N_2$ : 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 driver models with internal capacitors used for absorbing regenerative energy (i.e., models of 400 W or less), the values for both $Eg_1$ or $Eg_2$ (unit: J) must be lower than the driver's regeneration absorption capacity. (The capacity depends on the model. For details, refer to the next section.)
- For driver models with an Internal Regeneration Resistor used for absorbing regenerative energy (i.e., 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 driver'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]

## Vertical Axis
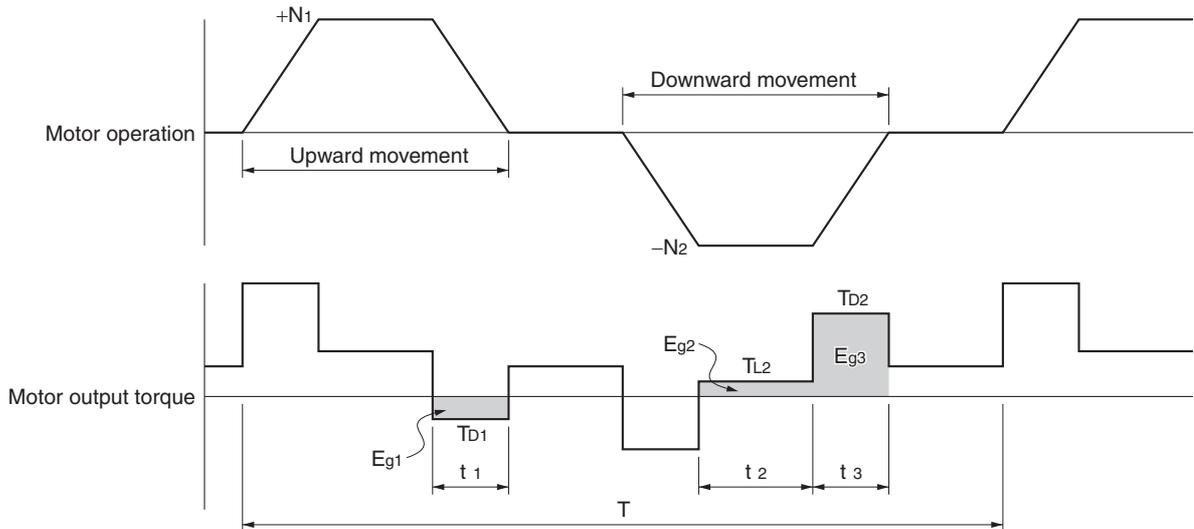


• In the output torque graph, acceleration in the forward direction (rising) is shown as positive, and acceleration in the reverse direction (falling) is shown as negative.

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

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

$$\cdot\ E_{g2} = \frac{2\pi}{60} \cdot N_2 \cdot T_{L2} \cdot t_2 \qquad [J]$$

$$\cdot\ E_{g3} = \frac{1}{2} \cdot \frac{2\pi}{60} \cdot N_2 \cdot T_{D2} \cdot t_3 \qquad [J]$$

$N_1$, $N_2$   : 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.

• For driver models with internal capacitors used for absorbing regenerative energy (i.e., models of 400 W or less), the values for both $Eg_1$ or $Eg_2 + Eg_3$ (unit: J) must be lower than the driver's regeneration absorption capacity. (The capacity depends on the model. For details, refer to the next section.)

• For driver models with an Internal Regeneration Resistor used for absorbing regenerative energy (i.e., 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 driver'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].

$$P_r = (E_{g1} + E_{g2} + E_{g3}) / T \ [W]$$

T: Operation cycle [s]

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**System Design**

## Driver Regeneration Absorption Capacity

### Amount of Internal Regeneration Absorption in Drivers

This driver absorbs regenerative energy internally with built-in capacitors.

If the regenerative energy is too large to be processed internally, an overvoltage error occurs and operation cannot continue.

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

⬩ Connect an External Regeneration Unit. (Regeneration process capacity improves.)

⬩ Reduce the operating 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 model | Regenerative energy (J) that can be absorbed by internal capacitor | Internal regeneration resistance | Minimum value of regeneration resistance ($\Omega$) |
|---|---|---|---|
| | | Average amount of regeneration that can be absorbed (W) | |
| R88D-KTA5L | 16 | – | 17 |
| R88D-KT01L | 16 | – | 17 |
| R88D-KT02L | 22 | – | 17 |
| R88D-KT04L | 32 | 17 | 13 |
| R88D-KT01H | 25 | – | 34 |
| R88D-KT02H | 25 | – | 34 |
| R88D-KT04H | 36 | – | 34 |
| R88D-KT08H | 62 | 12 | 25 |
| R88D-KT10H | 99 | 18 | 25 |
| R88D-KT15H | 99 | 18 | 25 |
| R88D-KT20H | 99 | 72 | 10 |
| R88D-KT30H | 150 | 60 | 7 |
| R88D-KT50H | 150 | 60 | 5 |
| R88D-KT75H | 282 | – | 4 |
| R88D-KT150H | 254 | – | 4 |
| R88D-KT06F | 128 | 21 | 100 |
| R88D-KT10F | 128 | 21 | 100 |
| R88D-KT15F | 128 | 21 | 100 |
| R88D-KT20F | 128 | 29 | 40 |
| R88D-KT30F | 285 | 60 | 40 |
| R88D-KT50F | 285 | 60 | 29 |
| R88D-KT75F | 273 | – | 14 |
| R88D-KT150F | 492 | – | 14 |

## Regenerative Energy Absorption with an External Regeneration Resistor

If the regenerative energy exceeds the regeneration absorption capacity of the driver, connect an External Regeneration Resistor.

Connect the External Regeneration Resistor between B1 and B2 terminals on the driver.

Double-check the terminal names when connecting the resistor because the driver 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 250 × 250, Thickness: 3.0 | Operating temperature 150°C ± 5% NC contact Rated output: 30 VDC, − 50 mA max. |
| R88A-RR080100S | 100 Ω | 80 W | 20 W | Aluminum 250 × 250, Thickness: 3.0 | Operating temperature 150°C ± 5% NC contact Rated output: 30 VDC, − 50 mA max. |
| R88A-RR22047S | 47 Ω | 220 W | 70 W | Aluminum 350 × 350, Thickness: 3.0 | Operating temperature: 170 ± 7°C NC contact Rated output: 250 VAC, 0.2 A max. |
| R88A-RR50020S | 20 Ω | 500 W | 180 W | Aluminum 600 × 600, Thickness: 3.0 | Operating temperature 200 ± 7°C NC contact Rated output: 250 VAC, 0.2 A max. 24 VDC, 0.2 A max. |

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**System Design**

## Connecting an External Regeneration Resistor

### R88D-KTA5L/-KT01L/-KT02L/-KT01H/-KT02H/-KT04H

Normally B2 and B3 are open.
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.

### R88D-KT04L/-KT08H/-KT10H/-KT15H/-KT20H/-KT30H/-KT50H/-KT06F/ -KT10F/-KT15F/-KT20F/-KT30F/-KT50F

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.

### R88D-KT75H/-KT150H/-KT75F/-KT150F

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.

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**System Design**

**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-RR22047S | R88A-RR22047S |
| 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-RR22047S | R88A-RR22047S | R88A-RR22047S |
| 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 |  |  |  |
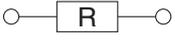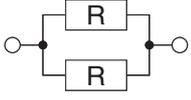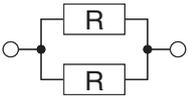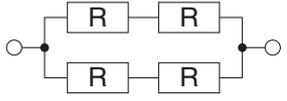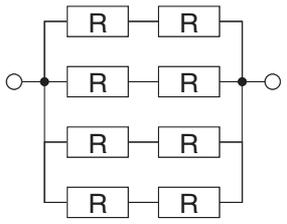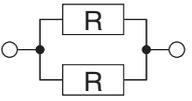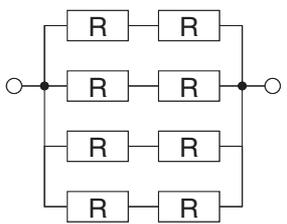
*1. Select a combination that has an absorption capacity greater than the average regeneration power (Pr).

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

Safty Points

⬧ 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 type of cover that enables heat dissipation.

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**System Design**

# 5

# BASIC CONTROL Mode

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

**5**

# 5-1 Position Control

## Outline of Operation

⬩ Position control is performed based on the pulse train input received from the controller.
⬩ The motor rotates using the value of the pulse train input multiplied by the Electronic Gear (Pn008 to Pn010).

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**BASIC CONTROL Mode**

Controller
(pulse train output type)

Position Control Unit
CJ1W-NC113/133
CJ1W-NC213/233
CJ1W-NC214/414
CJ1W-NC234/434
CJ1W-NC413/433
CS1W-NC113/133
CS1W-NC213/233
CS1W-NC413/433
CPU Unit with built-in pulse I/O
CJ1M-CPU21/22/23
CP1H-X/XA/Y
CP1L-M/L

Pulse train

Driver
Accurax G5

POSITION CONTROL mode

44 +CWLD
45 −CWLD
46 +CCWLD
47 −CCWLD
3 +CW
4 −CW
5 +CCW
6 −CCW

Electronic Gear
(Pn008 to Pn010)

Numerator
Denominator

Motor
Accurax G5

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn000 | Reference direction | Select the relation between the reference command and the rotation direction in the motor. | P.8-2 |
| Pn001 | CONTROL mode Selection | Select the CONTROL mode. | P.8-2 |
| Pn005 | Command Pulse Input Selection | Select the command pulse input terminal. | P.8-4 |
| Pn006 | Command Pulse Rotation Direction Switching Selection | Set the count direction for the command pulse input. | P.8-4 |
| Pn007 | COMMAND PULSE mode Selection | Set the count method for the command pulse input. | P.8-4 |
| Pn008 | COMMAND PULSE resolution | Define the number of command pulses per motor revolution. If this is zero, Pn009 and Pn010 become active. | P.8-6 |
| Pn009 | Electronic Gear Ratio Numerator 1 | Set the numerator of the electronic gear ratio for the command pulse input. | P.8-6 |
| Pn010 | Electronic Gear Ratio Denominator | Set the denominator of the electronic gear ratio for the command pulse input. | P.8-6 |

### CONTROL Mode Selection (Pn001)

Select the position control (Set values: 0=Position control, 3=Switch between position control and speed control or 4=Switch between position control and torque control).

### Command Pulse Input Process (Pn005, Pn006, Pn007)

Position command input terminals are classified into the input 1 system (+CW, -CW, +CCW, -CCW) and input 2 system (+CWLD, -CWLD, +CCWLD, -CCWLD).
 If the position command output is a line-driver output, set input 1. If it is an open collector output, set input 2. Although input 2 can also be used for a line-driver output, the allowable maximum input frequency will become lower than when input 1 is selected.

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BASIC CONTROL Mode

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn005 | Command Pulse Input Selection | Select the command pulse input terminal.<br>0: Photocoupler input (+CW, -CW, +CCW, -CCW)<br>1: Input for line driver only (+CWLD, -CWLD, +CCWLD, -CCWLD) | 0 to 1 | – |
| Pn006 | Command Pulse Rotation Direction Switching Selection | Set the count direction for the command pulse input.<br>0: Command pulse, forward direction<br>1: Command pulse, reverse direction | 0 to 1 | – |
| Pn007 | COMMAND PULSE mode Selection | Set the count method for the command pulse input.<br>0: 90 phase difference (A/B) signal input)<br>1: Forward/reverse pulse<br>2: 90 phase difference (A/B) signal input)<br>3: Feed pulse/direction signal | 0 to 3 | – |

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**BASIC CONTROL Mode**

The settings for command pulse rotation direction and COMMAND PULSE mode are as follows.

| Pn006 | Pn007 | Command pulse pattern | Signal name | Forward direction command | Reverse direction command |
|---|---|---|---|---|---|
| 0 | 0 or 2 | 90° phase difference, 2-phase pulse (phase A + phase B) | CW / CCW | Phase B is 90° ahead of phase A. | Phase B is 90° behind phase A. |
| | 1 | Forward direction pulse train + Reverse direction pulse train | CW / CCW | | |
| | 3 | Pulse train + Sign | CW / CCW | | |
| 1 | 0 or 2 | 90° phase difference, 2-phase pulse (phase A + phase B) | CW / CCW | Phase B is 90° behind phase A. | Phase B is 90° ahead of phase A. |
| | 1 | Forward direction pulse train + Reverse direction pulse train | CW / CCW | | |
| | 3 | Pulse train + Sign | CW / CCW | | |

| Symbol | | Allowable input maximum frequency | Minimum required duration [µs] | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | t1 | t2 | t3 | t4 | t5 | t6 |
| +CWLD, -CWLD, +CCWLD, -CCWLD | | 4 Mpps | 0.25 | 0.125 | 0.125 | 0.125 | 0.125 | 0.125 |
| +CW, -CW, +CCW, -CCW | Line driver | 500 kpps | 2 | 1 | 1 | 1 | 1 | 1 |
| | Open collector | 200 kpps | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |

### Electronic Gear Function (Pn008, Pn009, Pn010)

This function allows to adjust the units of the command pulses by setting a ratio between the encoder pulses and the command pulses.

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn008 | Electronic Gear Integer Setting | Set the number of command pulses corresponding to 1 motor rotation. | 0 to $2^{20}$ | Pulse |
| Pn009 | Electronic Gear Ratio Numerator 1 | 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 "6-4 Electronic Gear Function"(P.6-12).

## Related Functions

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn011 | Encoder Dividing Numerator | Set the pulse output resolution using the numbers of output pulses per rotation for OA and OB, respectively. | P.8-7 |
| Pn012 | Encoder Output Direction Switching Selection | Set the phase-B logic and output source for pulse output. | P.8-7 |
| Pn222 | Position Command Filter Time Constant | Set the time constant of the first-order lag filter for the position command. | P.8-24 |
| Pn223 | Smoothing Filter Time Constant | Set the time constant of the FIR filter for the position command. | P.8-25 |
| Pn431 | Positioning Completion Range 1 | Set the threshold of position error for output of the positioning completion signal. | P.8-41 |
| Pn432 | Positioning Completion Condition Selection | Select the condition under which the positioning completion signal is output. | P.8-42 |
| Pn433 | Positioning Completion Hold Time | Set the INP signal output time. | P.8-41 |
| Pn503 | Encoder Dividing Denominator | You can set a dividing ratio by using Encoder Dividing Numerator (Pn011) as the dividing numerator and Encoder Dividing Denominator (Pn503) as the dividing denominator. | P.8-46 |
| Pn517 | Error Counter Reset Condition Selection | Set the reset condition under which the error counter reset input signal. | P.8-53 |
| Pn518 | Command Pulse Prohibition Input Setting | Set whether to enable or disable the command pulse prohibition input. | P.8-53 |

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**BASIC CONTROL Mode**

## Parameter Block Diagram for POSITION CONTROL mode



**Gain switching**
Pn114 : Setting 2
Pn115 : Mode
Pn116 : Delay Time
Pn117 : Level
Pn118 : Hysteresis
Pn119 : Switching Time
Pn605 : Setting 3
Pn606 : Ratio

**Notch filter**
Pn200 : ADAPTIVE mode Setting
Pn201 : Frequency 1
Pn204 : Frequency 2
Pn207 : Frequency 3
Pn210 : Frequency 4
Pn202 : Notch 1 Width
Pn205 : Notch 2 Width
Pn208 : Notch 3 Width
Pn211 : Notch 4 Width
Pn203 : Notch 1 Depth
Pn206 : Notch 2 Depth
Pn209 : Notch 3 Depth
Pn212 : Notch 4 Depth

**Torque filter**
Pn104 : Torque Filter 1
Pn109 : Torque Filter 2

**Torque limit**
Pn521 : Torque Limit Selection
Pn013 : No. 1 Torque Limit
Pn522 : No. 2 Torque Limit

Torque command

**Friction compensation**
Pn607 : Added Value
Pn608 : Forward Direction
Pn609 : Reverse Direction

**Disturbance observer**
Pn623 : Gain
Pn624 : Filter

**Current control**
Pn611 : Response Setting

Main power supply

Internal position command speed

**Smoothing filter**
Pn222 : FIR
Pn223 : First-order Lag

Position command speed

**Torque feed forward**
Pn112 : Gain
Pn113 : Filter

**Speed control**
Pn101 : Speed Gain 1
Pn102 : Integration Time 1
Pn106 : Speed Gain 2
Pn107 : Integration Time 2
Pn004 : Inertia Ratio
Pn612 : Switching Selection
Pn613 : Inertia Ratio 2

**Speed detection filter**
Pn103 : Filter 1
Pn108 : Filter 2
Pn610 : Instantaneous Speed

Speed detection

Motor

Encoder

**Electronic gear setting**
Pn008 : 1 Rotation
Pn009 : Numerator
Pn010 : Denominator
Pn500 : Numerator 2
Pn501 : Numerator 3
Pn502 : Numerator 4

Command position error

Command pulse accumulation

Speed control command

Motor speed

**Speed feed-forward**
Pn110 : Gain
Pn111 : Filter

**Position control**
Pn100 : Loop Gain 1
Pn105 : Loop Gain 2

Encoder position error

Feedback pulse accumulation

**Input condition setting**
Pn005 : Input Setting
Pn006 : Rotation Direction
Pn007 : Mode

**Anti-vibration control**
Pn213 : Switching Selection 1
Pn214 : Frequency 1
Pn215 : Frequency 2
Pn216 : Frequency 3
Pn217 : Frequency 4
Pn218 : Filter 1
Pn219 : Filter 2
Pn220 : Filter 3
Pn221 : Filter 4

Electronic gear reverse conversion

Pulse train

**Pulse regeneration**
Pn011 : 1 Rotation
Pn012 : Reverse Numerator/Denominator
Pn503 : Denominator

Encoder pulse output
OA
OB
OZ

**5**

**BASIC CONTROL Mode**

# 5-2  Speed Control

## Outline of Operation

⋄ Motor speed control is performed based on the analog voltage input from the controller.
You can also perform position control by combining with a controller that has a position control function.

⋄ You can change the relation between the speed command and the rotation speed by setting the Speed Command Scale (Pn302).



## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn000 | Reference direction | Select the relation between the reference command and the rotation direction in the motor. | P.8-2 |
| Pn001 | CONTROL mode Selection | Select the CONTROL mode. | P.8-2 |
| Pn300 | Command Speed Selection | Select the speed command input method. | P.8-26 |
| Pn301 | Speed Command Direction Selection | Set the method for designating the forward or reverse direction for the speed command. | P.8-26 |
| Pn302 | Speed Command Scale | Set the input gain for the analog speed command input. | P.8-27 |
| Pn303 | Analog Speed Command Rotation Direction Switching | Inverts the polarity of the analogue speed command. | P.8-27 |
| 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.8-28 |
| 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.8-29 |
| 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.8-29 |

## CONTROL mode Selection (Pn001)

Select the speed control (Set values: 1=Speed control, 3=Switching between position and speed control or 5=Switching between speed control and torque control).

## Analog Speed Command Input Process (Pn300, Pn301, Pn302, Pn303)

Convert the voltage input by an analog input to a speed command to control the motor.

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn300 | Command Speed Selection | Select the speed command input method.<br>0: Analog torque command<br>1: No. 1 to 4 internally set speed<br>2: No. 1 to 3 internally set speed, analog torque command<br>3: No. 1 to 8 internally set speed | 0 to 3 | – |
| Pn301 | Speed Command Direction Selection | Select the method for designating the direction for the speed command.<br>0: By analogue command polarity<br>1: By digital input (VSIGN) | 0 to 1 | – |
| Pn302 | Speed Command Scale | Set the input gain for the analog speed command input. | 0 to 2000 | (r/min)/V |
| Pn303 | Analog Speed Command Rotation Direction Switching | Set to reverse the polarity of the speed command input.<br>0: The +command indicates the forward direction as viewed from the shaft end (CW).<br>1: The +command indicates the reverse direction as viewed from the shaft end (CCW). | 0 to 1 | – |

The conversion of analog speed command is explained below.

| Command Speed Selection (Pn300) | Speed Command Direction Selection (Pn301) | Analog Speed Command Rotation Direction Switching (Pn303) | Analog speed command (REF) | Speed command sign selection (VSIGN) | Motor rotation direction | Conversion graph |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | +Voltage (0 to 10 V) | Not affected | Forward direction | Figure A |
| | | | -Voltage (-10 to 0 V) | Not affected | Reverse direction | |
| | | 1 | +Voltage (0 to 10 V) | Not affected | Reverse direction | Figure B |
| | | | -Voltage (-10 to 0 V) | Not affected | Forward direction | |
| | 1 | Not affected | +Voltage (0 to 10 V) | OFF | Forward direction | Figure C |
| | | Not affected | -Voltage (-10 to 0 V) | | | |
| | | Not affected | +Voltage (0 to 10 V) | ON | Reverse direction | |
| | | Not affected | -Voltage (-10 to 0 V) | | | |

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BASIC CONTROL Mode

Example) When Speed Command Scale (Pn302) = 500

Speed command value = Speed Command Scale (Pn302) × input voltage
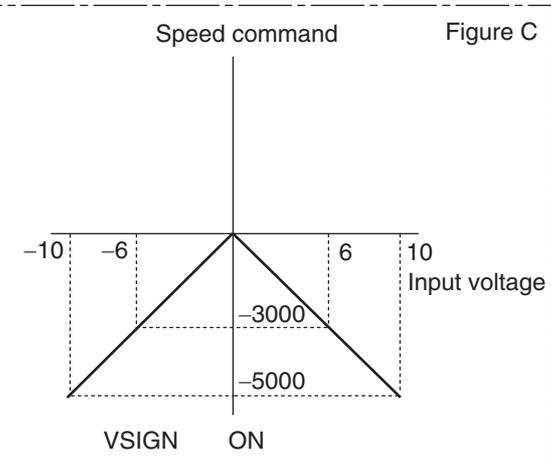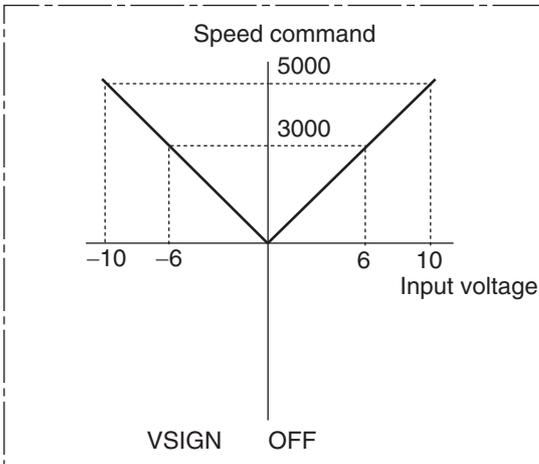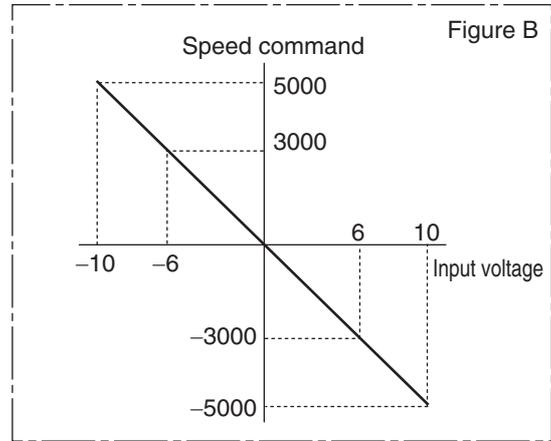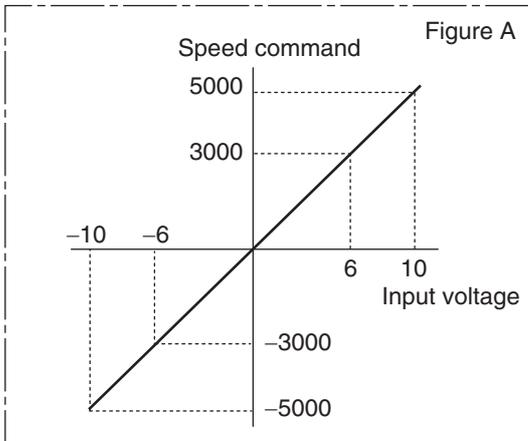
## Speed Command Acceleration/Deceleration Setting Function (Pn312, Pn313, Pn314)

With a step speed command, you can change the speed command based on this setting to reduce the shock caused by change in acceleration.

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn312 | Soft Start Acceleration Time | Set the acceleration time for acceleration process with respect to the speed command input. | 0 to 10000 | ms/(1,000 r/min) |
| Pn313 | Soft Start Deceleration Time | Set the deceleration processing deceleration time for speed command inputs. | 0 to 10000 | ms/(1,000 r/min) |
| Pn314 | S-curve Acceleration/ Deceleration Time Setting | Set the S-curve acceleration/ deceleration time. | 0 to 1000 | ms |

### Soft Start Acceleration Time (Pn312), Soft Start Deceleration Time (Pn313)

If a step speed command is input, set in Soft Start Acceleration Time (Pn312) the time needed for the speed command to reach 1,000 r/min. Also set in Soft Start Deceleration Time (Pn313) the time needed for the speed command to reach 0 r/min from 1,000 r/min.

Soft start acceleration time [ms] = Vc/1,000 × Pn312 × 1 ms
Soft start deceleration time [ms] = Vc/1,000 × Pn313 × 1 ms
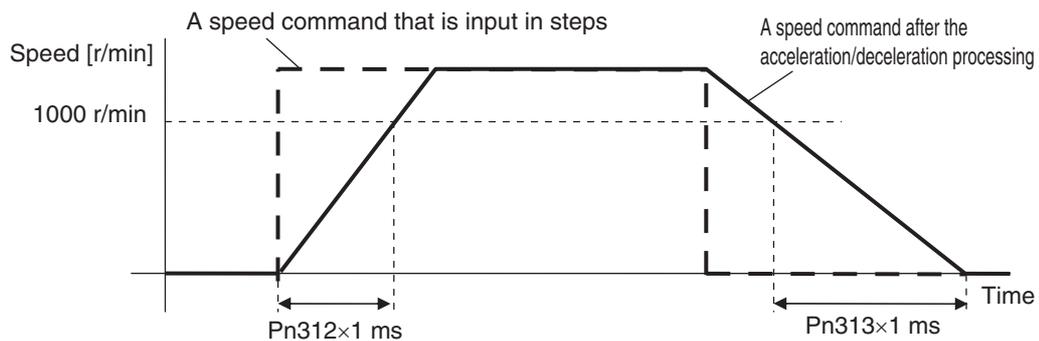


### S-curve Acceleration/Deceleration Time Setting (Pn314)

Set the S-curve time in the time width centered on the inflection points in acceleration/deceleration relative to the acceleration or deceleration time set in Soft Start Acceleration Time (Pn312) or Soft Start Deceleration Time (Pn313).

ta = Vc/1,000 × Pn312 × 1 ms
td = Vc/1,000 × Pn313 × 1 ms
ts = Pn314 × 1 ms

Set an appropriate time so that ta > ts and td > ts are satisfied.

## Related Functions

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn315 | Zero Speed Designation Selection | Set the zero speed designation. | P.8-29 |
| Pn316 | Speed Lock Level Setting | Set the threshold for transition to the servo lock state under position control. | P.8-31 |
| 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.<br>This setting has a hysteresis of 10 r/min for detection. | P.8-43 |
| Pn436 | Rotation Speed for Motor Rotation Detection | Set the detection threshold for speed reached output. A speed reached output is output when the motor speed exceeds the set value.<br>This setting has a hysteresis of 10 r/min for detection. | P.8-43 |
| Pn422 | Analog Input 1 Offset | Set the analog input 1 offset. | P.8-39 |
| Pn423 | Analog Input 1 Filter Time Constant | Set the filter for analog input 1. | P.8-40 |

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**BASIC CONTROL Mode**

## Parameter Block Diagram for SPEED CONTROL mode



**Gain switching**
Pn114 : Setting 2
Pn120 : Mode
Pn121 : Delay Time
Pn122 : Level
Pn123 : Hysteresis

**Notch filter**
Pn200 : ADAPTIVE mode Setting
Pn201 : Frequency 1
Pn204 : Frequency 2
Pn207 : Frequency 3
Pn210 : Frequency 4
Pn202 : Notch 1 Width
Pn205 : Notch 2 Width
Pn208 : Notch 3 Width
Pn211 : Notch 4 Width
Pn203 : Notch 1 Depth
Pn206 : Notch 2 Depth
Pn209 : Notch 3 Depth
Pn212 : Notch 4 Depth

**Torque filter**
Pn104 : Torque Filter 1
Pn109 : Torque Filter 2

**Torque limit**
Pn521 : Torque Limit Selection
Pn013 : No. 1 Torque Limit
Pn522 : No. 2 Torque Limit

Torque command

**Friction compensation**
Pn607 : Added Value
Pn608 : Forward Direction
Pn609 : Reverse Direction

**Disturbance observer**
Pn623 : Gain
Pn624 : Filter

**Torque feed forward**
Pn112 : Gain
Pn113 : Filter

**Speed control**
Pn101 : Speed Gain 1
Pn102 : Integration Time Constant 1
Pn106 : Speed Gain 2
Pn107 : Integration Time Constant 2
Pn004 : Inertia Ratio
Pn612 : Switching Selection
Pn613 : Inertia Ratio 2

**Speed detection filter**
Pn103 : Filter 1
Pn108 : Filter 2
Pn610 : Instantaneous Speed

**Current control**
Pn611 : Response Setting

Main power supply

Speed detection

Motor

Encoder

Speed control command

Motor speed

**Scaling**
Pn302 : Gain
Pn303 : Reverse

AI1 input voltage

**Acceleration/deceleration**
Pn312 : Acceleration time
Pn313 : Deceleration time
Pn314 : S-curve time

Feedback pulse accumulation

Analog input 16-bit A/D

**Analog input compensation**
Pn422 : Offset
Pn423 : Filter

**Speed command selection**
Pn300 : Command type
Pn301 : Direction source

**Internally set speed**
Pn201 : Speed 1
Pn202 : Speed 2
Pn204 : Speed 3
Pn205 : Speed 4
Pn207 : Speed 5
Pn208 : Speed 6
Pn210 : Speed 7
Pn211 : Speed 8

Encoder pulse output
OA
OB
OZ

**Pulse regeneration**
Pn011 : 1 Rotation
Pn012 : Reverse
Numerator/Denominator
Pn503 : Denominator

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**BASIC CONTROL Mode**

# 5-3 Torque Control

Torque control is performed based on the torque command specified by the analog voltage. In addition to the torque command, torque control also requires a speed limit input to prevent the motor rotation speed from becoming excessively high.

## Outline of Operation



Controller (analog voltage output type) — Analog voltage (torque command) — Driver Accurax G5

TORQUE CONTROL mode

Torque Command Scale (Pn319)

*None of OMRON controllers is a torque command voltage output type.

14 TREF1 /VLIM
15 AGND
16 TREF2
17 AGND

Torque

V

Motor Accurax G5
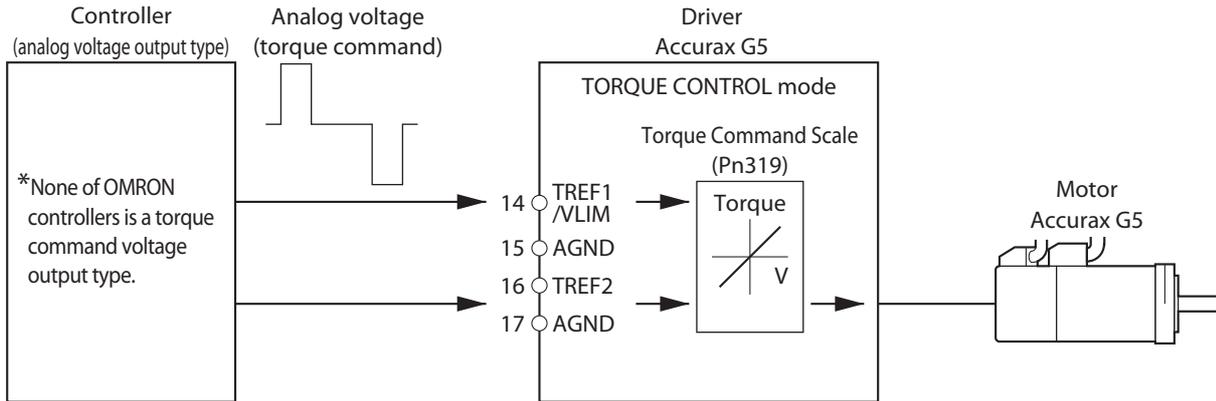
☑ Precautions for Correct Use

♦ If the motor speed is limited by the speed limit, the motor speed will be limited and will not reach the speed corresponding to the analog torque command.

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn001 | CONTROL mode Selection | Select the CONTROL mode. | P.8-2 |
| Pn317 | Torque Command/Speed Limit Selection | Select the input location for the torque command and speed limit. | P.8-31 |
| Pn318 | Torque Command Direction Selection | Select the rotation direction of the torque command. | P.8-31 |
| Pn319 | Torque Command Scale | Set the input gain for analog torque command input. | P.8-32 |
| Pn320 | Analog Torque Command Rotation Direction Switching | Reverse the polarity of the torque command input. | P.8-33 |

## CONTROL mode Selection (Pn001)

Select the torque control (Set values: 2=Torque control, 4=Switching between Position control and Torque control or 5=Switching between Speed control and torquecontrol).

## Analog Torque Command Input Process (Pn317, Pn318, Pn319, Pn320)

Convert the voltage input by an analog input to a torque command to control the motor.

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn317 | Torque Command/Speed Limit Selection | Select the input location for the torque command and speed limit value.<br>0: Torque command: Analog input 1 speed limit: Pn321<br>1: Torque command: Analog input 2 speed limit: Analog input 1<br>2: Torque command: Analog input 1 speed limit: Pn321, Pn322 | 0 to 2 | – |
| Pn318 | Torque Command Direction Selection | Select the method for selecting the direction for the torque command.<br>0: The direction depends on the polarity of the analogue torque command).<br>1: The direction depends on the state of a digital input (TSIGN). | 0 to 1 | – |
| Pn319 | Torque Command Scale | Set the input gain for analog torque command input. | 10 to 100 | 0.1 V/100% |
| Pn320 | Analog Torque Command Rotation Direction Switching | Reverse the polarity of the torque command input.<br>0: Forward operation<br>1: Reverse operation | 0 to 1 | – |

The conversion of analog torque command is explained below.

| Torque Command/Speed Limit Selection (Pn317) | Torque Command Direction Selection (Pn318) | Analog Torque Command Rotation Direction Switching (Pn320) | Analog torque command (TREF) | Torque command sign input (TSIGN) | Motor rotation direction | Conversion graph |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | +Voltage (0 to 10 V) | Not affected | Forward direction | Figure A |
| | | | -Voltage (-10 to 0 V) | Not affected | Reverse direction | |
| | | 1 | +Voltage (0 to 10 V) | Not affected | Reverse direction | Figure B |
| | | | -Voltage (-10 to 0 V) | Not affected | Forward direction | |
| | 1 | Not affected | +Voltage (0 to 10 V) | OFF | Forward direction | Figure C |
| | | Not affected | -Voltage (-10 to 0 V) | | | |
| | | Not affected | +Voltage (0 to 10 V) | ON | Reverse direction | |
| | | Not affected | -Voltage (-10 to 0 V) | | | |

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BASIC CONTROL Mode

Example) When the torque command scale is 30

Torque command = 100 × Input voltage / (Torque Command Scale (Pn302) × 0.1)

Figure A

Torque command

333

200

−10   −6        6    10
                Input voltage

−200

Figure B

Torque command

333

200

−10   −6        6    10
                Input voltage

−200

Torque command

333

200

−10   −6        6    10
                Input voltage

TSIGN OFF

Torque command          Figure C

−10   −6        6    10
                Input voltage

−200

−333

TSIGN ON

## Related Functions

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn315 | Zero Speed Designation Selection | Set the zero speed designation function. | P.8-29 |
| 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.8-33 |
| Pn322 | Reverse Direction Speed Limit Value Setting | Set this if you want to change the speed limit value depending on whether the direction is forward or reverse. | P.8-33 |
| Pn422 | Analog Input 1 Offset | Set the offset for analog input 1. | P.8-39 |
| Pn423 | Analog Input 1 Filter Time Constant | Set the filter for analog input 1. | P.8-40 |
| Pn425 | Analog Input 2 Offset | Set the offset for analog input 2. | P.8-40 |
| Pn426 | Analog Input 2 Filter Time Constant | Set the filter for analog input 2. | P.8-40 |

**5**

**BASIC CONTROL Mode**

**5**

**BASIC CONTROL Mode**

## Parameter Block Diagram for TORQUE CONTROL mode
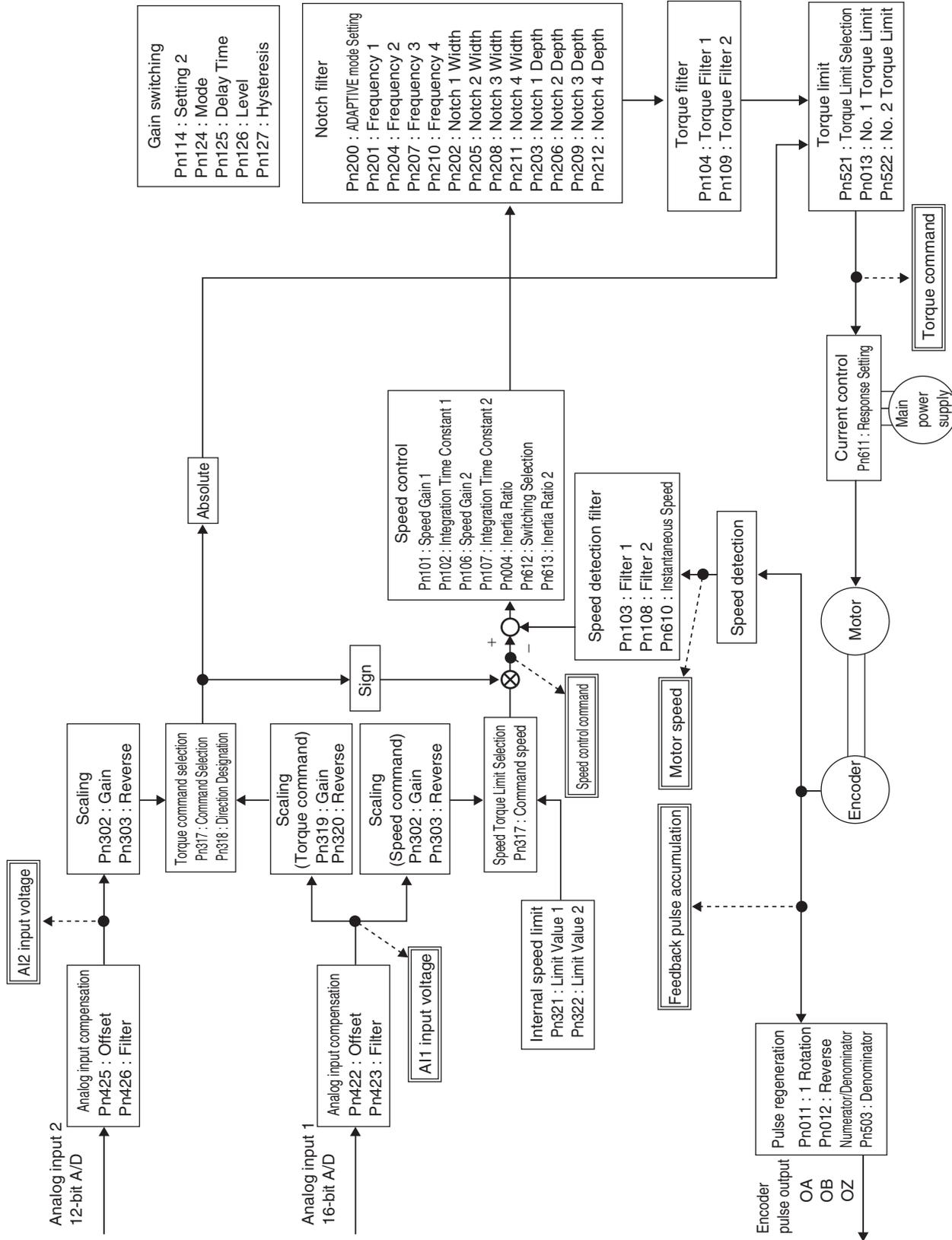
# 5-4   Internally Set Speed Control

## Outline of Operation

♦ Performs motor speed control using the speeds set in the No. 1 to 8 Internally Speed Settings.
♦ Select the internally set speed using Internally Set Speed Selections 1 to 3 of the control input terminals (VSEL1: CN-1 to 33 pins, VSEL2: CN-1 to 30 pins, VSEL3: CN-1 to 28 pins).
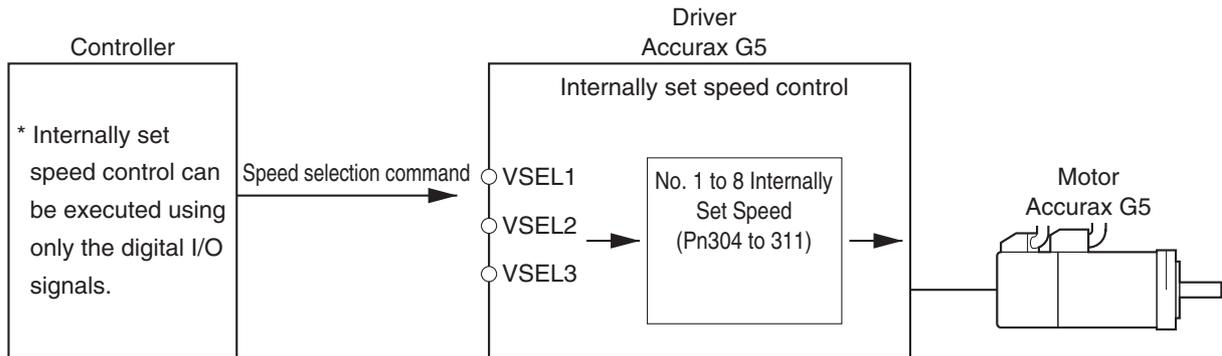


## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn001 | CONTROL mode Selection | Select the CONTROL mode for internally set speed control. (Set values: 1, 3 and 5) | P.8-2 |
| Pn300 | Command Speed Selection | Select the speed command input method. | P.8-26 |
| Pn304 | No. 1 Internally Set Speed | Set the internally set speeds (r/min). The settings can be made from -20,000 to 20,000 r/min. Be sure to set the speeds within the allowable range of rotation speed of the motor. | P.8-27 |
| Pn305 | No. 2 Internally Set Speed | | |
| Pn306 | No. 3 Internally Set Speed | | |
| Pn307 | No. 4 Internally Set Speed | | |
| Pn308 | No. 5 Internally Set Speed | | |
| Pn309 | No. 6 Internally Set Speed | | |
| Pn310 | No. 7 Internally Set Speed | | |
| Pn311 | No. 8 Internally Set Speed | | |

**5**

**BASIC CONTROL Mode**

## Selecting the Internally Set Speeds

The following tables show the internally set speeds that are set with VSEL1, VSEL2 and VSEL3 (internally set speed selection 1, 2 and 3).

### Pn300 = 1

| Number | VSEL1 | VSEL2 | VSEL3 | Set speed |
| --- | --- | --- | --- | --- |
| 0 | OFF | OFF | Disabled | Pn304 |
| 1 | ON | OFF | Disabled | Pn305 |
| 2 | OFF | ON | Disabled | Pn306 |
| 3 | ON | ON | Disabled | Pn307 |

### Pn300 = 2

| Number | VSEL1 | VSEL2 | VSEL3 | Set speed |
| --- | --- | --- | --- | --- |
| 0 | OFF | OFF | Disabled | Pn304 |
| 1 | ON | OFF | Disabled | Pn305 |
| 2 | OFF | ON | Disabled | Pn306 |
| 3 | ON | ON | Disabled | *1 |

*1. The mode will be analog speed control.
Input the proper current to REF.

### Pn300 = 3

| Number | VSEL1 | VSEL2 | VSEL3 | Set speed |
| --- | --- | --- | --- | --- |
| 0 | OFF | OFF | OFF | Pn304 |
| 1 | ON | OFF | OFF | Pn305 |
| 2 | OFF | ON | OFF | Pn306 |
| 3 | ON | ON | OFF | Pn307 |
| 4 | OFF | OFF | ON | Pn308 |
| 5 | ON | OFF | ON | Pn309 |
| 6 | OFF | ON | ON | Pn310 |
| 7 | ON | ON | ON | Pn311 |

## Operation Example

⬩ Internally set speed control with 4 speed changes when Pn300 = 1
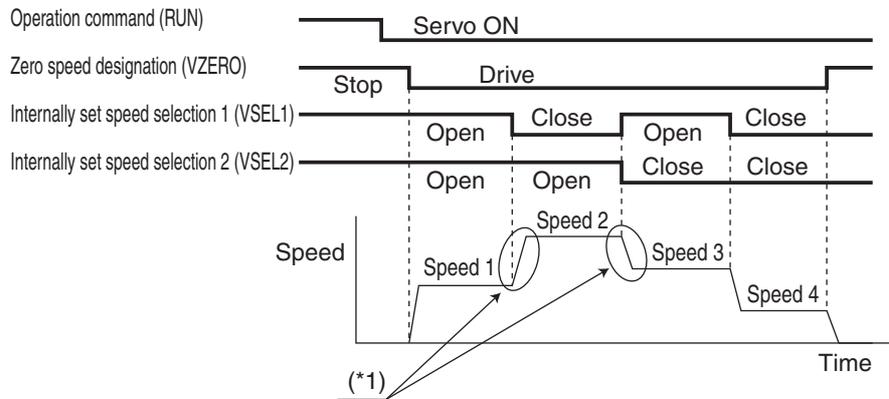


*1. The acceleration time, deceleration time, and S-curve acceleration/deceleration time can be set using parameters (Pn312, Pn313, and Pn314).

## Internal Speed Command (Pn304 to 311)

Control the motor speed according to the internal speed command value set by a parameter. The internally set speed becomes valid when the setting of Speed Setting Internal/External Switching is 1 to 3.
Up to 8 internally set speeds can be set.

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn304 | No. 1 Internally Set Speed | Set the speed 1 internally set speed. | -20,000 to 20,000 | r/min |
| Pn305 | No. 2 Internally Set Speed | Set the speed 2 internally set speed. | -20,000 to 20,000 | r/min |
| Pn306 | No. 3 Internally Set Speed | Set the speed 3 internally set speed. | -20,000 to 20,000 | r/min |
| Pn307 | No. 4 Internally Set Speed | Set the speed 4 internally set speed. | -20,000 to 20,000 | r/min |
| Pn308 | No. 5 Internally Set Speed | Set the speed 5 internally set speed. | -20,000 to 20,000 | r/min |
| Pn309 | No. 6 Internally Set Speed | Set the speed 6 internally set speed. | -20,000 to 20,000 | r/min |
| Pn310 | No. 7 Internally Set Speed | Set the speed 7 internally set speed. | -20,000 to 20,000 | r/min |
| Pn311 | No. 8 Internally Set Speed | Set the No. 8 internally set speed. | -20,000 to 20,000 | r/min |

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**BASIC CONTROL Mode**

# 5-5 Switching Control

## Outline of Operation

- This function controls the motor by switching between 2 CONTROL modes via external inputs.
- The CONTROL mode switching is performed by the CONTROL mode switching input (TVSEL: CN-1 pin 32).
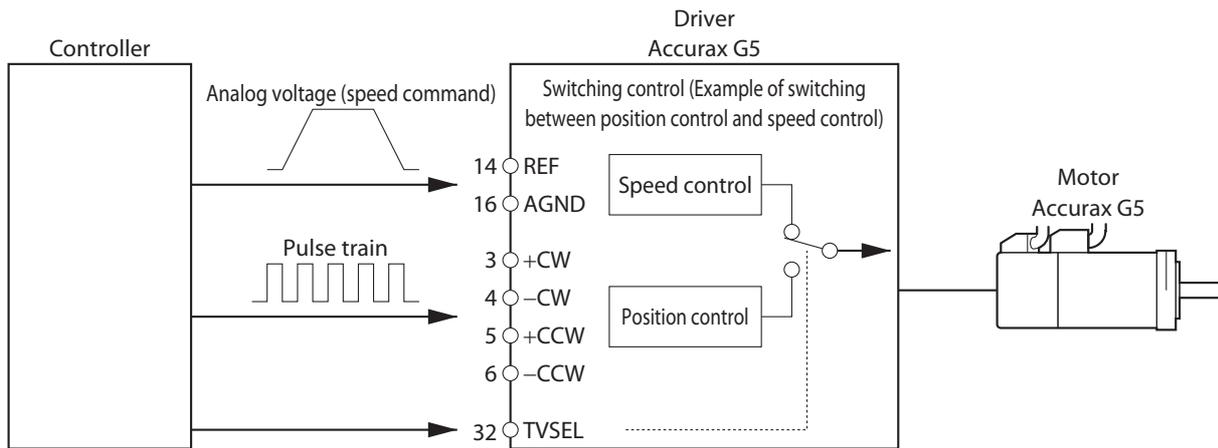


## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn001 | CONTROL mode Selection | Select CONTROL mode for switching control. (Set values: 3, 4 and 5) | P.8-2 |

### CONTROL mode Selected by TVSEL (CONTROL mode Switching Input)

- The following table shows the relation between TVSEL (CONTROL mode switching input) and the CONTROL mode selected.

| CONTROL mode Selection (Pn001) setting | TVSEL | |
|---|---|---|
| | OFF | ON |
| 3 | Position control | Speed control |
| 4 | Position control | Torque control |
| 5 | Speed control | Torque control |

Note. Use caution when switching CONTROL mode. Operation may change suddenly depending on the CONTROL mode settings.

## Operation Example

### Position and Speed Control Switching Example (Pn001 = 3)
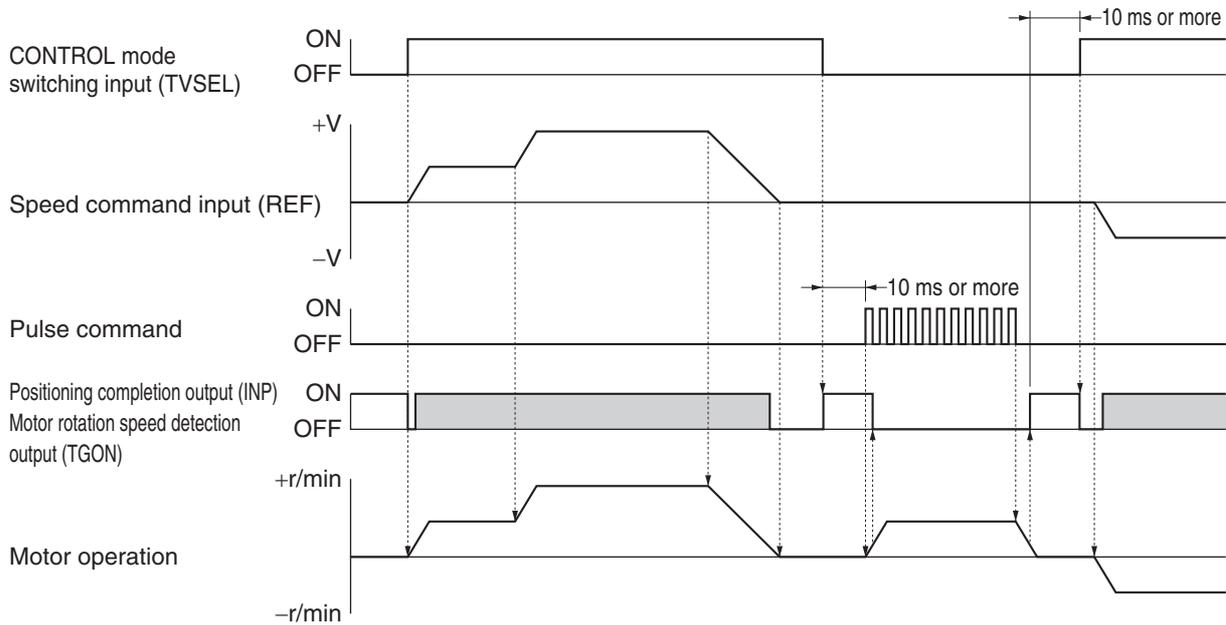


- There is a maximum delay of 10 ms in reading the input signal.
- When switching from speed control to position control, turn OFF the CONTROL mode switching input (TVSEL) and wait at least 10 ms after the positioning completion output (INP) turns ON before inputting the pulse command. The pulses input before INP turns ON will be ignored.
- The shaded areas for the positioning completion output (INP) in the time chart show that the signal is turned ON as the motor rotation speed detection output (TGON). (The meaning of the signal depends on the CONTROL mode.)

### Position and Torque Control Switching Example (Pn001 = 4)



Crash
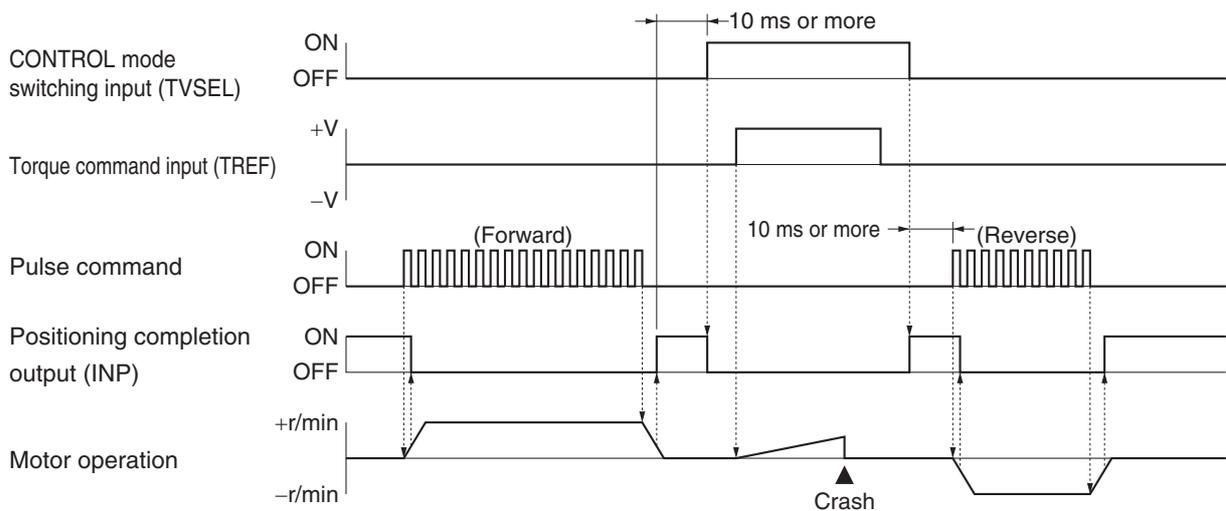
- This time chart shows an example of torque thrust.
- There is a maximum delay of 10 ms in reading the input signal.
- When switching from torque control to position control, turn OFF the CONTROL mode switching input (TVSEL) and wait at least 10 ms after the positioning completion output (INP) turns ON before inputting the pulse command. The pulses input before INP turns ON will be ignored.

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**BASIC CONTROL Mode**

### Speed and Torque Control Switching Example (Pn001 = 5)

CONTROL mode switching input (TVSEL)

Speed command input (REF)

Torque command input (TREF)

Motor operation

TORQUE CONTROL mode
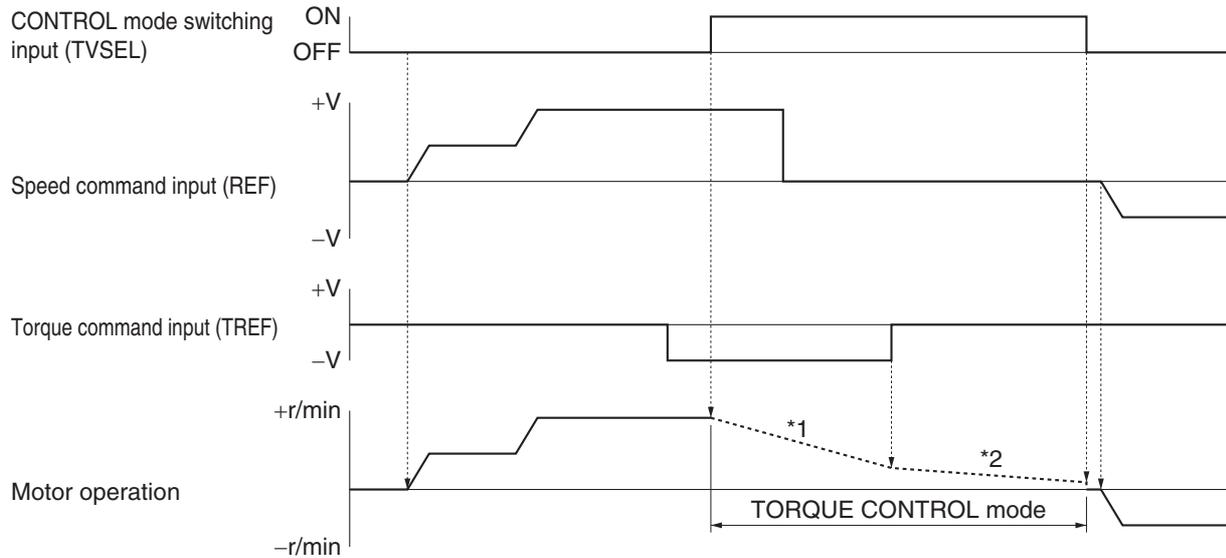
*1. Deceleration for the torque command.

*2. Deceleration due to load inertia energy and load friction torque.

⬩ There is a maximum delay of 10 ms in reading the input signal.

⬩ Motor operation in torque control changes according to the motor load conditions (e.g., friction, external power, inertia). Take safety measures on the machine side to prevent motor runaway.

⬩ Adjust the torque command using Analog Input 2 Offset (Pn425) and Analog Input 2 Filter Time Constant (Pn426) because the torque command input is analog input 2.

## Related Functions

Refer to the related functions for each CONTROL mode.

Accurax G5 AC SERVOMOTOR AND SERVO DRIVE USER'S MANUAL

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**BASIC CONTROL Mode**

# 5-6 Full Closing Control

## Outline of Operation

- ◆ An externally provided scale is used to directly detect the position of the machine and use it as position feedback. In this way the positioning is not affected by ball screw error, temperature shift, etc. You can achieve highly accurate positioning by configuring a full closing control system.
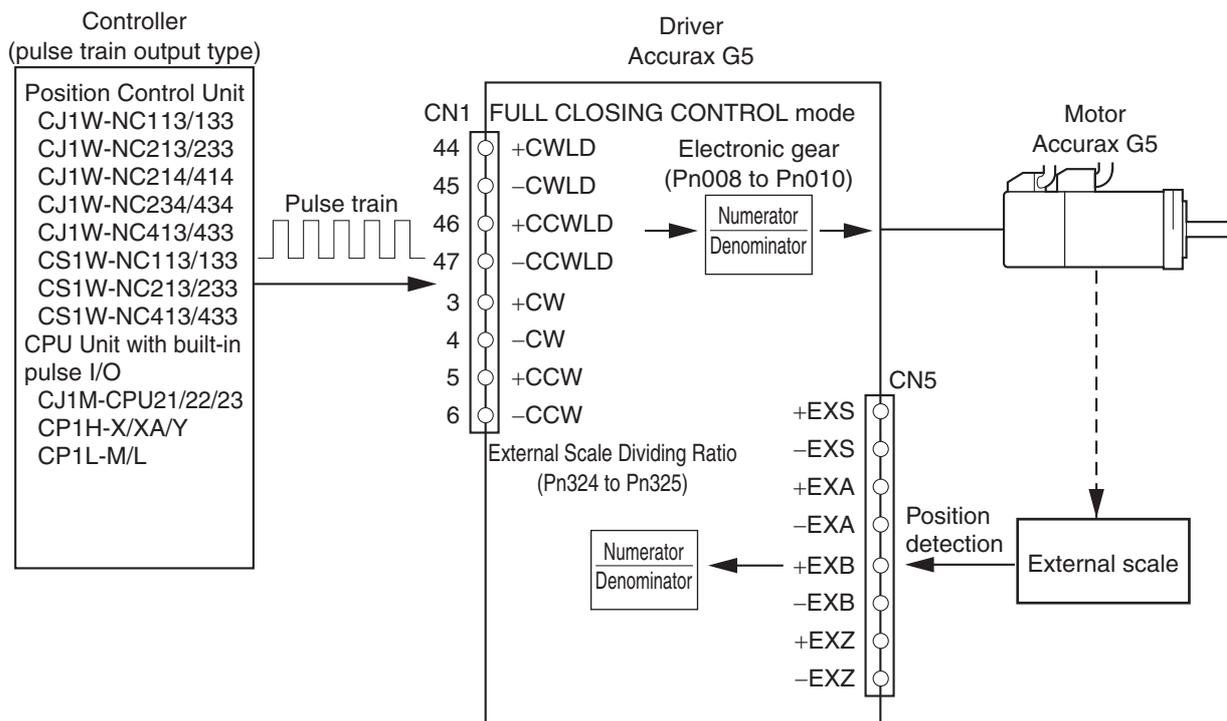


### Precautions for Correct Use

- ◆ If the electronic gear ratio is 1 : 1, 1 command pulse from the encoder constitutes 1 external scale pulse. Since the electronic gear ratio is set differently than in the POSITION CONTROL mode, set the external scale dividing ratio correctly.
- ◆ To prevent machine damage due to an external scale 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 scale ratio, it is recommended that $1/40 \leq$ External scale ratio $\leq 160$ be satisfied.
  If the external scale ratio is set excessively small, control to the unit of 1 external scale pulse may be disabled.
  If the external scale ratio is increased, on the other hand, operating noise may increase.

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**BASIC CONTROL Mode**

## 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.8-2 |
| Pn001 | CONTROL mode Selection | Select the CONTROL mode. | P.8-2 |
| Pn005 | Command Pulse Input Selection | Select the command pulse input. | P.8-4 |
| Pn006 | Command Pulse Rotation Direction Switching Selection | Set the count direction for the command pulse input. | P.8-4 |
| Pn007 | COMMAND PULSE mode Selection | Set the count method for the command pulse input. | P.8-4 |
| Pn008 | Electronic Gear Integer Setting | Set the number of command pulses corresponding to 1 motor rotation. | P.8-6 |
| Pn009 | Electronic Gear Ratio Numerator 1 | Set the numerator of the electronic gear ratio for the command pulse input. | P.8-6 |
| Pn010 | Electronic Gear Ratio Denominator | Use this parameter to set the denominator of the electronic gear ratio for the command pulse input. | P.8-6 |
| Pn011 | Encoder Dividing Numerator | Set the number of phase A and phase B output pulses, respectively per motor rotation. | P.8-7 |
| Pn012 | Encoder Output Direction Switching Selection | Select the phase B logic for pulse regeneration output and the output source. | P.8-7 |
| Pn323 | External Feedback Pulse Type Selection | Select the external scale type. | P.8-33 |
| Pn324 | External Feedback Pulse Dividing Numerator | Set the numerator of the external scale divider setting. | P.8-34 |
| Pn325 | External Feedback Pulse Dividing Denominator | Set the denominator of the external scale divider setting. | P.8-34 |
| Pn326 | External Feedback Pulse Direction Switching | Set the polarity of the external scale feedback pulse. | P.8-34 |
| 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 scale is used. | P.8-35 |
| 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.8-35 |
| Pn329 | Internal/External Feedback Pulse Error Counter Reset | The hybrid error becomes 0 every time the motor rotates by the set value. | P.8-35 |
| Pn503 | Encoder Dividing Denominator | Set the denominator when the number of pulses per motor rotation in pulse regeneration is not an integer. | P.8-46 |

## Rotation Direction Switching (Pn000)

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

## CONTROL mode Selection (Pn001)

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

## Command Pulse Input Process (Pn005, Pn006, Pn007)

Position command input terminals are classified into the input 1 system (+CW, -CW, +CCW, -CCW) and input 2 system (+CWLD, -CWLD, +CCWLD, -CCWLD).
If the position command output is a line-driver output, set input 1. If it is an open collector output, set input 2. Although input 2 can also be used for a line-driver output, the allowable maximum input frequency will become lower than when input 1 is selected.

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn005 | Command Pulse Input Selection | Select the command pulse input terminal.<br>0: Photocoupler input (+CW, -CW, +CCW, -CCW)<br>1: Input for line driver only (+CWLD, -CWLD, +CCWLD, -CCWLD) | 0 to 1 | – |
| Pn006 | Command Pulse Rotation Direction Switching Selection | Set the count direction for the command pulse input.<br>0: Command pulse, forward direction<br>1: Command pulse, reverse direction | 0 to 1 | – |
| Pn007 | COMMAND PULSE mode Selection | Set the count method for the command pulse input.<br>0: 90° phase difference (A/B) signal input)<br>1: Forward/reverse pulse<br>2: 90° phase difference (A/B) signal input)<br>3: Feed pulse/direction signal | 0 to 3 | – |

⬧ For information on the settings for command pulse rotation direction and COMMAND PULSE mode, refer to "5-1 Position Control"(P.5-2).

## Electronic Gear Function (Pn008, Pn009, Pn010)

This function uses as 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 |
|---|---|---|---|---|
| Pn008 | Electronic Gear Integer Setting | Set the number of command pulses corresponding to 1 motor rotation. | 0 to $2^{20}$ | Pulse |
| Pn009 | Electronic Gear Ratio Numerator 1 | 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 "6-4 Electronic Gear Function"(P.6-12).

## Encoder Dividing Function (Pn011, Pn012, Pn503)

The number of pulses can be set for the encoder signals output from the driver.

| Parameter number | Parameter name | Explanation | | | | Setting range | Unit |
|---|---|---|---|---|---|---|---|
| Pn011 | Encoder Dividing Numerator | Set the number of phase A and phase B output pulses, respectively per motor rotation. | | | | 1 to 262144 | Pulse/r |
| Pn012 | Encoder Output Direction Switching Selection | Select the phase B logic for pulse regeneration output and the output source. | | | | 0 to 3 | – |
| | | | **Set value** | **Output source** | **Phase B logic** | | |
| | | | 0 | Encoder | Non-reverse | | |
| | | | 1 | | Reverse | | |
| | | | 2 | External scale | Non-reverse | | |
| | | | 3 | | Reverse | | |
| Pn503 | Encoder Dividing Denominator | When the number of output pulse per rotation is not an integer, you can set a dividing ratio by setting the set value here to a number other than 0, and using Pn011 as the dividing numerator and Pn503 as the dividing denominator. | | | | 0 and 1 to 262144 | – |

⬩ For details on encoder dividing function, refer to "6-5 Encoder Dividing Function"(P.6-15).

### External Feedback Pulse Type Selection (Pn323, Pn326)

Set the external scale output type and direction.

| Parameter number | Parameter name | Explanation | | Setting range | Unit |
|---|---|---|---|---|---|
| Pn323 | External Feedback Pulse Type Selection | Select the type of the external scale to be used. | | 0 to 3 | – |
| | | **Set value** | **External scale type** | | |
| | | 0 | 90 phase difference output type | | |
| | | 1 | Serial communications (Incremental encoder specifications) | | |
| | | 2 | Serial communications (Absolute encoder specifications) | | |
| Pn326 | External Feedback Pulse Direction Switching | If the count directions of the external scale feedback pulse and the encoder total feedback pulses do not match, set the reversal of the external scale feedback pulse direction. 0: Not reversed, 1: Reversed | | 0 to 1 | – |

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**BASIC CONTROL Mode**

The corresponding scale for each output type is as follows.

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

*1. The driver count direction relative to the external encoder of phase-AB output type is explained below.

Count-down direction                          Count-up direction



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

EXB is 90° behind EXA.
t1>0.25 μs
t2>1.0 μs
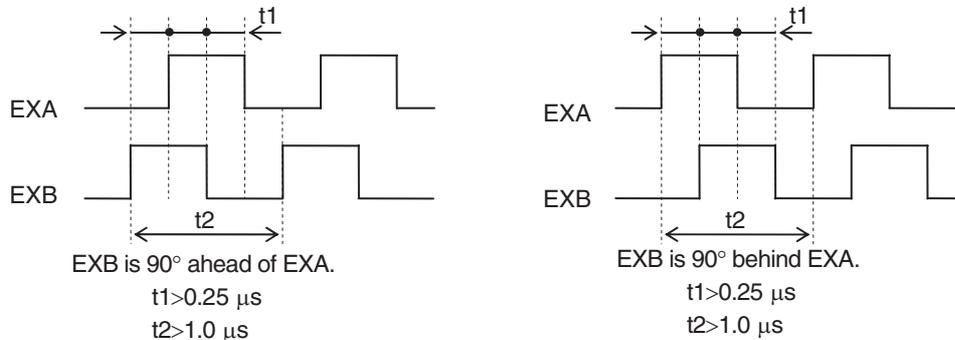
*2. These are the feedback speeds from the external scale at which Servo Drive can respond.
Check the external scale operation manual for its maximum output frequency.
For example, the maximum speed when an external scale with a resolution of 0.01 μm is used for the serial communication type is 0.01 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.

 Precautions for Correct Use

* For the external scale 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).
* Take note that if Pn000 = 1, the scale count direction becomes opposite to the count direction used for monitoring the total external scale feedback pulses, etc.
 If Pn000 = 0, the count direction matches the count direction for monitoring.
* Even when the driver speed is within the specified range, an acceleration error will occur 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 scale total feedback pulses and the encoder total feedback pulses. If they match, the connection is set up correctly.

### External Feedback Pulse Dividing Ratio Setting (Pn324, Pn325)

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

| Parameter number | Parameter name | Explanation | Setting range | Unit |
|---|---|---|---|---|
| Pn324 | External Feedback Pulse Dividing Numerator | Set the numerator of the external scale 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 $2^{20}$ | - |
| Pn325 | External Feedback Pulse Dividing Denominator | Set the denominator of the external scale divider setting. Normally, set the number of external scale output pulses per motor rotation. | 1 to $2^{20}$ | - |

Check the number of encoder feedback pulses and the number of external scale 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.

$$\frac{Pn324}{Pn325} = \frac{\text{Number of encoder output pulses per motor rotation}}{\text{Number of external scale output pulses per motor rotation}}$$

If this divider setting is wrong, there will be deviations between the position calculated from encoder pulses and the position calculated from external scale. 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 scale resolution 0.1 μm
- ◆ Encoder resolution 20 bits
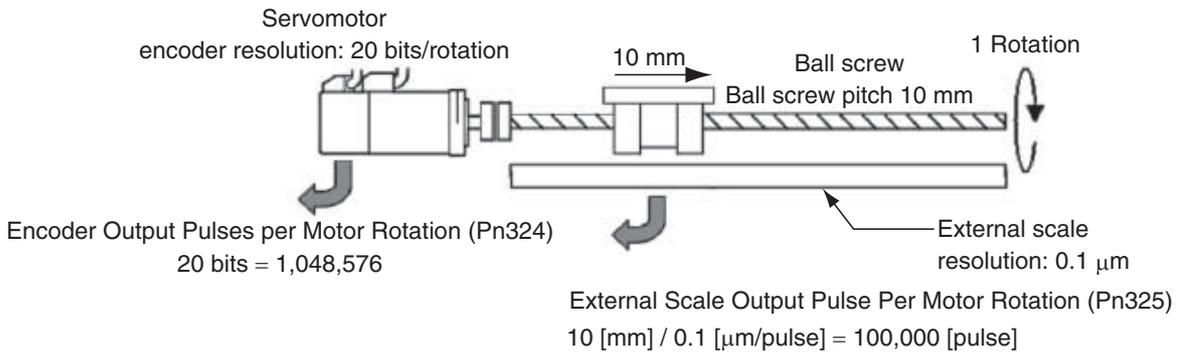


Servomotor
encoder resolution: 20 bits/rotation

10 mm    Ball screw
Ball screw pitch 10 mm    1 Rotation

Encoder Output Pulses per Motor Rotation (Pn324)
20 bits = 1,048,576

External scale
resolution: 0.1 μm

External Scale Output Pulse Per Motor Rotation (Pn325)
10 [mm] / 0.1 [μm/pulse] = 100,000 [pulse]

$$\frac{Pn324}{Pn325} = \frac{\text{Number of encoder output pulses per motor rotation}}{\text{Number of external scale output pulses per motor rotation}} = \frac{1,048,576}{100,000}$$

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**BASIC CONTROL Mode**

## External Feedback Pulse Error Setting (Pn328, Pn329)

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

| 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 scale-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 scale due to slipping, etc, and internal/external feedback pulse errors accumulate.

Amount of internal/external feedback pulse error
[command unit]

Error detection

Pn328 Internal/External Feedback Pulse Error Counter Overflow Level

0 clear

0 clear

Pn329
Internal/External Feedback
Pulse Error Counter Reset

Pn329
Internal/External Feedback
Pulse Error Counter Reset

Pn329
Internal/External Feedback
Pulse Error Counter Reset

Number of motor rotations [rotation]

📝 Precautions for Correct Use

- An internal/external feedback pulse error counter overflow level error occurs when the external scale 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



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**BASIC CONTROL Mode**

# 6
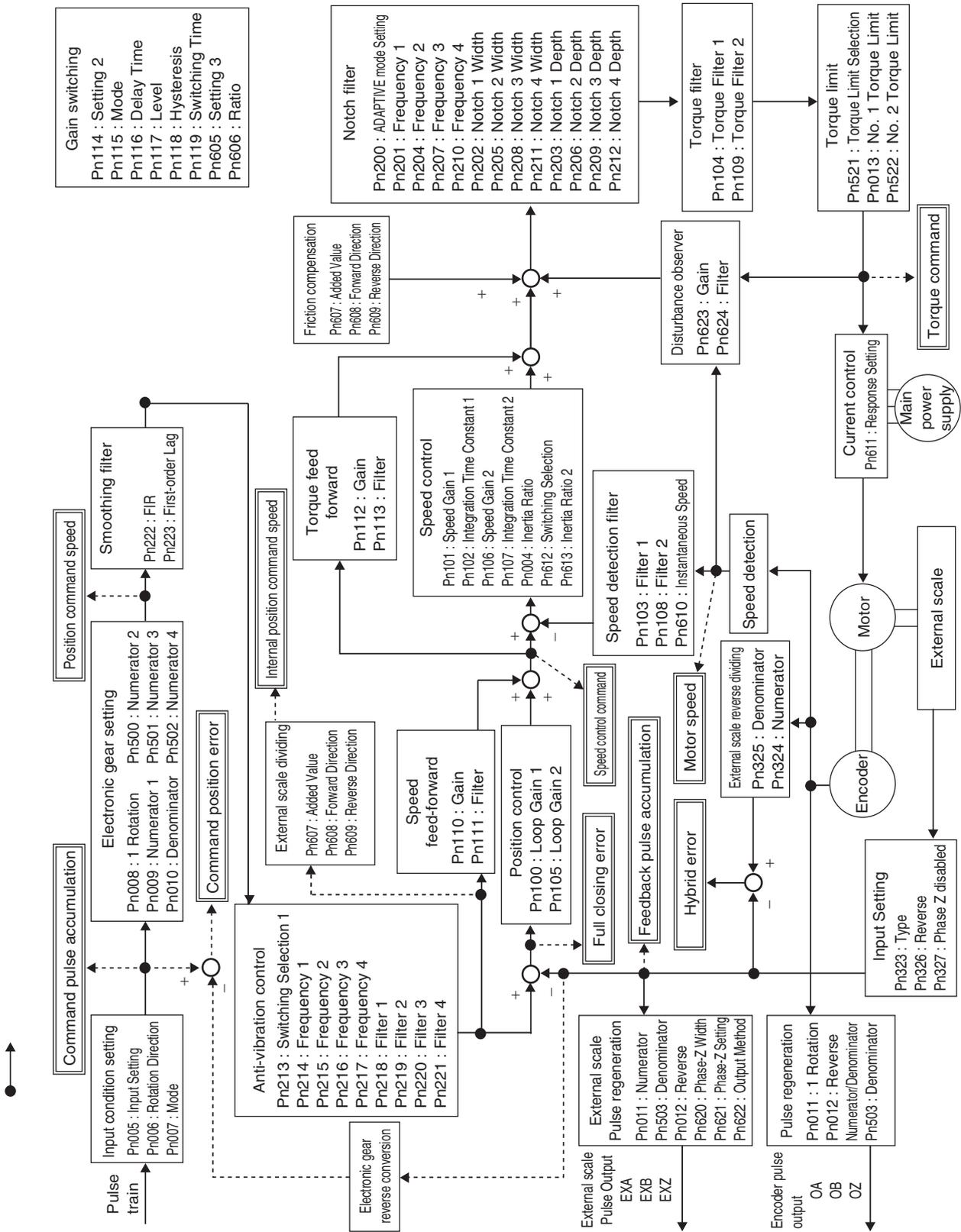
# Applied Functions

This chapter gives outline of applied functions such as anti-vibration control, electronic gears, gain switching and disturbance observer, and explains the contents of setting.

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**6**

**Applied Functions**

# 6-1 Anti-vibration Control

## Outline of Operation

If the tip of the mechanical unit vibrates, you can use the anti-vibration 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.

Since anti-vibration control is performed using position commands, it cannot be used with speed or torque control.

**Applied Functions**

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn001 | CONTROL mode Selection | Set to the POSITION or FULL CLOSING CONTROL mode.<br>0: Position control<br>3: FIRST CONTROL mode for position/speed control<br>4: FIRST CONTROL mode for position/torque control<br>6: Full closing control | P.8-2 |
| Pn213 | Vibration Filter Selection | Select the VIBRATION FILTER SWITCHING mode according to the condition of the unit.<br>0: Vibration filter 1 or 2 enabled<br>1: Switching by external input (DFSEL1)<br>2: Switching by external input (DFSEL1, DFSEL2)<br>3: Switching with command direction | P.8-22 |
| Pn214 | Vibration Frequency 1 | Set vibration frequency 1 to suppress vibration at the end of the load in anti-vibration control.<br>If the anti-vibration control function is not used, set 0. | P.8-23 |
| Pn215 | Vibration Filter 1 Setting | When the Vibration Frequency 1 (Pn214) is set, reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally 0 is set.<br>If the vibration filter 1 is disabled, this parameter is also disabled. | P.8-23 |
| Pn216 | Vibration Frequency 2 | The function is the same with Pn214. | P.8-23 |
| Pn217 | Vibration Filter 2 Setting | The function is the same with Pn215. | P.8-23 |
| Pn218 | Vibration Frequency 3 | The function is the same with Pn214. | P.8-24 |
| Pn219 | Vibration Filter 3 Setting | The function is the same with Pn215. | P.8-24 |
| Pn220 | Vibration Frequency 4 | The function is the same with Pn214. | P.8-24 |
| Pn221 | Vibration Filter 4 Setting | The function is the same with Pn215. | P.8-24 |

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 anti-vibration control is inhibited |
|---|---|
| CONTROL mode | - SPEED or TORQUE CONTROL mode |
| Load condition | - If forces other than position commands, such as external forces, cause vibration.<br>- If the vibration frequency is outside the range of 1 to 200 Hz.<br>- If the ratio of the resonance frequency to anti-resonance frequency is large. |

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**Applied Functions**

## Operating Procedure

1. **Adjust the position loop gain and speed loop gain.**
   Adjust Position Loop Gain (Pn100), Speed Loop Gain (Pn101), Speed Loop Integral Time Constant (Pn102) and Torque Command Filter Time Constant (Pn104).
   If no problem occurs in realtime autotuning, you can continue to use the settings.

2. **Measure the vibration frequency at the tip of the mechanical unit.**
   Measure the vibration frequency using a laser displacement sensor, servo acceleration meter, acceleration pick-up, etc.
   Set the vibration frequency in one of Vibration Frequency 1 to Vibration Frequency 4 (1: Pn214, 2: Pn216, 3: Pn218, 4: Pn220) according to the operation.
   Also set the SWITCHING mode using Vibration Filter Selection (Pn213).
   If the measurement device cannot be used, use CX-Drive tracing function, and read the residual vibration frequency (Hz) from the position error waveform as shown in the following figure.
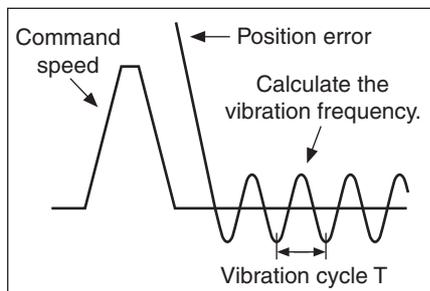


- The following gives the vibration frequency in the figure.

$$f \ (Hz) = \frac{1}{T \ (s)}$$

   Since the parameter unit is 0.1 Hz:
   (Pn214, Pn216, Pn218, Pn220) = 10 × f
- Application example
   If the vibration cycle is 100 ms or 20 ms, set 100 or 500 in the parameter so that the vibration frequency becomes 10 Hz or 50 Hz.

   If vibration persists after setting the frequency, increase or decrease the filter frequency to find the frequency at which vibration decreases.

3. **Set vibration filter setting.**
   Set vibration 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.
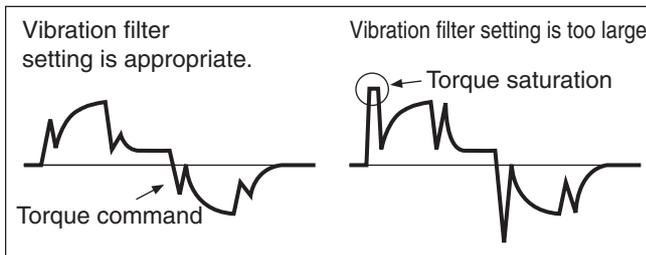


   When the Vibration Frequency 1 (Pn214) is set, reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally 0 is set.
   If the vibration filter 1 is enabled, use the following setting range.
   Setting range: 100 ≤ Pn214 + Pn215 ≤ Pn214 × 2 or 2,000
   Note: If the vibration filter 1 is disabled under Vibration Filter Selection (Pn213), this parameter is also disabled.

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**Applied Functions**

4. **Set the Vibration Filter Selection (Pn213).**
   Vibration filters 1 to 4 can be switched according to the conditions of the machine vibration.

| Set value | SWITCHING mode |
|---|---|
| 0 | Vibration filter 1 and 2 enabled |
| 1 | Switching by external input (DFSEL1)<br>Open: Vibration filter 1 or 3 enabled<br>Shorted: Vibration filter 2 or 4 enabled |
| 2 | Switching by external input (DFSEL1, DFSEL2)<br>When DFSEL1 and DFSEL2 are both open: Vibration filter 1 enabled<br>When DFSEL1 is shorted and DFSEL2 is open: Vibration filter 2 enabled<br>When DFSEL1 is open and DFSEL2 is shorted: Vibration filter 3 enabled<br>When DFSEL1 and DFSEL2 are both shorted: Vibration filter 4 enabled |
| 3 | Switching with command direction<br>Forward direction: Vibration filter 1 or 3 enabled<br>Reverse direction: Vibration filter 2 or 4 enabled |

Vibration Filter Selection (Pn213) is a parameter that becomes effective when the power is turned on. After setting this parameter, turn OFF the control power supply and then turn it ON again.

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**Applied Functions**

# 6-2 Adaptive Filter

## Outline of Operation

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 "6-3 Notch Filter" (P.6-9) for information on notch filter.



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Applied Functions

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | 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.<br>0: Adaptive filter disabled<br>1: 1 adaptive filters enabled<br>2: 2 adaptive filters enabled<br>3: RESONANCE FREQUENCY MEASUREMENT mode<br>The servodrive measures the resonant frequency automatically but the result is applied by the user by using the software tool (CX-Drive).<br>4: Adaptive result clear<br>   The notch filter 3 and notch filter 4 parameters are disabled, and adaptive result is cleared. | P.8-21 |

📝 Precautions for Correct Use

♦ Adaptive filter may not operate correctly under the following conditions.

| Item | Conditions under which the adaptive filter not operates properly |
|---|---|
| CONTROL mode | · TORQUE CONTROL mode |
| Resonance points | · If the resonance frequency is 300 Hz or lower.<br>· If the resonance peak or control gain is low, and the motor speed is not affected by it.<br>· 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. |

♦ 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 "6-3 Notch Filter" (P.6-9) for information on notch filter.

♦ 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 will be used as the default settings to perform adaptive operation.

♦ The adaptive filter is disabled when torque control is performed, but the adaptive filter frequency used in the CONTROL mode before switching will be held if torque control has been selected by setting the CONTROL mode Selection (Pn001) to 5 or 6.

# 6-3   Notch Filter

## Outline of Operation

You can set up to 4 notch filters for the torque command.

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.
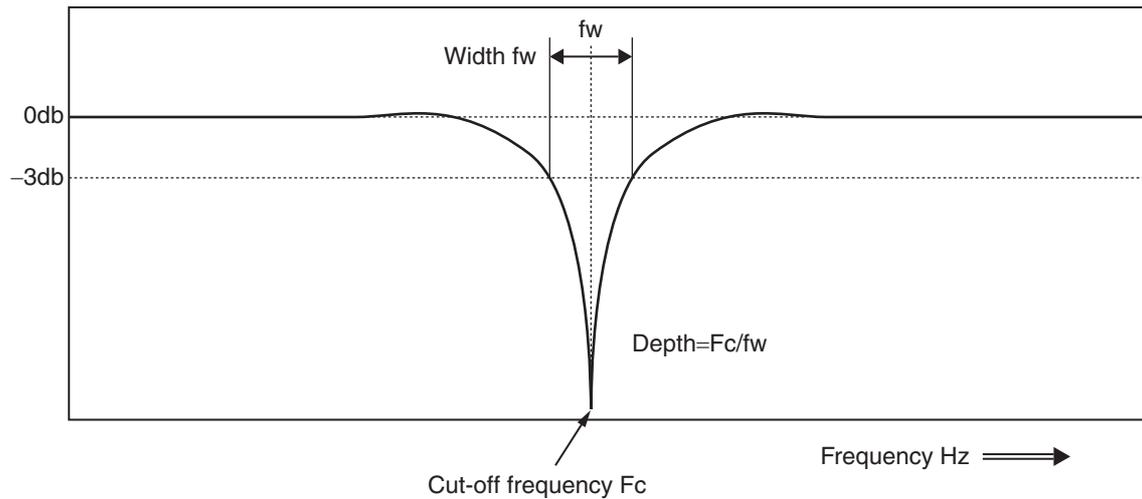


If machine resonance occurs, use this notch filter to eliminate resonance.
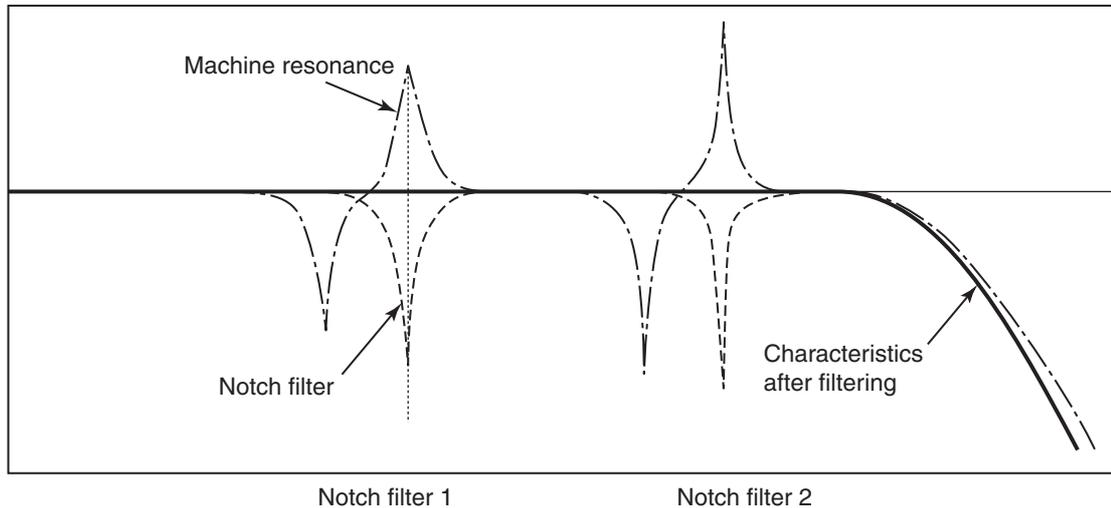


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**Applied Functions**

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn201 | Notch 1 Frequency Setting | Set the center frequency of the notch filter 1.<br> The notch filter is enabled at 50 to 4,999 Hz, and disabled at 5,000 Hz. | P.8-21 |
| Pn202 | Notch 1 Width Setting | Select the width of the notch filter 1 frequency.<br> Increasing the value will widen the notch.<br> (Setting range: 0 to 20) | P.8-21 |
| Pn203 | Notch 1 Depth Setting | Select the depth of the notch filter 1 center frequency.<br> Increasing the value will decrease the notch depth and thereby reduce the phase delay. The notch filter is disabled if 100 is set.<br> (Setting range: 0 to 99) | P.8-21 |
| Pn204 | Notch 2 Frequency Setting | Set the center frequency of the notch filter 2.<br> The details are the same with the notch filter 1 frequency. | P.8-21 |
| Pn205 | Notch 2 Width Setting | Select the width of the notch filter 2 frequency.<br> The details are the same with the notch filter 1 width. | P.8-21 |
| Pn206 | Notch 2 Depth Setting | Select the depth of the notch filter 2 center frequency.<br> The details are the same with the notch filter 1 depth. | P.8-22 |
| Pn207 | Notch 3 Frequency Setting [1] | Set the center frequency of the notch filter 3.<br> The details are the same with the notch filter 1 frequency. | P.8-22 |
| Pn208 | Notch 3 Width Setting [1] | Select the width of the notch filter 3 frequency.<br> The details are the same with the notch filter 1 width. | P.8-22 |
| Pn209 | Notch 3 Depth Setting [1] | Select the depth of the notch filter 3 center frequency.<br> The details are the same with the notch filter 1 depth. | P.8-22 |
| Pn210 | Notch 4 Frequency Setting [1] | Set the center frequency of the notch filter 4.<br> The details are the same with the notch filter 1 frequency. | P.8-22 |
| Pn211 | Notch 4 Width Setting [1] | Select the width of the notch filter 4 frequency.<br> The details are the same with the notch filter 1 width. | P.8-22 |
| Pn212 | Notch 4 Depth Setting [1] | Select the depth of the notch filter 4 center frequency.<br> The details are the same with the notch filter 1 depth. | P.8-22 |

*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.

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**Applied Functions**

## 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 | | Depth | | |
| --- | --- | --- | --- | --- |
| **Set value** | **Bandwidth/center frequency** | **Set value** | **I/O ratio (%)** | **Damping factor (dB)** |
| 0 | 0.50 | 0 | 0 (Cut off) | $-\infty$ |
| 1 | 0.59 | 1 | 1 | −40.0 |
| 2 | 0.71 | 2 | 2 | −34.0 |
| 3 | 0.84 | 3 | 3 | −30.5 |
| 4 | 1.00 | 4 | 4 | −28.0 |
| 5 | 1.19 | 5 | 5 | −26.0 |
| 6 | 1.41 | 10 | 10 | −20.0 |
| 7 | 1.68 | 15 | 15 | −16.5 |
| 8 | 2.00 | 20 | 20 | −14.0 |
| 9 | 2.38 | 25 | 25 | −12.0 |
| 10 | 2.83 | 30 | 30 | −10.5 |
| 11 | 3.36 | 35 | 35 | −9.1 |
| 12 | 4.00 | 40 | 40 | −8.0 |
| 13 | 4.76 | 45 | 45 | −6.9 |
| 14 | 5.66 | 50 | 50 | −6.0 |
| 15 | 6.73 | 60 | 60 | −4.4 |
| 16 | 8.00 | 70 | 70 | −3.1 |
| 17 | 9.51 | 80 | 80 | −1.9 |
| 18 | 11.31 | 90 | 90 | −0.9 |
| 19 | 13.45 | 100 | 100 (Passed) | 0.0 |
| 20 | 16.00 | | | |



Notch filter frequency characteristics

Legend:
- Depth 0, width 4
- Depth 50, width 4
- Depth 0, width 8

# 6-4 Electronic Gear Function

## Outline of Operation

- ◆ The motor can be rotated for the number of pulses obtained by multiplying the position command values by the electronic gear ratio.
- ◆ This function supports position and full closing control.

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn008 | Electronic Gear Integer Setting | Set the number of command pulses corresponding to 1 motor rotation. | |
| 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. <br>· 131,072 for a 17-bit absolute encoder <br>· 1,048,576 for a 20-bit incremental encoder | |
| Pn010 | Electronic Gear Ratio Denominator | Set the denominator of the electronic gear ratio. | P.8-6 |
| Pn500 | Electronic Gear Ratio Numerator 2 [1] | Set the numerator of the electronic gear ratio 2. | |
| Pn501 | Electronic Gear Ratio Numerator 3 [1] | Set the numerator of the electronic gear ratio 3. | |
| Pn502 | Electronic Gear Ratio Numerator 4 [1] | Set the numerator of the electronic gear ratio 4. | |

[1]. Switching among Electronic Gear Ratio Numerators 2 to 4 (Pn500 to Pn502) is performed using the electronic gear switching input (GESEL1/GESEL2).
The settings of GESEL1 and GESEL2 are as follows.

| GESEL1 | GESEL2 | Applicable parameters |
|---|---|---|
| OFF | OFF | Electronic Gear Ratio Numerator 1 (Pn009) |
| ON | OFF | Electronic Gear Ratio Numerator 2 (Pn500) |
| OFF | ON | Electronic Gear Ratio Numerator 3 (Pn501) |
| ON | ON | Electronic Gear Ratio Numerator 4 (Pn502) |

## Electronic Gear Ratio Setting (Pn008, Pn009, Pn010)

| Electronic Gear Integer Setting (Pn008) | Electronic Gear Ratio Numerator 1 (Pn009) | Electronic Gear Ratio Denominator (Pn010) | Explanation |
|---|---|---|---|
| 1 to 1058576 | – | – | When the Electronic Gear Integer Setting (Pn008) ≠ 0 The processing will be based on the set value of Electronic Gear Integer Setting (Pn008) regardless of the set values of Electronic Gear Ratio Numerator 1 (Pn009) and Electronic Gear Ratio Denominator (Pn010).<br><br>Command pulse input → $\dfrac{\text{Encoder resolution *}}{\text{Electronic Gear Integer Setting (Pn008)}}$ → Position command<br><br>Position command pulse = Encoder resolution / Electronic Gear Integer Setting (Pn008) Switching among electronic gear ratio numerators 1 to 4 is disabled when the Electronic Gear Integer Setting (Pn008) ≠ 0. |
| 0 | 0 | 1 to 1073741824 | When the Electronic Gear Integer Setting (Pn008) = 0, or Electronic Gear Ratio Numerator 1 (Pn009) = 0 The processing will be based on the set value of Electronic Gear Ratio Denominator (Pn010).<br><br>Command pulse input → $\dfrac{\text{Encoder resolution *}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$ → Position command<br><br>Position command pulse = Encode resolution / Electronic Gear Ratio Denominator (Pn010) |
| 0 | 1 to 1073741824 | 1 to 1073741824 | When the Electronic Gear Integer Setting (Pn008) = 0, or Electronic Gear Ratio Numerator 1 (Pn009) ≠ 0 The processing will be based on the set values of Electronic Gear Ratio Numerator 1 (Pn009) and Electronic Gear Ratio Denominator (Pn010).<br><br>Command pulse input → $\dfrac{\text{Electronic Gear Ratio Numerator 1 (Pn009)}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$ → Position command<br><br>Position command pulse = Electronic Gear Ratio Numerator 1 (Pn009) / Electronic Gear Ratio Denominator (Pn010) |

\* The encoder resolution is set as the numerator for full closing control. The command pulse is the external scale reference for full closing control. Accordingly, please be cautious that the Pn008 set value will not be the number of command pulses per motor rotation.

**6**

**Applied Functions**

## Operation Example

- Example of a motor with a 20-bit encoder (1,048,576 pulses/rotation)

### When the Electronic Gear Integer Setting (Pn008) ≠ 0

- If you set Pn008 = 2,000, it will operate the same as the 2,000 (pulses/rotation) Servomotor.
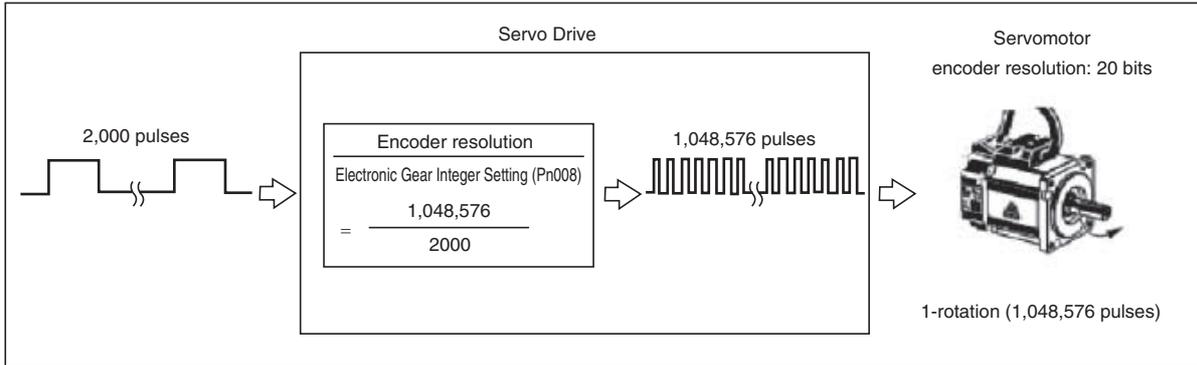


### When the Electronic Gear Integer Setting (Pn008) = 0 and the Electronic Gear Ratio Numerator = 0

- If you set Pn010 = 2,000, it will operate the same as the 2,000 (pulses/rotation) Servomotor.
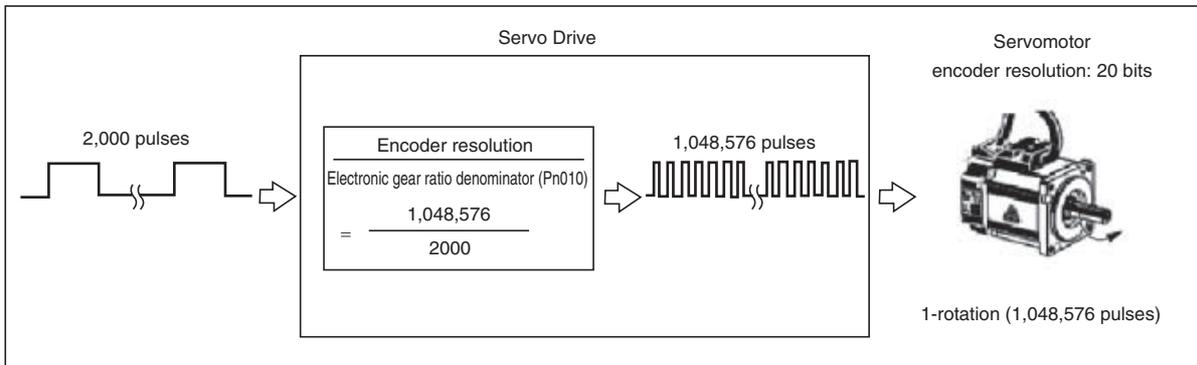


### When the Electronic Gear Integer Setting (Pn008) = 0 and the Electronic Gear Ratio Numerator ≠ 0

- If you set Pn009 and Pn010 = 1,048,576 and 2,048, respectively, it will operate the same as the 2,048 (pulses/rotation) Servomotor.
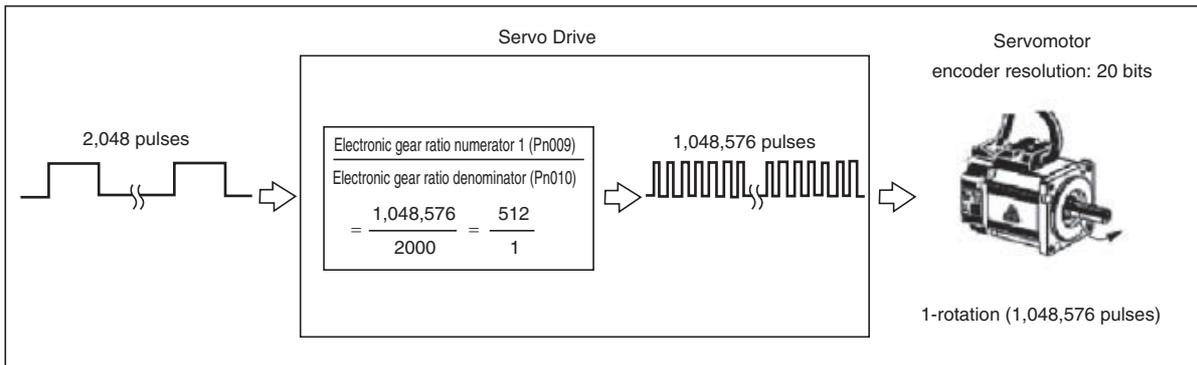
# 6-5 Encoder Dividing Function

## Outline of Operation

- The number of output pulses from the driver can be adjusted.
- You can set the number of pulses per motor rotation in the range of 1 to (the number of encoder resolution pulses).
- This function is used in the following cases:
    - When you use a controller with a low response frequency
    - When you want to set the pulse rate corresponding to a certain value
        Example: Set the encoder dividing ratio to 2,000 (pulses/rotation) for when the resolution is set to 5 μm/pulse on mechanical systems that travel 10 mm per motor rotation.

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn011 | Encoder Dividing Numerator | Set the number of phase-A and phase-B output pulses, respectively per motor rotation. | P.8-7 |
| Pn012 | Encoder Output Direction Switching Selection | Select the phase B logic for pulse regeneration output and the output source. | P.8-7 |
| Pn503 | Encoder Dividing Denominator | Set the denominator when the number of pulses per motor rotation in pulse regeneration is not an integer. | P.8-46 |
| Pn533 | Pulse Regeneration Output Limit Setting | Set whether to enable or disable the detection of Err28.0 "pulse regeneration error." 0: Disabled, 1: Enabled | P.8-58 |
| Pn620 | External Scale Phase-Z Setting | Set the external scale phase-Z output width. | P.8-61 |
| Pn621 | Serial Absolute External Scale Phase-Z Setting | Set the phase-Z regeneration position when the serial absolute external scale is used. 0: Phase-Z output only at a position where the absolute position is 0. 1 to $2^{28}$: After a phase-Z output at the position where the absolute position is 0, phase Z is output every the set value pulse cycle. No phase-Z is output until passing absolute position 0 | P.8-61 |
| Pn622 | Phase AB External Scale Pulse Output Method Selection | Select the regeneration method of pulse outputs OA and OB when an external scale of phase AB-output type is used. 0: Without signal regeneration. Z-out is directly Z-in in the scale 1: With signal regeneration | P.8-62 |

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**Applied Functions**

## Encoder Dividing Ratio Setting (Pn011, Pn503)

| Encoder Dividing Numerator (Pn011) | Encoder Dividing Denominator (Pn503) | Explanation |
|---|---|---|
| 1 to 262144 | 0 | When the output source is the encoder<br>When Encoder Dividing Denominator (Pn503) = 0<br>This is set by Encoder Dividing Numerator (Pn011), and the output pulse is the number of pulses set by Encoder Dividing Numerator (Pn011) as follows.<br><br>Encoder pulse → $\dfrac{\text{Pn011 set value} \times 4}{\text{Encoder resolution}}$ → Output pulse from the driver<br><br>Number of pulse output per rotation = Encoder Dividing Numerator (Pn011) × 4<br><br>When the output source is the external scale<br>When Encoder Dividing Denominator (Pn503) = 0<br>The dividing ratio is 1:1.<br><br>External scale pulse → $\dfrac{1}{1}$ → Output pulse from the driver |
| 1 to 262144 | 1 to 262144 | When Encoder Dividing Denominator (Pn503) ≠ 0<br>The output pulse will be as follows based on Encoder Dividing Numerator (Pn011) and Encoder Dividing Denominator (Pn503).<br><br>Encoder pulse or external scale pulse → $\dfrac{\text{Pn011 set value}}{\text{Pn503 set value}}$ → Output pulse from the driver |

$$\text{Number of pulse output per rotation} = \frac{\text{Encoder Dividing Denominator}}{\text{(Pn011)}} \times \text{encoder resolution}$$

1 phase-Z signal is output by 1 pulse per motor rotation.When the Encoder Dividing Denominator (Pn503) ≠ 0, and if the pulse output resolution per rotation is not a multiple of 4, phase-Z and phase-A outputs are not synchronized.The output will be made as an encoder resolution, resulting in narrower width.

### Phase Z Signal Output

If Pn011 and Pn503 are integers

A
B
Z

Synchronous
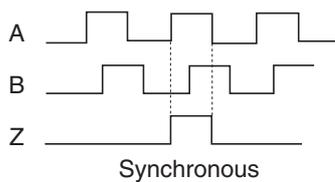
If Pn011 and Pn503 are not integers

A
B
Z

Asynchronous
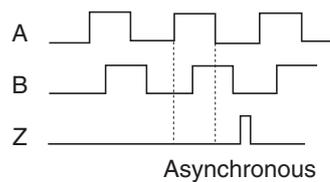
## Encoder Output Direction Switching Selection (Pn012)

The corresponding scale for each output type is as follows.

| Encoder Output Direction Switching Selection (Pn012) | Output source | Phase B logic | For forward direction operation | For reverse direction operation |
|---|---|---|---|---|
| 0 | Encoder | Non-reverse | | |
| 2 | External scale | | | |
| 1 | Encoder | Reverse | | |
| 3 | External scale | | | |

## External Scale Pulse Regeneration Function

### Serial Absolute External Scale

Phase Z is output only after the control power supply for amplifier is turned ON and when it crosses the zero absolute position of the external scale.Based on this position, phase Z is output at the intervals of phase-A pulse that is set to Pn621.However, if Pn621 = 0, phase Z is output only at the zero absolute position.

### Serial Incremental External Scale

Phase Z is output without dividing the phase Z of the serial incremental external scale.In addition, take note that there are differences as illustrated in the figure below depending on the direction passing phase Z.

Phase A

Phase B

Phase-Z position of external scale*1

Operating direction

Phase Z

*2

Operating direction

*2
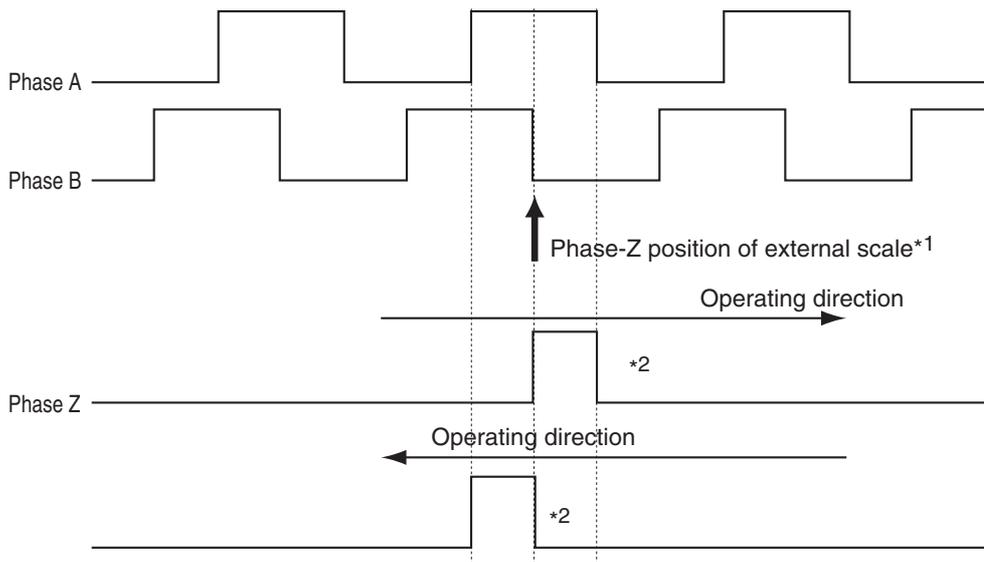
*1. Phase-Z position and its relationship with phases A and B vary depending on the scale.

*2. Phase Z is regenerated for 1 pulse.If the width is narrow, the output time can be extended by the External Scale Phase Z Setting (Pn620).

**6**

**Applied Functions**

### ABZ Parallel External Scale

- Phase Z is output without dividing the Z signal that is input from the ABZ parallel external scale.
- When the Phase-AB External Scale Pulse Output Method Selection (Pn622) = 1, the phase-AB signal can be loaded to the amplifier and regenerated.Note, in this case, that the phase-AB regeneration will be delayed compared to when Pn622 is set to 0.

### External Scale Common Items

- When detection cannot be made because the phase-Z signal width is narrow due to the external scale travel distance, if you set the phase-Z signal output time in the External Scale-Z Setting (Pn620), phase Z can be output at least for that period of time.
  In addition, take note that the output is made from when the phase-Z signal starts and, therefore, it will be different from the actual phase-Z signal width.Take note, also, that the direction of the time extension varies depending on the direction of the operation.

Phase-Z output for pulse regeneration (before time extension)

Operating direction

Phase-Z output for pulse regeneration (after time extension)

Pn620 External Scale Phase-Z Setting

Operating direction

Pn620 External Scale Phase-Z Setting
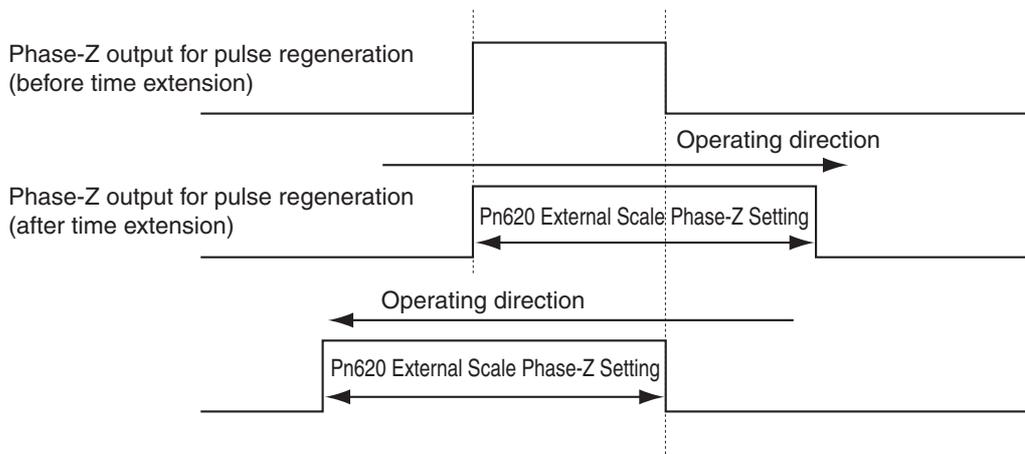
**Precautions for Correct Use**

- The maximum output frequency of the pulse regeneration output will be 4 Mpps (after quadruple multiplier).If operated at a speed that exceeds this, the regeneration function may not operate properly and position misalignment may result.

Phase A

Phase B

0.25 μs or more
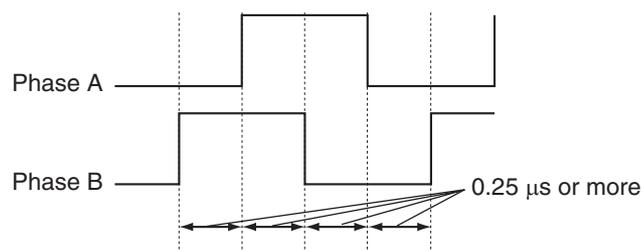
- You can generate Err28.0 "pulse regeneration error" when the pulse regeneration limit is reached based on the Pulse Regeneration Output Limit Setting (Pn533).Note that this error is generated when the pulse regeneration output limit is detected. Therefore, the error does not occur due to the maximum output frequency.Depending on the motor rotation status (uneven rotations), the error may occur when the detection is made at the frequency that goes up momentarily.
- Take not that if the encoder is used as the output source and the pulse output resolution per rotation is not a multiple of 4, phase Z and phase A are not synchronized, and the width may be narrow.
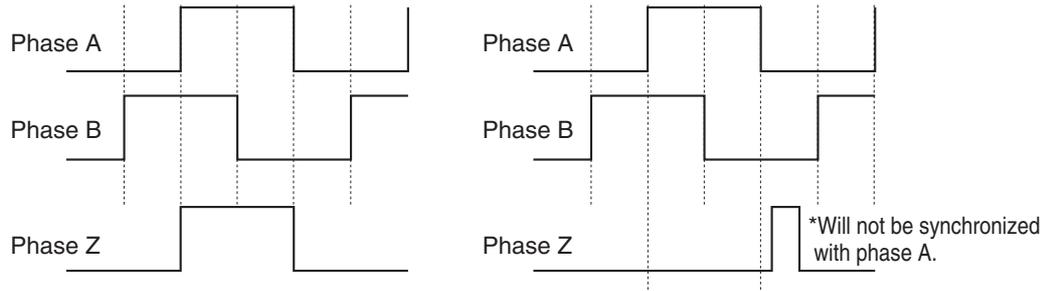
When the dividing ratio is multiple of 4   When the dividing ratio is not multiple of 4

Note: When Pn503 = 0 and the output resolution is set to Pn011, the dividing ratio is always a multiple of 4.

- When en encoder with the incremental specifications is used, the first phase Z output after the power supply is turned ON may not always be within the above pulse width.When you are using the phase-Z signal, rotate the motor more than once after turning ON the power supply, and confirm that phase-Z regeneration has been performed once before using the second and subsequent phase Z outputs.

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**Applied Functions**

# 6-6 Brake Interlock

## Outline of Operation

- This function lets you set the output timing for the brake interlock (BKIR) signal 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 (BKIR) signal turns OFF and power supply stops. | P.8-44 |
| Pn438 | Brake Timing during Operation | Set the time after a servo OFF command is issued while the motor is rotating, until the brake interlock (BKIR) signal turns OFF and power supply stops. If the speed drops to 30 r/min or below before the time set here, BKIR will turn OFF. | P.8-44 |
| Pn439 | Brake clear speed setting | To set the speed threshold for run time mechanical brake output determination | P.8-44 |

## Precautions for Correct Use of Holding Brake

- The brake on a Servomotor with brake is a normally closed brake designed only to hold when stopped.
  Accordingly, set an appropriate time so that the brake will actuate 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.

**6**

**Applied Functions**

Accurax G5 AC SERVOMOTOR AND SERVO DRIVE USER'S MANUAL

## Operation

### Servo ON/OFF Operation Timings <when Motor Is Stopped>
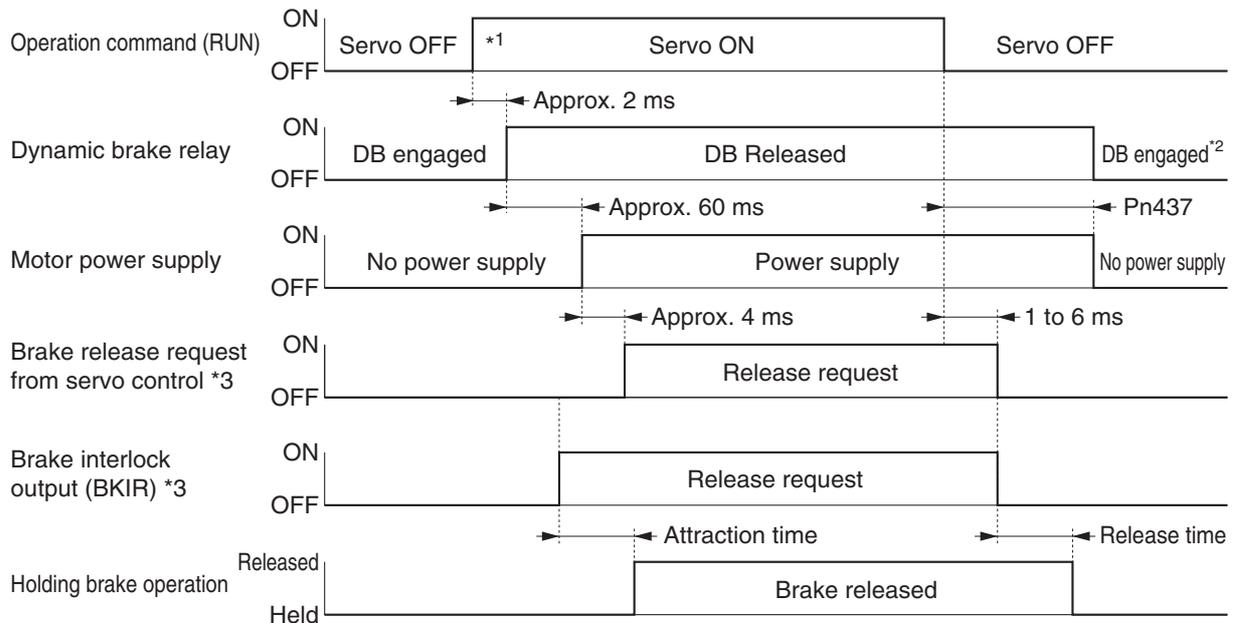
| Operation command (RUN) | ON / OFF | Servo OFF | *1 | Servo ON | | Servo OFF |

*Timing chart:*

- Operation command (RUN): Servo OFF → *1 → Servo ON → Servo OFF
- Approx. 2 ms
- Dynamic brake relay: DB engaged → DB Released → DB engaged *2
- Approx. 60 ms / Pn437
- Motor power supply: No power supply → Power supply → No power supply
- Approx. 4 ms / 1 to 6 ms
- Brake release request from servo control *3: Release request
- Brake interlock output (BKIR) *3: Release request
- Attraction time / Release time
- Holding brake operation: Released / Held → Brake released

*1. The servo will 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 (BKIR) signal is output upon a release request from servo control. The BKIR signal is allocated to a CN1 general-purpose output to be used.

Note: The brake attraction time and release time vary depending on the Servomotor brake. For details, refer to "3-3 Motor Specifications" (P.3-59).

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**Applied Functions**

## 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.
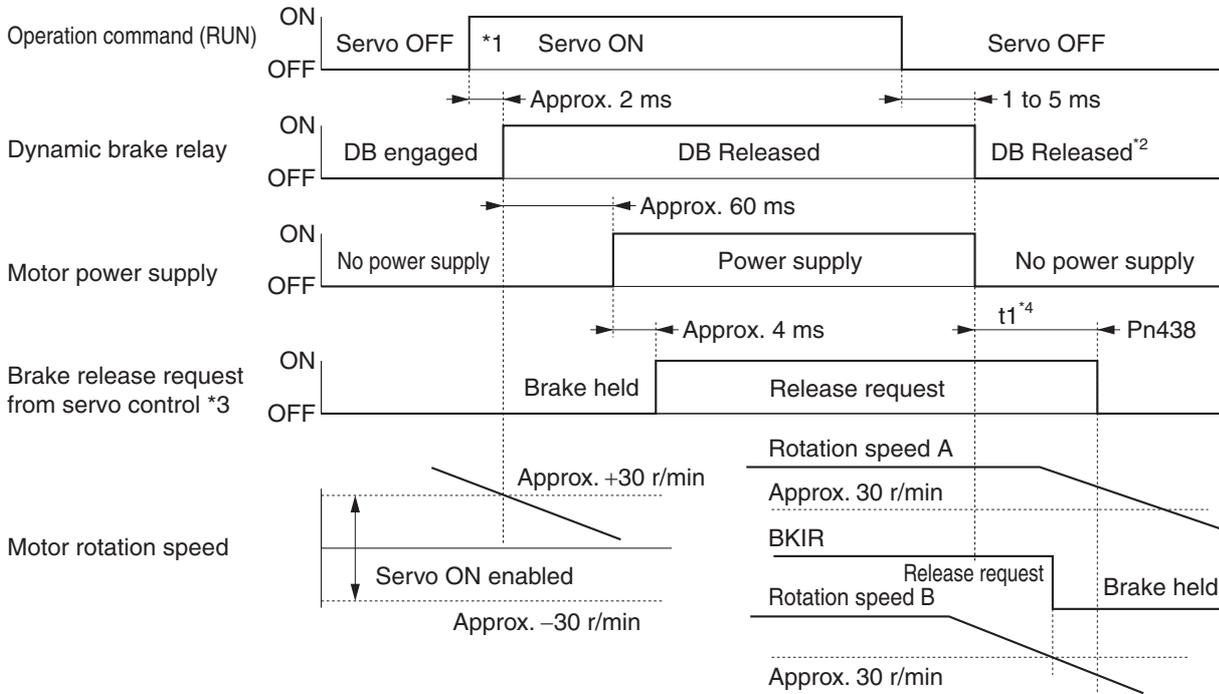


*1. The servo will not turn ON until the motor rotation speed drops to approx. 30 r/min or below.

*2. The dynamic brake operation when the servo is OFF depends on Stop Selection with Servo OFF (Pn506).

*3. The brake interlock (BKIR) signal is output upon a release request from servo control. The BKIR signal is allocated to a CN1 general-purpose output to be used.

In the above example, no release request is received from the network.

*4. t1 is the set value of Brake Timing during Operation (Pn438), or the time needed for the motor rotation speed to drop to 30 r/min or below, whichever occurs first.

Note: Even when the servo ON input is turned ON again while the motor is decelerating, the system will not enter the servo ON state until the motor stops.

### Operation Timings when Alarm Generates (Servo ON)
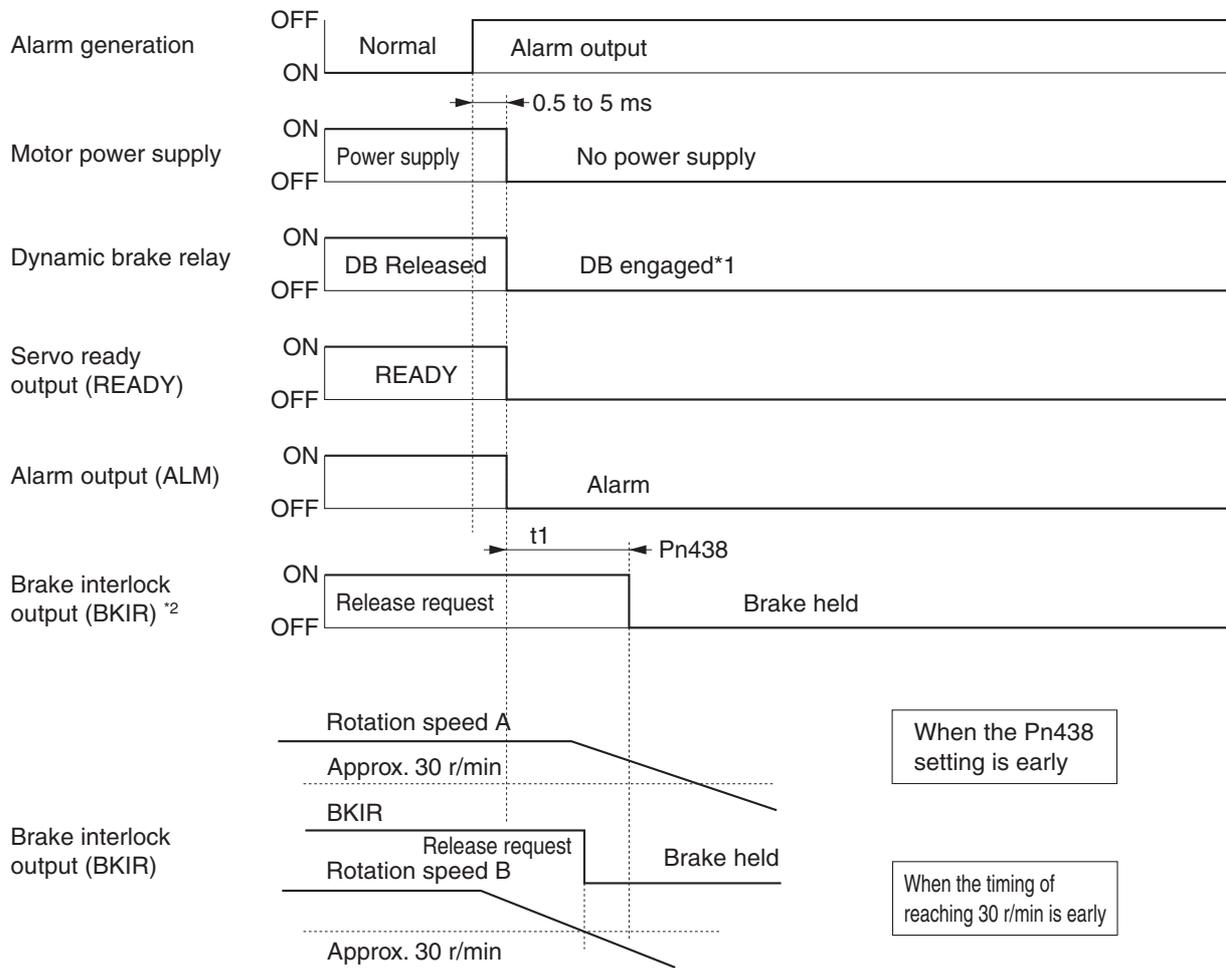


*1. The dynamic brake operation when an alarm generates depends on Stop Selection with Servo OFF (Pn506).

*2. t1 is the set value of Brake Timing during Operation (Pn438), or the time needed for the motor rotation speed to drop to 30 r/min or below, whichever occurs first.

Note 1. Even when the servo ON input is turned ON again while the motor is decelerating, the system will not enter the servo ON state until the motor stops. The brake interlock (BKIR) signal is allocated to a CN1 general-purpose output to be used.

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 will occur, in which case this operation timing will be applied.

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**Applied Functions**

## Operation Timings at Alarm Reset

Reset alarms by turning OFF the power supply and then turning it ON again.
The alarm reset input recognition time can be changed using Alarm Reset Condition Selection (Pn516). The default setting is 120 ms.
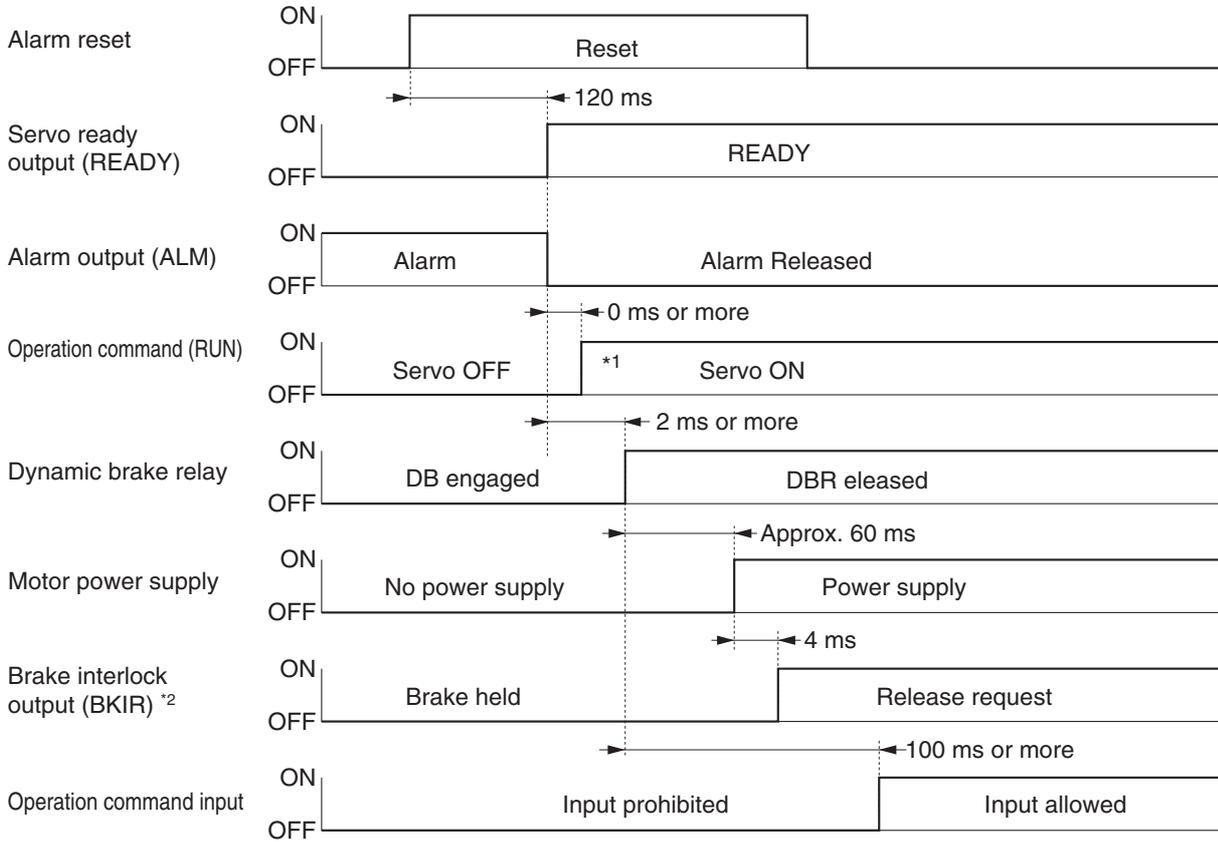


*1. The servo will not turn ON until the motor rotation speed drops to approx. 30 r/min or below.

*2. The brake interlock (BKIR) signal is output upon a release request from servo control. The BKIR signal is allocated to a CN1 general-purpose output to be used.

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.

# 6-7   Gain Switching Function

## Outline of Operation

- 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.
- Use gain switching when the realtime autotuning does not operate effectively, etc. (see below.)
    - 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.

Note. When the gain 2 has been selected, realtime autotuning will not operate normally. If using the gain switching, set the Realtime Autotuning to "not use" (Pn002 = 0).

**6**

**Applied Functions**

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn114 | GAIN SWITCHING ENABLE | Set whether to enable or disable gain switching function. | P.8-13 |

POSITION CONTROL mode

| | | | |
|---|---|---|---|
| Pn115 | SWITCHING mode in Position Control | Set the condition for switching between gain 1 and gain 2. | P.8-14 |
| Pn116 | Gain Switching Delay Time in Position Control | Set the delay time for switching from gain 1 to gain 2. (Unit: 0.1 ms) | P.8-16 |
| Pn117 | Gain Switching Level in Position Control | Set the judgment level for switching between the gain 1 and gain 2. | P.8-16 |
| 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.8-16 |
| Pn119 | Position Gain Switching Time | Set the time to change from one position gain to the other one. (Unit: 0.1 ms) | P.8-16 |

SPEED CONTROL mode

| | | | |
|---|---|---|---|
| Pn120 | SWITCHING mode in Speed Control | Set the condition for switching between gain 1 and gain 2. | P.8-16 |
| Pn121 | Gain Switching Delay Time in Speed Control | Set the delay to return from the gain 2 to gain 1. (Unit: 0.1 ms) | P.8-18 |
| Pn122 | Gain Switching Level in Speed Control | Set the judgment level for switching between the gain 1 and gain 2. | P.8-18 |
| 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.8-18 |

TORQUE CONTROL mode

| | | | |
|---|---|---|---|
| Pn124 | SWITCHING mode in Torque Control | Set the condition for switching between gain 1 and gain 2. | P.8-19 |
| 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.8-20 |
| Pn126 | Gain Switching Level in Torque Control | Set the judgment level for switching between the gain 1 and gain 2. | P.8-20 |
| 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.8-20 |

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**Applied Functions**

## Diagrams of 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.
For the details of each gain, refer to "Chapter 8, Parameters Details".

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.6-31).

### GAIN SWITCHING mode = 2: Gain Switching (GSEL)

Instant switching occurs when a gain switching command is issued from the network.



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**Applied Functions**
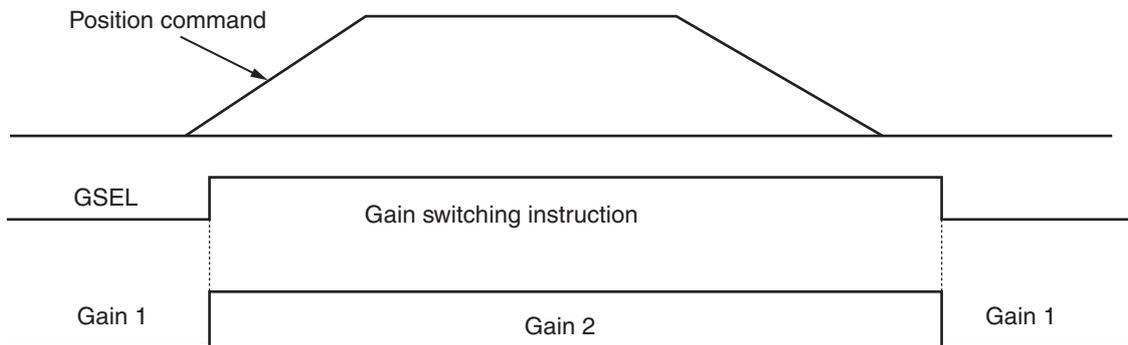
### GAIN SWITCHING mode = 3: Switching by Torque Command Change Amount

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 will be 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.)
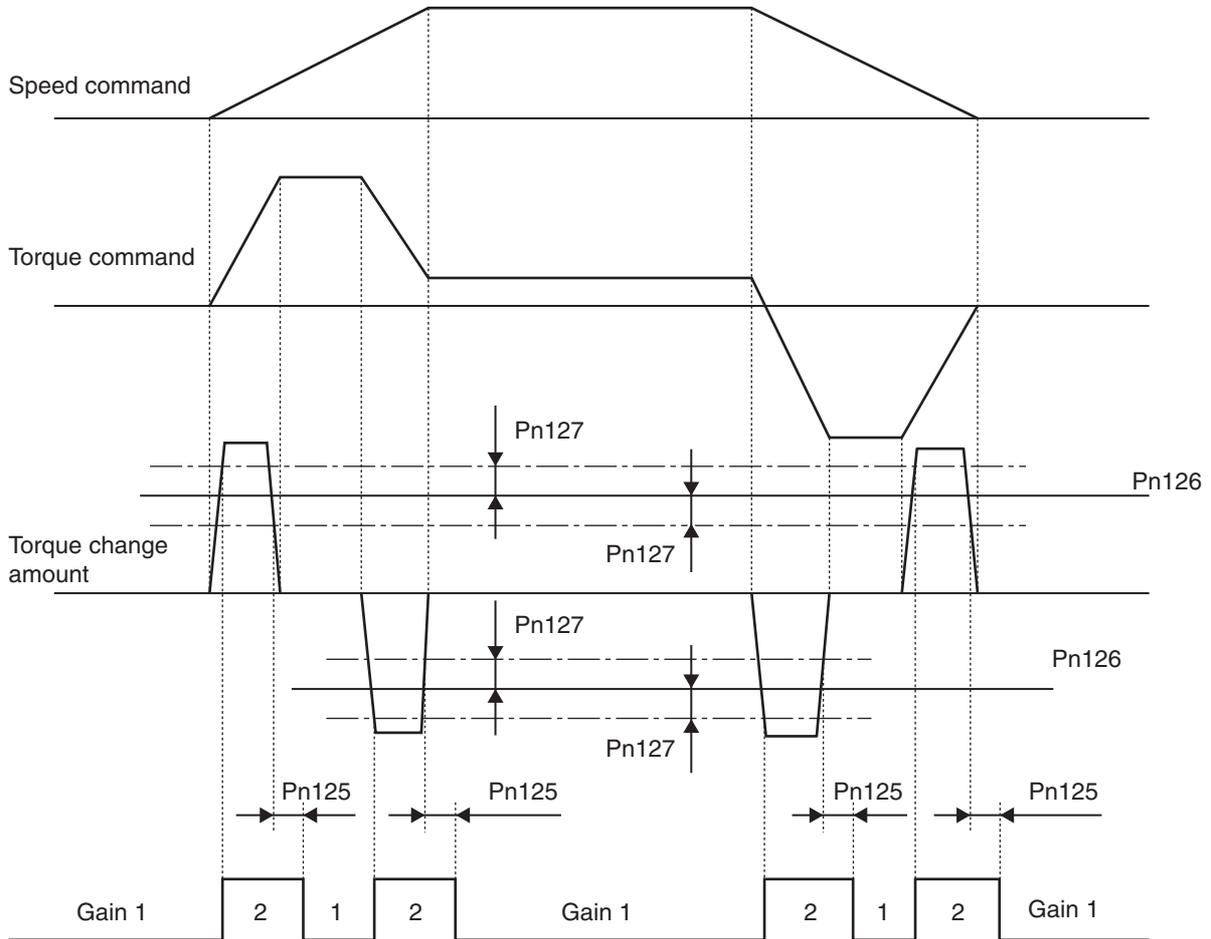


### GAIN SWITCHING mode = 5, 9: Switching by Speed Command or Actual Motor Speed
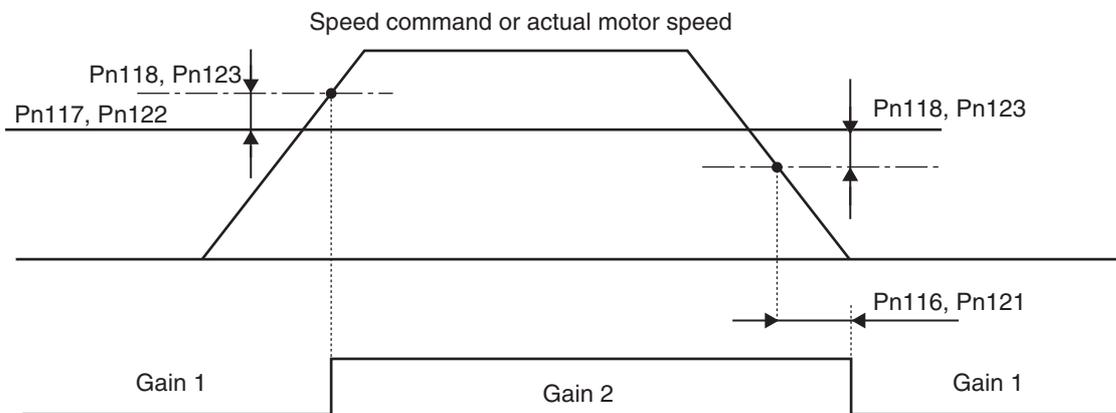
**GAIN SWITCHING mode (Pn031) = 6: Switching by Amount of Position Error**

Gain switching occurs based on the accumulated count in the error counter.

Amount of position error

Pn118

Pn117

Pn118

Pn116

Gain 1

Gain 2

Gain 1
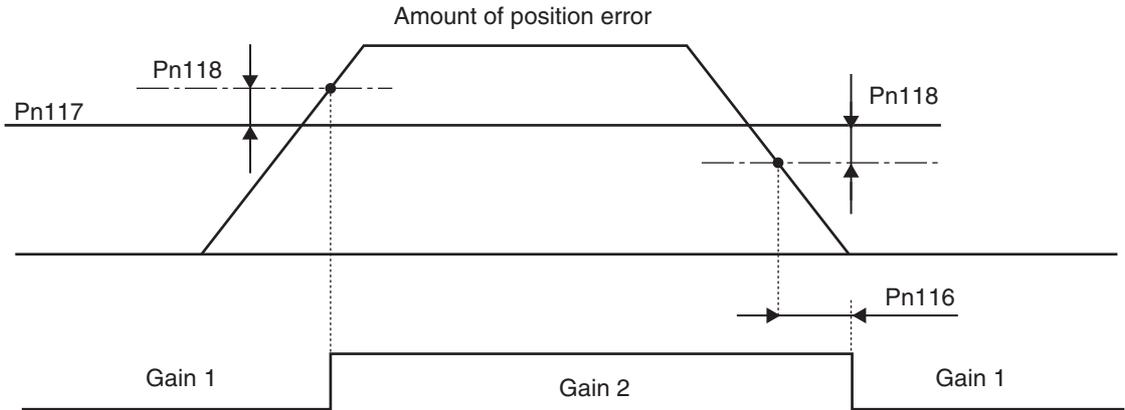
**GAIN SWITCHING mode = 7: Switching by Position Command Received**

Gain switching occurs when a position command corresponding to 1 command unit or more is received.

Position command

Pn116

Gain 1

Gain 2

Gain 1

**6**

**Applied Functions**
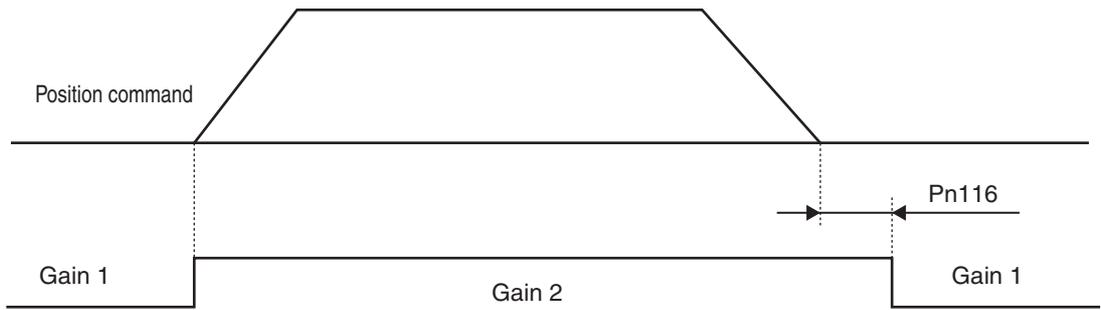
### GAIN SWITCHING mode = 8: Switching by Positioning Completion Signal OFF

Switching to the gain 2 occurs when the error counter accumulated pulse exceeds the Positioning Completion Range 1 (Pn431).

Amount of error counter accumulated pulse
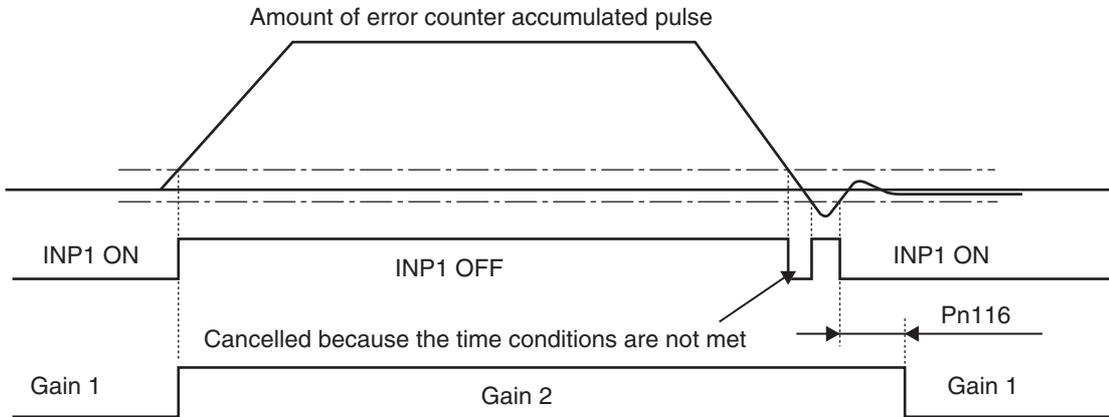


### GAIN SWITCHING mode = 10: Switching by Combination of Position Command Received and Speed

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 will occur.
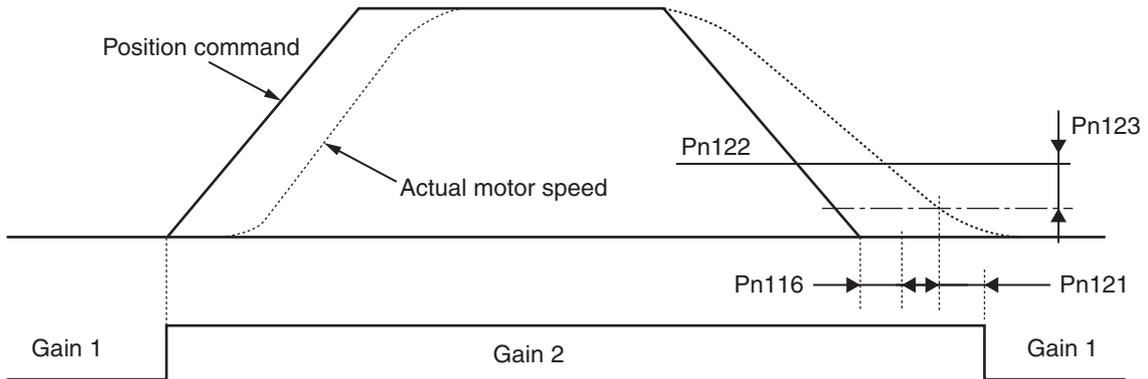


## Timings by Position Gain Switching Time (Pn119)

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 Pn119. 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.

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**Applied Functions**
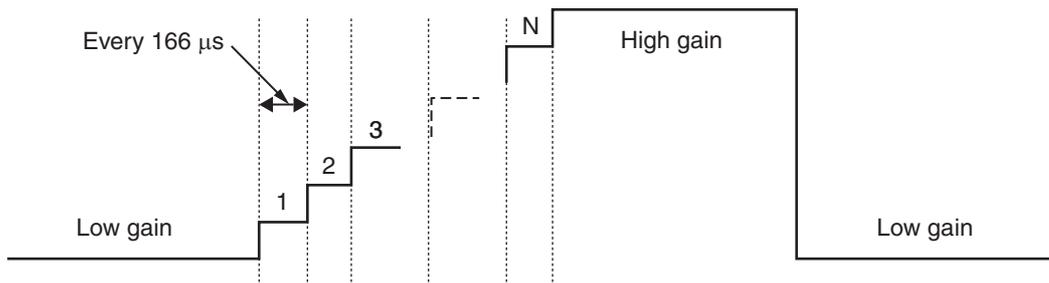
## Gain Switching Setting for Each CONTROL mode

The settable switching conditions vary depending on the CONTROL mode used. Set the parameters for each CONTROL mode.

### POSITION CONTROL mode

In the POSITION CONTROL mode, it varies as follows according to GAIN SWITCHING mode in Position Control (Pn115).

(√: Enabled, − : Disabled)

| Pn115 set value | Switching conditions | Gain Switching Delay Time (Pn116) | Gain Switching Level (Pn117) | Gain Switching Hysteresis (Pn118) | Position Gain Switching Time (Pn119) |
|---|---|---|---|---|---|
| 0 | Always gain 1 | − | − | − | − |
| 1 | Always gain 2 | − | − | − | − |
| 2 | Switching from gain switching (GSEL) | − | − | − | √ |
| 3 | Torque command change amount | √ | √ [× 0.05%] | √ [× 0.05%] | √ |
| 4 | Always gain 1 | − | − | − | − |
| 5 | Command speed | √ | √ [r/min] | √ [r/min] | √ |
| 6 | Amount of position error | √ | √ [pulse] | √ [pulse] | √ |
| 7 | Position command received | √ | − | − | √ |
| 8 | Positioning completion signal (INP1) OFF | √ | − | − | √ |
| 9 | Actual motor speed | √ | √ [r/min] | √ [r/min] | √ |
| 10 | Combination of position command received and speed | √ | √ | √ | √ |

### SPEED CONTROL mode

In the SPEED CONTROL mode, it varies as follows according to GAIN SWITCHING mode in Speed Control (Pn120).

(√: Enabled, − : Disabled)

| Pn120 set value | Switching conditions | Gain Switching Delay Time (Pn121) | Gain Switching Level (Pn122) | Gain Switching Hysteresis (Pn123) |
|---|---|---|---|---|
| 0 | Always gain 1 | − | − | − |
| 1 | Always gain 2 | − | − | − |
| 2 | Switching from gain switching (GSEL) | − | − | − |
| 3 | Torque command change amount | √ | √ [× 0.05%] | √ [× 0.05%] |
| 4 | Amount of change in speed command | − | − | − |
| 5 | Speed command | √ | √ [r/min] | √ [r/min] |

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### TORQUE CONTROL mode

In the TORQUE CONTROL mode, it varies as follows according to GAIN SWITCHING mode in Torque Control (Pn124).

($\sqrt{}$: Enabled, − : Disabled)

| Pn124 set value | Switching conditions | Gain Switching Delay Time (Pn125) | Gain Switching Level (Pn126) | Gain Switching Hysteresis (Pn127) |
|---|---|---|---|---|
| 0 | Always gain 1 | − | − | − |
| 1 | Always gain 2 | − | − | − |
| 2 | Switching from gain switching (GSEL) | − | − | − |
| 3 | Torque command change amount | $\sqrt{}$ | $\sqrt{}$ [× 0.05%] | $\sqrt{}$ [× 0.05%] |

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# 6-8 Gain Switching 3 Function

## Outline of Operation

You can newly set gain 3 right before stopping to the gain switching function of GAIN SWITCHING INPUT OPERATING mode Selection (Pn114).
You can use the gain 3 switching function in the following situations for position control or full closing control.

⬩ When servo is ON
⬩ When there is no trouble with the motor's normal rotation

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn605 | Gain 3 Effective Time | Set effective time of gain 3. | P.8-59 |
| Pn606 | Gain 3 Ratio Setting | Set gain 3 as a multiple of gain 1. | P.8-59 |

## Operation

### Gains 1, 2 and 3 Operation Timings

Example: When the SWITCHING mode in position control = 7 and the switching condition is set to position command received

Position command speed [r/min]

Pn605×0.1ms

Gain 2          Gain 3          Gain 1
Pn105 to Pn109              Pn100 to Pn104

Gain 3 region

Position loop gain=Pn100×Pn606/100

Speed loop gain=Pn101×Pn606/100
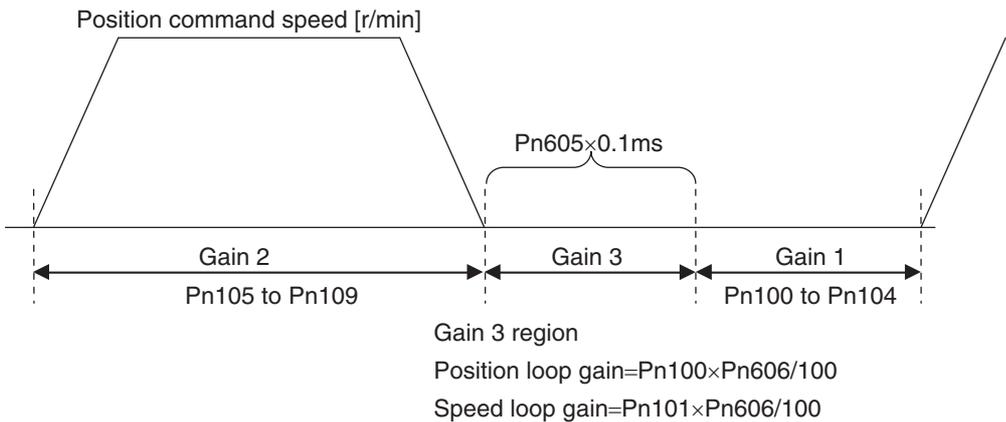
Continue to use gain 1 value for the speed loop integral time constant, speed feedback filter time constant, and torque command filter time constant.

**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 0.
⬩ Only the position loop gain and the speed loop gain are treated as gain 3 in the gain 3 region, 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 will be a gain 3 region even when gain 2 is switched to gain 1 due to a parameter change and so forth.

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**Applied Functions**

# 6-9 Torque Limit

## Outline of Operation

⋄ The output torque by the Servomotor can be limited.
⋄ 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.
⋄ Various methods are available according to Torque Control Selection (Pn521).

## 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.8-55 |
| Pn013 | No. 1 Torque Limit | Set the No. 1 motor output torque limit value. | P.8-7 |
| Pn522 | No. 2 Torque Limit | Set the No. 2 motor output torque limit value. | P.8-55 |
| Pn523 | Torque Limit Switching Rate 1 | Set the rate of change (fluctuate) when switching from the No. 1 torque limit to No. 2 torque limit. | P.8-56 |
| Pn524 | Torque Limit Switching Rate 2 | Set the rate of change (fluctuate) when switching from the No. 2 torque limit to No. 1 torque limit. | P.8-56 |
| Pn525 | Forward External Torque Limit | Set the forward torque limit using a digital signal. | P.8-56 |
| Pn526 | Reverse External Torque Limit | Set the reverse torque limit using a digital signal. | P.8-56 |
| Pn527 | Analog Torque Limit Scale | Gain for the analogue torque input. | P.8-56 |
| Pn425 | Analog Input 2 Offset | Set the offset adjustment value for the voltage applied to analog input 2. | P.8-40 |
| Pn426 | Analog Input 2 Filter Time Constant | Set the time constant of the first-order lag filter for the voltage applied to analog input 2. | P.8-40 |
| Pn428 | Analog Input 3 Offset | Set the offset adjustment value for the voltage applied to analog input 3. | P.8-41 |
| Pn429 | Analog Input 3 Filter Time Constant | Set the time constant of the first-order lag filter for the voltage applied to analog input 3. | P.8-41 |

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**Applied Functions**

## Torque Limit in Position, Speed and Full Closing Controls

| Pn521 set value | Explanation |
|---|---|
| 0 | Forward operation: Set by PCL (0 to 10 V)<br>Reverse operation: Set by NCL (−10 to 0 V) |
| 1 | Limit in both forward and reverse operation: Set by Pn013 |
| 2 | Forward operation: Set by Pn013<br>Reverse operation: Set by Pn522 |
| 3 | Switch the limit value using torque limit switching (TLSEL).<br>When TLSEL is OFF<br>Limit in both forward and reverse operation: Pn013<br>When TLSEL is ON<br>Limit in both forward and reverse operation: Pn522 |
| 4 | Forward operation: Set by PCL (0 to 10 V)<br>Reverse operation: Set by NCL (0 to 10 V) |
| 5 | Limit in both forward and reverse operation: Set by PCL (0 to 10 V) |
| 6 | Switch the limit value using torque limit switching (TLSEL).<br>When TLSEL is OFF<br>Forward operation: Pn013<br>Reverse operation: Pn522<br>When TLSEL is ON<br>Forward operation: Pn525<br>Reverse operation: Pn526 |

⬧ For the torque limit in torque control, always select No. 1 Torque Limit (Pn013).
⬧ The torque limit under torque feed-forward selection is enable only during speed control when the set value is 1 to 3.
⬧ PCL signal is asigned to the terminal 16 in CN1. See chapter 3 for details about the conection.
⬧ NCL signal is asigned to the terminal 18 in CN1. See chapter 3 for details about the conection.

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## Rate of Change Setting at Switching (Pn521 = 3)

If 3 is set in Torque Limit Selection (Pn521), you can add fluctuate the change at the time of switching. This function is disabled in any other setting.

### How to Set Rate of Change (Fluctuate)

Set the parameter according to the switching type.
• From No. 1 torque limit to No. 2 torque limit: Pn523
• From No. 2 torque limit to No. 1 torque limit: Pn524
The sign of the rate of change switches automatically inside the driver based on the magnitude correlation of the No. 1 torque limit and No. 2 torque limit.
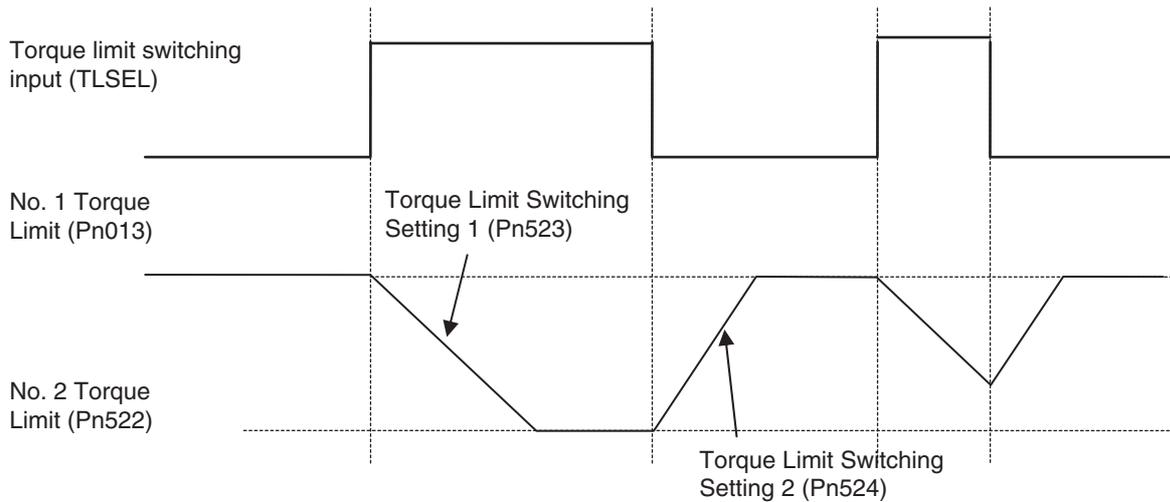


If the setting of No. 1 Torque Limit (Pn013) or No. 2 Torque Limit (Pn522) is changed from the front panel or CX-Drive, the rate of change setting will be ignored and the new torque limit value will be applied immediately.

## Torque Limit Set Value for Each Servomotor

• The setting range for the torque limit selection is 0% to 300% and the standard default setting is 300% except for the following combinations of drivers and motors.

| Driver | Applicable motor | Maximum torque limit [%] |
|---|---|---|
| R88D-KT15x | R88M-K90010x | 225 |
| R88D-KT30x | R88M-K2K010x | 250 |
| R88D-KT50x | R88M-K3K010x | 250 |
| | R88M-K4K510x | 263 |
| R88D-KT75x | R88M-K6K010x | 272 |
| R88D-KT75H | R88M-K7K515T | 265 |
| R88D-KT75F | R88M-K7K515C | 267 |
| R88D-KT150x | R88M-K11K015x | 265 |
| | R88M-K15K015x | 253 |

# 6-10 Sequence I/O Signal

## Outline of Operation

♦ 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.3-18).

## 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.6-38) for more information because some signals have allocation limitations.
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" when you change the allocation to use.

| Applicable parameters | Input signals | Default set value | Default setting state | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Position control or full closing control | | Speed control | | Torque control | |
| | | | Signal name | Logic | Signal name | Logic | Signal name | Logic |
| Pn400 | SI1 input | 00828282h (8553090) | NOT | NC | NOT | NC | NOT | NC |
| Pn401 | SI2 input | 00818181h (8487297) | POT | NC | POT | NC | POT | NC |
| Pn402 | SI3 input | 0091910Ah (9539850) | DFSEL1 | NO | VZERO | NC | VZERO | NC |
| Pn403 | SI4 input | 00060606h (394758) | GSEL | NO | GSEL | NO | GSEL | NO |
| Pn404 | SI5 input | 0000100Ch (4108) | GESEL1 | NO | VSEL3 | NO | – | – |
| Pn405 | SI6 input | 00030303h (1979379) | RUN | NO | RUN | NO | RUN | NO |
| Pn406 | SI7 input | 00000f07h (3847) | ECRST | NO | VSEL2 | NO | – | – |
| Pn407 | SI8 input | 00040404h (263172) | RESET | NO | RESET | NO | RESET | NO |
| Pn408 | SI9 input | 00050505h (328965) | TVSEL | NO | TVSEL | NO | TVSEL | NO |
| Pn409 | SI10 input | 00000E88h (3720) | IPG | NC | VSEL1 | NO | – | – |

Contacts NO and NC in the logic fields indicate the following statuses.

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**Applied Functions**

Contact NO: Disabled (OFF) when signal input is open with COM−
　　　　　　Enabled (ON) when signal input is shorted with COM−

Contact 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".

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn400 | Input Signal Selection 1 | Set the SI1 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.8-36 |
| Pn401 | Input Signal Selection 2 | Set the SI2 input function allocation. | P.8-36 |
| Pn402 | Input Signal Selection 3 | Set the SI3 input function allocation. | P.8-36 |
| Pn403 | Input Signal Selection 4 | Set the SI4 input function allocation. | P.8-36 |
| Pn404 | Input Signal Selection 5 | Set the SI5 input function allocation. | P.8-36 |
| Pn405 | Input Signal Selection 6 | Set the SI6 input function allocation. | P.8-36 |
| Pn406 | Input Signal Selection 7 | Set the SI7 input function allocation. | P.8-36 |
| Pn407 | Input Signal Selection 8 | Set the SI8 input function allocation. | P.8-36 |
| Pn408 | Input Signal Selection 9 | Set the SI9 input function allocation. | P.8-36 |
| Pn409 | Input Signal Selection 10 | Set the SI10 input function allocation. | P.8-36 |

## Input Signal Allocation Method

Input the setting for each CONTROL mode in any of the parameters of Pn400 to Pn409 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 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
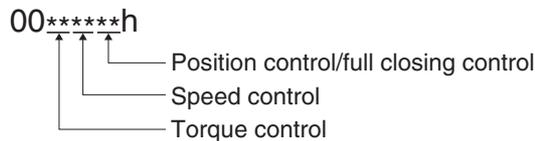
Example:
Position control or full closing control: Electronic gear switching input 1 for contact NO (0Ch)
Speed control:　　　　　　　　　　　　Internally set speed selection 1 for contact NC (8Eh)
Torque control:　　　　　　　　　　　　Disabled (00h)

00008E0Ch
　　　　└── Position control/full closing control
　　　└──── Speed control
　　└────── Torque control
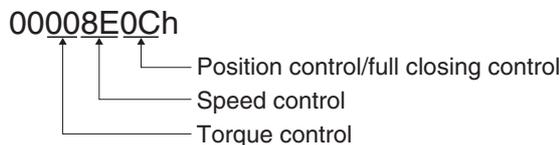
This will be 36364 since the front panel display is in decimal numbers.

**Function Number Table**

The set values to be used for allocations are as follows.

| Signal name | Symbol | Set value | |
|---|---|---|---|
| | | Contact NO | Contact NC |
| Disabled | – | 00h | Setting not available |
| Forward drive prohibition input | POT | 01h | 81h |
| Reverse drive prohibition input | NOT | 02h | 82h |
| Operation command [*1] | RUN | 03h | 83h |
| Alarm reset input | RESET | 04h | Setting not available |
| CONTROL mode switching input | TVSEL | 05h | 85h |
| Gain switching | GSEL | 06h | 86h |
| Error counter reset input [*2] | ECRST | 07h | Setting not available |
| Pulse prohibition input [*3] | IPG | 08h | 88h |
| Torque limit switching | TLSEL | 09h | 89h |
| Vibration filter switching 1 | DFSEL1 | 0Ah | 8Ah |
| Vibration filter switching 2 | DFSEL2 | 0Bh | 8Bh |
| Electronic gear switching input 1 | DIV1 | 0Ch | 8Ch |
| Electronic gear switching input 2 | DIV2 | 0Dh | 8Dh |
| Internally set speed selection 1 | VSEL1 | 0Eh | 8Eh |
| Internally set speed selection 2 | VSEL2 | 0Fh | 8Fh |
| Internally set speed selection 3 | VSEL3 | 10h | 90h |
| Zero speed designation input | VZERO | 11h | 91h |
| Speed command sign input | VSIGN | 12h | 92h |
| Torque command sign input | TSIGN | 13h | 93h |
| Forced alarm input | E-STOP | 14h | 94h |
| Inertia ratio switching input | J-SEL | 15h | 95h |

*1 The operation command (RUN) always needs to be allocated. Servo cannot be turned ON if it is not allocated.

*2 Allocate this to Input Signal Selection 7 (Pn406). An error will occur if it is allocated to anything other than that.

*3 Allocate this to Input Signal Selection 10 (Pn409). An error will occur if it is allocated to anything other than that.

📝 Precautions for Correct Use

⬩ Do not use any values other than the settings listed.
⬩ If you allocate the same function to multiple input signals, interface input duplicate allocation error 1 (Err33.0) or interface input duplicate allocation error 2 (Err33.1) will occur.
⬩ You can allocate error counter reset input (ECRST) to Input Signal Selection 7 (Pn406) only. If you allocate it to anything other than that, a counter reset allocation error (Err33.6) will occur.
⬩ You can allocate pulse prohibition input (IPG) to Input Signal Selection 10 (Pn409) only. If you allocate it to anything other than that, a command pulse prohibition input allocation error (Err33.7) will occur.
⬩ If you are using the CONTROL mode switching input (TVSEL), you must set it for all CONTROL modes. If you do not set it for all CONTROL modes, interface input function number error 1 (Err33.2) or interface input function number error 2 (Err33.3) will occur.
⬩ If you set Zero Speed Designation Selection (Pn315) to 2 or 3, you must always allocate zero speed designation input (VZERO) in speed control for the same pin where zero speed designation

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**Applied Functions**

input (VZERO) is allocated for speed control. In addition, specify the same settings for the logic.

⬥ Be sure to allocate the functions that are used by multiple CONTROL modes (such as operation command and alarm reset input) to the same pin, and do the same for the logic. If this is not set correctly, interface input duplicate allocation error 1 (Err33.0) or interface input duplicate allocation error 2 (Err33.1) will occur.

⬥ You must always allocate the operation command (RUN). Servo cannot be turned ON if it is not allocated.

## 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" when you change the allocation to use.

| Applicable parameters | Output Signals | Default set value | Default setting state | | |
|---|---|---|---|---|---|
| | | | Position control or full closing control | Speed control | Torque control |
| | | | Signal name | Signal name | Signal name |
| Pn410 | SO1 output | 00030303h (197379) | BKIR | BKIR | BKIR |
| Pn411 | SO2 output | 00020202h (131586) | READY | READY | READY |
| Pn412 | SO3 output | *1 | ALM | ALM | ALM |
| Pn413 | SO4 output | 00050504h (328964) | INP | TGON | TGON |

*1  Alarm output signal allocations cannot be changed.

### 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 SO1 input function allocation. This parameter is based on the hex display standard. Refer to the output signal function number table for details. | P.8-36 |
| Pn411 | Output Signal Selection 2 | Set the SO2 input function allocation. | P.8-36 |
| Pn412 | Output Signal Selection 3 | Set the SO3 input function allocation. This parameter is always fixed to the alarm output signals. | P.8-36 |
| Pn413 | Output Signal Selection 4 | Set the SO4 input function allocation. | P.8-36 |

## Output Signal Allocation Method

Input the setting for each CONTROL mode in any of the parameters of Pn410 to Pn413 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
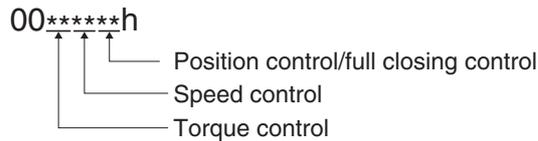
Example:
Position control or full closing control: Speed conformity output (08h)
Speed control: Motor rotation speed detection output (05h)
Torque control: Zero speed detection signal (07h)

$$00070508h$$

⎯ Position control/full closing control
⎯ Speed control
⎯ Torque control
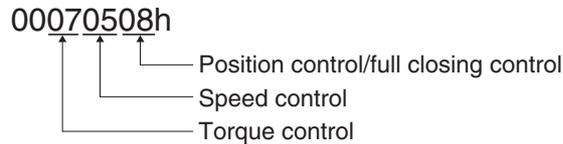
This will be 460040 since the front panel display is in decimal numbers.

### Function Number Table

The set values to be used for allocations are as follows.

| Signal name | Symbol | Set value |
|---|---|---|
| Disabled | – | 00h |
| Servo ready completed output | READY | 02h |
| Brake interlock output | BKIR | 03h |
| Positioning completion output | INP | 04h |
| Motor rotation speed detection output | TGON | 05h |
| Torque limiting signal | TLC | 06h |
| Zero speed detection signal | ZSP | 07h |
| Speed conformity output | TGON | 08h |
| Warning output 1 | WARN1 | 09h |
| Warning output 2 | WARN2 | 0Ah |
| Position command status output | P-CMD | 0Bh |
| Positioning completion 2 | INP2 | 0Ch |
| Output during speed limit | V-LIMIT | 0Dh |
| Alarm attribute output | ALM-ATB | 0Eh |
| Speed command status output | V-CMD | 0Fh |

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Precautions for Correct Use

- Do not use any values other than the settings listed.
- You can allocate the same function to multiple output signals.
- You cannot change the output signal logic. When the function is disabled (OFF), signal input is open with COM−, and when the function is enabled (ON), signal input is shorted with COM−.

# 6-11 Forward and Reverse Drive Prohibition Functions

## Outline of Operation

- When the forward drive prohibition input (POT) and the reverse drive prohibition input (NOT) are turned OFF, the motor will stop 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 Pn409 | Input Signal Selection 1 to 10 | Set the input signal allocation and logic. In the default setting, the allocations are as follows. Pn400 (CN1 - pin 8): NOT (Logic contact NC) Pn401 (CN1 - pin 9): POT (Logic contact NC) | |
| Pn504 | Drive Prohibition Input Selection | Set the operation to be performed upon forward and reverse drive prohibition input. | |
| Pn505 | Stop Selection for Drive Prohibition Input | Set the deceleration and stop methods upon forward and reverse drive prohibition input. | |

### Input Signal Selection Function (Default setting: Pn400, Pn401)

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 |
| Pn400 | Input Signal Selection 1 | 00828282 | NOT (contact NC) | NOT (contact NC) | NOT (contact NC) |
| Pn401 | Input Signal Selection 2 | 00818181 | POT (contact NC) | POT (contact NC) | POT (contact NC) |

- Refer to "6-10 Sequence I/O Signal" (P.6-37) for details on input signal selections 1 to 10.

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## Drive Prohibition Input Selection (Pn504)

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.**<br>The operation when a signal is input will be as follows.<br>   Forward drive prohibition input closed: Forward limit switch not operating and status normal.<br>   Forward drive prohibition input open: Forward direction prohibited and reverse direction permitted.<br>   Reverse drive prohibition input closed: Reverse limit switch not operating and status normal.<br>   Reverse drive prohibition input open: Reverse direction prohibited and forward direction permitted.<br>The Servomotor will decelerate and stop according to the sequence set in Stop Selection for Drive Prohibition Input (Pn505). For details, refer to explanation for Stop Selection for Drive Prohibition Input (Pn505).<br>If the forward and the reverse prohibition inputs are both open, an error will be detected in the driver, and a drive prohibition input error (Err380) will occur. |
| 1 | **Forward and reverse drive prohibition input disabled.** |
| 2 | **Forward and reverse drive prohibition input enabled.**<br>If either the forward or the reverse prohibition input is open, a drive prohibition input error (Err380) will occur. |

## Stop Selection for Drive Prohibition Input (Pn505)

Set the deceleration and stop methods upon a forward or reverse drive prohibition is input.

| Stop Selection for Drive Prohibition Input (Pn505) | Deceleration method | After stopping | Error counter |
|---|---|---|---|
| 0 | Dynamic brake | Torque command = 0 for drive prohibition direction | Held |
| 1 | Free-run (Torque command = 0 for drive prohibition direction) | Torque command = 0 for drive prohibition direction | Held |
| 2 | Immediate stop | Servo lock | Clear before and after deceleration. |
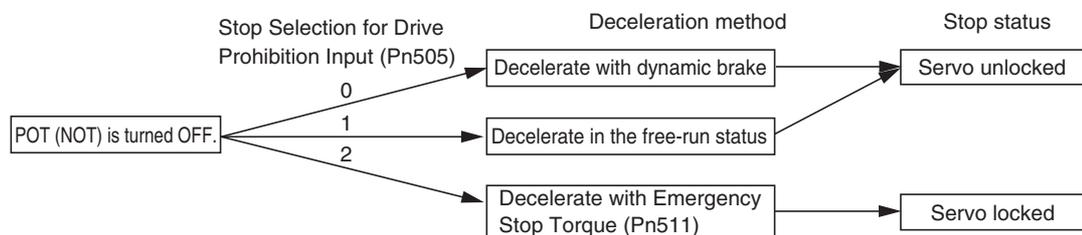


While the Forward Drive Prohibition Input (POT) is OFF, the Servomotor cannot be driven in the forward direction, but it can be driven in the reverse direction. Conversely, while the reverse drive prohibition input (NOT) is OFF, the Servomotor cannot be driven in the reverse direction, but it can be driven in the forward direction.

If immediate stop torque is set for deceleration and servo lock is set for stop (set value: 2), torque limit during deceleration will be limited with the set value of the Immediate Stop Torque (Pn511).

📝 Precautions for Correct Use

⬧ 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 immediate 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.

⬧ Because an immediate stop will force the motor to decelerate quickly, the position error will momentarily be a large value during position control, and Err24.0 "error counter overflow" or Err34.0 "overrun limit error" may occur.In such a case, set the Position Counter Overflow Level (Pn014) and the Overrun Limit Setting (Pn514) to appropriate values.

**6**

**Applied Functions**

# 6-12 Disturbance Observer Function

## Outline of Operation

You can lower the effect of the disturbance torque and reduce the vibration using the estimated disturbance torque value.

You can use the disturbance observer in the following situations for position control or speed control.

⋆ When servo is ON
⋆ When there is no trouble with the motor's normal rotation
⋆ When realtime autotuning function is disabled
⋆ When instantaneous speed observer function is disabled
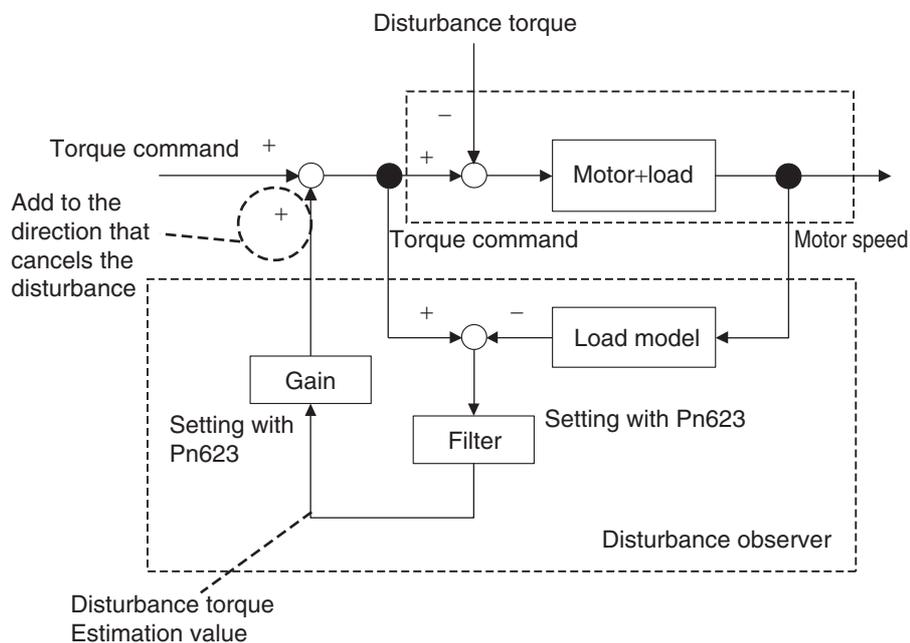


✍ Precautions for Correct Use

⋆ 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.

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn610 | Enable of several function | Set the bits related to the disturbance observer. | P.8-59 |
| Pn623 | Disturbance Torque Compensation Gain | Set the compensation gain for disturbance torque. | P.8-62 |
| Pn624 | Disturbance Observer Filter Setting | Set the filter time constant for disturbance torque compensation. | P.8-62 |

## Operating Procedure

1. **Set the Setting of Each Function (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 Disturbance Torque Compensation Gain (Pn623) to a small value, and then change the value of Disturbance Observer Filter Setting (Pn624) from a large value to a small value. And set to the set value in which the effectiveness of suppressing the impact of disturbance and the operating noise level are balanced.

3. **Set the Disturbance Torque Compensation Gain (Pn623).**

   Change the value of Disturbance Torque Compensation Gain (Pn623) from a small value to a large value. And set to the set value in which the effectiveness of suppressing the impact of disturbance and the operating noise level are balanced0.

**6**

**Applied Functions**

# 6-13 Friction Torque Compensation Function

## Outline of Operation

As a function to reduce the effect of friction, you can set the unbalanced load compensation that always compensates the constantly working offset torque, and the dynamic friction compensation that changes its direction depending on the operating direction.
You can use the torque compensation in the following situations for position control or speed control.

⋆ When servo is ON
⋆ When there is no trouble with the motor's normal rotation

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | 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.8-59 |
| 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.8-59 |
| 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.8-59 |

**6**

**Applied Functions**

## Operation Example

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 and so forth if that torque command value is set.

Forward Direction Torque Offset (Pn608) and Reverse Direction Torque Offset (Pn609) are used with 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.



**6**

**Applied Functions**
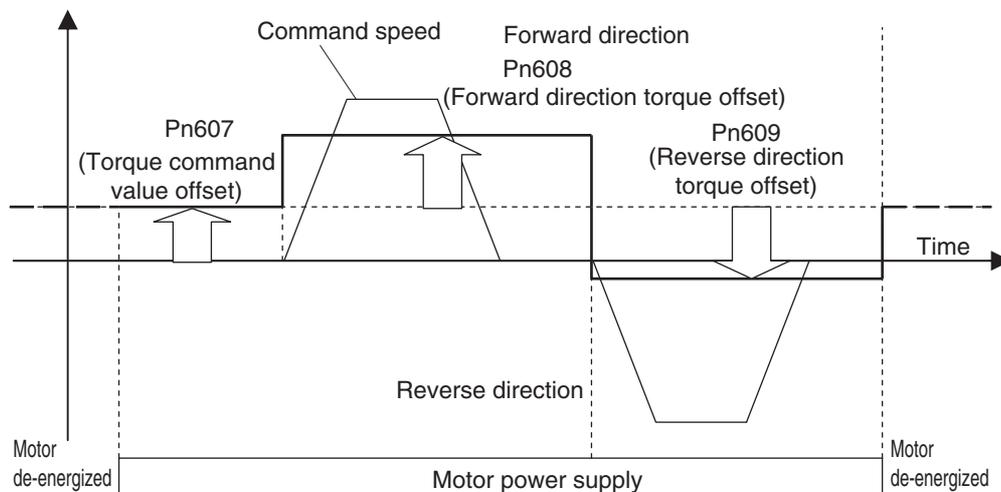
> ✍ Precautions for Correct Use

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

 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 will be held until the first position command is input.When the position command is input, the unbalanced load compensation will be updated based on Pn607.Also, based on the command direction, the dynamic friction compensation value will be updated according to parameters Pn608 or Pn609.

# 6-14 Inertia Ratio Switching Function

## Outline of Operation

You can switch the inertia ratio from 1 or 2 using inertia ratio switching input (JSEL). This functions effectively if used when the load inertia changes in 2 levels.
You can use inertia ratio switching in the following situations.

* When servo is ON
* When there is no trouble with the motor's normal rotation
* When realtime autotuning is disabled
* When adaptive filter function is disabled
* When instantaneous speed observer function is disabled
* When disturbance observer function is disabled

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn610 | Enable of several function | Set the bits related to inertia ratio switching. | P.8-59 |
| Pn004 | Inertia Ratio | Set the inertia ratio 1. | P.8-3 |
| Pn613 | Inertia Ratio 2 | Set the inertia ratio 2. | P.8-60 |

## Operating Procedure

1. **Set the Setting of Each Function (Pn610).**
   Set whether to enable or disable inertia ratio switching in bit 3.
   0: Disabled
   1: Enabled
2. **Set the Inertia Ratio 1 (Pn004).**
3. **Set the Inertia Ratio 2 (Pn613).**
4. **Set the inertia ratio switching input (JSEL).**

| Setting of Each Function (Pn610) | Inertia ratio switching input (JSEL) | Applicable inertia ratio |
|---|---|---|
| When bit 3 = 0: Inertia ratio switching is disabled | OFF | Inertia Ratio 1 (Pn004) |
| | ON | |
| When bit 3 = 1: Inertia ratio switching is enabled | OFF | |
| | ON | Inertia Ratio 2 (Pn613) |

Precautions for Correct Use

* Be sure that the motor is stopped when using the inertia ratio switching function.
* If the difference between inertia ratio 1 and inertia ratio 2 is large, a vibration may occur even if the

motor is stopped. Use it upon confirming that there is no problem with vibration on the actual machine.

**6**

**Applied Functions**

# 6-15 Hybrid Vibration Suppression Function

## Outline of Operation

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.

The hybrid vibration suppression function can be used in the following situations.

⬩ FULL CLOSING CONTROL mode
⬩ When servo is ON
⬩ When there is no trouble with the motor's normal rotation

## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | 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.8-63 |
| Pn635 | Hybrid Vibration Suppression Filter | Set the hybrid vibration suppression filter. | P.8-63 |

## 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.

**6**

**Applied Functions**

# 6-16 Feed-forward Function

## Outline of Operation

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 | Explanation | 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.8-13 |
| 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.8-13 |
| 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.8-13 |
| 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.8-13 |
| Pn600 | Analog Torque Feed-forward Gain Setting | Set the input gain for analog torque feed forward. 0 to 9 will be disabled. | P.8-59 |
| Pn610 | Enable of several function | Set the bits related to inertia ratio switching. | P.8-59 |

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**Applied Functions**

## 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 will be 0 during constant speed operation. 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] $\times$
   (100 - speed feed-forward amount [%]) / 100
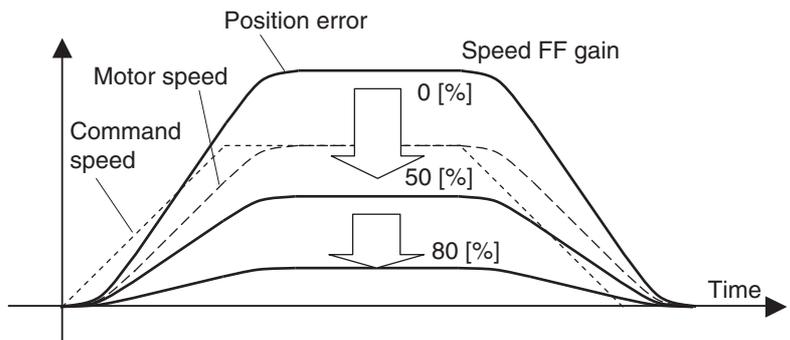


The position error in the range of constant speed becomes smaller as the speed feed-forward gain increases.

 Precautions for Correct Use

- The operating noise may increase when the speed feed forward is enabled if the update cycle of the position command input is longer than the amplifier control cycle, or if the pulse frequency is not uniform. In such cases, apply the position command filter (first-order lag or FIR smoothing) or raise the speed feed-forward filter setting.

## 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 (Pn112).**

Set it to 50 (0.5 ms) or so.

**3. Adjust the Torque Feed-forward Amount (Pn113).**

Gradually increase the value of Torque Feed-forward Amount (Pn113).

Since the position error during acceleration/deceleration at a certain speed can be brought close to 0, it can be brought 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 present and, therefore, the position error cannot be completely 0.
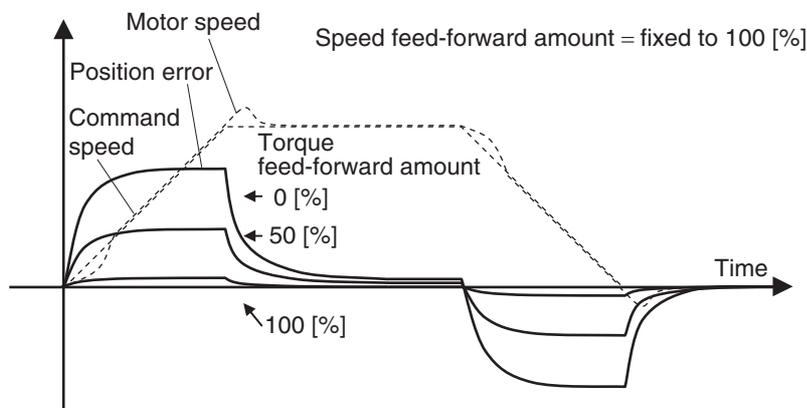


Torque feed forward can reduce the position error in a range of acceleration/deceleration specified.

- When operating in position control, this function normally is used together with the velocity feedforward.

### 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.

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**Applied Functions**

## Application Example of Analog Torque Feed Forward

The analog torque feed forward is enabled when bit 5 of the Setting of Each Function (Pn610) is set to 1. In addition, if analog input 3 is used by another function (for example, analog torque limit), this function is disabled.

It is converted to torque from the voltage [V] that is applied to analog input 3 based on the Analog Torque Feed-forward Gain Setting (Pn600) and is added to the torque command [%]. The conversion from the input voltage [V] to analog input 3 to a torque command [%] to the motor is performed as illustrated in the graph below.The slope of the graph is when Pn600 = 30.The slope changes based on the Pn600 set value.

Torque command [%] = 100 × Input voltage [V] / (Pn600 set value × 0.1)



Accurax G5 AC SERVOMOTOR AND SERVO DRIVE USER'S MANUAL
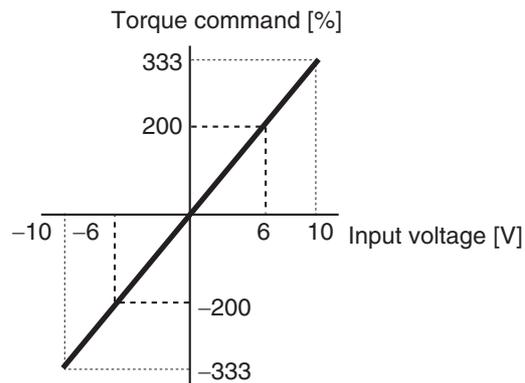
# 6-17 Instantaneous Speed Observer Function

## Outline of Operation

Estimating the motor speed using a load inertia increases responsiveness and reduces vibration at stopping and improves the speed detection accuracy. This function can be used for position control.

The instantaneous speed observer function can be used in the following situations.

- When servo is ON
- When there is no trouble with the motor's normal rotation
- When realtime autotuning is disabled
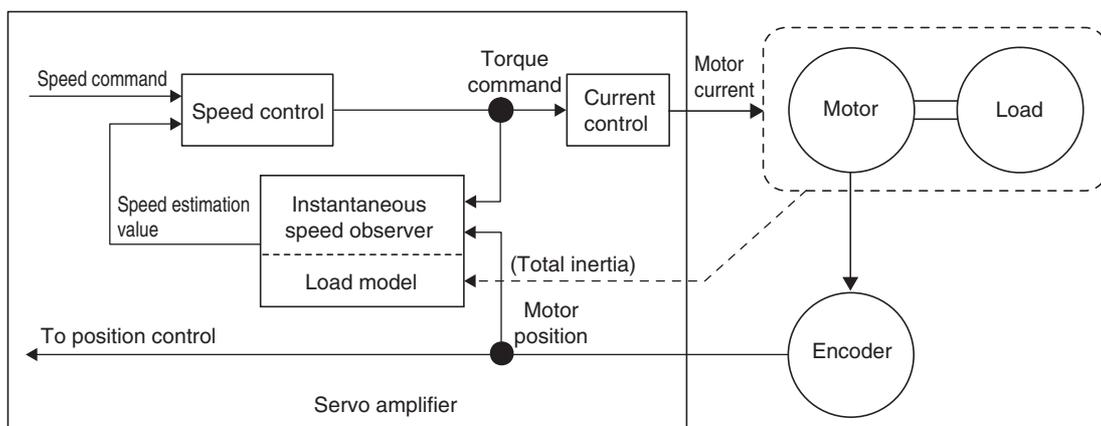


## Parameters Requiring Settings

| Parameter number | Parameter name | Explanation | Reference |
|---|---|---|---|
| Pn610 | Setting of Several Function | Set whether to enable or disable the instantaneous observer function. | P.8-59 |
| Pn004 | Inertia Ratio | Set the inertia ratio 1. | P.8-3 |
| Pn100 | Position Loop Gain | Set the position loop gain. | P.8-10 |
| Pn101 | Speed Loop Gain | Set the speed loop gain. | P.8-11 |
| Pn103 | Velocity detection filter 1 | To select the velocity detection filter 1 setting out of 6 preset values. | P.8-11 |
| Pn108 | Velocity detection filter 1 | To select the velocity detection filter 2 setting out of 6 preset values. | P.8-11 |

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**Applied Functions**

## Operating Procedure

1. **Set the Inertia Ratio (Pn004).**

   Set the inertia ratio as correctly as possible.
   - If the Inertia Ratio (Pn004) is requested 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 (Pn100), Speed Loop Gain (Pn101), Speed Loop Integral Time Constant (Pn102) and Torque Command Filter Time Constant (Pn104).
   If no problem occurs in realtime autotuning, you can continue to use the settings.

3. **Set the Setting of Each Function (Pn610).**

   Set whether to enable or disable the instantaneous speed observer function in bit 0.
   0: Disabled
   1: Enabled
   If you set this to 1 (enabled), the speed detection method will switch 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 (Pn100), Speed Loop Gain (Pn101) or Speed Loop Integral Time Constant (Pn102) is changed, the optimal value for the Inertia Ratio (Pn004) may have changed, 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

**6**

**Applied Functions**

# 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 example.

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# 7-1 Safe Torque OFF (STO) Function

## Outline of Operation

The safe torque OFF (hereinafter referred to as STO according to IEC61800-5-2) 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 driver turns OFF the servo ready completed output (READY) to go into the safety status.

◁⦆ Safety Points

- 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 driver 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 Generation (Pn510) is set to free-run (with the dynamic brake disabled), the motor operates as free-run and the stop distance is long.
  - The motor may operate in the range of up to 180 degrees of electrical angle due to a power transistor trouble and so forth.
  - The power supply to the motor is cut off by the STO function, but the power supply to the driver will not be cut off nor electrically insulated. For driver maintenance, cut off the power supply to the driver through another means.
- The EDM output signal is not a safety output. Do not use it for purposes other than the failure monitoring function.
- The dynamic brake and external brake release signal output are not safety-related parts.Make sure that the equipment does not become dangerous during system design 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 $2.30 \times 10^{-8}$.
- Following certifications are fulfilled:
  - CAT-3 (EN 954-1)
  - Performance level d (EN/ISO 13849-1)
  - SIL 2 (IEC/EN 62061)
- See the Appendix in chapter 12 for servo drive satefy certification

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**Safety Function**

## 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 driver is cut off. | √ | √ | √ | √ |
| | SF− | CN8-3 | | √ | √ | √ | √ |
| Safety input 2 | SF2+ | CN8-6 | • The lower arm drive signal of the power transistor inside the driver is cut off. | √ | √ | √ | √ |
| | SF2− | CN8-5 | | √ | √ | √ | √ |

- When the safety input is either 1 or 2, the STO function will start operating within 5 ms of the input, and the motor output torque will be turned OFF.
- Connect the equipment so that the safety input circuit is turned OFF when you operate the STO function.
- Use Stop Selection for Alarm Generation (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.



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**Safety Function**
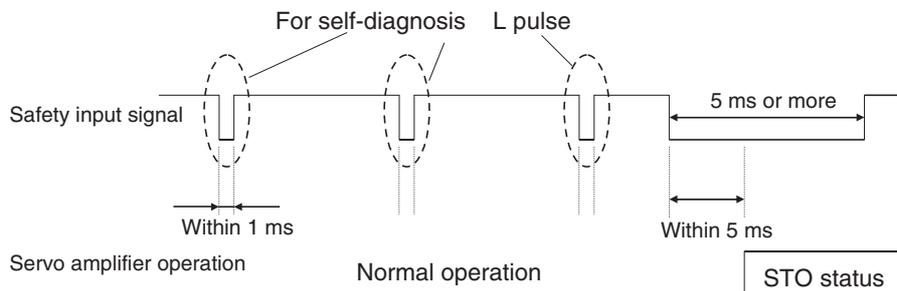
## External Device Monitor (EDM) Output Signal

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. | √ | √ | √ | √ |
| | EDM− | CN8-7 | * This output signal is not a safety output. | √ | √ | √ | √ |

## Relationship Between Safety Input Signal and EDM Output Signal

When safety inputs 1 and 2 are both OFF (where the STO function is operating for safety inputs for the 2 circuits), the EDM output circuit is turned 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.

| 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.

# 7-2 Operation Example

## Operation Timings to a Safety Status
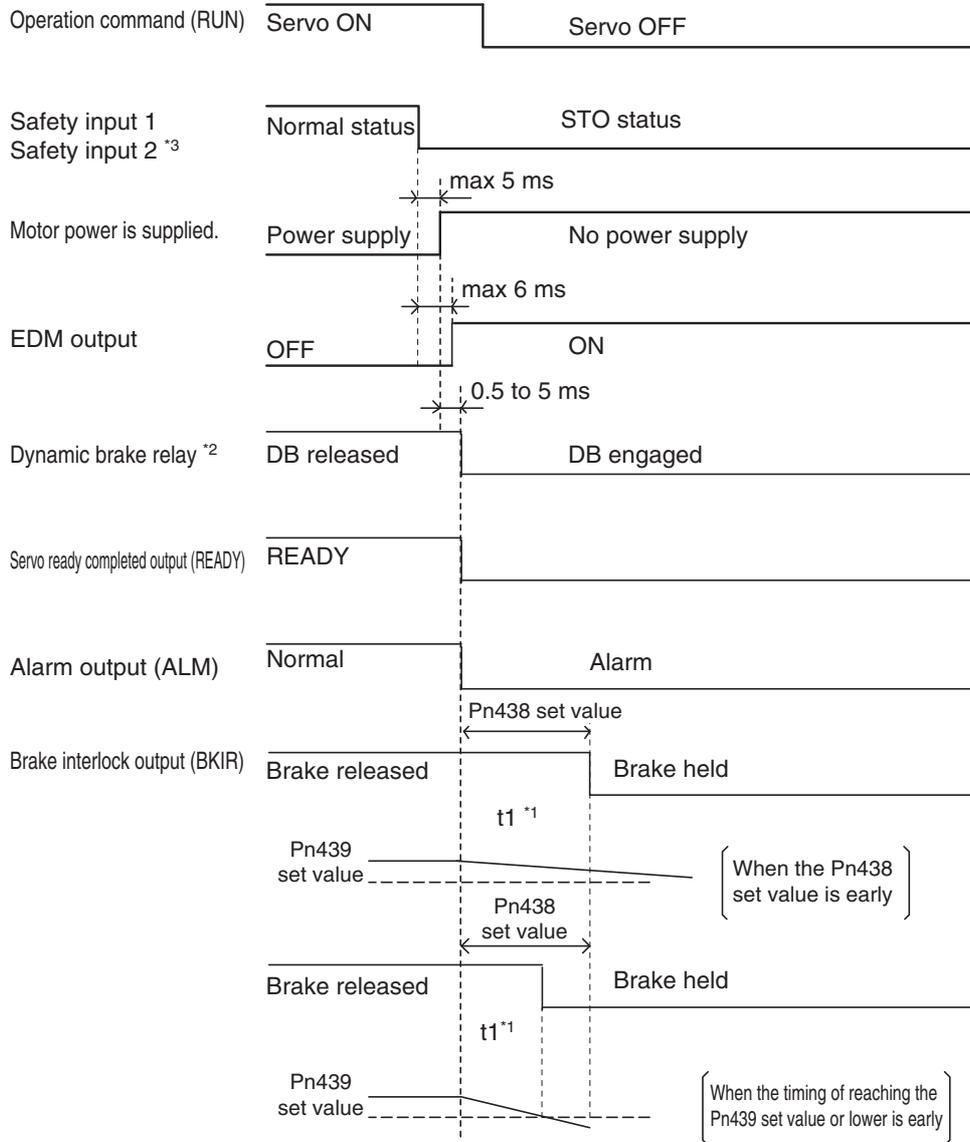


*1. t1 is the set value of the Brake Timing during Operation (Pn438), or the time needed for the motor rotation speed to drop to or below the Brake Release Speed Setting (Pn439), whichever occurs first.

*2. The dynamic brake is based on the Stop Selection for Alarm Generation (Pn510) setting.

*3. Safety inputs 1 and 2 transition to the STO status when either one of them is turned OFF.

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**Safety Function**

### Timings of Return from the Safety Status

| | | |
|---|---|---|
| Operation command (RUN) [1] | Servo OFF command | Servo ON |
| Safety input 1 Safety input 2 | STO status → Normal status | Follow the normal servo ON/OFF operation timing diagram upon input of the operation command (RUN). For details, refer to "6-6 Brake Interlock." |
| Motor power is supplied. | No power supply | |
| EDM output | OFF — max 6 ms — ON | |
| Dynamic brake relay | DB released/engaged [2] | DB released/engaged [3] |
| | Alarm generation status | Servo OFF |
| Servo ready completed output (READY) | | READY |
| Alarm reset input (RESET) [1] | Reset | |
| Alarm output (ALM) | Alarm | Normal |
| Brake interlock output (BKIR) | Brake held | |

*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 will occur. Be sure to execute the alarm clear when both safety inputs 1 and 2 are returned to the ON status. An alarm will occur immediately if the alarm reset is executed when even one of these is still in the OFF status.

*2. Since this is a status where alarms will occur, the dynamic brake is based on the Stop Selection for Alarm Generation (Pn510).

*3. Since this is a normal servo OFF status, the dynamic brake is based on the Stop Selection with Servo OFF (Pn506) setting.

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**Safety Function**

# 7-3   Connection Example

**Connection with a Safety Controller (2 safety input and EDM output)**
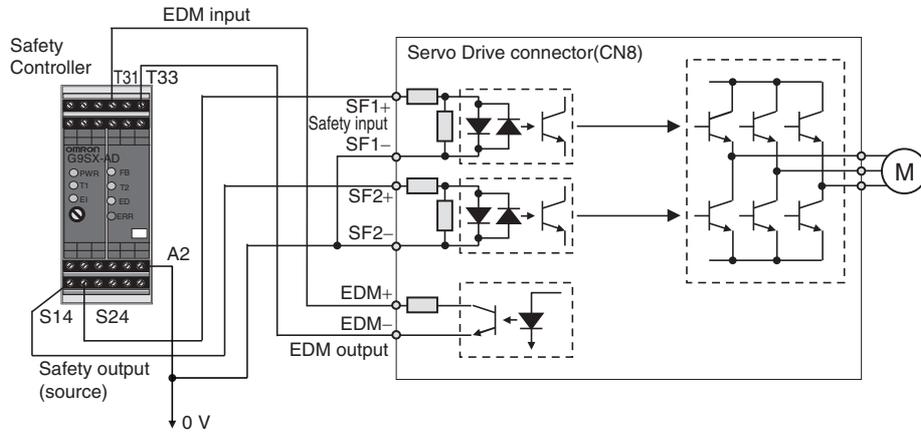
**7**

**Safety Function**

# 8

# Parameters Details

This chapter explains the set value and contents of setting of each parameter.

# 8-1 Basic Parameters

| **Pn000** | Rotation Direction Switching | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Forward direction command sets the motor rotation direction to CW. |
| 1 | Forward direction command sets the motor rotation direction to CCW. |
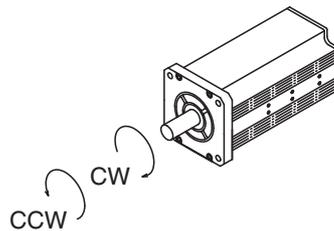


- Regarding the motor rotation direction, when seen from load-side axis, clockwise is referred to as CW and counterclockwise as CCW.

| **Pn001** | CONTROL mode Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Position control (pulse train command) |
| 1 | Speed control (analog command) |
| 2 | Torque control (analog command) |
| 3 | Mode 1: Position control, Mode 2: Speed control |
| 4 | Mode 1: Position control, Mode 2: Torque control |
| 5 | Mode 1: Speed control, Mode 2: Torque control |
| 6 | Full closing control |

- Set the CONTROL mode to be used.
- If COMPOSITE modes are set (set values: 3 to 5), mode 1 or mode 2 can be selected using the CONTROL mode switching input (TVSEL).
  - · When the CONTROL mode switching input is open: Select mode 1.
  - · When the CONTROL mode switching input is short-circuited: Select mode 2.
- Do not input a command within 10 ms before or after switching.

| Pn002 | REALTIME AUTOTUNING mode Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6 | Unit | – | Default setting | 1 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Disabled |
| 1 | This mode focuses on stability. |
| 2 | This mode focuses on positioning. |
| 3 | Used when unbalanced load is present as in vertical axes |
| 4 | Used when friction is large (unbalanced load also calculated). |
| 5 | Used in combination with the software tool. The drive calculates the correction and the user decides whether to apply them or not. |
| 6 | Used when freely combining REALTIME AUTOTUNING mode and APPLICABLE FILTER mode. |

♦ See Chapter 10 for details.

| Pn003 | Realtime Autotuning Machine Rigidity Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 31 | Unit | – | Default setting | See Note below | Power OFF and ON | – |

♦ Default settings:

    (1) Pn003 = 11 - For 200V drives of 1Kw or upper and 400V drives

    (2) Pn003 = 13 - For 200V drives of less than 1 Kw

♦ Set the machine rigidity to one of 32 levels when realtime autotuning is enabled.

Low ←Machine rigidity→ High

Low ←Servo gain→ High

Pn003 | 0.1 - - - - - - - - - - - - - - - 31

Low ←Responsiveness→ High

♦ If the set value is changed suddenly by a large amount, the gain will 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 | Power OFF and ON | – |

♦ 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 (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 will increase. If the Inertia Ratio (Pn004) is set smaller than the actual value, the setting for speed loop gain will decrease.

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**Parameters Details**

| **Pn005** | Command Pulse Input Selection | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Photocoupler input (+PULS: CN1 pin 3, -PULS: CN1 pin 4, +SIGN: CN1 pin 5, -SIGN: CN1 pin 6) |
| 1 | Input for line driver only (+CWLD: CN1 pin 44, -CWLD: CN1 pin 45, +CCWLD: CN1 pin 46, -CCWLD: CN1 pin 47) |

⬧ Selects whether to use photocoupler or input for line driver only for the command pulse input.

| **Pn006** | Command Pulse Rotation Direction Switching Selection | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | The motor rotates in the direction specified by the command pulse. |
| 1 | The motor rotates in the opposite direction from the direction specified by the command pulse. |

⬧ Set the motor rotation direction for the command pulse input.

| **Pn007** | COMMAND PULSE mode Selection | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

⬧ Set the count method for the command pulse input.

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**Parameters Details**

| Command Pulse Rotation Direction Switching Selection (Pn006) | COMMAND PULSE mode Setting (Pn007) | COMMAND PULSE mode | Motor forward command | Motor reverse command |
|---|---|---|---|---|
| 0 | 0 or 2 | 90° phase difference (phases A and B) signal inputs | Line driver: t1 ≥ 2 μs Open collector: t1 ≥ 5 μs | |
| | 1 | Reverse pulse/ forward pulse | Line driver: t2 ≥ 1 μs Open collector: t2 ≥ 2.5 μs | |
| | 3 | Feed pulse/ direction signal | Line driver: t2 ≥ 1 μs Open collector: t2 ≥ 2.5 μs | |
| 1 | 0 or 2 | 90° phase difference (phases A and B) signal inputs | Line driver: t1 ≥ 2 μs Open collector: t1 ≥ 5 μs | |
| | 1 | Reverse pulse/ forward pulse | Line driver: t2 ≥ 1 μs Open collector: t2 ≥ 2.5 μs | |
| | 3 | Feed pulse/ direction signal | Line driver: t2 ≥ 1 μs Open collector: t2 ≥ 2.5 μs | |

⬥ Set the form of the pulse inputs sent as command to the driver from a Position Controller.

⬥ Modes 0 and 2 are exactly the same.

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**Parameters Details**

| **Pn008** | Electronic Gear Integer Setting | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{20}$ | Unit | pulse | Default setting | 10000 | Power OFF and ON | Yes |

- Set the number of command pulses corresponding to 1 motor rotation.
- If the set value is 0, Electronic Gear Ratio Numerator 1 (Pn009) and Electronic Gear Ratio Denominator (Pn010) become valid.

| **Pn009** | Electronic Gear Ratio Numerator 1 | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{30}$ | Unit | – | Default setting | 0 | Power OFF and ON | – |

| **Pn010** | Electronic Gear Ratio Denominator | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to $2^{30}$ | Unit | – | Default setting | 10000 | Power OFF and ON | – |

- Set the electronic gear function.
  - It is enabled when Pn008 is 0.
- The electronic gear can be used for the following:
  - To set the amount of motor rotation or travel distance per input command pulse.
  - To increase the nominal command pulse frequency by using a multiplier when the desired motor speed cannot be achieved due to the limited pulse generation capability of the host device (possible maximum output frequency).
- Electronic Gear Block Diagram:
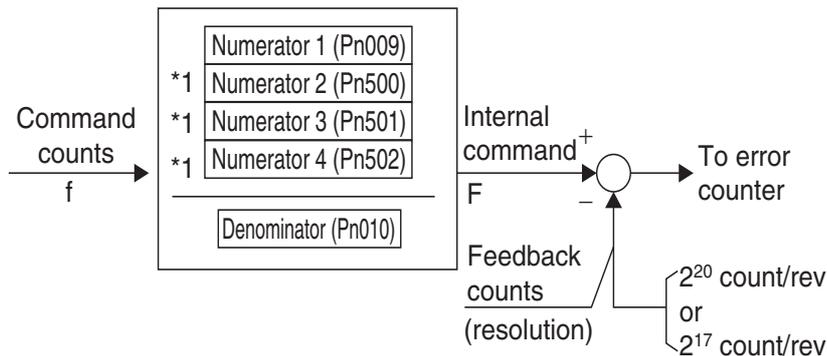


*1. Numerator 2 to 4 is selected using the electronic gear switching (GESEL1 and GESEL2).

| GESEL1 | GESEL2 | Selected numerator |
|---|---|---|
| OFF | OFF | Electronic Gear Ratio Numerator 1 |
| ON | OFF | Electronic Gear Ratio Numerator 2 |
| OFF | ON | Electronic Gear Ratio Numerator 3 |
| ON | ON | Electronic Gear Ratio Numerator 4 |

- The electronic gear ratio is set using the following equations.
  If Numerator = 0: Numerator is automatically set to encoder resolution, and the number of command pulses per rotation can be set in Pn010.

$$\text{Electronic gear ratio} = \frac{\text{Encoder resolution}}{\text{Electronic Gear Integer Setting (Pn010)}}$$

If Numerator $\neq$ 0:

$$\text{Electronic gear ratio} = \frac{\text{Electronic Gear Ratio Numerator (Pn009, Pn500, Pn501 and Pn502)}}{\text{Electronic Gear Ratio Denominator (Pn010)}}$$

| **Pn011** | Encoder Dividing Numerator | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to 262,144 | Unit | P/r | Default setting | 2500 | Power OFF and ON | Yes |

• If Encoder Dividing Denominator (Pn503) = 0, the encoder resolution becomes the pulse output dividing denominator.

• Note that 1 pulse corresponds to 4 counts. Encoder resolution corresponds with counts.

$$\text{Encoder pulse} \rightarrow \boxed{\frac{\text{Pn011} \times 4 \text{ (When the host side uses a 4 multiplier process)}}{\text{Encoder resolution}}} \rightarrow \text{Output pulse}$$

| **Pn012** | Encoder Output Direction Switching Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

• Setting 2 & 3 are available only in full-closed control

### Explanation of Set Values

| Set value | Phase B logic | Output source | Motor forward command | Motor reverse command |
|---|---|---|---|---|
| 0 | Non-reverse | Encoder | Phase A / Phase B | Phase A / Phase B |
| 1 | Reverse | Encoder | Phase A / Phase B | Phase A / Phase B |
| 2 | Non-reverse | External scale | Phase A / Phase B | Phase A / Phase B |
| 3 | Reverse | External scale | Phase A / Phase B | Phase A / Phase B |

| **Pn013** | No. 1 Torque Limit | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | % | Default setting | 500 | Power OFF and ON | – |
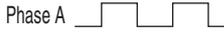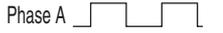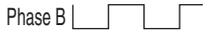
• Set the No. 1 limit value for the output torque of the motor.

| **Pn014** | Error Counter Overflow Level | | | | | | Position Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{27}$ | Unit | Command unit | Default setting | 100000 | Power OFF and ON | – |

• Set the range of the error counter overflow level.

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**Parameters Details**

| Pn015 | Operation Switching when Using Absolute Encoder | | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Use as absolute encoder. |
| 1 | Use as incremental encoder. |
| 2 | Use as absolute encoder but ignore multi-rotation counter overflow. |

⬧ Set the operating method for the 17-bit absolute encoder.

| Pn016 | Regeneration Resistor Selection | | | | | | | All |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | See Note below0 | Power OFF and ON | Yes |

⬧ Default settings:

    (1) Pn016 = 0 - For 200V drives of 750 W or upper and 400V drives

    (2) Pn016 = 3 - For 200V drives of less than 750 W

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Regeneration Resistor used: Built-in Resistor<br>The regeneration processing circuit will operate and the regeneration overload (alarm display No. 18) will be enabled according to the Built-in Resistor (with approx. 1% duty). |
| 1 | Regeneration Resistor used: External Resistor<br>The regeneration processing circuit will operate, and regeneration overload (alarm display No. 18) will cause a trip when the operating rate of the Regeneration Resistor exceeds 10%. |
| 2 | Regeneration Resistor used: External Resistor<br>The regeneration processing circuit will operate, but regeneration overload (alarm display No. 18) will not occur. |
| 3 | Regeneration Resistor used: None<br>The regeneration processing circuit and regeneration overload (alarm display No. 18) will not operate, and all regenerative energy will be processed by the built-in capacitor. |

⬧ 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.

⬧ Set this parameter depending on whether the Built-in Regeneration Resistor is used, or the Built-in Regeneration Resistor is disconnected and an External Regeneration Resistor is connected. (The External Regeneration Resistor connection terminal is connected.)

⬧ 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 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Regeneration load ratio is 100% when operating rate of the External Regeneration Resistor is 10%. |
| 1 | Reserved |
| 2 | Reserved |
| 3 | Reserved |
| 4 | Reserved |

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**Parameters Details**

# 8-2 Gain Parameters

| **Pn100** | Position Loop Gain | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 30,000 | Unit | 0.1/s | Default setting | See Note below | Power OFF and ON | – |

- Default settings:
  - (1) Pn100 = 320 - For 200V drives of 1Kw or upper and 400V drives
  - (2) Pn100 = 480 - For 200V drives of less than 1 Kw
- Adjust the position loop response to suit 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 vibration 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 400 (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 vibration 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:

$$\text{Position loop gain } (Kp) = \frac{\text{Command pulse frequency (pulse/s)}}{\text{Error counter accumulated pulse (pulse)}} \ (0.1/s)$$

Response when the position loop gain is operated
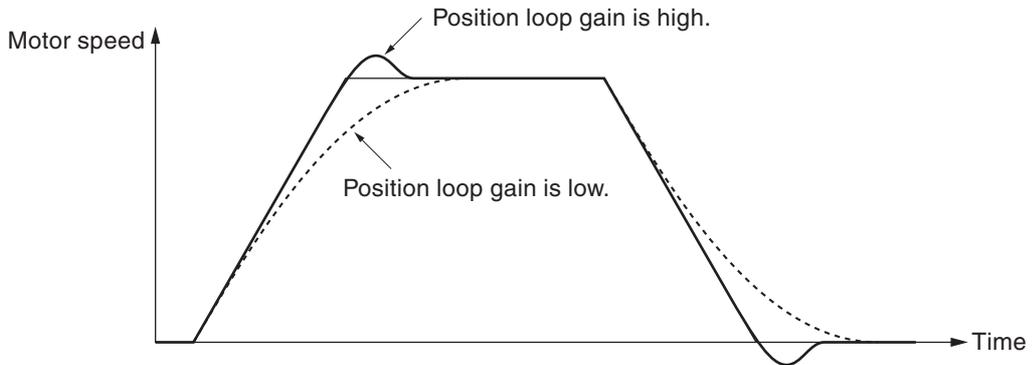


- If the speed loop gain and position loop gain are optimally set, the motor operation for the command will be delayed 2/Kp at acceleration and delayed 3/Kp at deceleration.
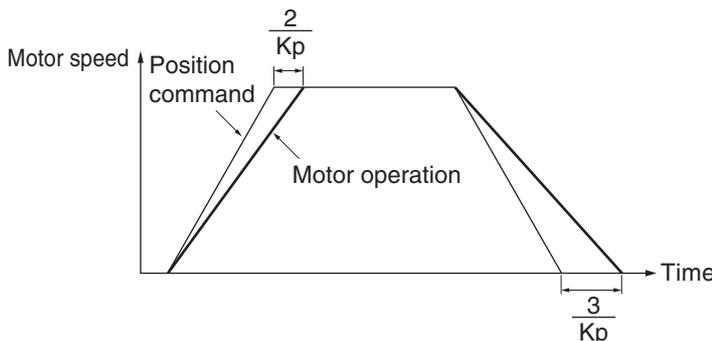
| **Pn101** | Speed Loop Gain | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to 32,767 | Unit | 0.1 Hz | Default setting | See Note below | Power OFF and ON | – |

♦Default settings:

  (1) Pn101 = 180 - For 200V drives of 1Kw or upper and 400V drives

  (2) Pn101 = 270 - For 200V drives of less than 1 Kw

♦ 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 will be 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.

Motor speed

Overshooting occurs if the speed loop gain is high. (Vibration occurs if the gain is too high.)

Speed loop gain is low.
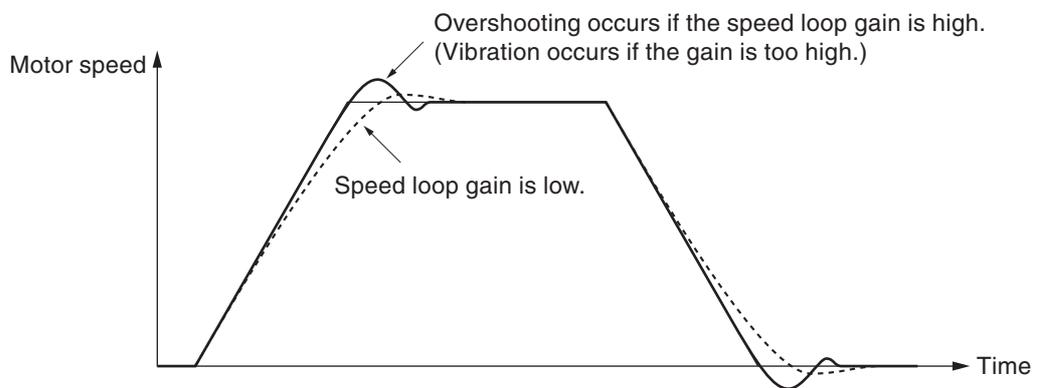
Time

| **Pn102** | Speed Loop Integral Time Constant | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to 10,000 | Unit | 0.1 ms | Default setting | See Note below | Power OFF and ON | – |

♦Default settings:

  (1) Pn102 = 310 - For 200V drives of 1Kw or upper and 400V drives

  (2) Pn102 = 210 - For 200V drives of less than 1 Kw

♦ Set the speed loop integration time constant.

♦ The smaller the set value, the faster the error will come 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.
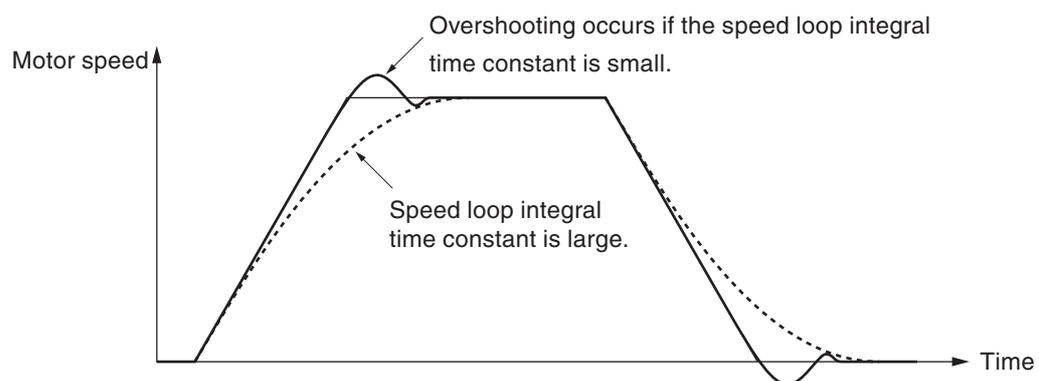
Motor speed

Overshooting occurs if the speed loop integral time constant is small.

Speed loop integral time constant is large.

Time

| **Pn103** | Speed Feedback Filter Time Constant | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 5 | Unit | – | Default setting | 0 | Power OFF and ON | – |

- 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.

| **Pn104** | Torque Command Filter Time Constant | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,500 | Unit | 0.01 ms | Default setting | See Note below | Power OFF and ON | – |

- Default settings:
    - (1) Pn104 = 126 - For 200V drives of 1Kw or upper and 400V drives
    - (2) Pn104 = 84   - For 200V drives of less than 1 Kw
- 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 | 1 to 30,000 | Unit | 0.1/s | Default setting | See Note below | Power OFF and ON | – |

- Default settings:
    - (1) Pn105 = 380 - For 200V drives of 1Kw or upper and 400V drives
    - (2) Pn105 = 570 - For 200V drives of less than 1 Kw
- Set the responsiveness of the position control system for the second position loop.

| **Pn106** | Speed Loop Gain 2 | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to 32,767 | Unit | 0.1 Hz | Default setting | See Note below | Power OFF and ON | – |

- Default settings:
    - (1) Pn106 = 180 - For 200V drives of 1Kw or upper and 400V drives
    - (2) Pn106 = 270 - For 200V drives of less than 1 Kw
- Set the responsiveness of the second speed loop.

| **Pn107** | Speed Loop Integration Time Constant 2 | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to 10,000 | Unit | 0.1 ms | Default setting | 10000 | Power OFF and ON | – |

- 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 | Power OFF and ON | – |

- Set the second speed feedback filter.

| **Pn109** | Torque Command Filter Time Constant 2 | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,500 | Unit | 0.01 ms | Default setting | See Note below | Power OFF and ON | – |

- Default settings:

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**Parameters Details**

(3) Pn109 = 126 - For 200V drives of 1Kw or upper and 400V drives

(4) Pn109 = 84   - For 200V drives of less than 1 Kw

♦ 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 gains are switched according to the condition set in the GAIN 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 1,000 | Unit | 0.1% | Default setting | 300 | Power OFF and ON | – |

♦Set the feed-forward amount. Increasing the set value decreases the position error and increases the responsiveness. Overshooting, however, will occur more easily.

| Pn111 | Speed Feed-forward Command Filter | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6,400 | Unit | 0.01 ms | Default setting | 50 | Power OFF and ON | – |

♦ 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.

| Pn112 | Torque Feed-forward Amount | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1% | Default setting | 0 | Power OFF and ON | – |

♦Set the feed-forward amount to the torque loop. Increasing the set value decreases the position error during acceleration and increases the responsiveness but the system may become more noisy.

| Pn113 | Torque Feed-forward Command Filter | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6,400 | Unit | 0.01 ms | Default setting | 0 | Power OFF and ON | – |

♦ Set the time constant for the first-order lag filter inserted into the feed forward.

♦Setting the filter may improve operation if the noise during operation is large when the feedforward is set high.

| Pn114 | GAIN SWITCHING INPUT OPERATING mode Selection | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Gain 1 (PI/P switching enabled) |
| 1 | Gain 1/gain 2 switching available |

♦ Select either PI/P operation switching or gain 1/gain 2 switching.

♦PI/P operation switching is performed using gain switching (GSEL: CN1 pin 27). PI is not changed, however, if the Torque Limit Selection (Pn521) is set to 3.

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**Parameters Details**

| Gain input | Speed loop operation |
|---|---|
| GSEL OFF | PI operation |
| GSEL ON | P operation |

⬩ For information on switching conditions between gain 1 and gain 2, refer to "6-7 Gain Switching Function" (P.6-25).

⬩ If autotunning is enabled, feedforward gain and filter are set at a fixed value.

| Pn115 | SWITCHING mode in Position Control | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Settings

(√: Enabled, −: Disabled)

| Set value | Explanation | | | |
|---|---|---|---|---|
| | Gain switching conditions | Gain Switching Delay Time in Position Control (Pn116) [*1] | Gain Switching Level in Position Control (Pn117) | Gain Switching 1 Hysteresis in Position Control (Pn118) [*2] |
| 0 | Always Gain 1 (Pn100 to Pn104) | – | – | – |
| 1 | Always Gain 2 (Pn105 to Pn109) | – | – | – |
| 2 | Switching using gain switching input (GSEL) for CN1 pin 27 | – | – | – |
| 3 | Torque command change amount (Refer to Figure A) | √ | √ [*3] (× 0.05%) | √ [*3] (× 0.05%) |
| 4 | Always Gain 1 (Pn100 to Pn104) | – | – | – |
| 5 | Command speed (Refer to Figure B) | √ | √ (r/min) | √ (r/min) |
| 6 | Amount of position error (Refer to Figure C) | √ | √ [*4] (pulse) | √ [*4] (pulse) |
| 7 | Command pulses received (Refer to Figure D) | √ | – | – |
| 8 | Positioning completion signal (INP) OFF (Refer to Figure E) | √ | – | – |
| 9 | Actual motor speed (Refer to Figure B) | √ | √ (r/min) | √ (r/min) |
| 10 | Combination of command pulse input and speed (Refer to Figure F) | √ | √ [*5] (r/min) | √ [*5] (r/min) |

⬩ 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 Gain Switch input is not assigned to any input if this setting is 2.

*1. The Gain Switching Delay Time in Position Control (Pn116) is enabled when returning from gain 2 to gain 1.

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**Parameters Details**

*2. The Gain Switching Hysteresis in Position Control (Pn118) is defined as shown in the following figure.

Pn117 →

Pn118

0

Gain 1      Gain 2      Gain 1

Pn116
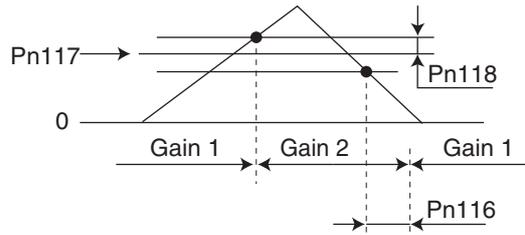
*3. The change amount is the value within ms.

[Example] When the condition is a 10% change in torque in 1 ms, the set value is 200.

*4. This is the encoder resolution.

*5. The meanings of the gain switching delay time in position control, gain switching level in position control, and gain switching hysteresis in position control are different from normal if this is set to 10. (Refer to Figure F)

Figure A

Speed V

Torque T

ΔT

Level    H
         L

         L
         H

Time

1   2   2   Gain 1   2   2   1
        1               1

Figure B

Speed V

Level    H
         L

Time

Gain 1    Gain 2    Gain 1

Figure C

Speed V

Accumulated pulse error

Level    H
         L

Time

Gain 1    Gain 2    1

Figure D

Command speed S

Time

Gain 1    Gain 2    1

Figure E

Actual speed N

INP

Time

Gain 1    Gain 2    1

Figure F

Command speed S

Actual speed N

H
L    Level

Time

Gain 1    Gain 2    Gain 1

Gain 2 only for the speed loop integral time constant
Gain 1 for all others

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**Parameters Details**

| **Pn116** | Gain Switching Delay Time in Position Control | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 50 | Power OFF and ON | – |

• 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 20,000 | Unit | – | Default setting | 50 | Power OFF and ON | – |

• This is enabled when the SWITCHING mode in Position Control (Pn115) is set to 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 20,000 | Unit | – | Default setting | 33 | Power OFF and ON | – |

• 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).
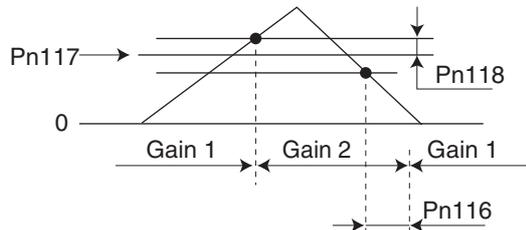


• The settings for the Gain Switching Level in Position Control (Pn117) and the Gain Switching Hysteresis in Position Control (Pn118) are enabled as absolute values (positive/negative).

| **Pn119** | Position Gain Switching Time | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 33 | Power OFF and ON | – |

• When switching between gain 1 and gain 2 is enabled, set the rate of change for position loop gain when gain switching is ececuted.



| **Pn120** | SWITCHING mode in Speed Control | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 5 | Unit | – | Default setting | 0 | Power OFF and ON | – |

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**Parameters Details**

## Explanation of Settings

(√: Enabled, −: Disabled)

| Set value | Explanation | | | |
|---|---|---|---|---|
| | 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 Gain 1 (Pn100 to Pn104) | − | − | − |
| 1 | Always Gain 2 (Pn105 to Pn109) | − | − | − |
| 2 | Switching using gain switching input (GSEL) for CN1 pin 27 | − | − | − |
| 3 | Torque command change amount (Refer to Figure A) | √ | √ [*3] (0.05%) | √ [*3] (0.05%) |
| 4 | Speed command change amount (Refer to Figure B) | √ | √ [*4] (10 r/min/s) | √ [*4] (10 r/min/s) |
| 5 | Speed command (Refer to Figure C) | √ | √ (r/min) | √ (r/min) |

⬧ 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 input is not assigned when Pn120 = 2.

*1. The Gain Switching Delay Time in Speed Control (Pn121) is enabled when returning from gain 2 to gain 1.

*2. The Gain Switching Hysteresis in Speed Control (Pn123) is defined as shown in the following figure.
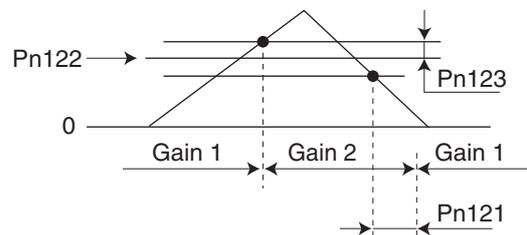


*3. The change amount is the value within 1 ms.

[Example] When the condition is a 10% change in torque in 1 ms, the set value is 200.

*4. The meanings of the Gain Switching Delay Time in Speed Control (Pn121), Gain Switching Level in Speed Control (Pn122), and Gain Switching Hysteresis in Speed Control (Pn123) are different from normal if this is set to 10. (Refer to Figure D)

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**Parameters Details**

Figure A

Speed V

Torque T

ΔT

Level

H
L
L
H

Time
1 2 2 Gain 1 2 2 1
1 1

Figure B

Speed V

Level
H
L

Time
Gain 1 Gain 2 Gain 1

Figure C

Speed V

Accumulated pulse

Level
H
L

Time
Gain 1 Gain 2 1

Figure D

Command speed S

Actual speed N

H
L
Level

Time

Gain 1 Gain 2 Gain 1

Gain 2 only for the speed loop integral time constant
Gain 1 for all others

| Pn121 | Gain Switching Delay Time in Speed Control | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 0 | Power OFF and ON | – |

- 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 20,000 | Unit | – | Default setting | 0 | Power OFF and ON | – |

- 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 20,000 | Unit | – | Default setting | 0 | Power OFF and ON | – |

- 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).

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Parameters Details

Pn122 →
Pn123
0
Gain 1   Gain 2   Gain 1
Pn121
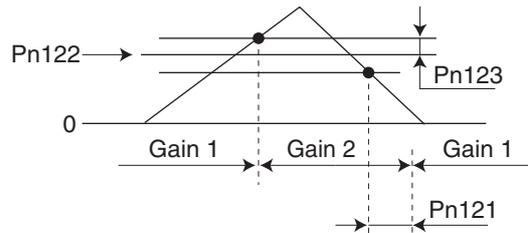
♦ The settings for the Gain Switching Level in Speed Control (Pn122) and the Gain Switching Hysteresis in Speed Control (Pn123) are enabled absolute values (positive/negative).

| Pn124 | SWITCHING mode in Torque Control | | | | | Torque |
|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Settings

| Set value | Explanation | | | |
|---|---|---|---|---|
| | 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) | – | – | – |
| 1 | Always Gain 2 (Pn105 to Pn109) | – | – | – |
| 2 | Switching using gain switching input (GSEL) for CN1 pin 27 | – | – | – |
| 3 | Torque command change amount (Refer to Figure A) | √ | √ [3] (0.05%) | √ [3] (0.05%) |

♦ Select the switching condition between gain 1 and gain 2 when the Gain 2 Setting (Pn114) is set to 1.

♦ The gain is always gain 1 regardless of the gain input if the switching input is not assigned when Pn124=2.

[1]. The Gain Switching Delay Time in Torque Control (Pn125) is enabled when returning from gain 2 to gain 1.

[2]. The Gain Switching Hysteresis in Torque Control (Pn127) is defined as shown in the following figure.

Pn126 →
Pn127
0
Gain 1   Gain 2   Gain 1
Pn125

[3]. The change amount is the value within 1 ms.
   [Example] When the condition is a 10% change in torque in 1 ms, the set value is 200.

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**Parameters Details**

Figure A

| **Pn125** | Gain Switching Delay Time in Torque Control | | | | | Torque | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 0 | Power OFF and ON | – |

- 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 20,000 | Unit | – | Default setting | 0 | Power OFF and ON | – |

- 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 20,000 | Unit | – | Default setting | 0 | Power OFF and ON | – |

- 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).
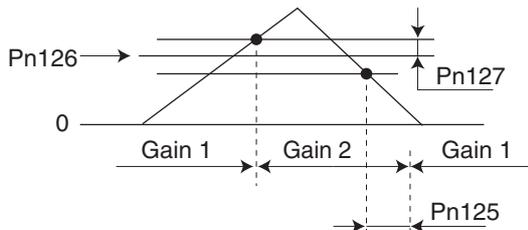


- The settings for the Gain Switching Level in Torque Control (Pn126) and the Gain Switching Hysteresis in Torque Control (Pn127) are enabled as absolute values (positive/negative).

# 8-3    Vibration Suppression Parameters

| Pn200 | Adaptive Filter Selection | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 4 | Unit | – | Default setting | 0 | Power OFF and ON | – |

## Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Disabled. The current values are held for the parameters related to notch filters 3 and 4. |
| 1 | 1 enabled.The parameter related to notch filter 3 is updated based on the applicable result. |
| 2 | 2 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. |

⬥ Set the operation of the adaptive filter.
⬥ The adaptive filter is normally disabled in the TORQUE CONTROL mode.

| Pn201 | Notch 1 Frequency Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 50 to 5,000 | Unit | Hz | Default setting | 5000 | Power OFF and ON | – |

⬥ Set the frequency of resonance suppression notch filter 1.
⬥ The notch filter function will be disabled if this parameter is set to 5,000.

| Pn202 | Notch 1 Width Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Power OFF and ON | – |

⬥ Set the width of resonance suppression notch filter 1 to one of 20 levels.
⬥ Increasing the setting widens the notch width. Normally, use the default set value.

| Pn203 | Notch 1 Depth Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Power OFF and ON | – |

⬥ Set the notch depth of resonance suppression notch filter 1.
⬥ Increasing the setting will shorten the notch depth and the phase lag.

| Pn204 | Notch 2 Frequency Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 50 to 5,000 | Unit | Hz | Default setting | 5000 | Power OFF and ON | – |

⬥ Set the notch frequency of resonance suppression notch filter 2.
⬥ The notch filter function will be disabled if this parameter is set to 5,000.

| Pn205 | Notch 2 Width Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Power OFF and ON | – |

⬥ Select the notch width of resonance suppression notch filter 2.
⬥ Increasing the setting widens the notch width. Normally, use the default set value.

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**Parameters Details**

## 8-3 Vibration Suppression Parameters

| **Pn206** | Notch 2 Depth Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Power OFF and ON | – |

• Set the notch depth of resonance suppression notch filter 2.
• Increasing the setting will shorten the notch depth and the phase lag.

| **Pn207** | Notch 3 Frequency Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 50 to 5,000 | Unit | Hz | Default setting | 5000 | Power OFF and ON | – |

• Set the notch frequency of resonance suppression notch filter 3.
• The notch filter function will be disabled if this parameter is set to 5,000.

| **Pn208** | Notch 3 Width Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Power OFF and ON | – |

• Select the notch width of resonance suppression notch filter 3.
• Increasing the setting widens the notch width. Normally, use the default set value.

| **Pn209** | Notch 3 Depth Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Power OFF and ON | – |

• Set the notch depth of resonance suppression notch filter 3.
• Increasing the setting will shorten the notch depth and the phase lag.

| **Pn210** | Notch 4 Frequency Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 50 to 5,000 | Unit | Hz | Default setting | 5000 | Power OFF and ON | – |

• Set the notch frequency of resonance suppression notch filter 4.
• The notch filter function will be disabled if this parameter is set to 5,000.

| **Pn211** | Notch 4 Width Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Power OFF and ON | – |

• Select the notch width of resonance suppression notch filter 4.
• Increasing the setting widens the notch width. Normally, use the default set value.

| **Pn212** | Notch 4 Depth Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Power OFF and ON | – |

• Set the notch depth of resonance suppression notch filter 4.
• Increasing the setting will shorten the notch depth and the phase lag.

| **Pn213** | Vibration Filter Selection | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Vibration filter 1 and 2 enabled |
| 1 | With external input (DFSEL1), either 1 and 3 or 2 and 4 can be selected.<br>· Open: Vibration filters 1 and 3 enabled<br>· Shorted: Vibration filters 2 and 4 enabled |
| 2 | With external input (DFSEL1 and DFSEL2), one of the filters 1 to 4 can be selected.<br>· When DFSEL1 and DFSEL2 are both open: Vibration filter 1 enabled<br>· When DFSEL1 is shorted and DFSEL2 is open: Vibration filter 2 enabled<br>· When DFSEL1 is open and DFSEL2 is shorted: Vibration filter 3 enabled<br>· When DFSEL1 and DFSEL2 are both shorted: Vibration filter 4 enabled |
| 3 | It is switched with position command direction.<br>· Forward direction: Vibration filters 1 and 3 enabled<br>· Reverse direction: Vibration filters 2 and 4 enabled |

| **Pn214** | Vibration Frequency 1 | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- Set vibration frequency 1 to suppress vibration at the end of the load in anti-vibration 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 will be disabled if the setting is 0 to 0.9 Hz.
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn215** | Vibration Filter 1 Setting | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- First set the Vibration 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: Corresponding vibration frequency
  Lower limit: Vibration frequency + vibration filter setting $\geq$ 100
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn216** | Vibration Frequency 2 | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- Set vibration 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 will be disabled if the setting is 0 to 0.9 Hz.
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn217** | Vibration Filter 2 Setting | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- First set the Vibration 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: Corresponding vibration frequency
  Lower limit: Vibration frequency + vibration filter setting $\geq$ 100
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

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**Parameters Details**

| **Pn218** | Vibration Frequency 3 | | | | | Position | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- Set vibration 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 will be disabled if the setting is 0 to 0.9 Hz.
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn219** | Vibration Filter 3 Setting | | | | | Position | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- First set the Vibration 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: Corresponding vibration frequency
  Lower limit: Vibration frequency + vibration filter setting $\geq$ 100
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn220** | Vibration Frequency 4 | | | | | Position | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- Set vibration 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 will be disabled if the setting is 0 to 0.9 Hz.
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn221** | Vibration Filter 4 Setting | | | | | Position | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1 Hz | Default setting | 0 | Power OFF and ON | – |

- First set the Vibration 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: Corresponding vibration frequency
  Lower limit: Vibration frequency + vibration filter setting $\geq$ 100
- Refer to "6-1 Anti-vibration Control" (P.6-3) for more information on settings.

| **Pn222** | Position Command Filter Time Constant | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 0 | Power OFF and ON | – |

- The position command filter time constant is the first-order lag filter inserted after the electronic gear ratio for the command pulse input.
- The position command filter time constant can be used for the following:
  - If the command pulses change abruptly, the filter can be used to reduce the stepping movement of the motor.
  - The following are examples of when the command pulses can change abruptly:
    The electronic gear ratio setting is high (10 times or higher).
    The command pulse frequency is low.

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**Parameters Details**

$t_f = (Pn222 \times 0.1 \text{ ms})$
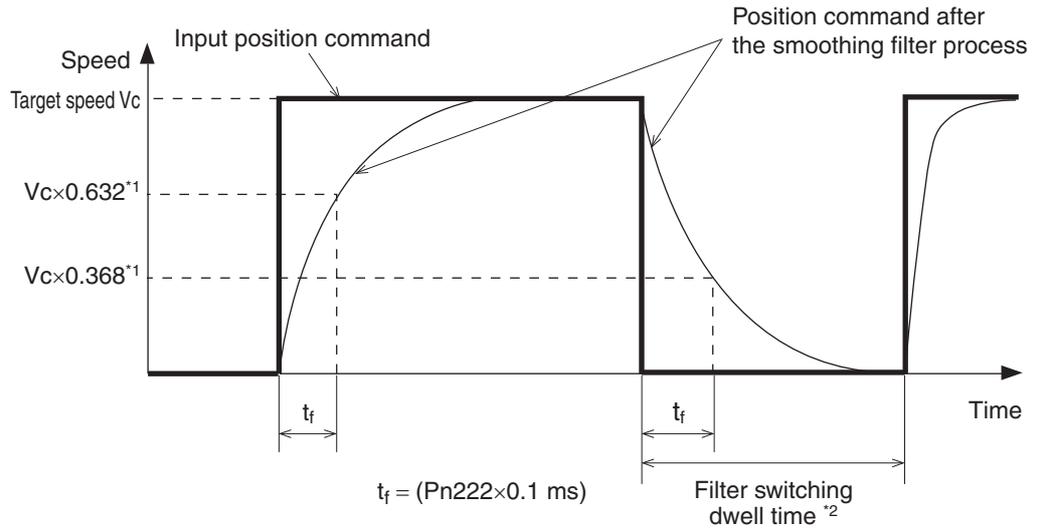
*1 The actual process is subject to calculation error.

*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.

| **Pn223** | Smoothing Filter Time Constant | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 0 | Power OFF and ON | – |

• Set the FIR filter time constant used for command pulse input. (FIR: Finite impulse response)
• The higher the set value, the smoother the command pulses.



$t_f = (Pn223 \times 0.1 \text{ ms})$

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**Parameters Details**
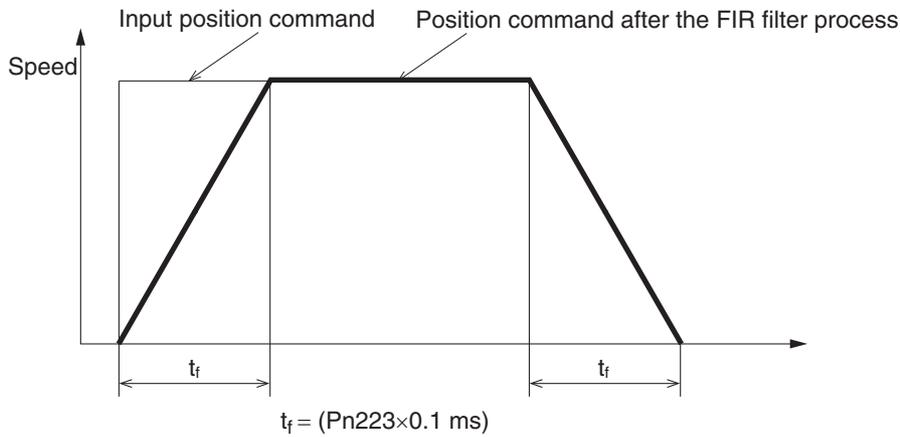
# 8-4　Analog Control Parameters

| **Pn300** | Command Speed Selection | | | | | Speed |
|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Analog speed command |
| 1 | No. 1 Internally Set Speed to No. 4 Internally Set Speed (Pn304 to Pn307) |
| 2 | No. 1 Internally Set Speed to No. 3 Internally Set Speed (Pn304 to Pn306), analog speed command |
| 3 | No. 1 Internally Set Speed to No. 8 Internally Set Speed (Pn304 to Pn311) |

♦ Select the speed command when using speed control. The driver has internally set speed function that can be used to easily achieve speed control by using contact inputs.
♦ For details on internally set speed function, refer to "5-4 Internally Set Speed Control" (P.5-19).

| **Pn301** | Speed Command Direction Selection | | | | | Speed |
|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Method for designating the direction for the speed command: By analogue command polarity |
| 1 | Method for designating the direction for the speed command: By digital input VSIGN |

♦ Set to reverse the polarity of the speed command input (REF: CN1 pin 14). This is used to change the motor rotation direction without changing the polarity of host device command signals.
♦ The default setting for this parameter is 0. By rotating to the reverse direction with the +command keeps the compatibility with all Accurax W-Series Servo Drives.
♦ The operation of the Servomotor may be abnormal if the polarity of the speed command signal from the Position Control Unit does not agree with the setting of this parameter when the Servo Drive system is comprised of the combination of the Servo Drive set to the SPEED CONTROL mode and an external Position Control Unit.

| Command Speed Selection (Pn300) | Speed Command Direction Selection (Pn301) | Analog Speed Command Rotation Direction Switching (Pn303) | Analog speed command (REF) | Speed command sign selection (VSIGN) | Motor rotation direction | Conversion graph |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | +Voltage (0 to 10 V) | Not affected | Forward direction | Refer to Figure A |
| | | | -Voltage (-10 to 0 V) | Not affected | Reverse direction | |
| | | 1 | +Voltage (0 to 10 V) | Not affected | Reverse direction | Refer to Figure B |
| | | | -Voltage (-10 to 0 V) | Not affected | Forward direction | |
| | 1 | Not affected | +Voltage (0 to 10 V) | OFF | Forward direction | Refer to Figure C |
| | | | -Voltage (-10 to 0 V) | | | |
| | | | +Voltage (0 to 10 V) | ON | Reverse direction | |
| | | | -Voltage (-10 to 0 V) | | | |

Figure A

Speed command

−10    10
Input voltage

Figure B

Speed command

−10    10
Input voltage

Figure C

Speed command

−10    10
Input voltage

VSIGN    OFF

Speed command

−10    10
Input voltage

VSIGN    ON

| **Pn302** | Speed Command Scale | | | | | Speed Torque | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2,000 | Unit | (r/min)/V | Default setting | 500 | Power OFF and ON | – |

♦ Set the relation between the voltage applied to the speed command input (REF: CN1 pin 14) and the motor speed.
♦ For details on speed control, refer to "5-2 Speed Control" (P.5-8).

| **Pn303** | Analog Speed Command Rotation Direction Switching | | | | | Speed | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Power OFF and ON | – |

**Explanation of Set Values**

| Set value | Explanation |
|---|---|
| 0 | Rotation direction is changed by analog speed command (REF) voltage.<br>+Voltage: Forward direction<br>-Voltage: Reverse direction |
| 1 | Rotation direction is changed by analog speed command voltage.<br>+Voltage: Reverse direction<br>-Voltage: Forward direction |

| **Pn304** | No. 1 Internally Set Speed | | | | | Speed | |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

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**Parameters Details**

| **Pn305** | No. 2 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

| **Pn306** | No. 3 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

| **Pn307** | No. 4 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

- This is also the speed limit in torque control. The Torque Command/Speed Limit Selection (Pn317) can be used to switch to an external analog limit.

| **Pn308** | No. 5 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

| **Pn309** | No. 6 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

| **Pn310** | No. 7 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

| **Pn311** | No. 8 Internally Set Speed | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | −20,000 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

- If internal speed settings are enabled in the Command Speed Selection (Pn300), set the No. 1 to 4 internally set speed in Pn304 to Pn307 and the No. 5 to 8 internally set speed in Pn308 to Pn311. Set the speed in r/min.
- The polarity of the set values indicates the polarity of the internally set speed.

| **+** | The forward direction as viewed from the shaft end |
|---|---|
| **−** | The reverse direction as viewed from the shaft end |

- The absolute value of the parameter setting is limited by the Overspeed Level Setting (Pn513).

| **Pn312** | Soft Start Acceleration Time | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | ms/(1,000 r/min) | Default setting | 0 | Power OFF and ON | – |

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| **Pn313** | Soft Start Deceleration Time | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | ms/(1,000 r/min) | Default setting | 0 | Power OFF and ON | – |

- ⬩ Control the speed by setting acceleration/deceleration to the speed command inside the driver.
- ⬩ 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 driver in combination with an external position loop. (Set both Pn312 and Pn313 to 0.)
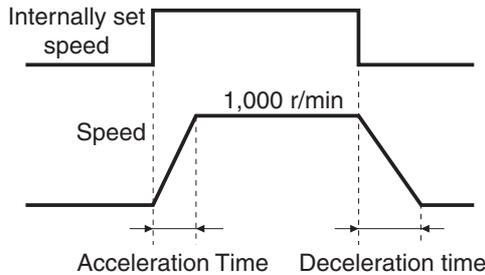


| **Pn314** | S-curve Acceleration/Deceleration Time Setting | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | ms | Default setting | 0 | Power OFF and ON | – |

- ⬩ 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.
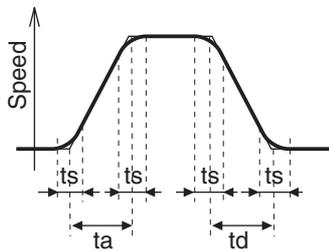


1. Basic linear acceleration time and deceleration time are set by Pn312 and Pn313, respectively.
2. The S-curve time is set by Pn314 (unit: 2 ms) based on the time width around the point of inflection during linear acceleration and deceleration.

ta: Pn312
td: Pn313
ts: Pn314

Use $\dfrac{ta}{2} > ts$, and $\dfrac{td}{2} > ts$ as settings.

| **Pn315** | Zero Speed Designation Selection | | | | | | Speed  Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Zero speed designation function is disabled. |
| 1 | Speed command becomes 0 upon zero speed designation input. (Refer to Figure A) |
| 2 | Speed command becomes 0 upon zero speed designation input, and servo locks with position control when actual speed reaches below Zero Speed Designation Level (Pn316). (Refer to Figure B) |
| 3 | Servo locks with position control upon zero speed designation input and when speed command reaches below Zero Destination Level (Pn316). (Refer to Figure C) |

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Figure A
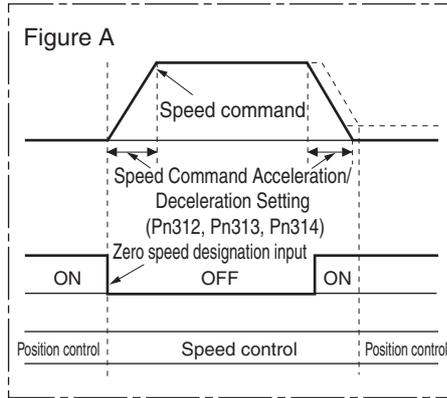
- When the zero speed designation input is turned ON, the speed command is forcibly set to 0.
- Set the acceleration/deceleration setting of the speed command using Soft Start Acceleration Time (Pn312), Soft Start Deceleration Time (Pn313) or S-curve Acceleration/Deceleration Time Setting (Pn314).



Figure B
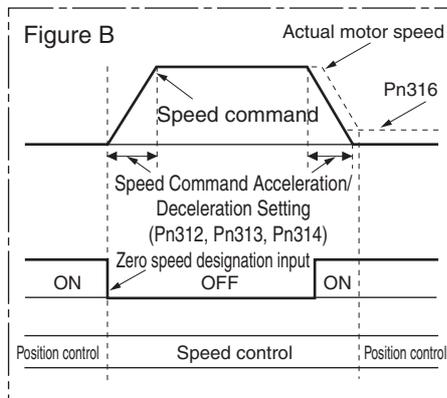
- When the zero speed designation input is tuned ON, the speed command is forcibly set to 0. When the actual motor speed is less than the Position Lock Level Setting (Pn316), the operation switches to position control and servo locks. In addition, when the zero speed designation input is turned OFF, the operation switches to speed control.
- Since the position command for position control is forced to be 0, properly set the position loop gain, various error detection functions and other settings.
- Use this parameter when the CONTROL mode Selection (Pn001) is set to 1 (speed control).
  This may not operate correctly if the CONTROL mode Setting (Pn001) is set to 3 (position or speed control) or 4 (position or torque control).



Figure C
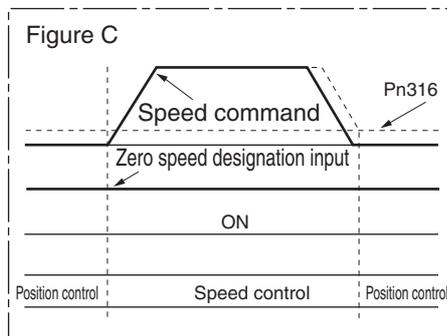
- When the zero speed designation input is turned ON and the speed command is less than the Position Lock Level Setting (Pn316), the operation switches to position control and servo locks.
- When the zero speed designation input is turned ON, the speed command will never be 0. You need to change the speed command.
- Since the operation is executed as a normal position control during position control, properly set the position loop gain, various error detection functions and other settings.
- Use this parameter when the CONTROL mode Selection (Pn001) is set to 1 (speed control).

This may not operate correctly if the CONTROL mode Setting (Pn001) is set to 3 (position or speed control) or 4 (position or torque control).

| **Pn316** | Position Lock Level Setting | | | | | | Speed Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 10 to 20,000 | Unit | r/min | Default setting | 30 | Power OFF and ON | – |

- Servo locks with position control when the speed of the motor is lower than the setting of this parameter.
- The setting of this parameter is valid for both forward and reverse direction regardless of the motor rotation direction.
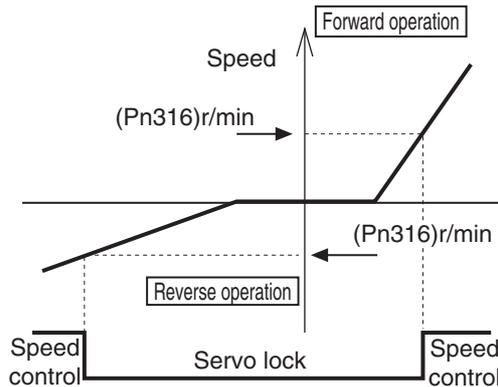


| **Pn317** | Torque Command/Speed Limit Selection | | | | | | Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Torque command | Speed limit |
|---|---|---|
| 0 | Analog input 1 (TREF1) | Pn321 |
| 1 | Analog input 2 (TREF2) | Analog input 1 (TREF1) |
| 2 | Analog input 1 (TREF1) | Pn321, Pn322 |

- It depends on the CONTROL mode.
- When the CONTROL mode is set to speed control/torque control, the torque command input is set to analog input 2.

| **Pn318** | Torque Command Direction Selection | | | | | | Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Method for designating the direction for the torque command: By analogue torque command polarity |
| 1 | Method for designating the direction for the torque command: By digital input TSIGN |

- The default setting for this parameter is 0. By rotating to the reverse direction with the +command keeps the compatibility with all Accurax W-Series Servo Drives.

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| Torque Command /Speed Limit Selection (Pn317) | Torque Command Direction Selection (Pn318) | Analog Torque Command Rotation Direction Switching (Pn320) | Analog torque command (TREF) | Torque command sign selection (TSIGN) | Motor rotation direction | Conversion graph |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | +Voltage (0 to 10 V) | Not affected | Forward direction | Refer to Figure A |
| | | | -Voltage (-10 to 0 V) | Not affected | Reverse direction | |
| | | 1 | +Voltage (0 to 10 V) | Not affected | Reverse direction | Refer to Figure B |
| | | | -Voltage (-10 to 0 V) | Not affected | Forward direction | |
| | 1 | Not affected | +Voltage (0 to 10 V) | OFF | Forward direction | Refer to Figure C |
| | | | -Voltage (-10 to 0 V) | | | |
| | | | +Voltage (0 to 10 V) | ON | Reverse direction | |
| | | | -Voltage (-10 to 0 V) | | | |



Figure A — Torque command vs Input voltage

Figure B — Torque command vs Input voltage

Figure C — TSIGN OFF / TSIGN ON

| Pn319 | Torque Command Scale | | | | | | Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 10 to 100 | Unit | 0.1 V/100% | Default setting | 30 | Power OFF and ON | – |

♦ Set the relation between the voltage applied to the speed limit input (VLIM: CN1 pin 14) and the

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motor speed.

♦ Refer to "5-3 Torque Control" (P.5-14) for more information on torque command scale.

| **Pn320** | Analog Torque Command Rotation Direction Switching | | | | | | Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Direction of motor torque: The +command indicates the forward direction as viewed from the shaft end. |
| 1 | Direction of motor torque: The +command indicates the reverse direction as viewed from the shaft end. |

♦ Reverse the polarity of the torque command input (REF/TREF1: CN1 pin 14 or PCL/TREF2: CN1 pin 16).

| **Pn321** | Speed Limit Value Setting | | | | | | Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

| **Pn322** | Reverse Direction Speed Limit Value Setting | | | | | | Torque |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

♦ Corresponding speed limit values during torque control is shown in the table below.

| Torque Command/ Speed Limit Selection (Pn327) | Speed Limit Value Setting (Pn321) | Reverse Direction Speed Limit Value Setting (Pn322) | Zero Speed Designation Selection (Pn315) | Zero speed clamp | Analog torque command direction | Speed limit value |
|---|---|---|---|---|---|---|
| 0 | 0 to 20,000 | Not affected | 0 | Not affected | Not affected | Pn321 set value |
| | | | 1 to 3 | OFF | | Pn321 set value |
| | | | | ON | | 0 |
| 1 | 0 to 20,000 | 0 to 20,000 | 0 | Not affected | Forward direction | Pn321 set value |
| | | | | | Reverse direction | Pn322 set value |
| | 0 to 20,000 | 1 to 20,000 | 1 to 3 | OFF | Forward direction | Pn321 set value |
| | | | | | Reverse direction | Pn322 set value |
| | 0 to 20,000 | 1 to 20,000 | 1 to 3 | ON | Not affected | 0 |

| **Pn323** | External Feedback Pulse Type Selection | | | | | | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

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### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Phase-AB output type * [1] |
| 1 | Serial communications type (Incremental encoder specifications) |
| 2 | Serial communications type (Absolute encoder specifications) |

*1. The driver internal process count direction relative to the external scale of phase-AB output type is explained below.

Count-down direction          Count-up direction

EXA

EXB

EXB is 90° ahead of EXA.
$t1 > 0.25 \ \mu s$
$t2 > 1.0 \ \mu s$

EXA

EXB

EXB is 90° behind EXA.
$t1 > 0.25 \ \mu s$
$t2 > 1.0 \ \mu s$
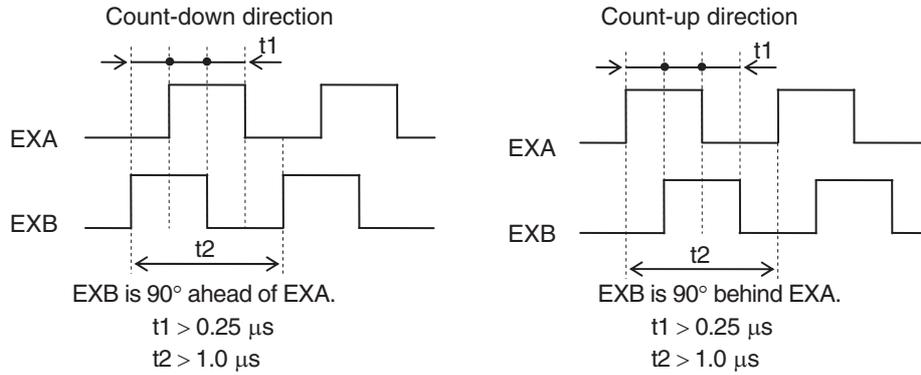
- For the external scale connection direction, set the direction so that count-up occurs when the motor shaft is rotating in the CCW direction, and count-down occurs when the motor shaft is rotating in the CW direction If the connection direction cannot be selected due to installation conditions, etc., the count direction can be reversed using External Feedback Pulse Direction Switching (Pn326).
- Take note that if Pn000 = 1, the scale count direction becomes opposite to the count direction used for monitoring the total external scale feedback pulses, etc.
  If Pn000 = 0, the count direction matches the count direction for monitoring.
- Even when the driver speed is within the specified range, an acceleration error will occur if the motor shaft rotation speed exceeds the maximum speed.

| **Pn324** | External Feedback Pulse Dividing Numerator | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{20}$ | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

| **Pn325** | External Feedback Pulse Dividing Denominator | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 1 to $2^{20}$ | Unit | – | Default setting | 10000 | Power OFF and ON | Yes |

- Check the number of encoder pulses per motor rotation and number of external scale pulses per motor rotation, and set External Feedback Pulse Dividing Numerator (Pn324) and External Feedback Pulse Dividing Denominator (Pn325).

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

- If this ratio is incorrect, the deviation between the position calculated from encoder pulses and position calculated from external scale pulses will increase. Particularly when the moving distance is long, an excessive deviation error will occur.
- Set Pn324 to 0 to have encoder resolution automatically set as numerator.

| **Pn326** | External Feedback Pulse Direction Switching | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

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### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | External scale feedback pulse count direction non-reverse |
| 1 | External scale feedback pulse count direction reverse |

| **Pn327** | External Feedback Pulse Phase-Z Setting | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### 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 $2^{27}$ | Unit | Command unit | Default setting | 16000 | Power OFF and ON | Yes |

⬧ Set the allowable difference (feedback pulse error) between the motor (encoder) position and load (external scale) position in command units.

| **Pn329** | Internal/External Feedback Pulse Error Counter Reset | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 100 | Unit | Rotation | Default setting | 0 | Power OFF and ON | Yes |

⬧ 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.
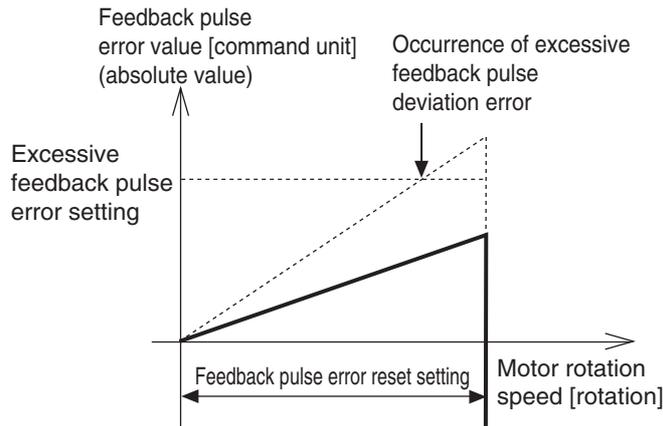


⬧ When using feedback pulse error reset, make sure the feedback pulse error reset setting is set to a proper value. In the case of an extremely small value, it may not function as a protection against error operations caused by erroneous connection of external scale.
Take sufficient care to ensure safety.

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# 8-5    Interface Monitor Setting Parameters

| Pn400 | Input Signal Selection 1 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 8553090 | Power OFF and ON | Yes |

| Pn401 | Input Signal Selection 2 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 8487297 | Power OFF and ON | Yes |

| Pn402 | Input Signal Selection 3 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 9539850 | Power OFF and ON | Yes |

| Pn403 | Input Signal Selection 4 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 394758 | Power OFF and ON | Yes |

| Pn404 | Input Signal Selection 5 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 4108 | Power OFF and ON | Yes |

| Pn405 | Input Signal Selection 6 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 197379 | Power OFF and ON | Yes |

| Pn406 | Input Signal Selection 7 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 3847 | Power OFF and ON | Yes |

| Pn407 | Input Signal Selection 8 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 263172 | Power OFF and ON | Yes |

| Pn408 | Input Signal Selection 9 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 328965 | Power OFF and ON | Yes |

| Pn409 | Input Signal Selection 10 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 3720 | Power OFF and ON | Yes |

| Pn410 | Output Signal Selection 1 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 197379 | Power OFF and ON | Yes |

| Pn411 | Output Signal Selection 2 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 131586 | Power OFF and ON | Yes |

| Pn412 | Not used | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | – | Unit | – | Default setting | - | Power OFF and ON | – |

| Pn413 | Output Signal Selection 4 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 00FFFFFFh | Unit | – | Default setting | 65793 | Power OFF and ON | Yes |

♦Refer to "6-10 Sequence I/O Signal" (P.6-37)for more information on settings.

| Pn416 | Analog Monitor 1 Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 21 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### 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 * 3 | r/min | 500 |
| 2 | Internal position command speed * 3 | r/min | 500 |
| 3 | Speed control command | r/min | 500 |
| 4 | Torque command | % | 33 |
| 5 | Command position error * 4 | pulse (command unit) | 3,000 |
| 6 | Encoder position error * 4 | pulse (encoder unit) | 3,000 |
| 7 | Full closing error * 4 | pulse (external scale unit) | 3,000 |
| 8 | Hybrid Error | pulse (command unit) | 3,000 |
| 9 | P-N voltage | V | 80 |
| 10 | Regeneration load ratio | % | 33 |
| 11 | Overload load ratio | % | 33 |
| 12 | Forward direction torque limit | % | 33 |
| 13 | Reverse direction torque limit | % | 33 |
| 14 | Speed limit value | r/min | 500 |
| 15 | Inertia ratio | % | 500 |
| 16 | Analog input 1 * 2 | V | 1 |
| 17 | Analog input 2 * 2 | V | 1 |
| 18 | Analog input 3 * 2 | V | 1 |
| 19 | Reserved | – | – |
| 20 | Driver temperature | °C | 10 |
| 21 | Encoder 1-rotation data * 1 | pulse (encoder unit) | 110,000 |

*1. Forward and reverse directions of monitor data are the direction set in Pn000. However, CCW will be the forward direction for the absolute encoder 1-rotation data. A normal value is output from the incremental encoder after the first phase Z is input.

*2. Analog inputs 1 to 3 will output terminal voltage even when terminal is not used.

*3. Corresponding to command pulse input, command pulse speed is before command filter (position command filter time constant and smoothing filter time constant), and internal command speed is after command filter.

*4. The position command error is an error from the command pulse input, while the encoder position error or full closing position error is the error at the input of the position loop.

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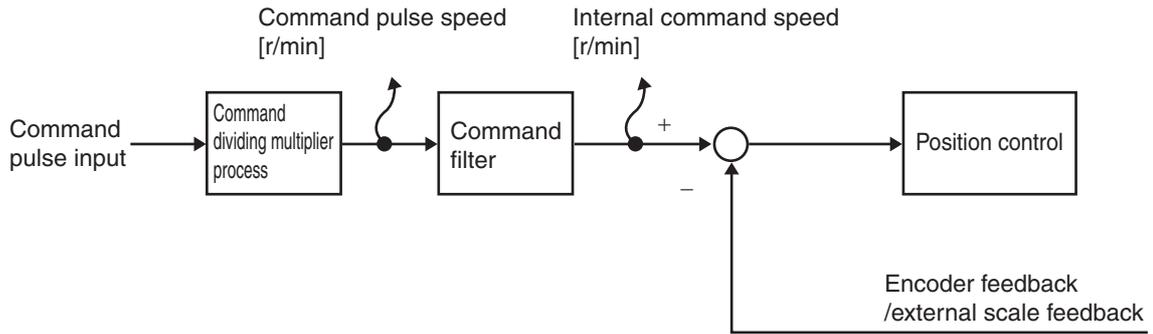
*4. Position error and feedback pulse error come in 2 types, encoder unit/external scale unit and command unit. Encoder unit/external scale unit will be an error of position control input section and command unit will be an error of command pulse input.
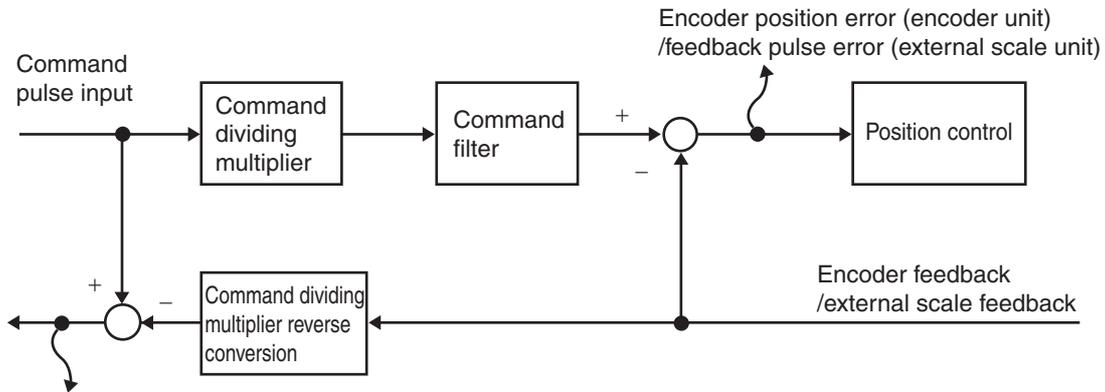


Position command error (command unit)
/command feedback pulse error (command unit)

| **Pn417** | Analog Monitor 1 Scale Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 214,748,364 | Unit | Pn416 monitor unit/V | Default setting | 0 | Power OFF and ON | – |

• Set output gain for analog monitor 1.

| **Pn418** | Analog Monitor 2 Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 21 | Unit | – | Default setting | 4 | Power OFF and ON | – |

• Select the type of analog monitor 2.
• The set value for this parameter is same as Analog Monitor 1 Type (Pn416).

| **Pn419** | Analog Monitor 2 Scale Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 214,748,364 | Unit | Pn418 monitor unit/V | Default setting | 0 | Power OFF and ON | – |

• Set output gain for analog monitor 2.

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| Pn421 | Analog Monitor Output Selection | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Power OFF and ON | – |

♦ Select the analog monitor output voltage direction.

| Set value | Output range | Data output |
|---|---|---|
| 0 | -10 to 10 V | Output voltage [V]<br><br>10 V ----<br>0 V ⟋ Motor speed<br>−5,000 / 5,000 [r/min]<br>−10 V |
| 1 | 0 to 10 V | Output voltage [V]<br>10 V<br>Motor speed<br>−5,000  0 V  5,000 [r/min]<br>−10 V |
| 2 | 0 to 10 V | Output voltage [V]<br>10 V<br>5 V ---- Motor speed<br>0 V ↘ 0  2,500 [r/min]<br>−2,500<br>−10 V |

♦ When monitor type is motor speed and gain of conversion is 500 (1 V = 500 r/min)

| Pn422 | Analog Input 1 Offset | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | −5,578 to 5,578 | Unit | 0.359 mV | Default setting | 0 | Power OFF and ON | – |

♦ Adjust the offset of the speed command input (REF: CN1 pin 14).

♦ The offset amount is approx. the set value times 0.359 mV.

♦ There are 2 ways to adjust the offset.

· Manual adjustment
· Automatic adjustment

♦ The manual adjustment is as follows:

· To adjust the offset for individual drivers, accurately input 0 V to the speed command input/torque command input (REF/TREF1) (or connect to the signal ground), and then set this parameter so that the motor does not rotate.
· If you use a position loop in the host device, set this parameter so that there are no accumulated pulses at servo lock stop status.

♦ The automatic adjustment is as follows:
This parameter will be automatically set when automatic offset adjustment is executed. Refer to "Analog Input Automatic Offset Adjustment" (P.9-27) for the automatic offset adjustment method.

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**Parameters Details**

| **Pn423** | Analog Input 1 Filter Time Constant | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6,400 | Unit | 0.01 ms | Default setting | 0 | Power OFF and ON | – |

 • Set the first-order lag filter time constant in the speed command input (REF: CN1 pin 14).

| **Pn424** | Excessive Analog Input 1 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 100 | Unit | 0.1 V | Default setting | 0 | Power OFF and ON | – |

 • Set the overflow level for speed command input (REF: CN1 pin 14) or torque command input (TREF1: CN1 pin 14) using voltage after offset compensation.
 • Excessive analog input (alarm display No. 39) will be disabled if this parameter is set to 0.

| **Pn425** | Analog Input 2 Offset | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | −342 to 342 | Unit | 5.86 mV | Default setting | 0 | Power OFF and ON | – |

 • Adjust the offset of the speed command input (REF: CN1 pin 14).
 • The offset amount is approx. the set value times 5.86 mV.
 • There are 2 ways to adjust the offset.
   · Manual adjustment
   · Automatic adjustment
 • The manual adjustment is as follows:
   · To adjust the offset for individual drivers, accurately input 0 V to the speed command input/torque command input (REF/TREF1) (or connect to the signal ground), and then set this parameter so that the motor does not rotate.
   · If you use a position loop in the host device, set this parameter so that there are no accumulated pulses at servo lock stop status.
 • The automatic adjustment is as follows:
   This parameter will be automatically set when automatic offset adjustment is executed. Refer to "Analog Input Automatic Offset Adjustment" (P.9-27) for the automatic offset adjustment method.

| **Pn426** | Analog Input 2 Filter Time Constant | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6,400 | Unit | 0.01 ms | Default setting | 0 | Power OFF and ON | – |

 • Set the first-order lag filter time constant in the speed command input (REF: CN1 pin 14).

| **Pn427** | Excessive Analog Input 2 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 100 | Unit | 0.1 V | Default setting | 0 | Power OFF and ON | – |

 • Set the overflow level for speed command input (REF: CN1 pin 14) or torque command input (TREF1: CN1 pin 14) using voltage after offset compensation.
 • Excessive analog input (alarm display No. 39) will be disabled if this parameter is set to 0.

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| **Pn428** | Analog Input 3 Offset | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | −342 to 342 | Unit | 5.86 mV | Default setting | 0 | Power OFF and ON | − | |

♦ Adjust the offset of the speed command input (REF: CN1 pin 14).

♦ The offset amount is approx. the set value times 5 mV.

♦ There are 2 ways to adjust the offset.
  · Manual adjustment
  · Automatic adjustment

♦ The manual adjustment is as follows:
  · To adjust the offset for individual drivers, accurately input 0 V to the speed command input/torque command input (REF/TREF1) (or connect to the signal ground), and then set this parameter so that the motor does not rotate.
  · If you use a position loop in the host device, set this parameter so that there are no accumulated pulses at servo lock stop status.

♦ The automatic adjustment is as follows:
  This parameter will be automatically set when automatic offset adjustment is executed. Refer to "Analog Input Automatic Offset Adjustment" (P.9-27) for the automatic offset adjustment method.

| **Pn429** | Analog Input 3 Filter Time Constant | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6,400 | Unit | 0.01 ms | Default setting | 0 | Power OFF and ON | − | |

♦ Set the first-order lag filter time constant in the speed command input (REF: CN1 pin 14).

| **Pn430** | Excessive Analog Input 3 | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 100 | Unit | 0.1 V | Default setting | 0 | Power OFF and ON | − | |

♦ Set the overflow level for speed command input (REF: CN1 pin 14) or torque command input (TREF1: CN1 pin 14) using voltage after offset compensation.

♦ Excessive analog input (alarm display No. 39) will be disabled if this parameter is set to 0.

| **Pn431** | Positioning Completion Range 1 | | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 262,144 | Unit | Command unit | Default setting | 10 | Power OFF and ON | − | |

♦ Use this in combination with the Positioning Completion Condition Selection (Pn432) to set the timing to output the positioning completion output. The positioning completion output (INP) will output when the Servomotor (workpiece) movement stops and the number of the accumulated pulses in the error counter is within the set value of this parameter, after command pulse input is completed.

♦ 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 will be changed as well.

♦ If this parameter is set to a very small value, the time required for the INP signal to be output will increase and the chattering may occur during output. The setting of the positioning completion range does not affect the precision of the final positioning.



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**Parameters Details**

| Pn432 | Positioning Completion Condition Selection | | | | | Position | Full closing | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Positioning completion output turns ON when the position error is within the Positioning Completion Range 1 (Pn431). |
| 1 | Positioning completion output turns ON when the position error is within the Positioning Completion Range 1 (Pn431) and there is no position command. |
| 2 | Positioning completion output turns ON when the zero speed detection signal 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 will then be held until the Positioning Completion Hold Time (Pn433) elapses. After that, an ON/OFF decision will be made based on the position error at the time. |

- Use this in combination with the Positioning Completion Range 1 (Pn431) to set the operation for positioning completion output (INP: CN1 pin 39).

| Pn433 | Positioning Completion Hold Time | | | | | Position | Full closing | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 30,000 | Unit | 1 ms | Default setting | 0 | Power OFF and ON | | – |

- 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.

| Pn434 | Zero Speed Detection | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 10 to 20,000 | Unit | r/min | Default setting | 50 | Power OFF and ON | | – |

- General-purpose output timing is set by rotation speed r/min.
- General-purpose output 1 (ZSP) will be turned ON when the speed of the motor is lower than the setting of this parameter.
- The setting of this parameter is valid for both forward and reverse direction regardless of the motor rotation direction. This setting has a hysteresis of 10 r/min.

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**Parameters Details**
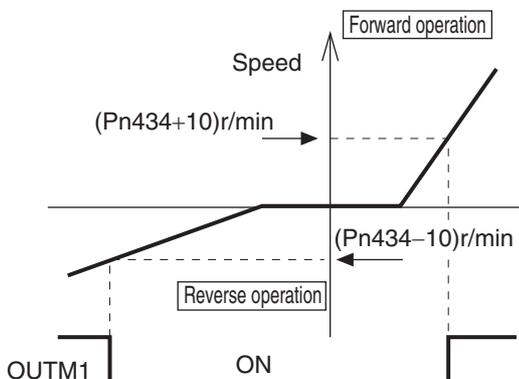
| **Pn435** | Speed Conformity Detection Width | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 10 to 20,000 | Unit | r/min | Default setting | 50 | Power OFF and ON | – |

 ♦ When speed command and motor speed are identical, speed conformity output signal is output.
 ♦ This setting has a hysteresis of 10 r/min for detection.
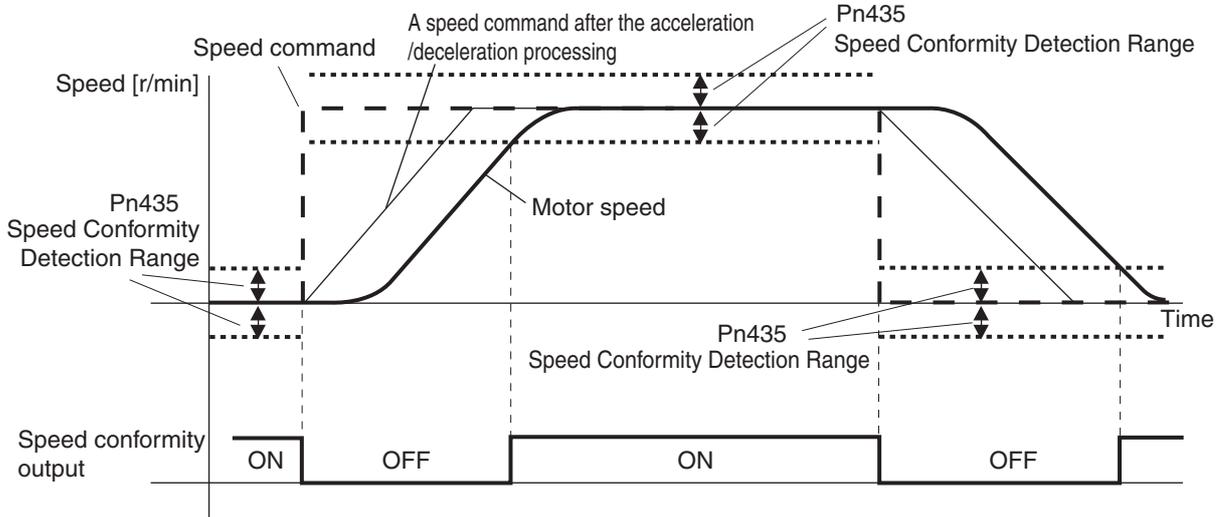


| **Pn436** | Rotation Speed for Motor Rotation Detection | | | | | | Speed |
|---|---|---|---|---|---|---|---|
| Setting range | 10 to 20,000 | Unit | r/min | Default setting | 1000 | Power OFF and ON | – |

 ♦ Speed reached output signal is output when the motor speed reaches the speed set as the achieved speed.
 ♦ This setting has a hysteresis of 10 r/min for detection.



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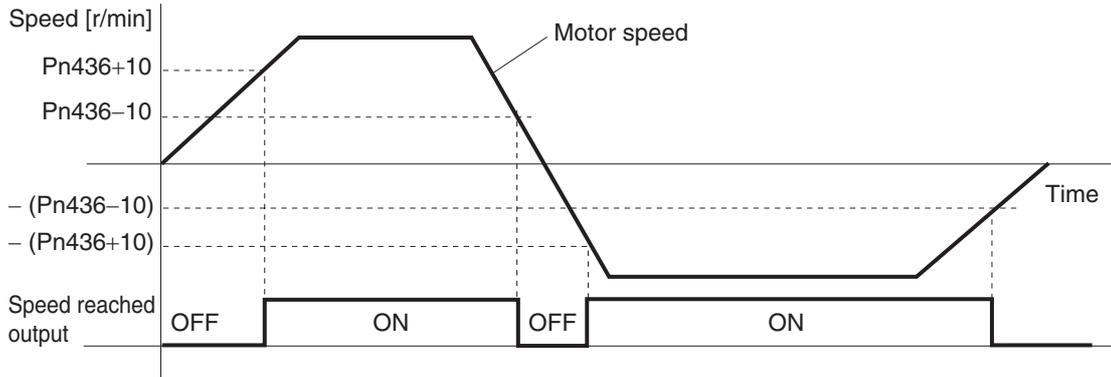
**Parameters Details**

| **Pn437** | Brake Timing when Stopped | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 1 ms | Default setting | 0 | Power OFF and ON | – |

- Set the time required for the Servomotor to be de-energized (servo free) after the brake interlock output (BKIR: CN1pin 10) 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 signal (BKIR) will turn ON, and the servo will turn OFF after waiting for the setting time (set value × ms).
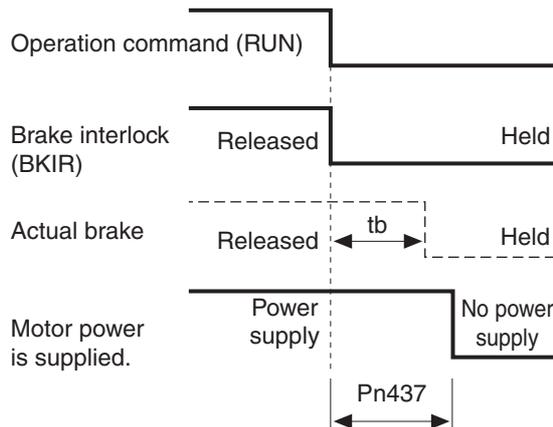


- Make the setting as follows to prevent the machine (workpiece) from moving or falling due to the delay time in the brake operation (tb).
- 
- Brake timing when stopped (set value × 1 ms) ≥ tb

- For details, refer to "6-6 Brake Interlock" (P.6-20).

| **Pn438** | Brake Timing during Operation | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 1 ms | Default setting | 0 | Power OFF and ON | – |

- Set the required time for the brake interlock output (BKIR: CN1 pin 10) to turn OFF after the operation command (RUN: CN1 pin 29) 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 will decelerate to reduce rotation speed, and the brake interlock signal (BKIR) will turn ON after the setting time (set value × 1 ms) has elapsed.
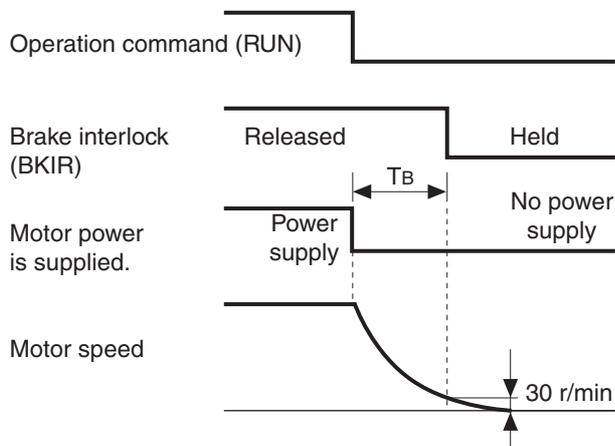


- $T_B$ in the above figure is the brake timing during operation (set value × 1 ms) or the time until the motor rotation speed falls to 30 r/min or lower, whichever is shorter.
- For details, refer to "6-6 Brake Interlock" (P.6-20).

| Pn439 | Brake Release Speed Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 30 to 3,000 | Unit | r/min | Default setting | 30 | Power OFF and ON | Yes |



| Pn440 | Warning Output Selection 1 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10 | Unit | – | Default setting | 0 | Power OFF and ON | – |
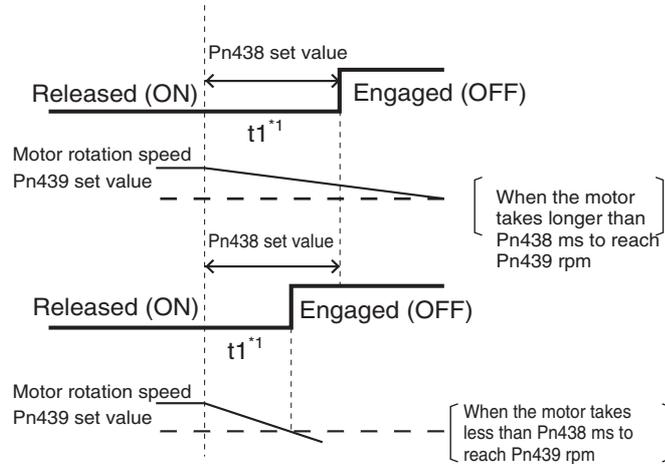
### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | No |
| 1 | Overload warning |
| 2 | Excessive regeneration warning |
| 3 | Battery warning |
| 4 | Fan warning |
| 5 | Encoder communications warning |
| 8 | Encoder overheating warning |
| 9 | External scale error warning |
| 10 | External scale communications error warning |

• Do not set it to a value other than a number 0 to 5, and 8 to 10.

• Refer to "11-2 Warning List" (P.11-5) for more information on settings.

| Pn441 | Warning Output Selection 2 | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 7 | Unit | – | Default setting | 0 | Power OFF and ON | – |

• The set values for this parameter are same as Warning Output Selection 1 (Pn440).

| Pn442 | Positioning Completion Range 2 | | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 262,144 | Unit | Command unit | Default setting | 10 | Power OFF and ON | – | |

• Set the positioning completion range.
• The set values for this parameter are same as Positioning Completion Range 1 (Pn431).

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**Parameters Details**

# 8-6 Extended Parameters

| **Pn500** | Electronic Gear Ratio Numerator 2 | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{30}$ | Unit | – | Default setting | 0 | Power OFF and ON | – |

| **Pn501** | Electronic Gear Ratio Numerator 3 | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{30}$ | Unit | – | Default setting | 0 | Power OFF and ON | – |

| **Pn502** | Electronic Gear Ratio Numerator 4 | | | | | | Position |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{30}$ | Unit | – | Default setting | 0 | Power OFF and ON | – |

| **Pn503** | Encoder Dividing Denominator | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 262,144 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

- If encoder dividing denominator $\neq 0$, division is performed at the rate according to the formula below.

$$\text{Encoder FB pulse} \rightarrow \boxed{\dfrac{\text{Pn011}}{\text{Pn503}}} \rightarrow \text{Output pulse}$$

- Therefore, the formula will be as follows when the host side counts pulses through processing with quadruple multiplier.

- Number of pulse output resolution per rotation = $\dfrac{\bullet}{P} \times$ Encoder resolution

- The pulse output resolution per rotation will never exceed the encoder resolution. (If the above settings are used, the pulse output resolution per rotation will be equal to the encoder resolution.)
- 1 phase-Z signal is output for each rotation of the motor.
- If the pulse output resolution per rotation from the above equation is a multiple of 4, phases Z and A are output in synchronization. In all other cases, the output width of phase Z will be output as the encoder resolution, resulting to be narrower than phase A. Accordingly, phases A and Z will not be synchronized.



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| **Pn504** | Drive Prohibition Input Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 2 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

### 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.
- Operation will be as follows if 0 is set.
  - Forward drive prohibition input (POT: CN1 pin 9) and COM connected: Normal status when the forward limit switch does not operate
  - Forward drive prohibition input (POT: CN1 pin 9) and COM open: Forward direction prohibited and reverse direction permitted
  - Reverse drive prohibition input (NOT: CN1 pin 8) and COM connected: Normal status when the reverse limit switch does not operate
  - Reverse drive prohibition input (NOT: CN1 pin 8) and COM open: Reverse direction prohibited and forward direction permitted.
- If this is set to 0, the Servomotor will decelerate and stop 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).
- If this parameter is set to 0 and the forward and reverse prohibition inputs are both open, an error will be detected in the driver, and a drive prohibition input error (alarm display No. 38) will occur.
- If this parameter is set to 2, a drive prohibition input error (alarm display No. 38) will occur 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 will be eliminated, 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 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 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | During deceleration: Dynamic brake operation<br>After stop: Torque command is 0 for drive prohibition direction<br>Error counter: Held |
| 1 | During deceleration: Torque command is 0 for drive prohibition direction<br>After stop: Torque command is 0 for drive prohibition direction<br>Error counter: Held |
| 2 | During deceleration: Immediate stop<br>After stop: Torque command is 0 for drive prohibition direction<br>Error counter: Clear before and after deceleration |

- Set the drive conditions during deceleration or after stopping after the drive prohibition input (POT: CN1 pin 9 or NOT: CN1 pin 8) is enabled.
- If this is set to 2, the Immediate Stop Torque (Pn511) will be used to torque limit during deceleration.

**8**

**Parameters Details**

| Pn506 | Stop Selection with Servo OFF | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 9 | | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation | | |
|---|---|---|---|
| | **During deceleration * 3** | **After stopping** | **Error counter** |
| 0 | Dynamic brake operation | Dynamic brake operation | Clear * 4 |
| 1 | Free-run | Dynamic brake operation | Clear * 4 |
| 2 | Dynamic brake operation | Servo unlocked | Clear * 4 |
| 3 | Free-run | Servo unlocked | Clear * 4 |
| 4 | Dynamic brake operation | Dynamic brake operation | Hold * 2 |
| 5 | Free-run | Dynamic brake operation | Hold * 2 |
| 6 | Dynamic brake operation | Servo unlocked | Hold * 2 |
| 7 | Free-run | Servo unlocked | Hold * 2 |
| 8 | Immediate stop * 1 | Dynamic brake operation | Clear * 4 |
| 9 | Immediate stop * 1 | Servo unlocked | Clear * 4 |

♦ If an error occurs when servo is turned OFF, the operation will be based on the Stop Selection for Alarm Generation (Pn510). Additionally, if the main power supply is turned OFF when servo is OFF, it will be based on the Stop Selection with Main Power Supply OFF (Pn507).

*1. Immediate stop refers to applying control while servo is still ON and stopping the operation immediately.
At that time, the torque command value is restricted by the Immediate Stop Torque (Pn511).

*2. If the position command is given or the motor runs continuously when servo is turned OFF, the position error accumulates and Err24.0, "error counter overflow," may occur. In addition, if servo is turned ON when the position error or external scale error is a large value, the motor may operate abruptly to perform a control operation to bring the error to 0. Take sufficient care when using while holding the position error or external scale error.

*3. 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.

*4. The position error or external scale error will always be cleared to 0.

**8**

**Parameters Details**

| **Pn507** | Stop Selection with Main Power Supply OFF | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 9 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation | | |
|---|---|---|---|
| | **During deceleration * [3]** | **After stopping** | **Error counter** |
| 0 | Dynamic brake operation | Dynamic brake operation | Clear * [4] |
| 1 | Free-run | Dynamic brake operation | Clear * [4] |
| 2 | Dynamic brake operation | Servo unlocked | Clear * [4] |
| 3 | Free-run | Servo unlocked | Clear * [4] |
| 4 | Dynamic brake operation | Dynamic brake operation | Hold * [2] |
| 5 | Free-run | Dynamic brake operation | Hold * [2] |
| 6 | Dynamic brake operation | Servo unlocked | Hold * [2] |
| 7 | Free-run | Servo unlocked | Hold * [2] |
| 8 | Immediate stop * [1] | Dynamic brake operation | Clear * [4] |
| 9 | Immediate stop * [1] | Servo unlocked | Clear * [4] |

◆ If an error occurs when the main power supply is turned OFF, the operation will be based on the Stop Selection for Alarm Generation (Pn510). If the main power supply is turned OFF when Servo is ON, and if the Undervoltage Alarm Selection (Pn508) is set to 1, Err13.1, "main power supply undervoltage (AC cut-off detection)," will occur. Follow the Stop Selection for Alarm Generation (Pn510).

*1. Immediate stop refers to applying control while servo is still ON and stopping the operation immediately. At that time, the torque command value is restricted by the Immediate Stop Torque (Pn511).

*2. If the position command is given or the motor runs continuously when the main power supply is turned OFF, the position error accumulates and Err24.0, "error counter overflow," may occur. In addition, if servo is turned ON when the position error or external scale error is a large value, the motor may operate abruptly to perform a control operation to bring the error to 0. Take sufficient care when using while holding the position error or external scale error.

*3. 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.

*4. The position error or external scale error will always be cleared to 0.

| **Pn508** | Undervoltage Alarm Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Turn the servo OFF based on the setting of the Stop Selection with Main Power Supply OFF (Pn507) and turn it back to servo ON by turning ON the main power supply. |
| 1 | Err13.1 "main power supply undervoltage" will occur and a trip will be caused. |

| **Pn509** | Momentary Hold Time | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 70 to 2,000 | Unit | 1 ms | Default setting | 70 | Power OFF and ON | Yes |

◆ Set main power supply alarm detection time.

◆ The main power supply OFF detection will be disabled if this is set to 2,000.

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**Parameters Details**

| Pn510 | Stop Selection for Alarm Generation | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 7 | | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation | | |
|---|---|---|---|
| | **During deceleration * 3** | **After stopping** | **Error counter** |
| 0 | Dynamic brake operation | Dynamic brake operation | Clear * 1 |
| 1 | Free-run | Dynamic brake operation | Clear * 1 |
| 2 | Dynamic brake operation | Servo unlocked | Clear * 1 |
| 3 | Free-run | Servo unlocked | Clear * 1 |
| 4 | Operation A: Immediate stop * 2 Operation B: Dynamic brake operation | Dynamic brake operation | Clear * 1 |
| 5 | Operation A: Immediate stop * 2 Operation B: Free-run | Dynamic brake operation | Clear * 1 |
| 6 | Operation A: Immediate stop * 2 Operation B: Dynamic brake operation | Servo unlocked | Clear * 1 |
| 7 | Operation A: Immediate stop * 2 Operation B: Free-run | Servo unlocked | Clear * 1 |

- Set the operation to be performed after stopping or during deceleration when any protective function of the driver operates and an error occurs.

*1. The error counter is cleared when an alarm is reset.

*2. Operations A and B indicate whether immediate stop takes place upon error generation. If an immediate stop alarm is generated, immediate stop in operation A is executed.
If an alarm that does not support immediate stop is generated, immediate stop in operation B will take place.

*3. 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.

**8**

**Parameters Details**

**Immediate Stop Operation when an Alarm that Supports Immediate Stop is Generated**
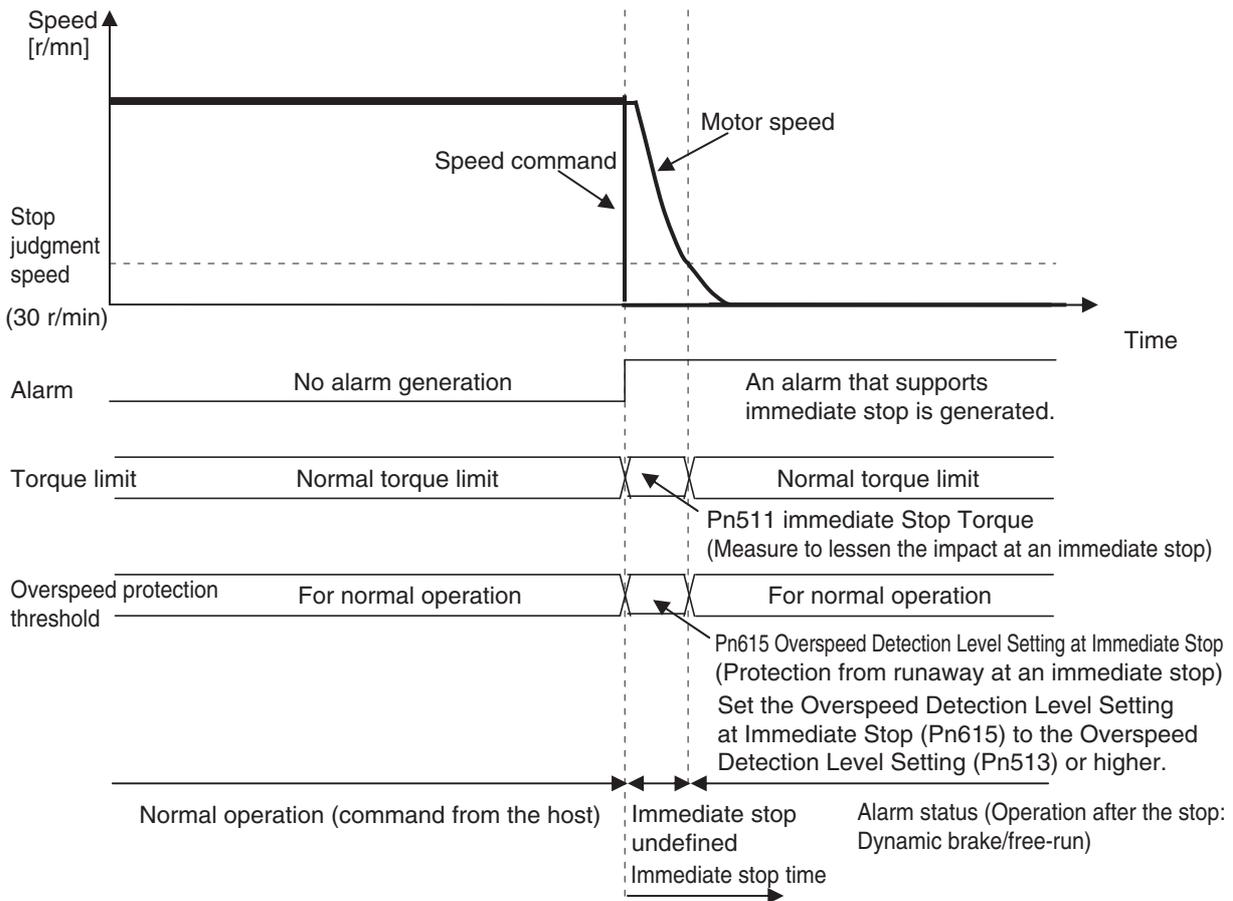


- If the actual speed is not 30 r/min or less after the time set by the Alarm Generation Allowable Time Setting (Pn614) elapses, an immediate alarm status will occur. In addition, if an alarm that does not support immediate stop occurs inside the driver at immediate stop, an immediate alarm status will occur.

- Set the allowable overspeed level to Pn615, "Overspeed Detection Level Setting at Immediate Stop," as a protective measure against runaway at an immediate stop. Err26.1, "overspeed 2," if it occurs, will cause an immediate error trip because it is an error that does not support immediate stop. However, if the setting is below Pn513, "Overspeed Detection Level Setting," an immediate stop will not take place because Err26.1, "overspeed 2," will occur before Err26.0, "overspeed." In addition, if Err26.0 and Err26.1 are detected at the same time, Err26.0 will be displayed. However, an immediate stop will not take place because Err26.1 has also occurred internally.

| **Pn511** | Immediate Stop Torque | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | % | Default setting | 0 | Power OFF and ON | – |

- 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 will be used if this parameter is set to 0.

| **Pn512** | Overload Detection Level Setting | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | % | Default setting | 0 | Power OFF and ON | – |

- Set the overload detection level.

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**Parameters Details**

⬧If this setting is 0, the level is set to 115% of nominal torque

⬧Internally ther is a limit of 115%, so higher values are limited to 115%

| **Pn513** | Overspeed Detection Level Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

⬧Set the overspeed detection level.

⬧The overspeed detection level setting will be 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 reduce 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 17 bit absolute encoder and ±36 r/min for a 20 bit incremental encoder

| **Pn514** | Overrun Limit Setting | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1 rotation | Default setting | 10 | Power OFF and ON | – |

⬧Set the allowable operating range for the position command input range.

⬧If the set value is exceeded, motor operation range setting protection is generated.

When position command is not input
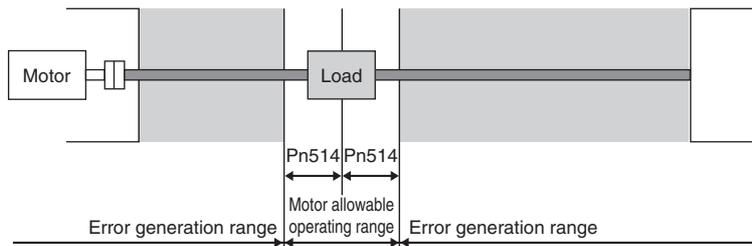


When position command is input
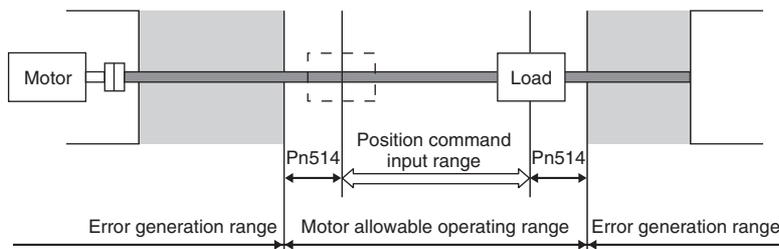


| **Pn515** | Control Input Signal Read Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | 0.166ms |
| 1 | 0.333ms |
| 2 | 1 ms |
| 3 | 1.666 ms |

♦ Select the signal read cycle for control signal (digital input).

| Pn516 | Alarm Reset Condition Selection | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | 120 ms |
| 1 | Follow the Control Input Signal Read Setting (Pn515). |

♦ Select the signal confirmation time for alarm reset input signal (RESET).

| Pn517 | Error Counter Reset Condition Selection | | | | | | Position Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 4 | Unit | – | Default setting | 3 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Disabled |
| 1 | Clears the error counter at level when the signal is shorted for 500 $\mu$s or longer. |
| 2 | Clears the error counter at level when the signal is shorted for 1 ms or longer. |
| 3 | Clears the error counter at edge when the signal changes from open to shorted for 100 $\mu$s or longer. |
| 4 | Clears the error counter at edge when the signal changes from open to shorted for 1 ms or longer. |

♦ When set to 1 or 2, the minimum time width will be as follows.

Error counter reset input signal

Set value 1: 500 $\mu$s or more
Set value 2: 1 ms or more
Error reset keeps repeating.
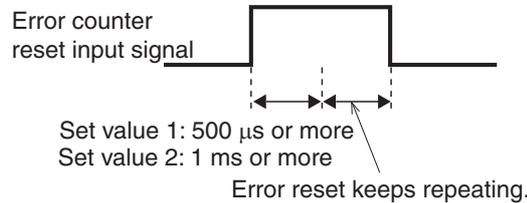
♦ When set to 3 or 4, the minimum time width will be as follows.

Error counter reset input signal

Set value 3: 100 $\mu$s or more
Set value 4: 1 ms or more

Error is reset once.
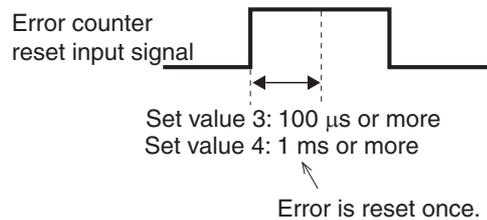
| Pn518 | Command Pulse Prohibition Input Setting | | | | | | Position Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Enabled |
| 1 | Disabled |

♦ Enable or disable the pulse prohibition input signal (IPG).

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**Parameters Details**

When command pulse prohibition input is enabled, command pulse input count process is force stopped.

| **Pn519** | Command Pulse Prohibition Input Read Setting | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Power OFF and ON | – |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | 0.166 ms |
| 1 | 0.333 ms |
| 2 | 1 ms |
| 3 | 1.666 ms |
| 4 | 0.166 ms (No judgment of multiple matches) |

⬧ Select the signal read cycle for the pulse prohibition input signal (IPG).

⬧ The signal status is updated when the signal status in each signal read cycle that has been set matches multiple times.

⬧ You can lower the possibility of incorrect operation caused by noise by extending the signal read cycle. However, the responsiveness to signal inputs will be reduced.

| **Pn520** | Position Setting Unit Selection | | | | | Position | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Command unit |
| 1 | Encoder unit |

⬧ Select the setting unit of Positioning Completion Range 1 and 2 (Pn431 and Pn442), and Error Counter Overflow Level (Pn014).

| Pn521 | Torque Limit Selection | | | | | Position Speed Full closing |
|---|---|---|---|---|---|---|
| Setting range | 0 to 6 | Unit | – | Default setting | 1 | Power OFF and ON | – |

### Explanation of Set Values

| Torque Limit Selection (Pn521) | Torque limit switching input (TLSEL) | Torque Limit Switching Setting (Pn523 and 524) | Forward direction analog limit input (PCL) | Reverse direction analog torque limit input (NCL) | Forward direction torque limit | Reverse direction torque limit |
|---|---|---|---|---|---|---|
| 0 | | | 0 to 10 V | -10 to 0 V | PCL | NCL |
| 1 | – | – | | | Pn013 | |
| 2 | – | – | | | Pn013 | Pn522 |
| 3 | OFF | Enabled | | | Pn013 | |
| | ON | Enabled | | | Pn522 | |
| 4 | | | 0 to 10 V | 0 to 10 V | PCL | NCL |
| 5 | | | 0 to 10 V | Not affected | PCL | NCL |
| 6 | OFF | – | | | Pn013 | Pn522 |
| | ON | – | | | Pn525 | Pn526 |

* Set the torque limit method for forward and reverse direction.
* If this parameter is set to 1, the forward and reverse torque limit input will be limited by the No. 1 Torque Limit (Pn013).
* When using torque control, the No. 1 Torque Limit (Pn013) will be the limit value for forward and reverse operation regardless of the setting of this parameter.

| Pn522 | No. 2 Torque Limit | | | | | Position Speed Full closing |
|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | % | Default setting | 500 | Power OFF and ON | – |

* 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) will be ignored.
* Make the settings as a percentage of the rated torque. [Example] Maximum torque is limited to 150%

Torque [%] Forward

300 (maximum)

When Pn013 or Pn522 = 150   200

100 (rated)

Speed

100
(rated) (maximum)

200

300

Reverse
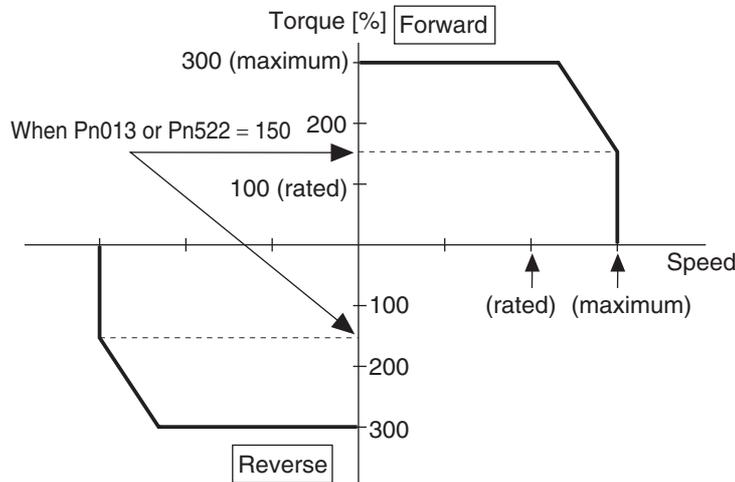
* Refer to "5-3 Torque Control" (P.5-14) for more information on torque limits and the torque limit selection.

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**Parameters Details**

| **Pn523** | Torque Limit Switching Setting 1 | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 4,000 | Unit | ms/100% | Default setting | 0 | Power OFF and ON | – |

⬩ Set the rate of change from torque limit 1 to torque limit 2
⬩ When set to 0, switching takes place immediately.
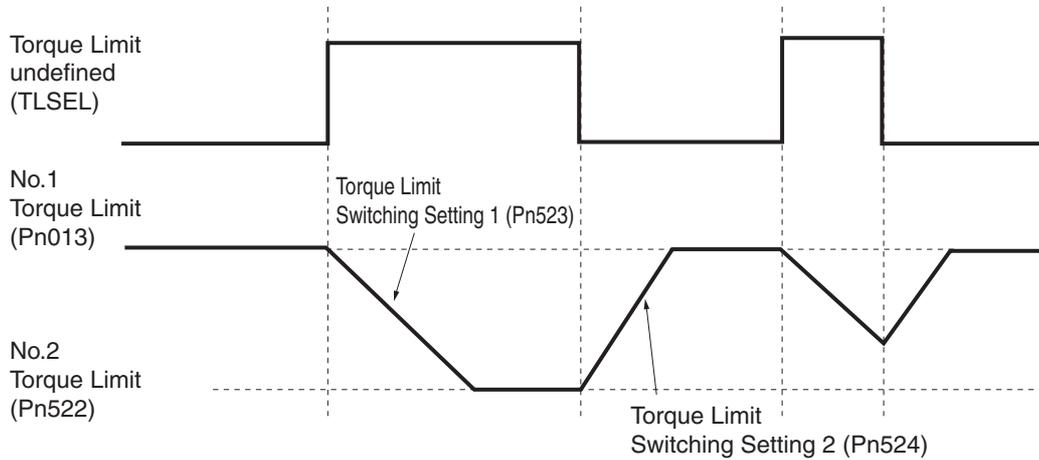


| **Pn524** | Torque Limit Switching Setting 2 | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 4,000 | Unit | ms/100% | Default setting | 0 | Power OFF and ON | – |

⬩ Set values for this parameter are same as those for Torque Limit Switching Setting 1 (Pn523).
⬩ Set the rate of change from torque limit 2 to torque limit 1

| **Pn525** | Forward External Torque Limit | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | % | Default setting | 500 | Power OFF and ON | – |

⬩ Set the forward external torque limit upon torque limit switching input when Pn521=6.

| **Pn526** | Reverse External Torque Limit | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | % | Default setting | 500 | Power OFF and ON | – |

⬩ Set the reverse external torque limit upon torque limit switching input when Pn521=6.

| **Pn527** | Analog Torque Limit Scale | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 10 to 100 | Unit | 0.1 V/100% | Default setting | 30 | Power OFF and ON | – |

⬩ Set the gain for the analogue torque limit input.

| **Pn528** | Default Display | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 35 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Command position error |
| 1 | Motor speed |

| Set value | Explanation |
|---|---|
| 2 | Position command speed |
| 3 | Speed control command |
| 4 | Torque command |
| 5 | Total encoder pulses |
| 6 | Total command pulses |
| 8 | Total external scale feedback pulses |
| 9 | CONTROL mode |
| 10 | I/O signal status |
| 11 | Analog input value |
| 12 | Error factor, history |
| 13 | Warning number |
| 14 | Regeneration resistance load ratio |
| 15 | Overload load ratio |
| 16 | Inertia ratio |
| 17 | Reason for no rotation |
| 18 | Display of the number of I/O signal changes |
| 20 | Absolute encoder data |
| 21 | Absolute external scale position |
| 22 | Monitor for the number of encoder communications errors |
| 23 | Display of axis numbers for communication |
| 24 | Position error (encoder unit) |
| 25 | External scale error (external scale unit) |
| 26 | Hybrid error |
| 27 | P-N voltage |
| 28 | Soft version |
| 29 | Driver serial number |
| 30 | Motor serial number |
| 31 | Accumulative operation time |
| 32 | Automatic motor recognition function |
| 33 | Driver temperature |
| 35 | Safety status monitor |

⬩ Select the data to be displayed on the 7-segment LED on the front panel after the power supply is turned ON.

⬩ For information on the display, refer to "9-4 Setting the Mode" (P.9-8).

| **Pn531** | Axis Number | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 127 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

⬩ Set the axis number for communication.

| **Pn532** | Command Pulse Input Maximum Setting | | | | | | Position Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 250 to 4,000 | Unit | kpps | Default setting | 4000 | Power OFF and ON | Yes |

⬩ Set the maximum command pulse input.

⬩ Err27.0 occurs if frecuency exceeds this range

| **Pn533** | Pulse Regeneration Output Limit Setting | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Error detection disabled |
| 1 | Error detection enabled |

♦Set the detection of Err28.0 "pulse regeneration error".

| **Pn535** | Front Key Protection Setting | | | | | | All | |
|---|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Front panel operation not blocked |
| 1 | Front panel operation blocked |

♦Set the operation limitation from the front panel.

♦The operation limits depend on the mode. The operation limits are as follows.

| Mode | Operation limits |
|---|---|
| MONITOR mode | All monitor data can be checked. |
| PARAMETER SETTING mode | Parameters cannot be changed. However, parameter set values can be checked. |
| EEPROM WRITE mode | Cannot be executed. (Will not be displayed) |
| AUXILIARY FUNCTION mode | Operations other than the release of the front key protection setting cannot be executed. (Will not be displayed) |

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**Parameters Details**

# 8-7 Special Parameters

| **Pn600** | Analog Torque Feed-forward Gain Setting | | | | | Position Speed Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 100 | Unit | 0.1 V/100% | Default setting | 0 | Power OFF and ON | – |

♦ Set the input gain for analog torque feed forward. 0 to 9 will disable the function.

| **Pn604** | Jog Speed | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 500 | Unit | r/min | Default setting | 300 | Power OFF and ON | – |

♦ Set the command speed during JOG trial operation (speed control).

| **Pn605** | Gain 3 Effective Time | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | 0.1 ms | Default setting | 0 | Power OFF and ON | – |

♦ Set effective time of gain 3 of 3-step gain switching.

| **Pn606** | Gain 3 Ratio Setting | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 100 to 1,000 | Unit | % | Default setting | 100 | Power OFF and ON | – |

♦ Set gain 3 as a multiple of gain 1.

| **Pn607** | Torque Command Value Offset | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | −100 to 100 | Unit | % | Default setting | 0 | Power OFF and ON | – |

♦ Set offset torque to add to torque command.

| **Pn608** | Forward Direction Torque Offset | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | −100 to 100 | Unit | % | Default setting | 0 | Power OFF and ON | – |

♦ Set the value to add to the torque command in the forward direction operation.

| **Pn609** | Reverse Direction Torque Offset | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | −100 to 100 | Unit | % | Default setting | 0 | Power OFF and ON | – |

♦ Set offset torque to add to torque command for reverse direction operation.

| **Pn610** | Function Expansion Setting | | | | | Position | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 63 | Unit | – | Default setting | 0 | Power OFF and ON | – |

♦ Set each function per bit.

| 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 | Inertia ratio switching function | Disabled | Enabled |
| bit 4 | Electric current response improvement function | Disabled | Enabled |

♦ Set the decimal value that has been converted from bit.
  [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.

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**Parameters Details**

‣If the settings are as described above, the bit will be 10,011, 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 | Power OFF and ON | – |

♦ Make fine adjustment on electric current response with default setting as 100%.

| **Pn613** | Inertia Ratio 2 | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10,000 | Unit | % | Default setting | 250 | Power OFF and ON | – |

♦ Set the second load inertia as a percentage of the motor rotor inertia.

| **Pn614** | Alarm Generation Allowable Time Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | ms | Default setting | 200 | Power OFF and ON | – |

♦ Set the allowable time for the immediate stop to complete when there is one alarm. If TB in the figure below is exceeded an alarm is forced

♦ The resolution is 2ms. For example if the setting is 11 the real value is 12.

Operation command (RUN)

Brake interlock (BKIR)        Released        Held

$T_B$

Motor power is supplied.        Power supply        No power supply
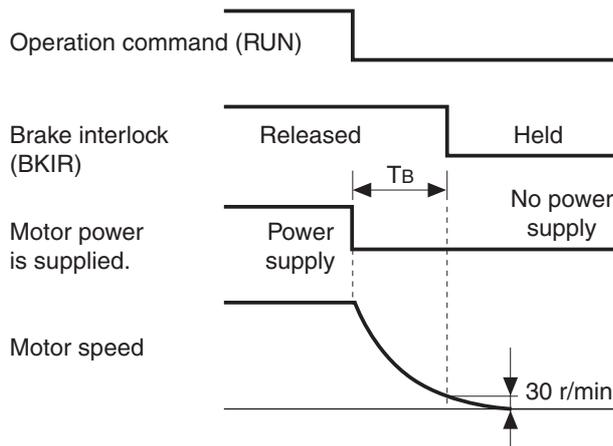
Motor speed        30 r/min

♦TB in the above figure is the brake timing during operation or the time until the motor rotation speed falls to 30 r/min or lower, whichever is shorter.

♦ For details, refer to "6-6 Brake Interlock" (P.6-20).

| **Pn615** | Overspeed Detection Level Setting at Immediate Stop | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 20,000 | Unit | r/min | Default setting | 0 | Power OFF and ON | – |

♦ Set overspeed detection level upon generation of immediate stop alarm.
♦The overspeed detection level setting will be 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 reduce the overspeed detection level.
♦The set value of this parameter is limited to 1.2 times the maximum motor rotation speed.

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| **Pn616** | Absolute Interface Function Selection | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Disabled |
| 1 | Enabled |

- Setting this parameter, when SEN input is activated, the driver send a serial transmission with the absolute encoder data.

| **Pn617** | Front Panel Parameter Write Selection | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | EEPROM write not performed when a parameter is changed from the front panel |
| 1 | EEPROM write performed at the same time |

- Set the EEPROM write conditions when the front panel parameter is changed.

| **Pn618** | Power Supply ON Initialization Time | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 100 | Unit | 0.1 s | Default setting | 0 | Power OFF and ON | Yes |

- Set initialization time after power supply ON to the standard 1.5 seconds plus some.

| **Pn619** | Encoder Phase-Z Setting | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 32,767 | Unit | Pulse | Default setting | 0 | Power OFF and ON | Yes |

- Finely adjust the encoder phase-Z width when the number of output pulses per motor rotation after the division of pulse output is not an integer.

| **Pn620** | External Scale Phase-Z Setting | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 400 | Unit | μs | Default setting | 0 | Power OFF and ON | Yes |

- Set the external scale phase-Z regeneration width with time.
- You can output the phase-Z signal at least for the period of time that has been set if the phase-Z signal width is too short for detection due to the travel distance from the external scale.

| **Pn621** | Serial Absolute External Scale Phase-Z Setting | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to $2^{28}$ | Unit | Pulse | Default setting | 0 | Power OFF and ON | Yes |

- The external scale phase-Z output width can be extended.
- When you perform the pulse output using an external scale as the output source under full closing control that uses the serial absolute external scale, use this to set the intervals of phase-Z output based on the number of external scale phase-A output pulses (before quadruple multiplier).

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**Parameters Details**

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Phase Z is output only at the position where the external scale value is 0. |
| 0 to $2^{28}$ | After the phase-Z output at the position where the external scale value is 0, phase Z is output in the set value pulse cycle.Phase Z is not output until the external scale value passes 0. |

| **Pn622** | Phase-AB Regeneration Method Selection for External Scale of Phase-AB Output Type | | | | | Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

♦Select the regeneration method of pulse outputs OA and OB when an external scale of phase AB-output type is used.

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Without signal regeneration |
| 1 | With signal regeneration [1],[2] |

*1. Through outputs are always made for phase Z without signal regeneration.

*2. If the signal regeneration setting is selected, the duties of OA and OB are regenerated on the amplifier side and disturbance of waveforms can be suppressed.Take note, however, that this causes delays in phase Z.

| **Pn623** | Disturbance Torque Compensation Gain | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | −100 to 100 | Unit | % | Default setting | 0 | Power OFF and ON | – |

♦Set compensation gain for disturbance torque.

| **Pn624** | Disturbance Observer Filter Setting | | | | | Position Full closing | |
|---|---|---|---|---|---|---|---|
| Setting range | 10 to 2,500 | Unit | 0.01 ms | Default setting | 53 | Power OFF and ON | – |

♦Set filter time constant for disturbance torque compensation.

| **Pn627** | Warning Latch Hold Time Selection | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 10 | Unit | – | Default setting | 5 | Power OFF and ON | Yes |

### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Latch time infinite |
| 1-10 | Latch time in seconds |

| **Pn631** | Realtime Autotuning Estimated Speed Selection | | | | | All | |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 3 | Unit | – | Default setting | 1 | Power OFF and ON | Yes |

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### Explanation of Set Values

| Set value | Explanation |
|---|---|
| 0 | Estimation result is finalized when load estimation stabilizes. |
| 1 | For load characteristics change, the estimation is made at time constant of approx. 7 minutes. |
| 2 | For load characteristics change, the estimation is made at time constant of approx. 4 seconds. |
| 3 | For load characteristics change, the estimation is made at time constant of approx. 2 seconds. |

| **Pn632** | REALTIME AUTOTUNING CUSTOMIZATION mode Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | −32,768 to 32,767 | Unit | – | Default setting | 0 | Power OFF and ON | – |

- Set the CUSTOMIZATION mode detail for realtime autotuning.

| **Pn633** | Absolute Encoder Initial Pulse Regeneration Speed | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 1,000 to 3,000 | Unit | r/min | Default setting | 1000 | Power OFF and ON | – |

- Set the pulse regeneration speed when the initial pulse is output.
- Connection with OMRON controller
  For the Host Controller to correctly receive the position from the absolute encoder, the pulse output from the driver must be set to be completed before the controller's timeout.
- Pulse are outputted to a speed equivalent to a motor rotating at a speed specified by this parameter.
  The following values or more are recommended for use.

| OMRON controller | Pn633 |
|---|---|
| CJ1W-NCxx4 | 1000 |
| CS1W-MCxxx | 1000 |
| CV500-MCxxx | 3000 |
| 3F88M-DRT141 | 1500 |

*1. You can set the timeout setting time on the controller side.

| **Pn634** | Hybrid Vibration Suppression Gain | | | | | | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 30,000 | Unit | 0.1/s | Default setting | 0 | Power OFF and ON | – |

- 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.

| **Pn635** | Hybrid Vibration Suppression Filter | | | | | | Full closing |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 6,400 | Unit | 0.01 ms | Default setting | 10 | Power OFF and ON | – |

- Set the hybrid vibration suppression filter.

| **Pn637** | Vibration Detection Threshold | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | 0 to 1,000 | Unit | 0.1% | Default setting | 0 | Power OFF and ON | – |

- Set the vibration detection threshold.

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⬥If torque vibration that exceeds this setting is detected, the vibration detection warning will occur.

| **Pn638** | Warning Mask Setting | | | | | | All |
|---|---|---|---|---|---|---|---|
| Setting range | −32,768 to 32,767 | Unit | – | Default setting | 0 | Power OFF and ON | Yes |

⬥Set the warning detection mask setting. See chapter 11-2 for detail of the bits.
⬥If you set the corresponding bit to 1, the corresponding warning detection will be disabled.

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**Parameters Details**

# 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 driver.
Then make the function settings as required according to the use of the motor and driver.
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 driver 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 driver to the power supply and peripheral equipment.<br>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.<br>Check on the display to see whether there are any internal errors in the driver.<br>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.<br>If using a motor with an absolute encoder, set up the absolute encoder and set the Motion Control Unit's initial parameters.<br>Turn ON the power supply again, and check to see whether protective functions, such as the immediate stop and operational limits, work properly.<br>Check operation at both low speed and high speed using the system without a workpiece, or with dummy workpieces. | Chapter 9, 9-5 |
| Adjustment | Manually adjust the gain if necessary.<br>Further adjust the various functions to improve the control performance. | Chapter 10 |
| Operation | Operation can now be started.<br>If any problems should occur, refer to "Chapter 11, Error and Maintenance". | Chapter 11 |

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**Operation**

# 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 driver. 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-KTA5L/KT01L/KT02L/KT04L (Single-phase 100-VAC input)
   Main circuit power supply: Single-phase 100 to 115 VAC (85 to 127) 50/60 Hz
   Control circuit power supply: Single-phase 100 to 115 VAC (85 to 127) 50/60 Hz

R88D-KT01H/KT02H/KT04H/KT08H/KT10H/KT15H (Single-phase or single-phase/3-phase 200-VAC input) 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-KT20H/KT30H/KT50H/KT75H/KT150H (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-KT06F/KT10F/KT15F/KT20F/KT30F/KT50F/KT75F/KT150F (3-phase 400-VAC input)
   Main circuit power supply: 3-phase 380 to 480 VAC (323 to 528 V)
   50/60 Hz Control circuit power supply: 24 VDC $\pm$ 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 U, V, and W power lines and the green/yellow ($\oplus$) 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 driver side.
* The encoder cable must be securely connected to the encoder connector at the motor side.

### Checking the Control I/O Connector

* The control cable must be securely connected to the control I/O connector (CN1).
* The operation command (RUN) must be OFF.

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**Operation**

## Turning ON Power Supply

- First carry out the preliminary checks, and then turn ON the control circuit power supply. It makes no difference whether or not the main circuit power supply is turned ON.

- The alarm output (/ALM) will take approx. 2 seconds to turn ON after the power supply has been turned ON. Do not attempt to detect an alarm using the Host Controller during this time. (If power supply is turned ON while the Host Controller is connected.)

## Checking Displays

### Displays on the Driver

- The following will appear on the display area on the driver when the power supply is turned ON.

$$\boxed{8.8.8.8.8.8.}$$

↓ Approx. 2 s

$$\boxed{.\quad.\quad.\quad.\quad.\quad.}$$

↓ 0.6 s

$$\boxed{888888}$$

↓ 0.6 s

$$\boxed{r \qquad\qquad 0}$$ Default display (determined by the Default Display setting of parameter Pn528.)

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## 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 display No. 40) occurs, or when the encoder cable is disconnected and then connected again.
When using an absolute encoder, set Pn015 to 0 or 2 and set Pn616 to 1.

### ▌Absolute Encoder Setup Procedure

1. **Turn ON the power supply and align the origin position.**
   Turn ON the power supply, perform the origin adjustment operation, and move the machine to the origin position.

2. **Go to AUXILIARY FUNCTION mode.**
   Press ↩ and (DATA) on the driver. AUXILIARY FUNCTION mode will be displayed.

3. **Use the Increment and Decrement keys to go to the ABSOLUTE ENCODER CLEAR mode.**
   Press (DATA) again. ABSOLUTE ENCODER CLEAR mode will be displayed.

(AUXILIARY FUNCTION mode)

| Mode selection | ◄──────────► | Execute |

| Display | Function | Execute |
|---|---|---|
| Fn_AcL. | Alarm clear | AcL    -. |
| Fn_oF1. | A1 automatic offset | oF1    -. |
| Fn_oF2. | A2 automatic offset | oF2    -. |
| Fn_oF3. | A3 automatic offset | oF3    -. |
| Fn_JoG. | Motor trial operation | JoG    -. |
| Fn_Enc. | Absolute encoder clear | Enc    -. |
| Fn_ini. | Parameter initialization | ini    -. |
| Fn_unL | Front panel lock | unL    -. |
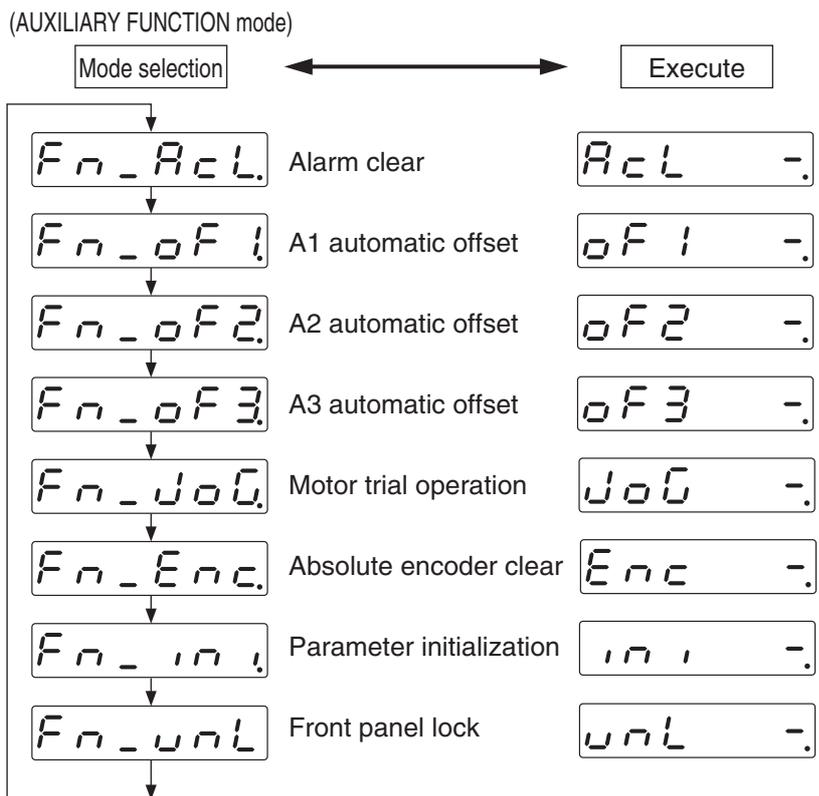
4. **Start clearing the absolute encoder.**
   Hold down ⊗. Clearing the absolute encoder will be started.

**9**

**Operation**

Pressing and holding ⊛
(for approx. 5 s) increases "**–**."

```
Enc      -.
```

```
Enc     - -.
```

```
- - - - - -.
```

Start absolute encoder clear.

```
StArt
```

Clearing is finished in an instant.

```
F in iSh.
```

```
Error .
```
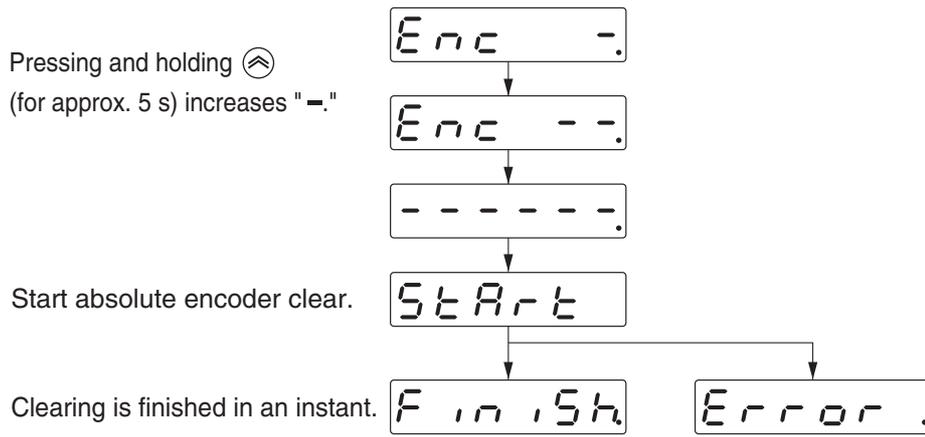
Note. `Error .` will be displayed if absolute encoder
clear is performed on an incremental encoder.

**5. Restart the driver.**
Turn OFF the control power supply to the driver and then turn it back ON.

**9**

**Operation**

# 9-3 Using the Front Display

LED display (6 digits)

All LEDs will flash when an error occurs and
the window switches to the error display.

**OMRON**

Mode key

Switches between the following 4 modes.
• MONITOR mode
• PARAMETER SETTING mode
• AUXIARY FUNCTION mode
• PARAMETR WRITE mode

Increment and Decrement key

Increases/decreases the parameter number or data value.

Shift key

Shifts the operating digit to the left.

Data key

Switches between the parameter and data displays,
and writes data.

9

**Operation**

# 9-4 Setting the Mode

## Changing the Mode
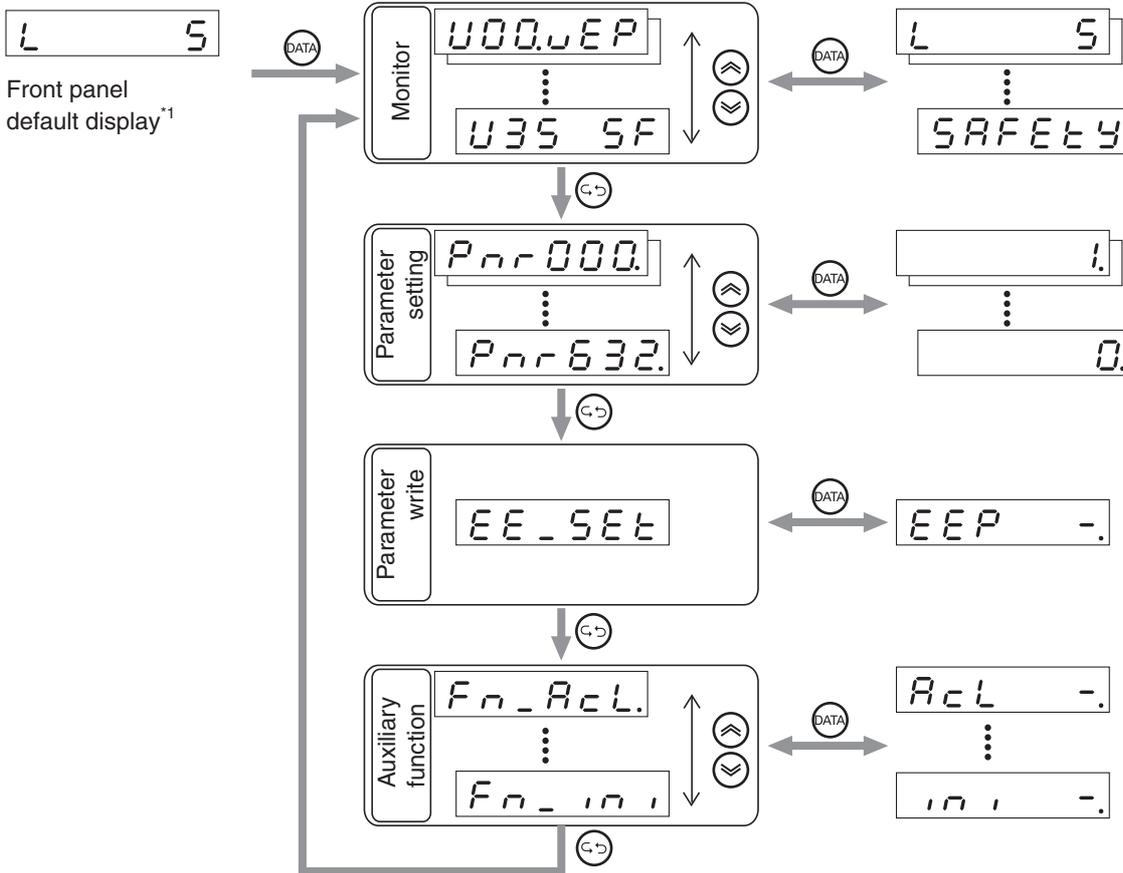


*1. The display will be based on the Default Display (Pn528) setting after the power supply is turned ON.

## MONITOR Mode

| | | | |
|---|---|---|---|
| Command Position Error | `U00.ᴗEP` | `U18.ict` | I/O signal change count display |
| Motor speed | `U01.SPd` | `U20.Ab5` | Absolute encoder data |
| Position command speed | `U02.cSP` | `U21.AES` | Absolute external scale position |
| Speed control command | `U03.cUL` | `U22.rEc` | Monitor for the count of encoder communications errors |
| Torque command | `U04.tr9` | `U23. id` | Communication axis number display |
| Total encoder pulses | `U05.nPS` | `U24.PEP` | Position error (encoder unit) |
| Total command pulses | `U06.cPS` | `U25.PFE` | External scale error (external scale unit) |
| Total external scale feedback pulses | `U08.FPS` | `U26.hYb` | Hybrid error |
| CONTROL mode | `U09.cnt` | `U27. Pn` | P-N voltage |
| I/O signal status | `U10. io` | `U28. no` | Soft version |
| Analog input value | `U11.A in` | `U29.ASE` | Driver serial number |
| Reason for error, history | `U12.Err` | `U30.nSE` | Motor serial number |
| Warning number | `U13. rn` | `U31. tE` | Accumulative operation time |
| Regeneration resistance load ratio | `U14. rG` | `U32.Aud` | Automatic motor recognition function |
| Overload load ratio | `U15. oL` | `U33.Ath` | Driver temperature |
| Inertia ratio | `U16.Jrt` | `U35 SF` | Safety status monitor |
| Reason for no rotation | `U17. ch` | | |

When ⊗ is pressed, the display position will move in the direction of the arrow.

When ⊗ is pressed, it will move in the opposite direction.

- The motor rotation speed will be displayed the first time the power supply is turned ON after purchase. To change the initial display when the power supply is turned ON, change the setting for the Default Display (Pn528). For details, refer to Pn528 "Default Display" (P.8-56).

**9**

**Operation**

- You can locate the monitor in the corresponding block diagrams for Position, Speed, Torque or full closed loop in Chapter 5, for a better understanding.

## Position Command Error

```
L 39025
```

Position command error [command unit]

Lower (L)
Higher (H)

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ⟷  H    103
```

## Motor Rotation Speed

```
r   1000
```
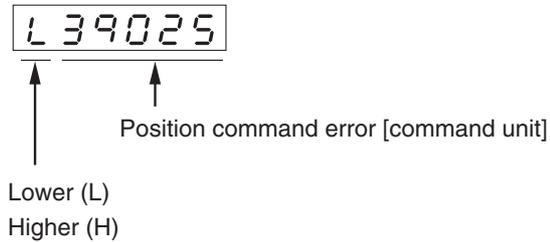
- Displays the motor rotation speed (unit: r/min).
- Rotation speeds in reverse operation are displayed with "-".

## Position Command Speed

```
r   1000
```

- Displays the position command speed (unit: r/min).

## Speed Control Command

```
r   1000
```

- Displays the speed control command, that is, the speed of the pulse command input (unit: r/min).

## Torque Command

```
t   100.0
```

- Displays the percentage of driver torque command.
- When the rated torque output for the driver is used, "100%" is displayed.
- Torque outputs in reverse operation are displayed with "-".

### Total Encoder Pulses
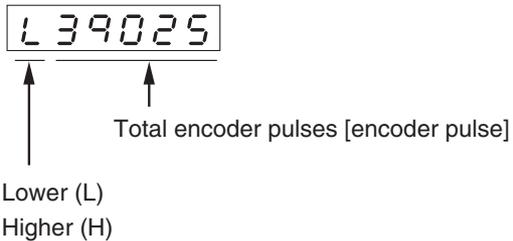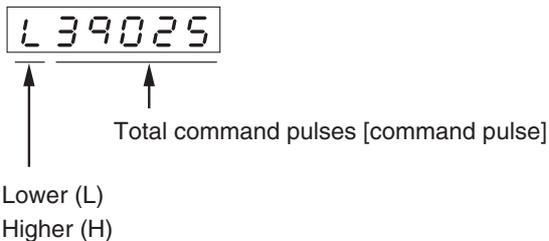
```
L 39025
```

Total encoder pulses [encoder pulse]

Lower (L)
Higher (H)

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ⟷  H    103
```

### Total Command Pulses

```
L 39025
```

Total command pulses [command pulse]

Lower (L)
Higher (H)

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ⟷  H    103
```

### Total External Scale Feedback Pulses

```
L 39025
```

Total external scale feedback pulses

Lower (L)
Higher (H)

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ⟷  H    103
```

**9**

**Operation**
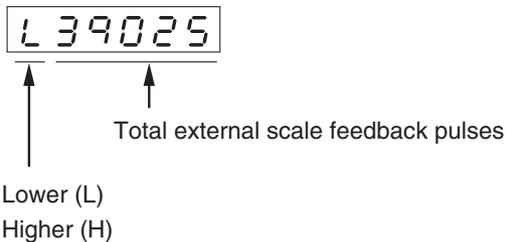
## CONTROL mode

| PoScnt | POSITION CONTROL mode |

| SPdcnt | SPEED CONTROL mode |

| trqcnt | TORQUE CONTROL mode |

| FcLcnt | FULL CLOSING CONTROL mode |

‣ Displays which CONTROL mode is being used: position control, speed control, torque control, or full closing control.

## I/O Signal Status

| in08. A | Input signal (pin 8) ON |

| ot 10. – | Output signal (pin 10) OFF or disabled |

$A$ ...ON

– ...OFF or disabled

Pin number
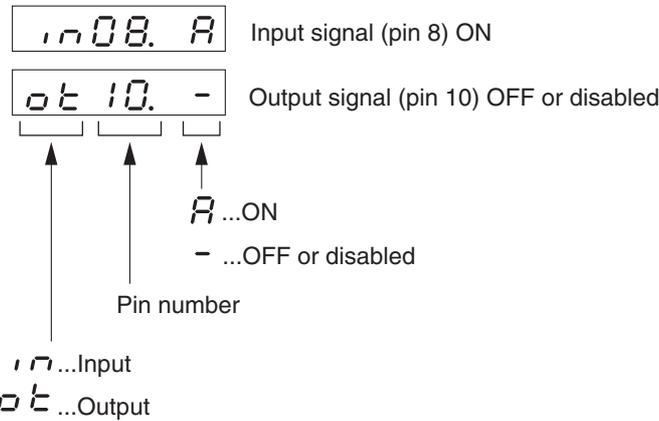
$in$ ...Input

$ot$ ...Output

‣ Displays the status of the control input and output signals connected to CN1.

### Switching between Input Signals and Output Signals

| in00. A | If the decimal point is on the right side of the signal number, the signal number can be changed. |

Use ⟪ to move the flashing decimal point.

| in00 A | If the decimal point is on the right side of the I/O switching point, you can switch between input and output. |

⟰ ⟱ Switch between input and output.

| ot.00 – |

Press ⟰ ⟱ to select the signal you want to monitor.

| in08. – | (Last input signal number) |

| in33. A | (First input signal number) |

| ot 10. – | (Last output signal number) |

| ot40. A | (First output signal number) |

**9-12**

**9**

**Operation**

## Analog Input Value

```
┌─────────────┐
│  A   10.00  │
└─────────────┘
    ↑      ↑
Input signal   Input voltage (V)
```

Press ⊗ ⊗ to select the signal you want to monitor.

```
┌─────────────┐
│  A   10.00  │   Analog input value 1 (V)
└─────────────┘   The value after offset compensation is displayed.

┌─────────────┐
│  b    5.00  │   Analog input value 2 (V)
└─────────────┘

┌─────────────┐
│  c    1.00  │   Analog input value 3 (V)
└─────────────┘
```

Note. Voltages exceeding +/−10 V are not displayed accurately.

## Error Factor, History

```
┌─────────────┐
│  Err.   - - │
└─────────────┘
    ↑      ↑
           Error code
           ( − − if no alarm is present)
```
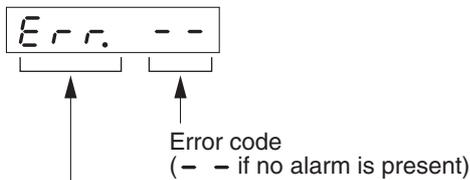
*Err.* ...Present error

*E - 0.* ...History 0 (latest history)

*E 13.* ...History 13 (oldest history)

⬥ Up to the most recent 14 alarms, including the current one, can be viewed in the reason of error.

⬥ The display area will flash when an alarm occurs.

⬥ If an alarm that is recorded in the history occurs, the alarm code for the current alarm and for history 0 will be the same.

**9**

**Operation**

### Alarm Codes and Meanings

| Alarm codes | Contents | Alarm codes | Contents |
|---|---|---|---|
| 11 | Control power supply undervoltage | 36 | Parameter error |
| 12 | Overvoltage | 37 | Parameters destruction |
| 13 | Main power supply undervoltage | 38 | Drive prohibition input error |
| 14 | Overcurrent | 39 | Excessive analog input |
| 15 | Driver overheat | 40 | Absolute encoder system down error **ABS** |
| 16 | Overload | 41 | Absolute encoder counter overflow error **ABS** |
| 18 | Regeneration overload | 42 | Absolute encoder overspeed error **ABS** |
| 21 | Encoder communications error | 44 | Absolute encoder 1-rotation counter error **ABS** |
| 23 | Encoder communications data error | 45 | Absolute encoder multi-rotation counter error **ABS** |
| 24 | Error counter overflow | 46 | Encoder error 1 |
| 26 | Overspeed | 47 | Absolute encoder status error **ABS** |
| 27 | Electronic gear setting error | 48 | Encoder phase-Z error |
| 34 | Overrun limit error | 49 | Encoder CS signal error |

Note. The following alarms are not recorded in the history.
- 11: Control power supply undervoltage
- 13: Main power supply undervoltage
- 36: Parameter error
- 37: Parameters destruction
- 38: Drive prohibition input error
- 95: Motor non-conformity

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**Operation**

## Warning Number

```
┌─────────────┐
│ r n      - -│
├─────────────┤
│ r n A0   A  │
└─────────────┘
```

$A$ ...Warning status

$- -$ , $-$ ...No warning status

Warning number
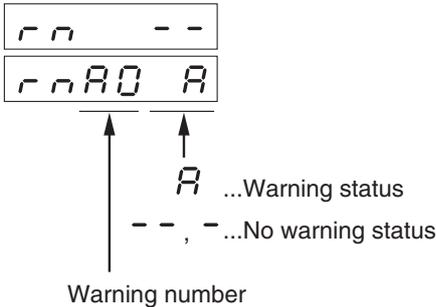
Press ⊗ ⊗ to display the occurrence status of each warning.

```
┌─────────────┐
│ r n A0   A  │
└─────────────┘
```

```
┌─────────────┐
│ r n A c   - │
└─────────────┘
```

## Regeneration Load Ratio

```
┌─────────────┐
│ r G   80.0  │
└─────────────┘
```
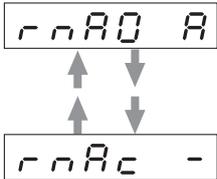
⬧ Displays the regeneration resistance load ratio as a percentage when the detection level for the regeneration overload is 100%.

## Overload Load Ratio

```
┌─────────────┐
│ r    1000   │
└─────────────┘
```
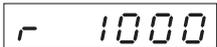
⬧ Displays the position command speed (unit: r/min).
⬧ Displays the overload ratio as a percentage when the rated load corresponds to 100%.

## Inertia Ratio

```
┌─────────────┐
│ J     100   │
└─────────────┘
```
The inertia ratio (%) is displayed.

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**Operation**

## Reasons for No Rotation

A number is displayed to indicate the reason the motor does not rotate.

$P$...Position control    $t$...Torque control
$S$...Speed control    $F$...Full closing control

CONTROL mode    Reason number

| Number | Item | RELEVANT CONTROL mode | Description |
|---|---|---|---|
| Flashing | Alarm or warning has occurred | All | An alarm has occurred. Warning has occurred. |
| 0 | No reason | All | No reason has been detected. The motor operation should be possible. |
| 1 | Main power supply interrupted | All | The main power supply to the driver is not turned ON. |
| 2 | No RUN input | All | The operation command (RUN) is not connected to COM. |
| 3 | Drive prohibition input is enabled. | All | When Pn504 = 0 (drive prohibition input enabled):<br>· The forward drive prohibition input (POT) is open and the speed command is in the forward direction.<br>· The reverse drive prohibition input (NOT) is open and the speed command is in the reverse direction. |
| 4 | Low torque limit setting | All | The currently effective torque limit set value, Pn013 (No. 1 Torque Limit) or Pn522 (No. 2 Torque Limit), is less than 5% of the rated torque. |
| 5 | Analog torque limit input is enabled. | P, S | When Pn527 = 0 (analog torque limit scale):<br>· The forward analog torque limit input is negative and the speed command is in the forward direction.<br>· The reverse analog torque limit input is positive and the speed command is in the reverse direction. |
| 6 | IPG input is enabled. | P | Pn518 = 0 (command pulse prohibition input enabled) and the IPG input is open. |
| 7 | Frequency of command pulse input is low. | P | · The command pulse is not input correctly.<br>· The input selected in Pn005 is not connected correctly.<br>· The type of input selected in Pn006 or Pn007 is not correct.<br>The position command per control cycle is 1 pulse or less and the above are some of the possible causes. |
| 8 | ECRST input is enabled. | P | Pn517 = 0 (Error counter reset at the level) and the error counter reset input (ECRST) is connected to COM. |
| 9 | VZERO input is enabled. | S, T | Pn315 = 1 (zero speed designation enabled) and the zero speed designation input (VZERO) is open. |
| 10 | External speed command is low. | S | The analog speed command is 0.06 V or lower when the analog speed command is selected. |
| 11 | Internal speed command is 0. | S | The internal speed command is 30 r/min or less when the internal speed command is selected. |
| 12 | Torque command is low | T | The analog torque command input (REF or PCL) is 5% or less of the rated torque. |
| 13 | Speed limit is low | T | · Pn317 = 0 (speed limit with No. 4 internally set speed) and the No. 4 Internally Set Speed (Pn307) is 30 r/min or lower.<br>· Pn317 = 1 (speed limit with REF input) and the analog speed command input (REF) is 0.06 V or lower. |

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**Operation**

| Number | Item | RELEVANT CONTROL mode | Description |
|--------|------|------------------------|-------------|
| 14 | Other reasons | All | Reasons 1 to 13 do not apply, but the motor is rotating at 20 r/min or lower. (Low command, heavy, locked, or crashed load, faulty driver or motor, etc.) |

Note.The motor may rotate even if a reason number other than 0 is displayed.

## Display of the Number of I/O Signal Changes

```
,08.    0
```

I/O signal change count

Pin number

' ...Input signal

◻ ...Output signal
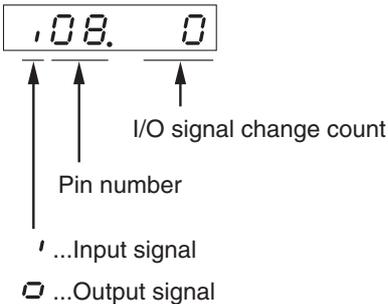
```
,08.    0
```
If the decimal point is on the right side of the pin number, the pin number can be changed.

Use ⟪ to move the flashing decimal point.

```
,08    0
```
If the decimal point is between the pin numbers, you can switch between input and output.

Press ⊼ ⊻ to switch between input and output.

```
o 1.0    0
```

⬧ Display the number of transitions in one input since last power-on

## Absolute Encoder Data

```
AL 3810
```

Encoder data

𝐴𝐿 ...1-rotation data, lower (L)

𝐴𝐻 ...1-rotation data, higher (H)

𝑏 ...Multi-rotation data
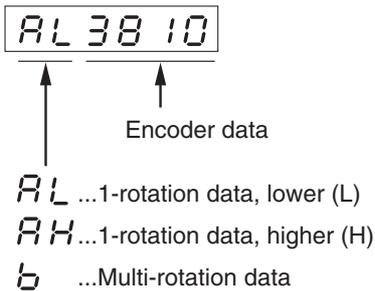
Press ⊼ ⊻ to select the data you want to display.

```
AL 3810
```
```
AH      8
```
```
b       8
```

## Absolute External Scale Position

```
L   3810
```

Encoder data
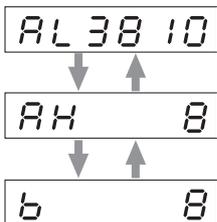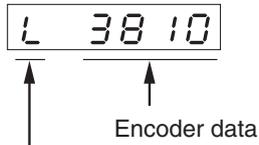
$L$ ...Absolute external scale position, lower (L)

$H$ ...Absolute external scale position, higher (H)

Press ⊗ ⊗ to switch between Lower (L) and Higher (H).

```
L   3810
```

```
H
```
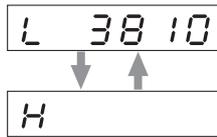
## Monitor for the Number of Encoder and External Scale Communications Error

```
E0      0
```

Communications error count

$E\,0$ ...Encoder      $F\,0$ ...External scale
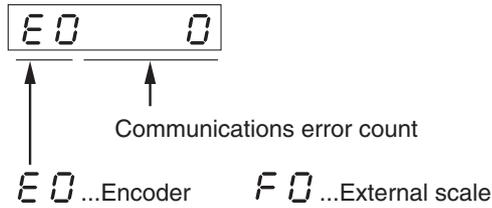
Press ⊗ ⊗ to switch between encoder and external scale.

```
E0      0
```

```
F0      0
```

## Display of Axis Numbers for Communication

```
id      16
```
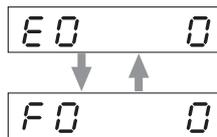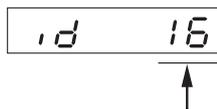
The value set by the Axis Number (Pn531) is displayed.

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**Operation**

## Encoder Position Error

```
L 39025
```

Lower (L)
Higher (H)

Encoder position error [encoder unit]

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ←→  H    103
```

## External Scale Position Error

```
L 39025
```

Lower (L)
Higher (H)

External scale error [external scale unit]

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ←→  H    103
```

## Hybrid Error

```
L 39025
```

Lower (L)
Higher (H)

Hybrid error [command unit]

Press 《 to switch between Lower (L) and Higher (H).

```
L 39025  ←→  H    103
```

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**Operation**

## P-N Voltage

```
Pn 280
```

P-N voltage [V] is displayed.

## Soft Version

```
A- 1. 23
```

⬧ Displays the soft version of the driver. (Display example: Ver. 1.23)

## Driver Serial Number

```
AL0001
```

Amplifier serial number

$AL$ ...Amplifier serial number, lower (L)  $AH$ ...Amplifier serial number, higher (H)

Press ⊗ ⊗ to switch between Lower (L) and Higher (H).

Display example) When serial number is 09040001

```
AL0001
```
```
AH0904
```

## Motor Serial Number

```
NL0001
```

Motor serial number

$NL$ ...Motor serial number, lower (L)     $NH$ ...Motor serial number, higher (H)

Press ⊗ ⊗ to switch between Lower (L) and Higher (H).

Display example) When serial number is 09040001

```
NL0001
```
```
NH0904
```

## Accumulative Operation Time

```
L       2.5
```
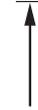
Accumulative operation time [h] is displayed.

Lower (L)
Higher (H)

Press 《 to switch between Lower (L) and Higher (H).

```
L       2.5  ←→  H
```

## Automatic Motor Recognition Function

```
Aud  on
```
Automatic recognition enabled

```
AudoFF
```
Automatic recognition disabled

## Driver Temperature

```
th    28
```

Amplifier temperature [°C] is displayed.

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**Operation**

## Safety Status Temperature

```
SAFEtY
```

SAFEty : Safety status ⎫
SrVoFF : Servo OFF      ⎪
SrVon  : Servo ON       ⎬ + Dot information
ALArM  : Alarm status   ⎭

Servo ready
OFF: The dot is not lit.
ON: The dot is lit.

Flash display
Status that allows
normal changes
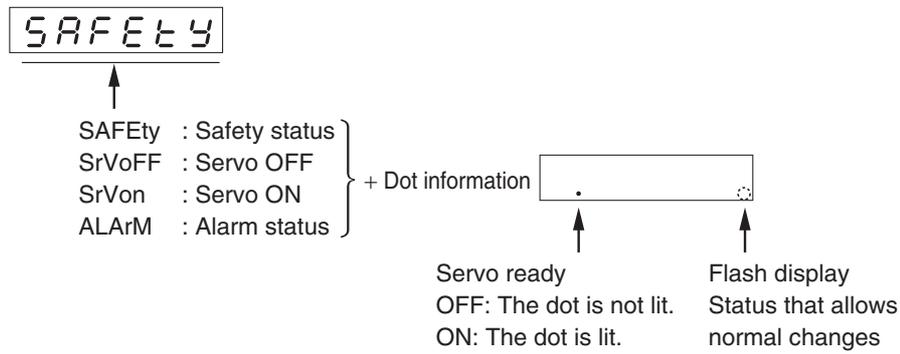
Press ⊗ ⊗ to switch between monitors you want to display.

```
SAFEtY
```

```
SF 1    -
```
− ...Input photocoupler OFF   ⊓...Input photocoupler ON

```
SF2     A
```
− ...Input photocoupler OFF   ⊓...Input photocoupler ON

```
EdΠ     -
```
− ...Output photocoupler OFF  ⊓...Output photocoupler ON
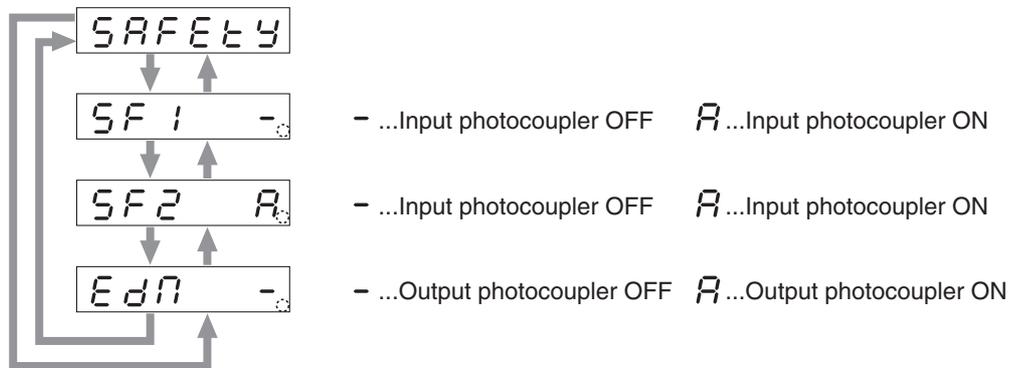
## PARAMETER SETTING Mode

### 1. Displaying PARAMETER mode

| Key operation | Display example | Explanation |
|---|---|---|
| | r    0 | The item set for the Default Display (Pn528) is displayed. |
| (DATA) | Un_5Pd. | Press the (DATA) key to display MONITOR mode. |
| (↺) | Pn_  10. | Press (↺) key to display PARAMETER SETTING mode. |

### 2. Setting the parameter number

| Key operation | Display example | Explanation |
|---|---|---|
| (《)(∧)(∨) | Pn_  10. | Use (《)(∧)(∨) keys to set the parameter number.<br>· Press (《) to move "." to the left and change the digit to be set.<br>· Press (∧) to increase the value of the digit with ".".<br>· Press (∨) to decrease the value of the digit with ".". |

### 3. Displaying parameter set values

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | 40. | Press the (DATA) key to display the set value. |

### 4. Changing the parameter set value

| Key operation | Display example | Explanation |
|---|---|---|
| (《)(∧)(∨) | 100. | Use the (《)(∧)(∨) keys to change the value.<br>· Press (《) to move "." to the left and change the digit to be set.<br>· Press (∧) to increase the value of the digit with ".".<br>· Press (∨) to decrease the value of the digit with ".". |
| (DATA) | 100. | Press the (DATA) key to save the new set value.<br>· To cancel the change, instead of pressing (DATA), press (↺) to return to the display in procedure 2. |

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**Operation**

### 5. Returning to PARAMETER SETTING mode

| Key operation | Display example | Explanation |
|---|---|---|
| DATA | $P \cap \_ \quad 10.$ | Press the DATA key to return to PARAMETER SETTING mode. |

**Precautions for Correct Use**

- Some parameters will be displayed with an "r" before the number when the display returns to the PARAMETER SETTING mode. To enable the set values that have been changed for these parameters, you must turn the power supply OFF and ON after saving the parameters to the EEPROM.
- If the Front Panel Parameter Write Selection (Pn617) is set to 1, the parameter set value is automatically written to EEPROM when changed.
- When the set value for a parameter is saved, the new setting will be used for control. Make gradual changes instead of changing the large numbers at once, when changing values for parameters that greatly affect motor operation (speed loop gain, position loop gain, etc. in particular).
- For details on parameters, refer to "Chapter 8, Parameters Details".

**9**

**Operation**

## PARAMETER WRITE Mode

Set values changed in PARAMETER SETTING mode must be saved to EEPROM. To do so, the following operation must be performed.

### 1. Saving changed set values

| Key operation | Display example | Explanation |
|---|---|---|
| (↰↩) | EE_SEt | Press the (↰↩) key to display PARAMETER WRITE mode. |
| (DATA) | EEP -. | Press the (DATA) key to enter PARAMETER WRITE mode. |
| (⌃) | EEP --. / ------. / StArt | Press and hold the (⌃) key for 5 seconds or longer until StArt is displayed. The bar indicator will increase. Writing will start. (This display will appear only momentarily.) |
| | Finish. | This indicates a normal completion. In addition to this display, either rESEt or Error may be displayed. If rESEt is displayed, writing has been completed normally, but some of the changed parameters will be valid only after the power supply has been turned OFF and ON again.Turn OFF the driver power supply and then turn it ON again. Error will be displayed if there is a write error. Write the data again. |
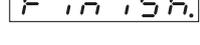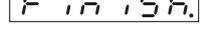
### 2. Returning to PARAMETER WRITE mode

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | EE_SEt | Press the (DATA) key to return to PARAMETER WRITE mode. |

📝 Precautions for Correct Use

- If a write error occurs, write the data again. If write errors continue to occur, there may be a fault in the driver.
- Do not turn OFF the power supply while writing to EEPROM. Incorrect data may be written if the power supply is turned OFF. If the power supply is turned OFF, perform the settings again for all parameters, and write the data again.

**9**

**Operation**

## AUXILIARY FUNCTION Mode

AUXILIARY FUNCTION mode includes the alarm clear, analog input automatic offset adjustment, absolute encoder reset, jog operation, parameter initialization, and front panel lock/release.

### Displaying AUXILIARY FUNCTION mode

| Key operation | Display example | Explanation |
|---|---|---|
| | `r      0` | The item set for the Default Display (Pn528) is displayed. |
| (DATA) | `Un_SPd.` | Press the (DATA) key to display MONITOR mode. |
| (⊡) | `AF_AcL.` | Press the (⊡) key 3 times to display AUXILIARY FUNCTION mode. |

### Alarm Clear

This releases the alarm generation status.
Some alarms cannot be released. Refer to "11-3 Alarm List" (P.11-6) for details.

#### 1. Execute alarm clear

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | `AcL    -.` | Press the (DATA) key to enter ALARM CLEAR mode. |
| (⌃) | `AcL   --.` `------.` `StArt` | Press and hold the (⌃) key for 5 seconds or longer until `StArt` is displayed. <br> The bar indicator will increase. <br><br> Alarm clear will start. |
| | `Fini5h.` | This indicates a normal completion. `Error` will be displayed if the alarm could not be cleared. Reset the power supply to clear the error. |

#### 2. Returning to AUXILIARY FUNCTION mode display

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | `Fn_AcL.` | Press the (DATA) key to return to AUXILIARY FUNCTION mode. |

**9**

**Operation**

## Analog Input Automatic Offset Adjustment

This performs automatic adjustment on the Offset Values (Pn422, Pn425 and Pn428) of Analog Inputs 1 to 3 (AI1 to AI3).
Do not perform this operation if a position loop has been configured with the host system.

### 1. Execute automatic offset adjustment

| Key operation | Display example | Explanation |
|---|---|---|
| $\otimes$ | $\boxed{F\ n\ \_\ o\ F\ l.}$ or $\boxed{F\ n\ \_\ o\ F\ 2.}$ or $\boxed{F\ n\ \_\ o\ F\ 3.}$ | Press the $\otimes$ key to display the ANALOG INPUT AUTOMATIC OFFSET ADJUSTMENT mode from the alarm clear display in the AUXILIARY FUNCTION mode. |
| DATA | $\boxed{o\ F\ l\quad\ \ -.}$ or $\boxed{o\ F\ 2\quad\ \ -.}$ or $\boxed{o\ F\ 3\quad\ \ -.}$ | Press the DATA key to enter the AUTOMATIC OFFSET ADJUSTMENT mode of the analog input number to be set. |
| $\otimes$ | $\boxed{o\ F\ l\quad\ -\ -.}$ or $\boxed{o\ F\ 2\quad\ -\ -.}$ or $\boxed{o\ F\ 3\quad\ -\ -.}$ <br><br> $\boxed{-\ -\ -\ -\ -\ -.}$ <br><br> $\boxed{S\ t\ A\ r\ t}$ | Press and hold the $\otimes$ key for 5 seconds or longer until $\boxed{S\ t\ A\ r\ t}$ is displayed. <br><br> The bar indicator will increase. <br><br> Automatic offset adjustment will start. |
| | $\boxed{F\ i\ n\ i\ S\ h.}$ | This indicates a normal completion. $\boxed{E\ r\ r\ o\ r}$ will be displayed if the automatic offset adjustment could not be performed. Set a valid CONTROL mode or make the setting so that the offset value does not exceed the range for the Speed Command Offset Adjustment (Pn52), and then execute the procedure again. |

### 2. Returning to AUXILIARY FUNCTION mode display

| Key operation | Display example | Explanation |
|---|---|---|
| DATA | $\boxed{F\ n\ \_\ o\ F\ l.}$ or $\boxed{F\ n\ \_\ o\ F\ 2.}$ or $\boxed{F\ n\ \_\ o\ F\ 3.}$ | Press the DATA key to return to AUXILIARY FUNCTION mode. |

**9**

**Operation**

---

📝 Precautions for Correct Use

---

- ⬧ Automatic offset adjustment function cannot be performed in POSITION CONTROL mode.
- ⬧ Data is not written to the EEPROM simply by performing automatic offset adjustment. The data must be written to the EEPROM for the results to be saved.

## Jog Operation

You can perform a trial operation of the motor with no load without wiring the control I/O connector (CN1).

### 1. Prepare for a jog operation

| Key operation | Display example | Explanation |
|---|---|---|
| ⊗ | $Fn\_JoG.$ | Press the ⊗ key to display the JOG OPERATION mode from the alarm clear display in AUXILIARY FUNCTION mode. |
| DATA | $JoG \quad -.$ | Press the DATA key to enter JOG OPERATION mode. |
| ⊗ | $JoG \quad --.$ <br><br> $------.$ <br><br> $rEAdY .$ | Press and hold the ⊗ key for 5 seconds or longer until $\boxed{StArt}$ is displayed. <br> The bar indicator will increase. <br><br> This completes preparations for jog operation. <br> $\boxed{Error .}$ will be displayed if the servo is not ready. |
| ⊗ | $rEAdY.$ <br><br> $r.EAdY$ <br><br> $SrU\_on$ | Press and hold the ⊗ key for 5 seconds or longer until $\boxed{StArt}$ is displayed. <br> The decimal point will move to the left. <br><br> The Servo will turn ON. |

### 2. Execute jog operation

| Key operation | Display example | Explanation |
|---|---|---|
| ⊗ ⊗ | $SrU\_on$ | Forward direction operation will be performed while the ⊗ key is pressed, and reverse direction operation will be performed while the ⊗ key is pressed. The motor will stop when the key is released. The rotation speed at this time will be the speed set for the Jog Speed (Pn604). <br> $\boxed{Error .}$ will be displayed if the servo is not ready. |

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**Operation**

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### 3. Returning to AUXILIARY FUNCTION mode display

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | $Fn\_JoG.$ | Press the (DATA) key to return to AUXILIARY FUNCTION mode. The servo lock will be released and the servo will be unlocked. |

> Precautions for Correct Use

- When performing a jog operation, be sure to first disconnect the motor from any load and remove the control I/O connector (CN1).
- When performing a jog operation, set the parameter related to gains to an appropriate value to avoid any troubles, such as vibration. Set the Inertia Ratio (Pn004) to 0.
- The motor operates in the SPEED CONTROL mode during a jog operation. Set each of the various settings so that the motor operates correctly for speed control.
- If the operation command (RUN) is turned ON during a jog operation, $Error$ will be displayed, and the jog operation will be cancelled and a normal operation through an external command will be performed.

## Absolute Encoder Reset  ABS

This resets the multi-rotation data and errors of the absolute encoder.

### 1. Execute absolute encoder reset

| Key operation | Display example | Explanation |
|---|---|---|
| (⌃) | $Fn\_Enc$ | Press the (⌃) key to display the ABSOLUTE ENCODER RESET mode from the alarm clear display in AUXILIARY FUNCTION mode. |
| (DATA) | $Enc\quad -.$ | Press the (DATA) key to enter ABSOLUTE ENCODER RESET mode. |
| (⌃) | $Enc\quad --.$  <br> $------.$  <br> $StArt$ | Press and hold the (⌃) key for 5 seconds or longer until $StArt$ is displayed. <br> The bar indicator will increase. <br> Absolute encoder reset will start. |
|  | $Finish.$ | This indicates a normal completion. <br> $Error$ will be displayed if the absolute encoder reset could not be performed. Check whether an unsupported encoder is connected, and then execute the procedure again. |

### 2. Returning to AUXILIARY FUNCTION mode display

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | $Fn\_Enc$ | Press the (DATA) key to return to AUXILIARY FUNCTION mode. |

> 🖊 Precautions for Correct Use

⋄ The absolute encoder reset function can be used only with systems that use an absolute encoder.

## Parameter Initialization

This initializes the selected parameter.

**1. Execute the initialization of the parameter.**

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | `Fn _ ini` | Press the (DATA) key to enter PARAMETER INITIALIZATION mode. |
| (⌃) | `ini - -.`  `- - - - - -.`  `StArt` | Press and hold the (⌃) key for 5 seconds or longer until `StArt` is displayed.  The bar indicator will increase.  The initialization of the selected parameter will start. |
| | `Fin iSh.` | This indicates a normal completion.  `Error` will be displayed if the parameter could not be initialized. Turn OFF the driver power supply and then execute again. |
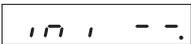
**2. Returning to AUXILIARY FUNCTION mode display**

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | `AF _ Enc` | Press the (DATA) key to return to AUXILIARY FUNCTION mode. |

> 🖊 Precautions for Correct Use

⋄ If alarm display No. 11 (power supply undervoltage), 36 (parameter error) or 37 (parameter destruction) is displayed, the parameter cannot be initialized.

## Front Panel Lock

This locks the front panel.

**1. Displaying PARAMETER mode**

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | `Un _ SPd.` | Press the (DATA) key to display MONITOR mode. |
| (↩) | `Pn _ 10.` | Press (↩) key to display PARAMETER SETTING mode. |

**2. Setting the parameter number**

| Key operation | Display example | Explanation |
|---|---|---|
| 《 ⌃ ⌄ | $Fn\_535.$ | Use the 《 ⌃ ⌄ keys to set to Pn535.<br>· Press 《 to move "." to the left and change the digit to be set.<br>· Press ⌃ to increase the value of the digit with ".".<br>· Press ⌄ to decrease the value of the digit with ".". |

**3. Displaying parameter set values**

| Key operation | Display example | Explanation |
|---|---|---|
| DATA | $0.$ | Press the DATA key to display the set value. |

**4. Changing the parameter set value**

| Key operation | Display example | Explanation |
|---|---|---|
| 《 ⌃ ⌄ | $1.$ | Use the 《 ⌃ ⌄ keys to change the value.<br>· Press 《 to move "." to the left and change the digit to be set.<br>· Press ⌃ to increase the value of the digit with ".".<br>· Press ⌄ to decrease the value of the digit with ".". |
| DATA | $1.$ | Press the DATA key to save the new set value.<br>· To cancel the change, instead of pressing DATA, press ↩ to return to the display in procedure 2. |

**5. Returning to PARAMETER SETTING mode**

| Key operation | Display example | Explanation |
|---|---|---|
| DATA | $Fn\_535.$ | Press the DATA key to return to PARAMETER SETTING mode. |

**6. Saving changed set values**

| Key operation | Display example | Explanation |
|---|---|---|
| ↩ | $EE\_SEt$ | Press the ↩ key to display PARAMETER WRITE mode. |
| DATA | $EEP \quad -.$ | Press the DATA key to enter PARAMETER WRITE mode. |
| ⌃ | $EEP \quad --.$ <br> $------.$ | Press and hold the ⌃ key for 5 seconds or longer until $StArt$ is displayed.<br>The bar indicator will increase. |

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**Operation**

| Key operation | Display example | Explanation |
|---|---|---|
| | $StArt$ | Writing will start. (This display will appear only momentarily.) |
| | $Finish.$ | This indicates a normal completion. In addition to this display, either $rESEt$ or $Error$ may be displayed.<br><br>If $rESEt$ is displayed, writing has been completed normally, but some of the changed parameters will be valid only after the power supply has been turned OFF and ON again. Turn OFF the driver power supply and then turn it ON again.<br><br>$Error$ will be displayed if there is a write error. Write the data again. |

### 7. Returning to PARAMETER WRITE mode

| Key operation | Display example | Explanation |
|---|---|---|
| (DATA) | $EE\_SEt$ | Press the (DATA) key to return to PARAMETER WRITE mode. |

### 8. Restart the power supply to the driver.

Precautions for Correct Use

- The items that are limited depend on the mode.
- If the Front Panel Parameter Write Selection (Pn617) is set to 1, the parameter set value is automatically written to EEPROM when changed.
- Refer to the Front Key Protection Setting (Pn535) in "8-6 Extended Parameters" (P.8-46) for details on the front panel lock function.

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**Operation**

## Front Panel Lock Release

This releases the front panel lock.

### 1. Release the front panel lock

| Key operation | Display example | Explanation |
|---|---|---|
| ⌃ | $Fn\_unL$ | Press the ⌃ key to display the FRONT PANEL LOCK mode from the alarm reset display in AUXILIARY FUNCTION mode. |
| DATA | $unL \quad -.$ | Press the DATA key to enter FRONT PANEL LOCK mode. |
| ⌃ | $unL \quad --.$ $------.$ $StArt$ | Press and hold the ⌃ key for 5 seconds or longer until $StArt$ is displayed.<br>The bar indicator will increase.<br>The front panel lock will be released. |
| | $Fin iSh.$ | This indicates a normal completion.<br>$Error$ will be displayed if the front panel lock is not released.<br>Turn OFF the driver power supply and then execute again. |

### 2. Returning to AUXILIARY FUNCTION mode display

| Key operation | Display example | Explanation |
|---|---|---|
| DATA | $Fn\_Enc$ | Press the DATA key to return to AUXILIARY FUNCTION mode. |

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**Operation**

# 9-5 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 in POSITION CONTROL Mode

1. **Connect connector CN1.**

2. **Input power supply (12 to 24 VDC) for the control signals (+24 VIN, COM).**

3. **Turn ON the power supply to the driver.**

4. **Confirm that the parameters are set to the standard set values.**

5. **Set to the output from the host device that agrees using the COMMAND PULSE INPUT mode (Pn007).**

6. **Write the parameters to EEPROM and then turn OFF the power supply and turn it ON again.**

7. **Connect the operation command input (RUN: CN1 pin 29) to COM (CN1 pin 41). Servo ON status will be entered and the motor will be activated.**

8. **Input a low-frequency pulse signal from the host device to start low-speed operation.**

9. **Check the motor rotation speed in MONITOR mode.**
   Check to see if the motor is rotating at the set speed and to see if the motor stops when the command (pulses) are stopped.

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**Operation**

## Trial Operation in SPEED CONTROL Mode

1. **Connect connector CN1.**

2. **Input power supply (12 to 24 VDC) for the control signals (+24 VIN, COM).**

3. **Turn ON the power supply to the driver.**

4. **Confirm that the parameters are set to the standard set values.**

5. **Connect the operation command input (RUN: CN1 pin 29) to COM (CN1 pin 41). Servo ON status will be entered and the motor will be activated.**

6. **Close the zero speed designation input (VZERO) and gradually increase the DC voltage between the speed command input REF (CN1 pin 14) and AGND1 (CN1 pin 15) from 0 V. Check to see if the motor rotates.**

7. **Check the motor rotation speed in MONITOR mode.**
   Check to see if the motor is rotating at the set speed and to see if the motor stops when the command (pulses) are stopped.
   Use the following parameters to change the motor rotation speed or direction.
   ⬩ Pn302: Speed Command Scale
   ⬩ Pn303: Command Speed Rotation Direction Switching

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**Operation**

## Trial Operation in TORQUE CONTROL Mode

1. **Connect connector CN1.**

2. **Input power supply (12 to 24 VDC) for the control signals (+24 VIN, COM).**

3. **Turn ON the power supply to the driver.**

4. **Confirm that the parameters are set to the standard set values.**

5. **Set a low speed in the No. 4 Internally Set Speed (Pn307).**

6. **Connect the operation command input (RUN: CN1 pin 29) to COM (CN1 pin 41). Servo ON status will be entered and the motor will be activated.**

7. **Apply a positive or negative DC voltage between the torque command input TREF1 (CN1 pin 14) and AGND1 (CN1 pin 15). Check to see if the motor rotates according to the direction (forward/reverse) set in Pn307.**
   Use the following parameters to change the amount of the torque, direction of the torque, or speed limit value for the command voltage.
   - Pn307: No. 4 Internally Set Speed (default set value: 50 r/min)
   - Pn319: Torque Command Scale
   - Pn320: Torque Output Direction Switching

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**Operation**

## Trial Operation in FULL CLOSING CONTROL Mode

1. **Connect connector CN1.**

2. **Input power supply (12 to 24 VDC) for the control signals (+24 VIN, COM).**

3. **Connect the external scale.**

4. **Turn ON the power supply to the driver.**

5. **Confirm that the parameters are set to the standard set values.**

6. **Set the outputs from the host device to agree with the COMMAND PULSE mode (Pn005).**

7. **Write the parameters to EEPROM and then turn OFF the power supply and turn it ON again.**

8. **Connect the operation command input (RUN: CN1 pin 29) to COM (CN1 pin 41). Servo ON status will be entered and the motor will be activated.**

9. **Input a low-frequency pulse signal from the host device to start low-speed operation.**

10. **Check the motor rotation speed in MONITOR mode.**
    Check to see if the motor is rotating at the set speed and to see if the motor stops when the command (pulses) are stopped.

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**Operation**

# 10

# Adjustment Functions

This chapter explains the functions, setting methods and items to note regarding various gain adjustments.

10

# 10-1 Gain Adjustment

Accurax G5 Servo Drives provide the realtime autotuning function.
With these functions, 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 driver 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 | : 140.0 |
| Speed loop integral time | : 190.0 | : 6.0 | : 6.0 |
| Speed feed-forward | : 30 | : 30 | : 100 |
| Inertia ratio | : 300 | : 300 | : 300 |
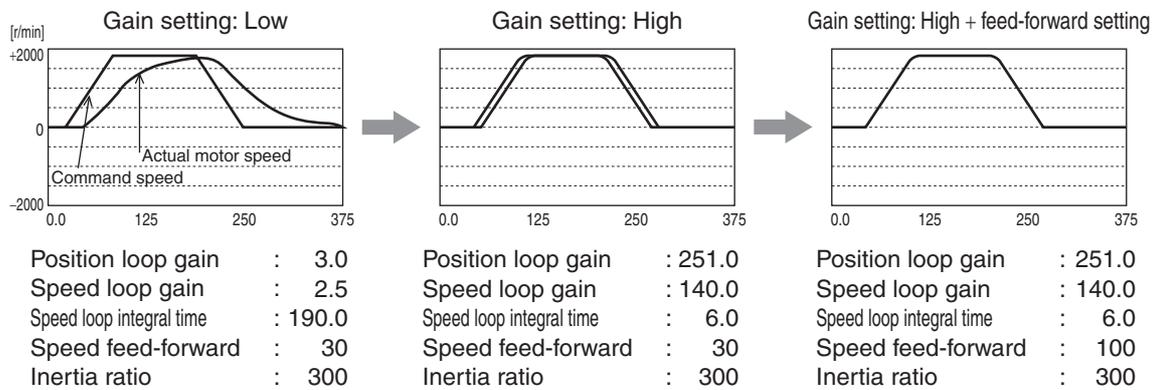
## Gain Adjustment Methods

| Function | | Explanation | 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.10-4 |
| 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.10-11 |
| | Basic procedure | POSITION CONTROL/FULL CLOSING CONTROL mode adjustment | P.10-12 |
| | | SPEED CONTROL mode adjustment | P.10-13 |
| | | TORQUE CONTROL mode adjustment | P.10-18 |

Note 1. Take sufficient care for safety.

Note 2. If vibration occurs (unusual noise or vibration), immediately turn OFF the power supply or let the servo OFF status occur.

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**Adjustment Functions**

## Gain Adjustment Procedure

```
                    ( Start adjustment. )
                            │
                            ▼
                    ◇ Automatic ◇ ──── No ──────────────────┐
                    ◇ adjustment? ◇                         │
                            │ Yes                            │
                            ▼                                │
                    ┌─────────────────┐                     │
                    │   Realtime      │                     │
                    │ autotuning      │                     │
                    │   setting       │                     │
                    └─────────────────┘                     │
                            │                                │
                            ▼                                │
                    ┌─────────────────┐                     │
                    │ Realtime        │                     │
                    │ autotuning      │                     │
                    └─────────────────┘                     │
                            │                                │
                            ▼                                │
                    ◇ Operation OK? ◇ ──── No ──────────────┤
                            │ Yes                            │
                            │                    (Default setting)
                            │                                ▼
                            │                    ┌─────────────────┐
                            │                    │  Manual tuning  │
                            │                    └─────────────────┘
                            │                            │
                            │                            ▼
                            │                    ◇ Operation OK? ◇ ── No ──┐
                            │                            │ Yes             │
                            │◄───────────────────────────┘                 │
                            ▼                                               │
                    ┌─────────────────┐                                    │
                    │ Write to EEPROM.│                                    │
                    └─────────────────┘                                    ▼
                            │                              ( Consult OMRON. )
                            ▼
                 ( Adjustment completed. )
```
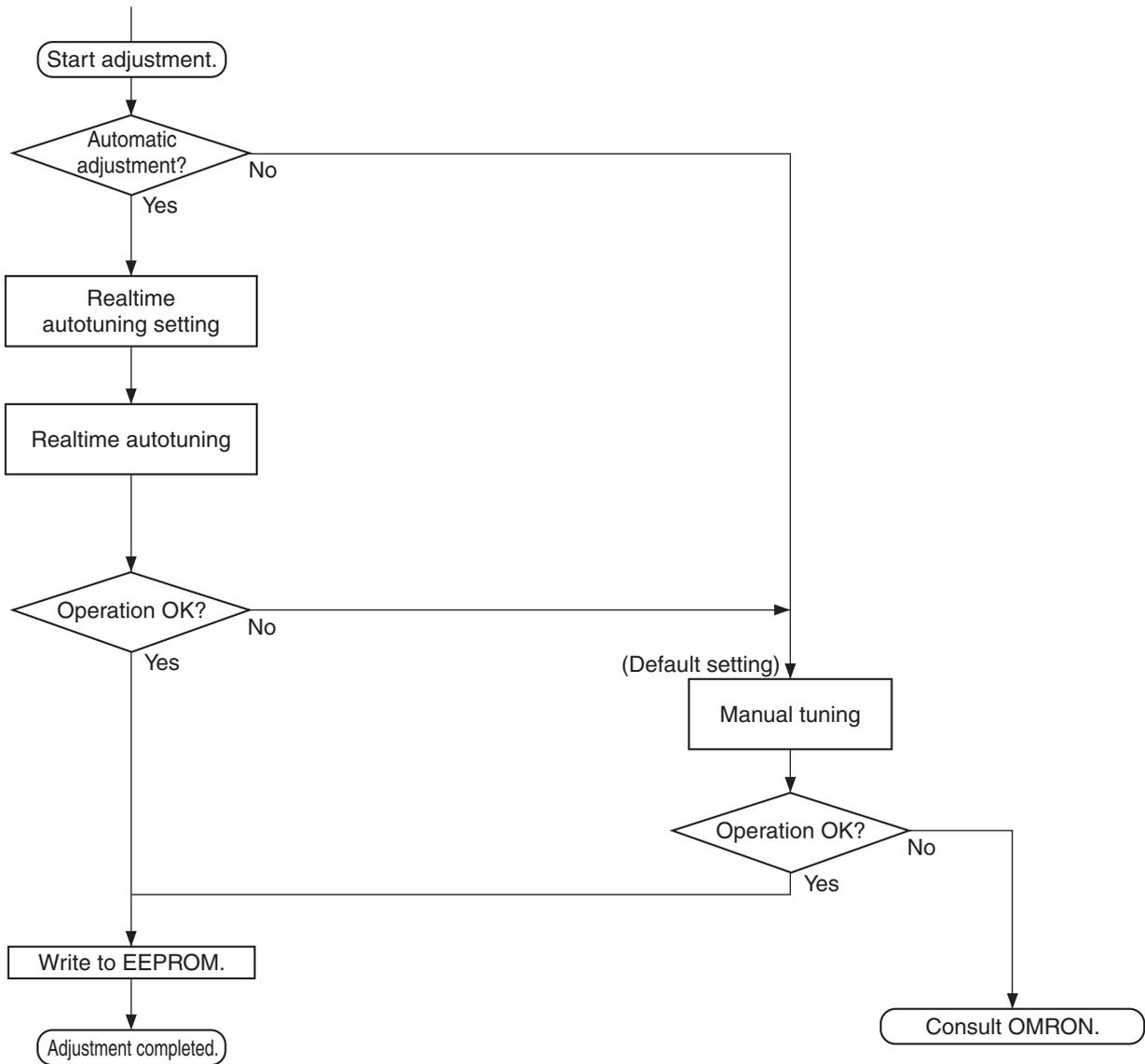
### Gain Adjustment and Machine Rigidity

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).

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**Adjustment Functions**

# 10-2 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. Realtime autotuning is enabled for any control to adjust the speed loop PI control.
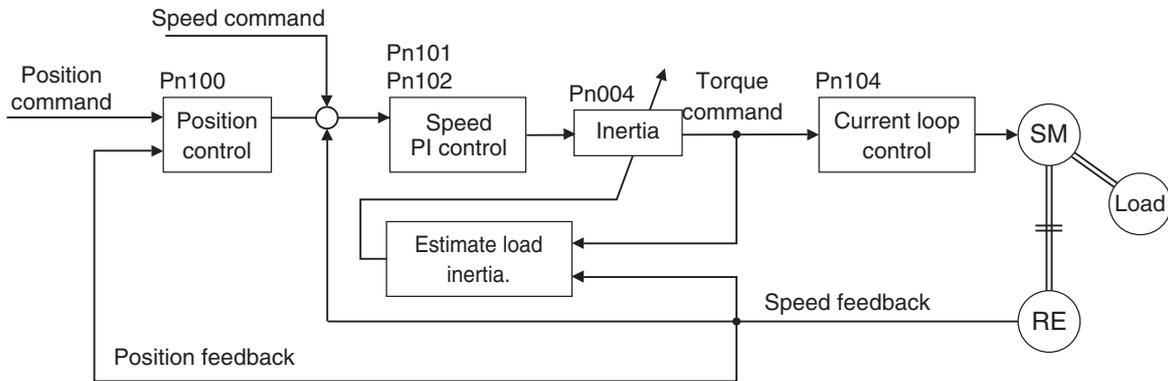


📝 Precautions for Correct Use

• 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)<br>• If the load inertia changes quickly. (in less than 10 s) |
| Load | • If the machine rigidity is extremely low.<br>• 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.<br>• If the acceleration/deceleration gradually changes at less than 2,000 r/min in 1 s.<br>• If the acceleration/deceleration torque is too small compared with the unbalanced load and the viscous friction torque.<br>• 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.

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Adjustment Functions

## Setting Realtime Autotuning

**1. When setting realtime autotuning, turn the servo OFF.**

**2. Set REALTIME AUTOTUNING mode Selection (Pn002) depending on the load.**

When the value is set to 3 to 5, the response is fast for a change in inertia during operation. Operation, however, may be unstable depending on the operating pattern. Normally, set the parameter to 1.

Use a setting of 3 to 5 when the vertical axis is used.

Gain switching function is enabled for set values 2 to 6.

| Set value | Realtime autotuning | Explanation |
|---|---|---|
| 0 | Disabled | Realtime autotuning is disabled. |
| 1 | STABILITY FOCUSED mode (default setting) | No unbalanced load or friction compensation, nor gain switching. |
| 2 | POSITIONING FOCUSED mode | Used when unbalanced load and friction are small. Gain switching is set. |
| 3 | VERTICAL AXIS mode | Used when unbalanced load is present like invertical axis. |
| 4 | FRICTION COMPENSATION mode | Used when friction is large. Also compensates the unbalanced load. |
| 5 | Tool mode | Used In combination with the software tool. The drive detects the values and the user decide to apply or not. |
| 6 | Customization | Used when freely combining REALTIME AUTOTUNING mode and APPLICABLE FILTER mode settings. |

## 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.

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**Adjustment Functions**

🖉 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 will use this saved data as the default setting when the power supply is turned OFF and turned ON again.
- The parameter will automatically be set based on the Realtime Autotuning Machine Rigidity Setting (Pn003) if realtime autotuning is enabled.

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**Adjustment Functions**

### 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 | 20 | 25 | 30 | 40 | 45 | 55 | 75 | 95 |
| Pn101 | Speed Loop Gain | 15 | 20 | 25 | 30 | 35 | 45 | 60 | 75 |
| Pn102 | Speed Loop Integral Time Constant | 3700 | 2800 | 2200 | 1900 | 1600 | 1200 | 900 | 700 |
| Pn103 | Speed Feedback Filter Time Constant | 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 | 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 | For Pn002= 2,3,4 or 5: 10 <br> For Pn002= 0 or 1: 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 |
| Pn605 | Gain 3 Effective Time | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn606 | Gain 3 Ratio Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn607 | Torque Command Value Offset | Estimated if Pn002=3,4 or 5 | | | | | | | |
| Pn608 | Forward Direction Torque Offset | Estimated If Pn002= 4 or 5 | | | | | | | |
| Pn609 | Reverse Direction Torque Offset | Estimated if Pn002= 4 or 5 | | | | | | | |
| Pn610.0, Pn610.3 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn611 | Electric Current Response Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn613 | Inertia Ratio 2 | 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.

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Adjustment Functions

| 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 | 115 | 140 | 175 | 320 | 390 | 480 | 630 | 720 |
| Pn101 | Speed Loop Gain | 90 | 110 | 140 | 180 | 220 | 270 | 350 | 400 |
| Pn102 | Speed Loop Integral Time Constant | 600 | 500 | 400 | 310 | 250 | 210 | 160 | 140 |
| Pn103 | Speed Feedback Filter Time Constant | 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 | 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 | For Pn002= 2,3,4 or 5: 10<br>For Pn002= 0 or 1: 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 |
| Pn605 | Gain 3 Effective Time | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn606 | Gain 3 Ratio Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn607 | Torque Command Value Offset | Estimated if Pn002=3,4 or 5 | | | | | | | |
| Pn608 | Forward Direction Torque Offset | Estimated If Pn002= 4 or 5 | | | | | | | |
| Pn609 | Reverse Direction Torque Offset | Estimated if Pn002= 4 or 5 | | | | | | | |
| Pn610.0, Pn610.3 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn611 | Electric Current Response Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn613 | Inertia Ratio 2 | 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.

| 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 | 900 | 1080 | 1350 | 1620 | 2060 | 2510 | 3050 | 3770 |
| Pn101 | Speed Loop Gain | 500 | 600 | 750 | 900 | 1150 | 1400 | 1700 | 2100 |
| Pn102 | Speed Loop Integral Time Constant | 120 | 110 | 90 | 80 | 70 | 60 | 50 | 40 |
| Pn103 | Speed Feedback Filter Time Constant | 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 | 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 | For Pn002= 2,3,4 or 5: 10<br>For Pn002= 0 or 1: 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 |
| Pn605 | Gain 3 Effective Time | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn606 | Gain 3 Ratio Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn607 | Torque Command Value Offset | Estimated if Pn002=3,4 or 5 | | | | | | | |
| Pn608 | Forward Direction Torque Offset | Estimated If Pn002= 4 or 5 | | | | | | | |
| Pn609 | Reverse Direction Torque Offset | Estimated if Pn002= 4 or 5 | | | | | | | |
| Pn610.0, Pn610.3 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn611 | Electric Current Response Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn613 | Inertia Ratio 2 | 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.

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**Adjustment Functions**

| 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 | 4490 | 5000 | 5600 | 6100 | 6600 | 7200 | 8100 | 9000 |
| Pn101 | Speed Loop Gain | 2500 | 2800 | 3100 | 3400 | 3700 | 4000 | 4500 | 5000 |
| Pn102 | Speed Loop Integral Time Constant | 40 | 35 | 30 | 30 | 25 | 25 | 20 | 20 |
| Pn103 | Speed Feedback Filter Time Constant | 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 | 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 | For Pn002= 2,3,4 or 5: 10<br>For Pn002= 0 or 1: 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 |
| Pn605 | Gain 3 Effective Time | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn606 | Gain 3 Ratio Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn607 | Torque Command Value Offset | Estimated if Pn002=3,4 or 5 | | | | | | | |
| Pn608 | Forward Direction Torque Offset | Estimated If Pn002= 4 or 5 | | | | | | | |
| Pn609 | Reverse Direction Torque Offset | Estimated if Pn002= 4 or 5 | | | | | | | |
| Pn610.0, Pn610.3 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pn611 | Electric Current Response Setting | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Pn613 | Inertia Ratio 2 | 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.

⬩ The parameters Pn103, Pn108, Pn110 to Pn127, Pn605, Pn606, Pn610, Pn611, Pn613, Pn623 and Pn624 are set to fixed values.

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**Adjustment Functions**

# 10-3 Manual Tuning

## Basic Settings

As described before, the Accurax G5 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.

### 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 "12-2 Parameter List" (P.12-12).

#### 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 (SBCE-337).



USB communications cable

Connect to CN7.

Adjustment Functions

## POSITION CONTROL/FULL CLOSING CONTROL Mode Adjustment

Use the following procedure to perform the adjustment in position control for the Accurax G5 Series.

Start adjustment.

Set the realtime autotuning to disabled (Pn002 = 0)

Set each parameter according to the parameter settings for different applications.

Operate based on the normal operation pattern and load.

Are the positioning time and other performances satisfied? — Yes → Adjustment completed.

No

Increase Speed Loop Gain (Pn101) to the extent that hunching does not occur upon servo lock.

Decrease Speed Loop Integral Time Constant (Pn102) to the extent that hunching does not occur upon servo lock.

Does hunching (vibration) occur when the motor rotates? — Yes

No

Increase position loop gain to the extent that overshooting does not occur.

Write to the EEPROM in the PARAMETER WRITE mode.

Adjustment completed.

Decrease Speed Loop Gain (Pn101).

Increase Speed Loop Integral Time Constant (Pn102).

⚠ Never adjust or set parameters to extreme values, as it will make the operation unstable.
Failure to follow this guideline may result in injury.
Gradually change the value to adjust the gain while checking the motor operation.

If vibration persists after repeated adjustments or the positioning is slow:

Increase Torque Command Filter Time Constant (Pn104).

Set the vibration frequency in the
Notch Filter 1 Frequency Setting (Pn201),
Notch Filter 2 Frequency Setting (Pn204),
Notch Filter 3 Frequency Setting (Pn207) or
Notch Filter 4 Frequency Setting (Pn210).

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**Adjustment Functions**

## SPEED CONTROL Mode Adjustment

Adjustments in speed control for the Accurax G5 Series are very similar to POSITION CONTROL mode adjustment.
Use the following procedure to perform the adjustment.

Start adjustment.

Set the realtime autotuning to disabled (Pn002 = 0)

Set each parameter according to the parameter settings for different applications.

Operate based on the normal operation pattern and load.

Are the speed responsiveness and other performances satisfied? — Yes → Adjustment completed.

No

> ⚠ Never adjust or set parameters to extreme values, as it will make the operation unstable.
> Failure to follow this guideline may result in injury.
> Gradually change the value to adjust the gain while checking the motor operation.

Increase Speed Loop Gain (Pn101) to the extent that hunching does not occur upon servo lock.

Decrease Speed Loop Integral Time Constant (Pn102) to the extent that hunching does not occur upon servo lock.

Does hunching (vibration) occur when the motor rotates? — Yes → Decrease Speed Loop Gain (Pn101).

No

Increase Speed Loop Integral Time Constant (Pn102).

Write to the EEPROM in the PARAMETER WRITE mode.

Adjustment completed.

If vibration persists after repeated adjustments or the positioning is slow:

Increase Torque Command Filter Time Constant (Pn104).

Set the vibration frequency in the Notch Filter 1 Frequency Setting (Pn201), Notch Filter 2 Frequency Setting (Pn204), Notch Filter 3 Frequency Setting (Pn207) or Notch Filter 4 Frequency Setting (Pn210).

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**Adjustment Functions**

## 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 | 40.0 [1/s] | Pn105 |
| Pn101 | Speed Loop Gain | 50.0 Hz | Pn106 |
| Pn102 | Speed Loop Integral Time Constant | 20.0 ms | Pn107 |
| Pn104 | Torque Command Filter Time Constant | 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 and 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 (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.
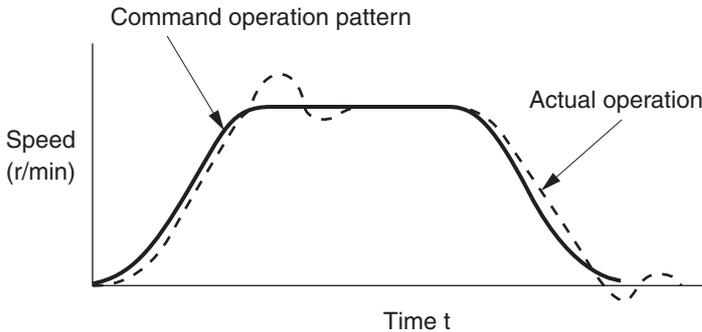


⬧ If the position loop gain is low, positioning completion speed becomes slow.



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**Adjustment Functions**
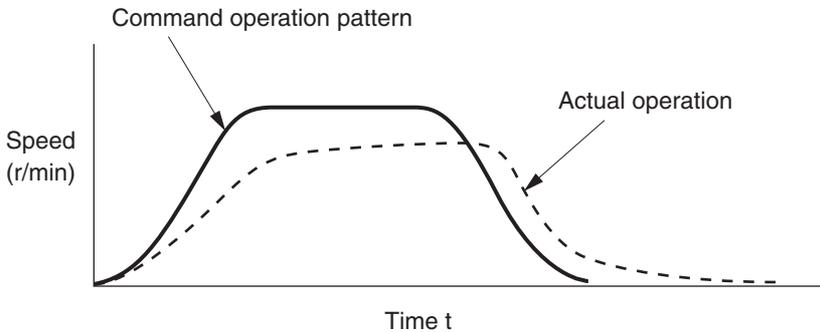
### Pn101 and Pn106 Speed Loop Gain

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 (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.
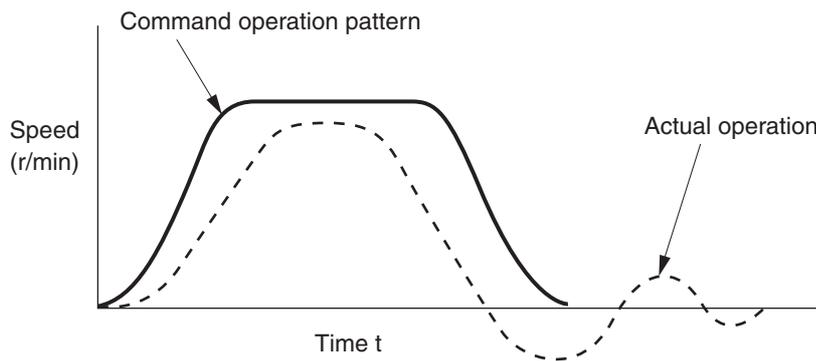


⬧ If the speed loop gain is high, vibrations are more likely to occur. Vibration or resonance may not disappear.
In such case, decrease the speed loop gain.
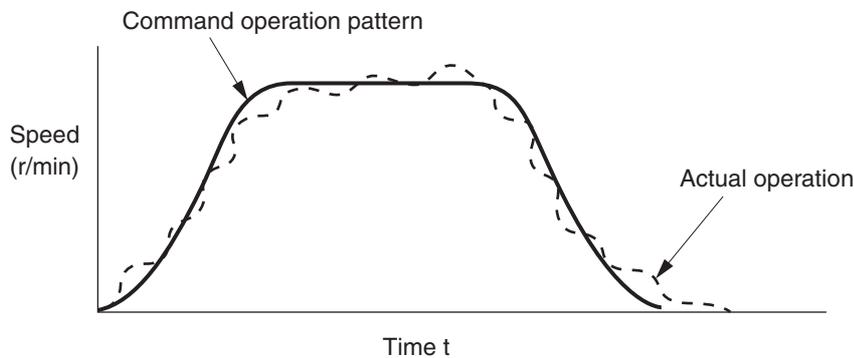
### Pn102 and Pn107 Speed Loop Integral Time Constant

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.
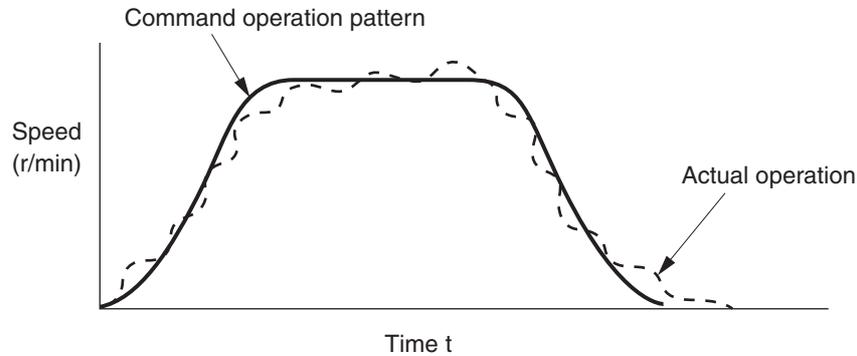


* If the speed loop integral time constant is high, the response is delayed. The servo rigidity becomes weak.
  In such case, decrease the speed loop integral time constant.
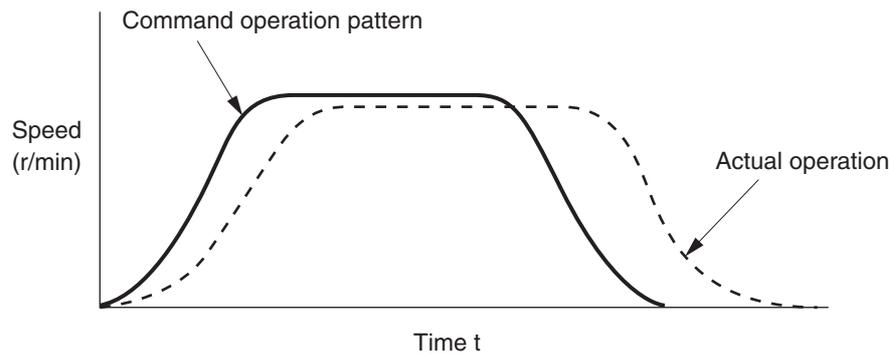


### Pn104 and Pn109 Torque Command Filter Time Constant (Current Loop Input Adjustment)

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 (Pn102).
Also, the torque command filter reduces vibration due to the machine rigidity.
This is related to Speed Loop Gain (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.

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**Adjustment Functions**

### 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.
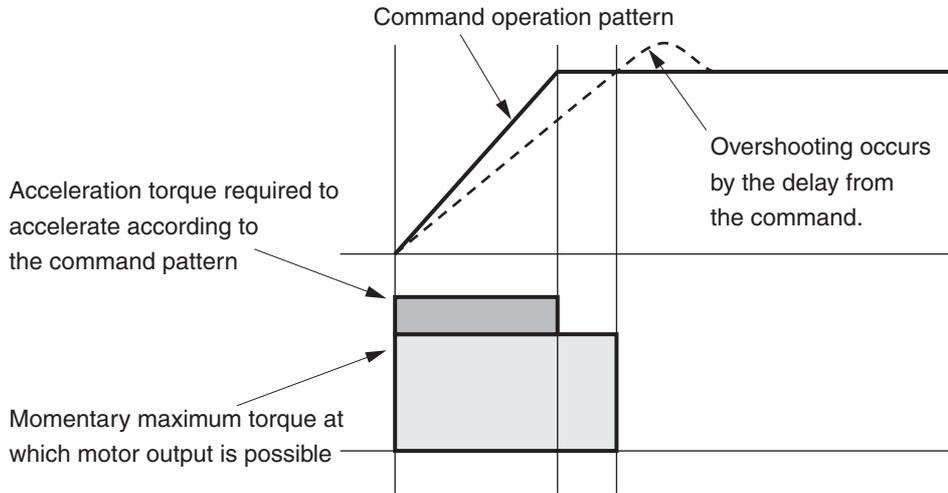


## TORQUE CONTROL Mode Adjustment

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 Torque Command/Speed Limit Selection (Pn317) is 0, speed limit will be the value set by Speed Limit Value Setting (Pn321) and Reverse Direction Speed Limit Value Setting (Pn322). If Torque Command/Speed Limit Selection (Pn317) is 1, the speed limit will be 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) and Reverse Direction Speed Limit Value Setting (Pn322) 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 will be small, when the speed limit values in Speed Limit Value Setting (Pn321) and Reverse Direction Speed Limit Value Setting (Pn322) are too low, when the speed loop gain is too low, or when the speed loop integral time constant is 10,000 (disabled).

# 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.

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# 11-1 Error Processing

## Preliminary Checks When a Problem Occurs

This section explains the preliminary checks and analytical softwares 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-KTxL | (50 to 400 W) | : Single-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz |
| R88D-KTxH | (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 15 kW) | : 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| R88D-KTxF | (750 W to 15 kW) | : 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz |

Control circuit power supply input terminal (L1C, L2C)

| | | |
|---|---|---|
| R88D-KTxL | (50 to 400 W) | : Single-phase 100 to 115 VAC (85 to 127 V) 50/60 Hz |
| R88D-KTxH | (100 W to 1.5 kW) | : Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| | (2 to 15 kW) | : Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| R88D-KTxF | (750 W to 15 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 driver and using the Operation keys.
⬩ When an alarm has occurred
　　… Check the alarm display that is displayed (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.11-11) for details.

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**Error and Maintenance**

## Precautions When a Problem Occurs

When checking and verifying I/O after a problem has occurred, the driver 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 measuring the encoder output, perform the measurement based on the SENGND (CN1 pin 13).
  When an oscilloscope is used for measurement, it will not be affected by noise if measurements are performed using the differential between CH1 and CH2.
- 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 immediate stop even if it runs away.

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**Error and Maintenance**

## 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 will be 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.9-5).

### Replacing the Servo Drive

**1. Copy the parameters.**
Use the Operation keys on the driver to write down all the contents of parameter settings.

**2. Replace the driver.**

**3. Set the parameters.**
Use the Operation keys on the driver to set all the parameters.

**4. Set up the absolute encoder.**

- If a motor with an absolute encoder is used, the absolute value data in the absolute encoder will be cleared when the driver 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.9-5).

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**Error and Maintenance**

# 11-2 Warning List

This is a function to output a warning signal before the protective function operates to notify the overload and other statuses in advance. Set the warning output type to Warning Output Selection 1 (Pn440) and Waning Output Selection 2 (Pn441).

📝 Precautions for Correct Use

♦ Each warning automatically returns to the status before it occurred once the system recovers from the error. However, for the time set in the Warning Latch Hold Time Selection (Pn627), the warning status will be held. To clear the warning during the latch hold time, do so by performing the same procedures as alarm clear.

## Warning List

| Warning number | Warning name | Latch[1] | Warning occurrence condition | Warning Output Selection (Pn440, Pn441) [2] | Warning Mask Setting (Pn638) |
|---|---|---|---|---|---|
| A0 | Overload warning | √ | The load ratio is 85% or more of the protection level. | 1 | bit 7 |
| A1 | Excessive regeneration warning | √ | The regeneration load ratio is 85% or more of the protection level. | 2 | bit 5 |
| A2 | Battery warning | Always fixed with no time limit | Battery voltage is 3.2 V or less. | 3 | bit 0 |
| A3 | Fan warning | √ | The fan stop status continues for 1 s. | 4 | bit 6 |
| A4 | Encoder communications warning | √ | The number of continuous occurrences of encoder communications error exceeded the specified value. | 5 | bit 4 |
| A5 | Encoder overheating warning | √ | The encoder detects the overheating warning. | 6 | bit 3 |
| A6 | Vibration detection warning | √ | Vibration is detected. | 7 | bit 9 |
| A7 | Limit detection warning | Always fixed with no time limit | The limit of the capacitor or the fan is below the specified value. | 8 | bit 2 |
| A8 | External scale error warning | √ | The external scale detected a warning. | 9 | bit 8 |
| A9 | External scale communications warning | √ | The number of occurrences of external scale communications error exceeded the specified value. | 10 | bit 10 |

*1. The "√" fields can be set to 1 to 10 s in the Warning Latch Hold Time Selection (Pn627) or to the no-time limit setting. However, the battery warning is fixed with no time limit.

*2. Select the type of warning to be output in warning output 1 (WARN1) and warning output 2 (WARN2) in the Warning Output Selection 1 (Pn440) and Warning Output Selection 2 (Pn441).If you set this to 0, all warning types will be output.Do not set it to a value other than above.

*3. Each warning detection can be masked using the Warning Mask Setting (Pn638).The table shows the corresponding bits.
The warning detection is masked when the bit = 1.

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**Error and Maintenance**

# 11-3 Alarm List

If the driver detects an error, the alarm output (ALM) will turn ON, the power drive circuit in the driver will turn OFF, and the alarm code will be displayed.

📝 Precautions for Correct Use

⬧ Refer to "Error Diagnosis Using the Alarm Displays"(P.11-11) for appropriate alarm measures.
⬧ Release the alarm using one of the following methods. Remove the cause of the alarm first.
· Input the alarm reset input (RESET) signal.
· Turn OFF the power supply, then turn it ON again.
· Execute the alarm reset on the Parameter Unit.

However, some alarms can only be reset by turning the power supply OFF then ON again. Refer to the next item "Alarm List".

⬧ If you release an alarm while the operation command (RUN) is turned ON, the Servo Drive will start 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.

⬧ When an alarm occurs, the servodrive latches the status of the servodrive just before the alarm occurence. Those latched values can be read with the software tool for diagnostics. Refer to the CX-Drive for details.

⬧ The stop mode in case of an alarm may vary depending on the „Immediate stop" attribute in each alarm.

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**Error and Maintenance**

## Alarm List

| Error number | | Error detection function | Detection details and probable cause | Attribute | | |
|---|---|---|---|---|---|---|
| Main | Sub | | | History | Can be cleared | Immediate stop *1 |
| 11 | 0 | Control power supply undervoltage | The DC voltage of the main circuit fell below the specified value while the operation command (RUN) input was ON. | – | √ | – |
| 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 | Driver overheat | The temperature of the driver 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. | √ | √ | – |
| 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 driver 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 driver. | √ | – | – |
| 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 position of load from external scale and position of motor due to encoder was larger than the pulse number set by Excessive Hybrid Error Setting (Pn332). | √ | – | √ |
| 26 | 0 | Overspeed | The motor rotation speed exceeded the set value of the Overspeed Level set (Pn513). | √ | √ | √ |
| | 1 | Overspeed 2 | The motor rotation speed exceeded the set value of the Overspeed Level set 2 (Pn615). | √ | √ | – |
| 27 | 0 | Command pulse | A command pulse frequency error was detected. | √ | √ | √ |
| 28 | 0 | Pulse regeneration error | The pulse regeneration output frequency exceeded the limit. | √ | √ | √ |

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**Error and Maintenance**

| Error number | | Error detection function | Detection details and probable cause | Attribute | | |
|---|---|---|---|---|---|---|
| Main | Sub | | | History | Can be cleared | Immediate stop *1 |
| 29 | 0 | Error counter overflow | Error counter value based on the encoder pulse reference exceeded $2^{29}$ (536,870,912). | √ | √ | – |
| 30 | 0 | Safety input error | Safety input signal turned OFF. | – | √ | – |
| 33 | 0 | Interface input duplicate allocation error 1 | A duplicate setting for the interface input signals was detected. | √ | – | – |
| | 1 | Interface input duplicate allocation error 2 | | √ | – | – |
| | 2 | Interface input function number error 1 | An undefined number was detected in the interface input signal allocations. | √ | – | – |
| | 3 | Interface input function number error 2 | | √ | – | – |
| | 4 | Interface output function number error 1 | An undefined number was detected in the interface output signal allocations. | √ | – | – |
| | 5 | Interface output function number error 2 | | √ | – | – |
| | 6 | Counter reset allocation error | The counter reset function was allocated to something other than input signal SI7. | √ | – | – |
| | 7 | Command pulse prohibition input allocation error | The command pulse prohibition input function was allocated to something other than input signal SI10. | √ | – | – |
| 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. | – | – | – |
| 38 | 0 | Drive prohibition input error | The forward drive prohibition and reverse drive prohibition inputs are both turned OFF. | – | √ | – |
| 39 | 0 | Excessive analog input 1 | A current exceeding the Speed Command/Torque Command Input Overflow Level Setting (Pn424, Pn427 or Pn430) was applied to the analog command input (pin 14). | √ | √ | √ |
| | 1 | Excessive analog input 2 | | √ | √ | √ |
| | 2 | Excessive analog input 3 | | √ | √ | √ |
| 40 | 0 | Absolute encoder system down error **ABS** | The voltage supplied to the absolute encoder is lower than the specified value. | √ | √ | – |
| 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. | √ | √ | – |

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**Error and Maintenance**

| Error number | | Error detection function | Detection details and probable cause | Attribute | | |
|---|---|---|---|---|---|---|
| Main | Sub | | | History | Can be cleared | Immediate stop *1 |
| 43 | 0 | Encoder initialization error protection | 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. | √ | – | – |
| 50 | 0 | External scale connection error | An error was detected in external scale connection. | √ | – | – |
| | 1 | External scale communications data error | An error was detected in external scale communications data. | √ | – | – |
| 51 | 0 | External scale status error 0 | An external scale error code was detected. | √ | – | – |
| | 1 | External scale status error 1 | | √ | – | – |
| | 2 | External scale status error 2 | | √ | – | – |
| | 3 | External scale status error 3 | | √ | – | – |
| | 4 | External scale status error 4 | | √ | – | – |
| | 5 | External scale status error 5 | | √ | – | – |
| 55 | 0 | Phase-A connection error | An error was detected in the external scale phase A connection. | √ | – | – |
| | 1 | Phase-B connection error | An error was detected in the external scale phase B connection. | √ | – | – |
| | 2 | Phase-Z connection error | An error was detected in the external scale phase Z connection. | √ | – | – |
| 87 | 0 | Forced alarm input error | The forced alarm input signal was input. | – | √ | – |
| 95 | 0 | 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. | – | – | – |

*1. An immediate stop means an error causing an immediate stop when the Pn510 "Stop Selection for Alarm Generation" is set to 4 to 7. For details, refer to "Stop Selection for Alarm Generation"(P.8-50).

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**Error and Maintenance**

**Extended Alarms**

| Error No. | | Error detection function | Detection details and probable cause |
|---|---|---|---|
| Main | Sub | | |
| 46 | 0 | Absolute Error | Absolute encoder status is abnormal |
| 51 | 6 | External Scale Error | External scale status is abnormal |
| 70 | 0 | U-Phase Phase Current Detection Error | U-Phase Current Detection Value is abnormal when objecting servo off to servo on |
| | 1 | W-Phase Phase Current Detection Error | W-Phase Current Detection Value is abnormal when objecting servo off to servo on |
| | 2 | Current Detection Syste Error | Setting value of Current Detection Systemu is abnormal |
| 71 | 0 | AI2 Input Error | Analog Input Voltage 2 value is abnormal  +11 V over is lasting 200 ms |
| | 1 | AI3Input Error | Analog Input Voltage 3 value is abnormal  +11 V over is lasting 200 ms |
| 72 | 0 | Thermal Error | Hardware is abnormal |
| 73 | 0 | VDC Detection System Error | Hardware is abnormal |
| 76 | 0 | Internal RAM Error | Microcomputer is abnormal |
| | 1 | Internal ROM Error | Internal ROM is abnormal |
| 77 | 0 | Stacke Error | Lack of Stack Area |
| 78 | 0 | Encoder EEPROM Error | Encoder EEPROM Check is abnormal |
| 96 | 0 | LSI Initialization Error | Falut of MNM1223 initialization |
| 97 | 0 | Setting Error | Encoder type and control mode are unmatching |
| 99 | 0 | Hardware Error | Power curcuit detects the something hardware error |
| 99 | 1 | Encoder Setting Error | Encoder Setting is not correct |

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**Error and Maintenance**

# 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 display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 11 | Power supply undervoltage | Occurs when the servo is turned ON. | · The power supply voltage is low.<br>· Momentary power interruption occurred.<br>· Power supply capacity is insufficient.<br>· The power supply voltage is reduced because the main power supply is OFF.<br>· The main power supply is not input. | · Increase the power supply capacity.<br>· Change the power supply.<br>· Turn ON the power supply. |
| | | | · Power supply capacity is insufficient. | · Increase the power supply capacity. |
| | | | · Phase loss | · Connect the phases (L1, L2, L3) of the power supply voltage correctly.<br>· For single-phase, connect to L1 and L3 correctly. |
| | | | · The main circuit power supply is damaged.<br>· Control PCB error. | · Replace the driver. |
| 12 | Overvoltage | Occurs when the power supply is turned ON. | · Main circuit power supply voltage is out of allowable range. | · Change the main circuit power supply voltage to within allowable range. |
| | | Occurs when the motor is decelerating. | · Load inertia is too large. | · Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity.<br>· Extend the deceleration time. |
| | | | · Main circuit power supply voltage is out of allowable range. | · Change the main circuit power supply voltage to within allowable range. |
| | | Occurs during descent (vertical axis). | · Gravitational torque is too large. | · Add a counterbalance to the machine to lower gravitational torque.<br>· Reduce the descent speed.<br>· Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity. |

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**Error and Maintenance**

| Alarm display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 13 | Main circuit power supply undervoltage | Occurs when the servo is turned ON. | · The power supply voltage is low.<br>· Momentary power interruption occurred.<br>· Power supply capacity is insufficient.<br>· The power supply voltage is reduced because the main power supply is OFF.<br>· The main power supply is not input. | · Check the power supply capacity.<br>· Change the power supply.<br>· Turn ON the power supply.<br>· Extend the Momentary Hold Time (Pn509). |
| | | Occurs when the power supply is turned ON. | · Phase loss | · Correctly connect the phases of the power supply voltage. |
| | | | | · Correctly connect the single-phase. |
| | | | · The main circuit power supply is damaged.<br>· Control PCB damage. | · Replace the driver. |
| 14 | Overcurrent | Occurs when the servo is turned ON. | · Control PCB error | · Replace the driver. |
| | | | · The motor power line is short-circuited or ground-faulted between phases. | · Repair the short-circuited or ground-faulted power line.<br>· Measure the insulation resistance at the motor and, if there is a short circuit, replace the motor. |
| | | | · Phase U, phase V, phase W, and the ground are wired incorrectly. | · Wire correctly. |
| | | | · Motor winding is burned out. | · Measure the winding resistance, and if the winding is burned out, replace the motor. |
| | | | · The relay for the dynamic brake has been deposited. | · Do not frequently input the operation command (RUN) input.<br>· Do not operate the system by turning the servo ON and OFF. |
| | | | · Motor non-conformity | · Use a motor that is appropriate for use with the driver. |
| | | | · The pulse input timing is too soon. | · Wait at least 100 ms before inputting pulses after turning ON the operation command (RUN). |
| | | | · The resistor in the driver is abnormally overheating. | · Reduce the ambient temperature of the driver to 55°C or lower.<br>· If the relay does not click when the power supply is turned ON, replace the driver. |

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**Error and Maintenance**

| Alarm display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 15 | Driver overheat | Occurs during operation. | · The ambient temperature is too high.<br>· The load is too large. | · Lower the ambient temperature.<br>· Increase the capacity of the driver and motor.<br>· Reduce the load.<br>· Extend the acceleration/deceleration times. |
| 16 | Overload | Occurs when the servo is turned ON. | · There is an error in the motor wiring (the wiring or the connections are faulty). | · Wire the motor power cable correctly. |
|  |  |  | · The electromagnetic brake is ON. | · Turn OFF the brake. |
|  |  |  | · The Servo Drive is faulty. | · Replace the driver. |
|  |  | Occurs during operation. | · The effective torque exceeds the rated torque.<br>· The initial torque exceeds the maximum torque. | · Review the load conditions and operating conditions.<br>· Review the motor capacity. |
|  |  |  | · Unusual noise or vibration is caused by faulty gain adjustment. | · Adjust the gain correctly. |
|  |  |  | · The Servo Drive is faulty. | · Replace the driver. |
| 18 | Regeneration overload | Occurs when the motor is decelerating. | · Load inertia is too large. | · Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity.<br>· Extend the deceleration time. |
|  |  |  | · The deceleration time is too short.<br>· The motor rotation speed is too high. | · Reduce the motor rotation speed.<br>· Extend the deceleration time.<br>· Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity. |
|  |  |  | · The operating limit of the External Regeneration Resistor is limited to 10% duty. | · Set Pn016 to 2.<br>For details, refer to "Parameters Details". |
|  |  | Occurs during descent (vertical axis). | · Gravitational torque is too large. | · Add a counterbalance to the machine to lower gravitational torque.<br>· Reduce the descent speed.<br>· Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity. |
|  |  |  | · The operating limit of the External Regeneration Resistor is limited to 10% duty. | · Set Pn016 to 2.<br>For details, refer to "Parameters Details". |

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**Error and Maintenance**

| Alarm display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 21 | Encoder communications error | Occurs during operation. | · The encoder is disconnected.<br>· Connector contacts are faulty. | · Fix the locations that are disconnected.<br>· Wire correctly. |
| | | | · The encoder is wired incorrectly. | · Wire correctly. |
| | | | · The encoder is damaged. | · Replace the motor. |
| | | | · The driver is faulty. | · Replace the driver. |
| | | | · The motor is mechanically held. | · If the motor shaft is held, release it. |
| 23 | Encoder communications data error | Occurs when the power supply is turned ON. Or, occurs during operation. | · The encoder signal line is wired incorrectly. | · Wire correctly. |
| | | | · Noise on the encoder wiring causes incorrect operation. | · Take measures against noise on the encoder wiring. |
| | | | · The encoder power supply voltage has dropped (especially when the cable is long.) | · Provide the required encoder power supply voltage (5 VDC ± 5%). |
| 24 | Error counter overflow | Occurs when the motor does not rotate even when command pulses are input. | · The motor power line or the encoder wiring is incorrect. | · Wire correctly. |
| | | | · The motor is mechanically held. | · If the motor shaft is held, release it.<br>· Release the electromagnetic brake. |
| | | | · Control PCB error | · Replace the driver. |
| | | Occurs during high-speed rotation. | · The motor power line or the encoder wiring is incorrect. | · Wire correctly. |
| | | Occurs when a long string of command pulses is given. | · Gain adjustment is insufficient. | · Adjust the gain. |
| | | | · The acceleration/deceleration is too rapid. | · Extend the acceleration/deceleration times. |
| | | | · The load is too large. | · Reduce the load.<br>· Select a suitable motor. |
| | | Occurs during operation. | · The set value for the Error Counter Overflow Level (Pn014) is exceeded. | · Increase the set value of Pn014.<br>· Reduce the rotation speed.<br>· Reduce the load.<br>· Extend the acceleration/deceleration times. |
| 25 | Excessive hybrid deviation error | Occurs for full closing control. | · There is deviation between the load position according to the external scale and the motor position according to the encoder. | · Check the motor and load connection.<br>· Check the external scale and driver connection.<br>· Check the external scale load position and encoder motor position settings. |

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**Error and Maintenance**

| Alarm display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 26 | Overspeed | Occurs during high-speed rotation. | · The speed command input is too large. | · Set the command pulse frequency to 500 Kpps max. |
| | | | · The setting for the Electronic Gear Ratio Numerator (Pn009, Pn500 to Pn502) is not appropriate. | · Set the electronic gear ratio numerator so that the command pulse frequency is 500 Kpps max. |
| | | | · The maximum rotation speed is exceeded due to overshooting. | · Adjust the gain.<br>· Reduce the maximum command speed. |
| | | | · The encoder is wired incorrectly. | · Wire correctly. |
| | | Occurs when torque limit switching function is used. | · The set value for the Overspeed Detection Level setting (Pn513) is exceeded. | · If torque limit switching function is used, correctly set the allowable operating speed for Pn014. |
| 27 | Command pulse error | Occurs when control signal is input or command is input. | · The command pulse input frequency exceeded the limit. | · Check the command pulse input.<br>· Increase the set value of Pn532. |
| | | | · The setting for the Electronic Gear Ratio Numerator (Pn009, Pn500 to Pn502) is not appropriate. | · Set the electronic gear ratio numerator so that the command pulse frequency is 500 Kpps max. |
| 28 | Pulse regeneration error | Occurs during operation. | · The pulse regeneration output frequency exceeded the limit. | · Check the set value of Pn011 and Pn503.<br>· Set Pn533 to 0 to disable the function. |
| 29 | Error counter overflow | Occurs during operation. | · The error counter value for the encoder pulse reference exceeded $2^{29}$ (536,870,912). | · Check that the motor rotates according to the position command.<br>· Check on the torque monitor that the output torque is not saturated.<br>· Adjust the gain.<br>· Increase the setting for Pn013 or Pn524 to the maximum.<br>· Wire the encoder correctly. |
| 30 | Safety input error | Occurs during operation. | · Safety input signal turned OFF. | · Check the statuses of safety inputs 1 and 2. |
| 33 | Interface I/O allocation error | Occurs when the power supply is turned ON. | · There is a duplicate setting in the I/O signal function allocation.<br>· Specify the undefined number with the I/O signal function allocation. | · Set the function allocation correctly. |
| | | | · There is a mistake in the counter function allocation. | · Allocate to SI7. |
| | | | · There is a mistake in the command pulse prohibition input function allocation. | · Allocate to SI10. |

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**Error and Maintenance**

| Alarm display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 34 | Overrun limit error | Occurs during operation. | · The Overrun Limit Setting (Pn514) was exceeded during operation. | · Adjust the gain.<br>· Increase the set value of Pn514.<br>· Set Pn514 to 0 to disable the function. |
| 36 | Parameter error | Occurs when the power supply is turned ON. | · There are data errors in the parameters that were read. | · Reset all parameters. |
| | | | · The driver is faulty. | · Replace the driver. |
| 37 | Parameters destruction | Occurs when the power supply is turned ON. | · The parameters that were read are corrupt. | · Replace the driver. |
| 38 | Drive prohibition input error | Occurs when the servo is turned ON.<br>Or, occurs during operation. | · The forward drive prohibition (POT) input and reverse drive prohibition (NOT) input were both OFF at the same time. | · Wire correctly.<br>· Replace the limit sensor.<br>· Check whether the power supply for control is input correctly.<br>· Check whether the setting for Drive Prohibition Input Selection (Pn504) is correct. |
| 39 | Excessive analog input 1 | Occurs during operation. | · The voltage input to pin 14 is too high. | · Reduce the input voltage.<br>· Change the value for Pn424, Pn427, and Pn430. |
| 40 | Absolute encoder system down error **ABS** | Occurs when the power supply is turned ON.<br>Occurs during operation. | · The voltage supplied to the absolute encoder is low. | · Set up the absolute encoder.<br>· Connect the battery power supply. |
| 41 | Absolute encoder counter overflow error **ABS** | Occurs during operation. | · The multi-rotation counter of the absolute encoder exceeds the specified value. | · Properly set the Operation Switch when Using Absolute Encoder (Pn015). |
| 42 | Absolute encoder overspeed error **ABS** | Occurs when the power supply is turned ON. | · The motor rotation speed exceeds the specified value when the battery power supply is turned ON.<br>· The wiring is incorrect. | · Reduce the motor rotation speed and supply power.<br>· Check the wiring. |
| 44 | Absolute encoder 1-turn counter error **ABS** | Occurs when the power supply is turned ON. | · The encoder is faulty. | · Replace the Servomotor. |
| 45 | Absolute encoder multi-rotation counter error **ABS** | Occurs when the power supply is turned ON. | · The encoder is faulty. | · Replace the Servomotor. |
| 47 | Absolute encoder status error **ABS** | Occurs when the power supply is turned ON. | · The motor was moving when the power supply was turned ON. | · Do not let the motor move when the power supply is turned ON. |
| 48 | Encoder phase-Z error | Occurs during operation. | · A phase Z pulse from the encoder was not detected regularly. | · Replace the motor. |
| 49 | Encoder PS signal error | Occurs during operation. | · A logic error was detected in the PS signal from the encoder. | · Replace the motor. |

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**Error and Maintenance**

| Alarm display | Error conditions | Status when error occurs | Cause | Measures |
|---|---|---|---|---|
| 50 | External scale communications error | Occurs during operation. | · The disconnection detection function was activated because communications between the external scale and driver were interrupted. | · Wire correctly.<br>· Fix the locations that are disconnected. |
| | | | · There was a communications error in data from external scale. | · Provide the required external scale power supply voltage.<br>· Wire correctly.<br>· Connect the shield to FG. |
| 51 | External scale status error | Occurs during operation. | · An external scale error code was detected. | · Check the external scale specifications.<br>· From the front panel, clear the external scale error, then turn the power supply OFF, then ON again. |
| 55 | Phases-A, B and Z connection error | Occurs during operation. | · A disconnection or other error was detected in external scale phase A, phase B, or phase Z connection. | · Check the connection. |
| 87 | Forced alarm input error | Occurs during operation. | · The forced alarm input signal was input. | · Turn OFF the EMG-STOP signal. |
| 95 | Motor non-conformity | Occurs when the power supply is turned ON. | · The motor and driver combination is incorrect. | · Use a correct combination. |
| | | | · The encoder wiring is disconnected. | · Wire the encoder wiring.<br>· Fix the locations that are disconnected. |

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**Error and Maintenance**

## Error Diagnosis Using the Operation Status

| Symptom | Probable cause | Items to check | Measures |
|---|---|---|---|
| The PWR LED indicator does not light when the power supply is turned ON. | The power supply cable is wired incorrectly. | 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 motor does not rotate even if commands are input from the controller. (Continued on next page) | The operation command (RUN) is OFF. | In MONITOR mode, check whether the RUN signal is ON or OFF. | · Turn ON the operation command (RUN). <br> · Wire correctly. |
| | The forward drive prohibition (POT) and reverse drive prohibition (NOT) are OFF. | In MONITOR mode, check whether the POT signal and NOT signal are ON or OFF. | · Turn ON the POT and NOT signals. <br> · If the POT and NOT inputs are not used, set them to be disabled. |
| | The CONTROL mode is not correct. | Check the CONTROL mode Selection (Pn001). | Set the CONTROL mode to match the command type. |
| | The error counter reset (ECRST) is ON. | In MONITOR mode, check whether the ECRST signal is ON or OFF. | · Turn OFF the ECRST signal. <br> · Wire correctly. |
| | The COMMAND PULSE mode (Pn007) selection is incorrect. | Check the controller's command pulse type and the Servo Drive's command pulse type. | Set the Servo Drive's pulse type to match the controller's command pulse type. |
| | The zero speed designation (VZERO) is OFF. | In MONITOR mode, check whether the VZERO signal is ON or OFF. | · Turn ON the VZERO signal. <br> · Wire correctly. |
| | The internally set speeds are not set. | Check the set value of Pn304 to Pn311. | Set the desired speeds. |
| | The No. 1 Torque Limit (Pn013) or No. 2 Torque Limit (Pn522) is set to 0. | Check the set value of Pn013 and Pn522. | Return the set value to the default setting. |
| | The motor power cable is wired incorrectly. | Check the wiring. | Wire correctly. |
| | The encoder cable is wired incorrectly. | | |
| | The control I/O connector (CN1) is wired incorrectly. | Check the command pulse's wiring. | Wire correctly. |
| | | Check the command pulse type. | Set the Servo Drive's pulse type to match the controller's command pulse type. |
| | | Check the command pulse's voltage. | Connect a resistor that matches the voltage. |
| | The power supply is not ON. | Check whether the power supply is ON and check the PWR LED indicator. | Turn ON the power supply. |
| | | Check the voltage across the power supply terminals. | Wire the power supply's ON circuit correctly. |
| | The speed command is disabled. | Check if the speed command method is correct. | · Set the external analog command correctly. <br> · Set the internal speed correctly. |

| Symptom | Probable cause | Items to check | Measures |
|---|---|---|---|
| The motor does not rotate even if commands are input from the controller. (Continued from previous page) | The torque command is disabled. | Check if the torque command input method is correct. | Set the torque command correctly. |
| | The CW input and CCW input are ON at the same time. | Check the command pulse's wiring. | · Input the pulse signal either to the CW input or CCW input.<br>· Always turn OFF the terminal that is not input to. |
| | Servo Drive is faulty. | – | Replace the Servo Drive. |
| The motor operates momentarily, but then it does not operate after that. | 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. |
| The motor rotates without a command. | The command pulse input is incorrect. | Check the command pulse type. | Set the correct command pulse input. |
| | | Check the command pulse's voltage. | Connect a resistor that matches the voltage. |
| | Servo Drive is faulty. | – | Replace the Servo Drive. |
| The motor rotates in the reverse direction from the command. | The CW input and CCW input connections are reversed. | Check the controller's command pulse type and the Servo Drive's command pulse type. | Connect the CW pulse signal to the CW input and the CCW pulse signal to the CCW input. |
| 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. |
| | The coupling system between the motor shaft and the mechanical system has eccentricity or loose screws, or the load torque is fluctuating due to engagement between pulleys or gears. | Check the mechanical system's coupling section. | Review and adjust the machine. |
| | | Try rotating the motor without a load. (Disconnect it from the mechanical system.) | |
| | The load's moment of inertia exceeds the Servo Drive's allowable value. | Try rotating the motor without a load. (Disconnect it from the mechanical system.) | · Reduce the load.<br>· Replace the Servomotor and Servo Drive with higher capacity models. |
| | 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 command pulse type. | Set the Servo Drive's pulse type to match the controller's command pulse type. |
| | The gain is wrong. | – | Perform manual tuning. |
| | The CN1 input signal is chattering. | Check the operation command (RUN), error counter reset (ECRST), zero speed designation (VZERO), internally set speed selection 1 (VSEL1) and internally set speed selection 2 (VSEL2). | Wire correctly so that there is no chattering. |
| The motor is overheating. | The ambient temperature is too high. | Check that the ambient temperature around the motor is 40°C or less. | Lower the ambient temperature around the motor to 40°C or less. (Use a fan or air conditioner.) |
| | Ventilation is obstructed. | Check to see whether anything is blocking ventilation. | Improve ventilation. |
| | The motor is overloaded. | Try rotating the motor without a load. (Disconnect it from the mechanical system.) | · Reduce the load.<br>· Replace the Servomotor and Servo Drive with higher capacity models. |
| | The motor is vibrating. | | |

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**Error and Maintenance**

| Symptom | Probable cause | Items to check | Measures |
|---|---|---|---|
| The motor holding brake is ineffective. | Power is supplied to the holding brake. | Check whether power is supplied to the holding brake. | Configure a circuit that cuts power supply to the holding brake when the motor stops and the load is held by the holding brake. |
| 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 following: ·Is the load too large? ·Is the motor rotation speed too high? | Review the load conditions, and replace the Servomotor and Servo Drive with appropriate models. |
| | The stop circuit failed. | – | Replace the driver. |
| The motor is producing unusual noises or the machine is vibrating. (Continued on next page) | There are problems with the machine's installation. | Check whether the Servomotor's mounting screws are loose. | Retighten the mounting screws. |
| | | Check whether the axes are misaligned in the coupling. | Align the coupling. |
| | | Check whether the coupling is unbalanced. | Adjust the coupling's balance. |
| | 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. | – | Perform manual tuning. |
| | The Speed Feedback Filter Time Constant (Pn??) is wrong. | Check the set value of Pn??. | Return the set to 0 (default set) or increase the set value. |
| | Noise is entering 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. |
| | Noise is entering 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 entering 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 entering 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 entering 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 entering 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. |

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**Error and Maintenance**

| Symptom | Probable cause | Items to check | Measures |
|---------|----------------|----------------|----------|
| The motor is producing unusual noises or the machine is vibrating. (Continued from previous page) | The machine and the motor are resonating. | Check whether the machine is resonating. | · Readjust the torque command filter time constant.<br>· If there is resonance, set the Notch Filter 1 Frequency (Pn201), Notch Filter 1 Width (Pn202), and Notch Filter 1 Depth (Pn203). |
| Vibration is occurring at the same frequency as the power supply. | Inductive noise is occurring. | Check whether the driver 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.<br>· Use a low-impedance power supply for control signals. |
| 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. |
| | Noise is entering the error counter reset (ECRST). | Check whether the control signal lines and power supply lines are not bound together. | Separate the control signal lines from the power lines or take other measures against noise. |
| | The gain is wrong. | – | Perform manual tuning. |
| | The load inertia is large. | Inspect the following.<br>· Is the load too large?<br>· Is the motor rotation speed too high? | · Adjust the gain.<br>· Review the load conditions, and replace the Servomotor and Servo Drive with appropriate models. |

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**Error and Maintenance**

# 11-5 Periodic Maintenance

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> ⚠️ **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 Limit

♦ The lifetime for the different motor parts 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 oil seal can be replaced.

♦ 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.

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**Error and Maintenance**

## Servo Drive Limit

- The lifetime for the different drive parts is listed below.
  Aluminum electrolytic capacitors:  28,000 hours
  (at an ambient driver 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 driver 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 driver.
- 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 limit by 50%. Following equation shows an example for 25°C: .

$$\text{Lifetime}_{25°C} = \text{Lifetime}_{55°C} \times 2^{\frac{55-25}{10}} = 224000 \text{ hours}$$

- The aluminum electrolytic capacitors deteriorate even when the Servo Drive is stored with no power supplied. If the driver 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.

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**Error and Maintenance**

## 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 display 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 for the First Time

Connect the absolute encoder battery to the motor, then set up the absolute encoder.Refer to "Absolute Encoder Setup"(P.9-5).

Once the absolute encoder battery 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 errors will occur due to voltage delay in the battery.

#### Replacing the Battery

If a battery warning occurs, the absolute encoder power supply must be replaced.

Replace the battery with the control power supply of the driver ON. If the battery is replaced with the control power supply of the driver OFF, data held in the encoder will be lost.

Once the absolute encoder battery has been replaced, clear the battery warning by alarm clear from the front panel. Refer to "Alarm Clear"(P.9-26) for information on clearing alarms.

Note. If the absolute encoder is cleared using the front panel or the absolute values are cleared using communications, all error and multi-rotation data will be lost and the absolute encoder must be set up. Refer to "Absolute Encoder Setup"(P.9-5).

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**Error and Maintenance**

**Battery Mounting Method**

**1. Prepare the replacement battery (R88A-BAT01G).**

R88A-BAT01G
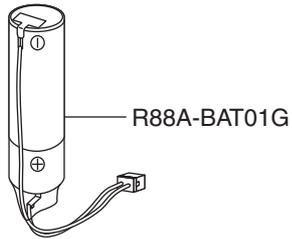
**2. Remove the battery box cover.**
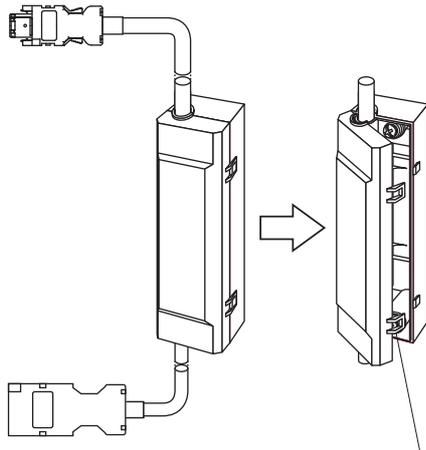
Raise the tabs and remove the cover.

**3. Put the battery into the battery box.**
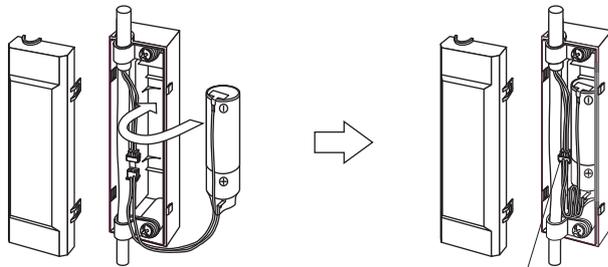
Insert the battery.                    Plug in the connector.

**4. Close the cover to the battery box.**
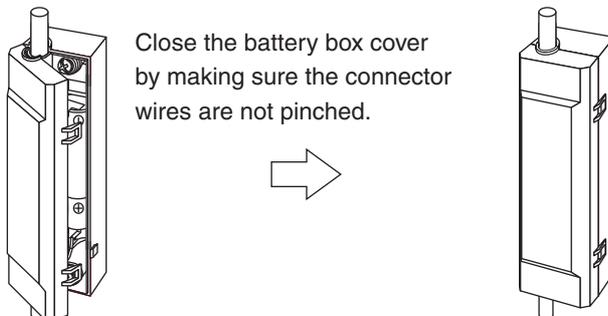
Close the battery box cover by making sure the connector wires are not pinched.

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**Error and Maintenance**

# 12

# Appendix

This chapter provides connection examples using OMRON's PLC and Position Controller, a list of parameters and Safety Certification.

**12**

# 12-1 Connection Examples

## Connection Example 1: Connecting to SYSMAC CJ1W-NC133/233/433
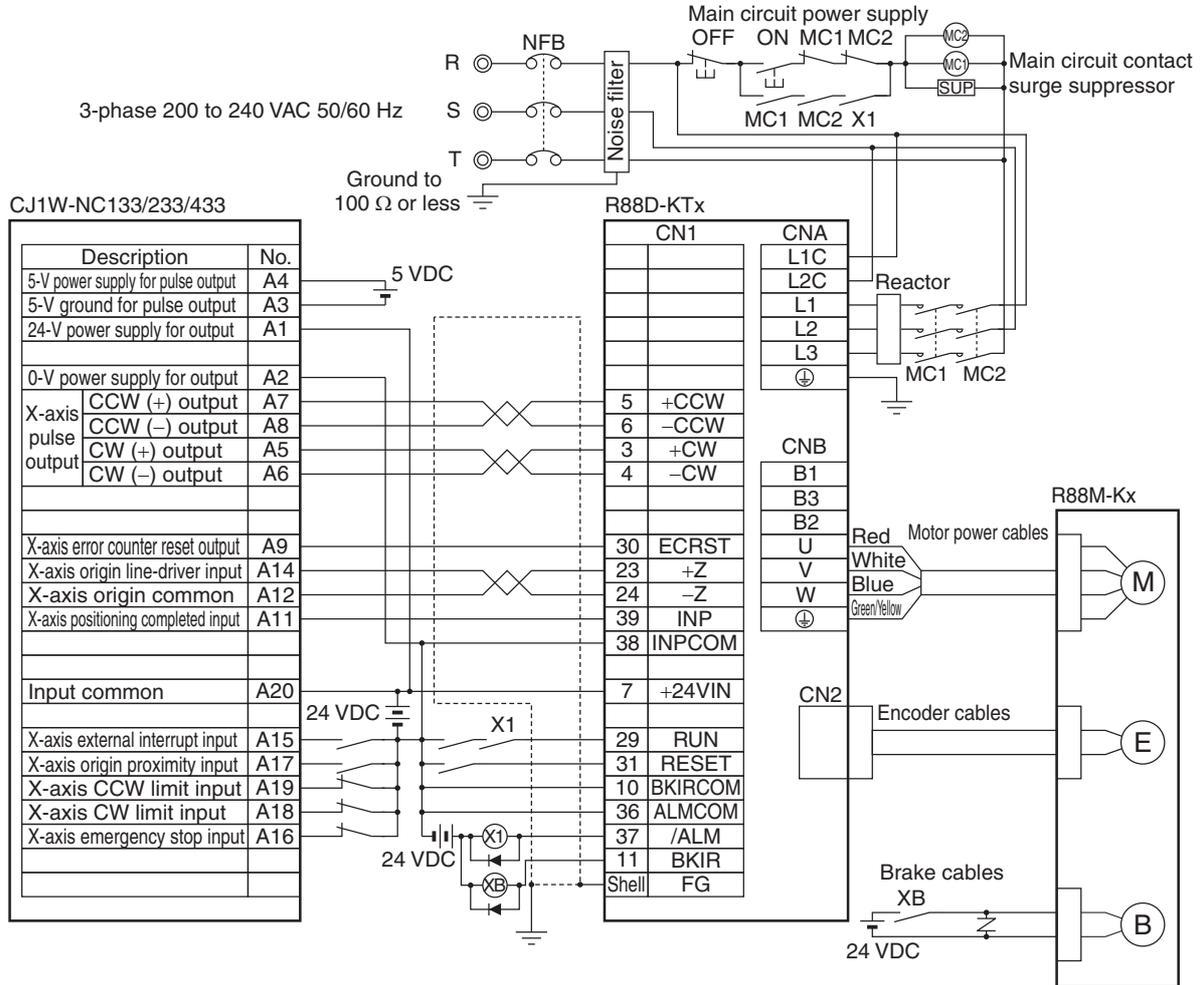


![Precautions for Correct Use icon] Precautions for Correct Use

- The example shows a 3-phase, 200-VAC input to the driver for the main circuit power supply. Be sure to provide a power supply and wiring conforming to the power supply specifications for the driver in use.
- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use mode 2 for origin search.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.
- Make the setting so that the servo can be turned ON/OFF with the RUN signal.

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**Appendix**

## Connection Example 2: Connecting to SYSMAC CJ1W-NC113/213/413
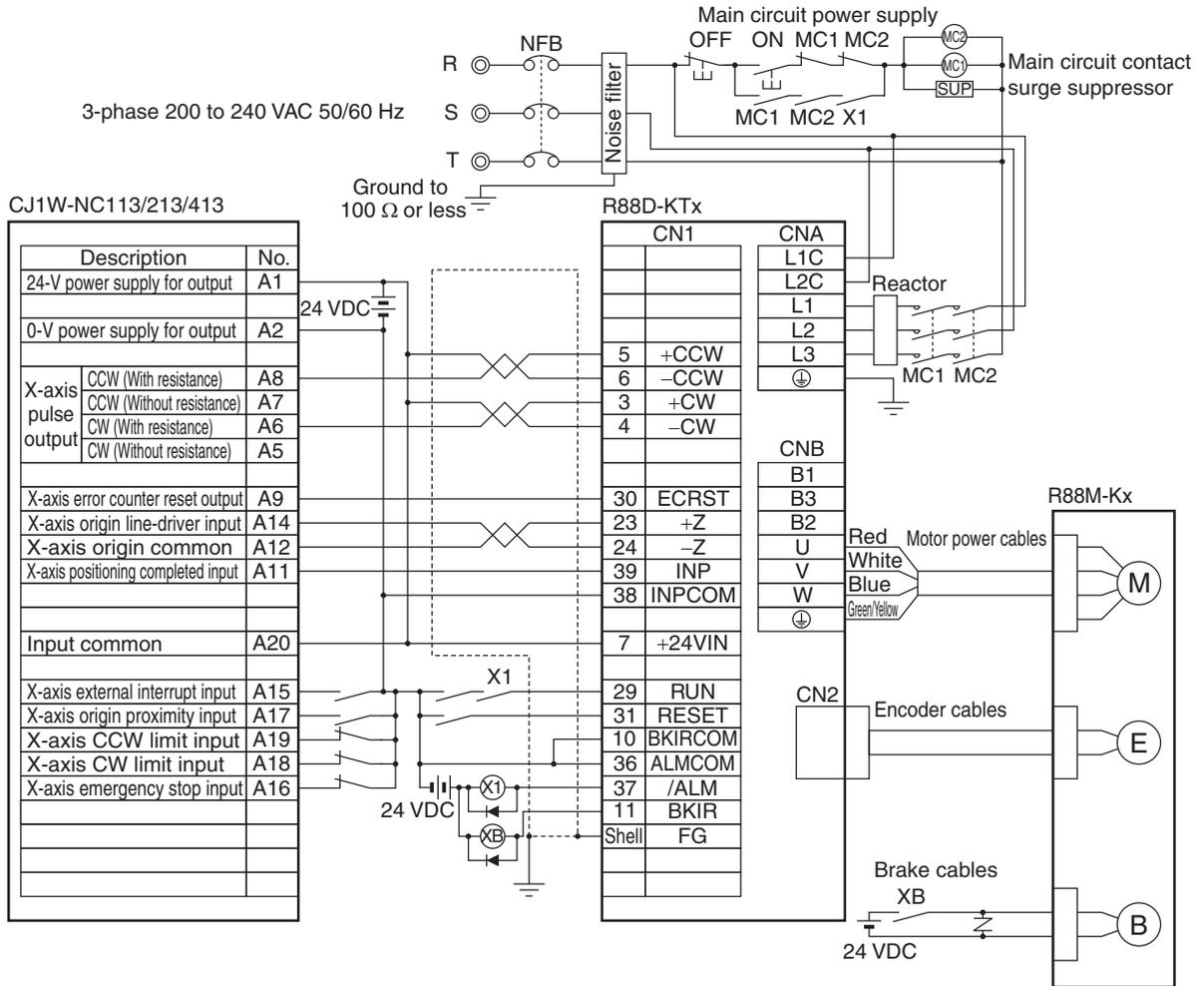


The diagram shows the connection between CJ1W-NC113/213/413, R88D-KTx driver, and R88M-Kx motor.

| Description | No. |
|---|---|
| 24-V power supply for output | A1 |
| 0-V power supply for output | A2 |
| X-axis pulse output — CCW (With resistance) | A8 |
| CCW (Without resistance) | A7 |
| CW (With resistance) | A6 |
| CW (Without resistance) | A5 |
| X-axis error counter reset output | A9 |
| X-axis origin line-driver input | A14 |
| X-axis origin common | A12 |
| X-axis positioning completed input | A11 |
| Input common | A20 |
| X-axis external interrupt input | A15 |
| X-axis origin proximity input | A17 |
| X-axis CCW limit input | A19 |
| X-axis CW limit input | A18 |
| X-axis emergency stop input | A16 |

CN1 signals: 5 +CCW, 6 −CCW, 3 +CW, 4 −CW, 30 ECRST, 23 +Z, 24 −Z, 39 INP, 38 INPCOM, 7 +24VIN, 29 RUN, 31 RESET, 10 BKIRCOM, 36 ALMCOM, 37 /ALM, 11 BKIR, Shell FG

CNA: L1C, L2C, L1, L2, L3, ⏚
CNB: B1, B3, B2, U, V, W, ⏚

3-phase 200 to 240 VAC 50/60 Hz
Ground to 100 Ω or less

![Precautions icon] Precautions for Correct Use

- The example shows a 3-phase, 200-VAC input to the driver for the main circuit power supply. Be sure to provide a power supply and wiring conforming to the power supply specifications for the driver in use.
- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use mode 2 for origin search.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.
- Make the setting so that the servo can be turned ON/OFF with the RUN signal.

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**Appendix**

## Connection Example 3: Connecting to SYSMAC CS1W-NC133/233/433



### Precautions for Correct Use

- The example shows a 3-phase, 200-VAC input to the driver for the main circuit power supply. Be sure to provide a power supply and wiring conforming to the power supply specifications for the driver in use.
- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use mode 2 for origin search.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.
- Make the setting so that the servo can be turned ON/OFF with the RUN signal.

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**Appendix**

### Connection Example 4: Connecting to SYSMAC CS1W-NC113/213/413 or C200HW-NC113/213/413
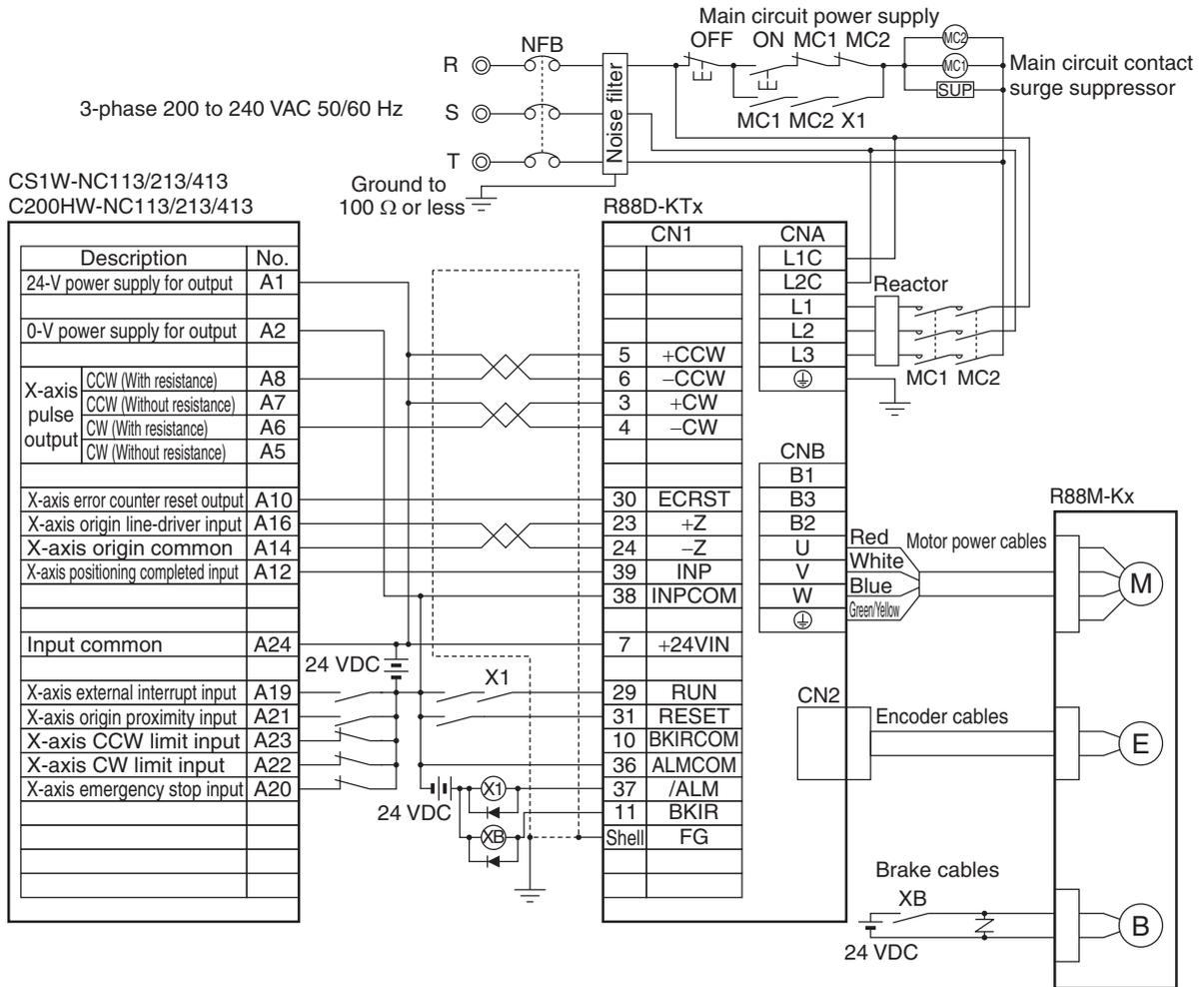


📝 Precautions for Correct Use

- The example shows a 3-phase, 200-VAC input to the driver for the main circuit power supply. Be sure to provide a power supply and wiring conforming to the power supply specifications for the driver in use.
- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use mode 2 for origin search.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.
- Make the setting so that the servo can be turned ON/OFF with the RUN signal.

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**Appendix**

## Connection Example 5: Connecting to a SYSMAC Motion Control Unit
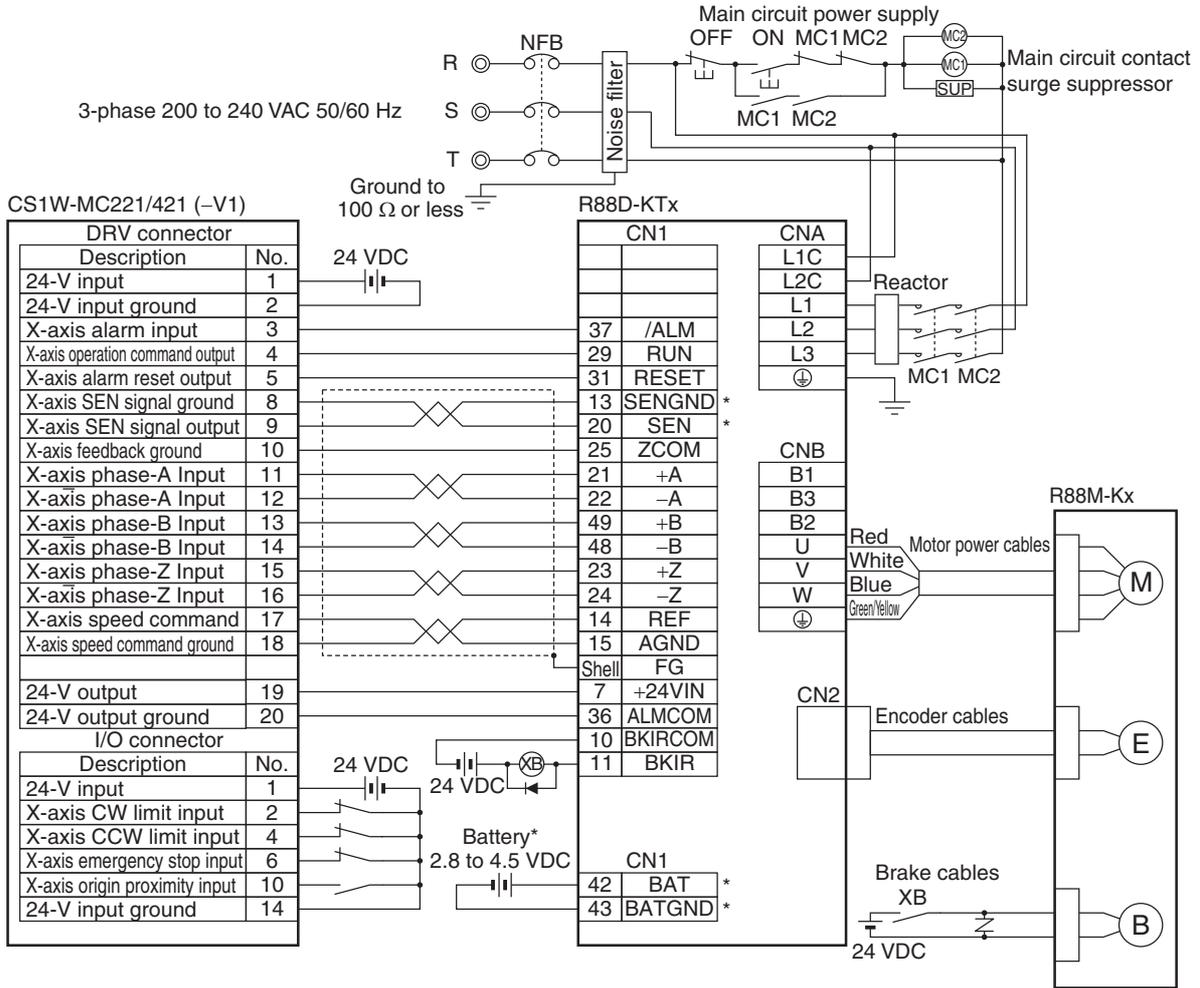


![Precautions for Correct Use]

Precautions for Correct Use

- The example shows a 3-phase, 200-VAC input to the driver for the main circuit power supply. Be sure to provide a power supply and wiring conforming to the power supply specifications for the driver in use.
- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Connect terminals and wiring marked with an asterisk (*) when using an absolute encoder.
- This wiring diagram is an example of X-axis wiring only. For other axes, connections must be made in the same way with the driver.
- Always short unused NC input terminals at the Motion Control Unit I/O connectors.
- Make the setting so that the servo can be turned ON/OFF with the RUN signal.

## Connection Example 6: Connecting to SYSMAC CP1H-YxxDT-D



📝 Precautions for Correct Use

• Incorrect signal wiring can cause damage to units and the driver.
• Leave unused signal lines open and do not wire them.
• Do not share the power supply for brakes (24 VDC) with the 24-VDC power supply for controls.
• The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.

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Appendix

## Connection Example 7: Connecting to SYSMAC CP1H-XxxDT-D/CP1L-xxxDT-D
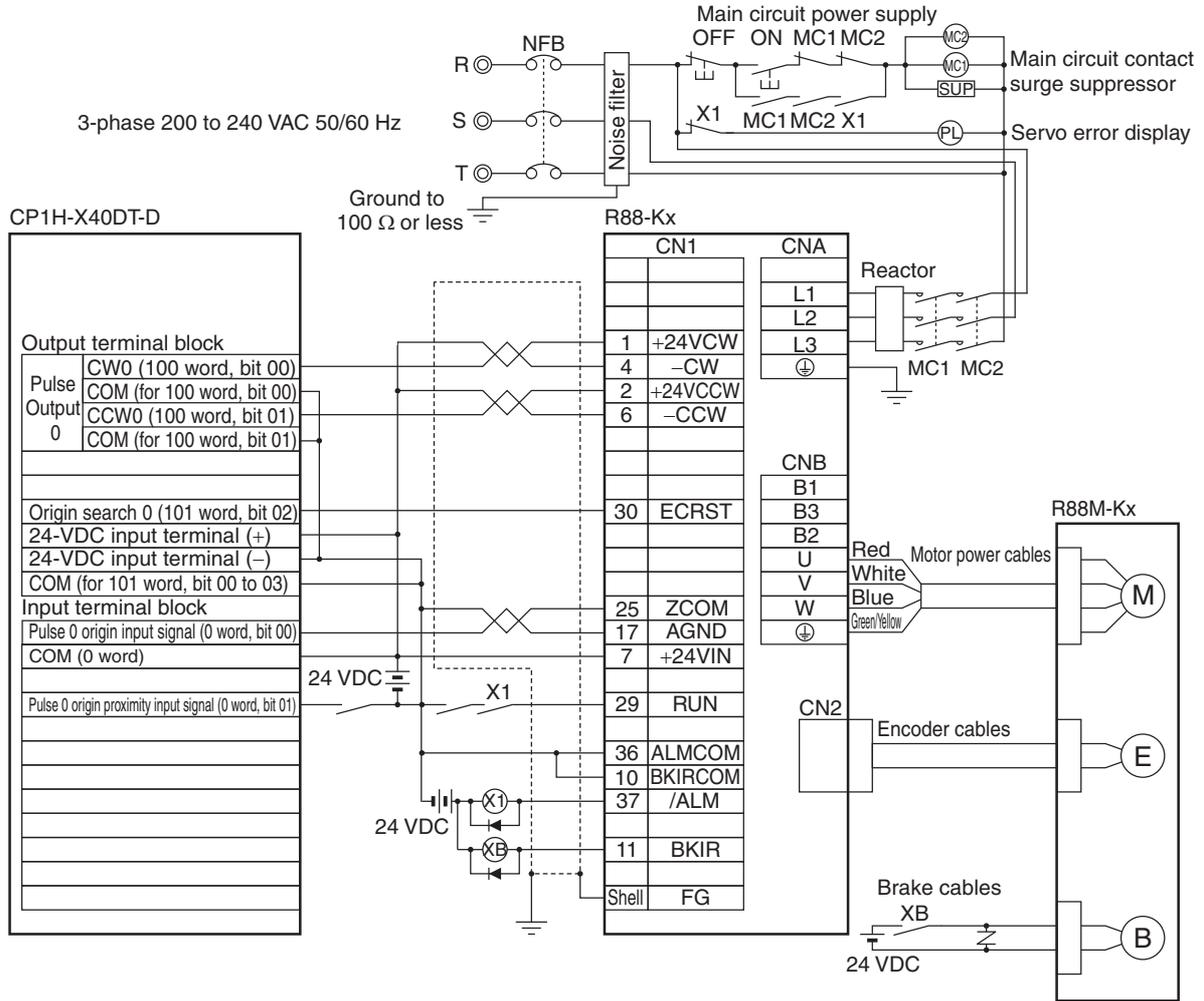


✍ Precautions for Correct Use

- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Do not share the power supply for brakes (24 VDC) with the 24-VDC power supply for controls.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.

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**Appendix**

## Connection Example 8: Connecting to SYSMAC CJ1M
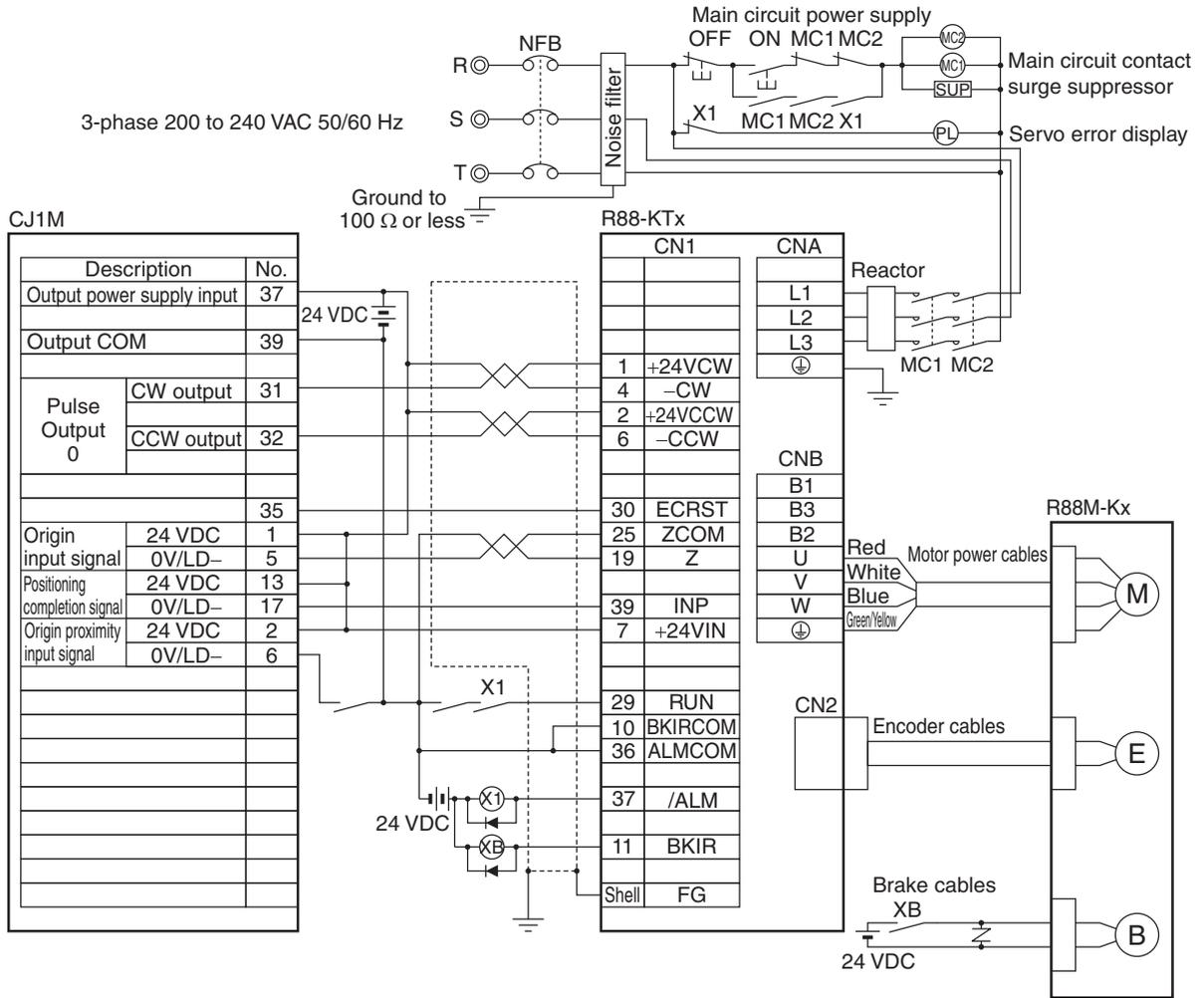


✓ Precautions for Correct Use

- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use mode 2 for origin search.
- Use the power supply for command pulse (24 VDC) as a dedicated power supply.
- Do not share the power supply for brakes (24 VDC) with the 24-VDC power supply for controls.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.

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**Appendix**

## Connection Example 9:
## Connecting to a SYSMAC CS1W-HCP22-V1 Customizable Counter Unit
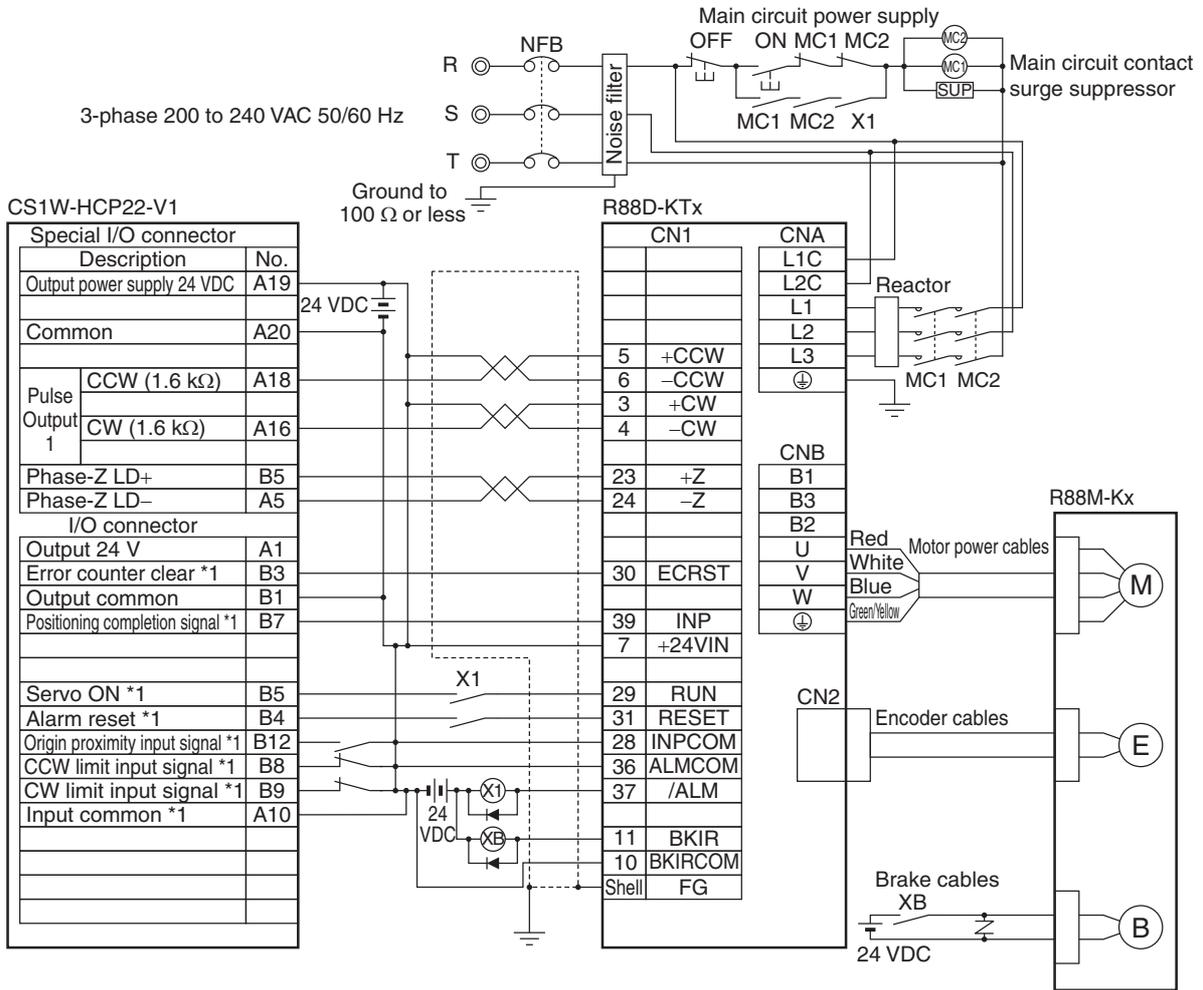


*1. The I/O signals for the HCP22 depend on the memory allocations in the Internal Memory area. Change the wiring according to the allocations.

**Precautions for Correct Use**

- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use the power supply for command pulse (24 VDC) as a dedicated power supply.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.
- Do not share the power supply for brakes (24 VDC) with the 24-VDC power supply for controls.

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**Appendix**

### Connection Example 10:
### Connecting to a SYSMAC CS1W-HCA12/22-V1 Customizable Counter Unit
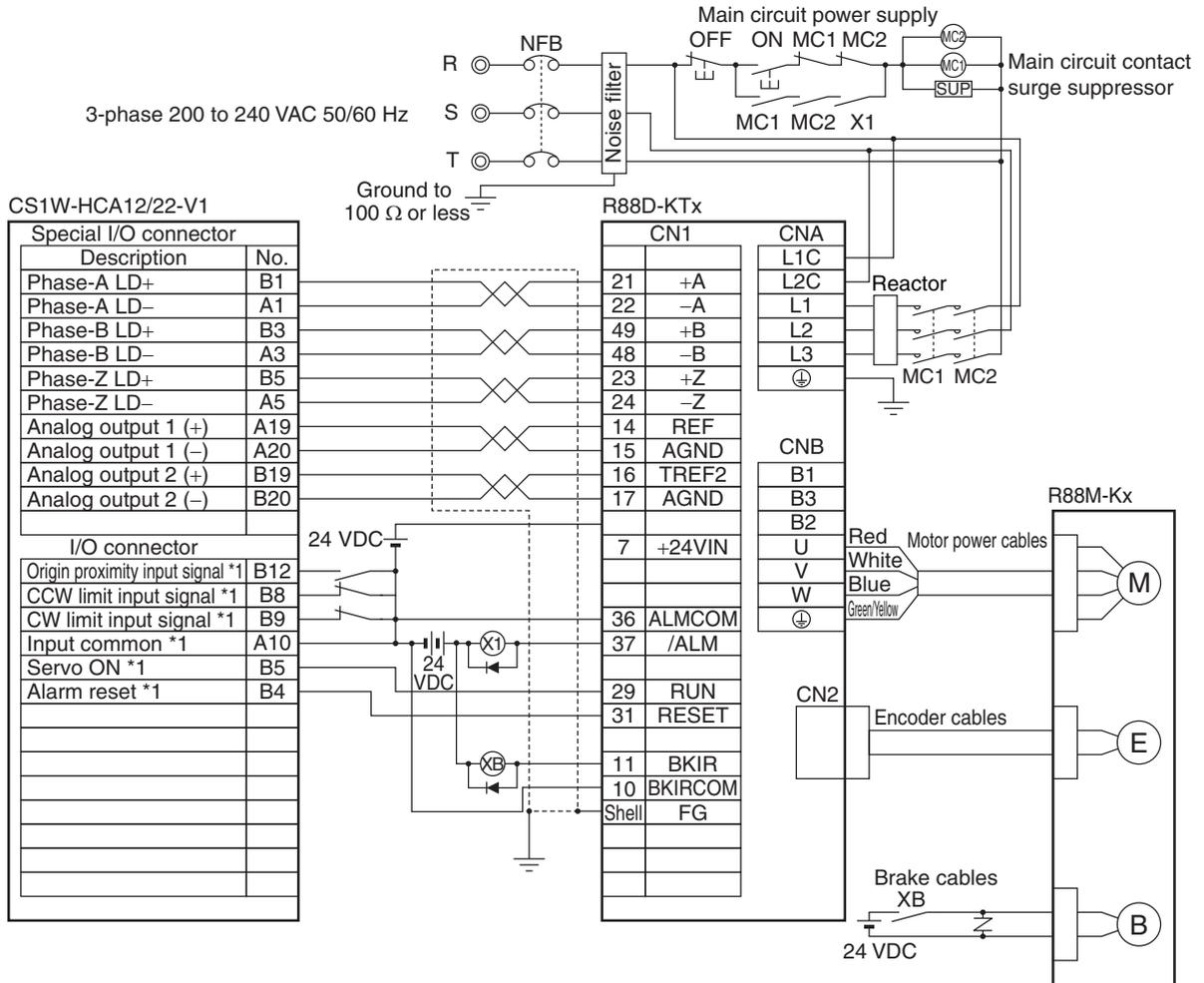


*1. The I/O signals for the HCA12/22 depend on the allocations in the Internal Memory area. Change the wiring according to the allocations.

📝 Precautions for Correct Use

- Incorrect signal wiring can cause damage to units and the driver.
- Leave unused signal lines open and do not wire them.
- Use the power supply for command pulse (24 VDC) as a dedicated power supply.
- The diode recommended for surge absorption is the RU 2 (Sanken Electric Co., Ltd.) or the equivalent.
- Do not share the power supply for brakes (24 VDC) with the 24-VDC power supply for controls.

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**Appendix**

# 12-2 Parameter List

⬥ Some parameters are enabled by turning the power supply OFF and then ON again. (Those parameters are indicated in the table.) 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". Do not change the settings marked "Reserved".

## Basic Setting Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 000 | Rotation Direction Switching | | Set the relation between the command direction and the motor rotation direction. | 1 | – | 0 to 1 | Yes |
| | | 0 | The +command indicates the forward direction as viewed from the shaft end (CW). | | | | |
| | | 1 | The +command indicates the reverse direction as viewed from the shaft end (CCW). | | | | |
| 001 | CONTROL mode Selection | | Select the driver CONTROL mode. | 0 | – | 0 to 6 | Yes |
| | | 0 | Position control (pulse train command) | | | | |
| | | 1 | Speed control (analog command) | | | | |
| | | 2 | Torque control (analog command) | | | | |
| | | 3 | No. 1: Position control<br>No. 2: Speed control | | | | |
| | | 4 | No. 1: Position control<br>No. 2: Torque control | | | | |
| | | 5 | No. 1: Speed control<br>No. 2: Torque control | | | | |
| | | 6 | Full closing control | | | | |
| 002 | REALTIME AUTOTUNING mode selection | | Set the OPERATION mode for realtime autotuning. | 1 | – | 0 to 6 | – |
| | | 0 | Disabled | | | | |
| | | 1 | Emphasizes stability | | | | |
| | | 2 | Emphasizes positioning | | | | |
| | | 3 | If there is an unbalanced load like in a vertical axis. | | | | |
| | | 4 | When friction is large (unbalanced load is estimated also). | | | | |
| | | 5 | Monitor mode in combination with the tool | | | | |
| | | 6 | Tuning where you can select the applied algorithms with Pn632. | | | | |
| 003 | Realtime Autotuning Machine Rigidity Setting | | Set the machine rigidity for executing realtime autotuning. | See Note 1 | – | 0 to 31 | – |
| 004 | Inertia Ratio | | Set the load inertia as a percentage of the motor rotor inertia. | 250 | % | 0 to 10,000 | – |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 005 | Command Pulse Input Selection | | Select the command pulse input. | 0 | – | 0 to 1 | Yes |
| | | 0 | Photocoupler input | | | | |
| | | 1 | Input for line driver only | | | | |
| 006 | Command Pulse Rotation Direction Switching Selection | | Set the command pulse count direction. | 0 | – | 0 to 1 | Yes |
| | | 0 | Forward direction | | | | |
| | | 1 | Reverse direction | | | | |
| 007 | COMMAND PULSE mode Selection | | Set the COMMAND PULSE mode. | 1 | – | 0 to 3 | Yes |
| | | 0 | 90° phase difference (A/B) signal inputs for rotation in forward direction | | | | |
| | | 1 | Forward pulse/reverse pulse for rotation in forward direction | | | | |
| | | 2 | 90° phase difference (A/B) signal inputs for reverse rotation | | | | |
| | | 3 | Feed pulse/direction signal for rotation in reverse direction | | | | |
| 008 | Electronic Gear Integer Setting | | Set the number of command pulses per motor rotation. | 10000 | Pulse | 0 to $2^{20}$ | Yes |
| 009 | Electronic Gear Ratio Numerator 1 | | Set the electronic gear ratio. If Pn009 = 0, the encoder resolution is set as the numerator. | 0 | – | 0 to $2^{30}$ | – |
| 010 | Electronic Gear Ratio Denominator | | $$\frac{\text{Electronic gear ratio numerator 1 (Pn009)}}{\text{Electronic gear ratio denominator (Pn010)}}$$ | 10000 | – | 1 to $2^{30}$ | – |
| 011 | Encoder Dividing Numerator | | Set the number of phase A and phase B output pulses, respectively per motor rotation. | 2500 | P/r | 0 to 262,144 | Yes |
| 012 | Encoder Output Direction Switching Selection | | Select the phase B logic for pulse regeneration output and the output source. | 0 | – | 0 to 3 | Yes |
| | | 0 | Phase B logic: Not reversed Output source: Encoder | | | | |
| | | 1 | Phase B logic: Reversed Output source: Encoder | | | | |
| | | 2 | Phase B logic: Not reversed Output source: External scale | | | | |
| | | 3 | Phase B logic: Reversed Output source: External scale | | | | |
| 013 | No. 1 Torque Limit | | Set the No. 1 limit value for the output torque of the motor. | 500 | % | 0 to 500 | – |
| 014 | Error Counter Overflow Level | | Set the range of the error counter overflow level. Detection of error counter overflow level error will be disabled if the set value is 0. | 100000 | Command unit | 0 to $2^{27}$ | – |
| 015 | Operation Switch when Using Absolute Encoder | | Select the absolute encoder usage method. | 1 | – | 0 to 2 | Yes |
| | | 0 | Used as absolute encoder. | | | | |
| | | 1 | Used as an incremental encoder. | | | | |
| | | 2 | Used as absolute encoder. (Multi-rotation counter overflows are ignored.) | | | | |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 016 | Regeneration Resistor Selection | | Select the Regeneration Resistor used. | See Note 2 | – | 0 to 3 | Yes |
| | | 0 | Use the Built-in Resistor. Triggering of regeneration overload protection (alarm display 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 display No. 18) is triggered when the operating rate of the Regeneration Resistor exceeds 10%. | | | | |
| | | 2 | Use an External Resistor. Regeneration overload protection (alarm display No. 18) does not operate. | | | | |
| | | 3 | No Regeneration Resistor All regeneration power is processed with built-in capacitors. | | | | |
| 017 | External Regeneration Resistor Setting | | Select the type of load ratio calculation for the External Regeneration Resistor. | 0 | – | 0 to 4 | Yes |
| | | 0 | Regeneration load ratio is 100% when operating rate of the External Regeneration Resistor is 10%. | | | | |
| | | 1 | Reserved | | | | |
| | | 2 | Reserved | | | | |
| | | 3 | Reserved | | | | |
| | | 4 | Reserved | | | | |

♦Note 1: Pn003 default settings:

    (1)  Pn003 = 11 - For 200V drives of 1Kw or upper and 400V drives

    (2)  Pn003 = 13 - For 200V drives of less than 1 Kw

♦Note 2: Pn016 default settings:

    (1)  Pn016 = 0 - For 200V drives of 750 W or upper and 400V drives

    (2)  Pn016 = 3 - For 200V drives of less than 750 W

## Gain Adjustment Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 100 | Position Loop Gain | | Set the position loop gain 1. | See Note 1 | 0.1/s | 0 to 30,000 | – |
| 101 | Speed Loop Gain | | Set the speed loop gain 1. | See Note 2 | 0.1 Hz | 1 to 32,767 | – |
| 102 | Speed Loop Integral Time Constant | | Set the speed loop integration time constant 1. | See Note 3 | 0.1 ms | 1 to 10,000 | – |
| 103 | Speed Feedback Filter Time Constant | | The speed feedback filter 1 can be set to one of 6 values. | 0 | – | 0 to 5 | – |

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 104 | Torque Command Filter Time Constant | | Set the time constant for the torque filter 1. | See Note 4 | 0.01 ms | 0 to 2,500 | – |
| 105 | Position Loop Gain 2 | | Set the position loop gain 2. | See Note 5 | 0.1/s | 0 to 30,000 | – |
| 106 | Speed Loop Gain 2 | | Set the speed loop gain 2. | See Note 6 | 0.1 Hz | 1 to 32,767 | – |
| 107 | Speed Loop Integration Time Constant 2 | | Set the speed loop integration time constant 2. | 10000 | 0.1 ms | 1 to 10,000 | – |
| 108 | Speed Feedback Filter Time Constant 2 | | The speed feedback filter 2 can be set to one of 6 values. | 0 | – | 0 to 5 | – |
| 109 | Torque Command Filter Time Constant 2 | | Set the time constant for the torque filter 2. | See Note 7 | 0.01 ms | 0 to 2,500 | – |
| 110 | Speed Feed-forward Amount | | Set the speed feed-forward amount. | 300 | 0.1% | 0 to 1,000 | – |
| 111 | Speed Feed-forward Command Filter | | Set the speed feed-forward filter time constant. | 50 | 0.01 ms | 0 to 6,400 | – |
| 112 | Torque Feed-forward Amount | | Set the torque feed-forward amount. | 0 | 0.1% | 0 to 1,000 | – |
| 113 | Torque Feed-forward Command Filter | | Set the torque feed-forward filter. | 0 | 0.01 ms | 0 to 6,400 | – |
| 114 | GAIN SWITCHING INPUT OPERATING mode Selection | | Execute optimum tuning using the gain switching function. | 1 | – | 0 to 1 | – |
| | | 0 | Gain 1 (PI/P switching enabled) | | | | |
| | | 1 | Gain 1 and gain 2 switching available | | | | |
| 115 | SWITCHING mode in Position Control | | Select the gain switching condition for position control.<br>It is necessary that Pn114 be set to 1. | 0 | – | 0 to 10 | – |
| | | 0 | Always gain 1 | | | | |
| | | 1 | Always gain 2 | | | | |
| | | 2 | Switching using gain switching input (GSEL) | | | | |
| | | 3 | Torque command change amount | | | | |
| | | 4 | Always gain 1 | | | | |
| | | 5 | Command speed | | | | |
| | | 6 | Amount of position error | | | | |
| | | 7 | Command pulses received | | | | |
| | | 8 | Positioning completion signal (INP) OFF | | | | |
| | | 9 | Actual motor speed | | | | |
| | | 10 | Combination of command pulse input and speed | | | | |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 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 10,000 | – |
| 117 | Gain Switching Level in Position Control | | Set the gain switching level. | 50 | – | 0 to 20,000 | – |
| 118 | Gain Switching Hysteresis in Position Control | | Set the hysteresis for gain switching. | 33 | – | 0 to 20,000 | – |
| 119 | Position Gain Switching Time | | Set the position gain switching time for gain switching. | 33 | 0.1 ms | 0 to 10,000 | – |
| 120 | SWITCHING mode in Speed Control | | Select the gain switching condition for speed control. It is necessary that Pn114 be set to 1. | 0 | – | 0 to 5 | – |
| | | 0 | Always gain 1 | | | | |
| | | 1 | Always gain 2 | | | | |
| | | 2 | Switching using gain switching input (GSEL) | | | | |
| | | 3 | Torque command change amount | | | | |
| | | 4 | Speed command change amount | | | | |
| | | 5 | Command speed | | | | |
| 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 10,000 | – |
| 122 | Gain Switching Level in Speed Control | | Set the gain switching level. | 0 | – | 0 to 20,000 | – |
| 123 | Gain Switching Hysteresis in Speed Control | | Set the hysteresis for gain switching. | 0 | – | 0 to 20,000 | – |
| 124 | SWITCHING mode in Torque Control | | Select the gain switching condition for torque control. It is necessary that Pn114 be set to 1. | 0 | – | 0 to 3 | – |
| | | 0 | Always gain 1 | | | | |
| | | 1 | Always gain 2 | | | | |
| | | 2 | Switching using gain switching input (GSEL) | | | | |
| | | 3 | Torque command change amount | | | | |
| 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 10,000 | – |
| 126 | Gain Switching Level in Torque Control | | Set the gain switching level. | 0 | – | 0 to 20,000 | – |
| 127 | Gain Switching Hysteresis in Torque Control | | Set the hysteresis for gain switching. | 0 | – | 0 to 20,000 | – |

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**Appendix**

♦Note 1: Pn100 default settings:

   (1)   Pn100 = 320 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn100 = 480 - For 200V drives of less than 1 Kw

♦Note 2: Pn101 default settings:

   (1)   Pn101 = 180 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn101 = 270 - For 200V drives of less than 1 Kw

♦Note 3: Pn102 default settings:

   (1)   Pn102 = 310 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn102 = 210 - For 200V drives of less than 1 Kw

♦Note 4: Pn104 default settings:

   (1)   Pn104 = 126 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn104 = 84   - For 200V drives of less than 1 Kw

♦Note 5: Pn105 default settings:

   (1)   Pn105 = 380 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn105 = 570 - For 200V drives of less than 1 Kw

♦Note 6: Pn106 default settings:

   (1)   Pn106 = 180 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn106 = 270 - For 200V drives of less than 1 Kw

♦Note 7: Pn109 default settings:

   (1)   Pn109 = 126 - For 200V drives of 1Kw or upper and 400V drives
   (2)   Pn109 = 84   - For 200V drives of less than 1 Kw

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**Appendix**

## Vibration Suppression Function Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 200 | Adaptive Filter Selection | | Set the operation of the adaptive filter. | 0 | – | 0 to 4 | – |
| | | 0 | Disabled | | | | |
| | | 1 | 1 enabled. Frequency limited after adaptation. | | | | |
| | | 2 | 2 enabled. Frequency limited after adaptation. | | | | |
| | | 3 | 1 enabled. Adaptation performed at all times. | | | | |
| | | 4 | 2 enabled. Adaptation performed with 1 filter at all times. | | | | |
| 201 | Notch 1 Frequency Setting | | Set the notch frequency of resonance suppression notch filter 1. | 5000 | Hz | 50 to 5,000 | – |
| 202 | Notch 1 Width Setting | | Set the notch width of the resonance suppression notch filter 1. | 2 | – | 0 to 20 | – |
| 203 | Notch 1 Depth Setting | | Set the notch depth of resonance suppression notch filter 1. | 0 | – | 0 to 99 | – |
| 204 | Notch 2 Frequency Setting | | Set the notch frequency of resonance suppression notch filter 2. | 5000 | Hz | 50 to 5,000 | – |
| 205 | Notch 2 Width Setting | | Set the notch width of the resonance suppression notch filter 2. | 2 | – | 0 to 20 | – |
| 206 | Notch 2 Depth Setting | | Set the notch depth of resonance suppression notch filter 2. | 0 | – | 0 to 99 | – |
| 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 5,000 | – |
| 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 | – |
| 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 | – |
| 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 5,000 | – |
| 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 | – |
| 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 | – |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 213 | Vibration Filter Selection | | Select the vibration filter switching method. | 0 | – | 0 to 3 | – |
| | | 0 | Enabled | | | | |
| | | 1 | When VS-SEL1 input open: Vibration filter 1 and 3 enabled When VS-SEL1 input shorted: Vibration filter 2 and 4 enabled | | | | |
| | | 2 | When VS-SEL1 open and VS-SEL2 open: Vibration filter 1 enabled When VS-SEL1 shorted and VS-SEL2 open: Vibration filter 2 enabled When VS-SEL1 open and VS-SEL2 shorted: Vibration filter 3 enabled When VS-SEL1 shorted and VS-SEL2 shorted: Vibration filter 4 enabled | | | | |
| | | 3 | Forward direction: Vibration filter 1 and 3 enabled Reverse direction: Vibration filter 2 and 4 enabled | | | | |
| 214 | Vibration Frequency 1 | | Set the vibration frequency 1. The function is enabled if the set value is 10 (= 1 Hz) or greater. | 0 | 0.1 Hz | 0 to 2,000 | – |
| 215 | Vibration 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 1,000 | – |
| 216 | Vibration Frequency 2 | | Set the vibration frequency 2. The function is enabled if the set value is 10 (= 1 Hz) or greater. | 0 | 0.1 Hz | 0 to 2,000 | – |
| 217 | Vibration 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 1,000 | – |
| 218 | Vibration Frequency 3 | | Set the vibration frequency 3. The function is enabled if the set value is 10 (= 1 Hz) or greater. | 0 | 0.1 Hz | 0 to 2,000 | – |
| 219 | Vibration 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 1,000 | – |
| 220 | Vibration Frequency 4 | | Set the vibration frequency 4. The function is enabled if the set value is 10 (= 1 Hz) or greater. | 0 | 0.1 Hz | 0 to 2,000 | – |
| 221 | Vibration 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 1,000 | – |
| 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 10,000 | – |
| 223 | Smoothing Filter Time Constant | | Set the time constant of the FIR filter for the position command. | 0 | 0.1 ms | 0 to 10,000 | – |

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**Appendix**

## Speed, Torque Control, and Full Closing Control Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 300 | Command Speed Selection | | Select the speed command when using speed control. | 0 | – | 0 to 3 | – |
| | | 0 | Analog speed command | | | | |
| | | 1 | No. 1 Internally Set Speed to No. 4 Internally Set Speed (Pn304 to Pn307) | | | | |
| | | 2 | No. 1 Internally Set Speed to No. 4 Internally Set Speed (Pn304 to Pn306), analog speed command | | | | |
| | | 3 | No. 1 Internally Set Speed to No. 8 Internally Set Speed (Pn304 to Pn311) | | | | |
| 301 | Speed Command Direction Selection | | Select the method for designating the direction for the speed command | 0 | – | 0 to 1 | – |
| | | 0 | By analogue command polarity | | | | |
| | | 1 | By digital input VSIGN | | | | |
| 302 | Speed Command Scale | | Set the input gain for the analog speed command input. | 500 | (r/min)/ V | 0 to 2,000 | – |
| 303 | Analog Speed Command Rotation Direction Switching | | Set the polarity for analog speed commands. | 1 | – | 0 to 1 | – |
| | | 0 | +Voltage: Forward direction -Voltage: Reverse direction | | | | |
| | | 1 | +Voltage: Reverse direction -Voltage: Forward direction | | | | |
| 304 | No. 1 Internally Set Speed | | Set the No. 1 internal speed command value. | 0 | r/min | | – |
| 305 | No. 2 Internally Set Speed | | Set the No. 2 internal speed command value. | 0 | r/min | | – |
| 306 | No. 3 Internally Set Speed | | Set the No. 3 internal speed command value. | 0 | r/min | | – |
| 307 | No. 4 Internally Set Speed | | Set the No. 4 internal speed command value. | 0 | r/min | -20,000 to 20,000 | – |
| 308 | No. 5 Internally Set Speed | | Set the No. 5 internal speed command value. | 0 | r/min | | – |
| 309 | No. 6 Internally Set Speed | | Set the No. 6 internal speed command value. | 0 | r/min | | – |
| 310 | No. 7 Internally Set Speed | | Set the No. 7 internal speed command value. | 0 | r/min | | – |
| 311 | No. 8 Internally Set Speed | | Set the No. 8 internal speed command value. | 0 | r/min | | – |
| 312 | Soft Start Acceleration Time | | Set the acceleration processing acceleration time for speed commands. | 0 | ms/ (1,000 r/min) | 0 to 10,000 | – |
| 313 | Soft Start Deceleration Time | | Set the deceleration processing acceleration time for speed commands. | 0 | ms/ (1,000 r/min) | 0 to 10,000 | – |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 314 | S-curve Acceleration/ Deceleration Time Setting | | Set the acceleration/deceleration processing S-curve time for speed commands. | 0 | ms | 0 to 1,000 | – |
| 315 | Zero Speed Designation Selection | | Select the function of the zero speed designation input (ZEROSPD). | 0 | – | 0 to 3 | – |
| | | 0 | Disabled | | | | |
| | | 1 | The speed command is 0. | | | | |
| | | 2 | If the speed command is 0 and the actual speed is less than the zero speed designation, the servo is locked. | | | | |
| | | 3 | If the speed command is less than the zero speed designation level, the speed command becomes 0 and the servo is locked. | | | | |
| 316 | Position Lock Level Setting | | Set the threshold for position lock moving. | 30 | r/min | 10 to 20,000 | – |
| 317 | Torque Command/ Speed Limit Selection | | Select the torque command and speed limit value. | 0 | – | 0 to 2 | – |
| | | 0 | Torque command: Analog input 1 Speed limit: Pn321 set value | | | | |
| | | 1 | Torque command: Analog input 2 Speed limit: Analog input 1 | | | | |
| | | 2 | Torque command: Analog input 1 Speed limit: Pn321 and Pn322 set values | | | | |
| 318 | Torque Command Direction Selection | | Select the method for selecting the direction for the torque command. | 0 | – | 0 to 1 | – |
| | | 0 | The direction depens on the polarity of the analogue torque command | | | | |
| | | 1 | The direction depens on a digital input (TSIGN) | | | | |
| 319 | Torque Command Scale | | Set the input gain for analog torque command input. | 30 | 0.1 V/ 100% | 10 to 100 | – |
| 320 | Analog Torque Command Rotation Direction Switching | | Set the analog torque command input polarity. | 0 | – | 0 to 1 | – |
| | | 0 | Forward operation | | | | |
| | | 1 | Reverse operation | | | | |
| 321 | Speed Limit Value Setting | | Set the speed limit value. | 0 | r/min | 0 to 20,000 | – |
| 322 | Reverse Direction Speed Limit Value Setting | | Switch the speed limit value according to the direction. | 0 | r/min | 0 to 20,000 | – |
| 323 | External Feedback Pulse Type Selection | | Select the external feedback pulse type. | 0 | – | 0 to 2 | Yes |
| | | 0 | Phase AB output | | | | |
| | | 1 | Serial communications (Incremental encoder specifications) | | | | |
| | | 2 | Serial communications (Absolute encoder specifications) | | | | |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 324 | External Feedback Pulse Dividing Numerator Selection | | Set the external feedback pulse dividing numerator. | 0 | – | 0 to $2^{20}$ | Yes |
| 325 | External Feedback Pulse Dividing Denominator | | Set the external feedback pulse dividing denominator. | 10000 | – | 1 to $2^{20}$ | Yes |
| 326 | External Feedback Pulse Direction Switching | | Reverse the external feedback pulse count direction by changing the setting. | 0 | – | 0 to 1 | Yes |
| | | 0 | Count direction not reversed | | | | |
| | | 1 | Count direction reversed | | | | |
| 327 | External Feedback Pulse Phase-Z Setting | | Set disconnection detection in the Phase-Z unconnected state when a phase AB output type external feedback pulse is used. | 0 | – | 0 to 1 | Yes |
| | | 0 | Enabled | | | | |
| | | 1 | Disabled | | | | |
| 328 | Internal/External Feedback Pulse Error Counter Overflow Level | | Set the threshold for feedback pulse deviation errors. | 16000 | Command unit | 1 to $2^{27}$ | Yes |
| 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 | Yes |

## Interface Monitor Setting Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 400 | Input Signal Selection 1 | | Set the input signal 1 function and logic. | 8553090 | – | 0 to 00FFFFFFh | Yes |
| 401 | Input Signal Selection 2 | | Set the input signal 2 function and logic. | 8487297 | – | 0 to 00FFFFFFh | Yes |
| 402 | Input Signal Selection 3 | | Set the input signal 3 function and logic. | 9539850 | – | 0 to 00FFFFFFh | Yes |
| 403 | Input Signal Selection 4 | | Set the input signal 4 function and logic. | 394758 | – | 0 to 00FFFFFFh | Yes |
| 404 | Input Signal Selection 5 | | Set the input signal 5 function and logic. | 4108 | – | 0 to 00FFFFFFh | Yes |
| 405 | Input Signal Selection 6 | | Set the input signal 6 function and logic. | 197379 | – | 0 to 00FFFFFFh | Yes |
| 406 | Input Signal Selection 7 | | Set the input signal 7 function and logic. | 3847 | – | 0 to 00FFFFFFh | Yes |
| 407 | Input Signal Selection 8 | | Set the input signal 8 function and logic. | 263172 | – | 0 to 00FFFFFFh | Yes |
| 408 | Input Signal Selection 9 | | Set the input signal 9 function and logic. | 328965 | – | 0 to 00FFFFFFh | Yes |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 409 | Input Signal Selection 10 | | Set the input signal 10 function and logic. | 3720 | – | 0 to 00FFFFFFh | Yes |
| 410 | Output Signal Selection 1 | | Set the output signal 1 function allocation. | 197379 | – | 0 to 00FFFFFFh | Yes |
| 411 | Output Signal Selection 2 | | Set the output signal 2 function allocation. | 131586 | – | 0 to 00FFFFFFh | Yes |
| 412 | Not used | | Do not change the set value. | - | – | – | – |
| 413 | Output Signal Selection 4 | | Set the output signal 4 function allocation. | 65793 | – | 0 to 00FFFFFFh | Yes |
| 416 | Analog Monitor 1 Selection | | Select the type for analog monitor 1. | 0 | – | 0 to 21 | – |
| | | 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 | Overload load ratio | | | | |
| | | 12 | Forward direction torque limit | | | | |
| | | 13 | Reverse direction torque limit | | | | |
| | | 14 | Speed limit value | | | | |
| | | 15 | Inertia Ratio | | | | |
| | | 16 | Analog input 1 | | | | |
| | | 17 | Analog input 2 | | | | |
| | | 18 | Analog input 3 | | | | |
| | | 19 | Reserved | | | | |
| | | 20 | Driver temperature | | | | |
| | | 21 | Encoder 1-rotation data | | | | |
| 417 | Analog Monitor 1 Scale Setting | | Set the output gain for analog monitor 1. | 0 | – | 0 to 214,748,364 | – |
| 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 | – |
| 419 | Analog Monitor 2 Scale Setting | | Select the output gain for analog monitor 2. | 0 | – | 0 to 214,748,364 | – |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 421 | Analog Monitor Output Setting | | Select the analog monitor output voltage method. | 0 | – | 0 to 2 | – |
| | | 0 | Output range: -10 to 10 V<br>Data output: Positive, negative | | | | |
| | | 1 | Output range: 0 to 10 V<br>Data output: Positive, negative | | | | |
| | | 2 | Output range: 0 to 10 V<br>Data output: Positive, negative | | | | |
| 422 | Analog Input 1 Offset | | Set the analog input 1 offset. | 0 | 0.359 mV | -5,578 to 5,578 | – |
| 423 | Analog Input 1 Filter Time Constant | | Set the analog input 1 filter. | 0 | 0.01 ms | 0 to 6,400 | – |
| 424 | Excessive Analog Input 1 | | Set the voltage after offset for the excess level of analog input 1 input voltage. | 0 | 0.1 V | 0 to 100 | – |
| 425 | Analog Input 2 Offset | | Set the analog input 2 offset. | 0 | 5.86 mV | -342 to 342 | – |
| 426 | Analog Input 2 Filter Time Constant | | Set the analog input 2 filter. | 0 | 0.01 ms | 0 to 6,400 | – |
| 427 | Excessive Analog Input 2 | | Set the voltage after offset for the excess level of analog input 2 input voltage. | 0 | 0.1 V | 0 to 100 | – |
| 428 | Analog Input 3 Offset | | Set the analog input 3 offset. | 0 | 5.86 mV | -342 to 342 | – |
| 429 | Analog Input 3 Filter Time Constant | | Set the analog input 3 filter. | 0 | 0.01 ms | 0 to 6,400 | – |
| 430 | Excessive Analog Input 3 | | Set the voltage after offset for the excess level of analog input 3 input voltage. | 0 | 0.1 V | 0 to 100 | – |
| 431 | Positioning Completion Range 1 | | Set the allowed number of pulses for the positioning completion range. | 10 | Command unit | 0 to 262,144 | – |
| 432 | Positioning Completion Condition Selection | | Set the judgment conditions for positioning completion output. | 0 | – | 0 to 3 | – |
| | | 0 | Positioning completion output turns ON when the position error is within the Positioning Completion Range 1 (Pn431). | | | | |
| | | 1 | Positioning completion output turns ON when the position error is within the Positioning Completion Range 1 (Pn431) and there is no position command. | | | | |
| | | 2 | Positioning completion output turns ON when the zero speed detection signal 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 will then be held until the next position command is received. | | | | |
| 433 | Positioning Completion Hold Time | | Set the positioning completion hold time. | 0 | 1 ms | 0 to 30,000 | – |
| 434 | Zero Speed Detection | | Set the detection threshold for zero speed (ZSP). | 50 | r/min | 10 to 20,000 | – |
| 435 | Speed Conformity Detection Range | | Set the detection threshold for speed conformity output (V-COIN) with the difference between the speed command and the actual speed. | 50 | r/min | 10 to 20,000 | – |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 436 | Rotation Speed for Motor Rotation Detection | | Set the detection threshold for speed reached output (AT-SPEED). | 1000 | r/min | 10 to 20,000 | – |
| 437 | Brake Timing when Stopped | | Set the operation time for the mechanical brake at stop. | 0 | 1 ms | 0 to 10,000 | – |
| 438 | Brake Timing during Operation | | Set the operation time for the mechanical brake during operation. | 0 | 1 ms | 0 to 10,000 | – |
| 439 | Brake Release Speed Setting | | Set the speed threshold for mechanical brake output judgment during operation. | 30 | r/min | 30 to 3,000 | Yes |
| 440 | Warning Output Selection 1 | | Select the warning type for warning output 1. | 0 | – | 0 to 10 | – |
| | | 0 | No | | | | |
| | | 1 | Overload warning | | | | |
| | | 2 | Excessive regeneration warning | | | | |
| | | 3 | Battery warning | | | | |
| | | 4 | Fan warning | | | | |
| | | 5 | Encoder communications warning | | | | |
| | | 8 | Encoder overheating warning | | | | |
| | | 9 | External scale error warning | | | | |
| | | 10 | External scale communications error warning | | | | |
| 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 10 | – |
| 442 | Positioning Completion Range 2 | | Set the allowable number of pulses for the second positioning completion range. | 10 | Command unit | 0 to 262,144 | – |

## Expansion Setting Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 500 | Electronic Gear Ratio Numerator 2 | | Set the electronic gear ratio. If Pn500, Pn501, Pn502 = 0, the encoder resolution is set as the numerator. | 0 | – | 0 to $2^{30}$ | – |
| 501 | Electronic Gear Ratio Numerator 3 | | Electronic gear ratio numerator 2 (Pn500) or | 0 | – | 0 to $2^{30}$ | – |
| 502 | Electronic Gear Ratio Numerator 4 | | Electronic gear ratio numerator 3 (Pn501) or Electronic gear ratio numerator 4 (Pn502) / Electronic gear ratio denominator (Pn010) | 0 | – | 0 to $2^{30}$ | – |
| 503 | Encoder Dividing Denominator | | Set the denominator when the number of pulses per motor rotation in pulse regeneration is not an integer. | 0 | – | 0 to 262,144 | Yes |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 504 | Drive Prohibition Input Selection | | Set the operation to be performed upon forward/reverse direction drive prohibition input. | 1 | – | 0 to 2 | Yes |
| | | 0 | Forward or reverse direction drive prohibition input enabled | | | | |
| | | 1 | Forward or reverse direction drive prohibition input disabled | | | | |
| | | 2 | Forward or reverse direction drive prohibition input enabled | | | | |
| 505 | Stop Selection for Drive Prohibition Input | | Make the setting upon drive prohibition input. | 0 | – | 0 to 2 | Yes |
| | | 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 immediate stop is performed. | | | | |
| 506 | Stop Selection with Servo OFF | | Set the stop operation when the servo is turned OFF. | 0 | – | 0 to 9 | – |
| | | 0 | During deceleration: Dynamic brake<br>After stopping: Dynamic brake<br>Error counter: Clear | | | | |
| | | 1 | During deceleration: Free-run<br>After stopping: Dynamic brake<br>Error counter: Clear | | | | |
| | | 2 | During deceleration: Dynamic brake<br>After stopping: Servo free<br>Error counter: Clear | | | | |
| | | 3 | During deceleration: Free-run<br>After stopping: Servo free<br>Error counter: Clear | | | | |
| | | 4 | During deceleration: Dynamic brake<br>After stopping: Dynamic brake<br>Error counter: Hold | | | | |
| | | 5 | During deceleration: Free-run<br>After stopping: Dynamic brake<br>Error counter: Hold | | | | |
| | | 6 | During deceleration: Dynamic brake<br>After stopping: Servo free<br>Error counter: Hold | | | | |
| | | 7 | During deceleration: Free-run<br>After stopping: Servo free<br>Error counter: Hold | | | | |
| | | 8 | During deceleration: Immediate stop<br>After stopping: Dynamic brake<br>Error counter: Clear | | | | |
| | | 9 | During deceleration: Immediate stop<br>After stopping: Servo free<br>Error counter: Clear | | | | |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 507 | Stop Selection with Main Power Supply OFF | | Set the stop operation when the main power supply is turned OFF. The set values for this parameter are the same as Stop Selection with Servo OFF (Pn506). | 0 | – | 0 to 9 | – |
| 508 | Undervoltage Alarm Selection | | Select whether to trip the LV or turn OFF the servo if there is a main power supply alarm. | 1 | – | 0 to 1 | – |
| 509 | Momentary Hold Time | | Set the main power supply alarm detection time. | 70 | 1 ms | 70 to 2,000 | Yes |
| 510 | Stop Selection for Alarm Generation | | Set the alarm sequence. | 0 | – | 0 to 7 | – |
| | | 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 Immediate stop alarm deceleration: Immediate stop During deceleration: Dynamic brake After stopping: Dynamic brake | | | | |
| | | 5 | During Immediate stop alarm deceleration: Immediate stop During deceleration: Free-run After stopping: Dynamic brake | | | | |
| | | 6 | During Immediate stop alarm deceleration: Immediate stop During deceleration: Free-run After stopping: Servo free | | | | |
| | | 7 | During Immediate stop alarm deceleration: Immediate stop During deceleration: Free-run After stopping: Servo free | | | | |
| 511 | Immediate Stop Torque | | Set the torque limit for immediate stops. | 0 | % | 0 to 500 | – |
| 512 | Overload Detection Level Setting | | Set the overload detection level. | 0 | % | 0 to 500 | – |
| 513 | Overspeed Detection Level Setting | | Set the overspeed error detection level. | 0 | r/min | 0 to 20,000 | – |
| 514 | Overrun Limit Setting | | Set the motor over-travel distance for position commands. | 10 | 0.1 Rotation | 0 to 1,000 | – |
| 515 | Control Input Signal Read Setting | | Select from one of 4 values for the IF read cycle. | 0 | – | 0 to 3 | Yes |
| | | 0 | 0.166ms | | | | |
| | | 1 | 0.333 ms | | | | |
| | | 2 | 1 ms | | | | |
| | | 3 | 1.666 ms | | | | |
| 516 | Alarm Reset Condition Setting | | Set the alarm clear input detection method. | 0 | – | 0 to 1 | – |
| | | 0 | 120 ms | | | | |
| | | 1 | Follow the Control Input Signal Read Setting (Pn515). | | | | |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 517 | Error Counter Reset Condition Selection | | Set the counter clear input signal clear conditions. | 0 | – | 0 to 4 | – |
| | | 0 | Disabled | | | | |
| | | 1 | Clears the error counter with the level. (Shorted for 500 μs or longer) | | | | |
| | | 2 | Clears the error counter with the level. (Shorted for 1 ms or longer) | | | | |
| | | 3 | Clears the error counter with the edge. (Change from open to shorted for 100 μs or longer) | | | | |
| | | 4 | Clears the error counter with the edge. (Change from open to shorted 1 ms or longer) | | | | |
| 518 | Command Pulse Prohibition Input Setting | | Enable or disable the command pulse prohibition input signals (INH). | 1 | – | 0 to 1 | – |
| | | 0 | Enabled | | | | |
| | | 1 | Disabled | | | | |
| 519 | Command Pulse Prohibition Input Read Setting | | Select the signal read cycle for the command pulse prohibition input. | 0 | – | 0 to 4 | – |
| | | 0 | 0.166ms | | | | |
| | | 1 | 0.333 ms | | | | |
| | | 2 | 1 ms | | | | |
| | | 3 | 1.666 ms | | | | |
| | | 4 | 0.166 ms | | | | |
| 520 | Position Setting Unit Selection | | Select the positioning completion range and error counter overflow level setting unit. | 0 | – | 0 to 1 | Yes |
| | | 0 | Command unit | | | | |
| | | 1 | Encoder unit | | | | |
| 521 | Torque Limit Selection | | Set the forward or reverse direction torque limit selection method. | 1 | – | 0 to 6 | – |
| | | 0 | Use P-ATL and N-ATL as analog torque limit inputs. | | | | |
| | | 1 | Pn013 is the limit value for both forward and reverse directions. | | | | |
| | | 2 | Forward operation: Set by Pn013, Reverse operation: Set by Pn522. | | | | |
| | | 3 | When TL-SEL input is open: Use Pn013. When TL-SEL input is shorted: Use Pn522. | | | | |
| | | 4 | Use P-ATL and N-ATL as analog torque limit inputs. | | | | |
| | | 5 | Use P-ATL and N-ATL as analog torque limit inputs. | | | | |
| | | 6 | When TL-SEL input is open: Forward direction, use Pn013; Reverse direction, use Pn522. When TL-SEL input is shorted: Forward direction, use Pn525; Reverse direction, use Pn526. | | | | |
| 522 | No. 2 Torque Limit | | Set the No. 2 limit value for the motor output torque. | 500 | % | 0 to 500 | – |
| 523 | Torque Limit Switching Setting 1 | | Set the change rate (fluctuate) for when the torque limit is switched from No. 1 to No. 2. | 0 | ms/ 100% | 0 to 4,000 | – |
| 524 | Torque Limit Switching Setting 2 | | Set the change rate (fluctuate) for when the torque limit is switched from No. 2 to No. 1. | 0 | ms/ 100% | 0 to 4,000 | – |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 525 | Forward External Torque Limit | | Set the forward direction torque limit for TL-SEL input when Pn521 Torque Limit Selection is set to 6. | 500 | % | 0 to 500 | – |
| 526 | Reverse External Torque Limit | | Set the reverse direction torque limit for TL-SEL input when Pn521 Torque Limit Selection is set to 6. | 500 | % | 0 to 500 | – |
| 527 | Analog Torque Limit Scale | | Set the gain of conversion for analog torque limit input. | 30 | 0.1 V/ 100% | 10 to 100 | – |
| 528 | Default Display | | Select the data to be displayed on the 7-segment LED initially when the control power supply is turned ON. | 1 | | 0 to 35 | Yes |
| | | 0 | Command position error | | Command unit | | |
| | | 1 | Motor speed | | r/min | | |
| | | 2 | Position command speed | | r/min | | |
| | | 3 | Speed Control Command | | r/min | | |
| | | 4 | Torque command | | % | | |
| | | 5 | Total encoder pulses | | Pulse | | |
| | | 6 | Total command pulses | | Pulse | | |
| | | 8 | Total External Scale Feedback Pulses | | Pulse | | |
| | | 9 | CONTROL mode | | – | | |
| | | 10 | I/O signal status | | – | | |
| | | 11 | Analog input value | | V | | |
| | | 12 | Error factor, history | | – | | |
| | | 13 | Warning number | | – | | |
| | | 14 | Regeneration resistance load ratio | | % | | |
| | | 15 | Overload load ratio | | % | | |
| | | 16 | Inertia Ratio | | % | | |
| | | 17 | Reason for no rotation | | – | | |
| | | 18 | Display of the number of I/O signal changes | | times | | |
| | | 20 | Absolute encoder data | | – | | |
| | | 21 | Absolute external scale position | | – | | |
| | | 22 | Monitor for the number of encoder communications errors | | times | | |
| | | 23 | Display of axis numbers for communication | | – | | |
| | | 24 | Position error (encoder unit) | | – | | |
| | | 25 | External scale error (external scale unit) | | – | | |
| | | 26 | Hybrid error | | Command unit | | |
| | | 27 | P-N voltage | | V | | |
| | | 28 | Soft version | | – | | |
| | | 29 | Driver serial number | | – | | |
| | | 30 | Motor serial number | | – | | |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 528 | Default Display | 31 | Accumulative operation time | | h | 0 to 35 | Yes |
| | | 32 | Automatic Motor Recognition Function | | – | | |
| | | 33 | Driver temperature | | °C | | |
| | | 35 | Safety status monitor | | – | | |
| 531 | Axis Number | | Set the axis number for communication. | 1 | – | 0 to 127 | Yes |
| 532 | Command Pulse Input Maximum Setting | | Set the maximum command pulse input. | 4000 | kpps | 250 to 4,000 | Yes |
| 533 | Pulse Regeneration Limit Output Setting | | Set the detection of pulse regeneration limit error. | 0 | – | 0 to 1 | Yes |
| | | 0 | Disabled | | | | |
| | | 1 | Enabled | | | | |
| 535 | Front Key Protection Setting | | Set the operation limit for the front panel. | 0 | – | 0 to 1 | Yes |
| | | 0 | Operation not blocked | | | | |
| | | 1 | Operation blocked | | | | |

## Special Setting Parameters

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 600 | Analog Torque Feed-forward Gain Setting | | Set the input gain for analog torque feed forward. 0 to 9 will be disabled. | 0 | 0.1 V/ 100% | 0 to 100 | – |
| 604 | Jog Speed | | Set the command speed during JOG trial operation (speed control). | 300 | r/min | 0 to 500 | – |
| 605 | Gain 3 Effective Time | | Set effective time of gain 3 of three-step gain switching. | 0 | 0.1 ms | 0 to 10,000 | – |
| 606 | Gain 3 Ratio Setting | | Set gain 3 as a multiple of gain 1. | 100 | % | 50 to 1,000 | – |
| 607 | Torque Command Value Offset | | Set offset torque to add to torque command. | 0 | % | -100 to 100 | – |
| 608 | Forward Direction Torque Offset | | Set the value to add to a torque command for forward direction operation. | 0 | % | -100 to 100 | – |
| 609 | Reverse Direction Torque Offset | | Set the value to add to a torque command for reverse direction operation. | 0 | % | -100 to 100 | – |
| 610 | Function Expansion Setting | | Set the function expansion. The setting contents vary depending on the function. | 0 | – | 0 to 63 | – |
| 611 | Electric Current Response Setting | | Make fine adjustment on electric current response with default setting as 100%. | 100 | % | 50 to 100 | – |
| 613 | Inertia Ratio 2 | | Set the inertia ratio switching. | 250 | – | 0 to 10,000 | – |
| 614 | Alarm Generation Allowable Time Setting | | Set the allowable time until stopping when an immediate stop is actuated upon alarm generation. | 200 | ms | 0 to 1,000 | – |
| 615 | Overspeed Detection Level Setting at Immediate Stop | | During an immediate stop upon alarm generation, if the motor speed excess this set value, this is an overspeed 2 error. | 0 | r/min | 0 to 20,000 | – |
| 616 | Absolute Interface Function Selection | | Select the absolute encoder data transfer. | 1 | – | 0 to 1 | Yes |
| | | 0 | Disabled | | | | |
| | | 1 | Enabled | | | | |
| 617 | Front Panel Parameter Write Selection | | Select the EEPROM write specifications when a parameter is changed. | 0 | – | 0 to 1 | Yes |
| | | 0 | Writing not to be performed when a parameter is changed. | | | | |
| | | 1 | Writing to be performed when a parameter is changed. | | | | |
| 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 | Yes |
| 619 | Encoder Phase-Z Setting | | Finely adjust the encoder phase-Z width when the number of output pulses per motor rotation after the division of pulse output is not an integer. | 0 | Pulse | 0 to 32,767 | Yes |

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**Appendix**

| Pn number | Parameter name | Setting | Explanation | Default setting | Unit | Setting range | Power supply OFF to ON |
|---|---|---|---|---|---|---|---|
| 620 | External Scale Phase-Z Expansion Setting | | Set the external scale phase-Z output width. | 0 | μs | 0 to 400 | Yes |
| 621 | Serial Absolute External Scale Phase-Z Setting | | Set the phase-Z regeneration position when the serial absolute external scale is used. | 0 | Pulse | 0 to $2^{28}$ | Yes |
| 622 | Phase-AB Regeneration Method Selection for External Scale of Phase-AB Output Type | | Select the regeneration method of pulse outputs OA and OB when an external scale of phase AB-output type is used. | 0 | – | 0 to 1 | Yes |
| | | 0 | Without signal regeneration | | | | |
| | | 1 | With signal regeneration | | | | |
| 623 | Disturbance Torque Compensation Gain | | Set the compensation gain for disturbance torque. | 0 | % | -100 to 100 | – |
| 624 | Disturbance Observer Filter Setting | | Set the filter time constant for disturbance torque compensation. | 53 | 0.01 ms | 10 to 2,500 | – |
| 627 | Warning Latch Hold Time Selection | | Select the warning latch time. | 5 | – | 0 to 10 | Yes |
| | | 0 | Latch time infinite | | | | |
| | | 1-10 | Latch time in seconds | | | | |
| 631 | Realtime Autotuning Estimated Speed Selection | | Set the load characteristics estimated speed when realtime autotuning is enabled. | 1 | – | 0 to 3 | – |
| | | 0 | Estimation result is finalized when load estimation stabilizes. | | | | |
| | | 1 | For load characteristics change, the estimation is made at time constant of approx. 7 minutes. | | | | |
| | | 2 | For load characteristics change, the estimation is made at time constant of approx. 4 seconds. | | | | |
| | | 3 | For load characteristics change, the estimation is made at time constant of approx. 2 seconds. | | | | |
| 632 | REALTIME AUTOTUNING CUSTOMIZATION mode Setting | | Set the CUSTOMIZATION mode detail for realtime autotuning. | 0 | – | -32,768 to 32,767 | – |
| 633 | Absolute Encoder Initial Pulse Regeneration Speed | | Set the pulse regeneration speed when the initial pulse is output. | 1000 | r/min | 1,000 to 3,000 | – |
| 634 | Hybrid Vibration Suppression Gain | | Set the hybrid vibration suppression gain during full closing control. | 0 | 0.1/s | 0 to 30,000 | – |
| 635 | Hybrid Vibration Suppression Filter | | Set the hybrid vibration suppression filter time constant during full closing control. | 10 | 0.01 ms | 0 to 6,400 | – |
| 637 | Vibration Detection Threshold | | Set the vibration detection threshold. If torque vibration that exceeds this setting is detected, the vibration detection warning will occur. | 0 | 0.1% | 0 to 1,000 | – |
| 638 | Warning Mask Setting | | Set the warning detection mask setting.If you set the corresponding bit to 1, the corresponding warning detection will be disabled. | 0 | – | -32,768 to 32,767 | Yes |

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**Appendix**

# 12-3 Safety Certification

CERTIFICATE

No. Z10 09 07 59301 130

**Holder of Certificate:** OMRON Corporation

2-2-1, Nishi-Kusatsu
Kusatsu-city
Shiga-ken
525-0035 JAPAN

**Certification Mark:**

**Product:** AC Servo Systems
AC Servo Amplifier

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

**Test report no.:** PO82586T

**Date,** 2009-07-23

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**Appendix**

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT ◆ CERTIFICAT

**CERTIFICATE**
**No. Z10 09 07 59301 130**

**Model(s):**

OMNUC G5 Series
For nomenclature see attachment

**Parameters:**

| | |
|---|---|
| Rated voltage: | 100-120 VAC |
| | 200-240 VAC |
| | 380-480 VAC |
| Rated input current: | Max. 21.6 A |
| Operating temperature: | 0°C ... +55°C |

**Tested according to:**

2006/42/EC Machinery Directive
(valid from 29 Dec. 2009)
IEC 61508:1998 (Part 1, 3 and 4) SIL 2
IEC 61508:2000 (Part 2) SIL 2
EN 61508:2001 (Part 1 to 4) SIL 2
EN 954-1:1996 Cat. 3
IEC 61800-5-2:2007 / EN 61800-5-2:2007
ISO 13849-1:2006  PL c, PL d
EN ISO 13849-1:2008  PL c, PL d
IEC 62061:2005 / EN 62061:2005 SIL 2
IEC 61800-5-1:2007 / EN 61800-5-1:2007
IEC 61800-3:2004 / EN 61800-3:2004
IEC 61000-6-2:2005 / EN 61000-6-2:2005
IEC 61326-3-1:2008
EN 55011/A2:2007

**Factory(ies):**          54068

**Main-Certificate no.:**   Z10 09 06 22944 150

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**Appendix**

**Attachment to certificate Z10 09 07 59301 130**

Nomenclature of product type

$$\underset{\text{I}}{\underline{R88D}} - \underset{\text{II}}{\underline{K}} \; \underset{\text{III}}{\underline{T}} \; \underset{\text{IV}}{\underline{01}} \; \underset{\text{V}}{\underline{H}} \; \underset{\text{VI}}{\underline{A}} - \underset{\text{VII}}{\underline{ZR1}}$$

I. Manufacturer's Designation:
    R88D – Normal

II. Manufacturer's Designation:
    K – Normal

III. Input Signal Specification:
    T – Analog / pulse input type

IV. Output rating:
    A5 – 50W
    01 – 100W
    02 – 200W
    04 – 400W
    08 – 750W
    10 – 1kW
    15 – 1.5kW
    20 – 2kW
    30 – 3kW
    50 – 5kW

V. Input Voltage Specification:
    L – AC100V
    H – AC200V
    F – AC400V

VI. Design Revision (Non-critical) (max 1 character): * See Remark
    blank or any number

VII. Internal Specification (Non-critical) (max 3 characters): * See Remark
    blank or any alphanumeric suffix
    (If VII is not blank, a hyphen is inserted between VI and VII.
    Otherwise, no hyphen is inserted.)

*) Remark

Details of the combination of VI and VII are shown below.

| VI | VII | Specification |
|---|---|---|
| Blank | Blank | Functional Safety Model |
| Any number | Blank or Alphanumeric | Functional Safety Model |
| No other 2 digits combination will be placed in the market | | |

**Department:**      TR-RAMUC
**Date:**          2009-07-23

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Note: Specifications subject to change without notice.
Cat. No. I571-E2-03

**OMRON**