

AC SERVOMOTORS/SERVO DRIVES

G5-series WITH BUILT-IN EtherCAT COMMUNICATIONS

User's Manual

R88M-K□ (AC Servomotors)

R88D-KN□-ECT (AC Servo Drives)



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Introduction

Thank you for purchasing a G5-series Servo Drive. This manual explains how to install and wire the Servo Drive, set parameters needed to operate the Servo Drive, 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 knowledge) and also being qualified for one of the following:

- Introducing FA equipment
- Designing FA systems
- Managing FA sites

Notice

This manual contains information you need to know to correctly use the Servo Drive and peripheral equipment. Before using the Servo Drive, read this manual and gain a full understanding of the information provided herein.

After you finished reading this manual, keep it in a convenient place so that it can be referenced at any time.

Make sure this manual is delivered to the end user.

Read and Understand this Manual

Warranty and Limitations of Liability

| <i>WARRANTY</i> |
|--|
| <p>OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.</p> <p>OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NONINFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.</p> |

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|--|
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Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property. Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS

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

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS



The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

Safety Precautions

- To ensure that the G5-series Servomotor and Servo Drive as well as peripheral equipment are used safely and correctly, be sure to read this Safety Precautions section and the main text before using the product in order to learn items you should know regarding the equipment as well as required 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 in a convenient place so that it can be referenced at any time.

Definition of Precautionary Information

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

| | |
|---|--|
|  DANGER | <p>Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Additionally, there may be severe property damage.</p> |
|  Caution | <p>Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.</p> |

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



Precautions for Safe Use

Indicates precautions on what to do and what not to do to ensure using the product safely.



Precautions for Correct Use




Indicates precautions on what to do and what not to do to ensure proper operation and performance.



Additional Information

Indicates an item that helps deepen your understanding of the product or other useful tip.

Explanation of Symbols

| Example of symbols | |
|---|---|
|  | <p>△ This symbol indicates danger and caution.</p> <p>The specific instruction is indicated using an illustration or text inside or near △. The symbol shown to the left indicates “beware of electric shock.”</p> |
|  | <p>⊘ This symbol indicates a prohibited item (an item you must not do).</p> <p>The specific instruction is indicated using an illustration or text inside or near ⊘. The symbol shown to the left indicates “disassembly prohibited,”</p> |
|  | <p>● This symbol indicates a compulsory item (an item that must be done).</p> <p>The specific instruction is indicated using an illustration or text inside or near ●. The symbol shown to the left indicates “grounding required,”</p> |

Precautions for Safe Use of This Product

- Illustrations contained in this manual sometimes depict conditions without covers and safety shields for the purpose of showing the details. When using this product, be sure to install the covers and shields as specified and use the product according to this manual.
- If the product has been stored for an extended period of time, contact your OMRON sales representative.

DANGER



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



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



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



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



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



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



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



Never modify the Servo Drive.
Injury or equipment damage may result.



DANGER



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



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



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



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



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



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



Install the Servomotor, Servo Drive, and Regeneration Resistor on 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 information 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 Servomotor.
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 Servomotor with shaft-end key grooves is being used.
Injury may result.



Caution



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



Do not store or install the Servo Drive in the following locations:

- 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 rapid temperature changes
- Location subject to corrosive or flammable gases
- Location subject to high levels of dust, salt content, or iron dust
- Location subject to splashes of water, oil, chemicals, etc.
- Location where the Servo Drive may receive vibration or impact directly

Installing or storing the Servo Drive in any of these locations may result in fire, electric shock, or equipment damage.



The Servo Drive radiator, Regeneration Resistor, Servomotor, 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 Servo Drive, do not hold it by the cables or Servomotor shaft. Injury or failure may result.



Do not overload the Servo Drive or Servomotor. (Follow the instructions on the product label.) Injury or failure may result.



Use the Servomotor eye-bolts only when transporting the Servomotor. Do not use them to transport the machine. Injury or failure may result.



When lifting a 15 kW or higher Servo Drive during moving or installation, always have two people lift the product by grasping a metal part. Do not grasp a plastic part. Risk of injury or product damage.

Installation and Wiring



Caution



Do not step on the Servo Drive or place heavy articles on it.
Injury may result.



Do not block the intake or exhaust openings. Do not allow foreign objects to enter the Servo Drive.
Fire may result.



Be sure to observe the mounting direction.
Failure may result.



Provide the specified clearance between the Servo Drive and the inner surface of the control panel or other equipment.
Fire or failure may result.



Do not apply strong impact on the Servomotor shaft or Servo Drive.
Failure may result.



Wire the cables correctly and securely.
Runaway Servomotor, injury, or failure may result.



Securely tighten the mounting screws, terminal block screws, and cable screws.
Failure may result.



Use crimp terminals for wiring.
If simple twisted wires are connected directly to the protective ground terminal, fire may result.



Only use the power supply voltage specified in this manual.
Burn damage may result.



In locations where the power supply infrastructure is poor, make sure the rated voltage can be supplied.
Equipment damage may result.



Provide safety measures, such as a breaker, to protect against short circuiting of external wiring.
Fire may result.



If the Servo Drive is used in the following locations, provide sufficient shielding measures.

- Location subject to noise e.g., due to static electricity
- Location subject to a strong electric or magnetic field
- Location where exposure to radioactivity may occur
- Location near power supply lines

Using the Servo Drive in any of these locations may result in equipment damage.



Connect an immediate stop relay in series with the brake control relay.
Injury or failure may result.



When connecting the battery, make sure the polarity is correct.
Battery damage or explosion may result.

Operation and Adjustment



Caution



Conduct a test operation after confirming that the equipment is not affected.
Equipment damage may result.



Before operating the Servo Drive in an actual environment, check if it operates correctly based on the parameters you have set.
Equipment damage may result.



Never adjust or set parameters to extreme values, because it will make the operation unstable.
Injury may result.



Separate the Servomotor from the mechanical system and check its operation before installing the Servomotor to the machine.
Injury may result.



If an error occurs, remove the cause of the error and ensure safety, and then reset the alarm and restart the operation.
Injury may result.



Do not use the built-in brake of the Servomotor for normal braking operation.
Failure may result.



Do not operate the Servomotor connected to an excessive load inertia.
Failure may result.



Install safety devices to prevent idling or locking of the electromagnetic brake or the gear head, or leakage of grease from the gear head.
Injury, damage, or taint damage result.



If the Servo Drive fails, cut off the power supply to the Servo Drive at the power supply.
Fire may result.



Do not turn ON and OFF the main Servo Drive power supply frequently.
Failure may result.

Maintenance and Inspection



Caution



After replacing the Servo Drive, transfer to the new Servo Drive all data needed to resume operation, before restarting operation.
Equipment damage may result.



Never repair the Servo Drive by disassembling it.
Electric shock or injury may result.

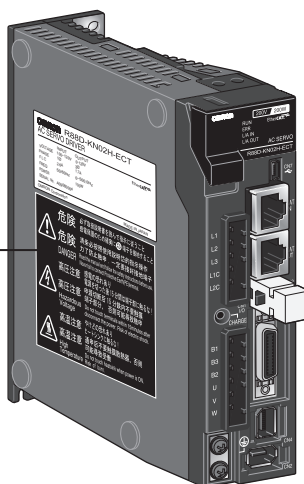


Be sure to turn OFF the power supply when the Servo Drive is not going to be used for a prolonged period of time.
Injury may result.

Location of Warning Label

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

Warning label display location



(R88D-KN02H-ECT)

Instructions on Warning Label

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

Disposal

- When disposing of the battery, insulate it using tape, and dispose of it by following the applicable ordinances of your local government.
- Dispose of the Servo Drive as industrial waste.

Items to Check after Unpacking

After unpacking, check the following items.

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

Accessories

Safety Precautions document x 1 copy

- Connectors, mounting screws, mounting brackets, and other accessories other than those in the table below are not supplied. They must be prepared by the customer.
- 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 | | Connector for main circuit power supply terminals and control circuit power supply terminals | Connector for External Regeneration Resistor connection terminals and Motor connection terminals | Safety bypass connector | Mounting Brackets | | |
|---------------------------------|--------|--|--|-------------------------|-------------------|----------|--------|
| Single-phase 100 VAC | 50 W | Included | | Included | - | | |
| | 100 W | | | | | | |
| | 200 W | | | | | | |
| | 400 W | | | | | | |
| Single-phase/3-phase 200 VAC | 100 W | - | | - | - | | |
| | 200 W | | | | | | |
| | 400 W | | | | | | |
| | 750 W | | | | | | |
| | 1 kW | | | | | | |
| | 1.5 kW | | | | | | |
| 3-phase 200 VAC | 2 kW | - | | - | Included | | |
| | 3 kW | | | | | | |
| | 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 |

Revision History

The manual revision code is a number appended to the end of the catalog number found in the bottom left-hand corner of the front or back cover.

Example

Cat. No. I576-E1-02

↑
Revision code

| Revision code | Revision Date | Revised content |
|---------------|---------------|--|
| 01 | January 2011 | Original production |
| 02 | July 2011 | Add description on functions associated with unit version 2.1 and correct errors in writing on Rev.01. |

Structure of This Document

This manual consists of the following chapters.

Read the necessary chapter or chapters referring the following table.

| | | Outline |
|------------|------------------------------------|---|
| Chapter 1 | Features and System Configuration | This chapter explains the features of the Servo Drive, name of each part, and applicable EC Directives and UL standards. |
| Chapter 2 | Models and External Dimensions | This chapter explains the models of Servo Drives, Servomotors, and peripheral equipment, and provides the external dimensions and mounting dimensions. |
| Chapter 3 | Specifications | This chapter provides the general specifications, characteristics, connector specifications, and I/O circuits of the Servo Drives as well as the general specifications, characteristics, encoder specifications of the Servomotors and other peripheral devices. |
| Chapter 4 | System Design | This chapter explains the installation conditions for the Servo Drive, Servomotor, and Decelerator, wiring methods including wiring conforming to EMC Directives and regenerative energy calculation methods as well as the performance of External Regeneration Resistors. |
| Chapter 5 | EtherCAT Communications | This chapter describes EtherCAT communications under the assumption that the G5-series Servo Drive is connected to a Machine Automation Controller NJ-series (Model: NJ501-1□00) or Position Control Unit (CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882). |
| Chapter 6 | Basic Control Functions | This chapter describes the profile that is used to control the Servo Drive. |
| Chapter 7 | Applied Functions | This chapter outlines the applied functions such as the electronic gear, gain switching and soft start, and explains the settings. |
| Chapter 8 | Safety Function | This chapter gives an outline of application functions, such as electronic gears, gain switching, and soft start, and explains the settings. |
| Chapter 9 | Details on Servo Parameter Objects | This chapter explains the set values and contents of each object. |
| Chapter 10 | Operation | This chapter gives the operating procedures and explains how to operate in each mode. |
| Chapter 11 | Adjustment Functions | This chapter explains the functions, setting methods, and items to note regarding various gain adjustments. |
| Chapter 12 | Troubleshooting and Maintenance | This chapter explains the items to check when problems occur, error diagnosis using the error display and measures, error diagnosis based on the operating condition and measures, and periodic maintenance. |
| Appendices | | The appendix provides explanation for the profile that is used to control the Servo Drive, lists of objects, Sysmac Error Status codes, and other information. |

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Index

1

Features and System Configuration

This chapter explains the features of the Servo Drive, name of each part, and applicable EC Directives and UL standards.

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1-1 Outline

The G5-series Servo Drives with Built-in EtherCAT Communications support 100-Mbps EtherCAT.

When you use the G5-series Servo Drive with a Machine Automation Controller NJ-series (Model: NJ501-1□00) or CJ1W-NC□8□ EtherCAT-compatible Position Control Unit, you can construct a sophisticated positioning control system. Also, you need only one communications cable to connect the Servo Drive and the Controller. Therefore, you can realize a position control system easily with reduced wiring effort.

With real time autotuning, adaptive filter, notch filter, and damping control, you can set up a system that provides stable operation by suppressing vibration in low-rigidity machines.

1-1-1 Features of G5-series Servo Drives

G5-series Servo Drives have the following features.

Optimal Functionality and Operability by Standardizing Specifications

As a Sysmac Device, you can use the G5-series AC Servo Drive (with Built-in EtherCAT Communications) together with the NJ-series Machine Automation Controller and the Sysmac Studio Automation Software to achieve optimum functionality and ease of operation.

* Sysmac Device is a generic term for OMRON control devices such as an EtherCAT Slave, designed with unified communications specifications and user interface specifications.

Data Transmission Using EtherCAT Communications

Combining the G5-series Servo Drive with a Machine Automation Controller NJ-series (Model: NJ501-1□00) or CJ1W-NC□8□ EtherCAT-compatible Position Control Unit enables you to exchange all position information with the controller in high-speed data communications.

Since the various control commands are transmitted via data communications, Servomotor's operational performance is maximized without being limited by interface specifications such as the response frequency of the encoder feedback pulses.

You can use the Servo Drive's various control parameters and monitor data on a host controller, and unify the system data for management.

Achievement of Accurate Positioning by Fully-closed Control

Feedback from the external encoder connected to the motor is used to accurately control positioning. Position control is not affected by deviations caused by ball screws or temperature changes.

Wide Range of Power Supplies to Meet Any Need

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

Safe Torque OFF (STO) Function to Ensure Safety

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

Suppressing Vibration of Low-rigidity Mechanisms during Acceleration/Deceleration

The damping control function suppresses vibration of low-rigidity mechanisms or devices whose tips tend to vibrate.

Two damping filters are provided to enable switching the damping frequency automatically according to the rotation direction and also via an external signal. In addition, the settings can be made easily by setting the damping frequency and filter values. You are assured of stable operation even if the set values are inappropriate.

1-1-2 What Is EtherCAT?

EtherCAT is an open high-speed industrial network system that conforms to Ethernet (IEEE 802.3). Each node achieves a short cycle time by transmitting Ethernet frames at high speed. A mechanism that allows sharing clock information enables high-precision synchronization control with low communications jitter.

EtherCAT is a registered trademark of Beckhoff Automation GmbH (Germany). EtherCAT technology is protected by patents.

1-1-3 Object Dictionary

G5-series Servo Drives with Built-in EtherCAT Communications use the object dictionary for CAN application protocol over EtherCAT (CoE) as a base for communications.

An object is a special data structure inside a device that consists of data, parameters, and methods.

An object dictionary is a data structure that describes the data type objects, communications objects, and application objects.

All objects are assigned four-digit hexadecimal numbers in the areas shown in the following table.

| Indexes | Area | Contents |
|------------------|------------------------------|--|
| 0000 to 0FFF hex | Data Type Area | Definitions of data types. |
| 1000 to 1FFF hex | CoE Communications Area | Definitions of variables that can be used by all servers for designated communications. |
| 2000 to 2FFF hex | Manufacturer Specific Area 1 | Variables with common definitions for all OMRON products. |
| 3000 to 5FFF hex | Manufacturer Specific Area 2 | Variables with common definitions for all G5-series Servo Drives (servo parameters). ^{*1} |
| 6000 to 9FFF hex | Device Profile Area | Variables defined in the Servo Drive's CiA402 drive profile. |
| A000 to FFFF hex | Reserved Area | Area reserved for future use. |

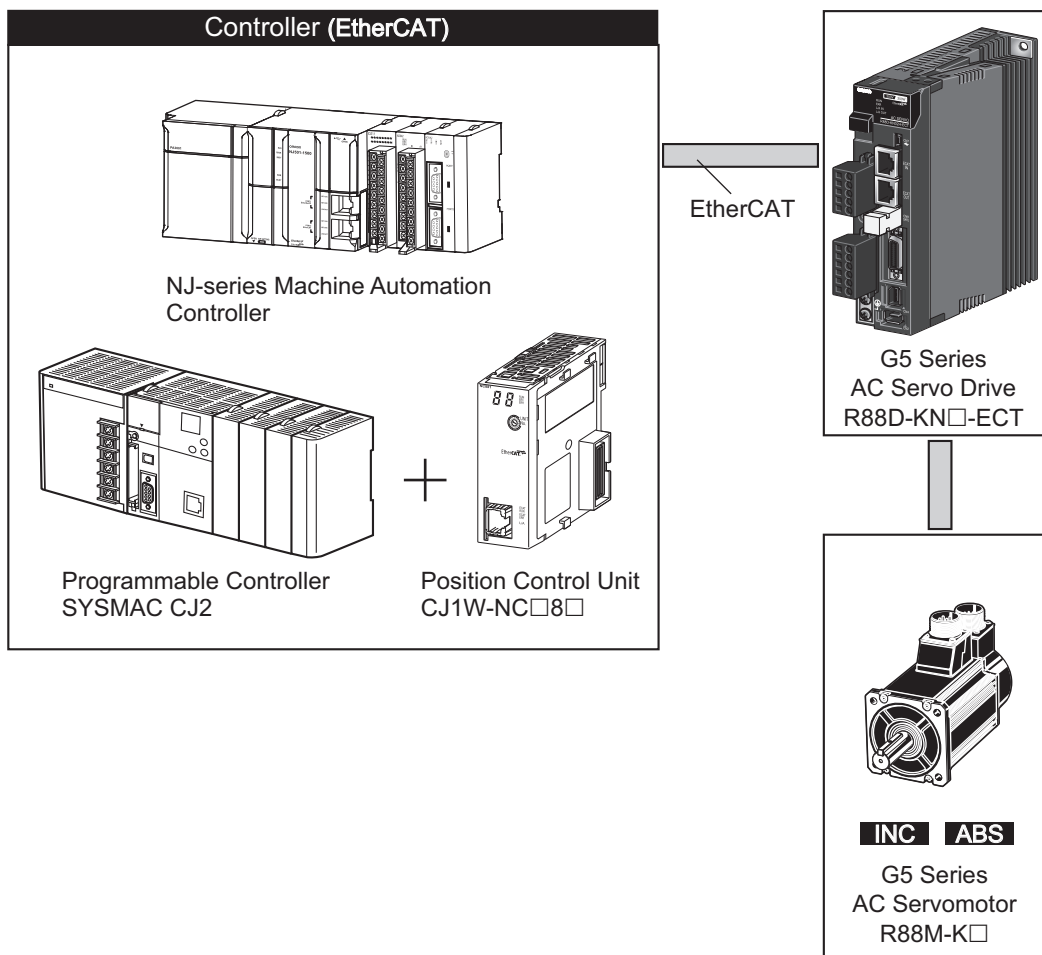
*1 G5-series Servo Drive parameters (Pn□□□) are allocated to objects 3000 to 3999 hex. Indexes 3□□□ hex correspond to G5-series Servo Drive parameters Pn□□□. For example, object 3504 hex is the same as parameter Pn504.

Pn□□□ uses decimal numbers but object 3□□□ is a hexadecimal number.

For details on servo parameters, refer to *Chapter 9 Details on Servo Parameter Objects*.

1-2 System Configuration

The system configuration for a G5-Series AC Servo Drive with Built-in EtherCAT Communications is shown below.

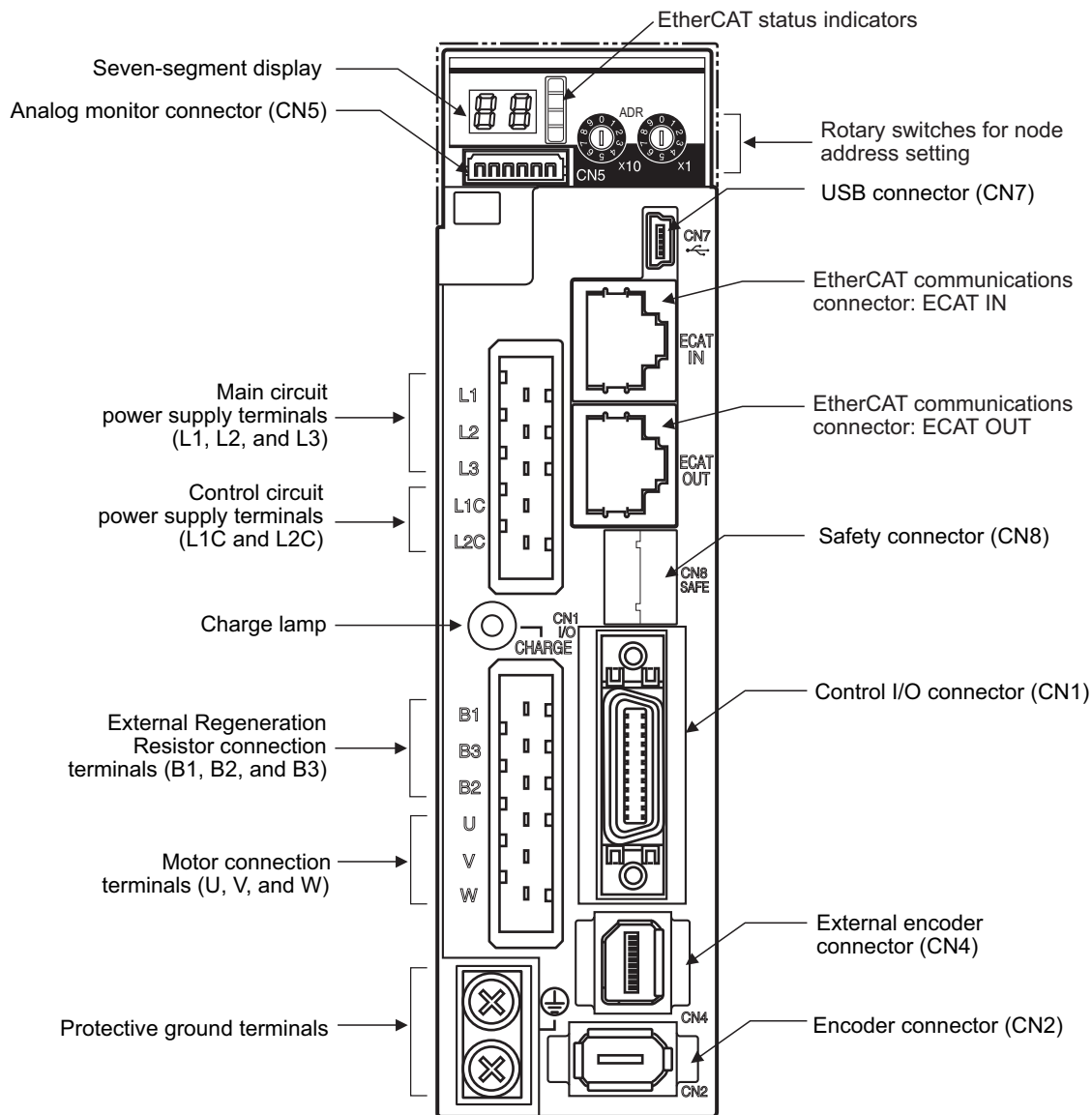


1-3 Names and Functions

This section describes the names and functions of Servo Drive parts.

1-3-1 Servo Drive Part Names

The Servo Drive part names are given below.



1-3-2 Servo Drive Functions

The functions of each part are described below.

Display

A 2-digit 7-segment display shows the node address, error codes, and other Servo Drive status.

Charge Lamp

Lights when the main circuit power supply is turned ON.

EtherCAT Status Indicators

These indicators show the status of EtherCAT communications.

For details, refer to *Status Indicators* on page 5-3.

Control I/O Connector (CN1)

Used for command input signals and I/O signals.

Encoder Connector (CN2)

Connector for the encoder installed in the Servomotor.

External Encoder Connector (CN4)

Connector for an encoder signal used during fully-closed control.

EtherCAT Communications Connectors (ECAT IN and ECAT OUT)

These connectors are for EtherCAT communications.

Analog Monitor Connector (CN5)

You can use a special cable to monitor values, such as the motor rotation speed, torque command value, etc.

USB Connector (CN7)

Communications connector for the computer.

Safety Connector (CN8)

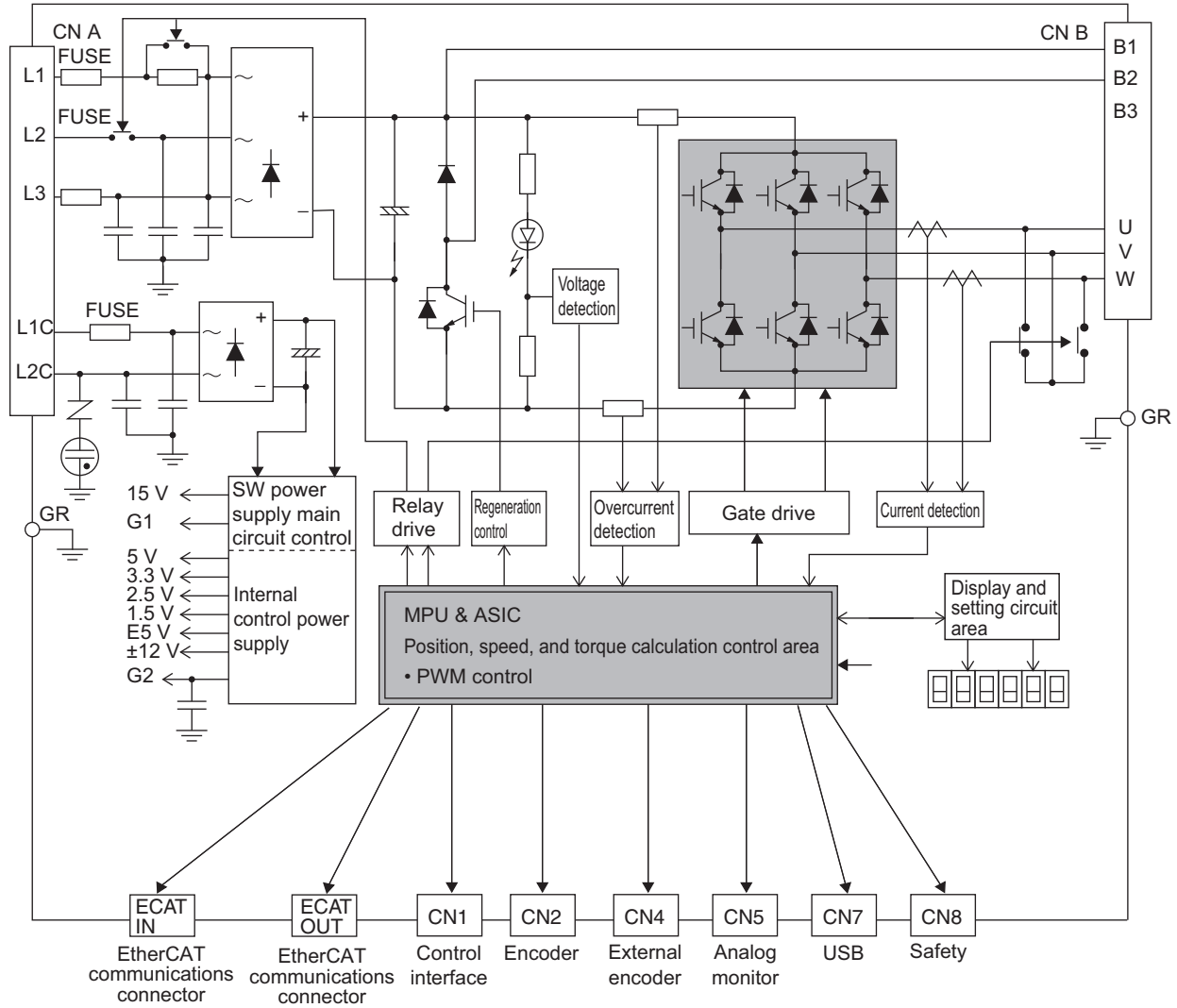
Connector for safety devices.

If no safety devices are used, keep the factory-set safety bypass connector installed.

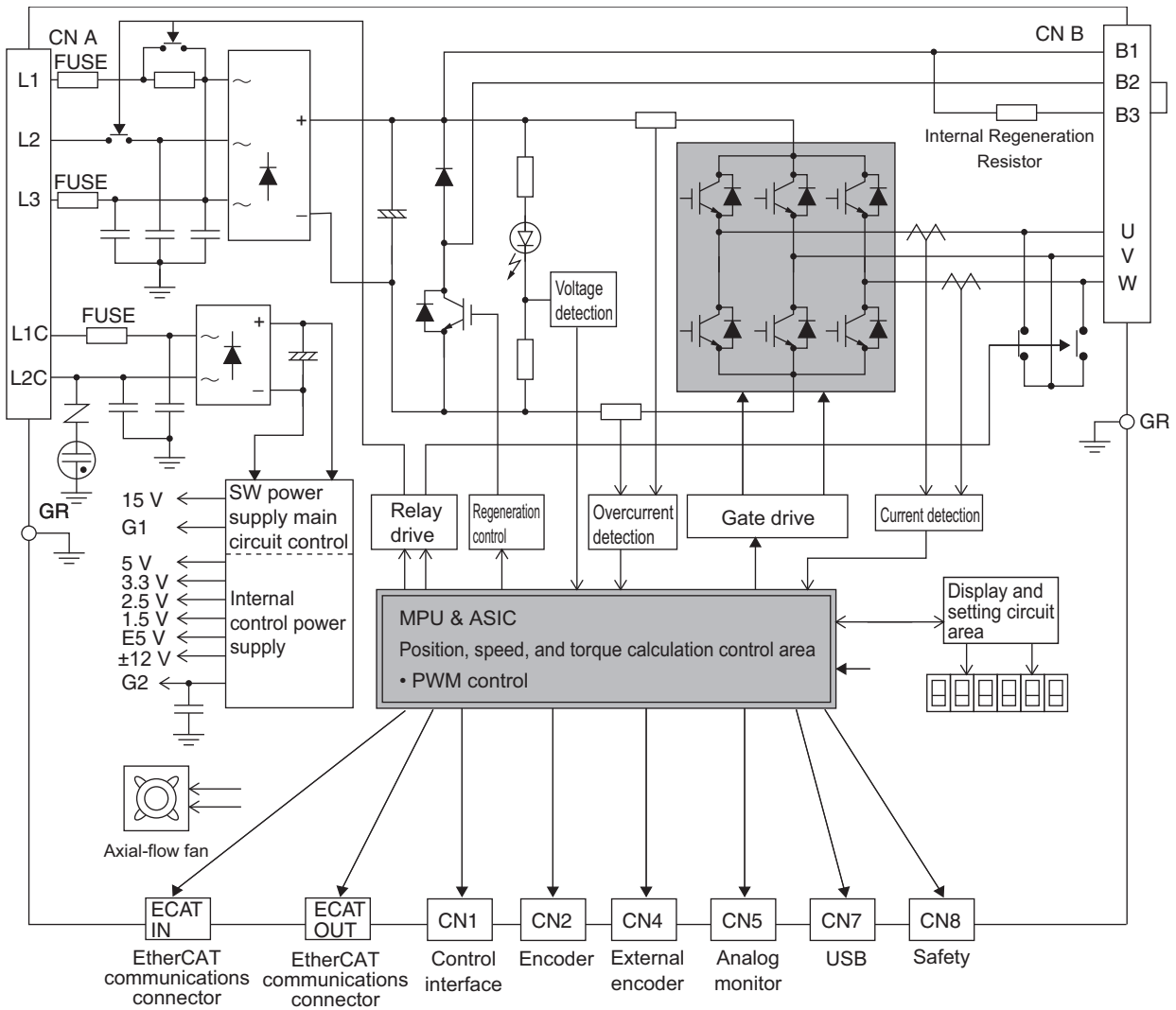
1-4 System Block Diagram

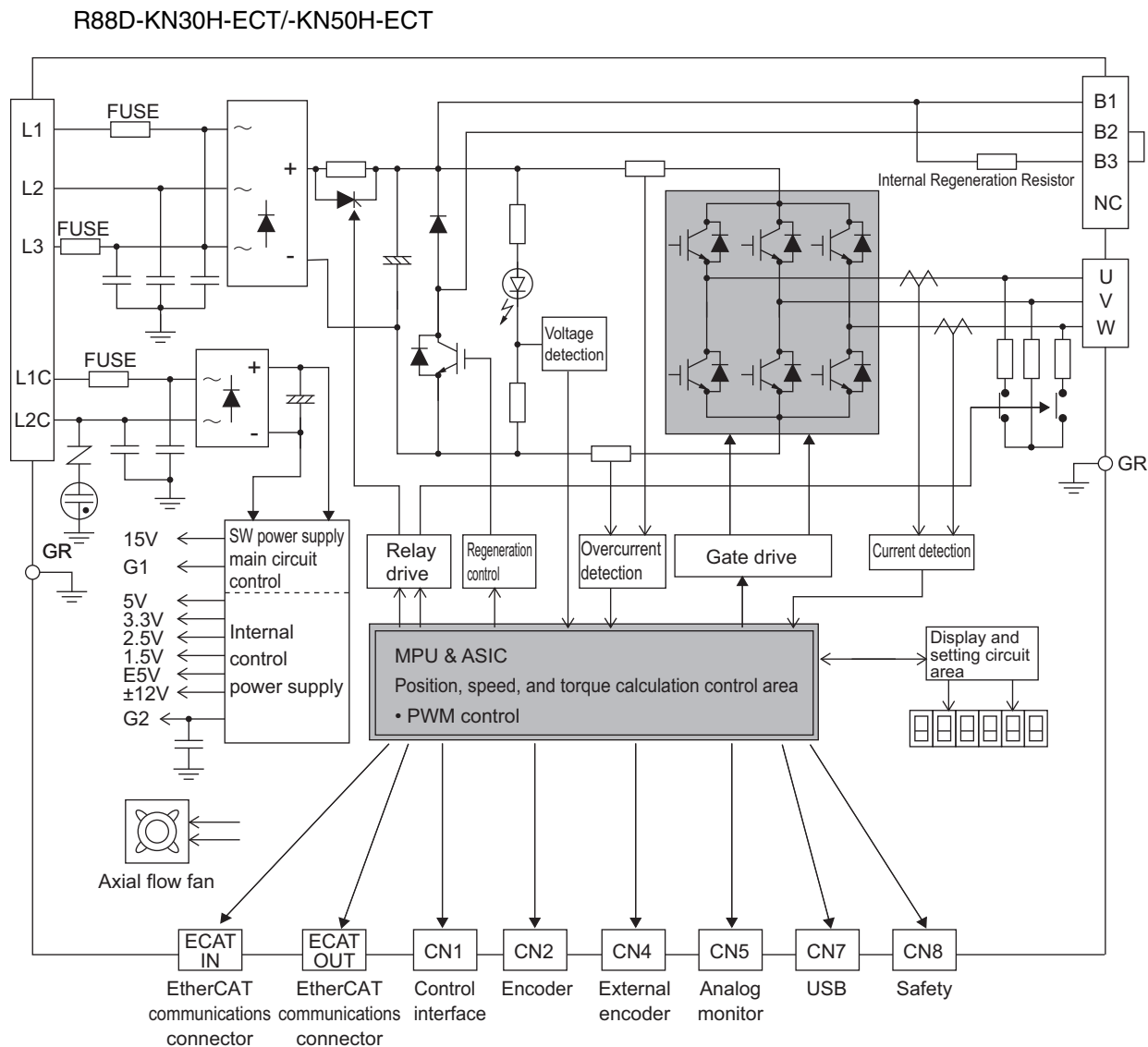
This is the block diagram of the G5-series AC Servo Drive with Built-in EtherCAT Communications.

R88D-KNA5L-ECT/-KN01L-ECT/-KN02L-ECT/-KN04L-ECT/
-KN01H-ECT/-KN02H-ECT/-KN04H-ECT/-KN08H-ECT

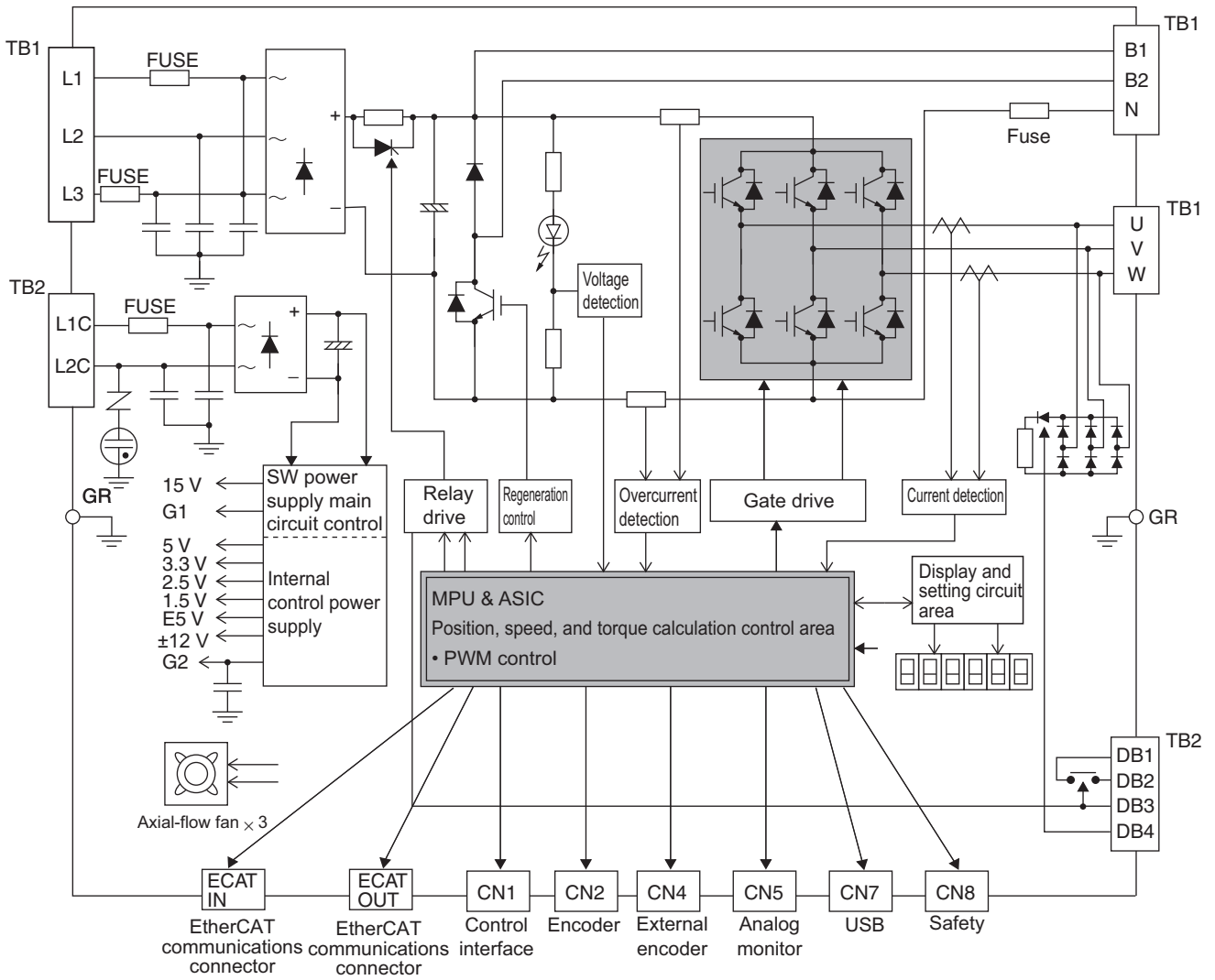


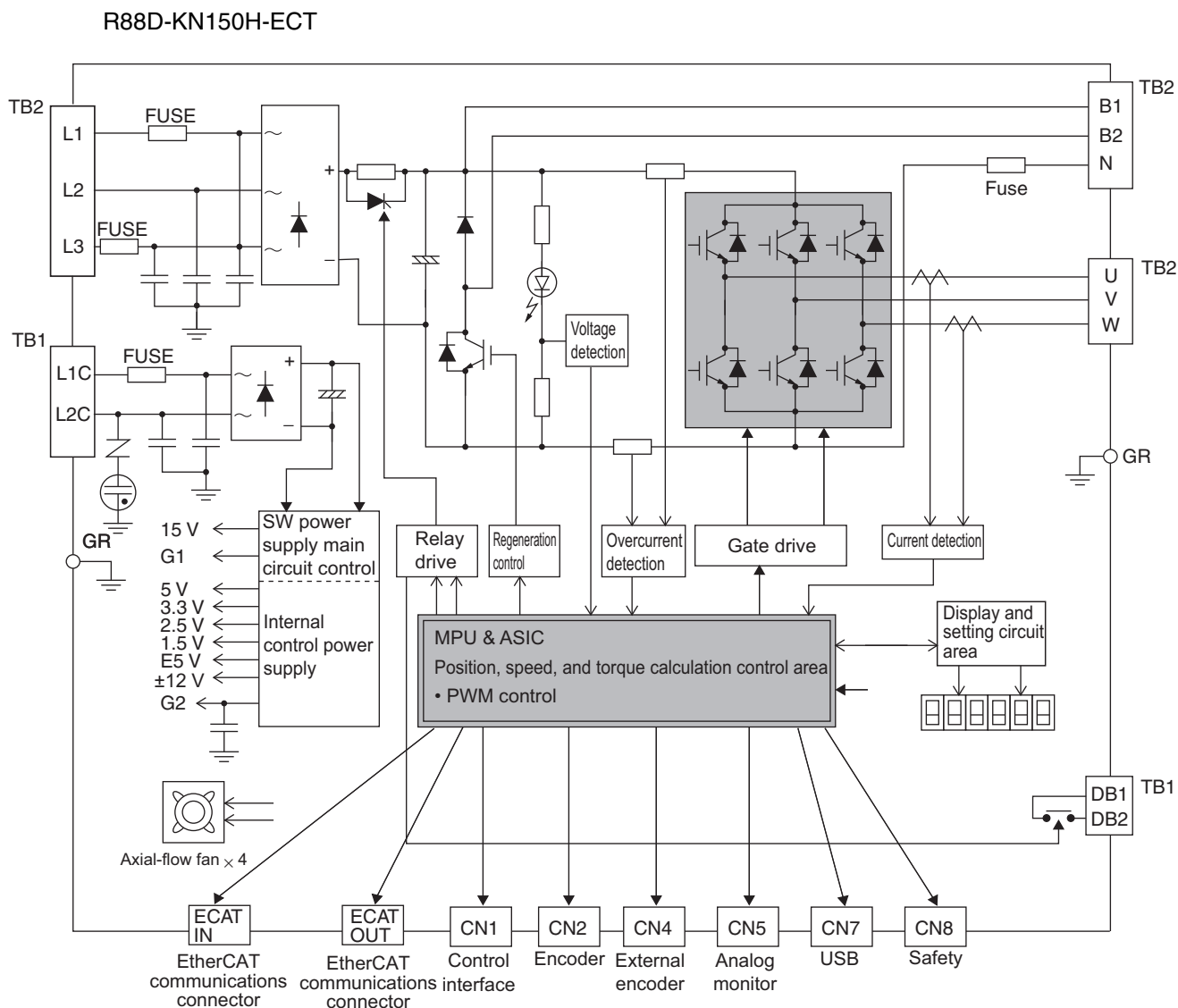
R88D-KN10H-ECT/-KN15H-ECT/-KN20H-ECT



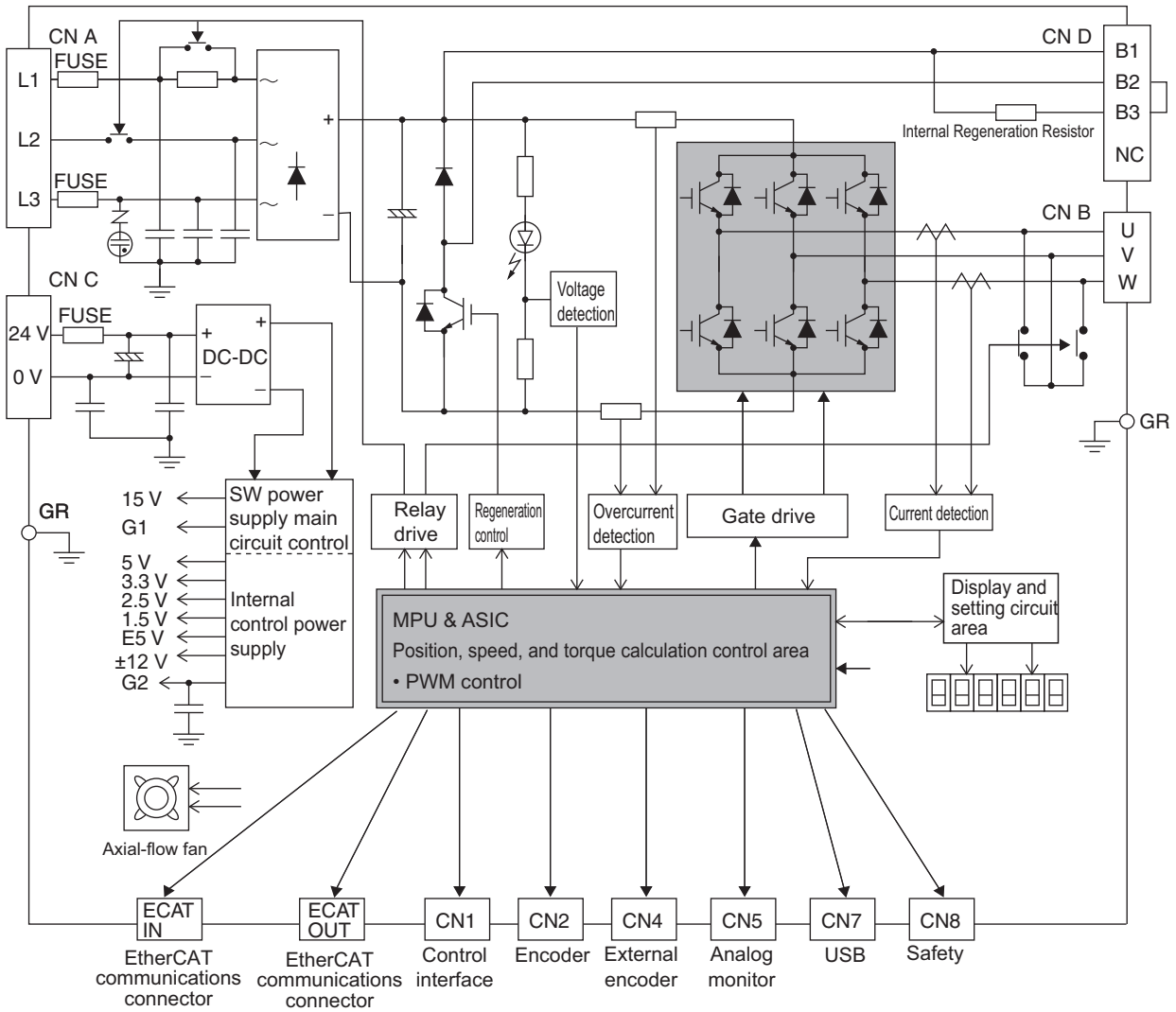


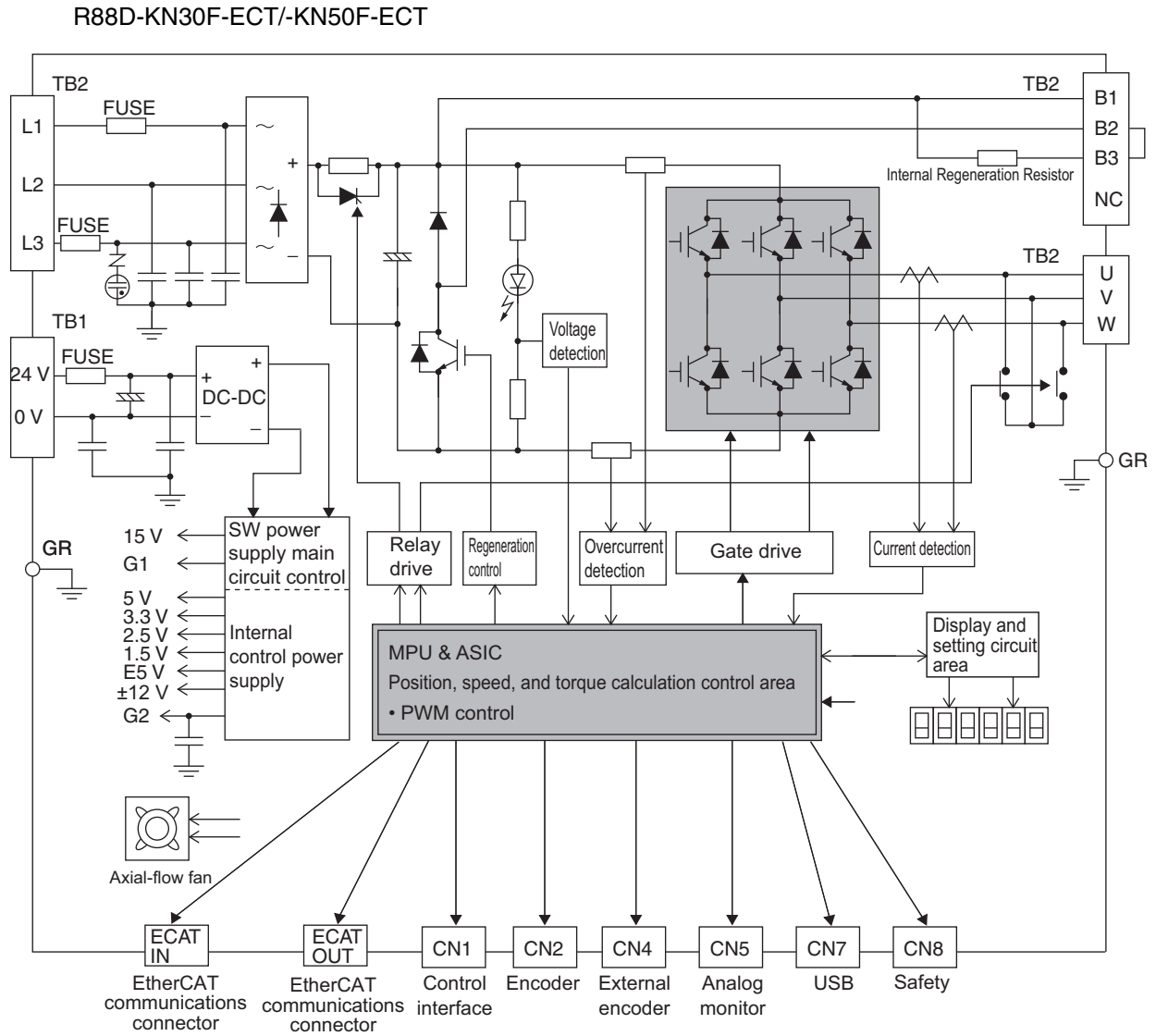
R88D-KN75H-ECT



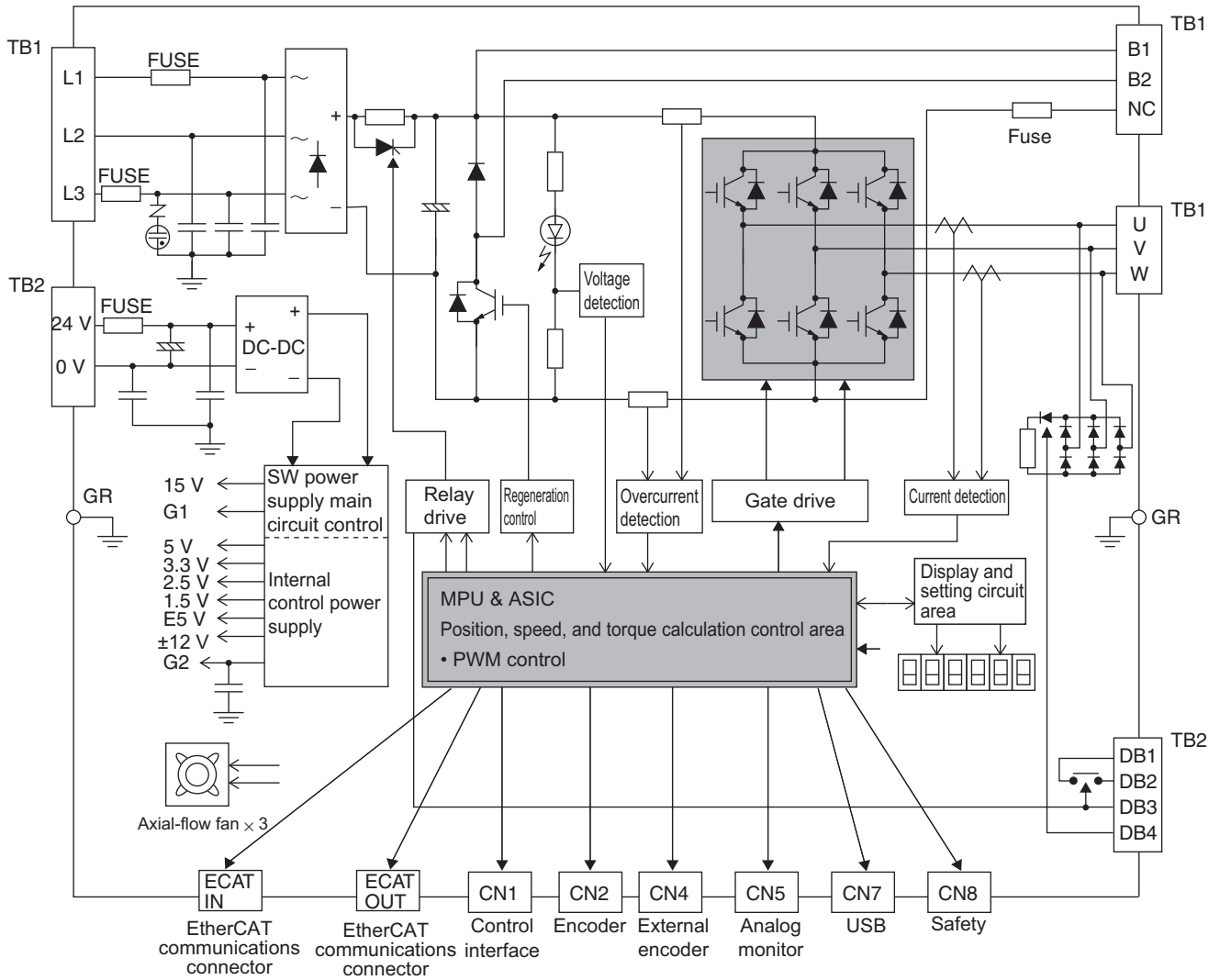


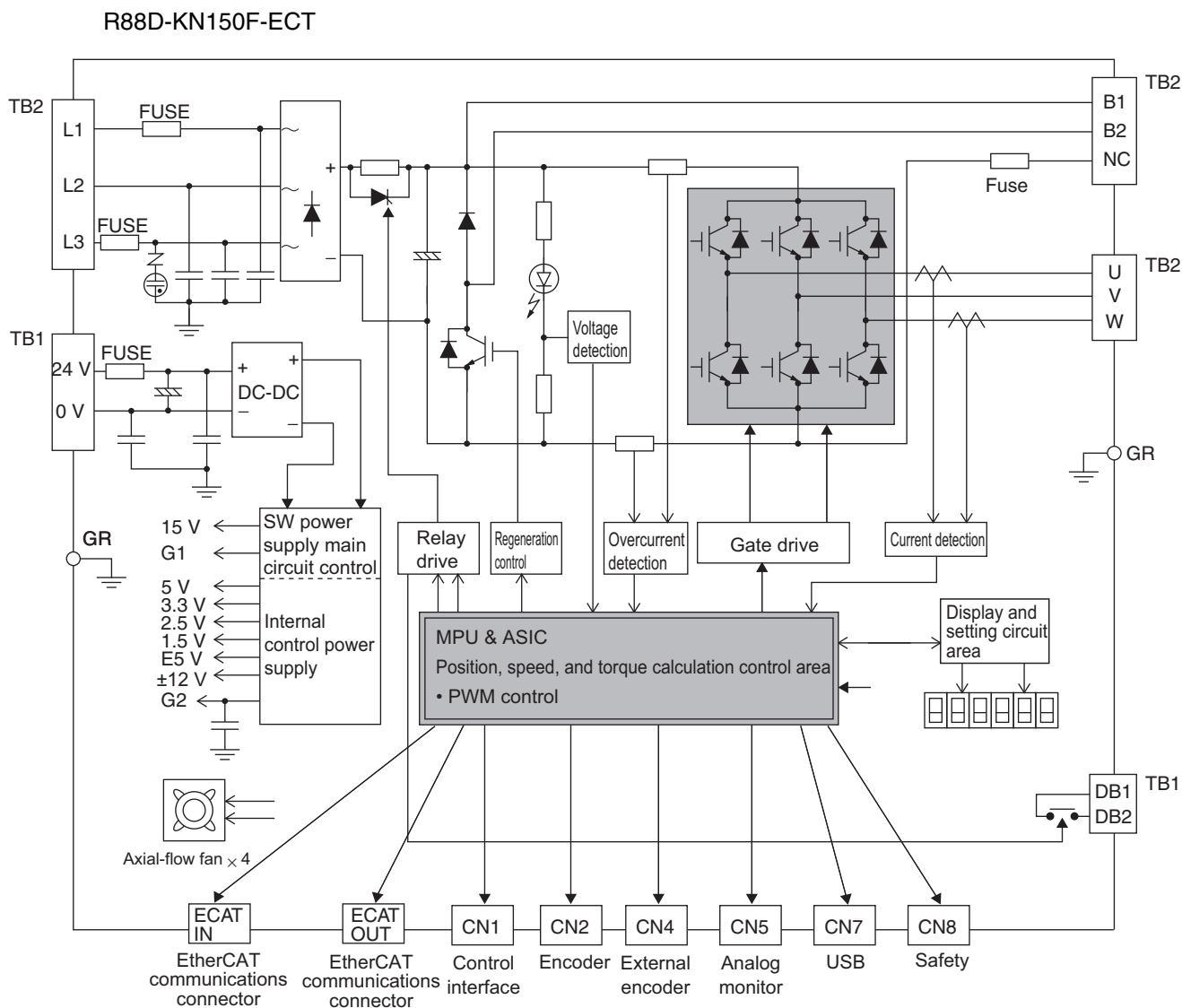
R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT/-KN20F-ECT





R88D-KN75F-ECT





1-5 Applicable Standards

This section describes applicable EMC Directives.

1-5-1 EC Directives

| EC Directive | Product | Applicable standards |
|-----------------------|-----------------|---|
| Low Voltage Directive | AC Servo Drives | EN 61800-5-1 |
| | AC Servomotors | EN 60034-1/-5 |
| EMC Directive | AC Servo Drives | EN 55011 class A group 1 |
| | AC Servomotors | IEC 61800-3 |
| | | EN 61000-6-2 |
| Machinery Directive | AC Servo Drives | EN 954-1 (Category 3) EN ISO 13849-1: 2008 (Category 3) (PLc, d) ISO 13849-1: 2006 (Category 3) (PLc, d) EN 61508 (SIL 2) EN 62061 (SIL 2) EN 61800-5-2 (STO) IEC 61326-3-1 (SIL 2) |

Note To conform to EMC Directives, the Servomotor and Servo Drive must be installed under the conditions described in *4-3 Wiring Conforming to EMC Directives* on page 4-35.

1-5-2 UL and cUL Standards

| Standard | Product | Applicable standards | File number |
|---------------|-----------------|----------------------|-----------------------|
| UL standards | AC Servo Drives | UL 508C | E179149 |
| | AC Servomotors | UL 1004-1 | E331224 |
| | | UL 1004-1, UL 1004-6 | E327868 ^{*1} |
| CSA standards | AC Servo Drives | CSA 22.2 No. 14 | E179149 |
| | AC Servomotors | CSA 22.2 No. 100 | E331224 |
| | | CSA 22.2 No. 100 | E327868 ^{*1} |

*1 Applies to 1,500-r/min Servomotors of 7.5 to 15 kW and 1,000-r/min Servomotors of 4.5 to 6 kW.

1-5-3 SEMI F47

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

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

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

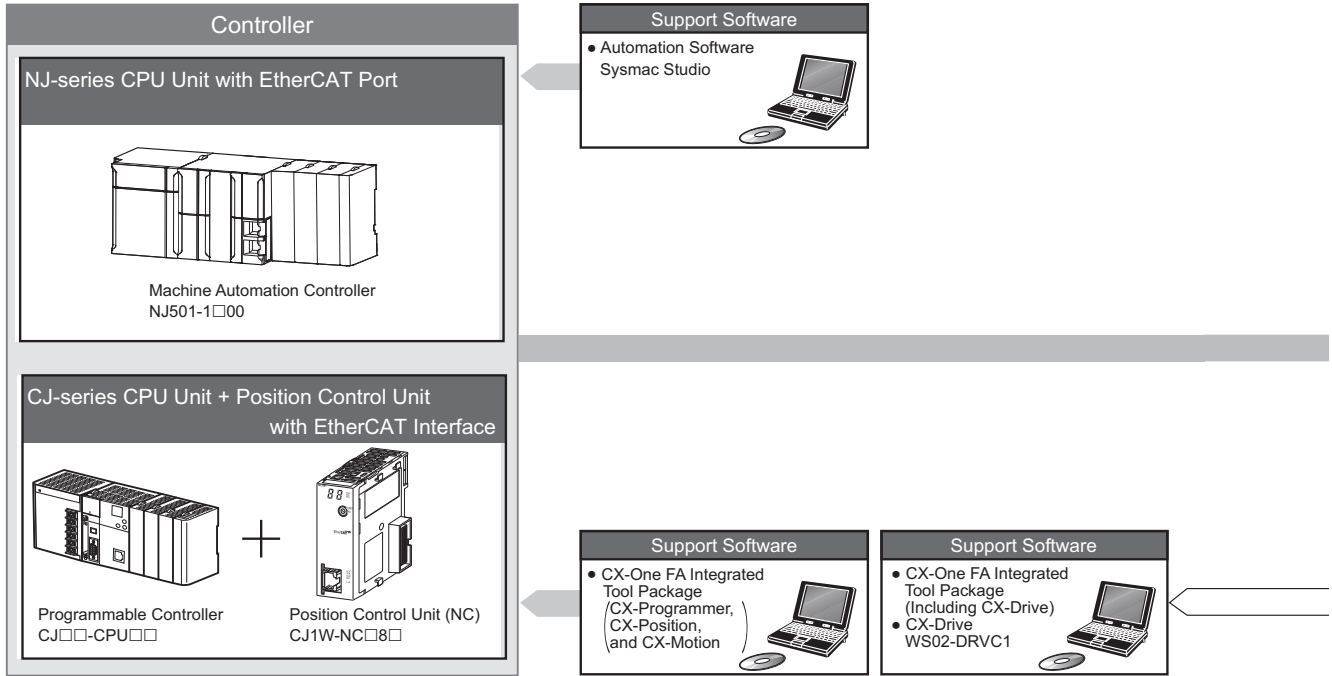
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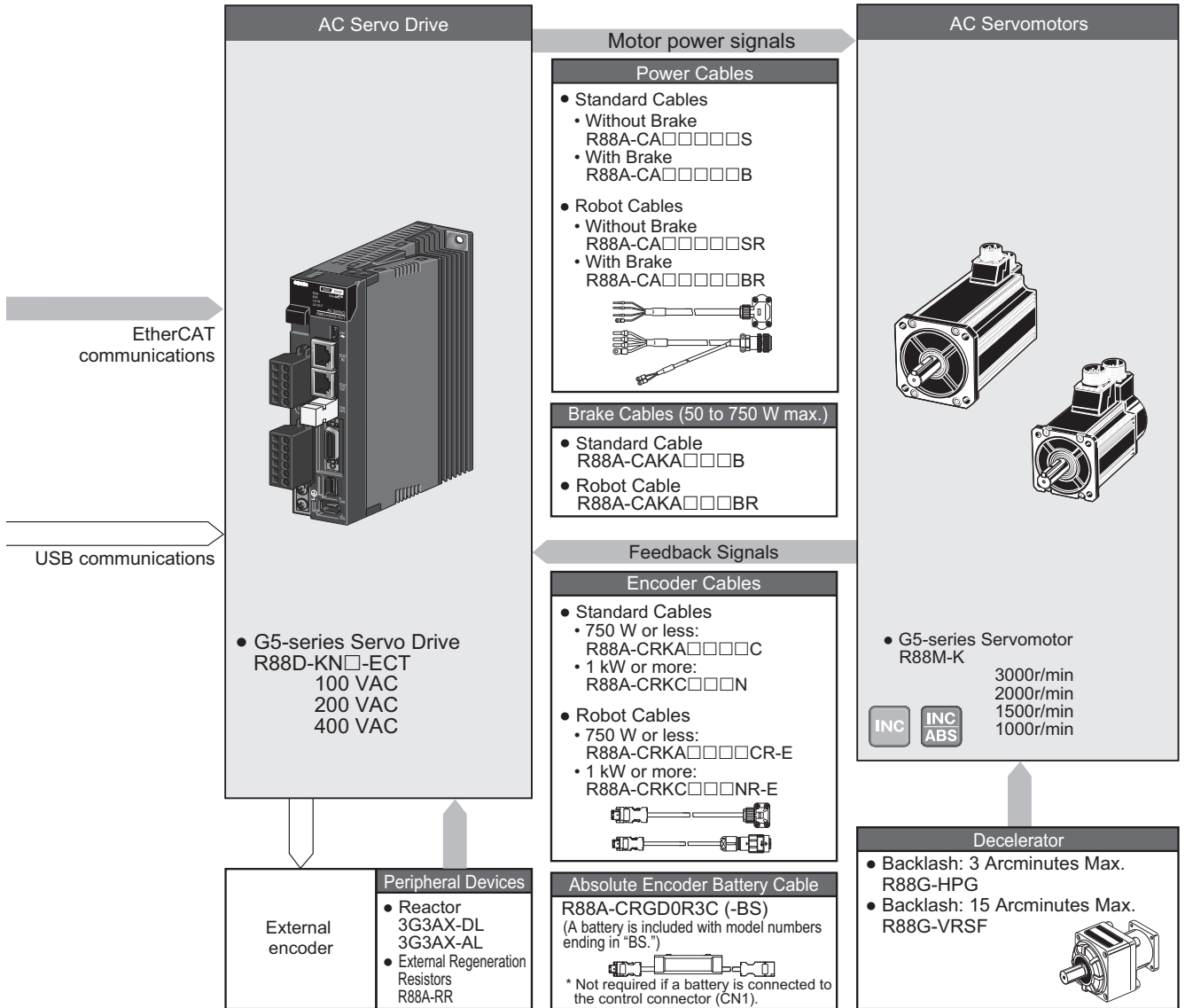
Models and External Dimensions

This chapter explains the models of Servo Drive, Servomotor, and peripheral devices, and provides the external dimensions and mounting dimensions.

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2-1 Servo System Configuration



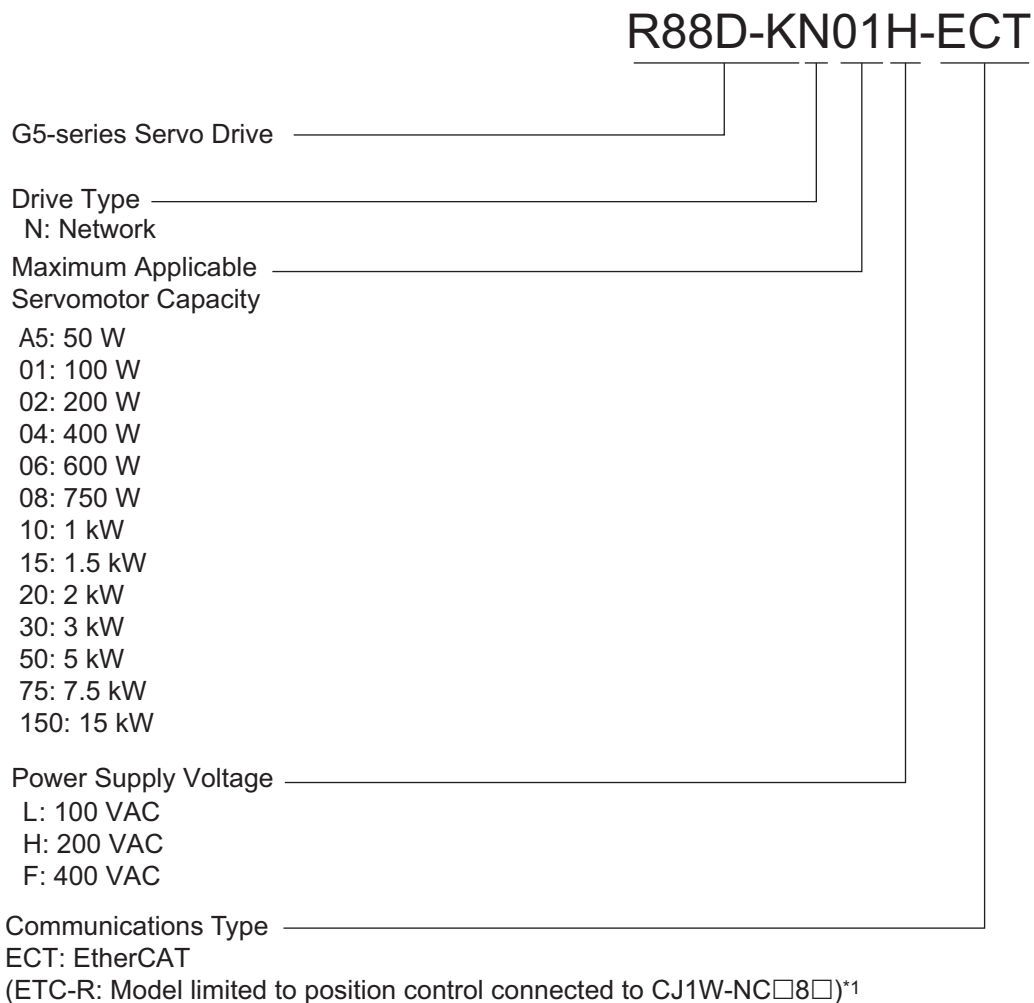


2-2 How to Read Model Numbers

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

2-2-1 Servo Drive

The Servo Drive model number tells the Servo Drive type, applicable Servomotor capacity, power supply voltage, etc.



*1 This manual is for the R88D-KN□□□-ECT Servo Drives.
For details on the R88D-KN□□□-ECT-R Servo Drives, refer to *G5 Series AC Servomotors/Servo Drives with Built-in EtherCAT Communications* (Cat. No. I573).

2-2-2 Servomotors

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

R88M-KP10030H-BOS2

G5-series Servomotor

Motor Type

Blank: Cylinder type

Servomotor Capacity

- 050: 50 W
- 100: 100 W
- 200: 200 W
- 400: 400 W
- 600: 600 W
- 750: 750 W
- 900: 900 W
- 1K0: 1 kW
- 1K5: 1.5 kW
- 2K0: 2 kW
- 3K0: 3 kW
- 4K0: 4 kW
- 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)
- H: 200 VAC (incremental encoder)
- L: 100 VAC (incremental encoder)
- C: 400 VAC (absolute encoder)
- T: 200 VAC (absolute encoder)
- S: 100 VAC (absolute encoder)

Options

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

2-2-3 Reduction Gear (3 Arcminutes Max.)

The model number provides information such as the reduction gear, flange size number, reduction ratio, applicable Servomotor, Servomotor type, and backlash.

R88G-HPG14A05100SBJ

For G5-series Servomotor
Reduction Gear
3 Arcminutes Max.

Flange Size Number
11B: □40
14A: □60
20A: □90
32A: □120
50A: □170
65A: □230

Reduction Ratio
05: 1/5
09: 1/9 (only for 11A flange)
11: 1/11 (except for 65A flange)
12: 1/12 (only for 65A flange)
20: 1/20 (only for 65A flange)
21: 1/21 (except for 65A flange)
25: 1/25 (only for 65A flange)
33: 1/33
45: 1/45

Applicable Servomotor Capacity
050: 50 W
100: 100 W
200: 200 W
400: 400 W
750: 750 W
900: 900 W
1K0: 1k W
1K5: 1.5 kW
2K0: 2 kW
3K0: 3 kW
4K0: 4 kW
4K5: 4.5 kW
5K0: 5 kW

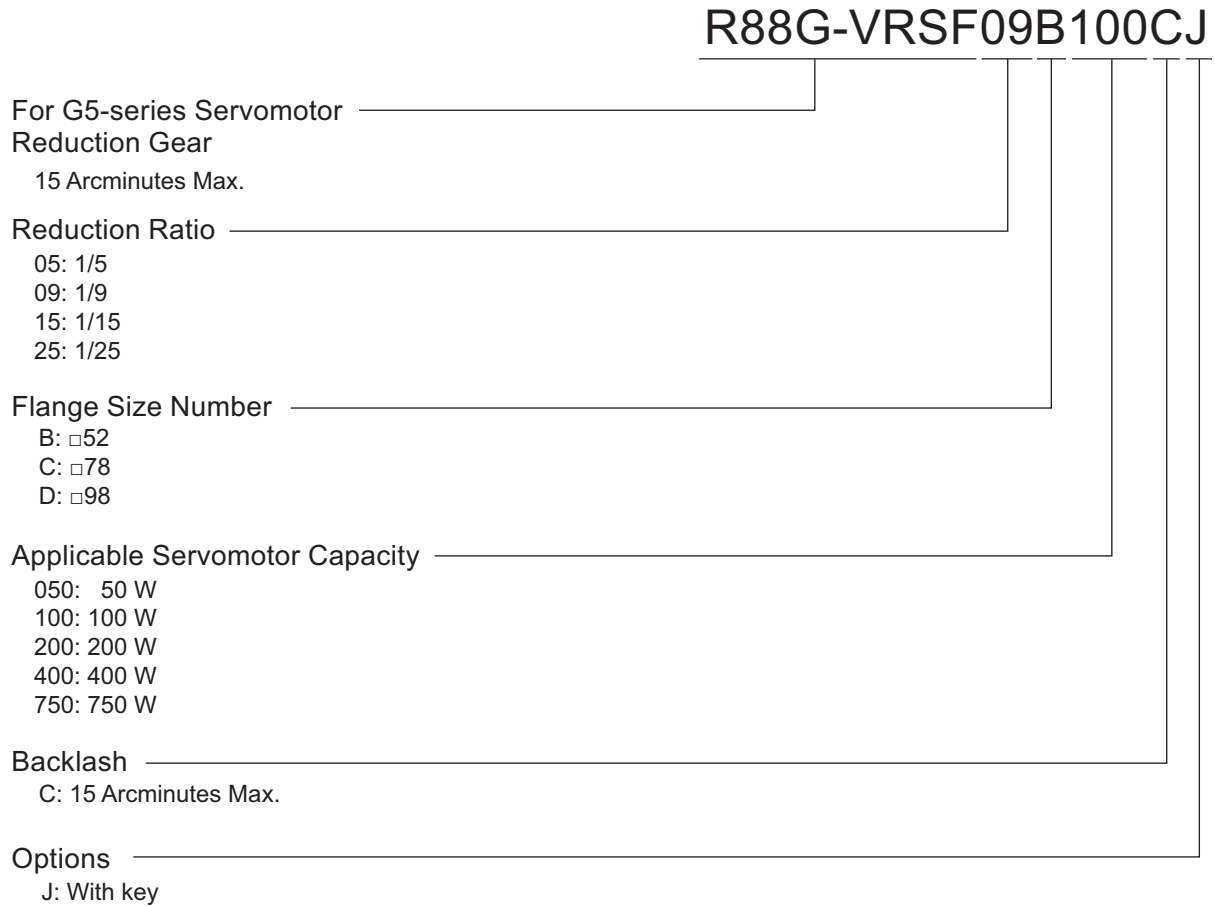
Servomotor Type
No: Cylinder type (3,000 r/min)
S: 1500r/min Servomotors, 2000r/min Servomotors
T: 1000r/min Servomotors

Backlash
B: 3 Arcminutes Max.

Options
No: Straight shaft
J: With key

2-2-4 Reduction Gear (15 Arcminutes Max.)

The model number provides information such as the reduction gear, flange size number, reduction ratio, applicable Servomotor, Servomotor type, and backlash.



2-3 Model Tables

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

2-3-1 Servo Drive Model Table

The table below lists the Servo Drive models.

| Specifications | | Model |
|------------------------------|--------|-----------------|
| Single-phase 100 VAC | 50 W | R88D-KNA5L-ECT |
| | 100 W | R88D-KN01L-ECT |
| | 200 W | R88D-KN02L-ECT |
| | 400 W | R88D-KN04L-ECT |
| Single-phase/3-phase 200 VAC | 100 W | R88D-KN01H-ECT |
| | 200 W | R88D-KN02H-ECT |
| | 400 W | R88D-KN04H-ECT |
| | 750 W | R88D-KN08H-ECT |
| | 1 kW | R88D-KN10H-ECT |
| | 1.5 kW | R88D-KN15H-ECT |
| 3-phase 200 VAC | 2 kW | R88D-KN20H-ECT |
| | 3 kW | R88D-KN30H-ECT |
| | 5 kW | R88D-KN50H-ECT |
| | 7.5 kW | R88D-KN75H-ECT |
| | 15 kW | R88D-KN150H-ECT |
| 3-phase 400 VAC | 600 W | R88D-KN06F-ECT |
| | 1 kW | R88D-KN10F-ECT |
| | 1.5 kW | R88D-KN15F-ECT |
| | 2 kW | R88D-KN20F-ECT |
| | 3 kW | R88D-KN30F-ECT |
| | 5 kW | R88D-KN50F-ECT |
| | 7.5 kW | R88D-KN75F-ECT |
| | 15 kW | R88D-KN150F-ECT |

2-3-2 Servomotor Model Tables

The following tables list the Servomotor models by the rated motor speed.

3,000-r/min Servomotors

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

Note Models with oil seals are also available.

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

| Specifications | | Model | | | | |
|----------------|-------|----------------------------|---------------------------------|----------------------------|---------------------------------|------------------|
| | | With incremental encoder | | With absolute encoder | | |
| | | Straight shaft without key | Straight shaft with key and tap | Straight shaft without key | Straight shaft with key and tap | |
| Without brakes | 200 V | 1 kW | R88M-K1K020H | R88M-K1K020H-S2 | R88M-K1K020T | R88M-K1K020T-S2 |
| | | 1.5 kW | R88M-K1K520H | R88M-K1K520H-S2 | R88M-K1K520T | R88M-K1K520T-S2 |
| | | 2 kW | R88M-K2K020H | R88M-K2K020H-S2 | R88M-K2K020T | R88M-K2K020T-S2 |
| | | 3 kW | R88M-K3K020H | R88M-K3K020H-S2 | R88M-K3K020T | R88M-K3K020T-S2 |
| | | 4 kW | R88M-K4K020H | R88M-K4K020H-S2 | R88M-K4K020T | R88M-K4K020T-S2 |
| | | 5 kW | R88M-K5K020H | R88M-K5K020H-S2 | R88M-K5K020T | R88M-K5K020T-S2 |
| | | 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 |

Note 1 Models with oil seals are also available.

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

| 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.

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

1,000-r/min Servomotors

| Specifications | | Model | | | | |
|----------------|-------|----------------------------|---------------------------------|----------------------------|---------------------------------|------------------|
| | | With incremental encoder | | With absolute encoder | | |
| | | Straight shaft without key | Straight shaft with key and tap | Straight shaft without key | Straight shaft with key and tap | |
| Without brakes | 200 V | 900 kW | R88M-K90010H | R88M-K90010H-S2 | R88M-K90010T | R88M-K90010T-S2 |
| | | 2 kW | R88M-K2K010H | R88M-K2K010H-S2 | R88M-K2K010T | R88M-K2K010T-S2 |
| | | 3 kW | R88M-K3K010H | R88M-K3K010H-S2 | R88M-K3K010T | R88M-K3K010T-S2 |
| | | 4.5 kW | – | – | R88M-K4K510T | R88M-K4K510T-S2 |
| | | 6 kW | – | – | R88M-K6K010T | R88M-K6K010T-S2 |
| | 400 V | 900 kW | R88M-K90010F | R88M-K90010F-S2 | R88M-K90010C | R88M-K90010C-S2 |
| | | 2 kW | R88M-K2K010F | R88M-K2K010F-S2 | R88M-K2K010C | R88M-K2K010C-S2 |
| | | 3 kW | R88M-K3K010F | R88M-K3K010F-S2 | R88M-K3K010C | R88M-K3K010C-S2 |
| | | 4.5 kW | – | – | R88M-K4K510C | R88M-K4K510C-S2 |
| | | 6 kW | – | – | R88M-K6K010C | R88M-K6K010C-S2 |
| With brakes | 200 V | 900 kW | R88M-K90010H-B | R88M-K90010H-BS2 | R88M-K90010T-B | R88M-K90010T-BS2 |
| | | 2 kW | R88M-K2K010H-B | R88M-K2K010H-BS2 | R88M-K2K010T-B | R88M-K2K010T-BS2 |
| | | 3 kW | R88M-K3K010H-B | R88M-K3K010H-BS2 | R88M-K3K010T-B | R88M-K3K010T-BS2 |
| | | 4.5 kW | – | – | R88M-K4K510T-B | R88M-K4K510T-BS2 |
| | | 6 kW | – | – | R88M-K6K010T-B | R88M-K6K010T-BS2 |
| | 400 V | 900 kW | R88M-K90010F-B | R88M-K90010F-BS2 | R88M-K90010C-B | R88M-K90010C-BS2 |
| | | 2 kW | R88M-K2K010F-B | R88M-K2K010F-BS2 | R88M-K2K010C-B | R88M-K2K010C-BS2 |
| | | 3 kW | R88M-K3K010F-B | R88M-K3K010F-BS2 | R88M-K3K010C-B | R88M-K3K010C-BS2 |
| | | 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.

2-3-3 Servo Drive and Servomotor Combination Tables

The tables in this section show the possible combinations of G5-series Servo Drives and Servomotors. The Servomotors and Servo Drives can only be used in the listed combinations.

“□” at the end of the motor model number is for options, such as the shaft type, brake, oil seal and key.

3,000-r/min Servomotors and Servo Drives

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

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

1,500-r/min and 2,000-r/min Servomotors and Servo Drives

| Voltage | Servomotor | | | Servo Drive |
|--------------------------------|---------------|--------------------------|-----------------------|-----------------|
| | Rated output | With incremental encoder | With absolute encoder | |
| Single-phase/ 3-phase 200 V | 1 kW | R88M-K1K020H-□ | R88M-K1K020T-□ | R88D-KN10H-ECT |
| | 1.5 kW | R88M-K1K520H-□ | R88M-K1K520T-□ | R88D-KN15H-ECT |
| 3-phase 200 V | 2 kW | R88M-K2K020H-□ | R88M-K2K020T-□ | R88D-KN20H-ECT |
| | 3 kW | R88M-K3K020H-□ | R88M-K3K020T-□ | R88D-KN30H-ECT |
| | *4 kW | R88M-K4K020H-□ | R88M-K4K020T-□ | R88D-KN50H-ECT |
| | 5 kW | R88M-K5K020H-□ | R88M-K5K020T-□ | R88D-KN50H-ECT |
| | 7.5 kW | – | R88M-K7K515T-□ | R88D-KN75H-ECT |
| | *11 kW | – | R88M-K11K015T-□ | R88D-KN150H-ECT |
| | 15 kW | – | R88M-K15K015T-□ | R88D-KN150H-ECT |
| | 3-phase 400 V | *400 W | R88M-K40020F-□ | R88M-K40020C-□ |
| | 600 W | R88M-K60020F-□ | R88M-K60020C-□ | R88D-KN06F-ECT |
| | 1 kW | R88M-K1K020F-□ | R88M-K1K020C-□ | R88D-KN10F-ECT |
| | 1.5 kW | R88M-K1K520F-□ | R88M-K1K520C-□ | R88D-KN15F-ECT |
| | 2 kW | R88M-K2K020F-□ | R88M-K2K020C-□ | R88D-KN20F-ECT |
| | 3 kW | R88M-K3K020F-□ | R88M-K3K020C-□ | R88D-KN30F-ECT |
| | *4 kW | R88M-K4K020F-□ | R88M-K4K020C-□ | R88D-KN50F-ECT |
| | 5 kW | R88M-K5K020F-□ | R88M-K5K020C-□ | R88D-KN50F-ECT |
| | 7.5 kW | – | R88M-K7K515C-□ | R88D-KN75F-ECT |
| | *11 kW | – | R88M-K11K015C-□ | R88D-KN150F-ECT |
| | 15 kW | – | R88M-K15K015C-□ | R88D-KN150F-ECT |

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

1,000-r/min Servomotors and Servo Drives

| Voltage | Servomotor | | | Servo Drive |
|--------------------------------|--------------|--------------------------|-----------------------|----------------|
| | Rated output | With incremental encoder | With absolute encoder | |
| Single-phase/ 3-phase 200 V | *900 W | R88M-K90010H-□ | R88M-K90010T-□ | R88D-KN15H-ECT |
| 3-phase 200 V | *2 kW | R88M-K2K010H-□ | R88M-K2K010T-□ | R88D-KN30H-ECT |
| | *3 kW | R88M-K3K010H-□ | R88M-K3K010T-□ | R88D-KN50H-ECT |
| | *4.5 kW | – | R88M-K4K510T-□ | R88D-KN50H-ECT |
| | *6 kW | – | R88M-K6K010T-□ | R88D-KN75H-ECT |
| 3-phase 400 V | *900 W | R88M-K90010F-□ | R88M-K90010C-□ | R88D-KN15F-ECT |
| | *2 kW | R88M-K2K010F-□ | R88M-K2K010C-□ | R88D-KN30F-ECT |
| | *3 kW | R88M-K3K010F-□ | R88M-K3K010C-□ | R88D-KN50F-ECT |
| | *4.5 kW | – | R88M-K4K510C-□ | R88D-KN50F-ECT |
| | *6 kW | – | R88M-K6K010C-□ | R88D-KN75F-ECT |

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

2-3-4 Reduction Gear Model Tables

The following tables list the Reduction Gear models for G5-series Servomotor. Select the model by the Servomotor capacity.

3 Arcminutes Max.

● For 3,000-r/min Servomotors

| Specifications | | Model |
|---------------------|-----------------|--------------------|
| Servomotor capacity | Reduction Ratio | |
| 50 W | 1/5 | R88G-HPG11B05100B□ |
| | 1/9 | R88G-HPG11B09050B□ |
| | 1/21 | R88G-HPG14A21100B□ |
| | 1/33 | R88G-HPG14A33050B□ |
| | 1/45 | R88G-HPG14A45050B□ |
| 100 W | 1/5 | R88G-HPG11B05100B□ |
| | 1/11 | R88G-HPG14A11100B□ |
| | 1/21 | R88G-HPG14A21100B□ |
| | 1/33 | R88G-HPG20A33100B□ |
| | 1/45 | R88G-HPG20A45100B□ |
| 200 W | 1/5 | R88G-HPG14A05200B□ |
| | 1/11 | R88G-HPG14A11200B□ |
| | 1/21 | R88G-HPG20A21200B□ |
| | 1/33 | R88G-HPG20A33200B□ |
| | 1/45 | R88G-HPG20A45200B□ |

| Specifications | | Model |
|---------------------|-----------------|---------------------|
| Servomotor capacity | Reduction Ratio | |
| 400 W | 1/5 | R88G-HPG14A05400B□ |
| | 1/11 | R88G-HPG20A11400B□ |
| | 1/21 | R88G-HPG20A21400B□ |
| | 1/33 | R88G-HPG32A33400B□ |
| | 1/45 | R88G-HPG32A45400B□ |
| 750 W (200 V) | 1/5 | R88G-HPG20A05750B□ |
| | 1/11 | R88G-HPG20A11750B□ |
| | 1/21 | R88G-HPG32A21750B□ |
| | 1/33 | R88G-HPG32A33750B□ |
| | 1/45 | R88G-HPG32A45750B□ |
| 750 W (400 V) | 1/5 | R88G-HPG32A052K0B□ |
| | 1/11 | R88G-HPG32A112K0B□ |
| | 1/21 | R88G-HPG32A211K5B□ |
| | 1/33 | R88G-HPG32A33600SB□ |
| | 1/45 | R88G-HPG50A451K5B□ |
| 1 kW | 1/5 | R88G-HPG32A052K0B□ |
| | 1/11 | R88G-HPG32A112K0B□ |
| | 1/21 | R88G-HPG32A211K5B□ |
| | 1/33 | R88G-HPG50A332K0B□ |
| | 1/45 | R88G-HPG50A451K5B□ |
| 1.5 kW | 1/5 | R88G-HPG32A052K0B□ |
| | 1/11 | R88G-HPG32A112K0B□ |
| | 1/21 | R88G-HPG32A211K5B□ |
| | 1/33 | R88G-HPG50A332K0B□ |
| | 1/45 | R88G-HPG50A451K5B□ |
| 2 kW | 1/5 | R88G-HPG32A052K0B□ |
| | 1/11 | R88G-HPG32A112K0B□ |
| | 1/21 | R88G-HPG50A212K0B□ |
| | 1/33 | R88G-HPG50A332K0B□ |
| 3 kW | 1/5 | R88G-HPG32A053K0B□ |
| | 1/11 | R88G-HPG50A113K0B□ |
| | 1/21 | R88G-HPG50A213K0B□ |
| 4 kW | 1/5 | R88G-HPG32A054K0B□ |
| | 1/11 | R88G-HPG50A115K0B□ |
| 5 kW | 1/5 | R88G-HPG50A055K0B□ |
| | 1/11 | R88G-HPG50A115K0B□ |

Note 1 The standard shaft type is a straight shaft.

- 2** A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box).
(Example: R88G-HPG11A05100BJ)

● For 2,000-r/min Servomotors

| Specifications | | Model |
|---------------------|-----------------|---------------------|
| Servomotor capacity | Reduction Ratio | |
| 400 W | 1/5 | R88G-HPG32A052K0B□ |
| | 1/11 | R88G-HPG32A112K0B□ |
| | 1/21 | R88G-HPG32A211K5B□ |
| | 1/33 | R88G-HPG32A33600SB□ |
| | 1/45 | R88G-HPG32A45400SB□ |
| 600 W | 1/5 | R88G-HPG32A052K0B□ |
| | 1/11 | R88G-HPG32A112K0B□ |
| | 1/21 | R88G-HPG32A211K5B□ |
| | 1/33 | R88G-HPG32A33600SB□ |
| | 1/45 | R88G-HPG50A451K5B□ |
| 1 kW | 1/5 | R88G-HPG32A053K0B□ |
| | 1/11 | R88G-HPG32A112K0SB□ |
| | 1/21 | R88G-HPG32A211K0SB□ |
| | 1/33 | R88G-HPG50A332K0SB□ |
| | 1/45 | R88G-HPG50A451K0SB□ |
| 1.5 kW | 1/5 | R88G-HPG32A053K0B□ |
| | 1/11 | R88G-HPG32A112K0SB□ |
| | 1/21 | R88G-HPG50A213K0B□ |
| | 1/33 | R88G-HPG50A332K0SB□ |
| 2 kW | 1/5 | R88G-HPG32A053K0B□ |
| | 1/11 | R88G-HPG32A112K0SB□ |
| | 1/21 | R88G-HPG50A213K0B□ |
| | 1/33 | R88G-HPG50A332K0SB□ |
| 3 kW | 1/5 | R88G-HPG32A054K0B□ |
| | 1/11 | R88G-HPG50A115K0B□ |
| | 1/21 | R88G-HPG50A213K0SB□ |
| | 1/25 | R88G-HPG65A253K0SB□ |
| 4 kW | 1/5 | R88G-HPG50A055K0SB□ |
| | 1/11 | R88G-HPG50A115K0SB□ |
| | 1/20 | R88G-HPG65A205K0SB□ |
| | 1/25 | R88G-HPG65A255K0SB□ |
| 5 kW | 1/5 | R88G-HPG50A055K0SB□ |
| | 1/11 | R88G-HPG50A115K0SB□ |
| | 1/20 | R88G-HPG65A205K0SB□ |
| | 1/25 | R88G-HPG65A255K0SB□ |

Note 1 The standard shaft type is a straight shaft.

- 2** A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box).
(Example: R88G-HPG32A053K0BJ)

● For 1,000-r/min Servomotors

| Specifications | | Model |
|---------------------|-----------------|---------------------|
| Servomotor capacity | Reduction Ratio | |
| 900 W | 1/5 | R88G-HPG32A05900TB□ |
| | 1/11 | R88G-HPG32A11900TB□ |
| | 1/21 | R88G-HPG50A21900TB□ |
| | 1/33 | R88G-HPG50A33900TB□ |
| 2 kW | 1/5 | R88G-HPG32A052K0TB□ |
| | 1/11 | R88G-HPG50A112K0TB□ |
| | 1/21 | R88G-HPG50A212K0TB□ |
| | 1/25 | R88G-HPG65A255K0SB□ |
| 3 kW | 1/5 | R88G-HPG50A055K0SB□ |
| | 1/11 | R88G-HPG50A115K0SB□ |
| | 1/20 | R88G-HPG65A205K0SB□ |
| | 1/25 | R88G-HPG65A255K0SB□ |

Note 1 The standard shaft type is a straight shaft.

2 A model with a key and tap is indicated by adding “J” to the end of the model number (the suffix shown in the box).

(Example: R88G-HPG32A05900TBJ)

15 Arcminutes Max.

● For 3,000-r/min Servomotors (Straight Shaft with Key)

| Specifications | | Model |
|---------------------|-----------------|-------------------|
| Servomotor capacity | Reduction Ratio | |
| 50 W | 1/5 | R88G-VRSF05B100CJ |
| | 1/9 | R88G-VRSF09B100CJ |
| | 1/15 | R88G-VRSF15B100CJ |
| | 1/25 | R88G-VRSF25B100CJ |
| 100 W | 1/5 | R88G-VRSF05B100CJ |
| | 1/9 | R88G-VRSF09B100CJ |
| | 1/15 | R88G-VRSF15B100CJ |
| | 1/25 | R88G-VRSF25B100CJ |
| 200 W | 1/5 | R88G-VRSF05B200CJ |
| | 1/9 | R88G-VRSF09C200CJ |
| | 1/15 | R88G-VRSF15C200CJ |
| | 1/25 | R88G-VRSF25C200CJ |
| 400 W | 1/5 | R88G-VRSF05C400CJ |
| | 1/9 | R88G-VRSF09C400CJ |
| | 1/15 | R88G-VRSF15C400CJ |
| | 1/25 | R88G-VRSF25C400CJ |
| 750 W | 1/5 | R88G-VRSF05C750CJ |
| | 1/9 | R88G-VRSF09D750CJ |
| | 1/15 | R88G-VRSF15D750CJ |
| | 1/25 | R88G-VRSF25D750CJ |

2-3-5 Cable and Peripheral Device Model Tables

The following tables list the models of cables and peripheral devices. The cables include motor power cables, brake cables, encoder cables, EtherCAT communications cables, and absolute encoder battery cables. The peripheral devices include Connectors, External Regeneration Resistors, and Mounting Brackets.

Encoder Cables (Standard Cable)

| Specifications | | Model |
|---|---|---------------|
| [100 V and 200 V] For 3,000-r/min Servomotors of 50 to 750 W (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] 3,000-r/min Servomotors of 1.0 kW or more For 2,000-r/min Servomotors For 1,500-r/min Servomotors For 1,000-r/min Servomotors | 3 m |
| 5 m | | R88A-CRKC005N |
| 10 m | | R88A-CRKC010N |
| 15 m | | R88A-CRKC015N |
| 20 m | | R88A-CRKC020N |
| 30 m | | R88A-CRKC030N |
| 40 m | | R88A-CRKC040N |
| [400 V] For 3,000-r/min Servomotors For 2,000-r/min Servomotors For 1,500-r/min Servomotors For 1,000-r/min Servomotors | 50 m | R88A-CRKC050N |

Motor Power Cables (Standard Cable)

| Specifications | Model | | |
|---|-------|-------------------------|----------------------|
| | | For motor without brake | For motor with brake |
| [100 V and 200 V] For 3,000-r/min Servomotors of 50 to 750 W | 3 m | R88A-CAKA003S | (See note 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] For 3,000-r/min Servomotors of 1 to 2 kW For 2,000-r/min Servomotors of 1 to 2 kW For 1,000-r/min Servomotors 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] For 3,000-r/min Servomotors of 750 W to 2 kW For 2,000-r/min Servomotors of 400 W to 2 kW For 1,000-r/min Servomotors 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 |
| For 3,000-r/min Servomotors of 3 to 5 kW For 2,000-r/min Servomotors of 3 to 5 kW For 1,000-r/min Servomotors of 2 to 4.5 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 |
| For 2,000-r/min Servomotors of 7.5 kW For 1,000-r/min Servomotors 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 | – |

- Note 1** Different connectors are used for the motor power and the brake on 100-V and 200-V, 3,000-r/min Servomotors of 50 to 750 W and Servomotors of 6 to 15 kW. When using a Servomotor with a brake, two cables are required: a Power Cable without Brake and a Brake Cable.
- 2** For flexible power cables for Servomotors of 11 to 15 kW, refer to 4-2 Wiring (page 4-10) and make your own cable.

Brake Cables (Standard Cable)

| Specifications | Model | |
|--|-------|---------------|
| [100 V and 200 V] For 3,000-r/min Servomotors 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 1,500-r/min Servomotors of 7.5 to 15 kW For 1,000-r/min Servomotors 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 (Robot Cable)

| Specifications | | Model |
|---|------|----------------|
| [100 V and 200 V] For 3,000-r/min Servomotors of 50 to 750 W (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] 3,000-r/min Servomotors of 1.0 kW or more For 2,000-r/min Servomotors For 1,000-r/min Servomotors | 3 m | R88A-CRKC003NR |
| | 5 m | R88A-CRKC005NR |
| | 10 m | R88A-CRKC010NR |
| | 15 m | R88A-CRKC015NR |
| | 20 m | R88A-CRKC020NR |
| [400 V] For 3,000-r/min Servomotors For 2,000-r/min Servomotors For 1,500-r/min Servomotors For 1,000-r/min Servomotors | 30 m | R88A-CRKC030NR |
| | 40 m | R88A-CRKC040NR |
| | 50 m | R88A-CRKC050NR |

Motor Power Cables (Robot Cable)

| Specifications | | Model | |
|---|------|-------------------------|----------------------|
| | | For motor without brake | For motor with brake |
| [100 V and 200 V] For 3,000-r/min Servomotors of 50 to 750 W | 3 m | R88A-CAKA003SR | – |
| | 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] For 3,000-r/min Servomotors of 1 to 2 kW For 2,000-r/min Servomotors of 1 to 2 kW For 1,000-r/min Servomotors 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] For 3,000-r/min Servomotors of 750 W to 2 kW For 2,000-r/min Servomotors of 400 W to 2 kW For 1,000-r/min Servomotors 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 |
| For 3,000-r/min Servomotors of 3 to 5 kW For 2,000-r/min Servomotors of 3 to 5 kW For 1,000-r/min Servomotors of 2 to 4.5 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 |

- Note 1** Different connectors are used for the motor power and the brake on 100-V and 200-V, 3,000-r/min Servomotors of 50 to 750 W and Servomotors of 6 to 15 kW. When using a Servomotor with a brake, two cables are required: a Power Cable without Brake and a Brake Cable.
- 2** For flexible power cables for Servomotors of 11 to 15 kW, refer to *4-2 Wiring* on page 4-10 and make your own cable.
For flexible power cables for Servomotors of 6 to 7.5 kW, refer to *3-5-1 Bend Radius of Robot Cable* on page 3-67 and *3-5-4 Motor Power Cable Specifications* on page 3-75 and make your own power cable.

Brake Cables (Robot Cable)

| Specifications | | Model |
|---|------|----------------|
| [100 V and 200 V] For 3,000-r/min Servomotors 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 |

Note For flexible brake cables for Servomotors of 6 to 15 kW, refer to *3-5 Cable and Connector Specifications* and make your own brake cable.

EtherCAT Communications Cable (Recommended)

| Size x Number of cable cores (pairs) | Recommended manufacturer | Model |
|--------------------------------------|------------------------------|--------------------------|
| AWG24 x 4P | Tonichi kyosan Cable, Ltd. | NETSTAR-C5E SAB 0.5 × 4P |
| | Kuramo Electric Co. | KETH-SB |
| | SWCC Showa Cable Systems Co. | FAE-5004 |
| AWG22 x 2P | Kuramo Electric Co. | KETH-PSB-OMR |

Ethernet Category 5 (100BASE-TX) or higher (twisted-pair cable with double, aluminum tape and braided shielding) is recommended.

Absolute Encoder Battery Cables

| Name | | Model |
|---|-------|------------------|
| Absolute Encoder Battery Cable (battery not supplied) | 0.3 m | R88A-CRGD0R3C |
| Absolute Encoder Battery Cable (R88A-BAT01G battery × 1 supplied) | 0.3 m | R88A-CRGD0R3C-BS |

Absolute Encoder Backup Battery

| Name | Model |
|---------------------------------|-------------|
| Absolute Encoder Backup Battery | R88A-BAT01G |

Analog Monitor Cable

| Name | | Model |
|----------------------|-----|--------------|
| Analog Monitor Cable | 1 m | R88A-CMK001S |

Connectors

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

Control Cables

| Name | | Model |
|---------------------------------|-------------|---------------|
| Connector-terminal Block Cables | 1 m | XW2Z-100J-B34 |
| | 2 m | XW2Z-200J-B34 |
| Connector-terminal Block | M3 screws | XW2B-20G4 |
| | M3.5 screws | XW2B-20G5 |
| | M3 screws | XW2D-20G6 |

External Regeneration Resistors

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

Reactor

| Applicable Servo Drives | Model | Reactor type |
|---|--------------|--------------|
| R88D-KNA5L-ECT/-KN01H-ECT (For single-phase input) | 3G3AX-DL2002 | DC reactor |
| R88D-KN01L-ECT/-KN02H-ECT (For single-phase input) | 3G3AX-DL2004 | |
| R88D-KN02L-ECT/-KN04H-ECT (For single-phase input) | 3G3AX-DL2007 | |
| R88D-KN04L-ECT/-KN08H-ECT/-KN10H-ECT (For single-phase input) | 3G3AX-DL2015 | |
| R88D-KN15H-ECT (For single-phase input) | 3G3AX-DL2022 | |
| R88D-KN01H-ECT/-KN02H-ECT/-KN04H-ECT/-KN08H-ECT/-KN10H-ECT/-KN15H-ECT (For 3-phase input) | 3G3AX-AL2025 | AC reactor |
| R88D-KN20H-ECT/-KN30H-ECT | 3G3AX-AL2055 | |
| R88D-KN50H-ECT | 3G3AX-AL2110 | |
| R88D-KN75H-ECT/-KN150H-ECT | 3G3AX-AL2220 | |
| R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT | 3G3AX-AL4025 | |
| R88D-KN20F-ECT/-KN30F-ECT | 3G3AX-AL4055 | |
| R88D-KN50F-ECT | 3G3AX-AL4110 | |
| R88D-KN75F-ECT/-KN150F-ECT | 3G3AX-AL4220 | |

Mounting Brackets (L-brackets for Rack Mounting)

| Applicable Servo Drives | Model |
|--|------------|
| R88D-KNA5L-ECT/-KN01L-ECT/-KN01H-ECT/-KN02H-ECT | R88A-TK01K |
| R88D-KN02L-ECT/-KN04H-ECT | R88A-TK02K |
| R88D-KN04L-ECT/-KN08H-ECT | R88A-TK03K |
| R88D-KN10H-ECT/-KN15H-ECT/-KN06F-ECT/-KN10F-ECT/-KN15F-ECT | R88A-TK04K |

2-4 External and Mounting Dimensions

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

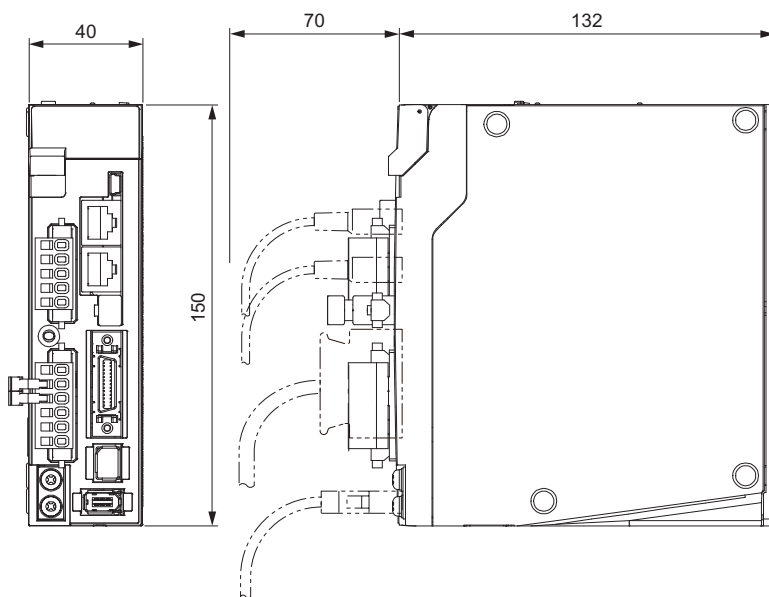
2-4-1 Servo Drive Dimensions

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

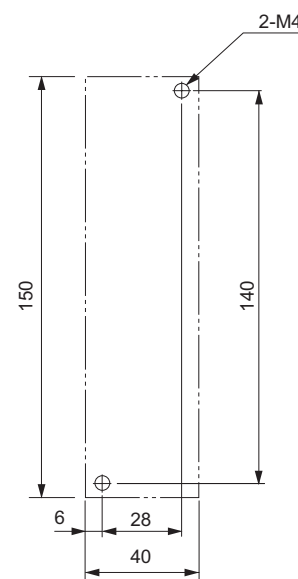
Single-phase 100 VAC: R88D-KNA5L-ECT/-KN01L-ECT (50 to 100 W)
Single-phase/3-phase 200 VAC: R88D-KN01H-ECT/-KN02H-ECT (100 to 200 W)

- Wall Mounting

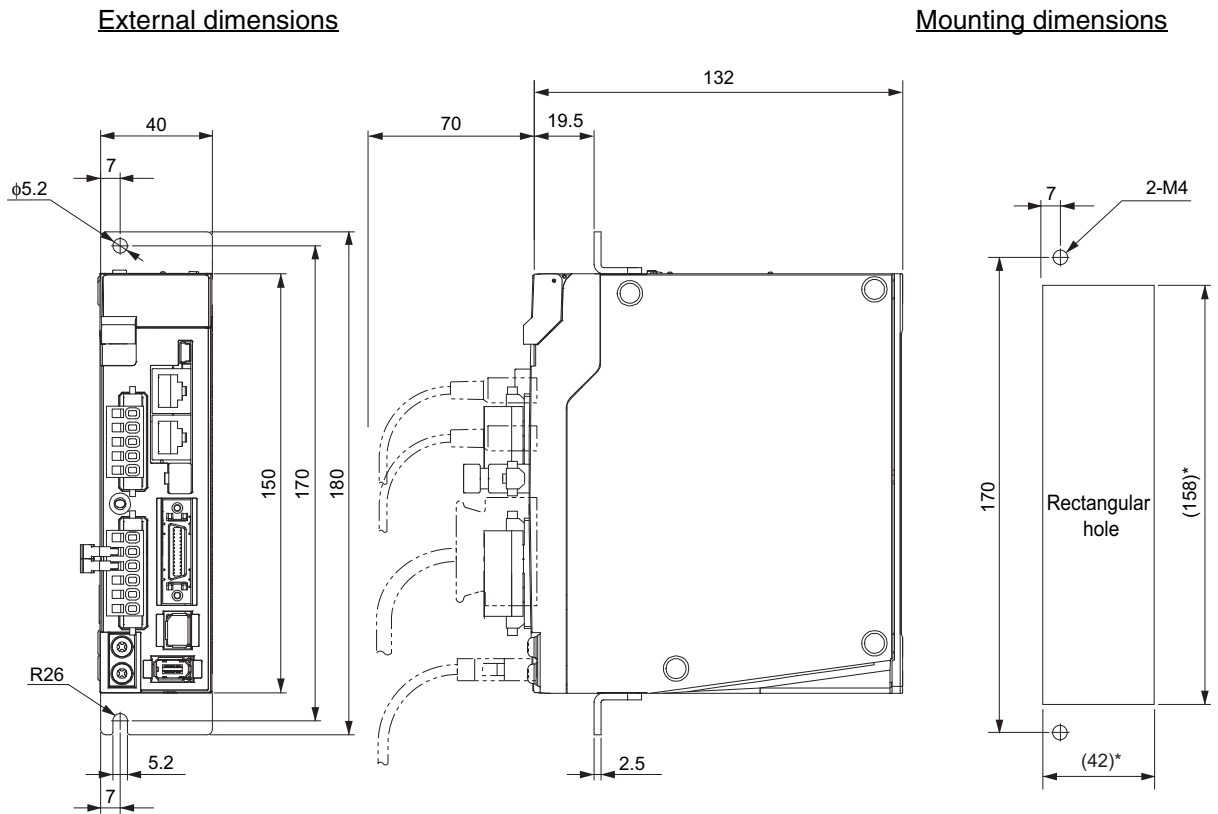
External dimensions



Mounting dimensions



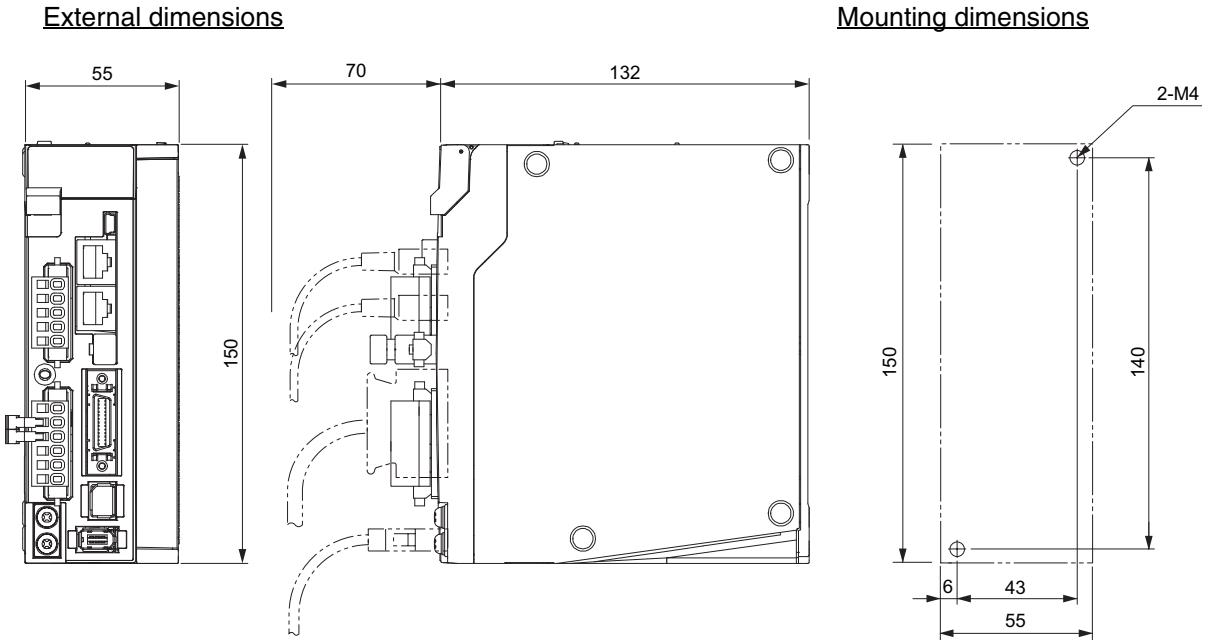
● Front Mounting (Using Front Mounting Brackets)



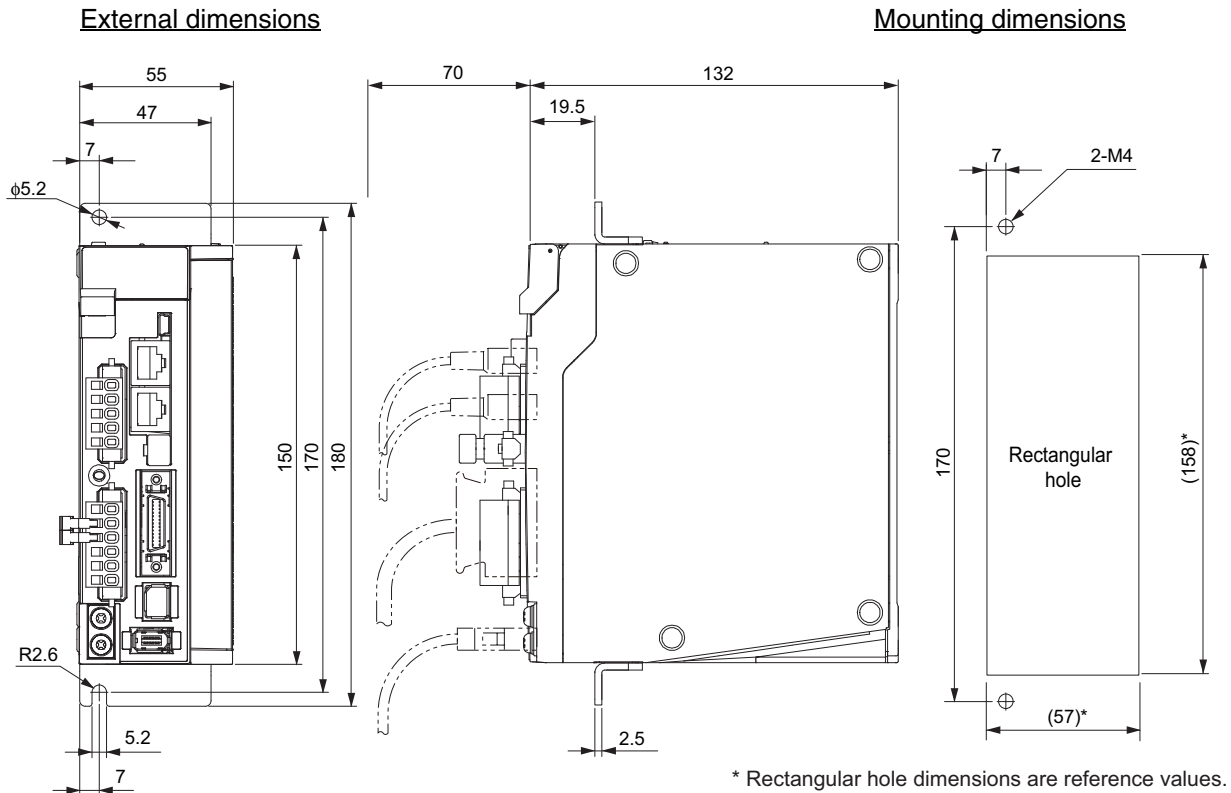
* Rectangular hole dimensions are reference values.

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

● **Wall Mounting**

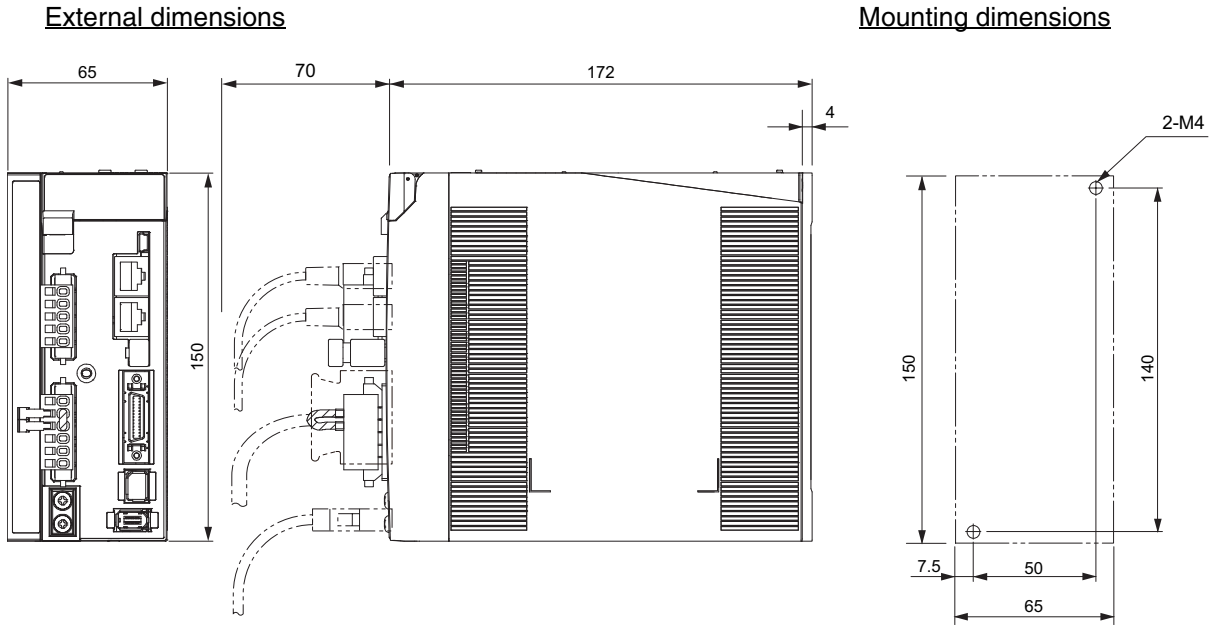


● **Front Mounting (Using Front Mounting Brackets)**

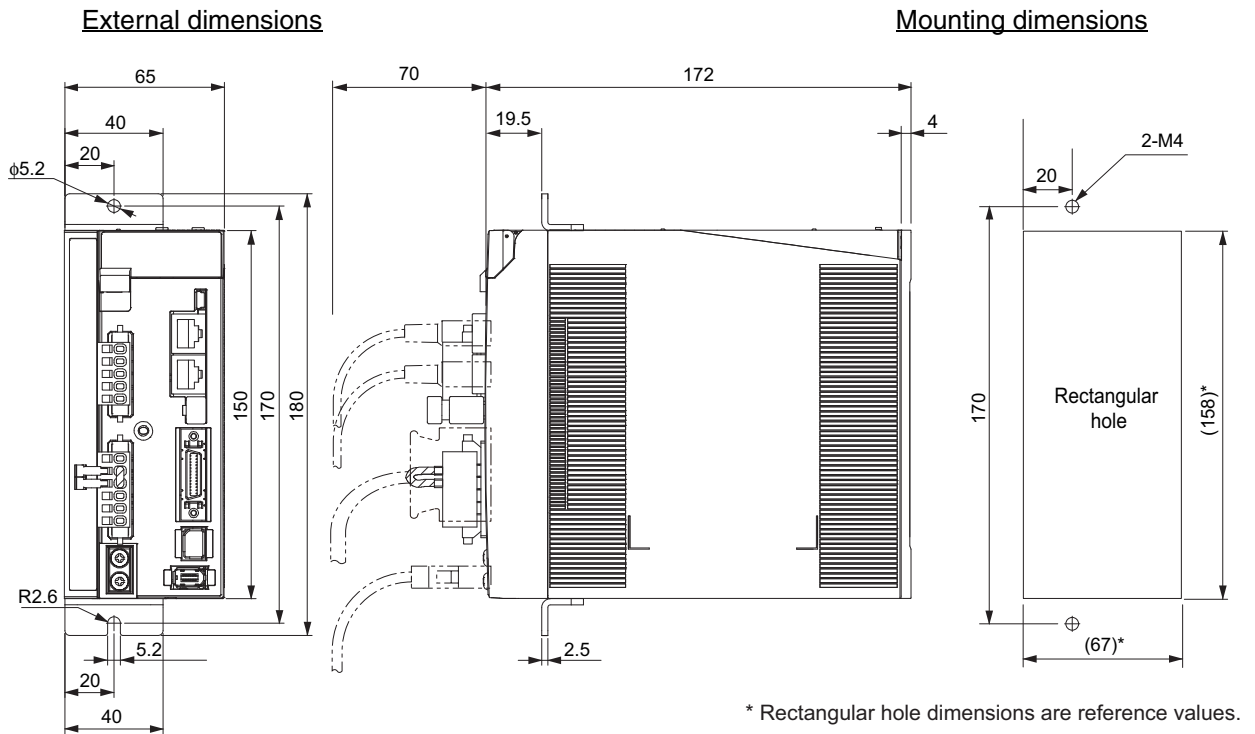


Single-phase/3-phase 100 VAC: R88D-KN04L-ECT (400 W)
Single-phase/3-phase 200 VAC: R88D-KN08H-ECT (750 W)

● **Wall Mounting**



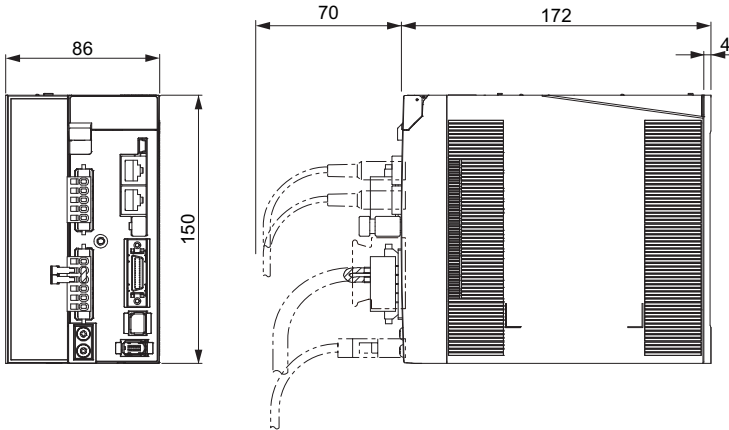
● **Front Mounting (Using Front Mounting Brackets)**



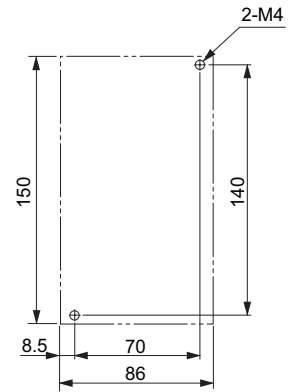
**Single-phase/3-phase 200 VAC: R88D-KN10H-ECT/-KN15H-ECT
(900 W to 1.5 kW)**

● **Wall Mounting**

External dimensions

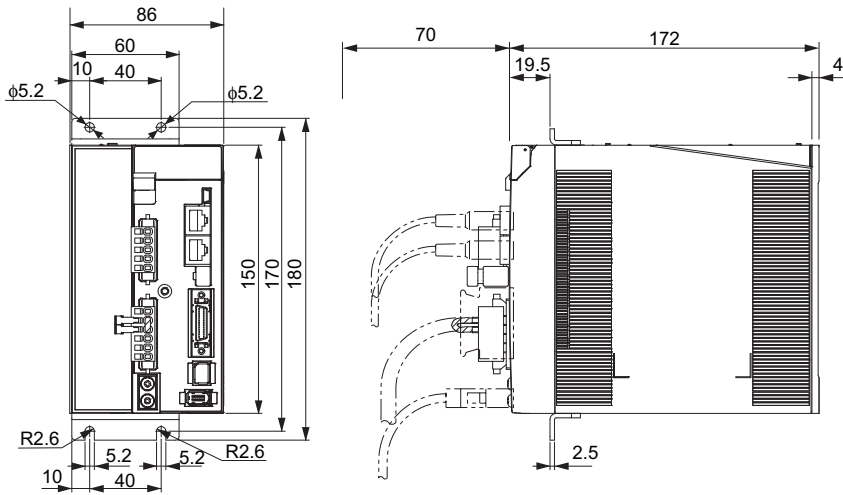


Mounting dimensions

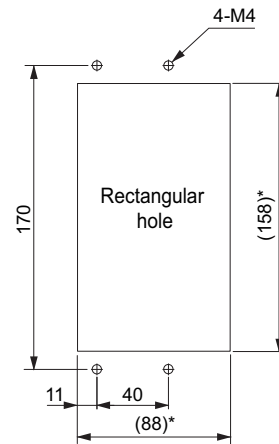


● **Front Mounting (Using Front Mounting Brackets)**

External dimensions



Mounting dimensions

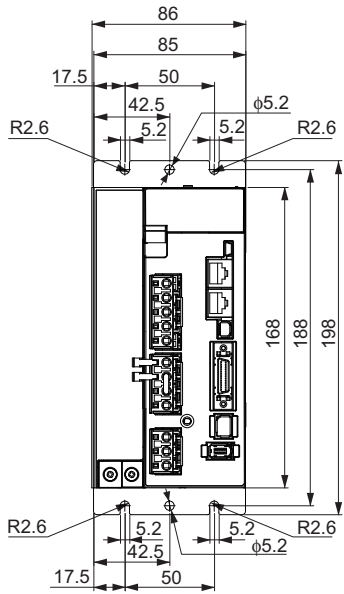


* Rectangular hole dimensions are reference values.

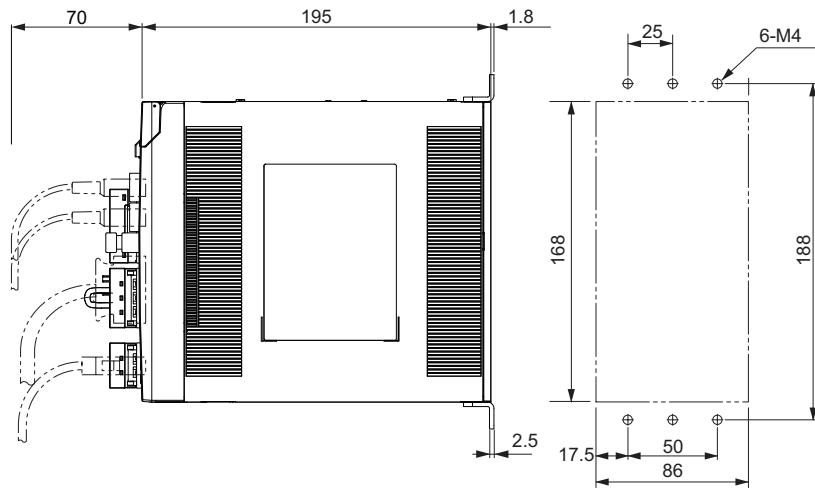
3-phase 200 VAC: R88D-KN20H-ECT (2 kW)

● Wall Mounting

External dimensions

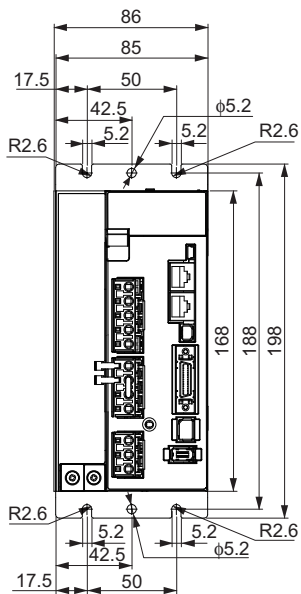


Mounting dimensions

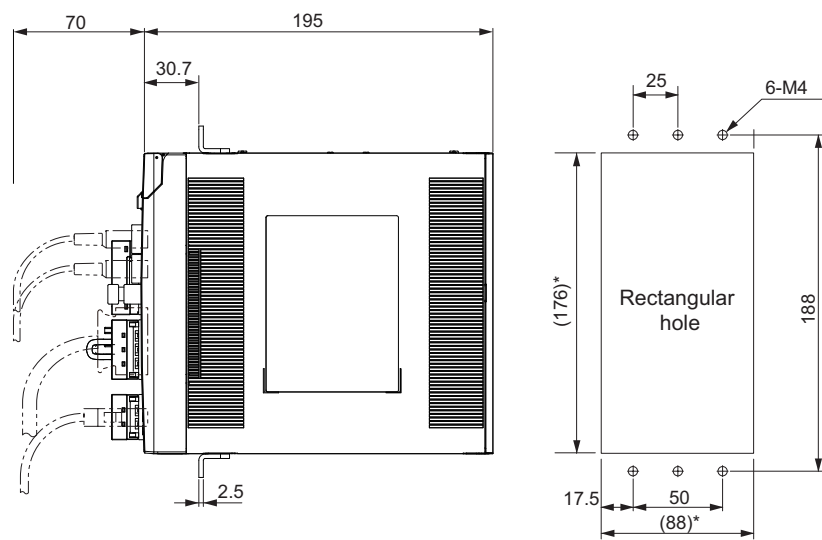


● Front Mounting (Using Front Mounting Brackets)

External dimensions



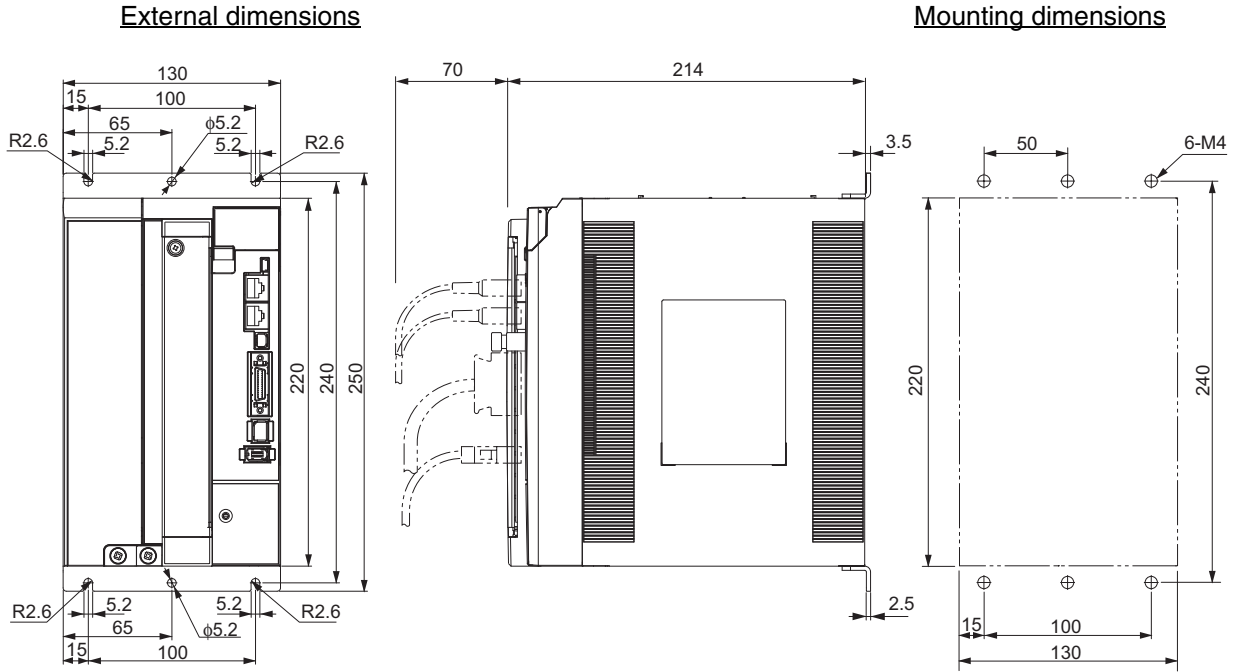
Mounting dimensions



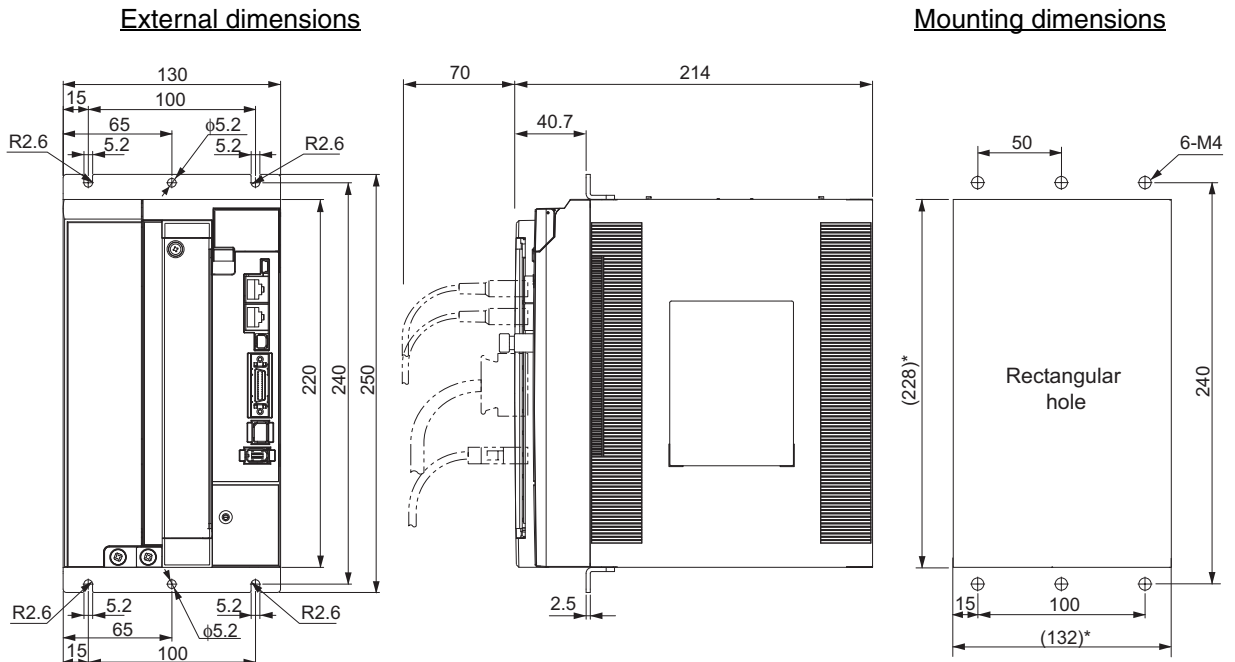
* Rectangular hole dimensions are reference values.

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

● **Wall Mounting**



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

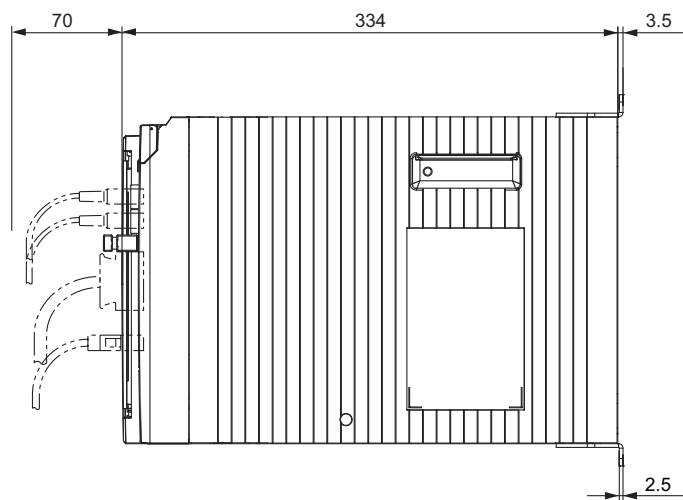
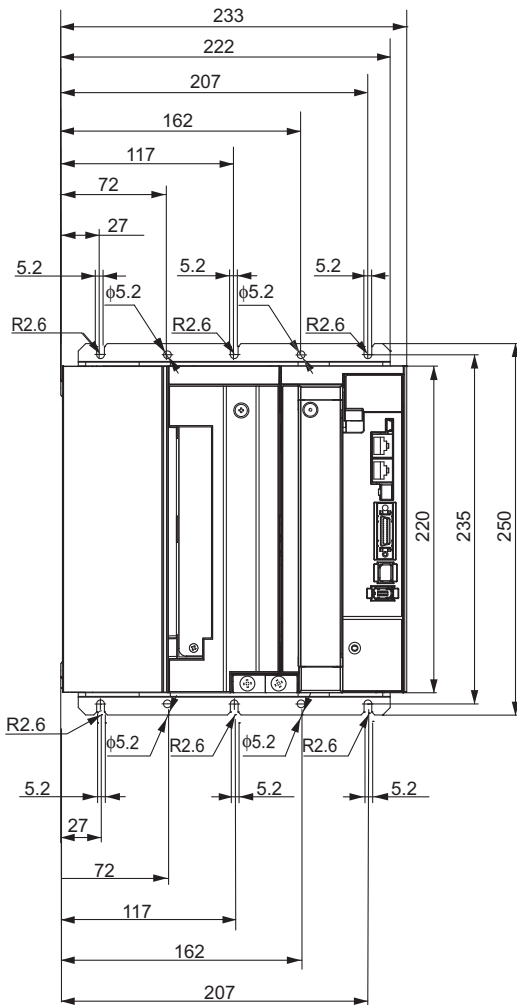


* Rectangular hole dimensions are reference values.

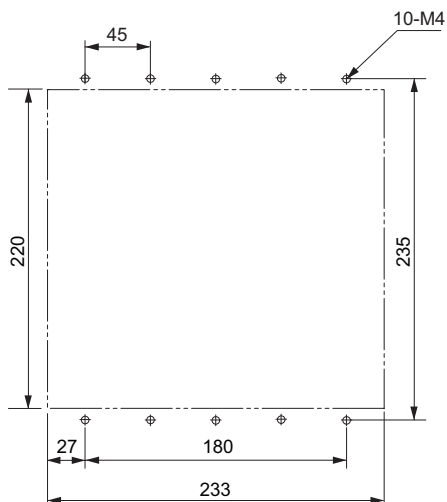
3-phase 200 VAC: R88D-KN75H-ECT (7.5 kW)

● Wall Mounting

External dimensions

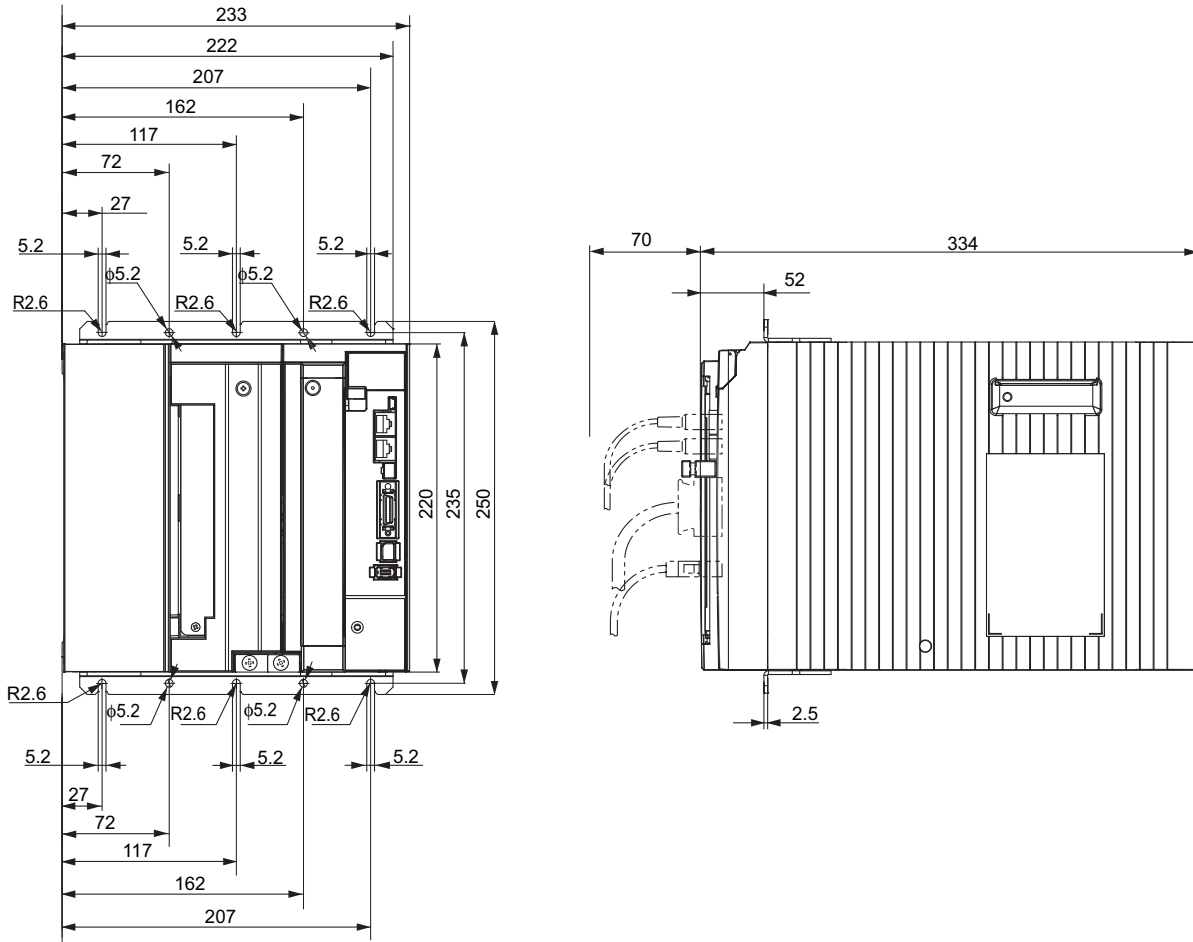


Mounting dimensions

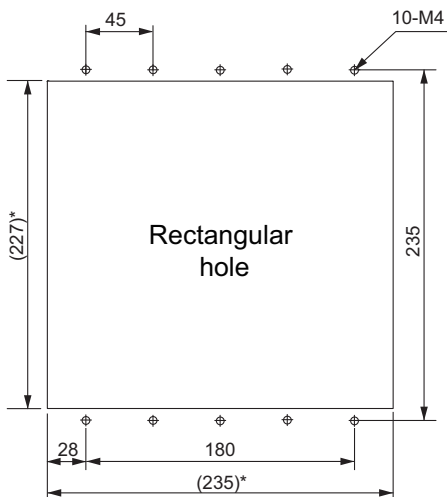


● **Front Mounting (Using Front Mounting Brackets)**

External dimensions



Mounting dimensions

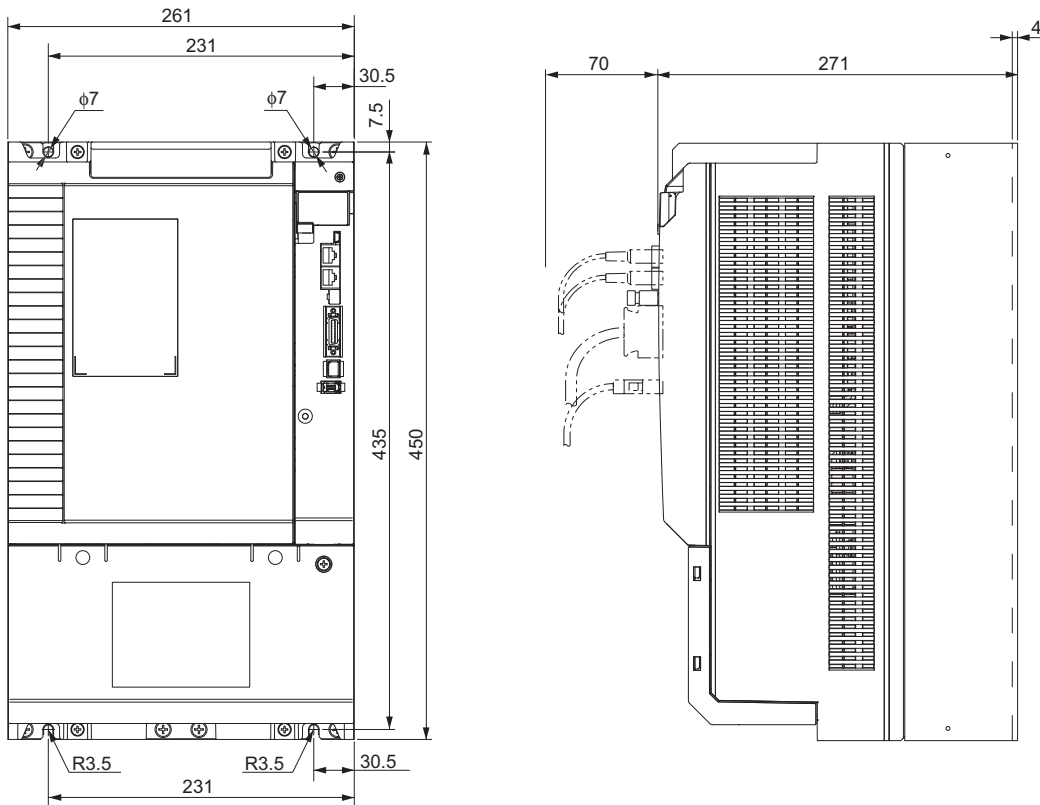


* Rectangular hole dimensions are reference values.

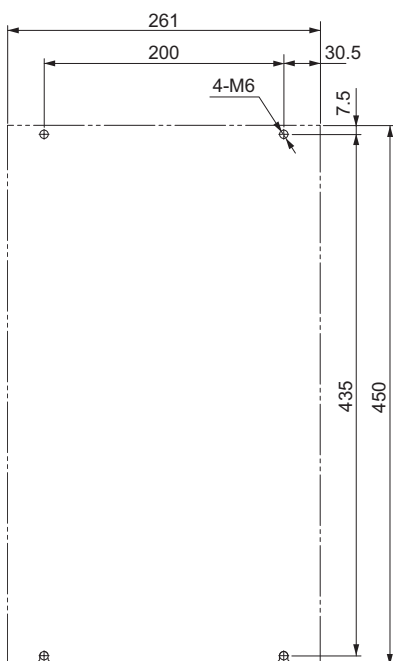
3-phase 200 VAC: R88D-KN150H-ECT (15 kW)

● Wall Mounting

External dimensions



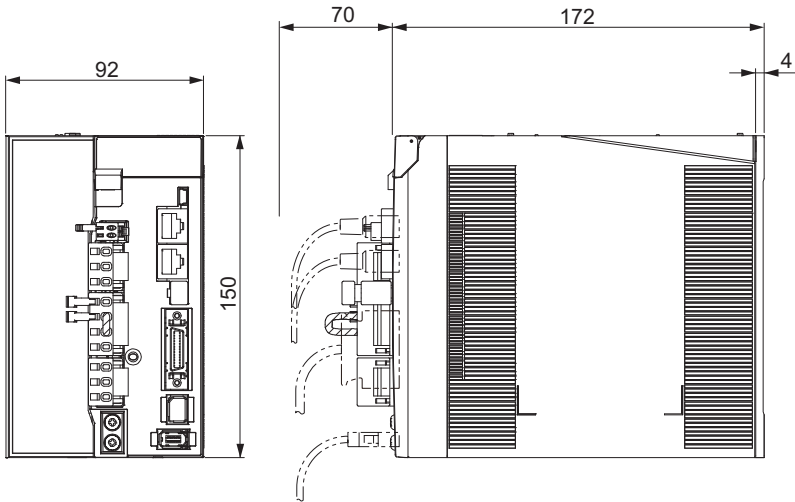
Mounting dimensions



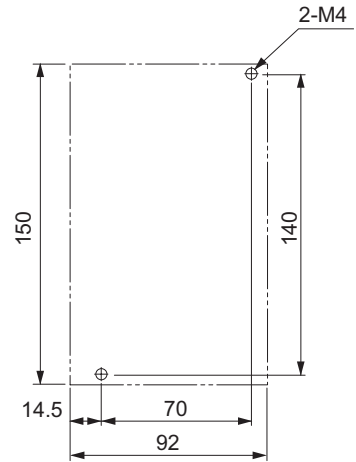
3-phase 400 VAC: R88D-KN06F-ECT/-KN10F-ECT (600 W to 1.0 kW)
3-phase 400 VAC: R88D-KN15F-ECT (1.5 kW)

● **Wall Mounting**

External dimensions

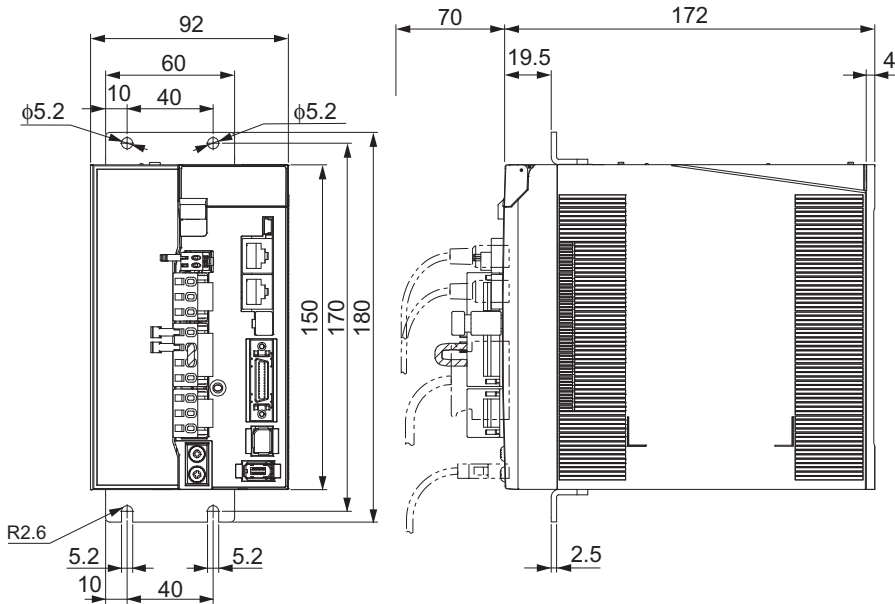


Mounting dimensions

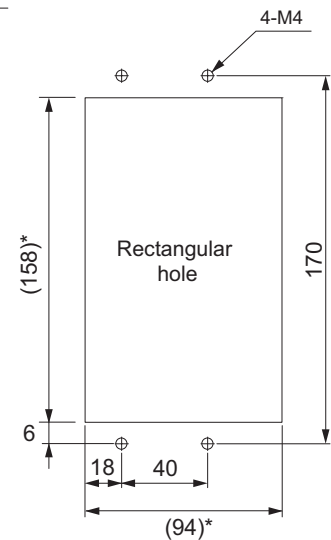


● **Front Mounting (Using Front Mounting Brackets)**

External dimensions



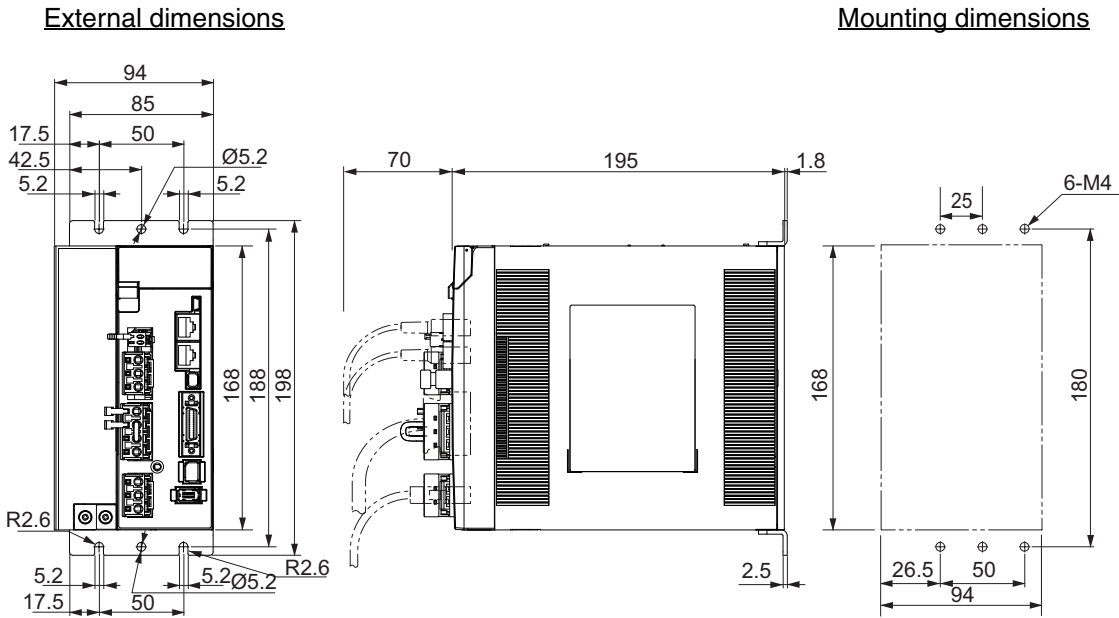
Mounting dimensions



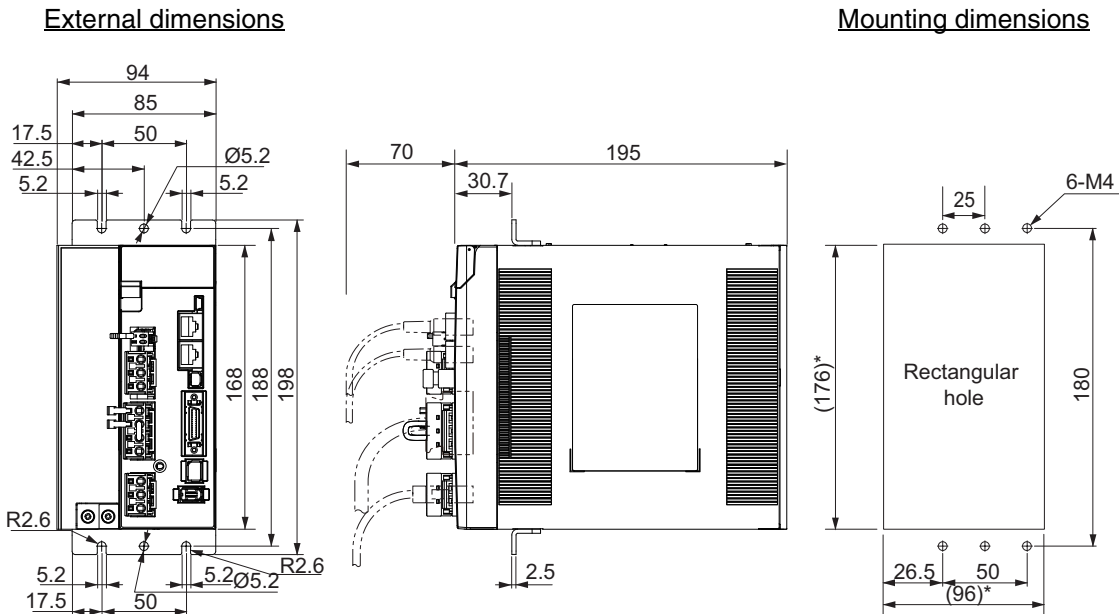
* Rectangular hole dimensions are reference values.

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

● Wall Mounting



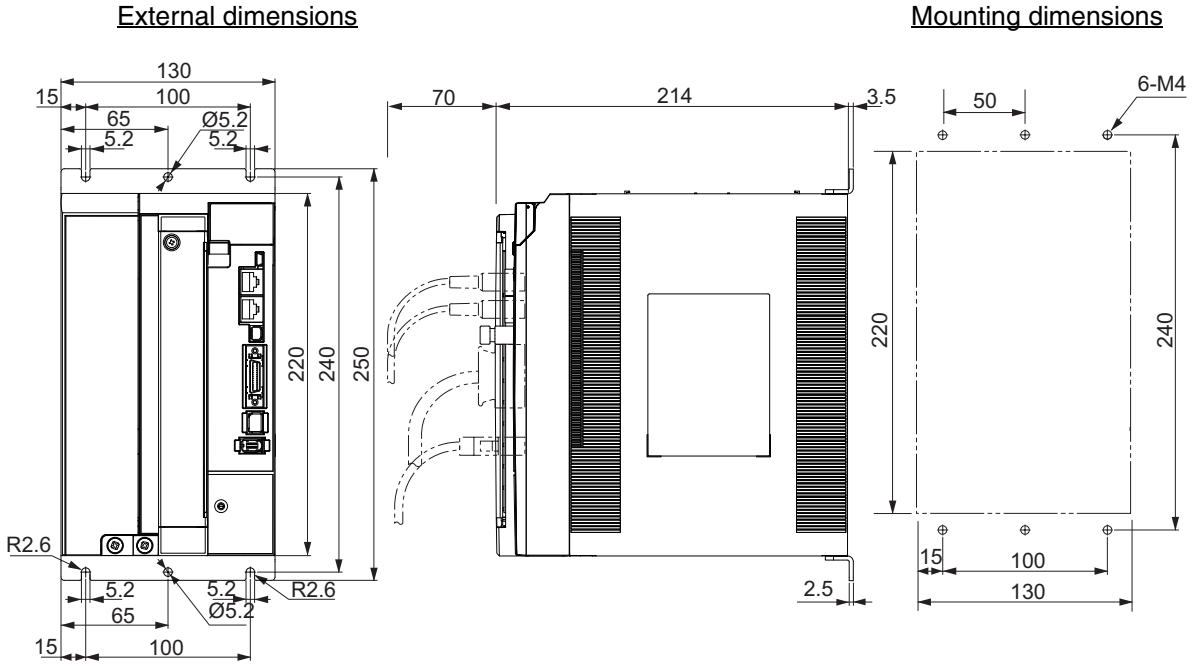
● Front Mounting (Using Front Mounting Brackets)



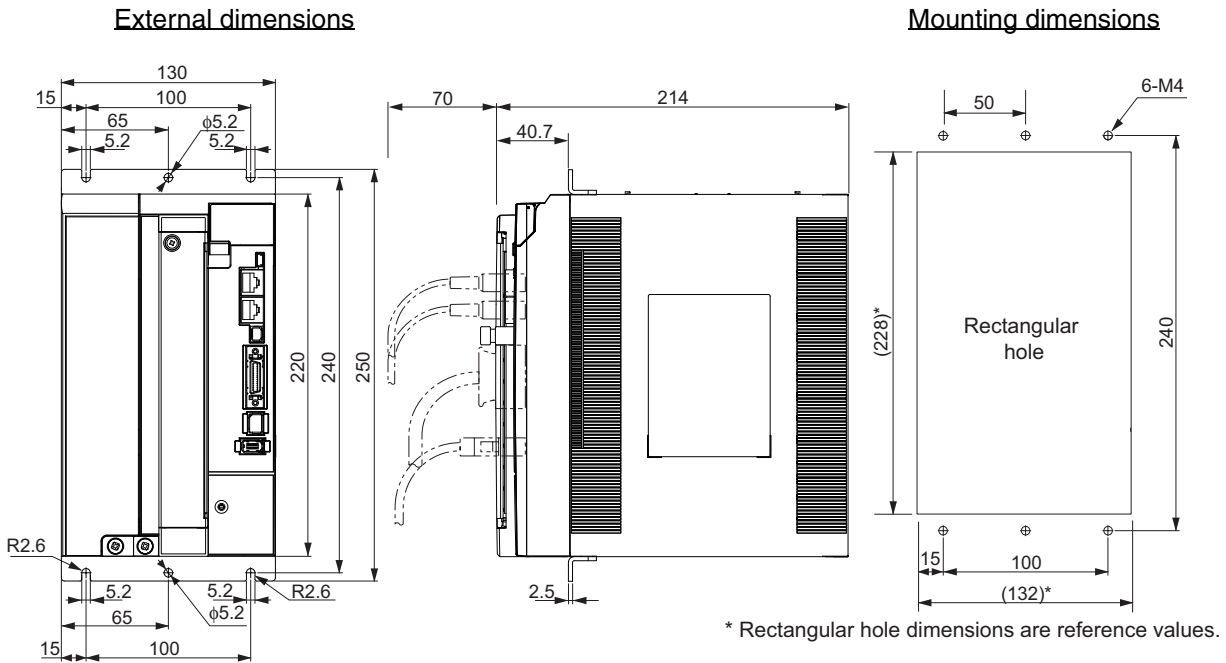
* Rectangular hole dimensions are reference values.

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

● **Wall Mounting**



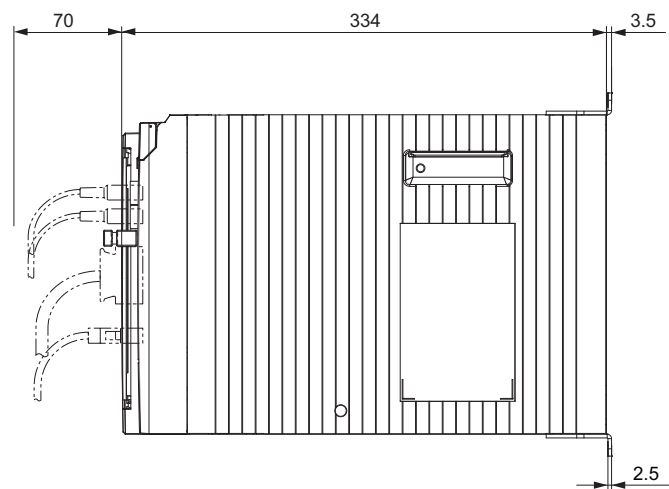
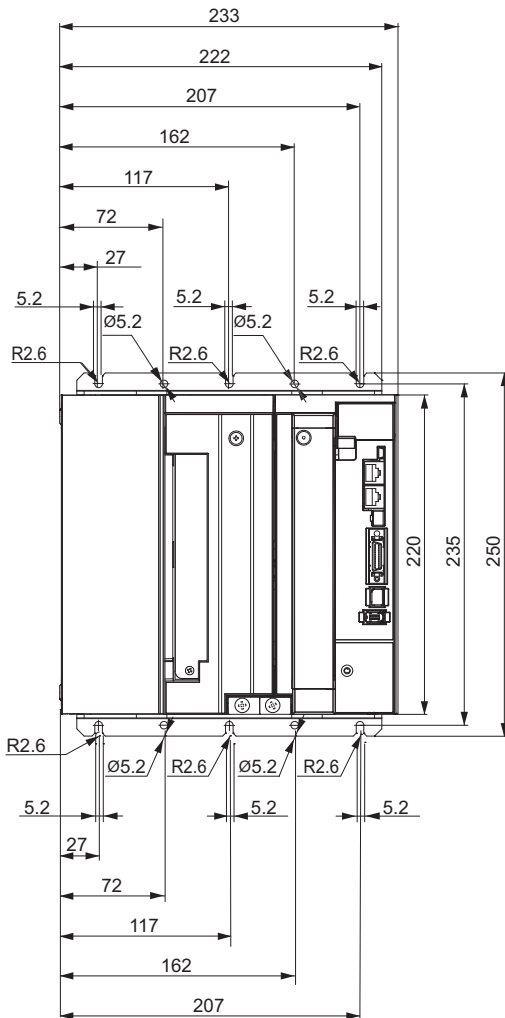
● **Front Mounting (Using Front Mounting Brackets)**



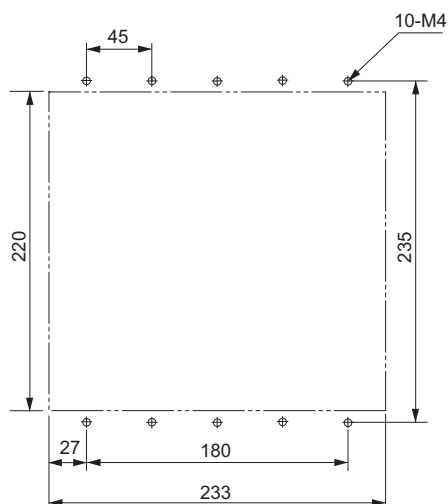
3-phase 400 VAC: R88D-KN75F-ECT (7.5 kW)

● Wall Mounting

External dimensions

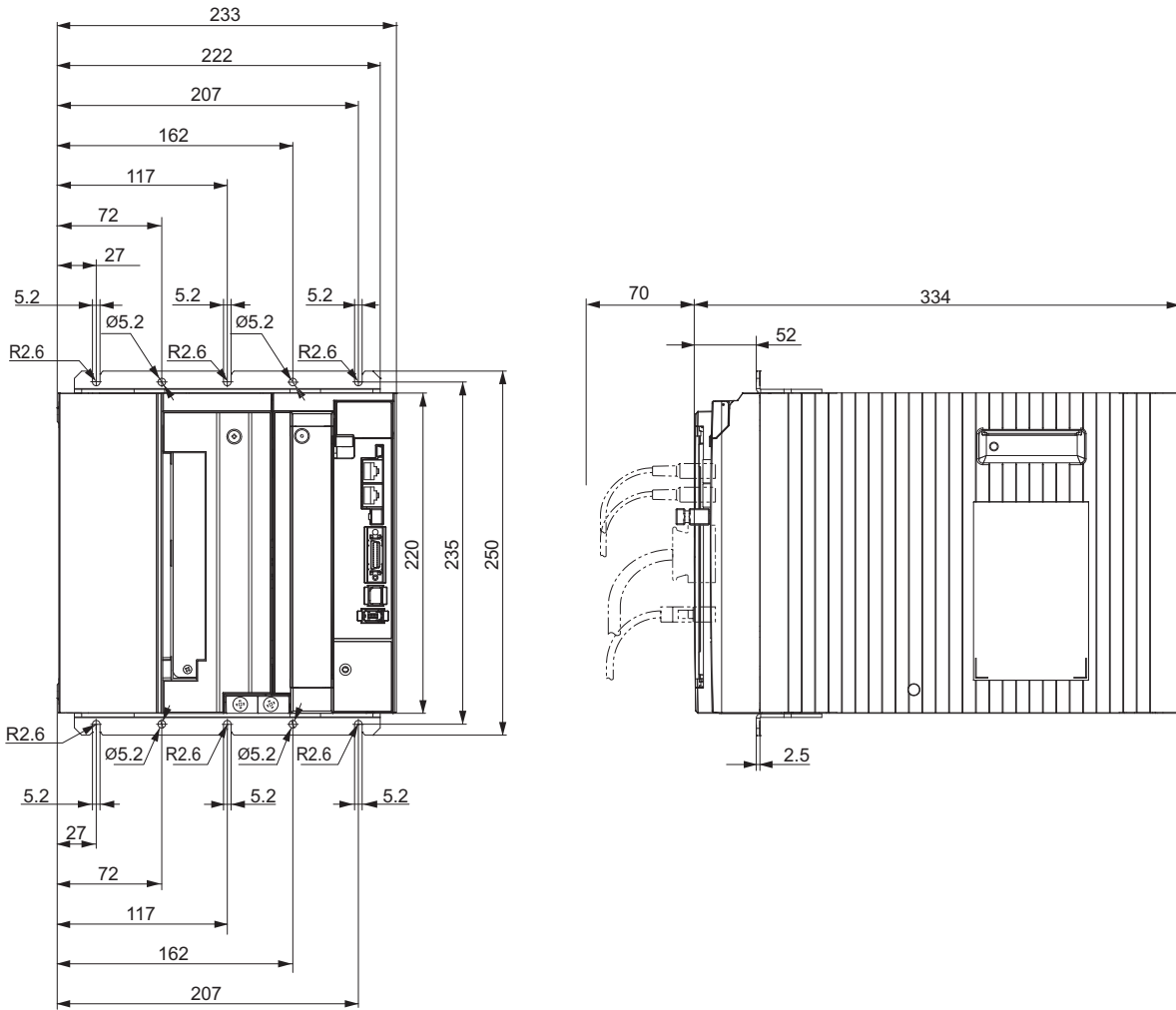


Mounting dimensions

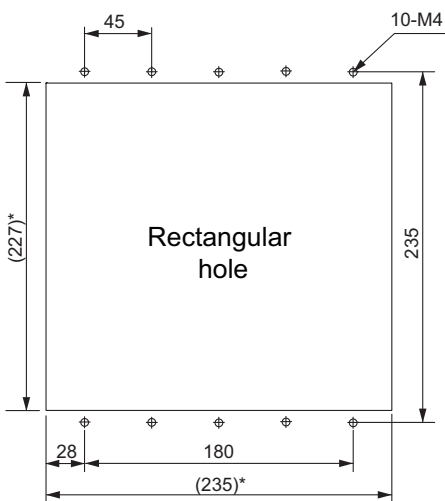


● **Front Mounting (Using Front Mounting Brackets)**

External dimensions



Mounting dimensions

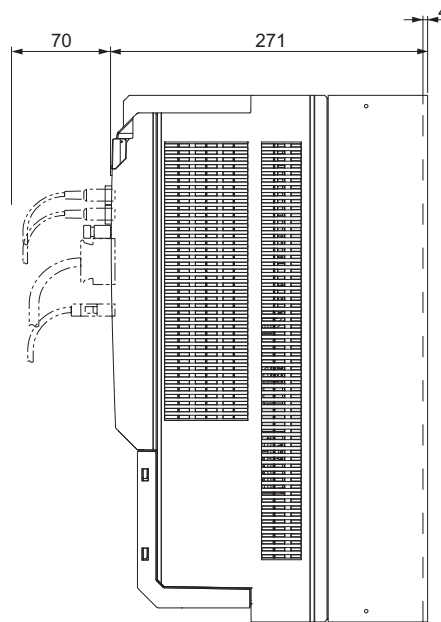
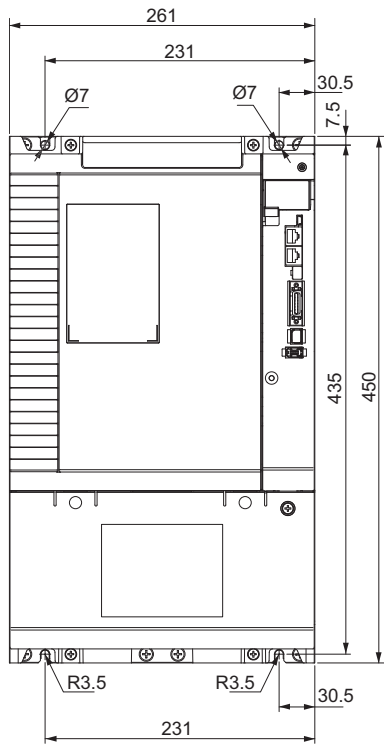


* Rectangular hole dimensions are reference values.

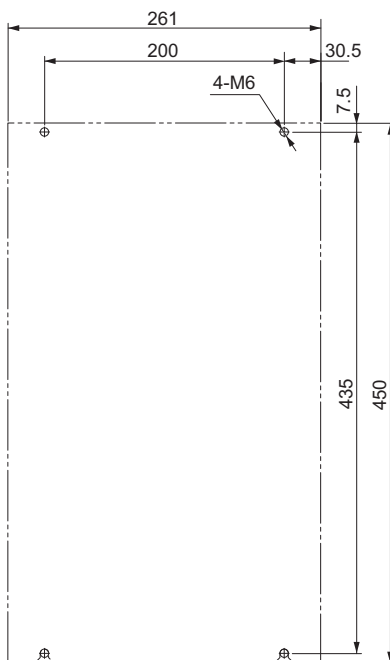
3-phase 400 VAC: R88D-KN150F-ECT (15 kW)

● Wall Mounting

External dimensions



Mounting dimensions



2-4-2 Servomotor Dimensions

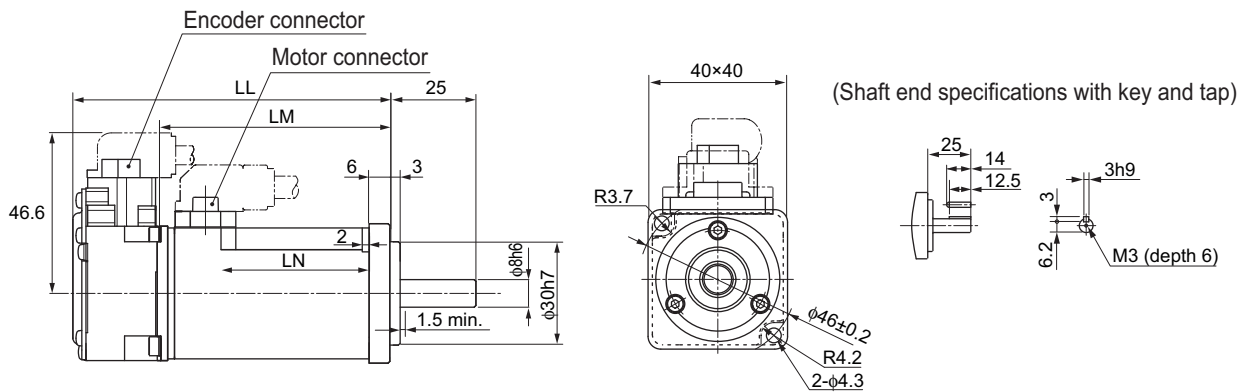
In this description, the Servomotors are grouped by rated rotation speed. The description starts with a Servomotor of the smallest capacity, which is followed by the next smallest, and so on.

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

● **50 W/100 W (without Brake)**

R88M-K05030H (-S2)/-K10030□ (-S2) **INC**

R88M-K05030T (-S2)/-K10030□ (-S2) **ABS**



| Model | Dimensions (mm) | | |
|--------------|-----------------|----|----|
| | LL | LM | LN |
| R88M-K05030□ | 72 | 48 | 23 |
| R88M-K10030□ | 92 | 68 | 43 |

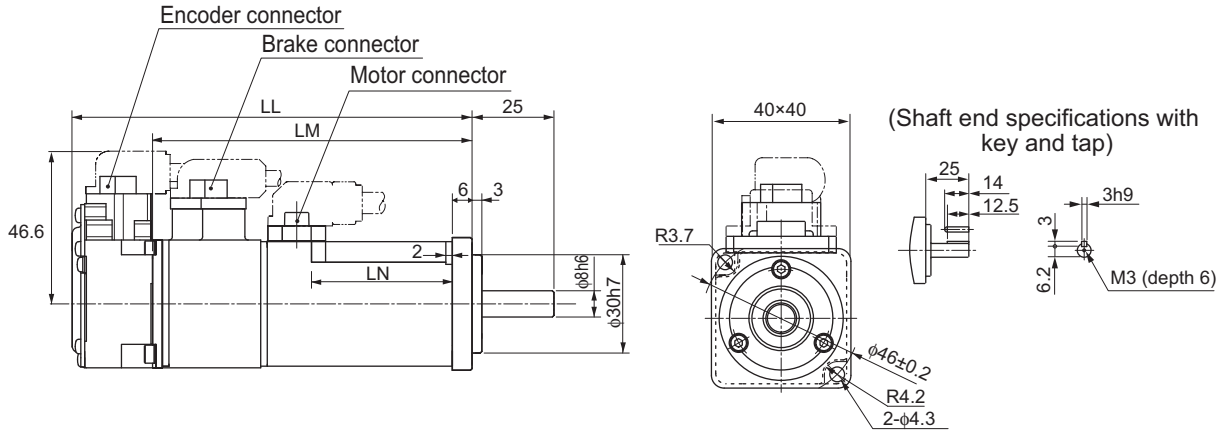
Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 50 W/100 W (with Brake)

R88M-K05030H-B (S2)/-K10030□-B (S2) **INC**

R88M-K05030T-B (S2)/-K10030□-B (S2) **ABS**



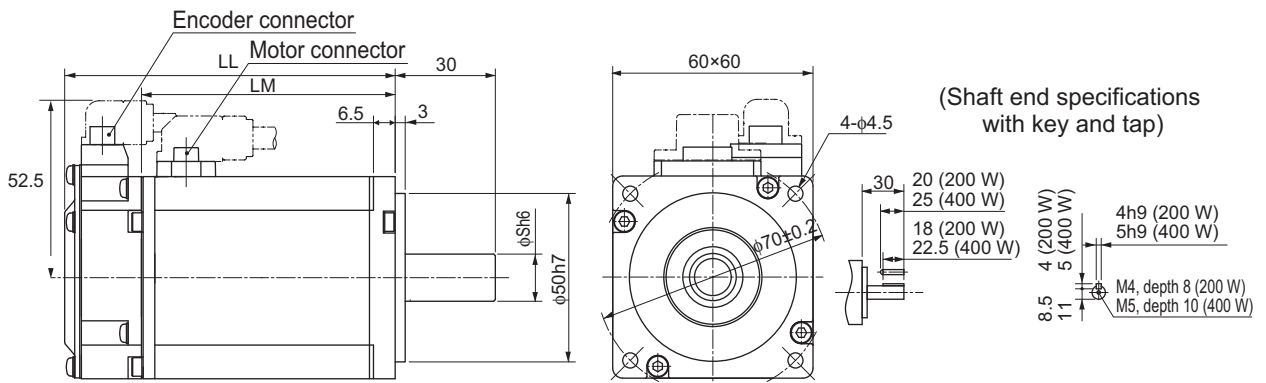
| Model | Dimensions (mm) | | |
|-----------------|-----------------|----|----|
| | LL | LM | LN |
| R88M-K05030□-B□ | 102 | 78 | 23 |
| R88M-K10030□-B□ | 122 | 98 | 43 |

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

● 200 W/400 W (without Brake)

R88M-K20030□ (-S2)/-K40030□ (-S2) **INC**

R88M-K20030□ (-S2)/-K40030□ (-S2) **ABS**



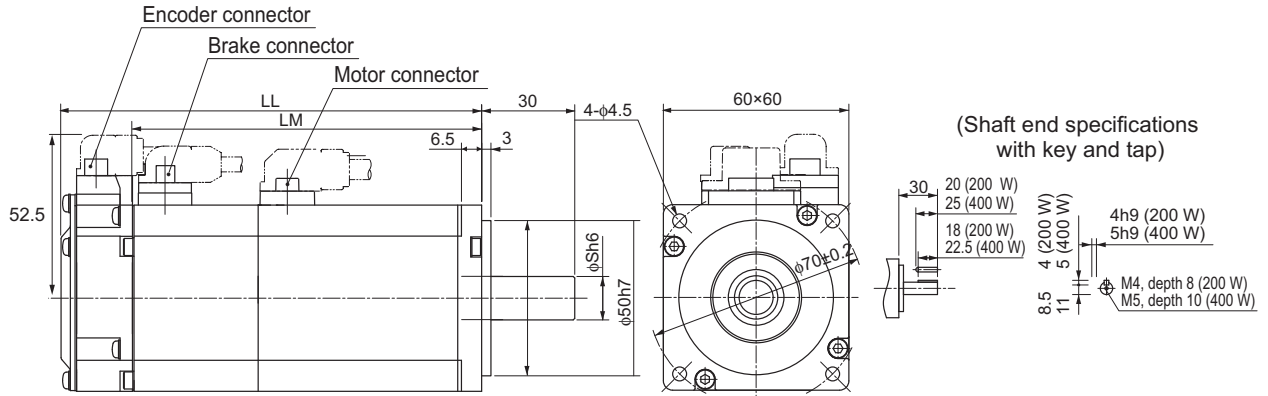
| Model | Dimensions (mm) | | |
|--------------|-----------------|------|----|
| | LL | LM | S |
| R88M-K20030□ | 79.5 | 56.5 | 11 |
| R88M-K40030□ | 99 | 76 | 14 |

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

● 200 W/400 W (with Brake)

R88M-K20030□-B (S2)/-K40030□-B (S2) **INC**

R88M-K20030□-B (S2)/-K40030□-B (S2) **ABS**



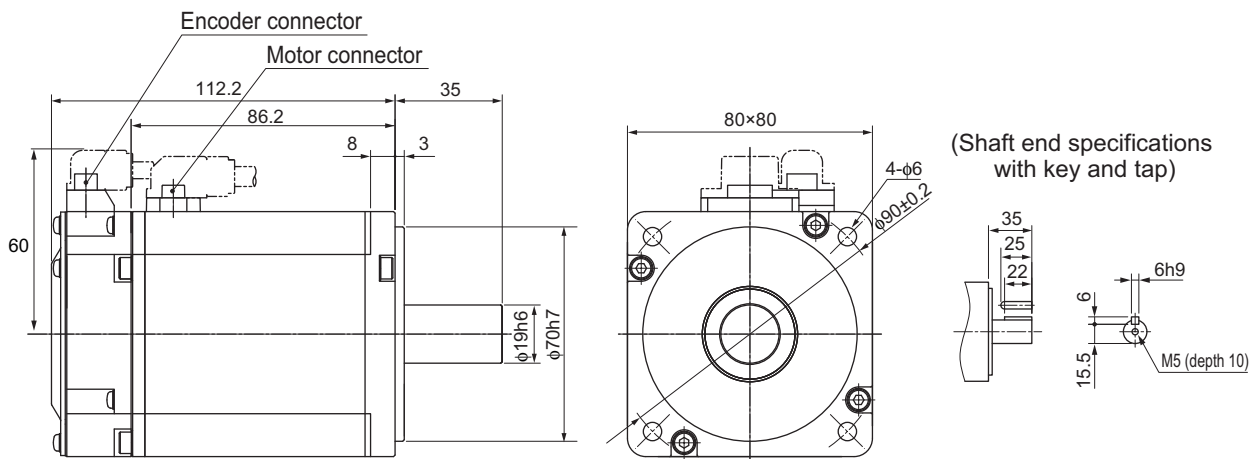
| Model | Dimensions (mm) | | |
|-----------------|-----------------|-------|----|
| | LL | LM | S |
| R88M-K20030□-B□ | 116 | 93 | 11 |
| R88M-K40030□-B□ | 135.5 | 112.5 | 14 |

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

● 750 W (without Brake)

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

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

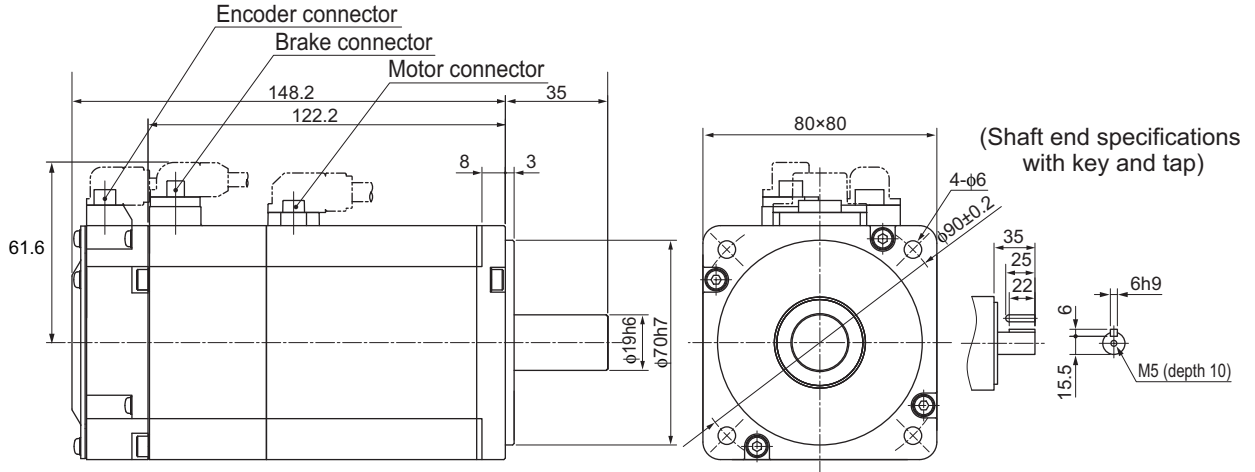


Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 750 W (with Brake)

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

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



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

● 1 kW/1.5 kW/2 kW (without Brake)

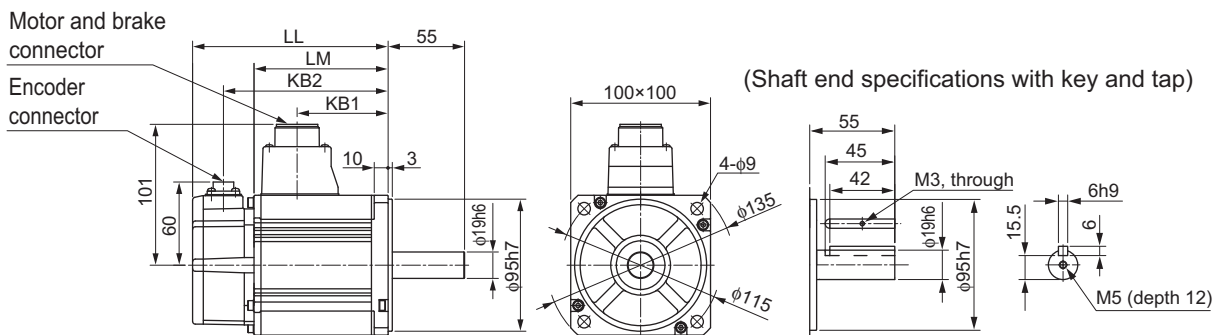
R88M-K1K030H (-S2)/-K1K530H (-S2)/-K2K030H (-S2) **INC**

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

● 1 kW/1.5 kW/2 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-------|-------|-------|
| | LL | LM | KB1 | KB2 |
| R88M-K1K030□ | 141 | 97 | 66 | 119 |
| R88M-K1K530□ | 159.5 | 115.5 | 84.5 | 137.5 |
| R88M-K2K030□ | 178.5 | 134.5 | 103.5 | 156.5 |
| R88M-K1K030□-B□ | 168 | 124 | 66 | 146 |
| R88M-K1K530□-B□ | 186.5 | 142.5 | 84.5 | 164.5 |
| R88M-K2K030□-B□ | 205.5 | 161.5 | 103.5 | 183.5 |

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

● 3 kW (without Brake)

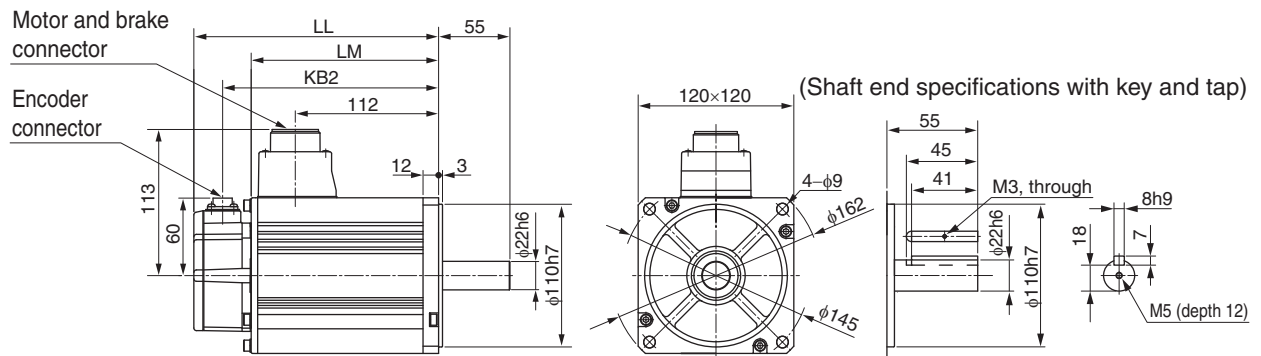
R88M-K3K030H (-S2) **INC**

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

● 3 kW (with Brake)

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

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



| Model | Dimensions (mm) | | |
|-----------------|-----------------|-----|-----|
| | LL | LM | KB2 |
| R88M-K3K030□ | 190 | 146 | 168 |
| R88M-K3K030□-B□ | 215 | 171 | 193 |

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

● 4 kW/5 kW (without Brake)

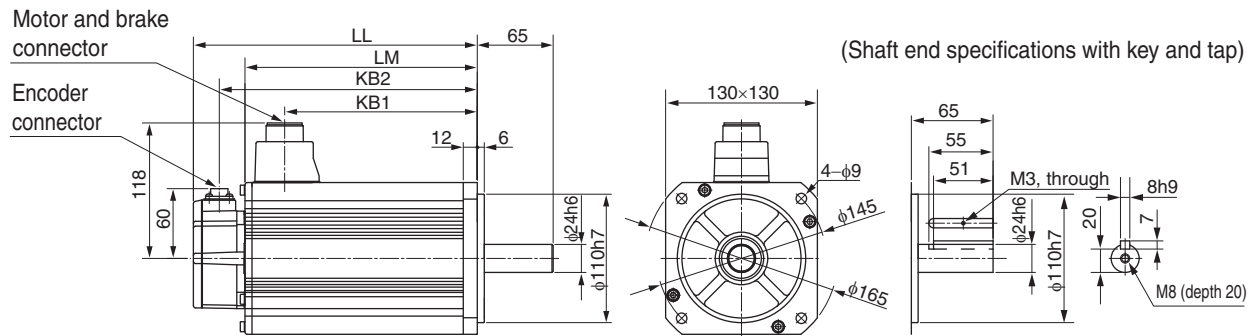
R88M-K4K030H (-S2)/-K5K030H (-S2) **INC**

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

● 4 kW/5 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-----|-----|-----|
| | LL | LM | KB1 | KB2 |
| R88M-K4K030□ | 208 | 164 | 127 | 186 |
| R88M-K5K030□ | 243 | 199 | 162 | 221 |
| R88M-K4K030□-B□ | 233 | 189 | 127 | 211 |
| R88M-K5K030□-B□ | 268 | 224 | 162 | 246 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

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

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

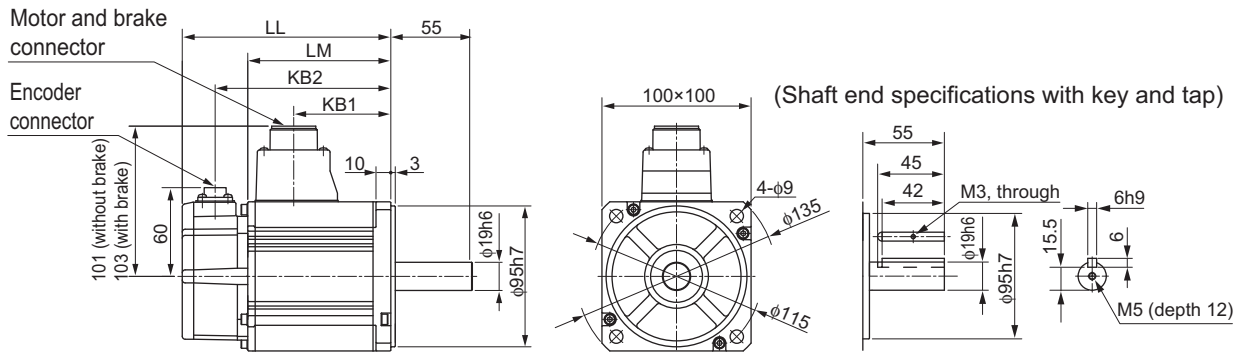
R88M-K75030F (-S2)/-K1K030F (-S2)/-K1K530F (-S2)/-K2K030F (-S2) **INC**

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-K75030□ | 131.5 | 87.5 | 56.5 | 109.5 |
| R88M-K1K030□ | 141 | 97 | 66 | 119 |
| R88M-K1K530□ | 159.5 | 115.5 | 84.5 | 137.5 |
| R88M-K2K030□ | 178.5 | 134.5 | 103.5 | 156.5 |
| R88M-K75030□-B□ | 158.5 | 114.5 | 53.5 | 136.5 |
| R88M-K1K030□-B□ | 168 | 124 | 63 | 146 |
| R88M-K1K530□-B□ | 186.5 | 142.5 | 81.5 | 164.5 |
| R88M-K2K030□-B□ | 205.5 | 161.5 | 100.5 | 183.5 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 3 kW (without Brake)

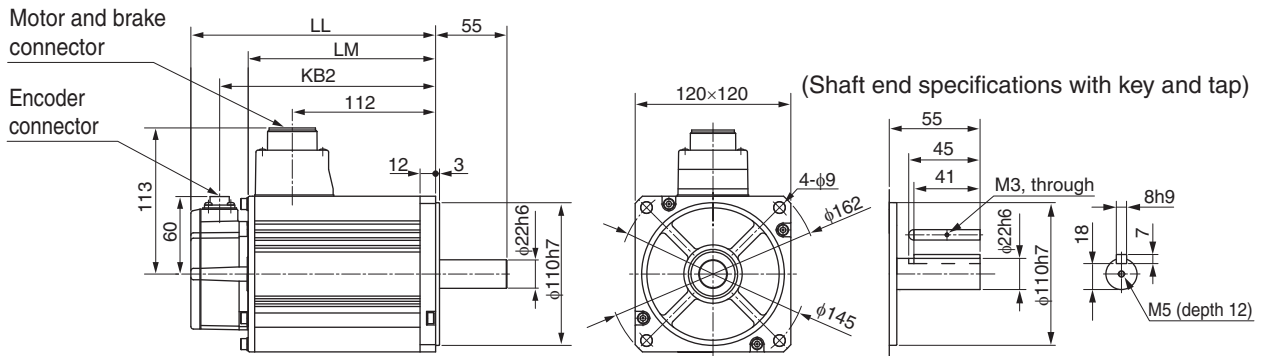
R88M-K3K030F (-S2) **INC**

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

● 3 kW (with Brake)

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

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



| Model | Dimensions (mm) | | |
|-----------------|-----------------|-----|-----|
| | LL | LM | KB2 |
| R88M-K3K030□ | 190 | 146 | 168 |
| R88M-K3K030□-B□ | 215 | 171 | 193 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 4 kW/5 kW (without Brake)

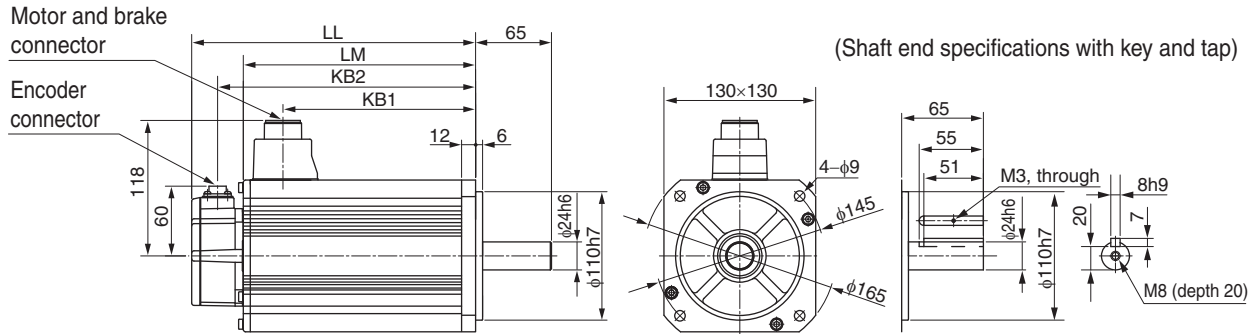
R88M-K4K030F (-S2)/-K5K030F (-S2) **INC**

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

● 4 kW/5 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-----|-----|-----|
| | LL | LM | KB1 | KB2 |
| R88M-K4K030□ | 208 | 164 | 127 | 186 |
| R88M-K5K030□ | 243 | 199 | 162 | 221 |
| R88M-K4K030□-B□ | 233 | 189 | 127 | 211 |
| R88M-K5K030□-B□ | 268 | 224 | 162 | 246 |

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

1,500-r/min and 2,000-r/min Servomotors (200 V)

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

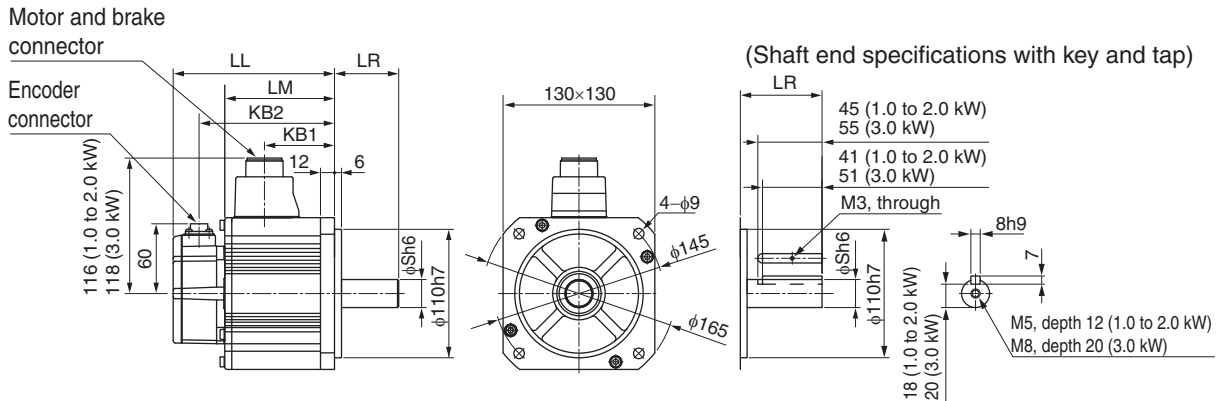
R88M-K1K020H (-S2)/-K1K520H (-S2)/-K2K020H (-S2)/-K3K020H (-S2) **INC**

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-K1K020□ | 138 | 55 | 94 | 22 | 60 | 116 |
| R88M-K1K520□ | 155.5 | 55 | 111.5 | 22 | 77.5 | 133.5 |
| R88M-K2K020□ | 173 | 55 | 129 | 22 | 95 | 151 |
| R88M-K3K020□ | 208 | 65 | 164 | 24 | 127 | 186 |
| R88M-K1K020□-B□ | 163 | 55 | 119 | 22 | 60 | 141 |
| R88M-K1K520□-B□ | 180.5 | 55 | 136.5 | 22 | 77.5 | 158.5 |
| R88M-K2K020□-B□ | 198 | 55 | 154 | 22 | 95 | 176 |
| R88M-K3K020□-B□ | 233 | 65 | 189 | 24 | 127 | 211 |

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

● 4 kW/5 kW (without Brake)

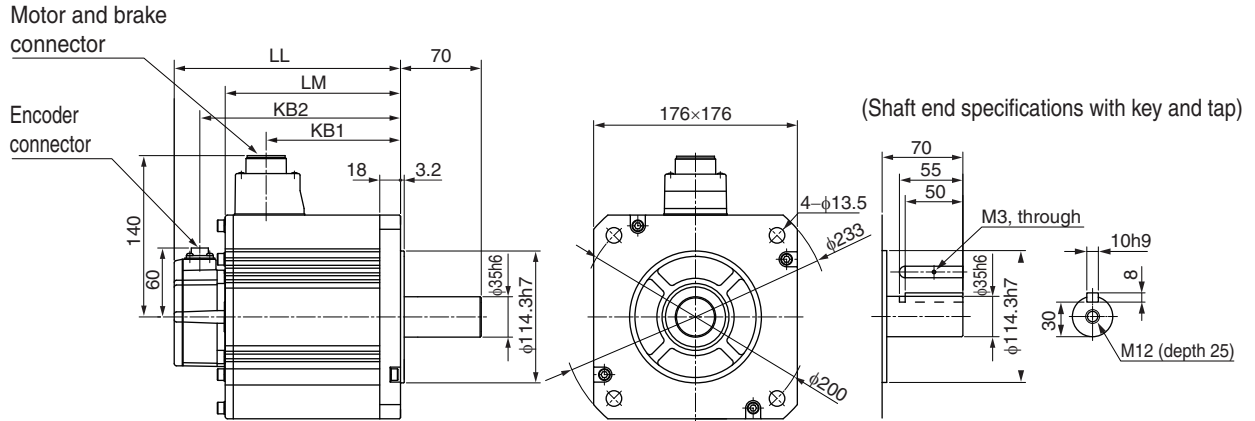
R88M-K4K020H (-S2)/-K5K020H (-S2) **INC**

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

● 4 kW/5 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-----|-----|-----|
| | LL | LM | KB1 | KB2 |
| R88M-K4K020□ | 177 | 133 | 96 | 155 |
| R88M-K5K020□ | 196 | 152 | 115 | 174 |
| R88M-K4K020□-B□ | 202 | 158 | 96 | 180 |
| R88M-K5K020□-B□ | 221 | 177 | 115 | 199 |

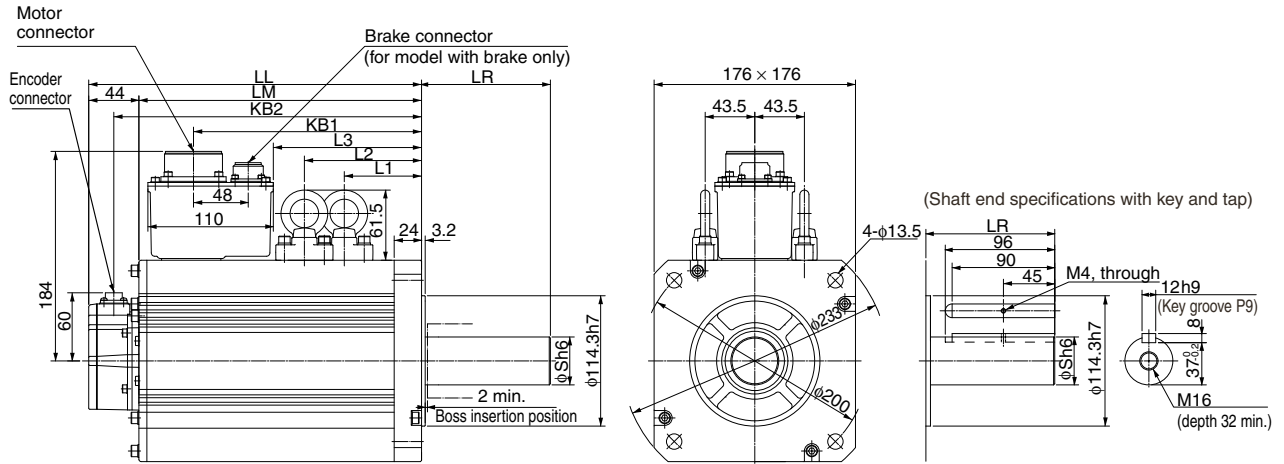
Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 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-K7K515T□ | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K7K515T-B□ | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

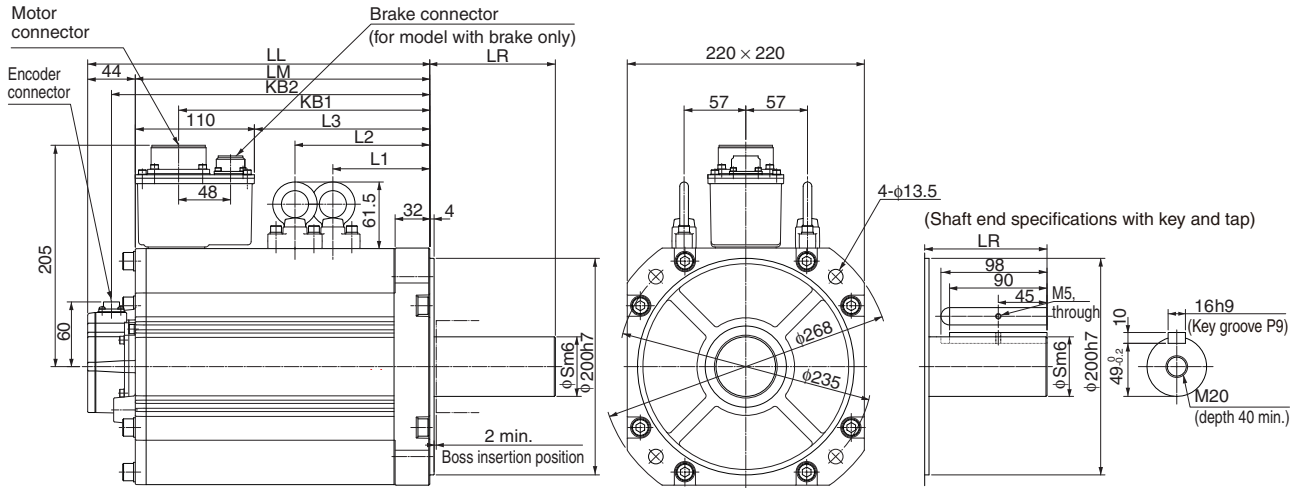
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 11 kW/15 kW (without Brake)

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

● 11 kW/15 kW (with Brake)

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



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

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

1,500-r/min and 2,000-r/min Servomotors (400 V)

● 400 W/600 W (without Brake)

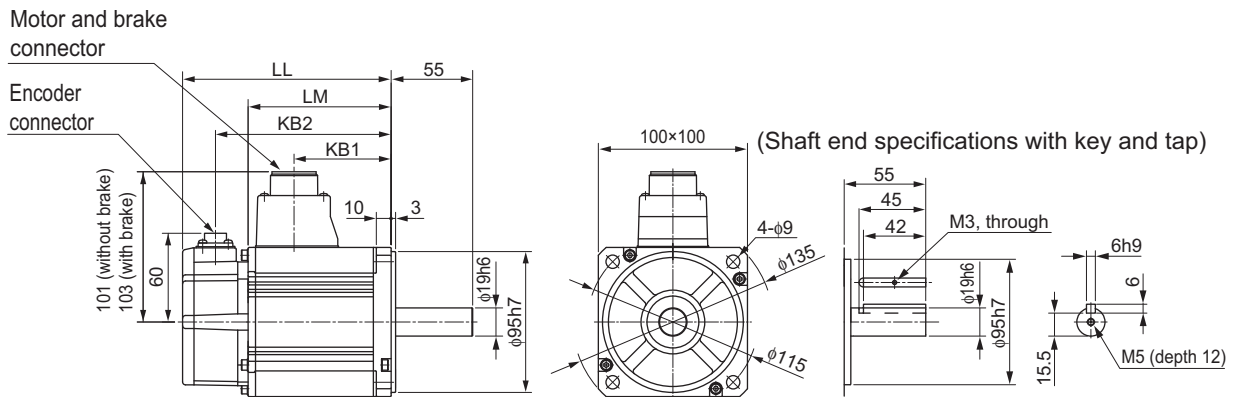
R88M-K40020F (-S2)/-K60020F (-S2) **INC**

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-K40020□ | 131.5 | 87.5 | 56.5 | 109.5 |
| R88M-K60020□ | 141 | 97 | 66 | 119 |
| R88M-K40020□-B□ | 158.5 | 114.5 | 53.5 | 136.5 |
| R88M-K60020□-B□ | 168 | 124 | 63 | 146 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

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

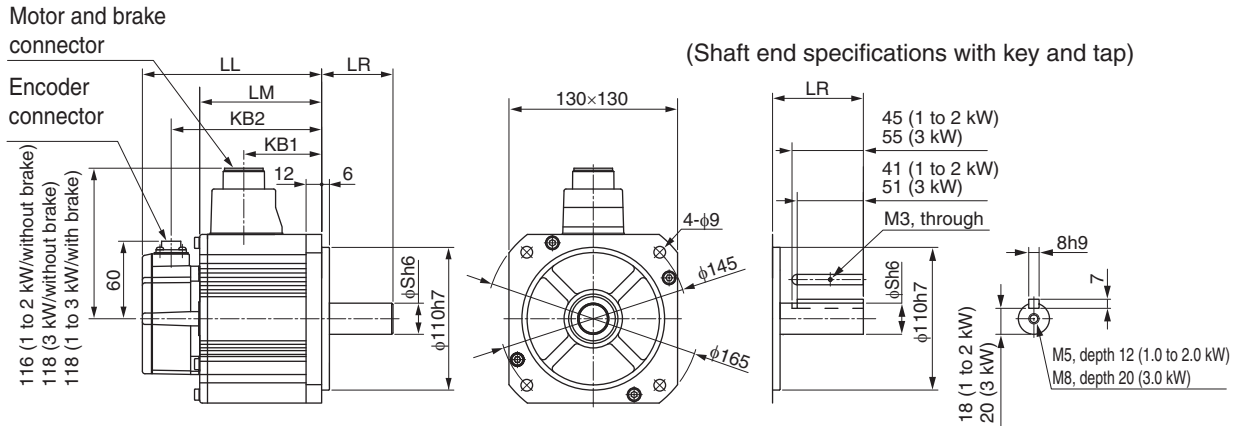
R88M-K1K020F (-S2)/-K1K520F (-S2)/-K2K020F (-S2)/-K3K020F (-S2) **INC**

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

● 1 kW/1.5 kW/2 kW/3 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | | | |
|-----------------|-----------------|----|-------|----|------|-------|
| | LL | LR | LM | S | KB1 | KB2 |
| R88M-K1K020□ | 138 | 55 | 94 | 22 | 60 | 116 |
| R88M-K1K520□ | 155.5 | 55 | 111.5 | 22 | 77.5 | 133.5 |
| R88M-K2K020□ | 173 | 55 | 129 | 22 | 95 | 151 |
| R88M-K3K020□ | 208 | 65 | 164 | 24 | 127 | 186 |
| R88M-K1K020□-B□ | 163 | 55 | 119 | 22 | 57 | 141 |
| R88M-K1K520□-B□ | 180.5 | 55 | 136.5 | 22 | 74.5 | 158.5 |
| R88M-K2K020□-B□ | 198 | 55 | 154 | 22 | 92 | 176 |
| R88M-K3K020□-B□ | 233 | 65 | 189 | 24 | 127 | 211 |

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

● 4 kW/5 kW (without Brake)

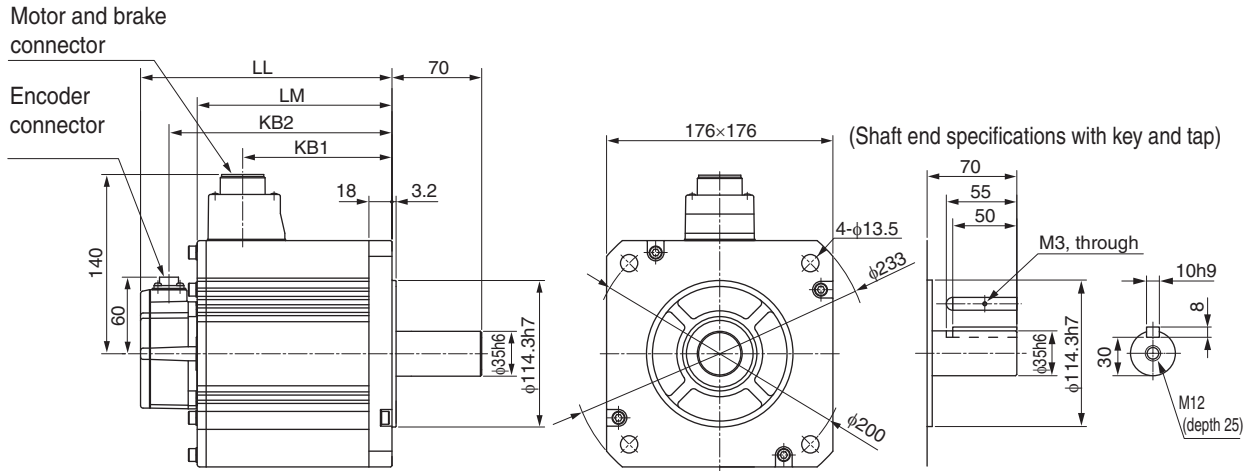
R88M-K4K020F (-S2)/-K5K020F (-S2) **INC**

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

● 4 kW/5 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-----|-----|-----|
| | LL | LM | KB1 | KB2 |
| R88M-K4K020□ | 177 | 133 | 96 | 155 |
| R88M-K5K020□ | 196 | 152 | 115 | 174 |
| R88M-K4K020□-B□ | 202 | 158 | 96 | 180 |
| R88M-K5K020□-B□ | 221 | 177 | 115 | 199 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

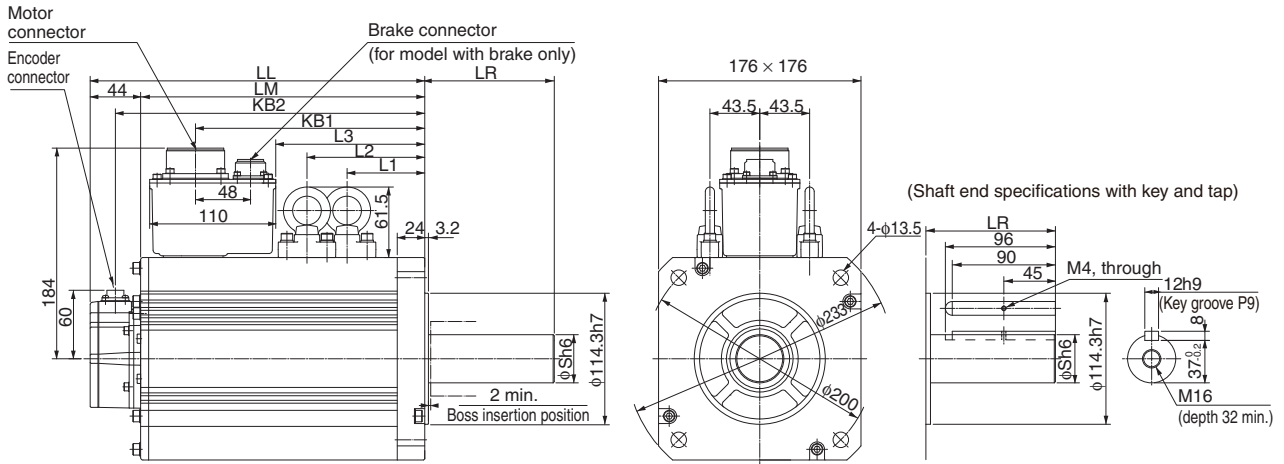
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 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-K7K515C□ | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K7K515C-B□ | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

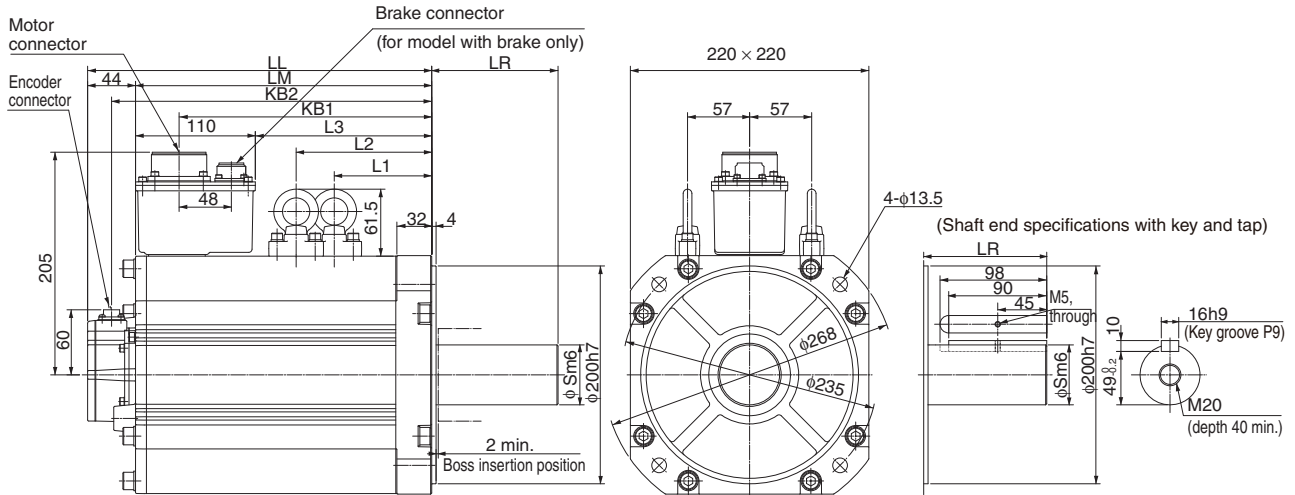
Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
 Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 11 kW/15 kW (without Brake)

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

● 11 kW/15 kW (with Brake)

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



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

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

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

- 900 W (without Brake)

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

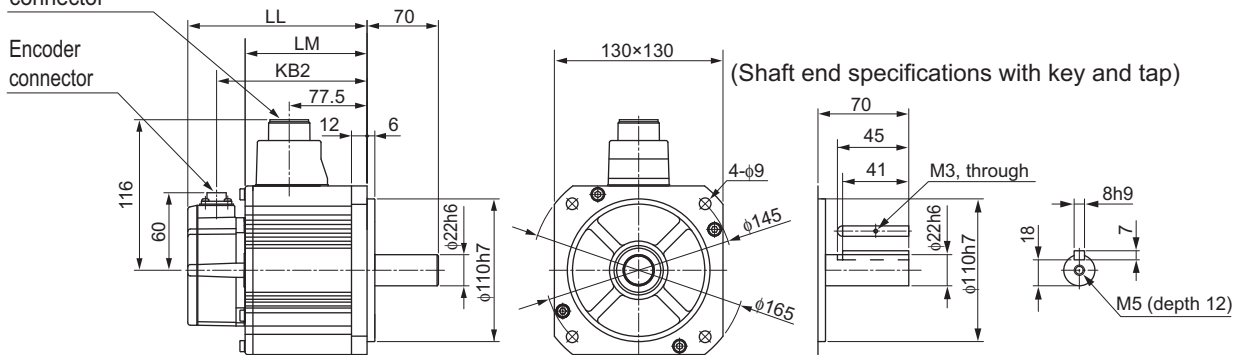
R88M-K90010T (-S2) **ABS**

- 900 W (with Brake)

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

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

Motor and brake connector



| Model | Dimensions (mm) | | |
|-----------------|-----------------|-------|-------|
| | LL | LM | KB2 |
| R88M-K90010□ | 155.5 | 111.5 | 133.5 |
| R88M-K90010□-B□ | 180.5 | 136.5 | 158.5 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 2 kW/3 kW (without Brake)

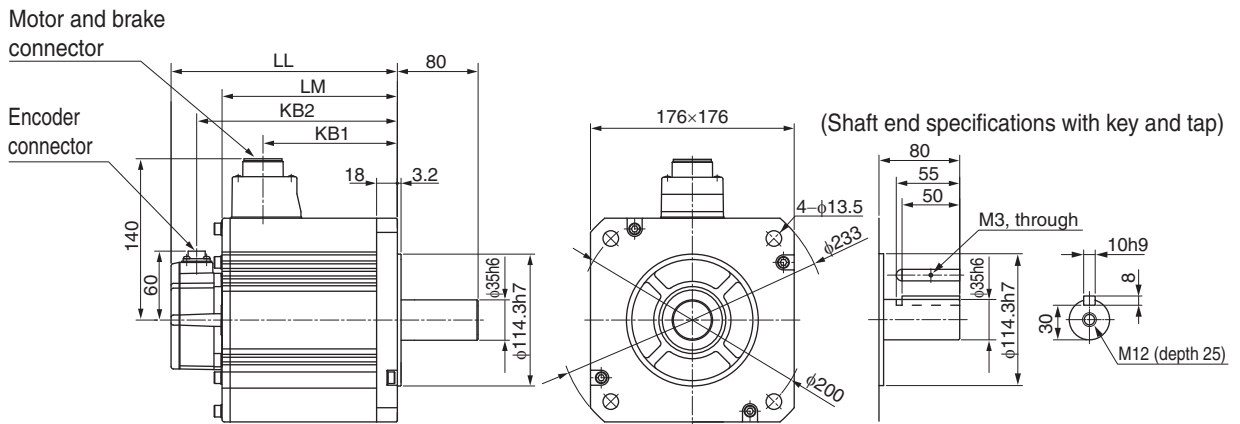
R88M-K2K010H (-S2)/-K3K010H (-S2) **INC**

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

● 2 kW/3 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-------|-------|-------|
| | LL | LM | KB1 | KB2 |
| R88M-K2K010□ | 163.5 | 119.5 | 82.5 | 141.5 |
| R88M-K3K010□ | 209.5 | 165.5 | 128.5 | 187.5 |
| R88M-K2K010□-B□ | 188.5 | 144.5 | 82.5 | 166.5 |
| R88M-K3K010□-B□ | 234.5 | 190.5 | 128.5 | 212.5 |

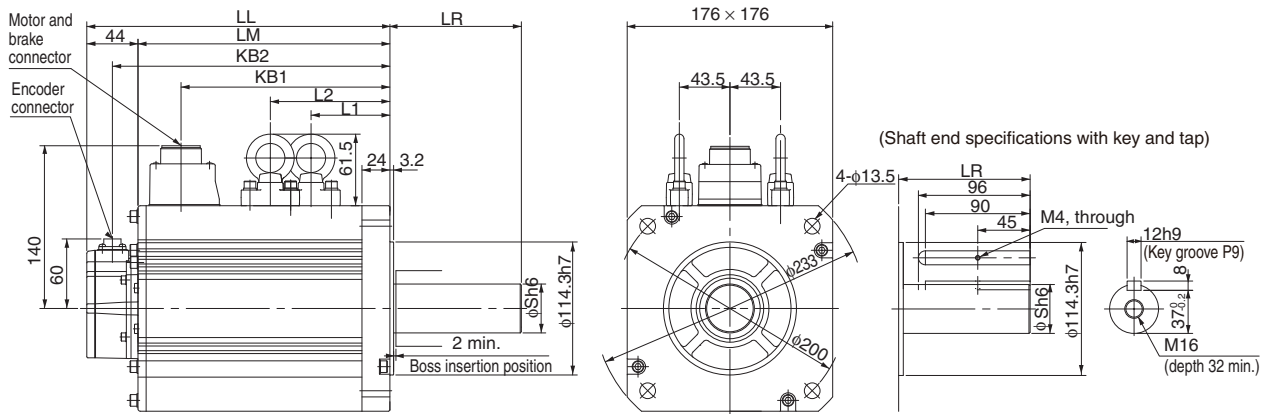
Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
 Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 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-K4K510T□ | 266 | 113 | 222 | 42 | 185 | 244 | 98 | 98 |
| R88M-K4K510T-B□ | 291 | 113 | 247 | 42 | 185 | 269 | 98 | 133 |

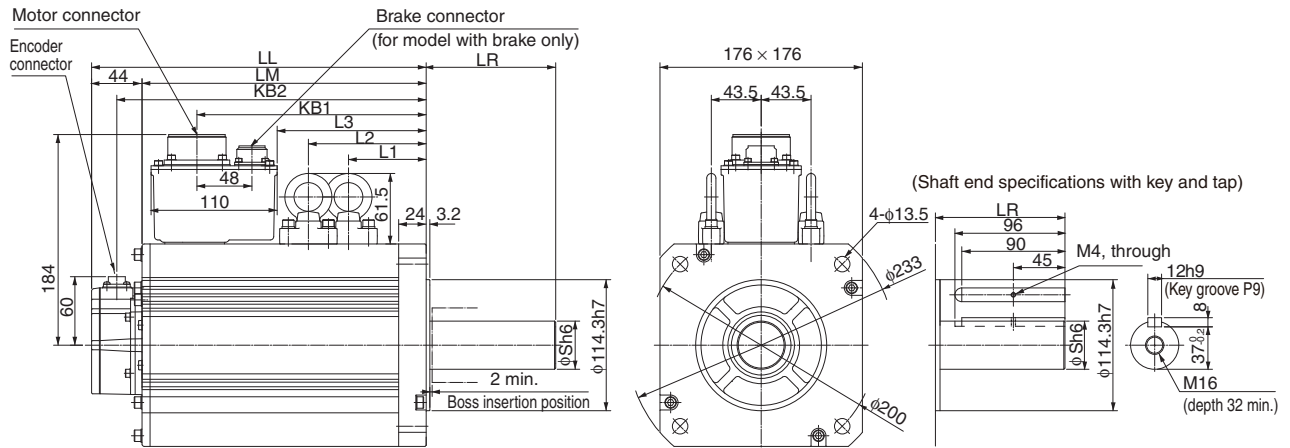
Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
 Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 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-K6K010T□ | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K6K010T-B□ | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

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

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

● 900 W (without Brake)

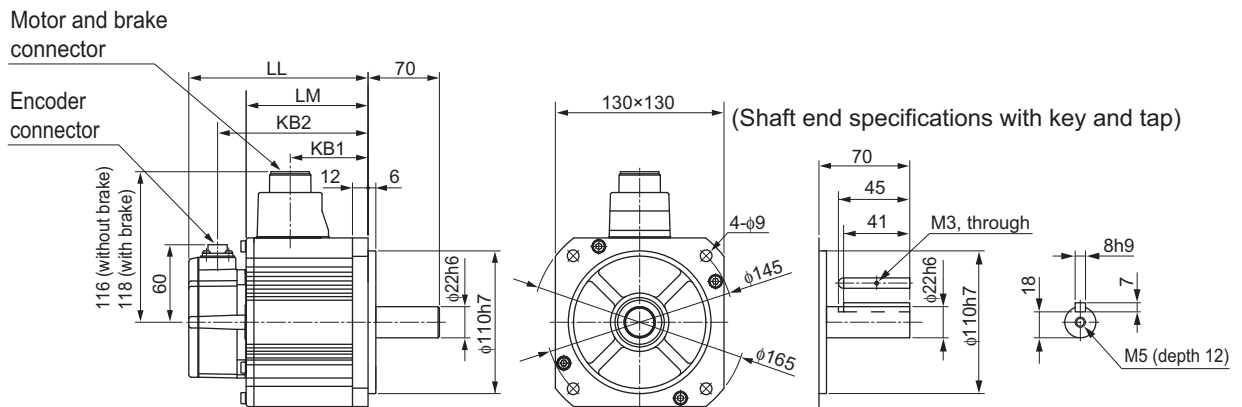
R88M-K90010F (-S2) **INC**

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-K90010□ | 155.5 | 111.5 | 77.5 | 133.5 |
| R88M-K90010□-B□ | 180.5 | 136.5 | 74.5 | 158.5 |

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

● 2 kW/3 kW (without Brake)

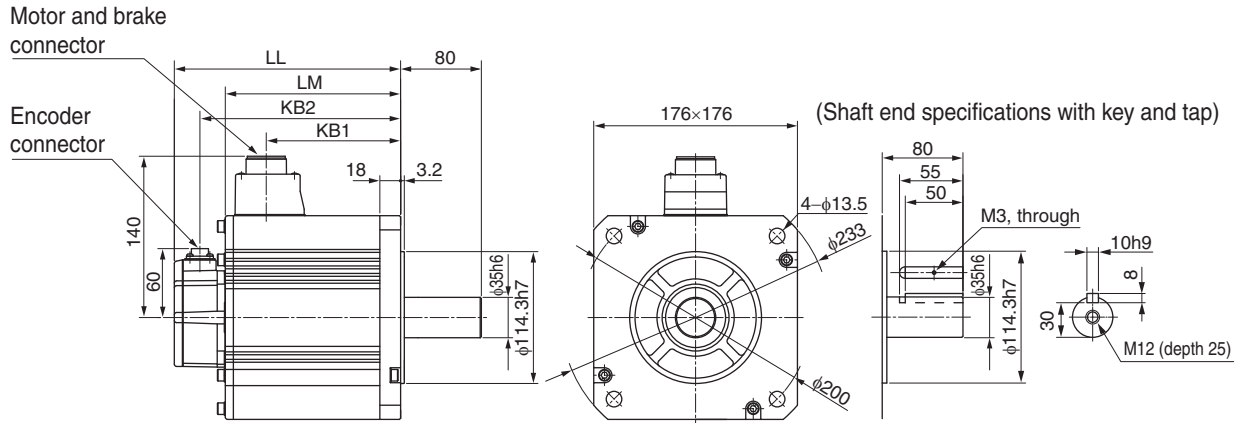
R88M-K2K010F (-S2)/-K3K010F (-S2) **INC**

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

● 2 kW/3 kW (with Brake)

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

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



| Model | Dimensions (mm) | | | |
|-----------------|-----------------|-------|-------|-------|
| | LL | LM | KB1 | KB2 |
| R88M-K2K010□ | 163.5 | 119.5 | 82.5 | 141.5 |
| R88M-K3K010□ | 209.5 | 165.5 | 128.5 | 187.5 |
| R88M-K2K010□-B□ | 188.5 | 144.5 | 82.5 | 166.5 |
| R88M-K3K010□-B□ | 234.5 | 190.5 | 128.5 | 212.5 |

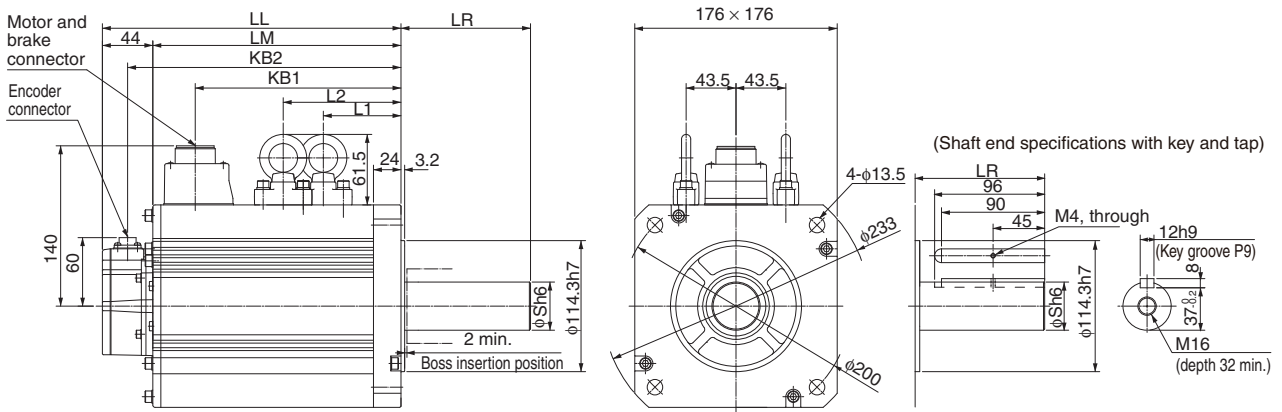
Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.
 Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 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-K4K510C□ | 266 | 113 | 222 | 42 | 185 | 244 | 98 | 98 |
| R88M-K4K510C-B□ | 291 | 113 | 247 | 42 | 185 | 269 | 98 | 133 |

Note The standard models have a straight shaft. Models with a key and tap are indicated with S2 at the end of the model number.

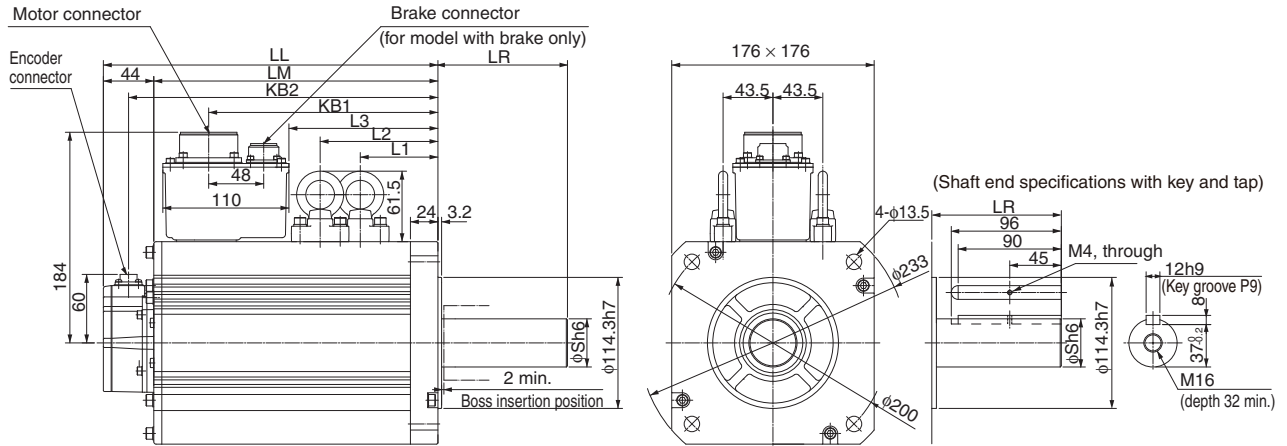
Models with an oil seal are indicated with O at the end of the model number. The motor dimensions do not change.

● 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-K6K010C□ | 312 | 113 | 268 | 42 | 219 | 290 | 117.5 | 117.5 | 149 |
| R88M-K6K010C-B□ | 337 | 113 | 293 | 42 | 253 | 315 | 117.5 | 152.5 | 183 |

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

2-4-3 Combinations of Servomotors and Reduction Gears

The tables in this section show the possible combinations of Servomotors and Reduction Gears by the rated motor rotation speed.

3,000-r/min Servomotors

| Servomotor models | 1/5 | 1/11 (1/9 for flange 11) | 1/21 | 1/33 | 1/45 |
|--------------------------|--|---|---|---|---|
| R88M-K05030□ | R88G-HPG11B05100B□ (for both with R88M-K10030□) | R88G-HPG11B09050B□ (Reduction Ratio 1/9) | R88G-HPG14A21100B□ (for both with R88M-K10030□) | R88G-HPG14A33050B□ | R88G-HPG14A45050B□ |
| R88M-K10030□ | R88G-HPG11B05100B□ | R88G-HPG14A11100B□ | R88G-HPG14A21100B□ | R88G-HPG20A33100B□ | R88G-HPG20A45100B□ |
| R88M-K20030□ | R88G-HPG14A05200B□ | R88G-HPG14A11200B□ | R88G-HPG20A21200B□ | R88G-HPG20A33200B□ | R88G-HPG20A45200B□ |
| R88M-K40030□ | R88G-HPG14A05400B□ | R88G-HPG20A11400B□ | R88G-HPG20A21400B□ | R88G-HPG32A33400B□ | R88G-HPG32A45400B□ |
| R88M-K75030H/T (200V) | R88G-HPG20A05750B□ | R88G-HPG20A11750B□ | R88G-HPG32A21750B□ | R88G-HPG32A33750B□ | R88G-HPG32A45750B□ |
| R88M-K75030F/C (400V) | R88G-HPG32A052K0B□ (for both with R88M-K2K030□) | R88G-HPG32A112K0B□ (for both with R88M-K2K030□) | R88G-HPG32A211K5B□ (for both with R88M-K1K5030□) | R88G-HPG32A33600SB□ (for both with R88M-K60020□) | R88G-HPG50A451K5B□ (for both with R88M-K1K5030□) |
| R88M-K1K030□ | R88G-HPG32A052K0B□ (for both with R88M-K2K030□) | R88G-HPG32A112K0B□ (for both with R88M-K2K030□) | R88G-HPG32A211K5B□ (for both with R88M-K1K5030□) | R88G-HPG50A332K0B□ (for both with R88M-K2K030□) | R88G-HPG50A451K5B□ (for both with R88M-K1K5030□) |
| R88M-K1K530□ | R88G-HPG32A052K0B□ (for both with R88M-K2K030□) | R88G-HPG32A112K0B□ (for both with R88M-K2K030□) | R88G-HPG32A211K5B□ | R88G-HPG50A332K0B□ (for both with R88M-K2K030□) | R88G-HPG50A451K5B□ |
| R88M-K2K030□ | R88G-HPG32A052K0B□ | R88G-HPG32A112K0B□ | R88G-HPG50A212K0B□ | R88G-HPG50A332K0B□ | — |
| R88M-K3K030□ | R88G-HPG32A053K0B□ | R88G-HPG50A113K0B□ | R88G-HPG50A213K0B□ | — | — |
| R88M-K4K030□ | R88G-HPG32A054K0B□ | R88G-HPG50A115K0B□ (for both with R88M-K1K5030□) | — | — | — |
| R88M-K5K030□ | R88G-HPG50A055K0B□ | R88G-HPG50A115K0B□ | — | — | — |

2,000-r/min Servomotors

| Servomotor models | 1/5 | 1/11 | 1/21 (1/20 for flange 65) | 1/33 (1/25 for flange 65) | 1/45 |
|----------------------------------|---|---|---|---|--|
| R88M-K40020□ (only for 400 V) | R88G-HPG32A052K0B□ (for both with R88M-K2K030□) | R88G-HPG32A112K0B□ (for both with R88M-K2K030□) | R88G-HPG32A211K5B□ (for both with R88M-K1K5030□) | R88G-HPG32A33600SB□ (for both with R88M-K60020□) | R88G-HPG32A45400SB□ |
| R88M-K60020□ (only for 400 V) | R88G-HPG32A052K0B□ (for both with R88M-K2K030□) | R88G-HPG32A112K0B□ (for both with R88M-K2K030□) | R88G-HPG32A211K5B□ (for both with R88M-K1K5030□) | R88G-HPG32A33600SB□ | R88G-HPG50A451K5B□ (for both with R88M-K1K530□) |
| R88M-K1K020□ | R88G-HPG32A053K0B□ (for both with R88M-K3K030□) | R88G-HPG32A112K0SB□ (for both with R88M-K2K020□) | R88G-HPG32A211K0SB□ | R88G-HPG50A332K0SB□ (for both with R88M-K2K020□) | R88G-HPG50A451K0SB□ |
| R88M-K1K520□ | R88G-HPG32A053K0B□ (for both with R88M-K3K030□) | R88G-HPG32A112K0SB□ (for both with R88M-K2K020□) | R88G-HPG50A213K0B□ (for both with R88M-K3K030□) | R88G-HPG50A332K0SB□ (for both with R88M-K2K020□) | – |
| R88M-K2K020□ | R88G-HPG32A053K0B□ (for both with R88M-K3K030□) | R88G-HPG32A112K0SB□ | R88G-HPG50A213K0B□ (for both with R88M-K3K030□) | R88G-HPG50A332K0SB□ | – |
| R88M-K3K020□ | R88G-HPG32A054K0B□ (for both with R88M-K4K030□) | R88G-HPG50A115K0B□ (for both with R88M-K5K030□) | R88G-HPG50A213K0SB□ | R88G-HPG65A253K0SB□ | – |
| R88M-K4K020□ | R88G-HPG50A055K0SB□ (for both with R88M-K5K020□) | R88G-HPG50A115K0SB□ (for both with R88M-K3K030□) | R88G-HPG65A205K0SB□ (for both with R88M-K3K030□) | R88G-HPG65A255K0SB□ (for both with R88M-K5K020□) | – |
| R88M-K5K020□ | R88G-HPG50A055K0SB□ | R88G-HPG50A115K0SB□ | R88G-HPG65A205K0SB□ | R88G-HPG65A255K0SB□ | – |

1,000-r/min Servomotors

| Servomotor models | 1/5 | 1/11 | 1/21 (1/20 for flange 65) | 1/33 (1/25 for flange 65) |
|-------------------|---|---|---|---|
| R88M-K90010□ | R88G-HPG32A05900TB□ | R88G-HPG32A11900TB□ | R88G-HPG50A21900TB□ | R88G-HPG50A33900TB□ |
| R88M-K2K010□ | R88G-HPG32A052K0TB□ | R88G-HPG50A112K0TB□ | R88G-HPG50A212K0TB□ (for both with R88M-K5K020□) | R88G-HPG65A255K0SB□ (for both with R88M-K5K020□) |
| R88M-K3K010□ | R88G-HPG50A055K0SB□ (for both with R88M-K5K020□) | R88G-HPG50A115K0SB□ (for both with R88M-K5K020□) | R88G-HPG65A205K0SB□ (for both with R88M-K5K020□) | R88G-HPG65A255K0SB□ (for both with R88M-K5K020□) |

2-4-4 Reduction Gear Dimensions

3 Arcminutes Max.

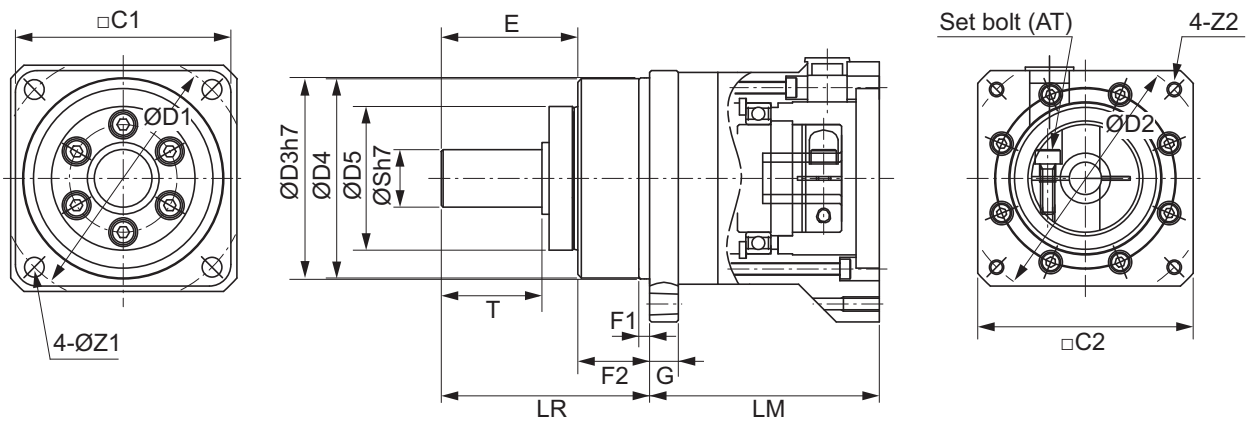
- For 3,000-r/min Servomotors (50 to 200 W)

| Model | | | External view | Dimensions (mm) | | | | | | | | | | | |
|-------|------|--------------------|---------------|-----------------|----|----|-----|-----|----|----|------|----|----|-----|----|
| | | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | D5 | E | F1 | F2 |
| 50 W | 1/5 | R88G-HPG11B05100B□ | 1 | 39.5 | 42 | 40 | □40 | 46 | 46 | 40 | 39.5 | 29 | 27 | 2.2 | 15 |
| | 1/9 | R88G-HPG11B09050B□ | 1 | 39.5 | 42 | 40 | □40 | 46 | 46 | 40 | 39.5 | 29 | 27 | 2.2 | 15 |
| | 1/21 | R88G-HPG14A21100B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 46 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/33 | R88G-HPG14A33050B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 46 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/45 | R88G-HPG14A45050B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 46 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| 100 W | 1/5 | R88G-HPG11B05100B□ | 1 | 39.5 | 42 | 40 | □40 | 46 | 46 | 40 | 39.5 | 29 | 27 | 2.2 | 15 |
| | 1/11 | R88G-HPG14A11100B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 46 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/21 | R88G-HPG14A21100B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 46 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/33 | R88G-HPG20A33100B□ | 2 | 66.5 | 80 | 90 | ∅55 | 105 | 46 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/45 | R88G-HPG20A45100B□ | 2 | 66.5 | 80 | 90 | ∅55 | 105 | 46 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| 200 W | 1/5 | R88G-HPG14A05200B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 70 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/11 | R88G-HPG14A11200B□ | 1 | 64.0 | 58 | 60 | □60 | 70 | 70 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/21 | R88G-HPG20A21200B□ | 2 | 71.0 | 80 | 90 | ∅89 | 105 | 70 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/33 | R88G-HPG20A33200B□ | 2 | 71.0 | 80 | 90 | ∅89 | 105 | 70 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/45 | R88G-HPG20A45200B□ | 2 | 71.0 | 80 | 90 | ∅89 | 105 | 70 | 85 | 84 | 59 | 53 | 7.5 | 27 |

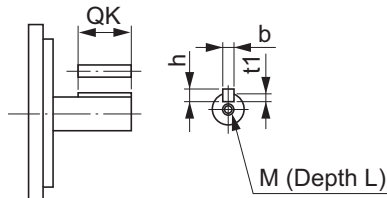
Note 1 The standard shaft type is a straight shaft.

- 2 A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box). (Example : R88G-HPG11A05100BJ)
- 3 The diameter of the motor shaft insertion is same as of the corresponding Servomotor shaft.

● External view 1



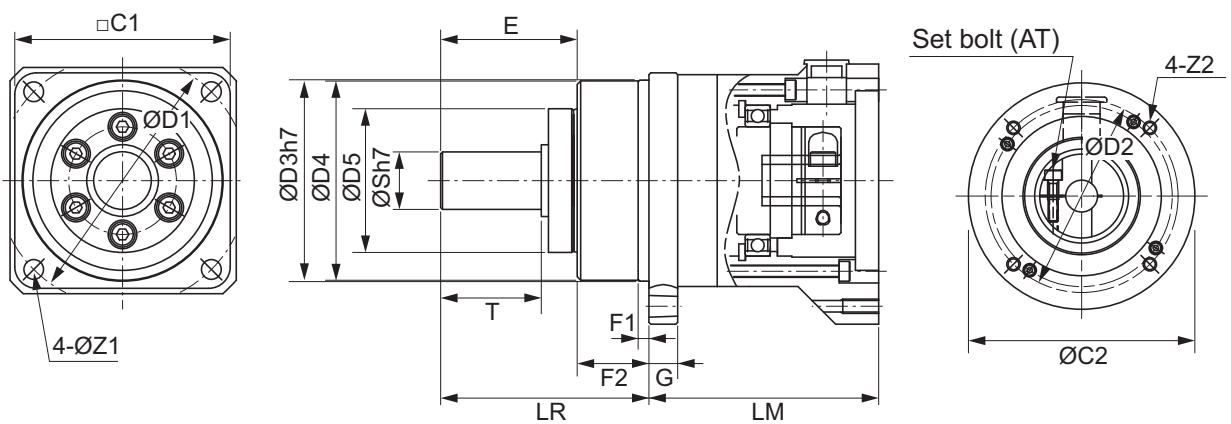
Key tap dimensions



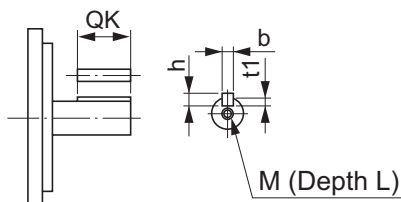
| Dimensions (mm) | | | | | | | | | | | | | Model | | |
|-----------------|----|----|-----|---------|------|-----|---|---|-----|-----|----|--------------------|-------|-------|--|
| G | S | T | Z1 | Z2 | AT*1 | Key | | | | Tap | | | | | |
| | | | | | | QK | b | h | t1 | M | L | | | | |
| 5 | 8 | 20 | 3.4 | M4 × 9 | M3 | 15 | 3 | 3 | 1.8 | M3 | 6 | R88G-HPG11B05100B□ | 1/5 | 50 W | |
| 5 | 8 | 20 | 3.4 | M4 × 9 | M3 | 15 | 3 | 3 | 1.8 | M3 | 6 | R88G-HPG11B09050B□ | 1/9 | | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M3 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A21100B□ | 1/21 | | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M3 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A33050B□ | 1/33 | 100 W | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M3 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A45050B□ | 1/45 | | |
| 5 | 8 | 20 | 3.4 | M4 × 9 | M3 | 15 | 3 | 3 | 1.8 | M3 | 6 | R88G-HPG11B05100B□ | 1/5 | | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M3 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A11100B□ | 1/11 | 200 W | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M3 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A21100B□ | 1/21 | | |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A33100B□ | 1/33 | | |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A45100B□ | 1/45 | 200 W | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M4 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A05200B□ | 1/5 | | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M4 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A11200B□ | 1/11 | | |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A21200B□ | 1/21 | 200 W | |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A33200B□ | 1/33 | | |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A45200B□ | 1/45 | | |

*1 Indicates set bolt.

● External view 2



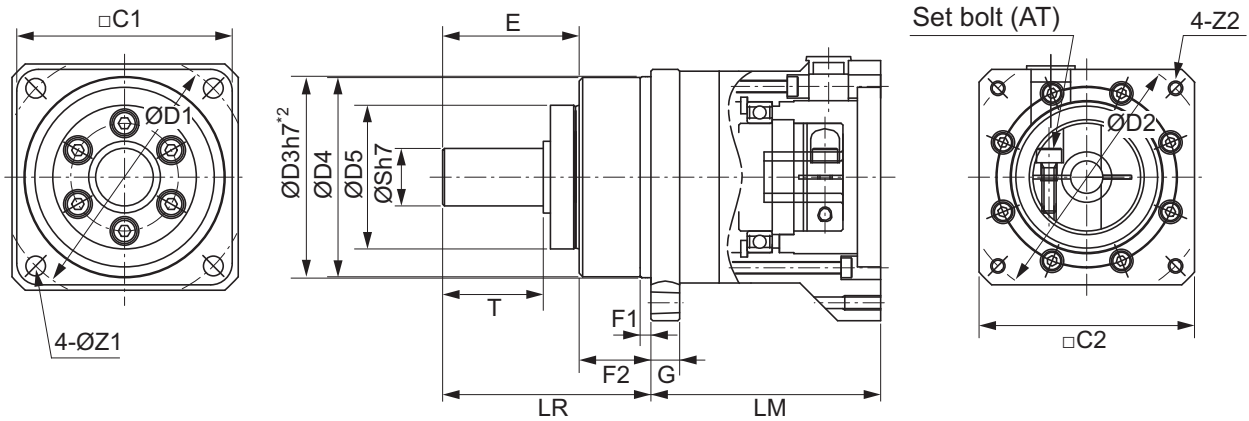
Key tap dimensions



● For 3,000-r/min Servomotors (400 to 750 W)

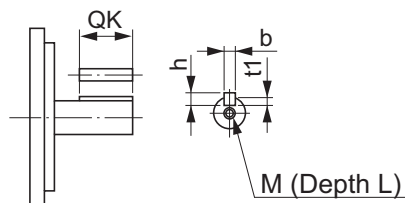
| Model | | | External view | Dimensions (mm) | | | | | | | | | | | |
|------------------|------|---------------------|---------------|-----------------|-----|-----|------|-----|-----|-----|------|-----|-----|------|----|
| | | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | D5 | E | F1 | F2 |
| 400 W | 1/5 | R88G-HPG14A05400B□ | 1 | 64 | 58 | 60 | □60 | 70 | 70 | 56 | 55.5 | 40 | 37 | 2.5 | 21 |
| | 1/11 | R88G-HPG20A11400B□ | 2 | 71 | 80 | 90 | ∅89 | 105 | 70 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/21 | R88G-HPG20A21400B□ | 2 | 71 | 80 | 90 | ∅89 | 105 | 70 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/33 | R88G-HPG32A33400B□ | 2 | 104 | 133 | 120 | ∅122 | 135 | 70 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/45 | R88G-HPG32A45400B□ | 2 | 104 | 133 | 120 | ∅122 | 135 | 70 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| 750 W (200 V) | 1/5 | R88G-HPG20A05750B□ | 1 | 78 | 80 | 90 | □80 | 105 | 90 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/11 | R88G-HPG20A11750B□ | 1 | 78 | 80 | 90 | □80 | 105 | 90 | 85 | 84 | 59 | 53 | 7.5 | 27 |
| | 1/21 | R88G-HPG32A21750B□ | 2 | 104 | 133 | 120 | ∅122 | 135 | 90 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG32A33750B□ | 2 | 104 | 133 | 120 | ∅122 | 135 | 90 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/45 | R88G-HPG32A45750B□ | 2 | 104 | 133 | 120 | ∅122 | 135 | 90 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| 750 W (400 V) | 1/5 | R88G-HPG32A052K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG32A211K5B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG32A33600SB□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/45 | R88G-HPG50A451K5B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |

● External view 1



Key tap dimensions

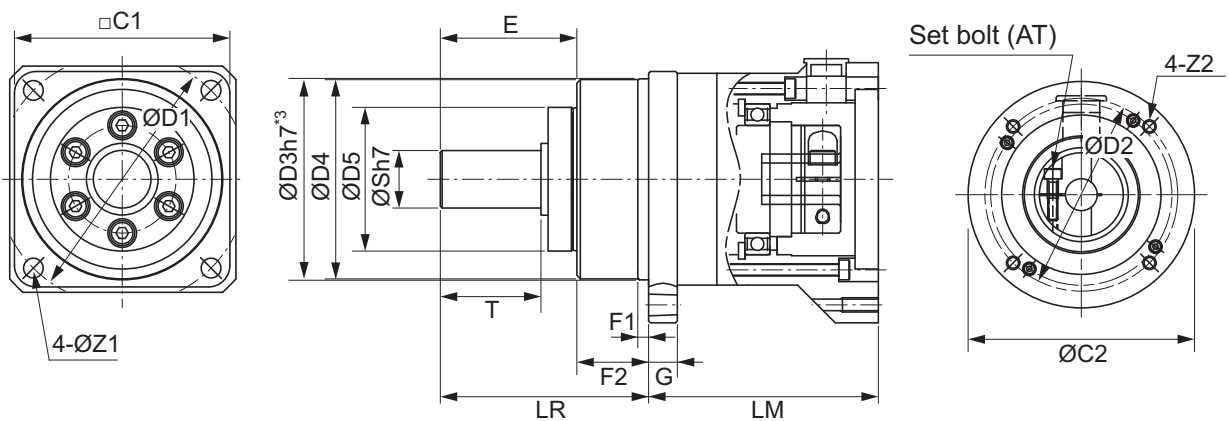
*2 The tolerance is "h8" for R88G-HPG50□ or R88G-HPG65□.



| Dimensions (mm) | | | | | | | | | | | | Model | | |
|-----------------|----|----|-----|---------|-------|-----|----|---|-----|-----|----|---------------------|------|------------------|
| G | S | T | Z1 | Z2 | AT *1 | Key | | | | Tap | | | | |
| | | | | | | QK | b | h | t1 | M | L | | | |
| 8 | 16 | 28 | 5.5 | M4 × 10 | M4 | 25 | 5 | 5 | 3 | M4 | 8 | R88G-HPG14A05400B□ | 1/5 | 400 W |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A11400B□ | 1/11 | 750 W (200 V) |
| 10 | 25 | 42 | 9 | M4 × 10 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A21400B□ | 1/21 | |
| 13 | 40 | 82 | 11 | M4 × 10 | M4 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A33400B□ | 1/33 | |
| 13 | 40 | 82 | 11 | M4 × 10 | M4 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A45400B□ | 1/45 | |
| 10 | 25 | 42 | 9 | M5 × 12 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A05750B□ | 1/5 | |
| 10 | 25 | 42 | 9 | M5 × 12 | M4 | 36 | 8 | 7 | 4 | M6 | 12 | R88G-HPG20A11750B□ | 1/11 | 750 W (400 V) |
| 13 | 40 | 82 | 11 | M5 × 12 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A21750B□ | 1/21 | |
| 13 | 40 | 82 | 11 | M5 × 12 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A33750B□ | 1/33 | |
| 13 | 40 | 82 | 11 | M5 × 12 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A45750B□ | 1/45 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0B□ | 1/5 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0B□ | 1/11 | 750 W (400 V) |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A211K5B□ | 1/21 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A33600SB□ | 1/33 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A451K5B□ | 1/45 | |

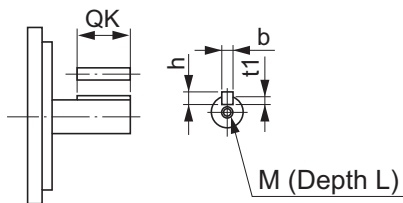
*1 Indicates set bolt.

● External view 2



Key tap dimensions

*3 The tolerance is "h8" for R88G-HPG50□ or R88G-HPG65□.



● For 3,000-r/min Servomotors (1 kW to 5 kW)

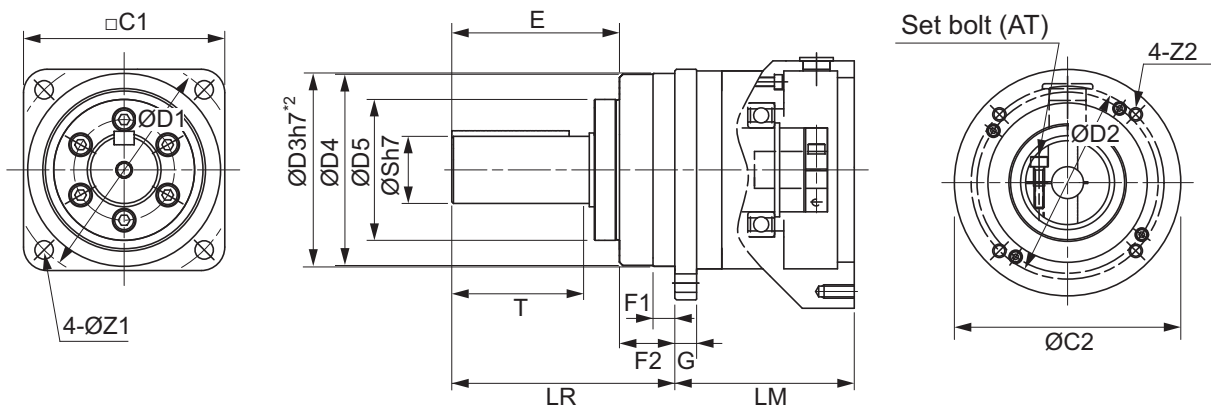
| Model | | | External view | Dimensions (mm) | | | | | | | | | | | |
|--------|------|--------------------|---------------|-----------------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|----|
| | | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | D5 | E | F1 | F2 |
| 1 kW | 1/5 | R88G-HPG32A052K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG32A211K5B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG50A332K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/45 | R88G-HPG50A451K5B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| 1.5 kW | 1/5 | R88G-HPG32A052K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG32A211K5B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG50A332K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/45 | R88G-HPG50A451K5B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| 2 kW | 1/5 | R88G-HPG32A052K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG50A212K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/33 | R88G-HPG50A332K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| 3 kW | 1/5 | R88G-HPG32A053K0B□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG50A113K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/21 | R88G-HPG50A213K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| 4 kW | 1/5 | R88G-HPG32A054K0B□ | 1 | 129 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG50A115K0B□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| 5 kW | 1/5 | R88G-HPG50A055K0B□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/11 | R88G-HPG50A115K0B□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |

Note 1 The standard shaft type is a straight shaft.

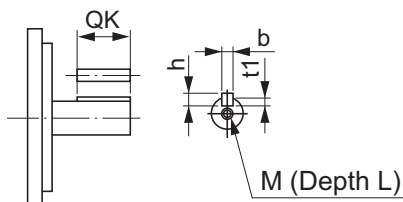
2 A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box).
(Example : R88G-HPG32A051K0BJ)

3 The diameter of the motor shaft insertion is same as of the corresponding Servomotor shaft.

● External view



Key tap dimensions

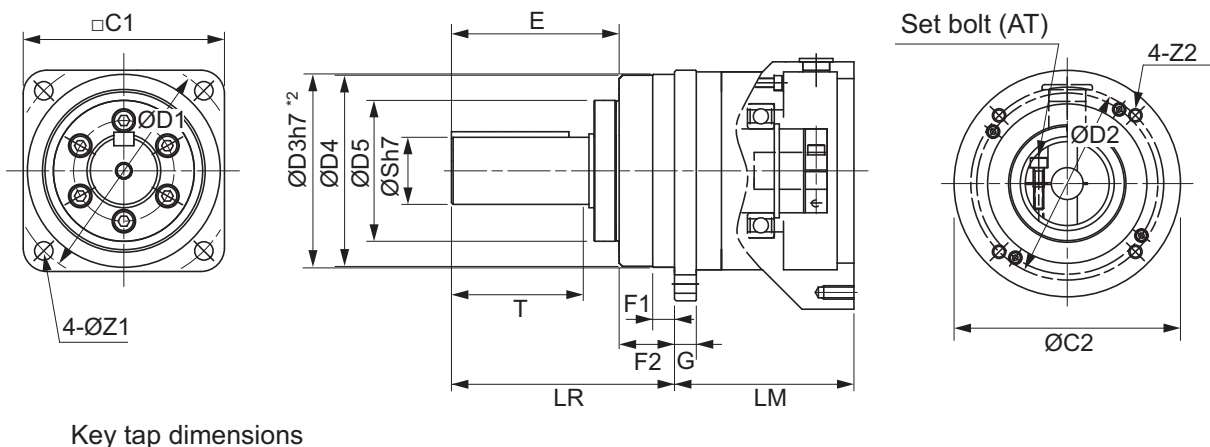


*2 The tolerance is "h8" for R88G-HPG50□.

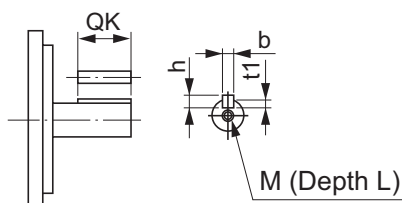
| Dimensions (mm) | | | | | | | | | | | | Model | | |
|-----------------|----|----|----|---------|------|-----|----|---|-----|-----|----|--------------------|------|--------|
| G | S | T | Z1 | Z2 | AT*1 | Key | | | | Tap | | | | |
| | | | | | | QK | b | h | t1 | M | L | | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0B□ | 1/5 | 1 kW |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0B□ | 1/11 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A211K5B□ | 1/21 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A332K0B□ | 1/33 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A451K5B□ | 1/45 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0B□ | 1/5 | 1.5 kW |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0B□ | 1/11 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A211K5B□ | 1/21 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A332K0B□ | 1/33 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A451K5B□ | 1/45 | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0B□ | 1/5 | 2 kW |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0B□ | 1/11 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A212K0B□ | 1/21 | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A332K0B□ | 1/33 | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A053K0B□ | 1/5 | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A113K0B□ | 1/11 | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A213K0B□ | 1/21 | |
| 13 | 40 | 82 | 11 | M8 × 25 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A054K0B□ | 1/5 | 4 kW |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A115K0B□ | 1/11 | |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A055K0B□ | 1/5 | 5 kW |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A115K0B□ | 1/11 | |

*1 Indicates set bolt.

● External view 2



Key tap dimensions



*2 The tolerance is "h8" for R88G-HPG50□ or R88G-HPG65□.

● For 2,000-r/min Servomotors (400 W to 1 kW)

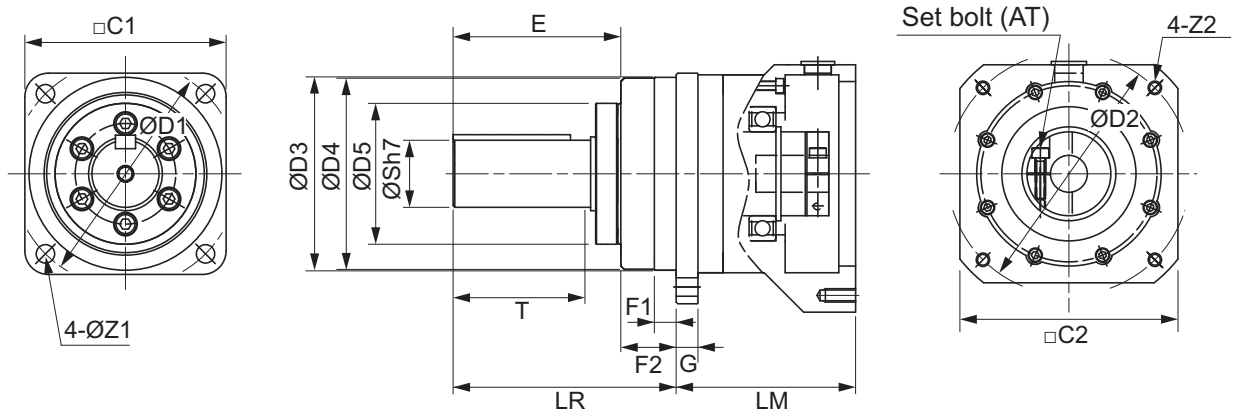
| Model | | | External view | Dimensions (mm) | | | | | | | | | | | |
|------------------|------|---------------------|---------------|-----------------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|----|
| | | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | D5 | E | F1 | F2 |
| 400 W (400 V) | 1/5 | R88G-HPG32A052K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG32A211K5B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG32A33600SB□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/45 | R88G-HPG32A45400SB□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| 600 W (400 V) | 1/5 | R88G-HPG32A052K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG32A211K5B□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG32A33600SB□ | 2 | 110 | 133 | 120 | ∅135 | 135 | 115 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/45 | R88G-HPG50A451K5B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 115 | 165 | 163 | 122 | 103 | 12 | 53 |
| 1 kW | 1/5 | R88G-HPG32A053K0B□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0SB□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG32A211K0SB□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/33 | R88G-HPG50A332K0SB□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/45 | R88G-HPG50A451K0SB□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |

Note 1 The standard shaft type is a straight shaft.

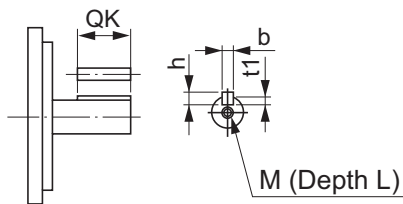
2 A model with a key and tap is indicated by adding “J” to the end of the model number (the suffix shown in the box).
(Example : R88G-HPG32A053K0BJ)

3 The diameter of the motor shaft insertion is same as of the corresponding Servomotor shaft.

● External view 1



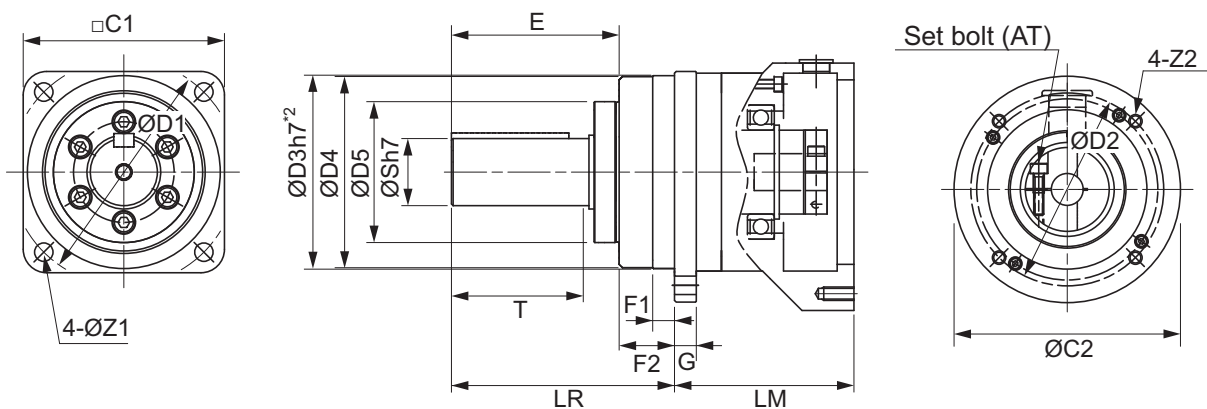
Key tap dimensions



| Dimensions (mm) | | | | | | | | | | | | | Model | | |
|-----------------|----|----|----|---------|------|-----|----|---|-----|-----|----|---------------------|-------|------------------|--|
| G | S | T | Z1 | Z2 | AT*1 | Key | | | | Tap | | | | | |
| | | | | | | QK | b | h | t1 | M | L | | | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0B□ | 1/5 | 400 W (400 V) | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0B□ | 1/11 | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A211K5B□ | 1/21 | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A33600SB□ | 1/33 | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A45400SB□ | 1/45 | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0B□ | 1/5 | 600 W (400 V) | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0B□ | 1/11 | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A211K5B□ | 1/21 | | |
| 13 | 40 | 82 | 11 | M8 × 10 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A33600SB□ | 1/33 | | |
| 16 | 50 | 82 | 14 | M8 × 10 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A451K5B□ | 1/45 | 1 kW | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A053K0B□ | 1/5 | | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0SB□ | 1/11 | | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A211K0SB□ | 1/21 | | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A332K0SB□ | 1/33 | | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A451K0SB□ | 1/45 | | |

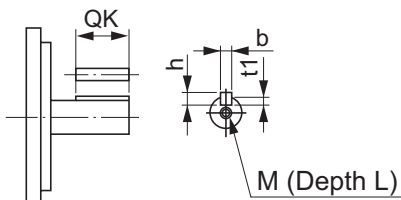
*1 Indicates set bolt.

● External view 2



Key tap dimensions

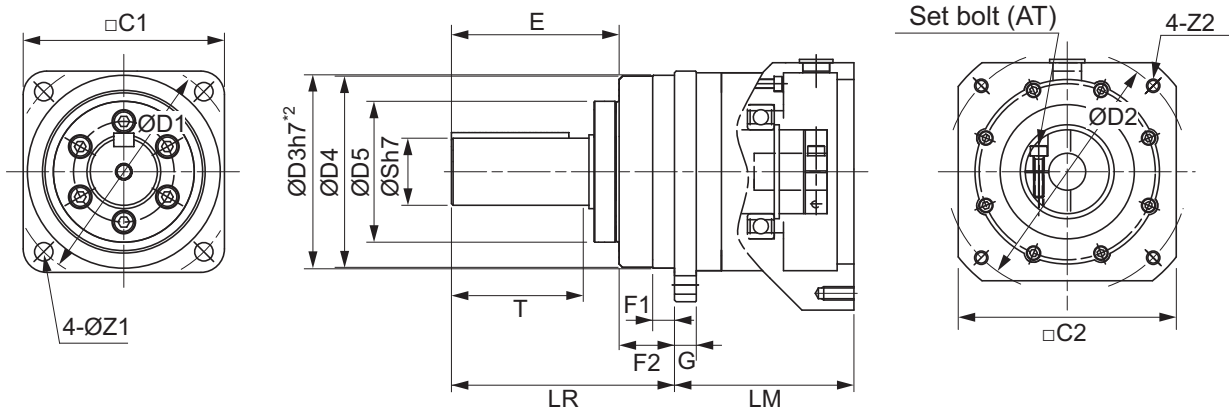
*2 The tolerance is "h8" for R88G-HPG50□ or R88G-HPG65□.



● For 2,000-r/min Servomotors (1.5 kW to 5 kW)

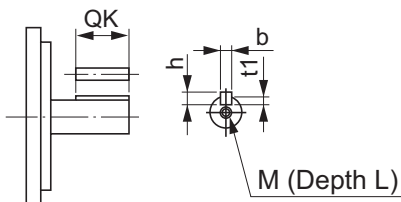
| Model | | | External view | Dimensions (mm) | | | | | | | | | | | |
|--------|------|---------------------|---------------|-----------------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|----|
| | | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | D5 | E | F1 | F2 |
| 1.5 kW | 1/5 | R88G-HPG32A053K0B□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0SB□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG50A213K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/33 | R88G-HPG50A332K0SB□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| 2 kW | 1/5 | R88G-HPG32A053K0B□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A112K0SB□ | 1 | 107 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG50A213K0B□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/33 | R88G-HPG50A332K0SB□ | 2 | 123 | 156 | 170 | ∅170 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| 3 kW | 1/5 | R88G-HPG32A054K0B□ | 1 | 129 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG50A115K0B□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/21 | R88G-HPG50A213K0SB□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/25 | R88G-HPG65A253K0SB□ | 1 | 231 | 222 | 230 | □130 | 260 | 145 | 220 | 214 | 168 | 165 | 12 | 57 |
| 4 kW | 1/5 | R88G-HPG50A055K0SB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/11 | R88G-HPG50A115K0SB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/20 | R88G-HPG65A205K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |
| | 1/25 | R88G-HPG65A255K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |
| 5 kW | 1/5 | R88G-HPG50A055K0SB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/11 | R88G-HPG50A115K0SB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/20 | R88G-HPG65A205K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |
| | 1/25 | R88G-HPG65A255K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |

● External view 1



Key tap dimensions

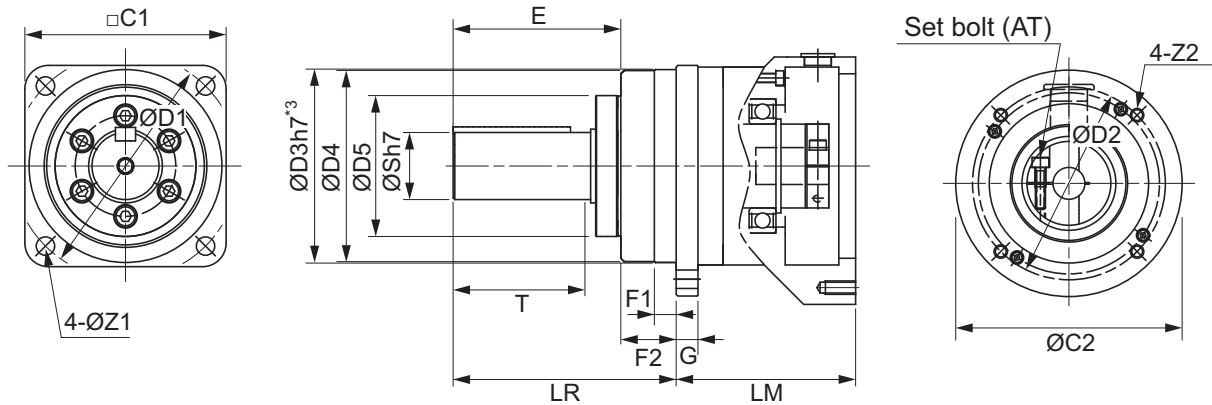
*2 The tolerance is "h8" for R88G-HPG50□ or R88G-HPG65□.



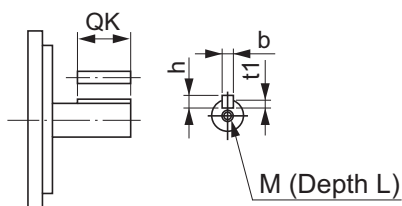
| Dimensions (mm) | | | | | | | | | | | | | Model | | |
|-----------------|----|-----|----|----------|------|-----|----|----|-----|-----|----|---------------------|-------|--------|--|
| G | S | T | Z1 | Z2 | AT*1 | Key | | | | Tap | | | | | |
| | | | | | | QK | b | h | t1 | M | L | | | | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A053K0B□ | 1/5 | 1.5 kW | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0SB□ | 1/11 | | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A213K0B□ | 1/21 | | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A332K0SB□ | 1/33 | | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A053K0B□ | 1/5 | 2 kW | |
| 13 | 40 | 82 | 11 | M8 × 18 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A112K0SB□ | 1/11 | | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A213K0B□ | 1/21 | | |
| 16 | 50 | 82 | 14 | M8 × 16 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A332K0SB□ | 1/33 | | |
| 13 | 40 | 82 | 11 | M8 × 25 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A054K0B□ | 1/5 | 3 kW | |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A115K0B□ | 1/11 | | |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A213K0SB□ | 1/21 | | |
| 25 | 80 | 130 | 18 | M8 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A253K0SB□ | 1/25 | | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A055K0SB□ | 1/5 | 4 kW | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A115K0SB□ | 1/11 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A205K0SB□ | 1/20 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A255K0SB□ | 1/25 | | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A055K0SB□ | 1/5 | 5 kW | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A115K0SB□ | 1/11 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A205K0SB□ | 1/20 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A255K0SB□ | 1/25 | | |

*1 Indicates set bolt.

● External view 2



Key tap dimensions



*3 The tolerance is "h8" for R88G-HPG50□ or R88G-HPG65□.

● For 1,000-r/min Servomotors (900 W to 3 kW)

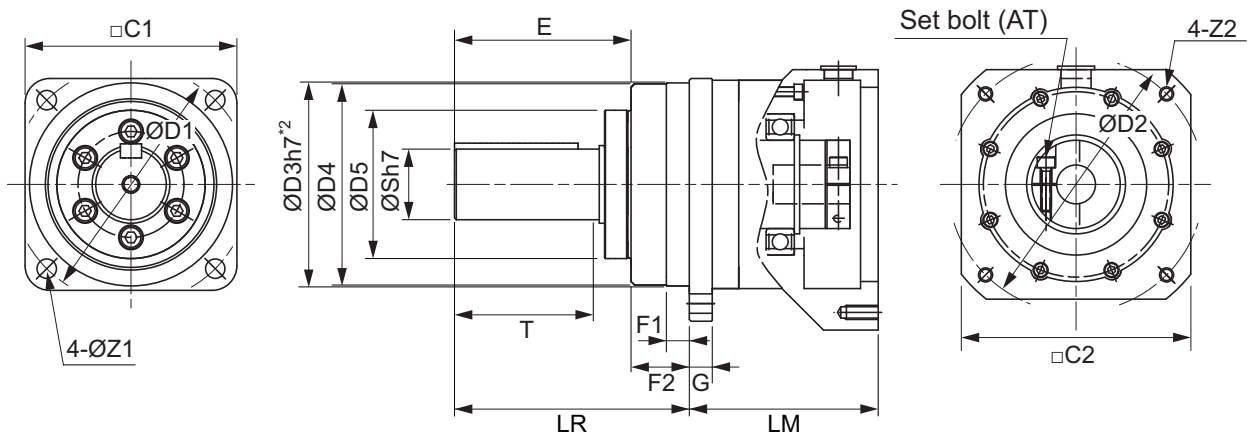
| Model | | | External view | Dimensions (mm) | | | | | | | | | | | |
|-------|------|---------------------|---------------|-----------------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|----|
| | | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | D5 | E | F1 | F2 |
| 900 W | 1/5 | R88G-HPG32A05900TB□ | 1 | 129 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG32A11900TB□ | 1 | 129 | 133 | 120 | □130 | 135 | 145 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/21 | R88G-HPG50A21900TB□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/33 | R88G-HPG50A33900TB□ | 1 | 149 | 156 | 170 | □130 | 190 | 145 | 165 | 163 | 122 | 103 | 12 | 53 |
| 2 kW | 1/5 | R88G-HPG32A052K0TB□ | 1 | 129 | 133 | 120 | □180 | 135 | 200 | 115 | 114 | 84 | 98 | 12.5 | 35 |
| | 1/11 | R88G-HPG50A112K0TB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/21 | R88G-HPG50A212K0TB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 53 |
| | 1/25 | R88G-HPG65A255K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |
| 3 kW | 1/5 | R88G-HPG50A055K0SB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/11 | R88G-HPG50A115K0SB□ | 1 | 149 | 156 | 170 | □180 | 190 | 200 | 165 | 163 | 122 | 103 | 12 | 53 |
| | 1/20 | R88G-HPG65A205K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |
| | 1/25 | R88G-HPG65A255K0SB□ | 1 | 231 | 222 | 230 | □180 | 260 | 200 | 220 | 214 | 168 | 165 | 12 | 57 |

Note 1 The standard shaft type is a straight shaft.

2 A model with a key and tap is indicated by adding “J” to the end of the model number (the suffix shown in the box).
(Example : R88G-HPG32A05900TBJ)

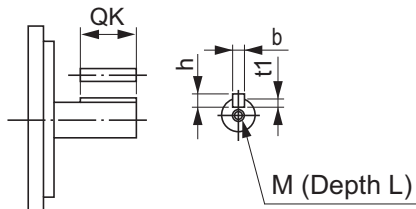
3 The diameter of the motor shaft insertion is same as of the corresponding Servomotor shaft.

● External view 1



Key tap dimensions

*2 The tolerance is “h8” for R88G-HPG50□ or R88G-HPG65□.



| Dimensions (mm) | | | | | | | | | | | | | Model | | |
|-----------------|----|-----|----|----------|------|-----|----|----|-----|-----|----|---------------------|-------|-------|--|
| G | S | T | Z1 | Z2 | AT*1 | Key | | | | Tap | | | | | |
| | | | | | | QK | b | h | t1 | M | L | | | | |
| 13 | 40 | 82 | 11 | M8 × 25 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A05900TB□ | 1/5 | 900 W | |
| 13 | 40 | 82 | 11 | M8 × 25 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A11900TB□ | 1/11 | | |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A21900TB□ | 1/21 | | |
| 16 | 50 | 82 | 14 | M8 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A33900TB□ | 1/33 | | |
| 13 | 40 | 82 | 11 | M12 × 25 | M6 | 70 | 12 | 8 | 5 | M10 | 20 | R88G-HPG32A052K0TB□ | 1/5 | 2 kW | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A112K0TB□ | 1/11 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG50A212K0TB□ | 1/21 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A255K0SB□ | 1/25 | 3 kW | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A055K0SB□ | 1/5 | | |
| 16 | 50 | 82 | 14 | M12 × 25 | M6 | 70 | 14 | 9 | 5.5 | M10 | 20 | R88G-HPG50A115K0SB□ | 1/11 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A205K0SB□ | 1/20 | | |
| 25 | 80 | 130 | 18 | M12 × 25 | M8 | 110 | 22 | 14 | 9 | M16 | 35 | R88G-HPG65A255K0SB□ | 1/25 | | |

*1 Indicates set bolt.

15 Arcminutes Max.

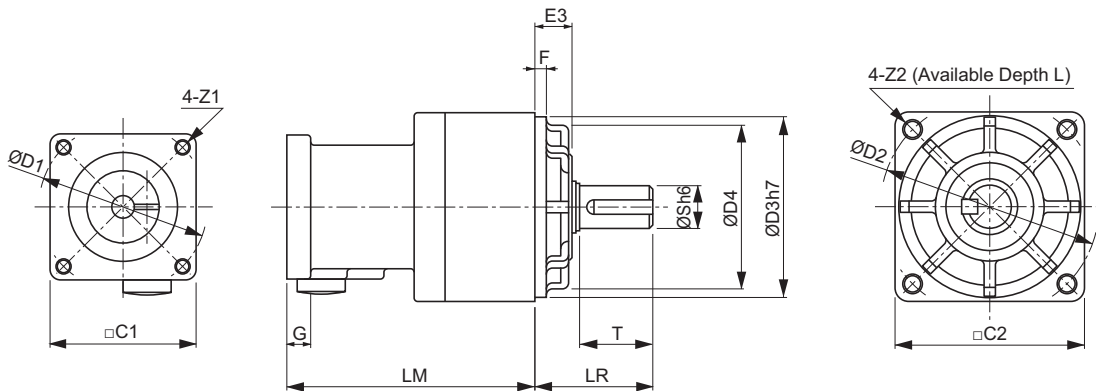
● For 3,000-r/min Servomotors

| Model | | | Dimensions (mm) | | | | | | | | | | |
|-------|------|-------------------|-----------------|----|----|----|----|-----|----|----|----|---|----|
| | | | LM | LR | C1 | C2 | D1 | D2 | D3 | D4 | E3 | F | G |
| 50 W | 1/5 | R88G-VRSF05B100CJ | 67.5 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| | 1/9 | R88G-VRSF09B100CJ | 67.5 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| | 1/15 | R88G-VRSF15B100CJ | 78.0 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| | 1/25 | R88G-VRSF25B100CJ | 78.0 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| 100 W | 1/5 | R88G-VRSF05B100CJ | 67.5 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| | 1/9 | R88G-VRSF09B100CJ | 67.5 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| | 1/15 | R88G-VRSF15B100CJ | 78.0 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| | 1/25 | R88G-VRSF25B100CJ | 78.0 | 32 | 40 | 52 | 46 | 60 | 50 | 45 | 10 | 3 | 6 |
| 200 W | 1/5 | R88G-VRSF05B200CJ | 72.5 | 32 | 60 | 52 | 70 | 60 | 50 | 45 | 10 | 3 | 10 |
| | 1/9 | R88G-VRSF09C200CJ | 89.5 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| | 1/15 | R88G-VRSF15C200CJ | 100.0 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| | 1/25 | R88G-VRSF25C200CJ | 100.0 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| 400 W | 1/5 | R88G-VRSF05C400CJ | 89.5 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| | 1/9 | R88G-VRSF09C400CJ | 89.5 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| | 1/15 | R88G-VRSF15C400CJ | 100.0 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| | 1/25 | R88G-VRSF25C400CJ | 100.0 | 50 | 60 | 78 | 70 | 90 | 70 | 62 | 17 | 3 | 8 |
| 750 W | 1/5 | R88G-VRSF05C750CJ | 93.5 | 50 | 80 | 78 | 90 | 90 | 70 | 62 | 17 | 3 | 10 |
| | 1/9 | R88G-VRSF09D750CJ | 97.5 | 61 | 80 | 98 | 90 | 115 | 90 | 75 | 18 | 5 | 10 |
| | 1/15 | R88G-VRSF15D750CJ | 110.0 | 61 | 80 | 98 | 90 | 115 | 90 | 75 | 18 | 5 | 10 |
| | 1/25 | R88G-VRSF25D750CJ | 110.0 | 61 | 80 | 98 | 90 | 115 | 90 | 75 | 18 | 5 | 10 |

Note 1 The standard shaft type is a shaft with key.

2 The diameter of the motor shaft insertion is same as of the corresponding Servomotor shaft.

● External view

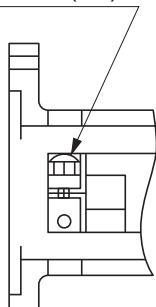


| Dimensions (mm) | | | | | | | | | | | Model | | | | |
|-----------------|----|----|----|------|----|-----|---|---|-----|-------------------|-------|-------|--|-----|------|
| S | T | Z1 | Z2 | AT*1 | L | Key | | | | R88G-VRSF05B100CJ | | | | 1/5 | 50 W |
| | | | | | | QK | b | h | t1 | | | | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF09B100CJ | 1/9 | 100 W | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF15B100CJ | 1/15 | | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF25B100CJ | 1/25 | | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF05B200CJ | 1/5 | | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF09C200CJ | 1/9 | 200 W | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF15C200CJ | 1/15 | | | | |
| 12 | 20 | M4 | M5 | M3 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF25C200CJ | 1/25 | | | | |
| 12 | 20 | M4 | M5 | M4 | 12 | 16 | 4 | 4 | 2.5 | R88G-VRSF05C400CJ | 1/5 | 400 W | | | |
| 19 | 30 | M4 | M6 | M4 | 20 | 22 | 6 | 6 | 3.5 | R88G-VRSF09C400CJ | 1/9 | | | | |
| 19 | 30 | M4 | M6 | M4 | 20 | 22 | 6 | 6 | 3.5 | R88G-VRSF15C400CJ | 1/15 | | | | |
| 19 | 30 | M4 | M6 | M4 | 20 | 22 | 6 | 6 | 3.5 | R88G-VRSF25C400CJ | 1/25 | | | | |
| 19 | 30 | M4 | M6 | M4 | 20 | 22 | 6 | 6 | 3.5 | R88G-VRSF05C750CJ | 1/5 | 750 W | | | |
| 19 | 30 | M5 | M6 | M4 | 20 | 22 | 6 | 6 | 3.5 | R88G-VRSF09D750CJ | 1/9 | | | | |
| 24 | 40 | M5 | M8 | M4 | 20 | 30 | 8 | 7 | 4 | R88G-VRSF15D750CJ | 1/15 | | | | |
| 24 | 40 | M5 | M8 | M4 | 20 | 30 | 8 | 7 | 4 | R88G-VRSF25D750CJ | 1/25 | | | | |

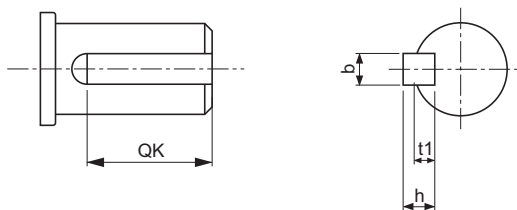
*1 Indicates set bolt.

● External view

Set bolt (AT)



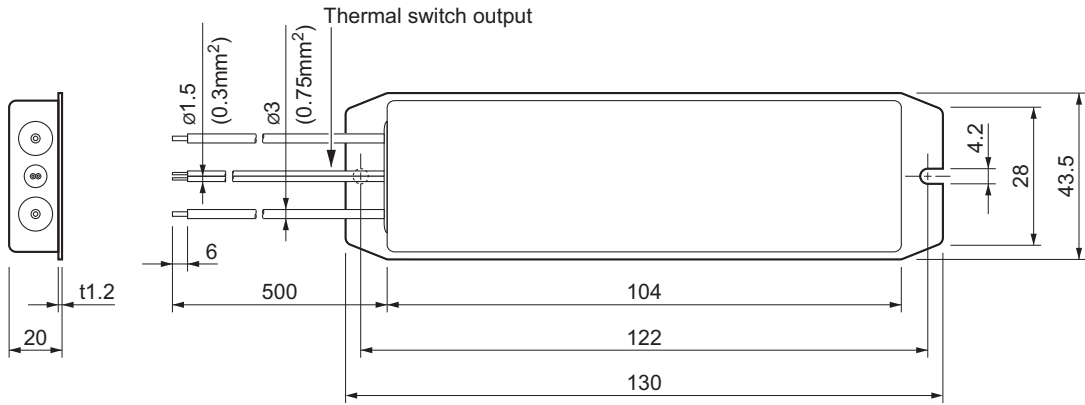
Key dimensions



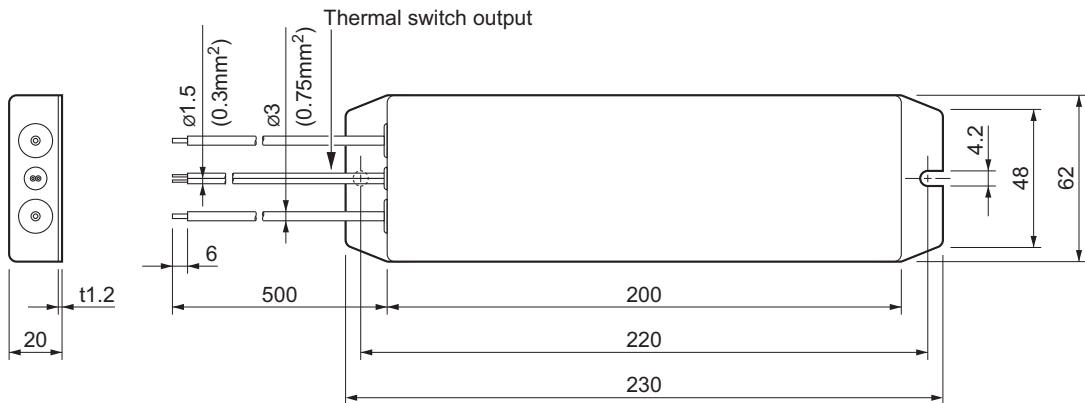
2-4-5 External Regeneration Resistor Dimensions

External Regeneration Resistor

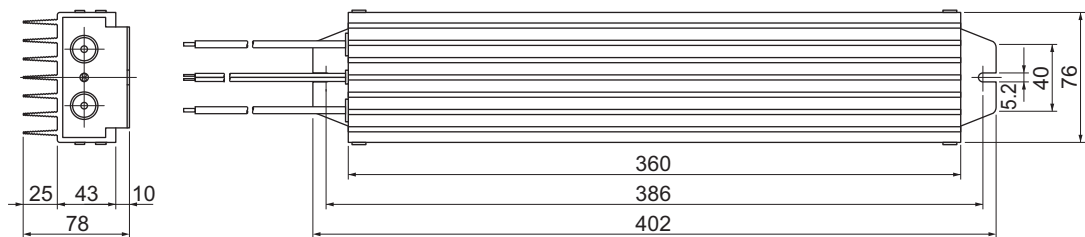
- R88A-RR08050S/-RR080100S



- R88A-RR22047S/-RR22047S1

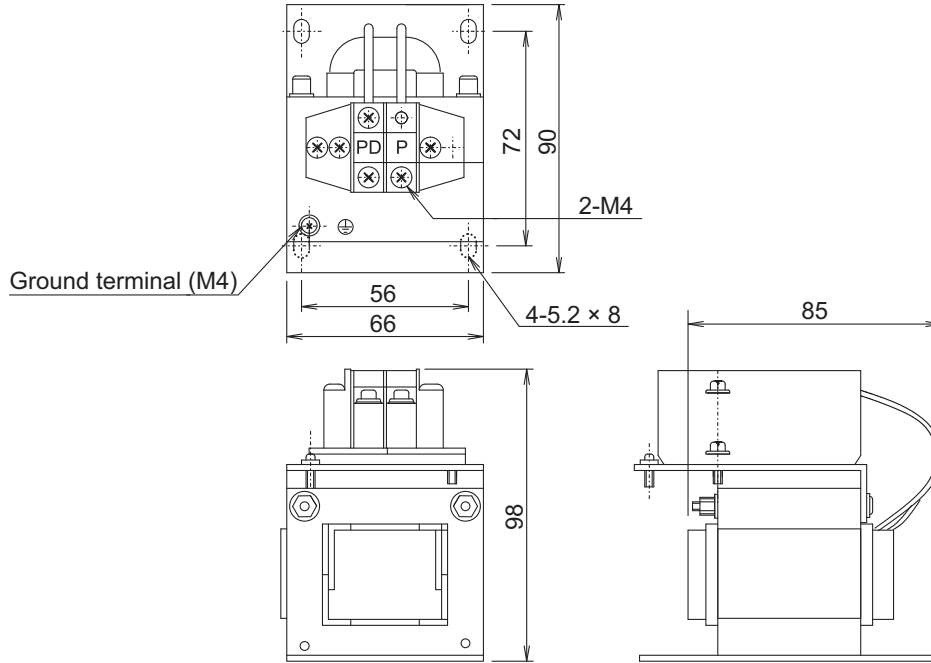


- R88A-RR50020S

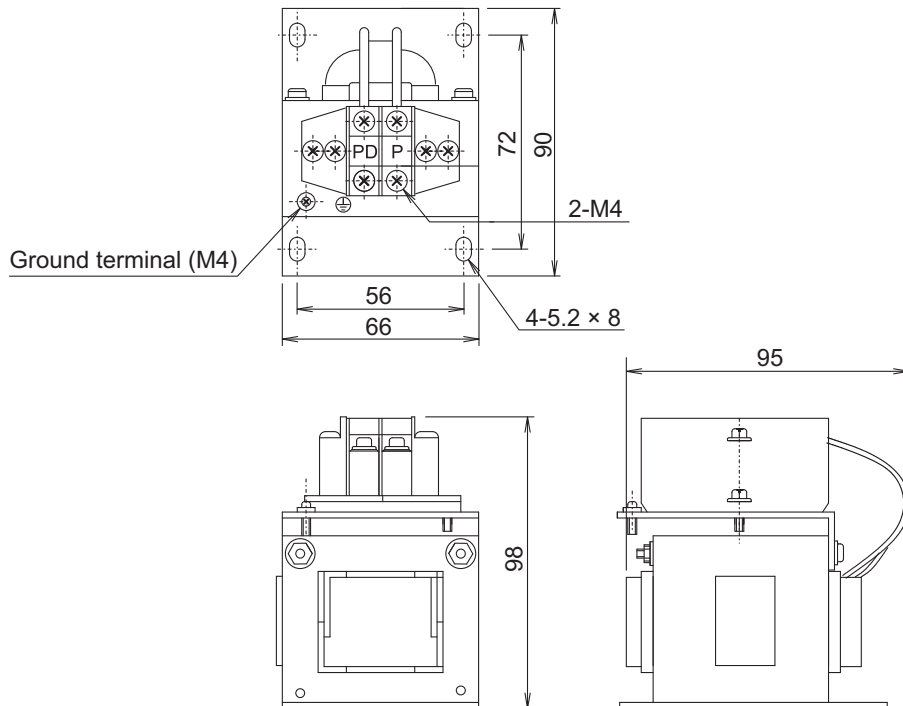


2-4-6 Reactor Dimensions

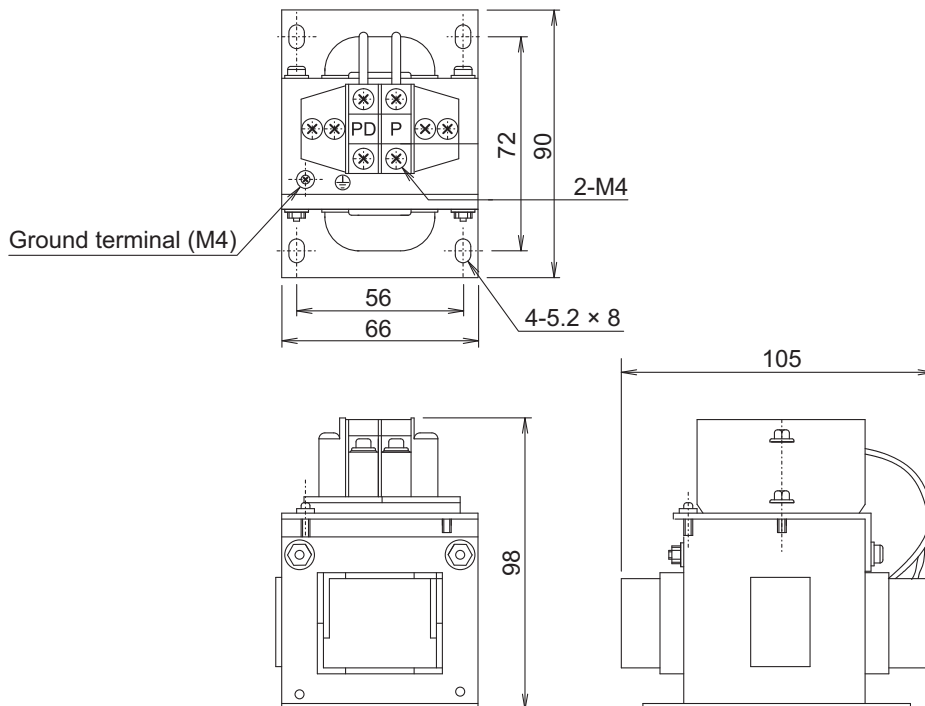
3G3AX-DL2002



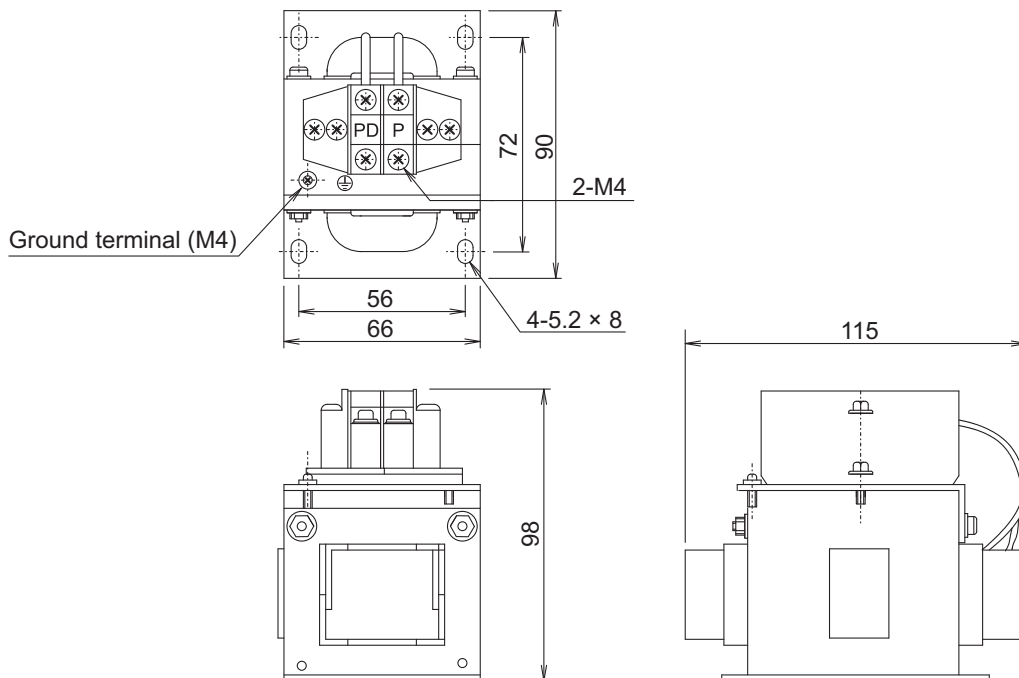
3G3AX-DL2004



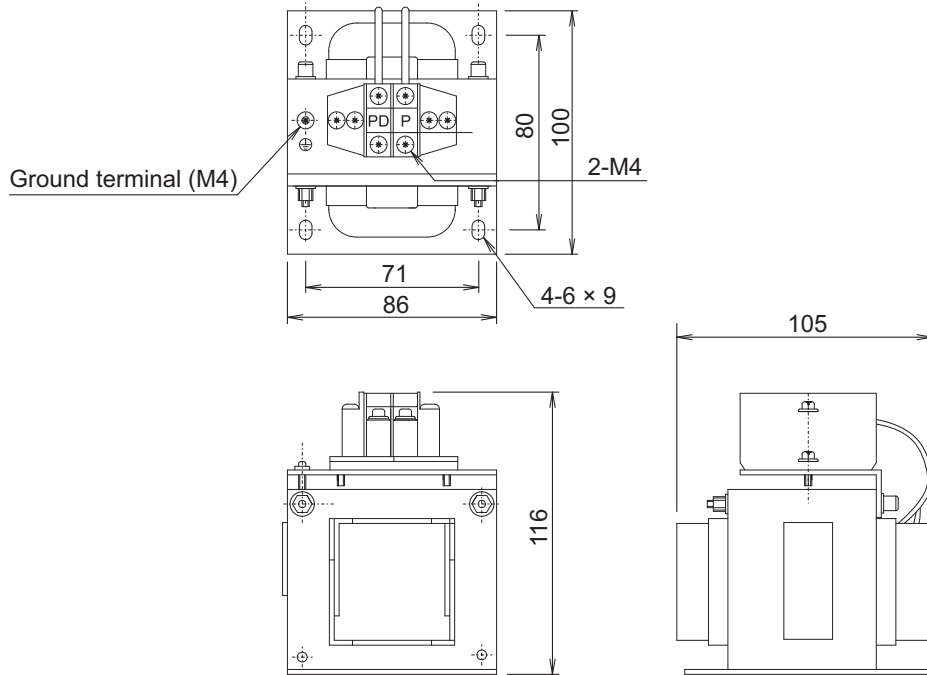
3G3AX-DL2007



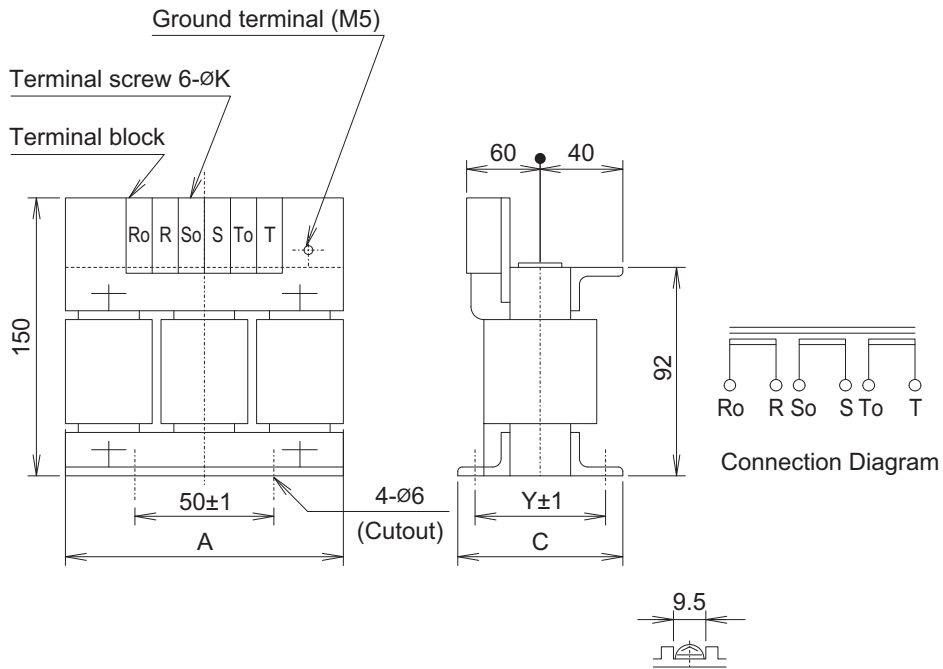
3G3AX-DL2015



3G3AX-DL2022

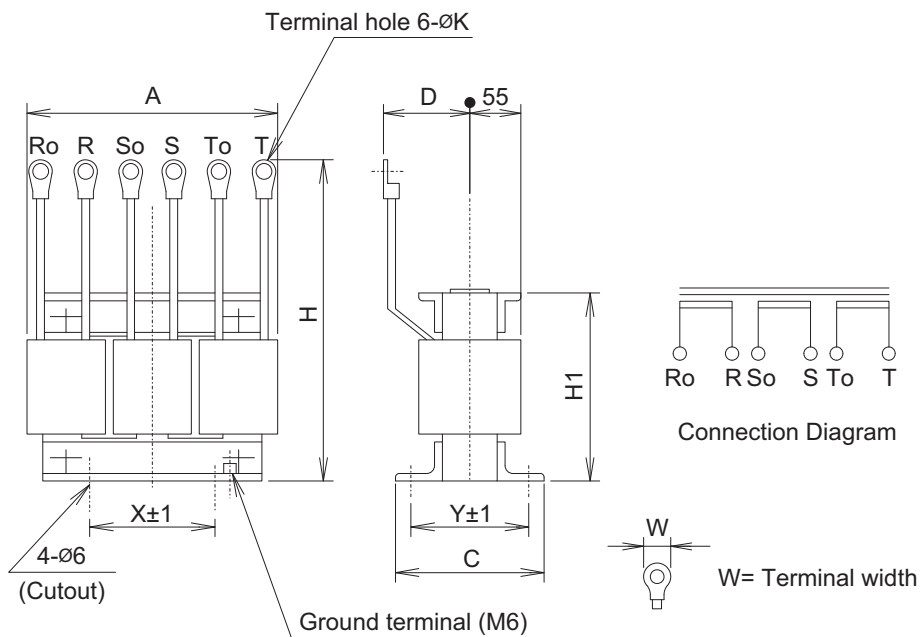


3G3AX-AL2025/-AL2055/-AL4025/-AL4055



| Model | Dimensions (mm) | | | |
|--------------|-----------------|----|----|---|
| | A | C | Y | K |
| 3G3AX-AL2025 | 130 | 82 | 67 | 4 |
| 3G3AX-AL2055 | 140 | 98 | 75 | 4 |
| 3G3AX-AL4025 | 130 | 82 | 67 | 4 |
| 3G3AX-AL4055 | 130 | 98 | 75 | 5 |

3G3AX-AL2110/-AL2220/-AL4110/-AL4220

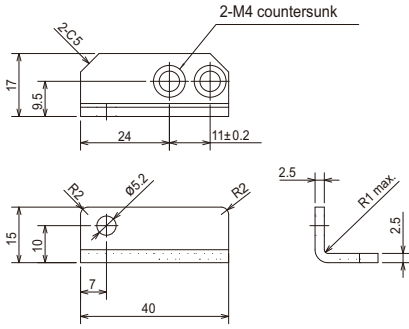


| Model | Dimensions (mm) | | | | | | | | |
|--------------|-----------------|-----|----|-----|-----|-----|----|-----|------|
| | A | C | D | H | H1 | X | Y | K | W |
| 3G3AX-AL2110 | 160 | 103 | 70 | 170 | 106 | 60 | 80 | 5.3 | 12 |
| 3G3AX-AL2220 | 180 | 113 | 75 | 190 | 136 | 90 | 90 | 8.4 | 16.5 |
| 3G3AX-AL4110 | 160 | 116 | 75 | 170 | 106 | 60 | 98 | 5.0 | 12.5 |
| 3G3AX-AL4220 | 180 | 103 | 75 | 190 | 138 | 100 | 80 | 5.3 | 12 |

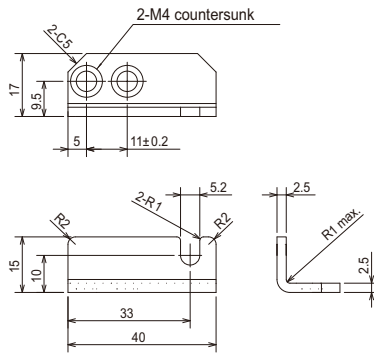
2-4-7 Mounting Bracket (L-brackets for Rack Mounting) Dimensions

R88A-TK01K

Mounting bracket for top side

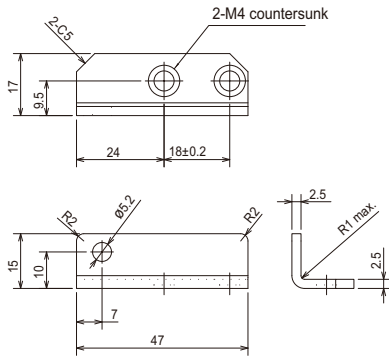


Mounting bracket for bottom side

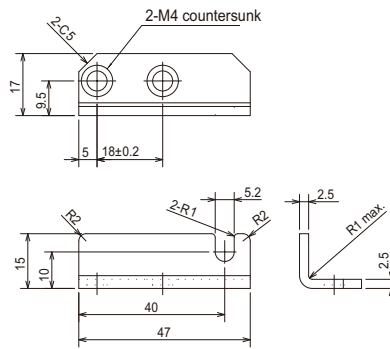


R88A-TK02K

Mounting bracket for top side

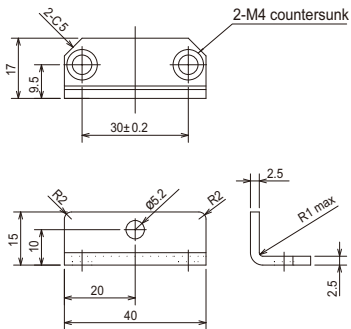


Mounting bracket for bottom side

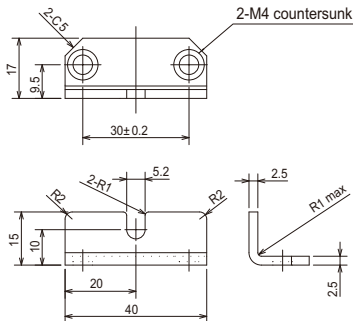


R88A-TK03K

Mounting bracket for top side

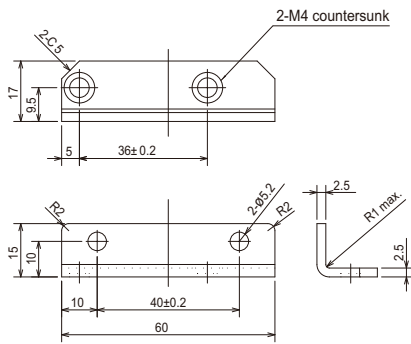


Mounting bracket for bottom side

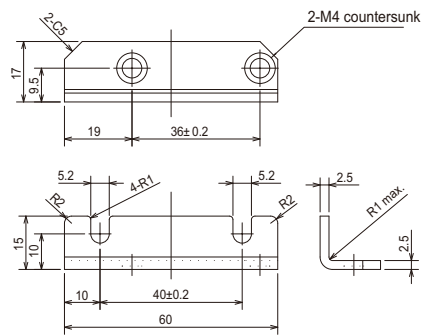


R88A-TK04K

Mounting bracket for top side



Mounting bracket for bottom side



3

Specifications

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

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3-1 Servo Drive Specifications

Select a Servo Drive that matches the Servomotor to be used. Refer to *2-3-3 Servo Drive and Servomotor Combination Tables* on page 2-14.

3-1-1 General Specifications

| Item | | Specifications | |
|--|----------------|---|---|
| Ambient operating temperature and operating humidity | | 0 to 55°C, 90% max. (with no condensation) | |
| Storage ambient temperature and humidity | | -20 to 65°C, 90% 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 a resonance point) | |
| Insulation resistance | | Between power supply terminals/power terminals and FG terminal: 0.5 MΩ min. (at 500 VDC) | |
| 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 Directives | EMC Directive | EN 55011, EN 61000-6-2, IEC 61800-3 |
| | | Low Voltage Directive | EN 61800-5-1 |
| | | Machinery Directive | EN954-1 (Category 3), EN ISO 13849-1: 2008 (Category 3) (PLc,d), ISO 13849-1: 2006 (Category 3) (PLc,d), EN61508 (SIL2), EN62061 (SIL2), EN61800-5-2 (STO), IEC61326-3-1 (SIL2) |
| | UL standards | UL 508C | |
| CSA standards | CSA22.2 No. 14 | | |

- Note 1** The above items reflect individual evaluation testing. The results may differ under compound conditions.
- 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.
- 3** Depending on the operating conditions, some Servo Drive parts will require maintenance. For details, refer to *12-5 Periodic Maintenance* on page 12-34.

3-1-2 Characteristics

100-VAC Input Models

| Item | | | R88D-KNA5L-ECT | R88D-KN01L-ECT | R88D-KN02L-ECT | R88D-KN04L-ECT |
|-----------------------------------|--|--------------------------|--|----------------|----------------|----------------|
| Continuous output current (rms) | | | 1.2 A | 1.7 A | 2.5 A | 4.6 A |
| Input power supply | Main circuit | Power supply capacity | 0.4 KVA | 0.4 KVA | 0.5 KVA | 0.9 KVA |
| | | Power supply voltage | Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz | | | |
| | | Rated current | 1.7 A | 2.6 A | 4.3 A | 7.6 A |
| | | Heat value* ¹ | 11 W | 16.6 W | 21 W | 25 W |
| | Control circuit | Power supply voltage | Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz | | | |
| | | Heat value* ¹ | 4 W | 4 W | 4 W | 4 W |
| 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 Servomotor | 3,000 r/min | INC | K05030H | K10030L | K20030L | K40030L |
| | | ABS | K05030T | K10030S | K20030S | K40030S |
| | 2,000 r/min | ABS | – | – | – | – |
| | 1,000 r/min | ABS | – | – | – | – |
| Performance | Speed control range | | 1:5000 | | | |
| | Speed variation (load characteristic) | | 0.01% max. from 0% to 100% (percentage of rated speed) | | | |
| | Speed variation (voltage characteristic) | | 0% at rated voltage $\pm 10\%$ (percentage of rated speed) | | | |
| | Temperature variation (temperature characteristic) | | $\pm 0.01\%$ max. (percentage of rated speed) from 0 to 50°C | | | |
| | Torque control repeatability | | $\pm 1\%$ | | | |

*1 The heat value is given for rated operation.

200-VAC Input Models

| Item | | | R88D-KN01H-ECT | R88D-KN02H-ECT | R88D-KN04H-ECT | R88D-KN08H-ECT | R88D-KN10H-ECT | R88D-KN15H-ECT | |
|--|-----------------|--|--|--|----------------|----------------|----------------|--------------------|--|
| Continuous output current (rms) | | | 1.2 A | 1.6 A | 2.6 A | 4.1 A | 5.9 A | 9.4 A | |
| Input power supply | Main circuit | Power supply capacity | 0.5 KVA | 0.5 KVA | 0.9 KVA | 1.3 KVA | 1.8 KVA | 2.3KVA | |
| | | Power supply voltage | Single-phase or 3-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz | | | | | | |
| | | Rated current | 1.6/0.9 A *1 | 2.4/1.3 A*1 | 4.1/2.4 A*1 | 6.6/3.6 A*1 | 9.1/5.2 A*1 | 14.2/8.1 A*1 | |
| | | Heat value*2 | 14.3/13.7 W*1 | 23/19 W*1 | 33/24 W*1 | 30/35.5 W*1 | 57/49 W*1 | 104/93 W*1 | |
| | Control circuit | Power supply voltage | Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz | | | | | | |
| | | Heat value*2 | 4 W | 4 W | 4 W | 4 W | 7 W | 7 W | |
| Weight | | | Approx. 0.8 kg | Approx. 0.8 kg | Approx. 1.0 kg | Approx. 1.6 kg | Approx. 1.8 kg | Approx. 1.8 kg | |
| Maximum applicable motor capacity | | | 100 W | 200 W | 400 W | 750 W | 1 kW | 1.5 kW | |
| Applicable Servomotor | 3,000 r/min | INC | K05030H K10030H | K20030H | K40030H | K75030H | – | K1K030H K1K530H | |
| | | ABS | K05030T K10030T | K20030T | K40030T | K75030T | – | K1K030T K1K530T | |
| | 2,000 r/min | INC | – | – | – | – | K1K020H | K1K520H | |
| | | ABS | – | – | – | – | K1K020T | K1K520T | |
| | 1,000 r/min | INC | – | – | – | – | – | K90010H | |
| | | ABS | – | – | – | – | – | K90010T | |
| | Performance | Speed control range | | 1:5000 | | | | | |
| | | Speed variation (load characteristic) | | 0.01% max. from 0% to 100% (percentage of rated speed) | | | | | |
| Speed variation (voltage characteristic) | | 0% at rated voltage $\pm 10\%$ (percentage of rated speed) | | | | | | | |
| Temperature variation (temperature characteristic) | | $\pm 0.01\%$ max. (percentage of rated speed) from 0 to 50°C | | | | | | | |
| Torque control repeatability | | $\pm 1\%$ | | | | | | | |

*1 The first value is for single-phase input power and the second value is for 3-phase input power.

*2 The heat value is given for rated operation.

| Item | | | R88D-KN20H-ECT | R88D-KN30H-ECT | R88D-KN50H-ECT | R88D-KN75H-ECT | R88D-KN150H-ECT | |
|--|-----------------|--|---|--|--------------------|-----------------|----------------------|--|
| 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 | 11.0 KVA | 22.0 KVA | |
| | | Power supply voltage | 3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz ^{*2} | | | | | |
| | | Rated current | 11.8 A | 15.1 A | 21.6 A | 32.0 A | 58.0 A | |
| | | Heat value ^{*1} | 139 W | 108 W | 328 W | 381 W | 720 W | |
| | Control circuit | Power supply voltage | Single-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz ^{*2} | | | | | |
| | | Heat value ^{*1} | 10 W | 13 W | 13 W | 15 W | 17 W | |
| 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 Servomotor | 3,000-r/min | INC | K2K030H | K3K030H | K4K030H K5K030H | – | – | |
| | | ABS | K2K030T | K3K030T | K4K030T K5K030T | – | – | |
| | 2,000-r/min | INC | K2K020H | K3K020H | K4K020H K5K020H | – | – | |
| | | ABS | K2K020T | K3K020T | K4K020T K5K020T | K7K515T | K11K015T K15K015T | |
| | 1,000-r/min | INC | – | K2K010H | K3K010H | – | – | |
| | | ABS | – | K2K010T | K3K010T K4K510T | K6K010T | – | |
| | Performance | Speed control range | | 1:5000 | | | | |
| | | Speed variation (load characteristic) | | 0.01% max. from 0% to 100% (percentage of rated speed) | | | | |
| Speed variation (voltage characteristic) | | 0% at rated voltage ±10% (percentage of rated speed) | | | | | | |
| Temperature variation (temperature characteristic) | | ±0.01% max. (percentage of rated speed) from 0 to 50°C | | | | | | |
| Torque control repeatability | | ±2% | | | | | | |

*1 The heat value is given for rated operation.

*2 R88D-KN75H-ECT and R88D-KN150H-ECT support DC power input in addition to AC power input. DC power supplies with a voltage rating of 280 to 325 VDC (238 to 357 V) can be connected.

400-VAC Input Models

| Item | | | R88D-KN06F-ECT | R88D-KN10F-ECT | R88D-KN15F-ECT | R88D-KN20F-ECT | R88D-KN30F-ECT | R88D-KN50F-ECT | R88D-KN75F-ECT | R88D-KN150F-ECT | |
|-----------------------------------|--|--------------------------|--|----------------|--------------------|----------------|----------------|--------------------|-----------------|----------------------|--|
| Continuous output current (rms) | | | 1.5 A | 2.9 A | 4.7 A | 6.7 A | 9.4 A | 16.5 A | 22.0 A | 33.1 A | |
| Input power supply | Main circuit | Power supply capacity | 1.2 KVA | 1.8 KVA | 2.3 KVA | 3.8 KVA | 4.5 KVA | 6.0 KVA | 11.0 KVA | 22.0 KVA | |
| | | Power supply voltage | 3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz | | | | | | | | |
| | | Rated current | 2.1 A | 2.8 A | 3.9 A | 5.9 A | 7.6 A | 12.1 A | 16.0 A | 29.0 A | |
| | | Heat value* ¹ | 32.2 W | 48 W | 49 W | 65 W | 108 W | 200 W | 300 W | 590 W | |
| Control circuit | Power supply voltage | 24 VDC (20.4 to 27.6 V) | | | | | | | | | |
| | | Heat value* ¹ | 7 W | 7 W | 7 W | 10 W | 13 W | 13 W | 15 W | 22 W | |
| 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 Servomotor | 3,000-r/min | INC | – | K75030F | K1K030F K1K530F | K2K030F | K3K030F | K4K030F K5K030F | – | – | |
| | | ABS | – | K75030C | K1K030C K1K530C | K2K030C | K3K030C | K4K030C K5K030C | – | – | |
| | 2,000-r/min | INC | K40020F K60020F | K1K020F | K1K520F | K2K020F | K3K020F | K4K020F K5K020F | – | – | |
| | | ABS | K40020C K60020C | K1K020C | K1K520C | K2K020C | K3K020C | K4K020C K5K020C | K7K515C | K11K015C K15K015C | |
| | 1,000-r/min | INC | – | – | K90010F | – | K2K010F | K3K010F | – | – | |
| | | ABS | – | – | K90010C | – | K2K010C | K3K010C K4K510C | K6K010C | – | |
| Performance | Speed control range | | 1:5000 | | | | | | | | |
| | Speed variation (load characteristic) | | 0.01% max. from 0% to 100% (percentage of rated speed) | | | | | | | | |
| | Speed variation (voltage characteristic) | | 0% at rated voltage $\pm 10\%$ (percentage of rated speed) | | | | | | | | |
| | Temperature variation (temperature characteristic) | | $\pm 0.01\%$ max. (percentage of rated speed) from 0 to 50°C | | | | | | | | |
| | Torque control repeatability | | $\pm 1\%$ | | | | $\pm 2\%$ | | | | |

*1 The heat value is given for rated operation.

3-1-3 EtherCAT Communications Specifications

| Item | Specification |
|-------------------------|--|
| Communications standard | IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile |
| Physical layer | 100BASE-TX (IEEE802.3) |
| Connectors | RJ45 × 2 (shielded) ECAT IN: EtherCAT input ECAT OUT: EtherCAT output |
| Communications media | Ethernet Category 5 (100BASE-TX) or higher (twisted-pair cable with double, aluminum tape and braided shielding) is recommended. |
| Communications distance | Distance between nodes: 100 m max. |
| Process data | Fixed PDO mapping |
| Mailbox (CoE) | Emergency messages, SDO requests, SDO responses, and SDO information |
| Distributed clock (DC) | Synchronization in DC mode. DC cycle: 250 μs, 500 μs, 1 ms, 2 ms, 4 ms |
| Indicators | L/A IN (Link/Activity IN) × 1 L/A OUT (Link/Activity OUT) × 1 RUN × 1 ERR × 1 |
| CiA402 Drive Profile | <ul style="list-style-type: none"> • Cyclic synchronous position mode • Cyclic synchronous velocity mode • Cyclic synchronous torque mode • Profile potion mode • Homing mode • Touch probe function (Latch function) • Torque limit function |

3-1-4 Main Circuit and Motor Connections

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

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

● Main Circuit Connector Specifications (CNA)

| Symbol | Name | Function |
|--------|------------------------------------|--|
| L1 | Main circuit power supply input | R88D-KN□L-ECT |
| L2 | | 50 to 400 W: Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz |
| L3 | | 200 to 400 W: 3-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| | | R88D-KN□H-ECT |
| | | 50 W to 1.5 kW: Single-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| | | 100 W to 1.5 kW: 3-phase: 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| | | Note: Single-phase should connect to L1 and L3. |
| L1C | Control circuit power supply input | R88D-KN□L-ECT: Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz |
| L2C | | R88D-KN□H-ECT : 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 | 50 to 400 W: Normally, do not short B1 and B2. Doing so may result in malfunctioning. If there is high regenerative energy, connect an External Regeneration Resistor between B1 and B2. |
| B3 | | |
| B2 | | |
| | | 750 W to 1.5 kW: Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. 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. |
| U | Motor connection terminals | Phase U |
| V | | Phase V |
| W | | Phase W |
| | | These are the output terminals to the Servomotor. Be sure to wire them correctly. |

R88D-KN20H-ECT

● Main Circuit Connector Specifications (CNA)

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

● Motor Connector Specifications (CNB)

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

● External Regeneration Resistor Connector Specifications (CNC)

| Symbol | Name | Function |
|--------|---|---|
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. If there is high regenerative energy, remove the short bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2. |
| B3 | | |
| B2 | | |
| 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).
- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN30H-ECT/R88D-KN50H-ECT

● Main Circuit Terminal Block Specifications

| Symbol | Name | Function | |
|--------|---|---|--|
| L1 | Main circuit power supply input | R88D-KT□H-ECT (3 to 5 kW): 3-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| L1C | Control circuit power supply input | R88D-KT□H : Single-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz | |
| L2C | | | |
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. 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 | | | |
| 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 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).
- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN75H-ECT

● Terminal Block Specifications, Left Terminal Block (TB1)

| Symbol | Name | Function | |
|--------|---|--|--|
| L1 | Main circuit power supply input | R88D-KT□H-ECT (7.5 kW): 3-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VDC) | |
| L2 | | | |
| L3 | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | |
| B2 | | | |
| N*1 | | | |
| 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 | |

*1 The symbol "N" is found on G5-series AC Servo Drives with unit version 2.1 or later.

● Terminal Block Specifications, Right Terminal Block (TB2)

| Symbol | Name | Function |
|--------|--|---|
| L1C | Control circuit power supply input | R88D-KT□H-ECT: Single-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VDC) |
| L2C | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |
| DB3 | | Normally DB3 and DB4 are shorted. |
| DB4 | | When using an externally connected Dynamic Brake Resistor, remove the short bar from between DB3 and DB4. |
| ⊕ | Frame ground | This is the ground terminal. Ground it to 100 Ω or less. |



Precautions for Correct Use

- Tighten the fixing screw of the terminal block cover 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 screw to a torque of 1.4 to 1.6 N·m (M5).
- Do not connect any External Regeneration Resistors between B1 and N (or NC).

R88D-KN150H-ECT

● Terminal Block Specifications, Top Terminal Block (TB1)

| Symbol | Name | Function |
|--------|--|---|
| L1C | Control circuit power supply input | R88D-KT□H-ECT: Single-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VDC) |
| L2C | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |

● Terminal Block Specifications, Bottom Terminal Block (TB2)

| Symbol | Name | Function |
|--------|---|--|
| L1 | Main circuit power supply input | R88D-KT□H-ECT (7.5 kW): 3-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VDC) |
| L2 | | |
| L3 | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. |
| B2 | | |
| N*1 | | |
| U | Motor connection terminals | Red |
| V | | White |
| W | | Blue |
| ⊕ | | Green/ Yellow |
| ⊕ | | These are the output terminals to the Servomotor. Be sure to wire them correctly. |
| ⊕ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

*1 The symbol "N" is found on G5-series AC Servo Drives with unit version 2.1 or later.



Precautions for Correct Use

- Tighten the fixing screw of the terminal block cover 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 screw to a torque of 2.4 to 2.6 N·m (M6).
- Do not connect any External Regeneration Resistors between B1 and N (or NC).

R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT/-KN20F-ECT

● Main Circuit Connector Specifications (CNA)

| Symbol | Name | Function |
|--------|---------------------------------|---|
| L1 | Main circuit power supply input | R88D-KN□F-ECT 600 W to 1.5 kW: 3-phase: 380 to 480 VAC (323 to 528 VAC) 50/60 Hz |
| L2 | | |
| L3 | | |

● Motor Connector Specifications (CNB)

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

● Control Circuit Connector Specifications (CNC)

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

● External Regeneration Resistor Connector Specifications (CND)

| Symbol | Name | Function |
|--------|---|---|
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. 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 | | |
| B2 | | |
| NC | Do not connect. | |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN30F-ECT/R88D-KN50F-ECT

● Main Circuit Terminal Block Specifications (TB1)

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

● Main Circuit Terminal Block Specifications (TB2)

| Symbol | Name | Function |
|--------|---|---|
| L1 | Main circuit power supply input | R88D-KN□F-ECT (3 to 5 kW): 3-phase 380 to 480 VAC (323 to 528 VAC) 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 as required. Normally, do not short B1 and B2. Doing so may result in malfunctioning. |
| B3 | | |
| B2 | | |
| NC | Do not connect. | |
| U | Motor connection terminals | Phase U |
| V | | Phase V |
| W | | Phase W |
| | | These are the output terminals to the Servomotor. Be sure to wire them correctly. |



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).
- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN75F-ECT

● Terminal Block Specifications, Left Terminal Block (TB1)

| Symbol | Name | Function | |
|--------|---|---|--|
| L1 | Main circuit power supply input | R88D-KN□F-ECT (7.5 kW): 3-phase 380 to 480 VAC (323 to 528 VAC) 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 | |

● Terminal Block Specifications, Right Terminal Block (TB2)

| Symbol | Name | Function |
|--------|--|---|
| 24 V | Control circuit power supply input | 24 VDC \pm 15% |
| 0 V | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |
| DB3 | | Normally DB3 and DB4 are shorted. |
| DB4 | | When using an externally connected Dynamic Brake Resistor, remove the short bar from between DB3 and DB4. |
| ⊕ | Frame ground | This is the ground terminal. Ground to 10 Ω or less. |



Precautions for Correct Use

- Tighten the fixing screw of the terminal block cover 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 screw to a torque of 1.4 to 1.6 N·m (M5).
- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN150F-ECT

● Terminal Block Specifications, Top Terminal Block (TB1)

| Symbol | Name | Function |
|--------|--|---|
| 24 V | Control circuit power supply input | 24 VDC \pm 15% |
| 0 V | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |

● Terminal Block Specifications, Bottom Terminal Block (TB2)

| Symbol | Name | Function |
|--------|---|--|
| L1 | Main circuit power supply input | R88D-KN□F-ECT (15 kW): 3-phase 380 to 480 VAC (323 to 528 VAC) 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 | 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 10 Ω or less. |




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 screw to a torque of 2.4 to 2.6 N·m (M6).
- Do not connect any External Regeneration Resistors between B1 and NC.

3-1-5 EtherCAT Communications Connector Specifications (RJ45)

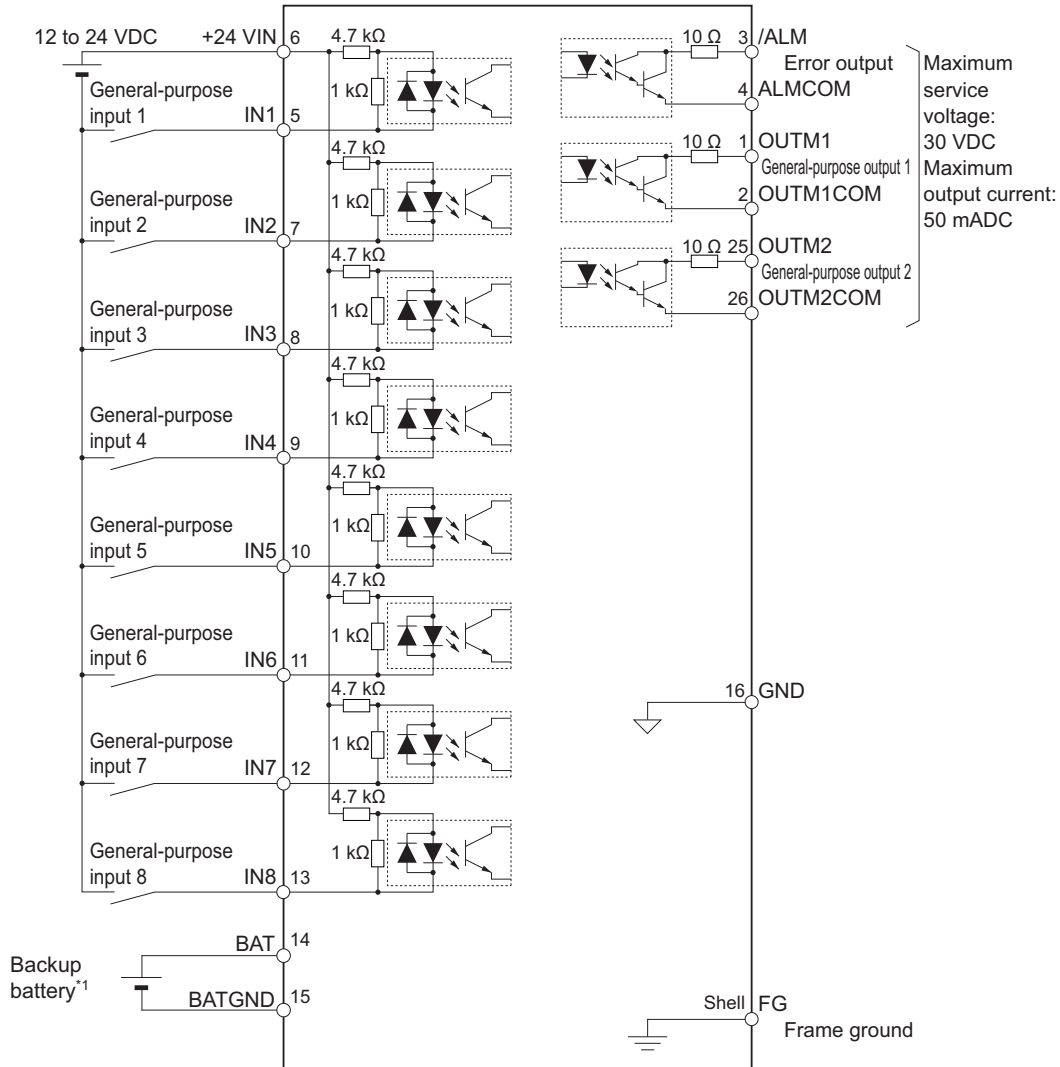
The EtherCAT twisted-pair cable is connected to a shielded connector.

- Electrical characteristics: Confirm to IEEE 802.3.
- Connector structure: RJ45 8-pin modular connector (conforms to ISO 8877)

| | Pin No. | Signal name | Abbreviation | Direction |
|---|----------------|-------------------|--------------|-----------|
|  | 1 | Send data + | TD+ | Output |
| | 2 | Send data – | TD– | Output |
| | 3 | Receive data + | RD+ | Input |
| | 4 | Not used | – | – |
| | 5 | Not used | – | – |
| | 6 | Receive data – | RD– | Input |
| | 7 | Not used | – | – |
| | 8 | Not used | – | – |
| | Connector hood | Protective ground | FG | – |

3-1-6 Control I/O Connector Specifications (CN1)

Control I/O Signal Connections and External Signal Processing



*1 A cable equipped with a battery is not required if a backup battery is connected.

- Note 1** The input function of pins 5 and 7 to 13 are determined by object settings.
2 The output function of pins 1, 2, 25 and 26 are determined by object settings.
3 It is not necessary to wire input pins that are not being used.

Control I/O Signal Tables

● CN1 Control Inputs

| Pin number | Symbol | Signal | | Function and interface |
|------------|---------|----------------------------------|---------------------------------|--|
| | | Name | Default | |
| 6 | +24 VIN | Power supply input 12 to 24 VDC. | | The positive input terminal of the external power supply (12 to 24 VDC) for sequence inputs |
| 5 | IN1 | General-purpose Input 1 | Immediate Stop Input | These are general-purpose inputs. The input functions can be selected with objects. External Latch Signals 1 to 3 can be allocated only to IN5 to IN7 (or pins 10 to 12) respectively. Refer to <i>7-1 Sequence I/O Signals</i> on page 7-2 for the allocations. |
| 7 | IN2 | General-purpose Input 2 | Forward Drive Prohibition Input | |
| 8 | IN3 | General-purpose Input 3 | Reverse Drive Prohibition Input | |
| 9 | IN4 | General-purpose Input 4 | Origin Proximity Input | |
| 10 | IN5 | General-purpose Input 5 | External Latch Signal 3 | |
| 11 | IN6 | General-purpose Input 6 | External Latch Signal 2 | |
| 12 | IN7 | General-purpose Input 7 | External Latch Signal 1 | |
| 13 | IN8 | General-purpose Input 8 | Monitor Input 0 | |
| 14 | BAT | Backup battery input | ABS | Backup battery connection terminals when the absolute encoder power is interrupted. (Connection to this terminal is not necessary if you use the absolute encoder battery cable for backup.) |
| 15 | BATGND | | | |

● CN1 Control Outputs

| Pin number | Symbol | Signal | | Function and interface |
|------------|----------|--------------------------|------------------------|---|
| | | Name | Default | |
| 3 | /ALM | Error Output | | The output turns OFF when an error occurs in the Servo Drive. |
| 4 | ALMCOM | | | |
| 1 | OUTM1 | General-purpose Output 1 | Brake Interlock Output | These are general-purpose outputs. The output functions can be selected with objects. Refer to <i>7-1 Sequence I/O Signals</i> on page 7-2 for the allocations. |
| 2 | OUTM1COM | | | |
| 25 | OUTM2 | General-purpose Output 2 | Servo Ready Output | |
| 26 | OUTM2COM | | | |
| 16 | GND | Signal Ground | | This is the signal ground. |

CN1 Pin Arrangement

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

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

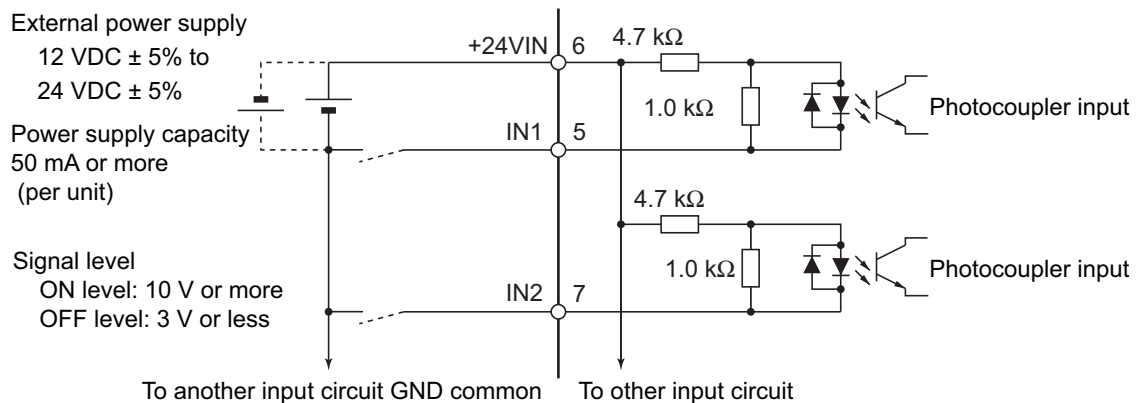
The input functions for general-purpose inputs 1 to 8 (or IN1 to IN8) and the output functions for general-purpose outputs (OUTM1 and OUTM2) are determined by the objects 3400 to 3407 hex (Input Signal Selection 1 to 8) and objects 3410 and 3411 hex (Output Signal Selection 1 and 2). The functions that are allocated by default are given in parentheses. Refer to *7-1 Sequence I/O Signals* on page 7-2 for the allocation.

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

Connectors for CN1 (Pin 26)

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

3-1-7 Control Input Circuits



3-1-8 Control Input Details

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

General-purpose Inputs (IN1 to IN8)

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

Note The functions that are allocated by default are given in brackets.

Refer to *7-1 Sequence I/O Signals* on page 7-2 for the allocation procedures.

● Immediate Stop Input (STOP)

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



Precautions for Safe Use

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

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

- These two signals are the inputs to prohibit forward and reverse rotation (over-travel inputs).
- When these terminals are shorted (factory setting), the Servo Drive can rotate in the specified direction.
- In the drive prohibition state, Servomotor switches to servo lock state after a deceleration stop.
- The maximum torque for a deceleration stop is the same as the maximum Servomotor torque.
- In the drive prohibition state, the Servo Drive does not switch to an error state.
- When the Drive Prohibition Input Selection (3504 hex) is set to 1, the operation at a drive prohibit input can be selected in the Stop Selection for Drive Prohibition Input (3505 hex).
- If the Drive Prohibition Input Selection (3504 hex) is set to 2, a Drive Prohibition Input Error (Error No. 38.0) will occur when there is a drive prohibition input.
- With the default settings, the Forward Drive Prohibition Input (POT) is allocated to pin 7, and the Reverse Drive Prohibition Input (NOT) is allocated to pin 8.



Precautions for Correct Use

Both signals are disabled (in a state in which drive prohibition will not operation) in the default settings. If prohibiting the drive input is required, set the Drive Prohibit Input Selection (3504 hex) to either 0 or 2. The setting on the Input Signal Selection 1 to 10 (3400 to 3409 hex) can change the logic and allocation for the respective Input terminals (CN1 to 7 and 8).

● Origin Proximity Input (DEC)

- This is the deceleration signal for origin returns.
- If the Origin Proximity Input turns ON while the Servomotor is traveling at the origin proximity input search speed, it will decelerate to the Speed during search for zero (6099 hex).
- With the default settings, the Origin Proximity Input is assigned to pin 9.

● External Latch Input Signals (EXT1, EXT2, and EXT3)

- These are the external input signals to latch the actual value in the feedback pulse counter.
- The encoder position data is obtained when the External Latch Input is turned ON.
- With the default settings, External Latch Input 1 is allocated to pin 12, External Latch Input 2 to pin 11, and External Latch Input 3 to pin 10.



Precautions for Correct Use

- The external latch inputs are detected by on the rising edge of the signal, but the minimal signal ON and OFF widths must be 2 ms.
 - The external latch inputs can only be set to NO (normally open) contacts.
 - The external latch inputs can be allocated to pins 10 to 12 only.
-

● Monitor Inputs (MON0, MON1, and MON2)

- These are the general-purpose monitor inputs.
- The general-purpose monitor inputs do not affect operation and can be monitored from the host controller.
- With the default settings, MON0 is allocated to pin 13.

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

- Turn ON these inputs to limit the torque to the value set in the Forward External Torque Limit (3525 hex) and the Reverse External Torque Limit (3526 hex).
- While the input is ON, operation continues within the torque limit.
- With the default settings, the inputs are not allocated.

Backup Battery Inputs (BAT)

Pin 14: Backup Battery + Input (BAT)

Pin 15: Backup Battery – Input (BATGND)

● Function:

- These are the backup battery connection terminals used when the absolute encoder power is interrupted.
- If a battery is connected to the battery holder for the absolute encoder battery cable, do not connect anything to these terminals.

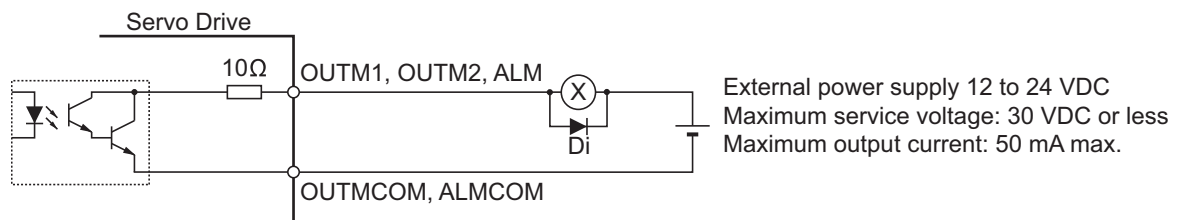


Precautions for Correct Use

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

3-1-9 Control Output Circuits

Sequence Outputs



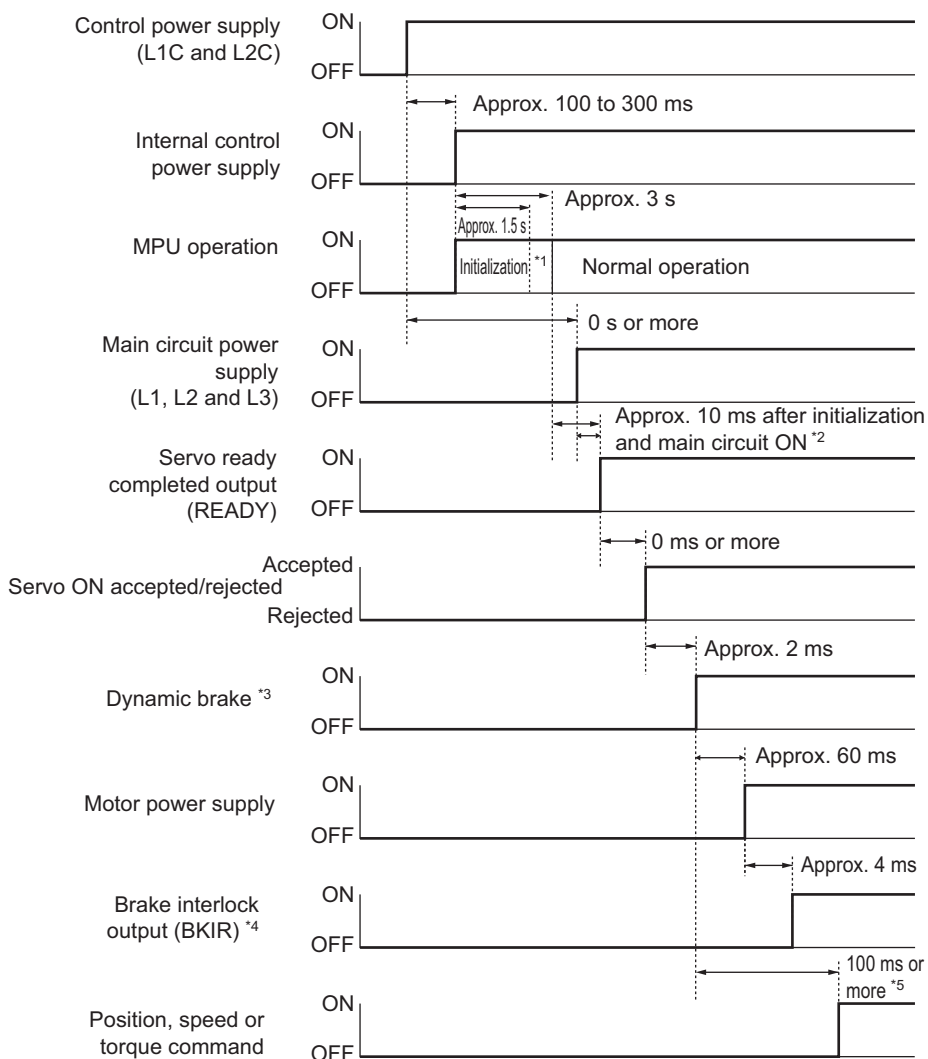
Di: Surge voltage prevention diode*1

*1 When driving a relay directly with an output signal, always insert a diode as shown in the above figure. Use high-speed diodes.

3-1-10 Control Output Details

Control Output Sequence

The chart below illustrates the timing of the command inputs after the control power supply is turned ON. Input the Servo ON/OFF operation, position, speed, and torque commands in the correct timing, as shown in the chart.



*1 Once the internal control power is established, the protective function starts working about 1.5 s after the MPU starts initializing itself. Be sure that all I/O signals that are connected to the Servo Drive, especially the Forward/Reverse Drive Prohibition Input (POT/NOT), the Origin Proximity Input (DEC), the external encoder input, are stable before the protective function starts working. The period can be extended by setting the Power Supply ON Initialization Time (3618 hex).

*2 The Servo Ready Completed Output (READY) turns ON only when all of these conditions are met: MPU initialization is completed. The main power supply is established. No error exists. EtherCAT communications and servo are synchronized (phase alignment).

*3 The above timing chart applies when the servo ON signal is accepted as soon as doing so is enabled.

*4 The Brake Interlock Output (BKIR) turns ON either when a release request is received via servo controls or when a release request is received via EtherCAT communications.

*5 Although the servo ON operation is accepted in this section, it is not yet enabled.

Error Output (/ALM)

Pin 3: Error Output (/ALM)
 Pin 4: Error Output Common (ALMCOM)

● Function

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

General-purpose Outputs (OUTM1 and OUTM2)

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

Note The functions that are allocated by default are given in brackets.

Refer to the description in Output Signals in *7-1 Sequence I/O Signals* on page 7-2 for the allocations.

● Servo Ready Completed Output (READY)

- This output signal indicates the Drive is ready to be energized.
- It turns ON when no error is detected after the main circuit power supply turns ON.
- With the default settings, the output is allocated to pins 25 and 26.

● Brake Interlock Output (BKIR)

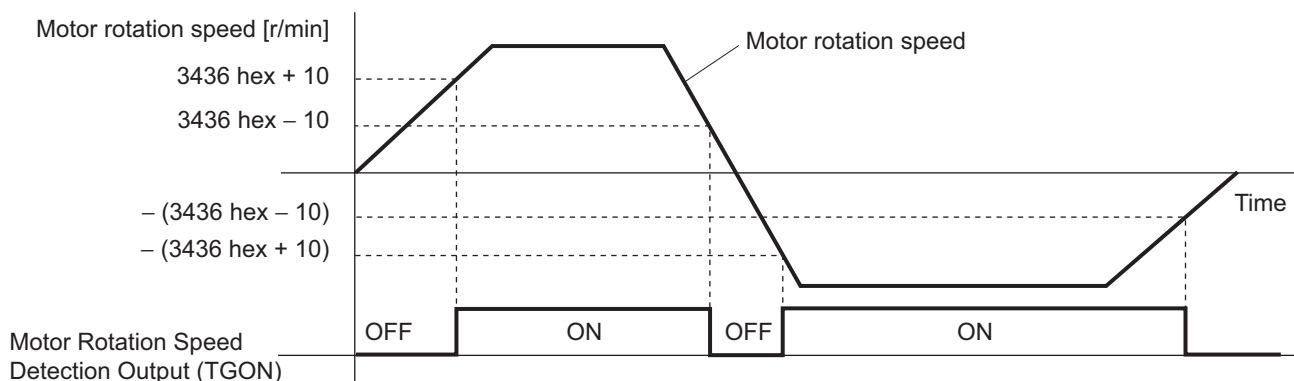
- The Brake Interlock Output outputs the external brake timing signal according to the settings of the Brake Timing When Stopped (3437 hex), the Brake Timing During Operation (3438 hex), and the Brake Threshold Speed During Operation (3439 hex).
- With the default settings, the output is allocated to pins 1 and 2.

● Positioning Completion Output 2 (INP2)

- INP2 will turn ON when the position error is equal to or less than Positioning Completion Range 2 (3442 hex).
- With the default settings, the output is not allocated.

● Motor Rotation Speed Detection Output (TGON)

- It turns on when the motor rotation speed exceeds the value set by the Rotation Speed for Motor Rotation Detection (3436 hex).
- The output is effective both in forward and reverse directions regardless the actual direction that the motor rotates.
- The detection contains a hysteresis of 10 r/min.
- With factory setting, the output is not allocated.

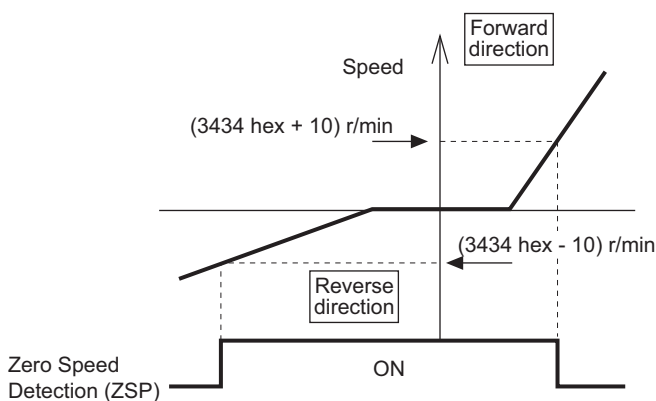


● Torque Limit Output (TLIMIT)

- The output turns ON when the output torque reaches the limit set in the Positive torque limit value (60E0 hex) or the Negative torque limit value (60E1 hex).
- With the default settings, the output is not allocated.

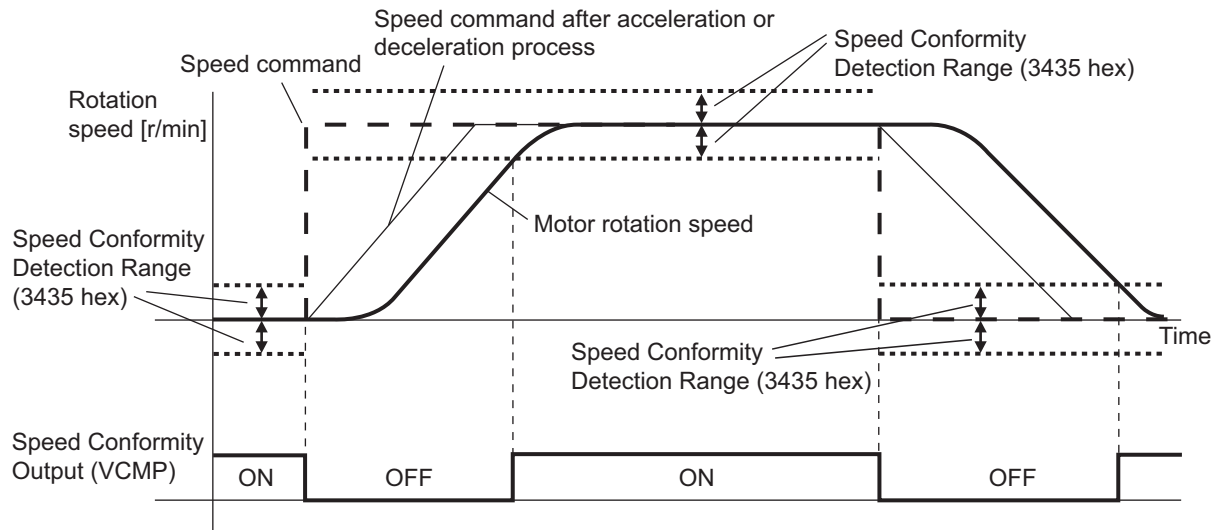
● Zero Speed Detection Output (ZSP)

- It turns ON when the motor rotation speed goes below the value set by the Zero Speed Detection (3434 hex).
- The output is effective both in forward and reverse directions regardless of the actual direction that the motor rotates.
- The detection contains a hysteresis of 10 r/min.
- With the default settings, the output is not allocated.



● Speed Conformity Output (VCMP)

- The output turns ON when the motor rotation speed falls into the range set by the Speed Conformity Detection Range (3435 hex).
- It is determined to be conforming when the difference between the commanded speed before acceleration or deceleration process inside the Drive and the motor rotation speed is within the set range of Speed Conformity Detection Range (3435 hex).
- A hysteresis of 10 r/min is set for the detection.
- The output is always OFF except in the Position Control Mode (including the Fully-closed Control Mode).
- With factory setting, the output is not allocated.



● Warning Outputs (WARN1 and WARN2)

- The Warning Output 1 (WARN1) turns ON when the warning set by the Warning Output Selection 1 (3440 hex) is detected.
- The Warning Output 2 (WARN2) turns ON when the warning set by the Warning Output Selection 2 (3441 hex) is detected.
- With the default settings, the outputs are not allocated.

● Error Clear Attribute Output (ALM-ATB)

- This output turns ON when an error that can be reset occurs.
- With the default settings, the output is not allocated.

● Remote Outputs (R-OUT1 and R-OUT2)

- Remote Output 1 (R-OUT1) turns ON and OFF according to the ON/OFF status of bit 16 in the Digital outputs (60FE hex).
- Remote Output 2 (R-OUT2) turns ON and OFF according to the ON/OFF status of bit 17 in the Digital outputs (60FE hex).
- With the default settings, the output is not allocated.

3-1-11 Encoder Connector Specifications (CN2)

| Pin No. | Symbol | Name | Function and interface |
|---------|--------|---------------------------|---|
| 1 | E5V | Encoder power supply +5 V | Power supply output for the encoder |
| 2 | E0V | Encoder power supply GND | |
| 3 | BAT+ | Battery + | Backup power supply output for the absolute encoder |
| 4 | BAT- | Battery - | |
| 5 | PS+ | Encoder + phase S input | Encoder signal I/O (serial signal) |
| 6 | PS- | Encoder - phase S input | |
| Shell | FG | Frame ground | Frame ground |

● Connectors for CN2 (6 Pins)

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

3-1-12 External Encoder Connector Specifications (CN4)

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

| Pin No. | Symbol | Name | Function and interface |
|---------|--------|---|---|
| 1 | E5V | External encoder power supply output | Use at $5.2\text{ V} \pm 5\%$ and at or below 250 mA. |
| 2 | E0V | | This is connected to the control circuit ground connected to connector CN1. |
| 3 | +EXS | External encoder signal I/O (serial signal) | Perform serial signal input and output. |
| 4 | -EXS | | |
| 5 | +EXA | External encoder signal input (phase A, B, and Z signals) | Perform input and output of phase A, B, and Z signals. |
| 6 | -EXA | | |
| 7 | +EXB | | |
| 8 | -EXB | | |
| 9 | +EXZ | | |
| 10 | -EXZ | | |
| Shell | FG | Frame ground | Frame ground |

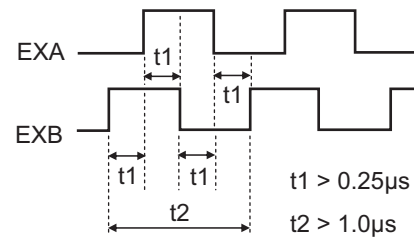
● Connectors for CN4 (10 Pins)

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

External Encoder Input Signal Table

● External Encoder I/O (CN4)

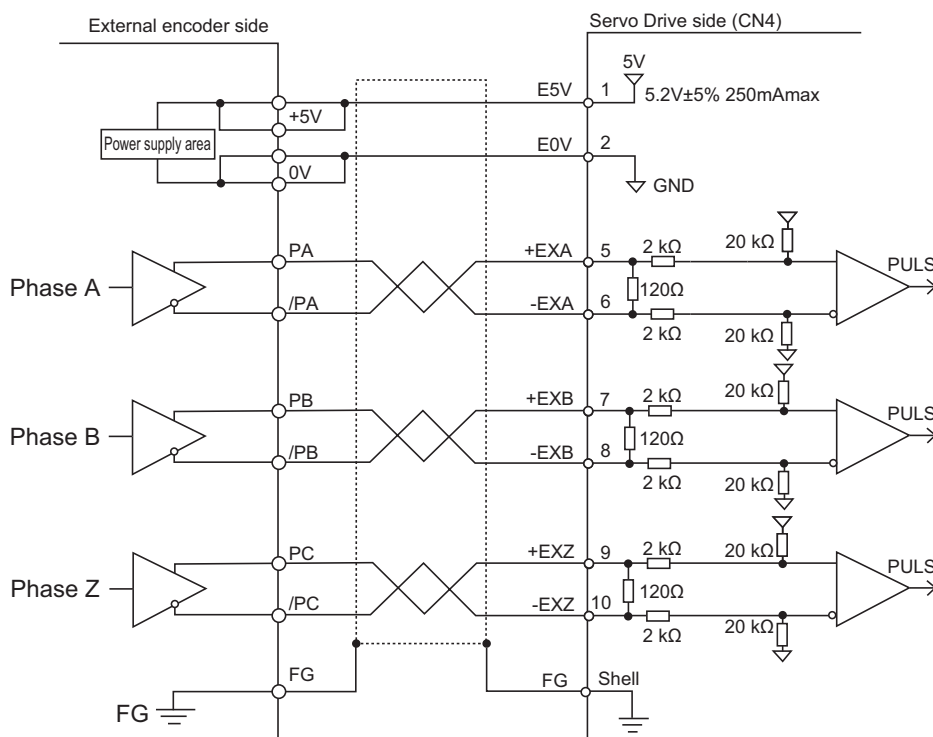
| Pin No. | Symbol | Name | Function and interface |
|---------|--------|--|--|
| 1 | E5V | External encoder power supply output | External encoder power supply: 5.2 VDC \pm 5%, 250 mA max. If the above capacity is exceeded, provide a separate power supply. |
| 2 | E0V | | |
| 3 | +EXS | External encoder signal serial interface | This is an external encoder serial bi-directional signal. ^{*1} (Conforms to EIA485) Maximum response frequency: 400 Mpps |
| 4 | -EXS | | |
| 5 | +EXA | External encoder signal 90° phase difference input (Phases A, B and Z) | This is an external encoder 90 phase input signal. ^{*1} Maximum response frequency: 4 Mpps (quadruple multiplier) |
| 6 | -EXA | | |
| 7 | +EXB | | |
| 8 | -EXB | | |
| 9 | +EXZ | | |
| 10 | -EXZ | | |
| Shell | FG | Frame ground | Frame ground |



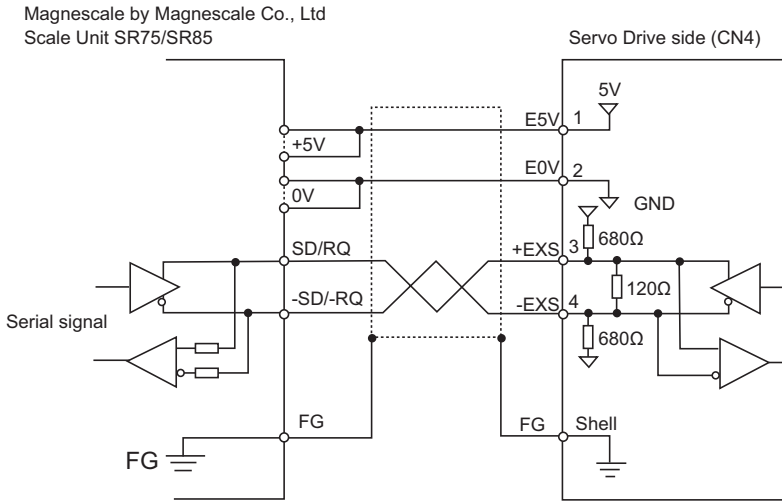
*1 Connect external encoder signals to the serial interface (+EXS/-EXS) or 90° phase difference inputs according to the encoder type.

Example of Connection with External Encoder

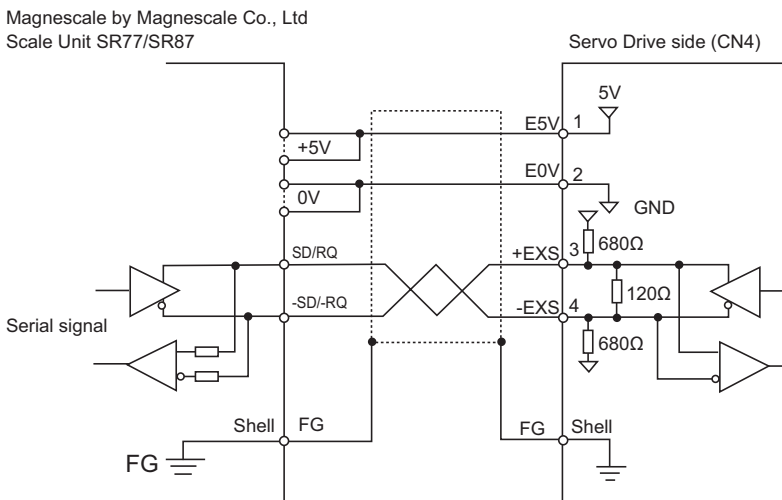
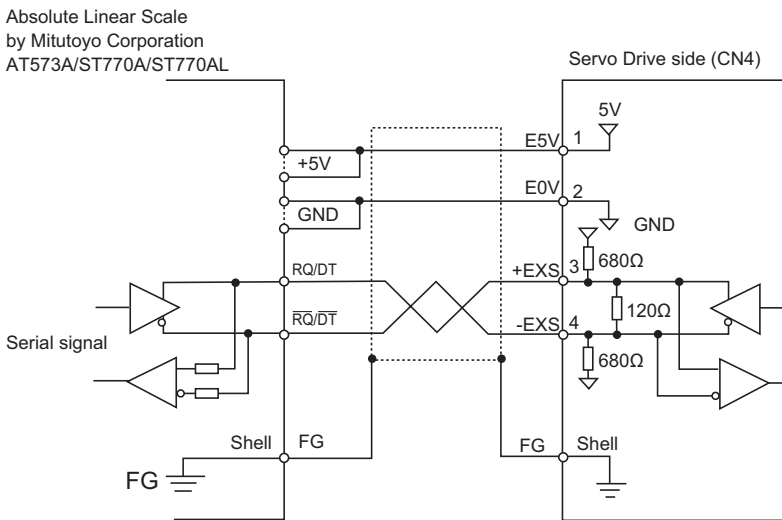
● 90° Phase Difference Input (3323 Hex = 0)



● Serial Communications, Incremental Encoder Specifications (3323 Hex = 1)



● Serial Communications, Absolute Encoder Specifications (3323 Hex = 2)



3-1-13 Analog Monitor Connector Specifications (CN5)

Monitor Output Signal Table

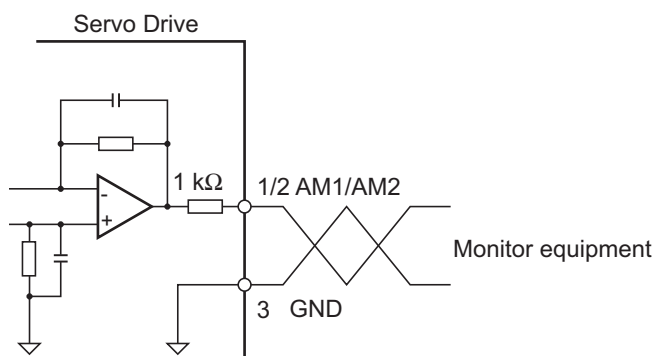
● Monitor Output (CN5)

| Pin No. | Symbol | Name | Function and interface |
|---------|--------|-------------------------|---|
| 1 | AM1 | Analog monitor output 1 | Outputs the analog signal for the monitor. Default setting: Motor rotation speed 1 V/(500 r/min) You can use objects 3416 hex and 3417 hex to change the item and unit. You can use object 3421 hex to change the output method. |
| 2 | AM2 | Analog monitor output 2 | Outputs the analog signal for the monitor. Default setting: Torque command 1 V/(33 %) You can use objects 3418 hex and 3419 hex to change the item and unit. You can use object 3421 hex to change the output method. |
| 3 | GND | Analog monitor ground | Ground for analog monitors 1, 2 |
| 4 | – | Not used | Do not connect. |
| 5 | – | Not used | Do not connect. |
| 6 | – | Not used | Do not connect. |

● Connectors for CN5 (6 pins)

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

Monitor Output Circuit



3-1-14 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 No. | 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 |

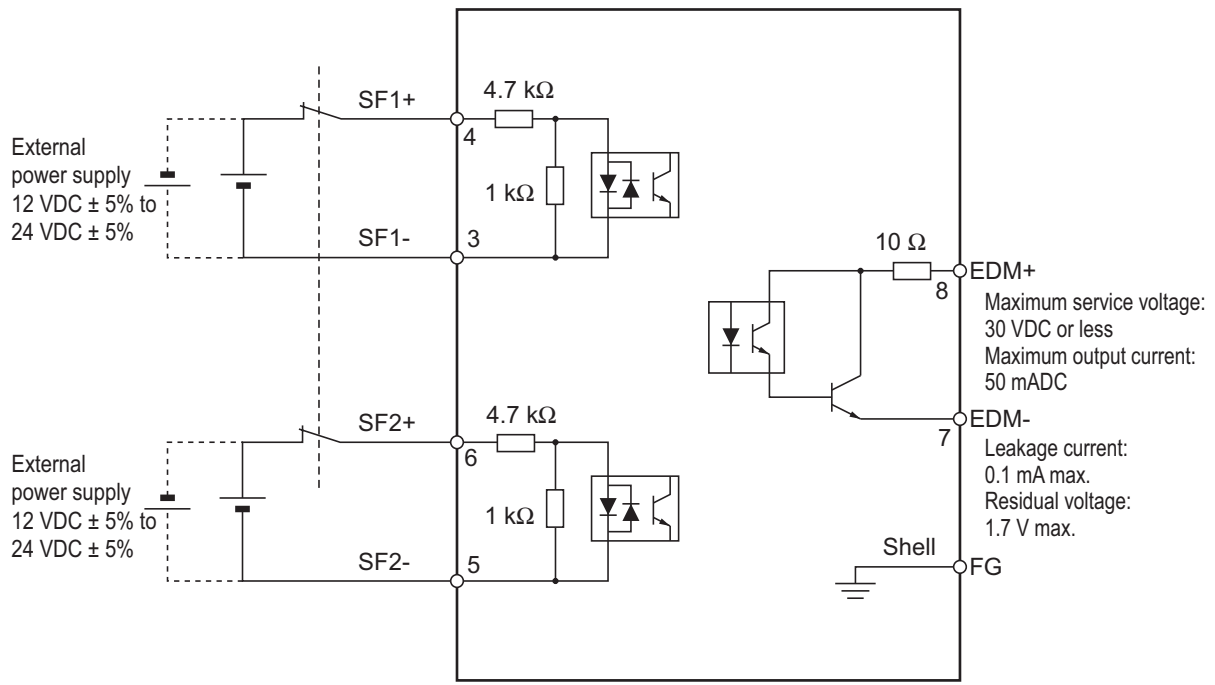


Precautions for Correct Use

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

3-1-15 Safety Connector Specifications (CN8)

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



Safety I/O Signal Table

● Safety I/O (CN8)

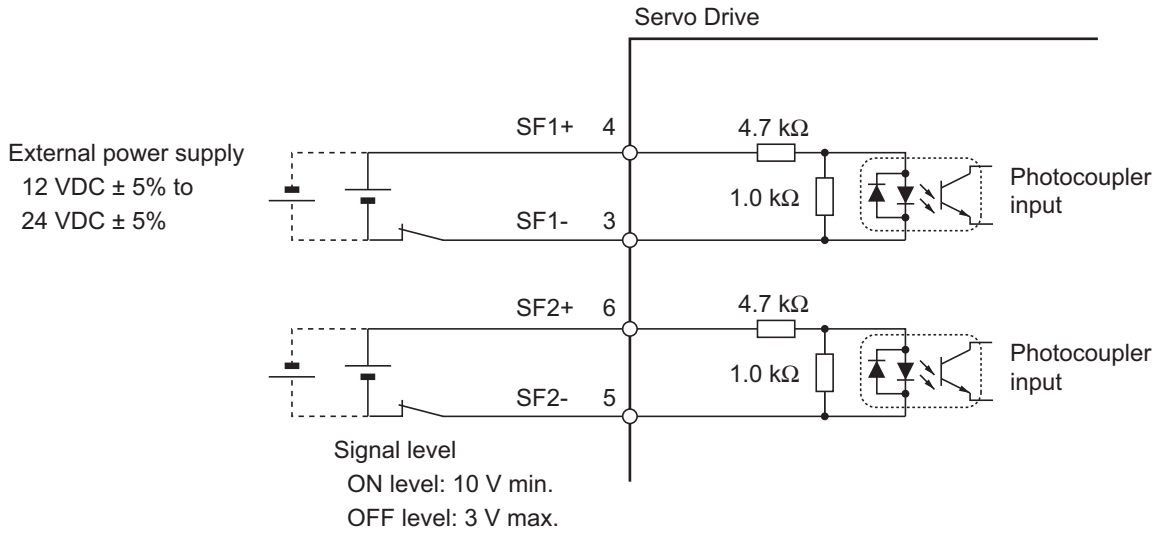
| Pin No. | Symbol | Name | Function and interface |
|---------|--------|----------------|---|
| 1 | - | Reserved | Do not connect. |
| 2 | - | Reserved | |
| 3 | SF1- | Safety input 1 | Inputs 1 and 2 for operating the STO function, which are 2 independent circuits. This input turns OFF the power transistor 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+ | EDM output | |
| Shell | FG | Frame ground | Connected to the ground terminal inside the Servo Drive. |

● Connector for CN8 (8 pins)

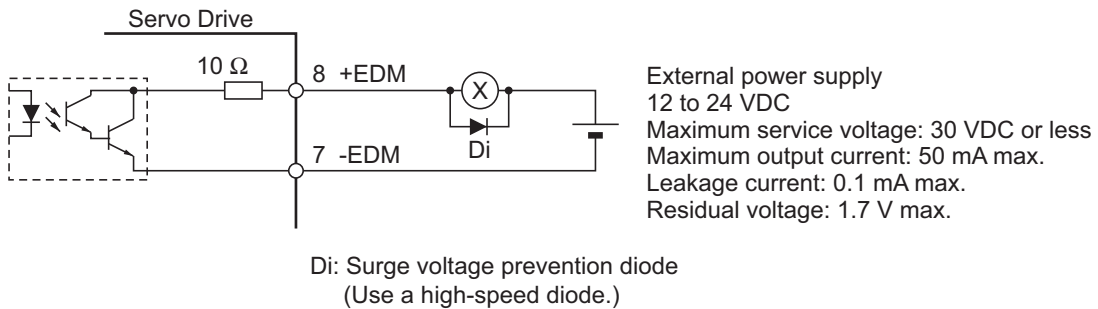
| Name | Model | Manufacturer | OMRON model number |
|--|-----------|-------------------------|--------------------|
| Industrial Mini I/O Connector (D-SHAPE1) | 2013595-1 | Tyco Electronics AMP KK | R88A-CNK81S |

Note The recommended cable is a 6-core shielded cable with a wire size of AWG30 to AWG26 and a finished outer diameter of 6.7 mm or less.

Safety Input Circuits



EDM Output Circuit



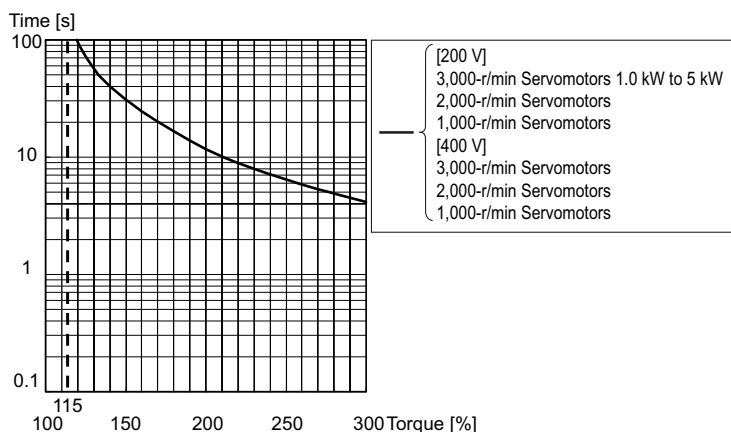
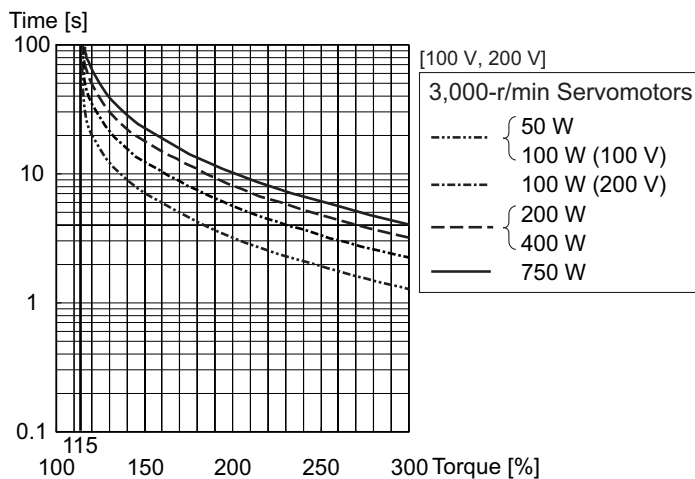
Note When driving a relay directly with an output signal, always insert a diode as shown in the above figure.

3-2 Overload Characteristics (Electronic Thermal Function)

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

3-2-1 Overload Characteristics Graphs

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



When the torque command = 0, and a constant torque command is continuously applied after 3 or more times the overload time constant has elapsed, the overload time t [s] is

$$t [\text{s}] = -\text{Overload time constant} [\text{s}] \times \log_e (1 - \text{Overload level} [\%] / \text{Torque command} [\%])^2$$

(The overload time constant [s] depends on the motor. The standard overload level is 115%.)

3-3 Servomotor Specifications

The following G5-Series AC Servomotors are available.

- 3,000-r/min Servomotors
- 1,500-r/min Servomotors
- 2,000-r/min Servomotors
- 1,000-r/min Servomotors

There are various options available, such as models with brakes, or different shaft types.

Select a Servomotor based on the mechanical system's load conditions and the installation environment.

3-3-1 General Specifications

| Item | 3,000-r/min Servomotors | | 1,000-r/min Servomotors 1,500-r/min Servomotors 2,000-r/min Servomotors | |
|--|---|-----------------------|---|----------------------|
| | 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 85% (with no condensation) | | | |
| Storage ambient temperature and humidity | -20 to 65°C, 20% to 85% (with no condensation) Maximum temperature: 80°C for 72 hours | | | |
| 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) | | | |
| Dielectric strength | 1,500 VAC between power terminal and FG terminal for 1 min (voltage 100 V, 200 V) 1,800 VAC between power terminal and FG terminal for 1 min (voltage 400 V) 1,000 VAC between brake terminal and FG terminal for 1 min | | | |
| Insulation class | Class B | Class F | | |
| Protective structure | IP67 (except for through-shaft parts and motor and encoder connector pins) | | | |
| International standard | EC Directives | EMC Directive | EN 55011 class A group 1 EN 61000-6-2, IEC 61800-3 and IEC 61326-3-1 | |
| | | Low Voltage Directive | EN 60034-1/-5 | |
| | UL standards | | UL1004-1 | UL1004-1, UL1004-6*2 |
| | CSA standards | | CSA22.2 No. 100 | |

*1 The amplitude may be increased by machine resonance. As a guideline, do not exceed 80% of the specified value.

*2 UL1004-6 applies only to 1,500-r/min Servomotors of 7.5 to 15 kW and 1,000 r/min Servomotors of 4.5 to 6 kW.

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

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

3-3-2 Characteristics

3,000-r/min Servomotors

| 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 | | | | |
| Maximum rotation speed | r/min | 6,000 | | | | |
| Momentary maximum torque *1 | N · m | 0.48 | 0.95 | 1.91 | 3.8 | |
| Rated current *1 | A (rms) | 1.1 | 1.6 | 2.5 | 4.6 | |
| Momentary maximum current *1 | A (rms) | 4.7 | 6.9 | 10.6 | 19.5 | |
| Rotor inertia | Without brake | kg · m ² | 0.025 × 10 ⁻⁴ | 0.051 × 10 ⁻⁴ | 0.14 × 10 ⁻⁴ | 0.26 × 10 ⁻⁴ |
| | With brake | kg · m ² | 0.027 × 10 ⁻⁴ | 0.054 × 10 ⁻⁴ | 0.16 × 10 ⁻⁴ | 0.28 × 10 ⁻⁴ |
| Applicable load inertia | – | 30 times the rotor inertia max. *2 | | | | |
| Torque constant *1 | N · m/A | 0.11±10% | 0.14±10% | 0.20±10% | 0.21±10% | |
| Power rate *1 | Without brake | kW/s | 10.1 | 19.8 | 28.9 | 62.3 |
| | With brake | kW/s | 9.4 | 18.7 | 25.3 | 57.8 |
| Mechanical time constant | Without brake | ms | 1.43 | 1.03 | 0.61 | 0.48 |
| | With brake | ms | 1.54 | 1.09 | 0.70 | 0.52 |
| Electrical time constant | ms | 0.82 | 0.91 | 3.0 | 3.4 | |
| Allowable radial load *3 | N | 68 | 68 | 245 | 245 | |
| Allowable thrust load *3 | N | 58 | 58 | 98 | 98 | |
| Weight | Without brake | kg | Approx. 0.31 | Approx. 0.45 | Approx. 0.78 | Approx. 1.2 |
| | With brake | kg | Approx. 0.51 | Approx. 0.65 | Approx. 1.2 | Approx. 1.6 |
| Radiator plate dimensions (material) | | 100 × 80 × t10 (Al) | | 130 × 120 × t12 (Al) | | |
| Applicable drives (R88D-) | | KNA5L-ECT | KN01L-ECT | KN02L-ECT | KN04L-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 2 × 10 ⁻⁷ | 2 × 10 ⁻⁷ | 1.8 × 10 ⁻⁶ | 1.8 × 10 ⁻⁶ |
| | Excitation voltage *4 | V | 24 VDC ± 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° | | | |
| | Allowable work per braking | J | 39.2 | 39.2 | 137 | 137 |
| | Allowable total work | J | 4.9 × 10 ³ | 4.9 × 10 ³ | 44.1 × 10 ³ | 44.1 × 10 ³ |
| | Allowable angular acceleration | rad/s ² | 30,000 max. (Speed of 2,800 r/min or more must not be changed in less than 10 ms.) | | | |
| | Brake limit | – | 10 million times min. | | | |
| | Insulation class | – | Type F | | | |

| 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 | | | | |
| Maximum rotation speed | r/min | 6,000 | | | | |
| Momentary maximum torque *1 | N · m | 0.48 | 0.95 | 1.91 | 3.8 | |
| Rated current *1 | A (rms) | 1.1 | 1.1 | 1.5 | 2.4 | |
| Momentary maximum current *1 | A (rms) | 4.7 | 4.7 | 6.5 | 10.2 | |
| Rotor inertia | Without brake | kg · m ² | 0.025 × 10 ⁻⁴ | 0.051 × 10 ⁻⁴ | 0.14 × 10 ⁻⁴ | 0.26 × 10 ⁻⁴ |
| | With brake | kg · m ² | 0.027 × 10 ⁻⁴ | 0.054 × 10 ⁻⁴ | 0.16 × 10 ⁻⁴ | 0.28 × 10 ⁻⁴ |
| Applicable load inertia | – | 30 times the rotor inertia max.*2 | | | | |
| Torque constant *1 | N · m/A | 0.11±10% | 0.21±10% | 0.32±10% | 0.40±10% | |
| Power rate *1 | Without brake | kW/s | 10.1 | 19.8 | 28.9 | 62.3 |
| | With brake | kW/s | 9.4 | 18.7 | 25.3 | 57.8 |
| Mechanical time constant | Without brake | ms | 1.43 | 1.07 | 0.58 | 0.43 |
| | With brake | ms | 1.54 | 1.13 | 0.66 | 0.46 |
| Electrical time constant | ms | 0.82 | 0.90 | 3.2 | 3.4 | |
| Allowable radial load *3 | N | 68 | 68 | 245 | 245 | |
| Allowable thrust load *3 | N | 58 | 58 | 98 | 98 | |
| Weight | Without brake | kg | Approx. 0.31 | Approx. 0.46 | Approx. 0.79 | Approx. 1.2 |
| | With brake | kg | Approx. 0.51 | Approx. 0.66 | Approx. 1.2 | Approx. 1.6 |
| Radiator plate dimensions (material) | | 100 × 80 × t10 (Al) | | 130 × 120 × t12 (Al) | | |
| Applicable drives (R88D-) | | KN01H-ECT | KN01H-ECT | KN02H-ECT | KN04H-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 2 × 10 ⁻⁷ | 2 × 10 ⁻⁷ | 1.8 × 10 ⁻⁶ | 1.8 × 10 ⁻⁶ |
| | Excitation voltage *4 | V | 24 VDC ± 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° | | | |
| | Allowable work per braking | J | 39.2 | 39.2 | 137 | 137 |
| | Allowable total work | J | 4.9 × 10 ³ | 4.9 × 10 ³ | 44.1 × 10 ³ | 44.1 × 10 ³ |
| | Allowable angular acceleration | rad/s ² | 30,000 max. (Speed of 2,800 r/min or more must not be changed in less than 10 ms.) | | | |
| | Brake limit | – | 10 million times min. | | | |
| | Insulation class | – | Type F | | | |

| 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 | | | |
| 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 | 0.87×10^{-4} | 2.03×10^{-4} | 2.84×10^{-4} |
| | With brake | kg · m ² | 0.97×10^{-4} | 2.35×10^{-4} | 3.17×10^{-4} |
| Applicable load inertia | – | 20 times the rotor inertia max. *2 | 15 times the rotor inertia max. *2 | | |
| Torque constant *1 | N · m/A | 0.45±10% | 0.37 | 0.45 | |
| Power rate *1 | Without brake | kW/s | 65.4 | 49.8 | 80.1 |
| | With brake | kW/s | 58.7 | 43.0 | 71.8 |
| Mechanical time constant | Without brake | ms | 0.37 | 0.61 | 0.49 |
| | With brake | ms | 0.42 | 0.71 | 0.55 |
| Electrical time constant | ms | 5.3 | 5.8 | 6.3 | |
| Allowable radial load *3 | N | 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 drives (R88D-) | | KN08H-ECT | KN15H-ECT | KN15H-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 0.33×10^{-4} | 0.33×10^{-4} | 0.33×10^{-4} |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | |
| | Power consumption (at 20°C) | W | 17 | 19 | 19 |
| | 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° | | |
| | Allowable work per braking | J | 392 | 392 | 392 |
| | Allowable total work | J | 4.9×10^5 | 4.9×10^5 | 4.9×10^5 |
| | Allowable angular acceleration | rad/s ² | 10,000 | | |
| | Brake limit | – | 10 million times min. | | |
| | Insulation class | – | Type F | | |

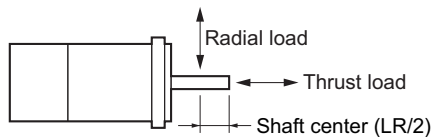
3 Specifications

| 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 | 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 | 3.68×10^{-4} | 6.50×10^{-4} | 12.9×10^{-4} | 17.4×10^{-4} |
| | With brake | kg · m ² | 4.01×10^{-4} | 7.85×10^{-4} | 14.2×10^{-4} | 18.6×10^{-4} |
| Applicable load inertia | – | 15 times the rotor inertia max. *2 | | | | |
| Torque constant *1 | N · m/A | 0.44 | 0.41 | 0.49 | 0.49 | |
| Power rate *1 | Without brake | kW/s | 110 | 140 | 126 | 146 |
| | With brake | kW/s | 101 | 116 | 114 | 136 |
| Mechanical time constant | Without brake | ms | 0.44 | 0.41 | 0.51 | 0.50 |
| | With brake | ms | 0.48 | 0.49 | 0.56 | 0.54 |
| Electrical time constant | ms | 6.7 | 11 | 12 | 13 | |
| Allowable radial load *3 | N | 490 | 490 | 784 | 784 | |
| Allowable thrust load *3 | N | 196 | 196 | 343 | 343 | |
| Weight | Without brake | kg | Approx. 5.3 | Approx. 8.3 | Approx. 11.0 | Approx. 14.0 |
| | With brake | kg | Approx. 6.3 | Approx. 9.4 | Approx. 12.6 | Approx. 16.0 |
| Radiator plate dimensions (material) | | 380 × 350 × t30 (Al) | | | | |
| Applicable drives (R88D-) | | KN20H-ECT | KN30H-ECT | KN50H-ECT | KN50H-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 0.33×10^{-4} | 0.33×10^{-4} | 1.35×10^{-4} | 1.35×10^{-4} |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | |
| | Power consumption (at 20°C) | W | 19 | 19 | 22 | 22 |
| | Current consumption (at 20°C) | A | 0.81±10% | 0.81±10% | 0.90±10% | 0.90±10% |
| | Static friction torque | N · m | 7.8 min. | 11.8 min. | 16.1 min. | 16.1 min. |
| | Attraction time *5 | ms | 50 max. | 80 max. | 110 max. | 110 max. |
| | Release time *5 | ms | 15 max. *6 | 15 max. *6 | 50 max. *7 | 50 max. *7 |
| | Backlash | | ± 1° | | | |
| | Allowable work per braking | J | 392 | 392 | 1470 | 1470 |
| | Allowable total work | J | 4.9×10^6 | 4.9×10^6 | 2.2×10^6 | 2.2×10^6 |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | |
| | Brake limit | – | 10 million times min. | | | |
| | Rating | – | Continuous | | | |
| | Insulation class | – | Type F | | | |

| Model (R88M-) | | 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 | | | | |
| 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 × 10 ⁻⁴ | 2.03 × 10 ⁻⁴ | 2.84 × 10 ⁻⁴ | 3.68 × 10 ⁻⁴ |
| | With brake | kg · m ² | 1.93 × 10 ⁻⁴ | 2.35 × 10 ⁻⁴ | 3.17 × 10 ⁻⁴ | 4.01 × 10 ⁻⁴ |
| Applicable load inertia | – | 20 times the rotor inertia max. *2 | 15 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 Servo Drives (R88D-) | | KN10F-ECT | KN15F-ECT | KN15F-ECT | KN20F-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 0.33 × 10 ⁻⁴ | 0.33 × 10 ⁻⁴ | 0.33 × 10 ⁻⁴ | 0.33 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | |
| | Power consumption (at 20°C) | W | 17 | 19 | 19 | 19 |
| | Current consumption (at 20°C) | A | 0.70±10% | 0.81±10% | 0.81±10% | 0.81±10% |
| | Static friction torque | N · m | 2.5 min. | 7.8 min. | 7.8 min. | 7.8 min. |
| | Attraction time *5 | ms | 50 max. | 50 max. | 50 max. | 50 max. |
| | Release time *5 | ms | 15 max. *6 | 15 max. *6 | 15 max. *6 | 15 max. *6 |
| | Backlash | | ± 1° | | | |
| | Allowable work per braking | J | 392 | 392 | 392 | 392 |
| | Allowable total work | J | 4.9 × 10 ⁵ | 4.9 × 10 ⁵ | 4.9 × 10 ⁵ | 4.9 × 10 ⁵ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | |
| | Brake limit | – | 10 million times min. | | | |
| | Rating | – | Continuous | | | |
| | Insulation class | – | Type F | | | |

| Model (R88M-) | | 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 | | | |
| 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 × 10 ⁻⁴ | 12.9 × 10 ⁻⁴ | 17.4 × 10 ⁻⁴ |
| | With brake | kg · m ² | 7.85 × 10 ⁻⁴ | 14.2 × 10 ⁻⁴ | 18.6 × 10 ⁻⁴ |
| Applicable load inertia | – | 15 times the rotor inertia max. *2 | | | |
| Torque constant *1 | N · m/A | 0.81 | 0.98 | 0.98 | |
| Power rate *1 | Without brake | kW/s | 140 | 126 | 146 |
| | With brake | kW/s | 116 | 114 | 136 |
| Mechanical time constant | Without brake | ms | 0.40 | 0.51 | 0.50 |
| | With brake | ms | 0.49 | 0.56 | 0.54 |
| Electrical time constant | ms | 12 | 13 | 13 | |
| Allowable radial load *3 | N | 490 | 784 | 784 | |
| Allowable thrust load *3 | N | 196 | 343 | 343 | |
| Weight | Without brake | kg | Approx. 8.3 | Approx. 11.0 | Approx. 14.0 |
| | With brake | kg | Approx. 9.4 | Approx. 12.6 | Approx. 16.0 |
| Radiator plate dimensions (material) | | 380 × 350 × t30 (Al) | | | |
| Applicable Servo Drives (R88D-) | | KN30F-ECT | KN50F-ECT | KN50F-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 0.33 × 10 ⁻⁴ | 0.33 × 10 ⁻⁴ | 1.35 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | |
| | Power consumption (at 20°C) | W | 19 | 22 | 22 |
| | Current consumption (at 20°C) | A | 0.81±10% | 0.90±10% | 0.90±10% |
| | Static friction torque | N · m | 11.8 min. | 16.1 min. | 16.1 min. |
| | Attraction time *5 | ms | 80 max. | 110 max. | 110 max. |
| | Release time *5 | ms | 15 max. *6 | 50 max. *7 | 50 max. *7 |
| | Backlash | | ± 1° | | |
| | Allowable work per braking | J | 392 | 1470 | 1470 |
| | Allowable total work | J | 4.9 × 10 ⁵ | 2.2 × 10 ⁶ | 2.2 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | |
| | Brake limit | – | 10 million times min. | | |
| | Rating | – | Continuous | | |
| | Insulation class | – | Type F | | |

- *1 These are the values when the motor is combined with a drive at normal temperature (20°C, 65%). The momentary maximum torque indicates the standard value.
- *2 Applicable load inertia.
 - The operable load inertia ratio (load inertia/rotor inertia) depends on the mechanical configuration and its rigidity. For a machine with high rigidity, operation is possible even with high load inertia. Select an appropriate motor and confirm that operation is possible.
 - The dynamic brake is intended for emergency stop and therefore has a short-time rating. If the dynamic brake is activated, allow it to be in a stop state for 3 minutes or more to prevent a circuit failure and burning of the Dynamic Brake Resistor.
- *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.



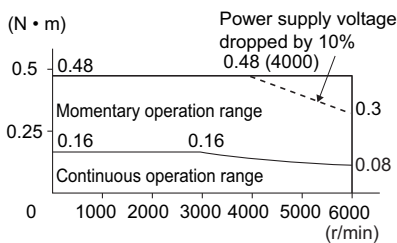
- *4 This is a non-excitation brake. (It is released when excitation voltage is applied.)
- *5 The operation time is the value (reference value) measured with a surge suppressor (CR50500 by Okaya Electric Industries Co., Ltd.).
- *6 Direct current switching with a varistor (Z15D151 by Ishizuka Electronics Co.).
- *7 Direct current switching with a varistor (TNR9G820K by Nippon Chemi-Con Corporation).

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

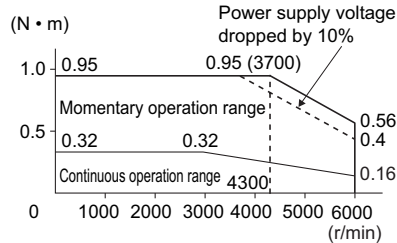
- 3,000-r/min Servomotors (100 VAC)

The following graphs show the characteristics with a 3-m standard cable and a 100-VAC input.

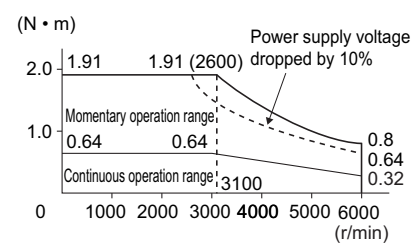
• R88M-K05030H/T (50 W)



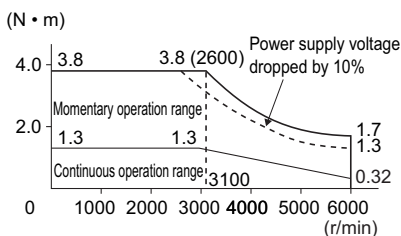
• R88M-K10030L/S (100 W)



• R88M-K20030L/S (200 W)



• R88M-K40030L/S (400 W)



Note 1 The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

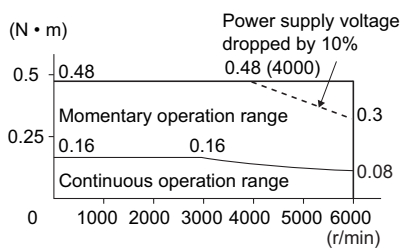
- 2 If the motor power cable exceeds 20 m, the voltage drop will increase and the momentary operation range will become narrower.

3 Specifications

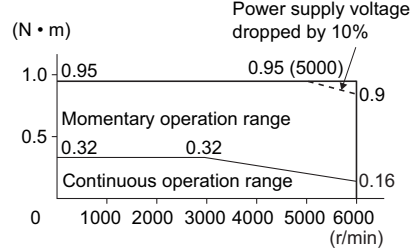
- 3,000-r/min Servomotors (200 VAC)

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

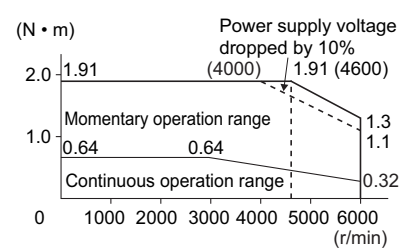
- R88M-K05030H/T (50 W)



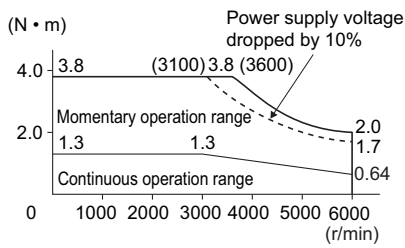
- R88M-K10030H/T (100 W)



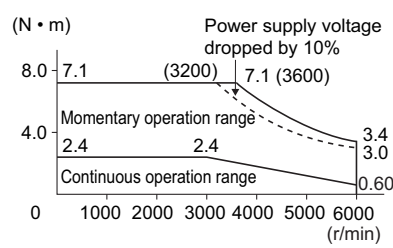
- R88M-K20030H/T (200 W)



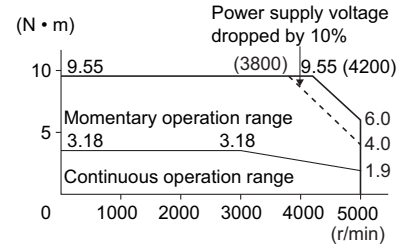
- R88M-K40030H/T (400 W)



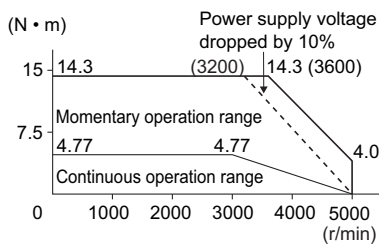
- R88M-K75030H/T (750 W)



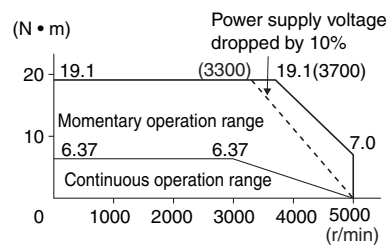
- R88M-K1K030H/T (1 kW)



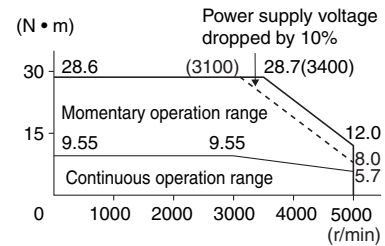
- R88M-K1K530H/T (1.5 kW)



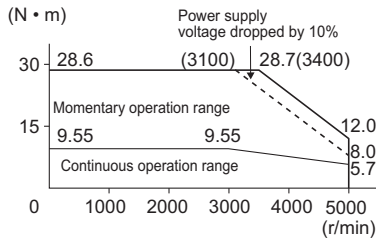
- R88M-K2K030H/T (2 kW)



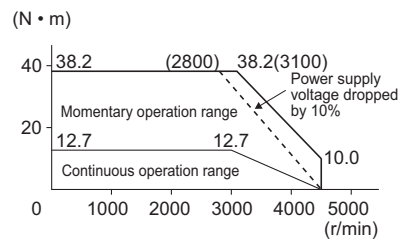
- R88M-K3K030H/T (3 kW)



- R88M-K4K030H/T (4 kW)



- R88M-K5K030H/T (5 W)



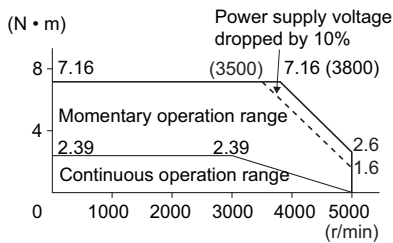
Note 1 The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

2 If the motor power cable exceeds 20 m, the voltage drop will increase and the momentary operation range will become narrower.

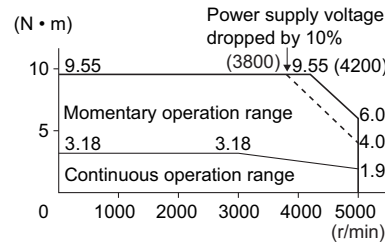
• 3,000-r/min Servomotors (400 VAC)

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

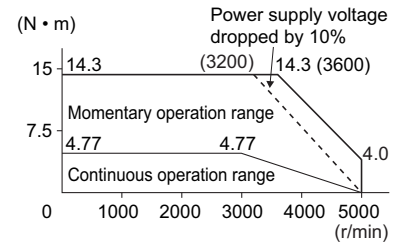
• R88M-K75030F/C (750 W)



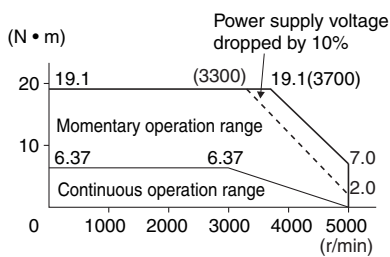
• R88M-K1K030F/C (1 kW)



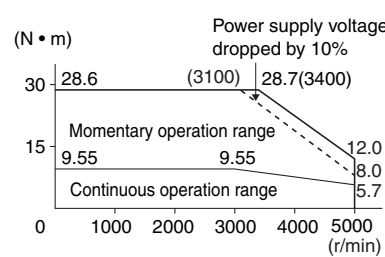
• R88M-K1K530F/C (1.5 kW)



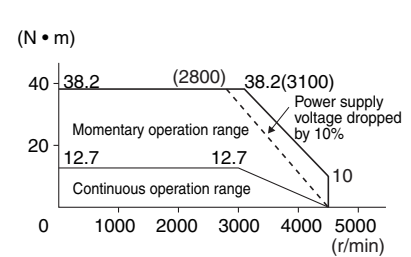
• R88M-K2K030F/C (2 kW)



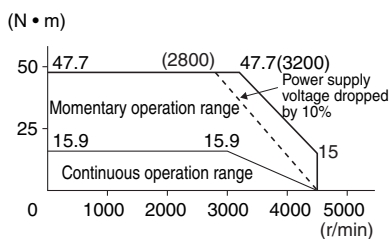
• R88M-K3K030F/C (3 kW)



• R88M-K4K030F/C (4 kW)



• R88M-K5K030F/C (5 kW)



Note 1 The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

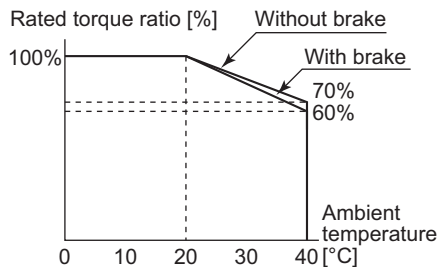
2 If the motor power cable exceeds 20 m, the voltage drop will increase and the momentary operation range will become narrower.



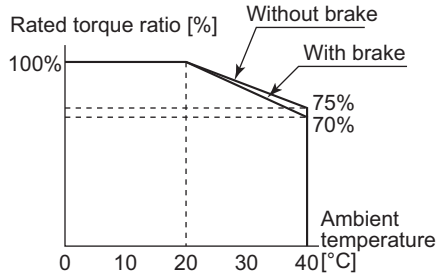
Precautions for Correct Use

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

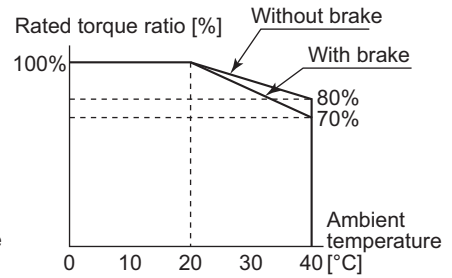
- R88M-K05030L/S/H/T
(50 W: With oil seal)



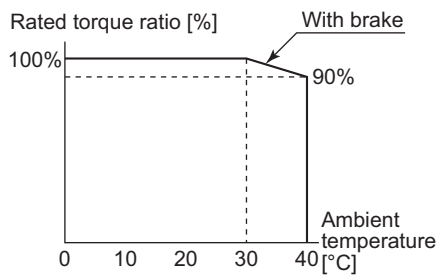
- R88M-K10030L/S/H/T
(100 W: With oil seal)



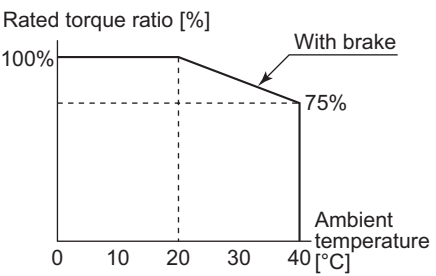
- R88M-K20030L/S/H/T
(200 W: With oil seal)



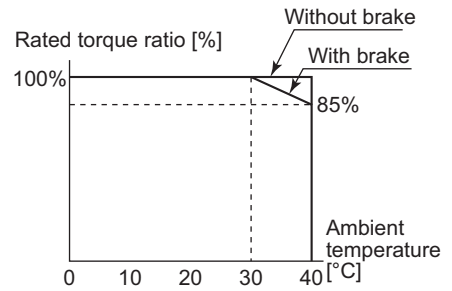
- R88M-K40030L/S/H/T
(400 W: Without oil seal)



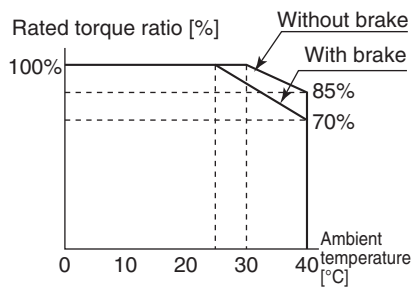
- R88M-K40030L/S/H/T
(400 W: With oil seal)



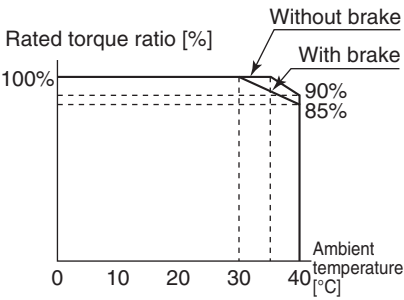
- R88M-K1K530H/T/F/C
(1.5 kW)



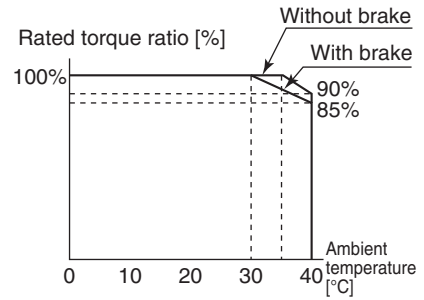
- R88M-K2K030H/T/F/C (2 kW)



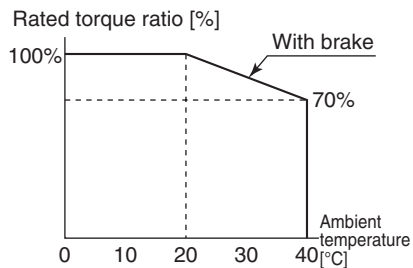
- R88M-K3K030H/T/F/C (3 kW)



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



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



1,500-r/min, 2,000-r/min Servomotors

| 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 | | | |
| 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 × 10 ⁻⁴ | 6.70 × 10 ⁻⁴ | 8.72 × 10 ⁻⁴ |
| | With brake | kg · m ² | 5.90 × 10 ⁻⁴ | 7.99 × 10 ⁻⁴ | 10.0 × 10 ⁻⁴ |
| Applicable load inertia | – | 10 times the rotor inertia max. *2 | | | |
| Torque constant *1 | N · m/A | 0.63 | 0.58 | 0.64 | |
| Power rate *1 | Without brake | kW/s | 49.5 | 76.5 | 105 |
| | With brake | kW/s | 38.6 | 64.2 | 91.2 |
| Mechanical time constant | Without brake | ms | 0.80 | 0.66 | 0.66 |
| | With brake | ms | 1.02 | 0.80 | 0.76 |
| Electrical time constant | ms | 9.4 | 10 | 10 | |
| Allowable radial load *3 | N | 490 | 490 | 490 | |
| Allowable thrust load *3 | N | 196 | 196 | 196 | |
| Weight | Without brake | kg | Approx. 5.2 | Approx. 6.7 | Approx. 8.0 |
| | With brake | kg | Approx. 6.7 | Approx. 8.2 | Approx. 9.5 |
| Radiator plate dimensions (material) | | 275 × 260 × t15 (Al) | | | |
| Applicable Servo Drives (R88D-) | | KN10H-ECT | KN15H-ECT | KN20H-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 1.35 × 10 ⁻⁴ | 1.35 × 10 ⁻⁴ | 1.35 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | |
| | Power consumption (at 20°C) | W | 14 | 19 | 19 |
| | Current consumption (at 20°C) | A | 0.59±10% | 0.79±10% | 0.79±10% |
| | Static friction torque | N · m | 4.9 min. | 13.7 min. | 13.7 min. |
| | Attraction time *5 | ms | 80 max. | 100 max. | 100 max. |
| | Release time *5 | ms | 70 max. *6 | 50 max. *6 | 50 max. *6 |
| | Backlash | | ± 1° | | |
| | Allowable work per braking | J | 588 | 1176 | 1176 |
| | Allowable total work | J | 7.8 × 10 ⁵ | 1.5 × 10 ⁶ | 1.5 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | |
| | Brake limit | – | 10 million times min. | | |
| | Rating | – | Continuous | | |
| Insulation class | – | Type F | | | |

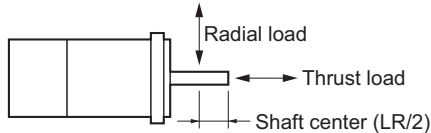
| Model (R88M-) | | 200 VAC | | | | | | |
|--------------------------------------|--------------------------------|------------------------------------|-------------------------|-------------------------|-----------------------------------|------------------------|------------------------|------------------------|
| | | K3K020H | K4K020H | K5K020H | – | – | – | |
| Item | Unit | K3K020T | K4K020T | K5K020T | K7K515T | K11K015T | K15K015T | |
| Rated output *1 | W | 3,000 | 4,000 | 5,000 | 7,500 | 11,000 | 15,000 | |
| Rated torque *1 | N · m | 14.3 | 19.1 | 23.9 | 47.8 | 70.0 | 95.5 | |
| Rated rotation speed | r/min | 2,000 | | | 1,500 | | | |
| Maximum rotation speed | r/min | 3,000 | | | | 2000 | | |
| Momentary maximum torque *1 | N · m | 43.0 | 57.3 | 71.6 | 119.0 | 175.0 | 224.0 | |
| Rated current *1 | A (rms) | 17.4 | 21.0 | 25.9 | 44.0 | 54.2 | 66.1 | |
| Momentary maximum current *1 | A (rms) | 74 | 89 | 110 | 165 | 203 | 236 | |
| Rotor inertia | Without brake | kg · m ² | 12.9 × 10 ⁻⁴ | 37.6 × 10 ⁻⁴ | 48.0 × 10 ⁻⁴ | 101 × 10 ⁻⁴ | 212 × 10 ⁻⁴ | 302 × 10 ⁻⁴ |
| | With brake | kg · m ² | 14.2 × 10 ⁻⁴ | 38.6 × 10 ⁻⁴ | 48.8 × 10 ⁻⁴ | 107 × 10 ⁻⁴ | 220 × 10 ⁻⁴ | 311 × 10 ⁻⁴ |
| Applicable load inertia | – | 10 times the rotor inertia max. *2 | | | 5 times the rotor inertia max. *2 | | | |
| Torque constant *1 | N · m/A | 0.59 | 0.70 | 0.70 | 0.77 | 0.92 | 1.05 | |
| Power rate *1 | Without brake | kW/s | 159 | 97.1 | 119 | 226 | 231 | 302 |
| | With brake | kW/s | 144 | 94.5 | 117 | 213 | 223 | 293 |
| Mechanical time constant | Without brake | ms | 0.57 | 0.65 | 0.63 | 0.58 | 0.80 | 0.71 |
| | With brake | ms | 0.63 | 0.66 | 0.64 | 0.61 | 0.83 | 0.74 |
| Electrical time constant | ms | 12 | 20 | 19 | 21 | 31 | 32 | |
| Allowable radial load *3 | N | 784 | 784 | 784 | 1176 | 2254 | 2254 | |
| Allowable thrust load *3 | N | 343 | 343 | 343 | 490 | 686 | 686 | |
| Weight | Without brake | kg | Approx. 11.0 | Approx. 15.5 | Approx. 18.6 | Approx. 36.4 | Approx. 52.7 | Approx. 70.2 |
| | With brake | kg | Approx. 12.6 | Approx. 18.7 | Approx. 21.8 | Approx. 40.4 | Approx. 58.9 | Approx. 76.3 |
| Radiator plate dimensions (material) | | 380 × 350 × t30 (Al) | 470 × 440 × t30 (Al) | | 550 × 520 × t30 (Al) | 670 × 630 × t35 (Al) | | |
| Applicable Servo Drives (R88D-) | | KN30H-ECT | KN50H-ECT | KN50H-ECT | KN75H-ECT | KN150H-ECT | KN150H-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 1.35 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 7.1 × 10 ⁻⁴ | 7.1 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | | | |
| | Power consumption (at 20°C) | W | 22 | 31 | 31 | 34 | 26 | 26 |
| | Current consumption (at 20°C) | A | 0.90±10% | 1.3±10% | 1.3±10% | 1.4±10% | 1.08±10% | 1.08±10% |
| | Static friction torque | N · m | 16.2 min. | 24.5 min. | 24.5 min. | 58.8 min. | 100 min. | 100 min. |
| | Attraction time *5 | ms | 110 max. | 80 max. | 80 max. | 150 max. | 300 max. | 300 max. |
| | Release time *5 | ms | 50 max. *6 | 25 max. *7 | 25 max. *7 | 50 max. | 140 max. | 140 max. |
| | Backlash | | ± 1° | | | | | |
| | Allowable work per braking | J | 1470 | 1372 | 1372 | 1372 | 2000 | 2000 |
| | Allowable total work | J | 2.2 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ | 4.0 × 10 ⁶ | 4.0 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | 5,000 | 3,000 | |
| | Brake limit | – | 10 million times min. | | | | | |
| | Rating | – | Continuous | | | | | |
| Insulation class | – | Type F | | | | | | |

| 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 | | | | |
| 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 | 1.61×10^{-4} | 2.03×10^{-4} | 4.60×10^{-4} | 6.70×10^{-4} |
| | With brake | kg · m ² | 1.90×10^{-4} | 2.35×10^{-4} | 5.90×10^{-4} | 7.99×10^{-4} |
| Applicable load inertia | – | 10 times the rotor inertia max. *2 | | | | |
| Torque constant *1 | N · m/A | 1.27 | 1.38 | 1.27 | 1.16 | |
| Power rate *1 | Without brake | kW/s | 22.7 | 40.3 | 49.5 | 76.5 |
| | 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 drives (R88D-) | | KN06F-ECT | KN06F-ECT | KN10F-ECT | KN15F-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 1.35×10^{-4} | 1.35×10^{-4} | 1.35×10^{-4} | 1.35×10^{-4} |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | |
| | Power consumption (at 20°C) | W | 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° | | | |
| | Allowable work per braking | J | 392 | 392 | 588 | 1176 |
| | Allowable total work | J | 4.9×10^5 | 4.9×10^5 | 7.8×10^5 | 1.5×10^6 |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | |
| | Brake limit | – | 10 million times min. | | | |
| | Rating | – | Continuous | | | |
| | Insulation class | – | Type F | | | |

| Model (R88M-) | | 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 | | | | |
| 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 × 10 ⁻⁴ | 12.9 × 10 ⁻⁴ | 37.6 × 10 ⁻⁴ | 48.0 × 10 ⁻⁴ |
| | With brake | kg · m ² | 10.0 × 10 ⁻⁴ | 14.2 × 10 ⁻⁴ | 38.6 × 10 ⁻⁴ | 48.8 × 10 ⁻⁴ |
| Applicable load inertia | – | 10 times the rotor inertia max. *2 | | | | |
| Torque constant *1 | N · m/A | 1.27 | 1.18 | 1.40 | 1.46 | |
| Power rate *1 | Without brake | kW/s | 105 | 159 | 97.1 | 119 |
| | With brake | kW/s | 91.2 | 144 | 94.5 | 117 |
| Mechanical time constant | Without brake | ms | 0.68 | 0.56 | 0.60 | 0.60 |
| | With brake | ms | 0.78 | 0.61 | 0.61 | 0.61 |
| Electrical time constant | ms | 10 | 12 | 21 | 19 | |
| Allowable radial load *3 | N | 490 | 784 | 784 | 784 | |
| Allowable thrust load *3 | N | 196 | 343 | 343 | 343 | |
| Weight | Without brake | kg | Approx. 8.0 | Approx. 11.0 | Approx. 15.5 | Approx. 18.6 |
| | With brake | kg | Approx. 9.5 | Approx. 12.6 | Approx. 18.7 | Approx. 21.8 |
| Radiator plate dimensions (material) | | 275 × 260 × t15 (Al) | 380 × 350 × t30 (Al) | 470 × 440 × t30 (Al) | | |
| Applicable Servo Drives (R88D-) | | KN20F-ECT | KN30F-ECT | KN50F-ECT | KN50F-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 1.35 × 10 ⁻⁴ | 1.35 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | |
| | Power consumption (at 20°C) | W | 19 | 22 | 31 | 31 |
| | Current consumption (at 20°C) | A | 0.79±10% | 0.90±10% | 1.3±10% | 1.3±10% |
| | Static friction torque | N · m | 13.7 min. | 16.2 min. | 24.5 min. | 24.5 min. |
| | Attraction time *5 | ms | 100 max. | 110 max. | 80 max. | 80 max. |
| | Release time *5 | ms | 50 max. *6 | 50 max. *6 | 25 max. *7 | 25 max. *7 |
| | Backlash | | ± 1° | | | |
| | Allowable work per braking | J | 1176 | 1470 | 1372 | 1372 |
| | Allowable total work | J | 1.5 × 10 ⁶ | 2.2 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | |
| | Brake limit | – | 10 million times min. | | | |
| | Rating | – | Continuous | | | |
| | Insulation class | – | Type F | | | |

| 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 | 95.5 | |
| 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 × 10 ⁻⁴ | 212 × 10 ⁻⁴ | 302 × 10 ⁻⁴ |
| | With brake | kg · m ² | 107 × 10 ⁻⁴ | 220 × 10 ⁻⁴ | 311 × 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 | 2,254 | |
| Allowable thrust load *3 | N | 490 | 686 | 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 × 520 × t30 (Al) | 670 × 630 × t35 (Al) | | |
| Applicable Servo Drives (R88D-) | | KN75F-ECT | KN150F-ECT | KN150F-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 4.7 × 10 ⁻⁴ | 7.1 × 10 ⁻⁴ | 7.1 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | |
| | Power consumption (at 20°C) | W | 34 | 26 | 26 |
| | Current consumption (at 20°C) | A | 1.4±10% | 1.08±10% | 1.08±10% |
| | Static friction torque | N · m | 58.8 min. | 100 min. | 100 min. |
| | Attraction time *5 | ms | 150 max. | 300 max. | 300 max. |
| | Release time *5 | ms | 50 max. | 140 max. | 140 max. |
| | Backlash | | ± 1° | | |
| | Allowable work per braking | J | 1372 | 2000 | 2000 |
| | Allowable total work | J | 2.9 × 10 ⁶ | 4.0 × 10 ⁶ | 4.0 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 5,000 | 3,000 | |
| | Brake limit | – | 10 million times min. | | |
| | Rating | – | Continuous | | |
| | Insulation class | – | Type F | | |

- *1 These are the values when the motor is combined with a drive at normal temperature (20°C, 65%). The momentary maximum torque indicates the standard value.
- *2 Applicable load inertia.
 - The operable load inertia ratio (load inertia/rotor inertia) depends on the mechanical configuration and its rigidity. For a machine with high rigidity, operation is possible even with high load inertia. Select an appropriate motor and confirm that operation is possible.
 - The dynamic brake is intended for emergency stop and therefore has a short-time rating. If the dynamic brake is activated, allow it to be in a stop state for 3 minutes or more to prevent a circuit failure and burning of the Dynamic Brake Resistor.
- *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.



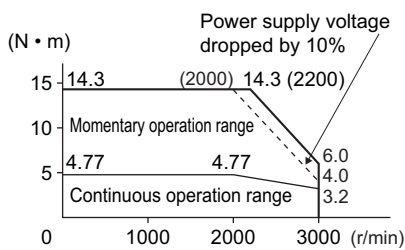
- *4 This is a non-excitation brake. (It is released when excitation voltage is applied.)
- *5 The operation time is the value (reference value) measured with a surge suppressor (CR50500 by Okaya Electric Industries Co., Ltd.).
- *6 Direct current switching with a varistor (TNR9G820K by Nippon Chemi-Con Corporation).
- *7 Direct current switching with a varistor (Z15D151 by Ishizuka Electronics Co.).

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

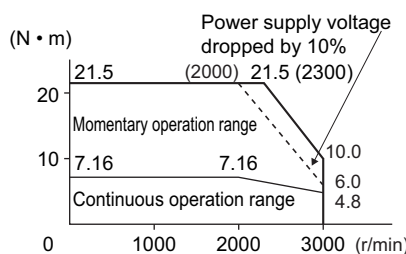
- 1,500-r/min and 2,000-r/min Servomotors (200 VAC)

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

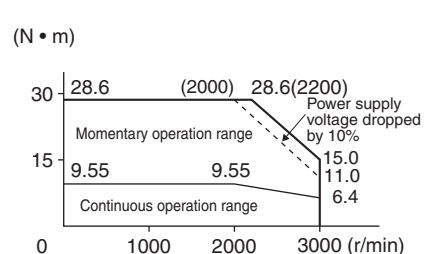
• R88M-K1K020H/T (1 kW)



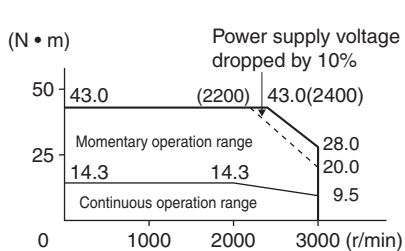
• R88M-K1K520H/T (1.5 kW)



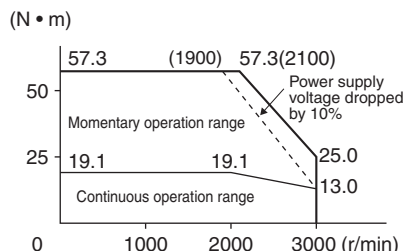
• R88M-K2K020H/T (2 kW)



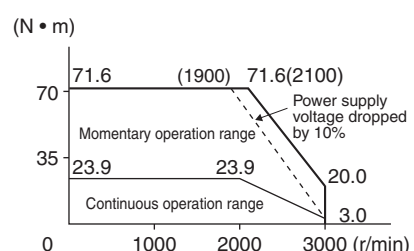
• R88M-K3K020H/T (3 kW)



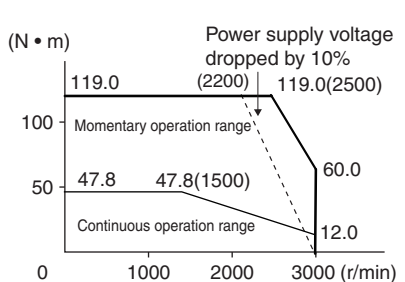
• R88M-K4K020H/T (4 kW)



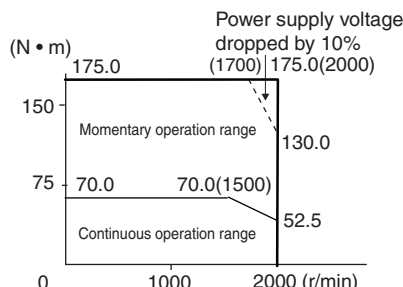
• R88M-K5K020H/T (5 kW)



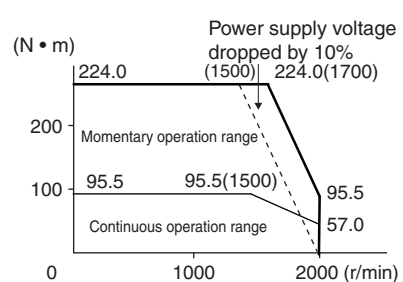
• R88M-K7K515T (7.5 kW)



• R88M-K11K015T (11 kW)



• R88M-K15K015T (15 kW)



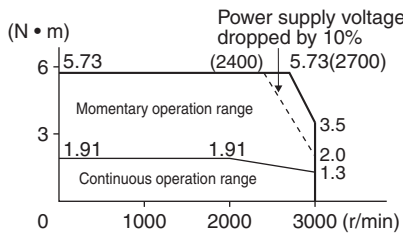
Note 1 The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

2 If the motor power cable exceeds 20 m, the voltage drop will increase and the momentary operation range will become narrower.

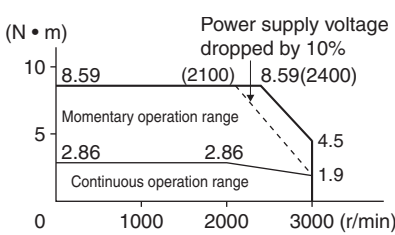
• 1,500-r/min and 2,000-r/min Servomotors (400 VAC)

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

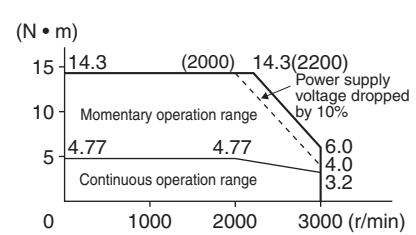
• R88M-K40020F/C (400 W)



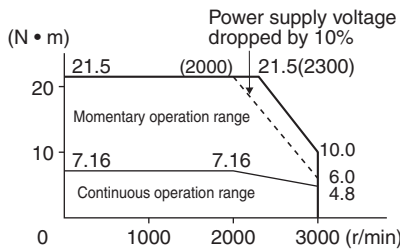
• R88M-K60020F/C (600 W)



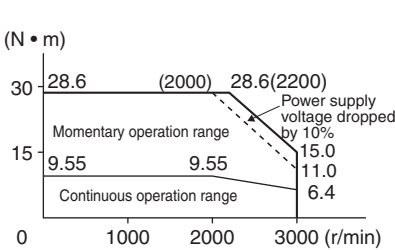
• R88M-K1K020F/C (1 kW)



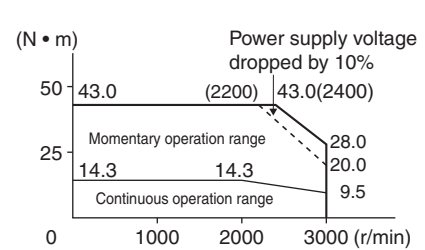
• R88M-K1K520F/C (1.5 kW)



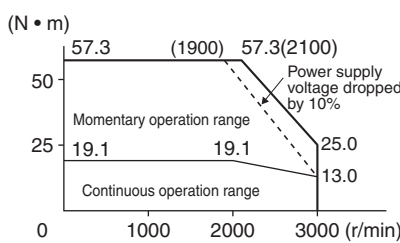
• R88M-K2K020F/C (2 kW)



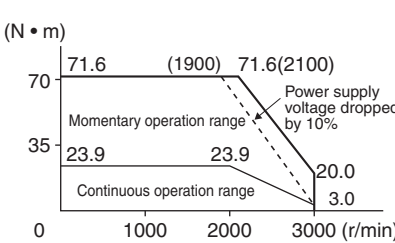
• R88M-K3K020F/C (3 kW)



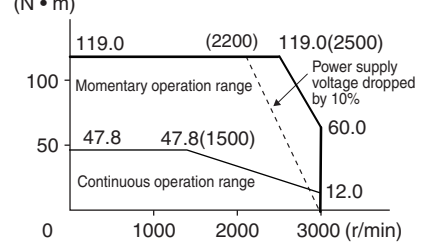
• R88M-K4K020F/C (4 kW)



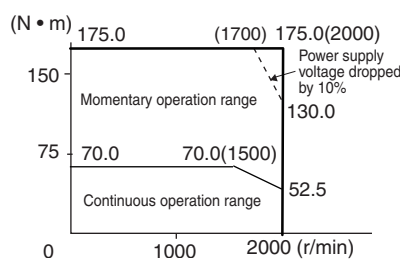
• R88M-K5K020F/C (5 kW)



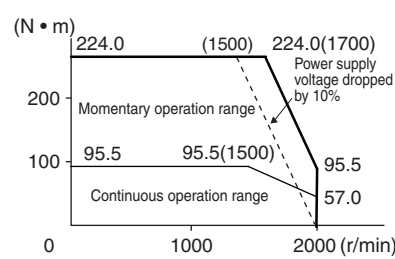
• R88M-K7K515C (7.5 kW)



• R88M-K11K015C (11 kW)



• R88M-K15K015C (15 kW)

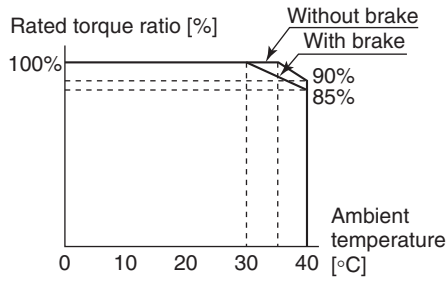


Note 1 The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

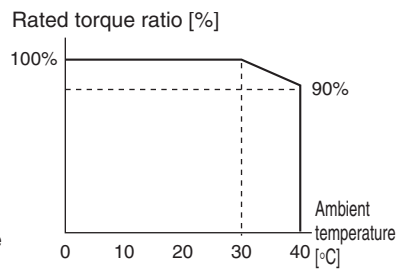
2 If the motor power cable exceeds 20 m, the voltage drop will increase and the momentary operation range will become narrower.

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.

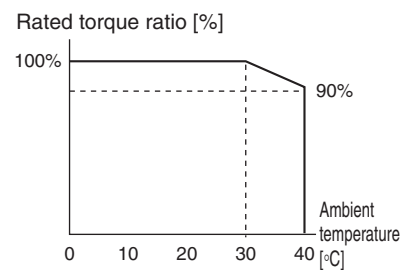
- R88M-K5K020H/T/F/C (5 kW)



- R88M-K7K515T/C (7.5 kW)



- R88M-K15K015T/C (15 kW)



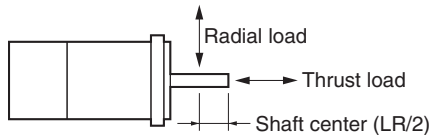
1,000-r/min Servomotors

| Model (R88M-) | | | 200 VAC | | | | |
|--------------------------------------|--------------------------------|------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| | | | K90010H | K2K010H | K3K010H | – | – |
| Item | Unit | 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 | 57.3 | |
| Rated rotation speed | r/min | 1,000 | | | | | |
| 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 × 10 ⁻⁴ | 30.3 × 10 ⁻⁴ | 48.4 × 10 ⁻⁴ | 79.1 × 10 ⁻⁴ | 101 × 10 ⁻⁴ |
| | With brake | kg · m ² | 7.99 × 10 ⁻⁴ | 31.4 × 10 ⁻⁴ | 49.2 × 10 ⁻⁴ | 84.4 × 10 ⁻⁴ | 107 × 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 | 1470 | 1764 | |
| Allowable thrust load *3 | N | 196 | 490 | 490 | 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 × 440 × t30 (Al) | 550 × 520 × t30 (Al) | |
| Applicable Servo Drives (R88D-) | | KN15H-ECT | KN30H-ECT | KN50H-ECT | KN50H-ECT | KN75H-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 1.35 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | | |
| | Power consumption (at 20°C) | W | 19 | 31 | 34 | 34 | 34 |
| | Current consumption (at 20°C) | A | 0.79±10% | 1.3±10% | 1.4±10% | 1.4±10% | 1.4±10% |
| | Static friction torque | N · m | 13.7 min. | 24.5 min. | 58.8 min. | 58.8 min. | 58.8 min. |
| | Attraction time *5 | ms | 100 max. | 80 max. | 150 max. | 150 max. | 150 max. |
| | Release time *5 | ms | 50 max. *6 | 25 max. *7 | 50 max. *7 | 50 max. | 50 max. |
| | Backlash | | ± 1° | | | | |
| | Allowable work per braking | J | 1176 | 1372 | 1372 | 1372 | 1372 |
| | Allowable total work | J | 1.5 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | 5,000 | |
| | Brake limit | – | 10 million times min. | | | | |
| | Rating | – | Continuous | | | | |
| Insulation class | – | Type F | | | | | |

| Model (R88M-) | | 400 VAC | | | | | |
|--------------------------------------|--------------------------------|------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| | | K90010F | K2K010F | K3K010F | – | – | |
| Item | Unit | K90010C | K2K010C | K3K010C | 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 | | | | | |
| 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 × 10 ⁻⁴ | 30.3 × 10 ⁻⁴ | 48.4 × 10 ⁻⁴ | 79.1 × 10 ⁻⁴ | 101 × 10 ⁻⁴ |
| | With brake | kg · m ² | 7.99 × 10 ⁻⁴ | 31.4 × 10 ⁻⁴ | 49.2 × 10 ⁻⁴ | 84.4 × 10 ⁻⁴ | 107 × 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 | 1470 | 1764 | |
| Allowable thrust load *3 | N | 196 | 490 | 490 | 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 × 440 × t30 (Al) | | 470 × 440 × t30 (Al) | 550 × 520 × t30 (Al) | |
| Applicable Servo Drives (R88D-) | | KN15F-ECT | KN30F-ECT | KN50F-ECT | KN50F-ECT | KN75F-ECT | |
| Brake specifications | Brake inertia | kg · m ² | 1.35 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ | 4.7 × 10 ⁻⁴ |
| | Excitation voltage *4 | V | 24 VDC ± 10% | | | | |
| | Power consumption (at 20°C) | W | 19 | 31 | 34 | 34 | 34 |
| | Current consumption (at 20°C) | A | 0.79±10% | 1.3±10% | 1.4±10% | 1.4±10% | 1.4±10% |
| | Static friction torque | N · m | 13.7 min. | 24.5 min. | 58.8 min. | 58.8 min. | 58.8 min. |
| | Attraction time *5 | ms | 100 max. | 80 max. | 150 max. | 150 max. | 150 max. |
| | Release time *5 | ms | 50 max. *6 | 25 max. *7 | 50 max. *7 | 50 max. | 50 max. |
| | Backlash | | ± 1° | | | | |
| | Allowable work per braking | J | 1176 | 1372 | 1372 | 1372 | 1372 |
| | Allowable total work | J | 1.5 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ | 2.9 × 10 ⁶ |
| | Allowable angular acceleration | rad/s ² | 10,000 | | | 5,000 | |
| | Brake limit | – | 10 million times min. | | | | |
| | Rating | – | Continuous | | | | |
| | Insulation class | – | Type F | | | | |

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

- *2 Applicable load inertia.
 - The operable load inertia ratio (load inertia/rotor inertia) depends on the mechanical configuration and its rigidity. For a machine with high rigidity, operation is possible even with high load inertia. Select an appropriate motor and confirm that operation is possible.
 - The dynamic brake is intended for emergency stop and therefore has a short-time rating. If the dynamic brake is activated, allow it to be in a stop state for 3 minutes or more to prevent a circuit failure and burning of the Dynamic Brake Resistor.
- *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.



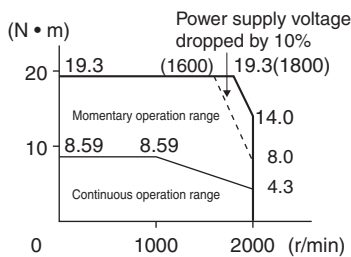
- *4 This is a non-excitation brake. (It is released when excitation voltage is applied.)
- *5 The operation time is the value (reference value) measured with a surge suppressor (CR50500 by Okaya Electric Industries Co., Ltd.).
- *6 Direct current switching with a varistor (TNR9G820K by Nippon Chemi-Con Corporation).
- *7 Direct current switching with a varistor (Z15D151 by Ishizuka Electronics Co.).

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

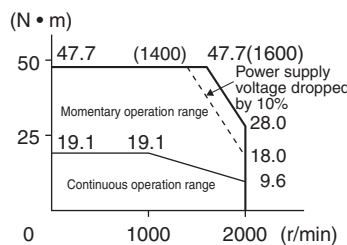
- 1,000-r/min Servomotors (200/400 VAC)

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

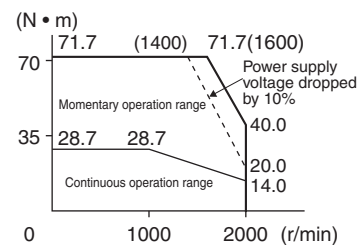
• R88M-K90010H/T/F/C (900 W)



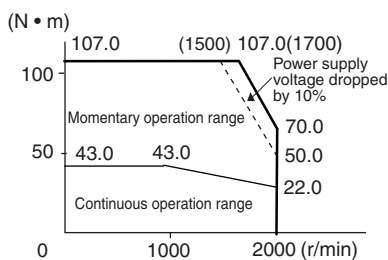
• R88M-K2K010H/T/F/C (2 kW)



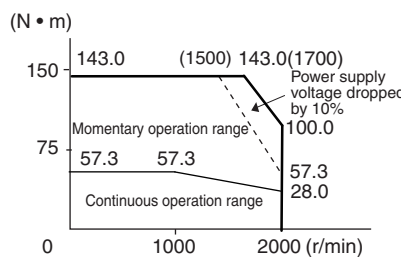
• R88M-K3K010H/T/F/C (3 kW)



• R88M-K4K510T/C (900 W)



• R88M-K6K010T/C (900 W)



Note 1 The continuous operation range is the range in which continuous operation is possible. Continuous operation at the maximum speed is also possible. However, doing so will reduce the output torque.

- 2 If the motor power cable exceeds 20 m, the voltage drop will increase and the momentary operation range will become narrower.

Temperature Characteristics of the Motor and Mechanical System

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

3-3-3 Encoder Specifications

Incremental Encoder Specifications

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

Absolute Encoder Specifications

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



Additional Information

Multi-rotation Data Backup

- The multi-rotation data will be lost if the battery cable connector is disconnected at the motor when connecting the battery cable for the absolute encoder and battery.
- The multi-rotation data will be lost if CN2 is disconnected when connecting the battery to CN1 without the use of a battery cable for the absolute encoder.

3-4 Reduction Gear Specifications

The following tables list the Reduction Gear models for G5-series Servomotor. Select the model by the Servomotor capacity.

3-4-1 Models and Specifications

3 Arcminutes Max.

● For 3,000-r/min Servomotors

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|-------|------|--------------------|----------------------|--------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 50 W | 1/5 | R88G-HPG11B05100B□ | 600 | 0.50 | 63 | 1200 | 1.51 | 5.00×10^{-7} | 135 | 538 | 0.3 |
| | 1/9 | R88G-HPG11B09050B□ | 333 | 1.12 | 78 | 666 | 3.37 | 3.00×10^{-7} | 161 | 642 | 0.3 |
| | 1/21 | R88G-HPG14A21100B□ | 143 | 2.18 | 65 | 286 | 6.55 | 5.00×10^{-6} | 340 | 1358 | 1.0 |
| | 1/33 | R88G-HPG14A33050B□ | 91 | 3.75 | 71 | 182 | 11.2 | 4.40×10^{-6} | 389 | 1555 | 1.0 |
| | 1/45 | R88G-HPG14A45050B□ | 67 | 5.11 | 71 | 134 | 15.3 | 4.40×10^{-6} | 427 | 1707 | 1.0 |
| 100 W | 1/5 | R88G-HPG11B05100B□ | 600 | 1.28 | 80 | 1200 | 3.80 | 5.00×10^{-7} | 135 | 538 | 0.3 |
| | 1/11 | R88G-HPG14A11100B□ | 273 | 2.64 | 75 | 546 | 7.84 | 6.00×10^{-6} | 280 | 1119 | 1.0 |
| | 1/21 | R88G-HPG14A21100B□ | 143 | 5.38 | 80 | 286 | 16.0 | 5.00×10^{-6} | 340 | 1358 | 1.0 |
| | 1/33 | R88G-HPG20A33100B□ | 91 | 6.86 | 65 | 182 | 20.4 | 6.50×10^{-6} | 916 | 3226 | 2.4 |
| | 1/45 | R88G-HPG20A45100B□ | 67 | 9.36 | 65 | 134 | 27.8 | 6.50×10^{-6} | 1006 | 3541 | 2.4 |
| 200 W | 1/5 | R88G-HPG14A05200B□ | 600 | 2.50 | 78 | 1200 | 7.45 | 2.07×10^{-5} | 221 | 883 | 1.0 |
| | 1/11 | R88G-HPG14A11200B□ | 273 | 5.98 | 85 | 546 | 17.9 | 1.93×10^{-5} | 280 | 1119 | 1.1 |
| | 1/21 | R88G-HPG20A21200B□ | 143 | 10.2 | 76 | 286 | 30.5 | 4.90×10^{-5} | 800 | 2817 | 2.9 |
| | 1/33 | R88G-HPG20A33200B□ | 91 | 17.1 | 81 | 182 | 51.1 | 4.50×10^{-5} | 916 | 3226 | 2.9 |
| | 1/45 | R88G-HPG20A45200B□ | 67 | 23.3 | 81 | 134 | 69.6 | 4.50×10^{-5} | 1006 | 3541 | 2.9 |

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|------------------|------|---------------------|----------------------|--------------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 400 W | 1/5 | R88G-HPG14A05400B□ | 600 | 5.66 | 87 | 1200 | 16.5 | 2.07×10^{-5} | 221 | 883 | 1.1 |
| | 1/11 | R88G-HPG20A11400B□ | 273 | 11.7 | 82 | 546 | 34.3 | 5.67×10^{-5} | 659 | 2320 | 2.9 |
| | 1/21 | R88G-HPG20A21400B□ | 143 | 23.5 | 86 | 286 | 68.6 | 4.90×10^{-5} | 800 | 2547 | 2.9 |
| | 1/33 | R88G-HPG32A33400B□ | 91 | 34.7 | 81 | 182 | 101.6 | 6.20×10^{-5} | 1565 | 6240 | 7.5 |
| | 1/45 | R88G-HPG32A45400B□ | 67 | 47.4 | 81 | 134 | 138.5 | 6.10×10^{-5} | 1718 | 6848 | 7.5 |
| 750 W (200 V) | 1/5 | R88G-HPG20A05750B□ | 600 | 9.96 | 83 | 1000 | 29.5 | 6.80×10^{-5} | 520 | 1832 | 2.9 |
| | 1/11 | R88G-HPG20A11750B□ | 273 | 20.0 ^{*1} | 88 | 455 | 68.7 | 6.00×10^{-5} | 659 | 2320 | 3.1 |
| | 1/21 | R88G-HPG32A21750B□ | 143 | 42.3 | 84 | 238 | 125.2 | 3.00×10^{-4} | 1367 | 5448 | 7.8 |
| | 1/33 | R88G-HPG32A33750B□ | 91 | 69.7 | 88 | 152 | 206.2 | 2.70×10^{-4} | 1565 | 6240 | 7.8 |
| | 1/45 | R88G-HPG32A45750B□ | 67 | 95.0 | 88 | 112 | 281.2 | 2.70×10^{-4} | 1718 | 6848 | 7.8 |
| 750 W (400 V) | 1/5 | R88G-HPG32A052K0B□ | 600 | 7.65 | 64 | 1000 | 22.9 | 3.90×10^{-4} | 889 | 3542 | 7.4 |
| | 1/11 | R88G-HPG32A112K0B□ | 273 | 20.5 | 78 | 455 | 61.4 | 3.40×10^{-4} | 1126 | 4488 | 7.9 |
| | 1/21 | R88G-HPG32A211K5B□ | 143 | 42.2 | 84 | 238 | 126.3 | 3.00×10^{-4} | 1367 | 5448 | 7.9 |
| | 1/33 | R88G-HPG32A33600SB□ | 91 | 69.4 | 88 | 152 | 207.9 | 2.80×10^{-4} | 1565 | 6240 | 7.9 |
| | 1/45 | R88G-HPG50A451K5B□ | 67 | 90.3 | 84 | 112 | 270.6 | 4.70×10^{-4} | 4538 | 15694 | 19.0 |
| 1 kW | 1/5 | R88G-HPG32A052K0B□ | 600 | 11.4 | 72 | 1000 | 34.4 | 3.90×10^{-4} | 889 | 3542 | 7.4 |
| | 1/11 | R88G-HPG32A112K0B□ | 273 | 29.0 | 83 | 454 | 87.2 | 3.40×10^{-4} | 1126 | 4488 | 7.9 |
| | 1/21 | R88G-HPG32A211K5B□ | 143 | 58.1 | 87 | 238 | 174.5 | 3.00×10^{-4} | 1367 | 5448 | 7.9 |
| | 1/33 | R88G-HPG50A332K0B□ | 91 | 91.3 | 87 | 151 | 274.2 | 4.80×10^{-4} | 4135 | 14300 | 19.0 |
| | 1/45 | R88G-HPG50A451K5B□ | 67 | 124.5 | 87 | 100 ^{*2} | 373.9 | 4.70×10^{-4} | 4538 | 15694 | 19.0 |

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|--------|------|--------------------|----------------------|--------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 1.5 kW | 1/5 | R88G-HPG32A052K0B□ | 600 | 19.1 | 80 | 1000 | 57.2 | 3.90×10^{-4} | 889 | 3542 | 7.4 |
| | 1/11 | R88G-HPG32A112K0B□ | 273 | 45.6 | 87 | 454 | 136.9 | 3.40×10^{-4} | 1126 | 4488 | 7.9 |
| | 1/21 | R88G-HPG32A211K5B□ | 143 | 90.2 | 90 | 238 | 270.3 | 3.00×10^{-4} | 1367 | 5448 | 7.9 |
| | 1/33 | R88G-HPG50A332K0B□ | 91 | 141.7 | 90 | 136 | 424.7 | 4.80×10^{-4} | 4135 | 14300 | 19.0 |
| | 1/45 | R88G-HPG50A451K5B□ | 67 | 193.2 | 90 | 100*2 | 579.2 | 4.70×10^{-4} | 4538 | 15694 | 19.0 |
| 2 kW | 1/5 | R88G-HPG32A052K0B□ | 600 | 26.8 | 84 | 1000 | 80.2 | 3.90×10^{-4} | 889 | 3542 | 7.4 |
| | 1/11 | R88G-HPG32A112K0B□ | 273 | 62.4 | 89 | 454 | 187.0 | 3.40×10^{-4} | 1126 | 4488 | 7.9 |
| | 1/21 | R88G-HPG50A212K0B□ | 143 | 119.1 | 89 | 214*2 | 357.0 | 5.80×10^{-4} | 3611 | 12486 | 19.0 |
| | 1/33 | R88G-HPG50A332K0B□ | 91 | 191.3 | 91 | 136*2 | 573.6 | 4.80×10^{-4} | 4135 | 14300 | 19.0 |
| 3 kW | 1/5 | R88G-HPG32A053K0B□ | 600 | 42.0 | 88 | 1000 | 125.8 | 3.80×10^{-4} | 889 | 3542 | 7.3 |
| | 1/11 | R88G-HPG50A113K0B□ | 273 | 92.4 | 88 | 409*2 | 276.8 | 7.70×10^{-4} | 2974 | 10285 | 19.0 |
| | 1/21 | R88G-HPG50A213K0B□ | 143 | 182.5 | 91 | 214*2 | 546.5 | 5.80×10^{-4} | 3611 | 12486 | 19.0 |
| 4 kW | 1/5 | R88G-HPG32A054K0B□ | 600 | 54.6 | 86 | 900*2 | 164.3 | 3.80×10^{-4} | 889 | 3542 | 7.9 |
| | 1/11 | R88G-HPG50A115K0B□ | 273 | 125.7 | 90 | 409*2 | 378.2 | 8.80×10^{-4} | 2974 | 10285 | 19.1 |
| 5 kW | 1/5 | R88G-HPG50A055K0B□ | 600 | 70.0 | 88 | 900*2 | 209.9 | 1.20×10^{-3} | 2347 | 8118 | 18.6 |
| | 1/11 | R88G-HPG50A115K0B□ | 273 | 159.2 | 91 | 409*2 | 477.5 | 8.80×10^{-4} | 2974 | 10285 | 19.1 |

*1 The value is the maximum continuous output torque of the Reduction Gear. Do not exceed the torque.

*2 The value is the allowable maximum rotation speed of the Reduction Gear. Do not exceed the motor shaft rotation speed over 4,500 r/min.

Note 1 The value given for the reduction gear inertia is the Servomotor shaft conversion value.

2 The protection structure of the Servomotor with the reduction gear meets the requirements of IP44.

3 The value given for the allowable radial load is the value at the center of the shaft (T/2).

4 The standard shaft type is a straight shaft. A model with a key and tap is indicated by adding “J” to the end of the model number (the suffix shown in the box).

● For 2,000-r/min Servomotors

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|--------|------|---------------------|----------------------|--------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 400 W | 1/5 | R88G-HPG32A052K0B□ | 400 | 6.49 | 68 | 600 | 19.5 | 3.90×10^{-4} | 889 | 3542 | 7.4 |
| | 1/11 | R88G-HPG32A112K0B□ | 182 | 16.8 | 80 | 273 | 50.4 | 3.40×10^{-4} | 1126 | 4488 | 7.9 |
| | 1/21 | R88G-HPG32A211K5B□ | 95 | 34.1 | 85 | 143 | 102.3 | 3.00×10^{-4} | 1367 | 5448 | 7.9 |
| | 1/33 | R88G-HPG32A33600SB□ | 60 | 55.5 | 88 | 91 | 166.4 | 2.80×10^{-4} | 1565 | 6240 | 7.9 |
| | 1/45 | R88G-HPG32A45400SB□ | 44 | 73.9 | 86 | 67 | 221.8 | 2.70×10^{-4} | 1718 | 6848 | 7.9 |
| 600 W | 1/5 | R88G-HPG32A052K0B□ | 400 | 11.2 | 78 | 600 | 33.5 | 3.90×10^{-4} | 889 | 3542 | 7.4 |
| | 1/11 | R88G-HPG32A112K0B□ | 182 | 26.7 | 85 | 273 | 80.3 | 3.40×10^{-4} | 1126 | 4488 | 7.9 |
| | 1/21 | R88G-HPG32A211K5B□ | 95 | 53.4 | 89 | 143 | 160.5 | 3.00×10^{-4} | 1367 | 5448 | 7.9 |
| | 1/33 | R88G-HPG32A33600SB□ | 60 | 85.9 | 91 | 91 | 258.0 | 2.80×10^{-4} | 1565 | 6240 | 7.9 |
| | 1/45 | R88G-HPG50A451K5B□ | 44 | 114.5 | 89 | 67 | 344.0 | 4.70×10^{-4} | 4538 | 15694 | 19.0 |
| 1 kW | 1/5 | R88G-HPG32A053K0B□ | 400 | 20.3 | 85 | 600 | 60.8 | 3.90×10^{-4} | 889 | 3542 | 7.3 |
| | 1/11 | R88G-HPG32A112K0SB□ | 182 | 47.2 | 90 | 273 | 141.6 | 3.40×10^{-4} | 1126 | 4488 | 7.8 |
| | 1/21 | R88G-HPG32A211K0SB□ | 95 | 92.2 | 92 | 143 | 276.3 | 2.90×10^{-4} | 1367 | 5448 | 7.8 |
| | 1/33 | R88G-HPG50A332K0SB□ | 60 | 144.8 | 92 | 91 | 434.1 | 4.70×10^{-4} | 4135 | 14300 | 19.0 |
| | 1/45 | R88G-HPG50A451K0SB□ | 44 | 197.5 | 92 | 67 | 592.2 | 4.70×10^{-4} | 4538 | 15694 | 19.0 |
| 1.5 kW | 1/5 | R88G-HPG32A053K0B□ | 400 | 31.8 | 89 | 600 | 95.7 | 3.80×10^{-4} | 889 | 3542 | 7.3 |
| | 1/11 | R88G-HPG32A112K0SB□ | 182 | 72.5 | 92 | 273 | 217.6 | 3.40×10^{-4} | 1126 | 4488 | 7.8 |
| | 1/21 | R88G-HPG50A213K0B□ | 95 | 138.3 | 92 | 143 | 415.4 | 5.80×10^{-4} | 3611 | 12486 | 19.0 |
| | 1/33 | R88G-HPG50A332K0SB□ | 60 | 219.7 | 93 | 91 | 659.8 | 4.70×10^{-4} | 4135 | 14300 | 19.0 |

Note 1 The value given for the reduction gear inertia is the Servomotor shaft conversion value.

2 The protection structure of the Servomotor with the reduction gear meets the requirements of IP44.

3 The value given for the allowable radial load is the value at the center of the shaft (T/2).

4 The standard shaft type is a straight shaft. A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box).

3 Specifications

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|-------|------|---------------------|----------------------|---------------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 2 kW | 1/5 | R88G-HPG32A053K0B□ | 400 | 43.5 | 91 | 600 | 130.6 | 3.80×10^{-4} | 889 | 3542 | 7.3 |
| | 1/11 | R88G-HPG32A112K0SB□ | 182 | 97.7 | 93 | 273 | 293.6 | 3.40×10^{-4} | 1126 | 4488 | 7.8 |
| | 1/21 | R88G-HPG50A213K0B□ | 95 | 186.5 | 93 | 143 | 560.5 | 5.80×10^{-4} | 3611 | 12486 | 19.0 |
| | 1/33 | R88G-HPG50A332K0SB□ | 60 | 270.0 ^{*1} | 93 | 91 | 850.0 ^{*3} | 4.70×10^{-4} | 4135 | 14300 | 19.0 |
| 3 kW | 1/5 | R88G-HPG32A054K0B□ | 400 | 64.4 | 90 | 600 | 197.8 | 3.80×10^{-4} | 889 | 3542 | 7.9 |
| | 1/11 | R88G-HPG50A115K0B□ | 182 | 144.7 | 92 | 273 | 435.2 | 8.80×10^{-4} | 2974 | 10285 | 19.1 |
| | 1/21 | R88G-HPG50A213K0SB□ | 95 | 260.0 ^{*1} | 93 | 143 | 839.8 | 6.90×10^{-4} | 3611 | 12486 | 19.1 |
| | 1/25 | R88G-HPG65A253K0SB□ | 80 | 321.8 | 90 | 120 | 967.5 | 3.00×10^{-3} | 7846 | 28654 | 52.0 |
| 4 kW | 1/5 | R88G-HPG50A055K0SB□ | 400 | 86.9 | 91 | 600 | 260.7 | 1.10×10^{-3} | 2347 | 8118 | 22.0 |
| | 1/11 | R88G-HPG50A115K0SB□ | 182 | 195.4 | 93 | 273 | 586.2 | 8.40×10^{-4} | 2974 | 10285 | 23.5 |
| | 1/20 | R88G-HPG65A205K0SB□ | 100 | 347.6 | 91 | 150 | 1042.9 | 2.85×10^{-3} | 7338 | 26799 | 55.4 |
| | 1/25 | R88G-HPG65A255K0SB□ | 80 | 439.3 | 92 | 120 | 1317.9 | 2.81×10^{-3} | 7846 | 28654 | 55.4 |
| 5 kW | 1/5 | R88G-HPG50A055K0SB□ | 400 | 109.9 | 92 | 600 | 329.4 | 1.10×10^{-3} | 2347 | 8118 | 22.0 |
| | 1/11 | R88G-HPG50A115K0SB□ | 182 | 200.0 ^{*1} | 93 | 273 | 732.5 | 8.40×10^{-4} | 2974 | 10285 | 23.5 |
| | 1/20 | R88G-HPG65A205K0SB□ | 100 | 439.7 | 92 | 150 | 1317.4 | 2.85×10^{-3} | 7338 | 26799 | 55.4 |
| | 1/25 | R88G-HPG65A255K0SB□ | 80 | 555.7 | 93 | 120 | 1664.7 | 2.81×10^{-3} | 7846 | 28654 | 55.4 |

*1 The value is the maximum continuous output torque of the Reduction Gear. Do not exceed the torque.

*2 The value is the allowable maximum rotation speed of the Reduction Gear. Do not exceed the motor shaft rotation speed over 4,500 r/min.

*3 The value is the maximum allowable torque of the Reduction Gear. Do not exceed the torque.

Note 1 The value given for the reduction gear inertia is the Servomotor shaft conversion value.

2 The protection structure of the Servomotor with the reduction gear meets the requirements of IP44.

3 The value given for the allowable radial load is the value at the center of the shaft (LR/2).

4 The standard shaft type is a straight shaft. A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box).

● For 1,000-r/min Servomotors

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|-------|------|---------------------|----------------------|---------------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 900 W | 1/5 | R88G-HPG32A05900TB□ | 200 | 39.9 | 93 | 400 | 89.7 | 3.80×10^{-4} | 889 | 3542 | 7.9 |
| | 1/11 | R88G-HPG32A11900TB□ | 90 | 88.8 | 94 | 182 | 199.6 | 3.40×10^{-4} | 1126 | 4488 | 8.4 |
| | 1/21 | R88G-HPG50A21900TB□ | 47 | 169.6 | 94 | 95 | 381.0 | 7.00×10^{-4} | 3611 | 12486 | 19.1 |
| | 1/33 | R88G-HPG50A33900TB□ | 30 | 266.5 | 94 | 60 | 598.7 | 5.90×10^{-4} | 4135 | 14300 | 19.1 |
| 2 kW | 1/5 | R88G-HPG32A052K0TB□ | 200 | 90.7 | 95 | 400 | 226.6 | 4.90×10^{-4} | 889 | 3542 | 8.90 |
| | 1/11 | R88G-HPG50A112K0TB□ | 90 | 197.5 | 94 | 182 | 493.2 | 8.40×10^{-4} | 2974 | 10285 | 20.1 |
| | 1/21 | R88G-HPG50A212K0TB□ | 47 | 260.0 ^{*1} | 95 | 95 | 850.0 ^{*1} | 6.50×10^{-3} | 3611 | 12486 | 20.1 |
| | 1/25 | R88G-HPG65A255K0SB□ | 40 | 448.9 | 94 | 80 | 1121.0 | 2.81×10^{-3} | 7846 | 28654 | 55.4 |
| 3 kW | 1/5 | R88G-HPG50A055K0SB□ | 200 | 134.9 | 94 | 400 | 337.0 | 1.10×10^{-3} | 2347 | 8118 | 22.0 |
| | 1/11 | R88G-HPG50A115K0SB□ | 90 | 246.0 ^{*1} | 95 | 182 | 749.3 | 8.40×10^{-4} | 2974 | 10285 | 23.5 |
| | 1/20 | R88G-HPG65A205K0SB□ | 50 | 539.6 | 94 | 100 | 1348.0 | 2.85×10^{-3} | 7338 | 26799 | 55.4 |
| | 1/25 | R88G-HPG65A255K0SB□ | 40 | 674.5 | 94 | 80 | 1684.9 | 2.81×10^{-3} | 7846 | 28654 | 55.4 |

*1 The value is the maximum continuous output torque of the Reduction Gear. Do not exceed the torque.

Note 1 The value given for the reduction gear inertia is the Servomotor shaft conversion value.

2 The protection structure of the Servomotor with the reduction gear meets the requirements of IP44.

3 The value given for the allowable radial load is the value at the center of the shaft (T/2).

4 The standard shaft type is a straight shaft. A model with a key and tap is indicated by adding "J" to the end of the model number (the suffix shown in the box).

15 Arcminutes Max.

● For 3,000-r/min Servomotors

| Model | | | Rated rotation speed | Rated torque | Efficiency | Momentary maximum rotation speed | Momentary maximum torque | Reduction gear inertia | Allowable radial load | Allowable thrust load | Weight |
|-------|------|-------------------|----------------------|--------------|------------|----------------------------------|--------------------------|------------------------|-----------------------|-----------------------|--------|
| | | | r/min | N·m | % | r/min | N·m | kg·m ² | N | N | kg |
| 50 W | 1/5 | R88G-VRSF05B100CJ | 600 | 0.52 | 65 | 1000 | 1.56 | 4.00×10^{-6} | 392 | 196 | 0.55 |
| | 1/9 | R88G-VRSF09B100CJ | 333 | 0.94 | 65 | 556 | 2.81 | 3.50×10^{-6} | 441 | 220 | 0.55 |
| | 1/15 | R88G-VRSF15B100CJ | 200 | 1.68 | 70 | 333 | 5.04 | 3.50×10^{-6} | 588 | 294 | 0.70 |
| | 1/25 | R88G-VRSF25B100CJ | 120 | 2.80 | 70 | 200 | 8.40 | 3.25×10^{-6} | 686 | 343 | 0.70 |
| 100 W | 1/5 | R88G-VRSF05B100CJ | 600 | 1.20 | 75 | 1000 | 3.56 | 4.00×10^{-6} | 392 | 196 | 0.55 |
| | 1/9 | R88G-VRSF09B100CJ | 333 | 2.30 | 80 | 556 | 6.84 | 3.50×10^{-6} | 441 | 220 | 0.55 |
| | 1/15 | R88G-VRSF15B100CJ | 200 | 3.84 | 80 | 333 | 11.4 | 3.50×10^{-6} | 588 | 294 | 0.70 |
| | 1/25 | R88G-VRSF25B100CJ | 120 | 6.40 | 80 | 200 | 19.0 | 3.25×10^{-6} | 686 | 343 | 0.70 |
| 200 W | 1/5 | R88G-VRSF05B200CJ | 600 | 2.72 | 85 | 1000 | 8.12 | 1.18×10^{-5} | 392 | 196 | 0.72 |
| | 1/9 | R88G-VRSF09C200CJ | 333 | 3.80 | 66 | 556 | 11.3 | 2.75×10^{-5} | 931 | 465 | 1.70 |
| | 1/15 | R88G-VRSF15C200CJ | 200 | 6.34 | 66 | 333 | 18.9 | 3.00×10^{-5} | 1176 | 588 | 2.10 |
| | 1/25 | R88G-VRSF25C200CJ | 120 | 11.2 | 70 | 200 | 33.4 | 2.88×10^{-5} | 1323 | 661 | 2.10 |
| 400 W | 1/5 | R88G-VRSF05C400CJ | 600 | 5.40 | 85 | 1000 | 15.6 (15.3) | 3.63×10^{-5} | 784 | 392 | 1.70 |
| | 1/9 | R88G-VRSF09C400CJ | 333 | 9.50 | 83 | 556 | 27.4 (26.8) | 2.75×10^{-5} | 931 | 465 | 1.70 |
| | 1/15 | R88G-VRSF15C400CJ | 200 | 15.8 | 83 | 333 | 45.7 (44.8) | 3.00×10^{-5} | 1176 | 588 | 2.10 |
| | 1/25 | R88G-VRSF25C400CJ | 120 | 26.4 | 83 | 200 | 76.1 (74.7) | 2.88×10^{-5} | 1323 | 661 | 2.10 |
| 750 W | 1/5 | R88G-VRSF05C750CJ | 600 | 10.7 | 90 | 1000 | 31.7 | 7.13×10^{-5} | 784 | 392 | 2.10 |
| | 1/9 | R88G-VRSF09D750CJ | 333 | 18.2 | 85 | 556 | 53.9 | 6.50×10^{-5} | 1176 | 588 | 3.40 |
| | 1/15 | R88G-VRSF15D750CJ | 200 | 30.4 | 85 | 333 | 89.9 | 7.00×10^{-5} | 1372 | 686 | 3.80 |
| | 1/25 | R88G-VRSF25D750CJ | 120 | 50.7 | 85 | 200 | 149.8 | 6.80×10^{-5} | 1617 | 808 | 3.80 |

Note 1 The value in the brackets indicates the value of the Servomotor with 100-V power supply.

2 The value given for the reduction gear inertia is the Servomotor shaft conversion value.

3 The protection structure of the Servomotor with the reduction gear meets the requirements of IP44.

4 The value given for the allowable radial load is the value at the center of the shaft (T/2).

5 The standard shaft type is a straight shaft.

6 The allowable input rotation speed of the Reduction Gear is 5,000 r/min.
Do not exceed the limit.

3-5 Cable and Connector Specifications

The specifications of the cables to connect Servo Drives and Servomotors are shown below. The information on the cable types are also provided.

Select the optimum cable according to the Servomotor.

3-5-1 Bend Radius of Robot Cable

If the cable is used at a moving part, use a robot cable.

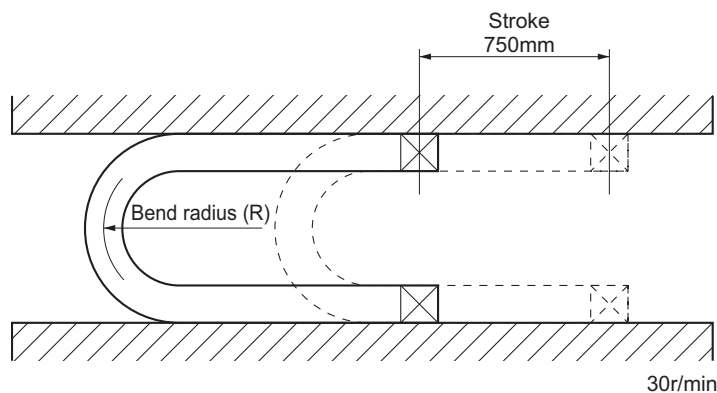
For bend radius limit of robot cable, the wire rod with the durability of more than 20 million times of use is used.



Precautions for Correct Use

- As for the limit data of bend radius durability is reference only, use cables with margin.
- The data of the minimum bend radius indicates the number of cracks or scratches that occur on sheath through the functional flow, and does not cover the disconnection of shielded wire.
- Malfunction or grounding fault may be occurred by dielectric breakdown if cables are used with a smaller radius of the minimum bend radius.

Moving Flexural Testing



Note The following shows the stroke in some parts of the model.

| | |
|-------------------------|----------|
| R88A-CRK□ | : 500mm |
| R88A-CAKA□SR | : 1000mm |
| R88A-CAKA□BR (3 to 20m) | : 1000mm |

Encoder Cables

| Model | Minimum bending radius (R) |
|------------------------------|----------------------------|
| R88A-CRKA□□□CR ^{*1} | 33 mm |
| R88A-CRKA△△△CR ^{*2} | 48 mm |
| R88A-CRKC□□□NR ^{*1} | 42 mm |
| R88A-CRKC△△△NR ^{*2} | 48 mm |

*1 Numbers 003 to 020 are indicated in □□□.

*2 Numbers 030 to 050 are indicated in △△△.

Power Cables without Brakes

| Model | Minimum bending radius (R) |
|------------------------------|----------------------------|
| R88A-CAKA□□□SR ^{*1} | 40 mm |
| R88A-CAGB□□□SR ^{*1} | 90 mm |
| R88A-CAGD□□□SR ^{*1} | 100 mm |

*1 Numbers 003 to 020 are indicated in □□□.

Power Cables with Brakes

| Model | Cable types | Minimum bending radius (R) |
|------------------------------|--------------|----------------------------|
| R88A-CAGB□□□BR ^{*1} | Power Cables | 90 mm |
| | Brake Cables | 45 mm |
| R88A-CAKF□□□BR ^{*1} | Power Cables | 90 mm |
| | Brake Cables | 45 mm |
| R88A-CAGD□□□BR ^{*1} | Power Cables | 100 mm |
| | Brake Cables | 45 mm |

*1 Numbers 003 to 020 are indicated in □□□.

Brake Cables

| Model | Minimum bending radius (R) |
|------------------------------|----------------------------|
| R88A-CAKA□□□BR ^{*1} | 30 mm |
| R88A-CAKA△△△BR ^{*2} | 45 mm |

*1 Numbers 003 to 020 are indicated in □□□.

*2 Numbers 030 to 050 are indicated in △△△.

3-5-2 Encoder Cable Specifications

These cables are used to connect the encoder between the Servo Drive and the Servomotor. Select the cable matching the Servomotor.

Encoder Cables (Standard Cable)

● R88A-CRKA□C

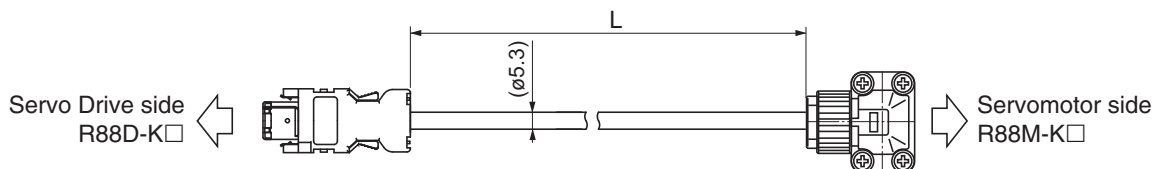
Cable types

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

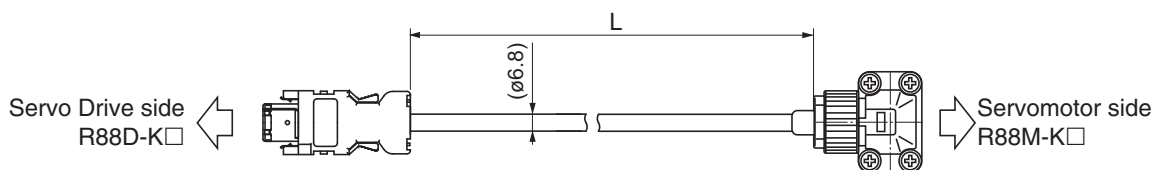
| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|----------------|
| R88A-CRKA003C | 3 m | ø5.3 | Approx. 0.1 kg |
| R88A-CRKA005C | 5 m | | Approx. 0.2 kg |
| R88A-CRKA010C | 10 m | | Approx. 0.4 kg |
| R88A-CRKA015C | 15 m | | Approx. 0.6 kg |
| R88A-CRKA020C | 20 m | | Approx. 0.8 kg |
| R88A-CRKA030C | 30 m | ø6.8 | Approx. 2.4 kg |
| R88A-CRKA040C | 40 m | | Approx. 3.2 kg |
| R88A-CRKA050C | 50 m | | Approx. 4.0 kg |

Connection configuration and external dimensions

[R88A-CRKA□C : 3 to 20m]



[R88A-CRKA□C : 30 to 50m]

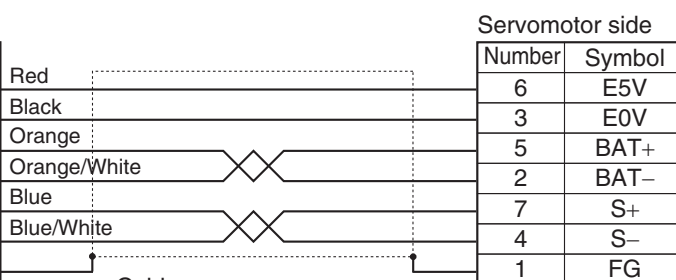


Wiring

Servo Drive side

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

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



Cable
AWG22×2C + AWG24×2P
UL20276 (3~20m)
AWG16×2C + AWG26×2P
UL20276 (30~50m)

Servomotor side

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

[Servomotor side connector]
Angle clamp model
JN6FR07SM1 (Japan Aviation Electronics)
Connector pin model
LY10-C1-A1-10000 (Japan Aviation Electronics)

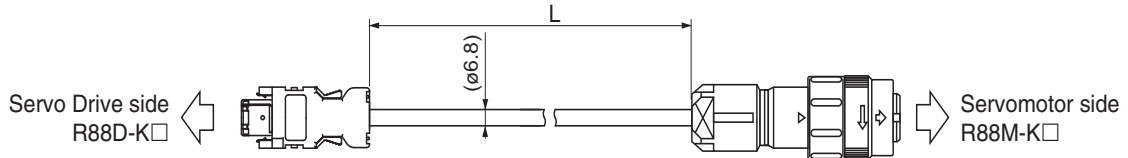
● **R88A-CRKC□N**

Cable types

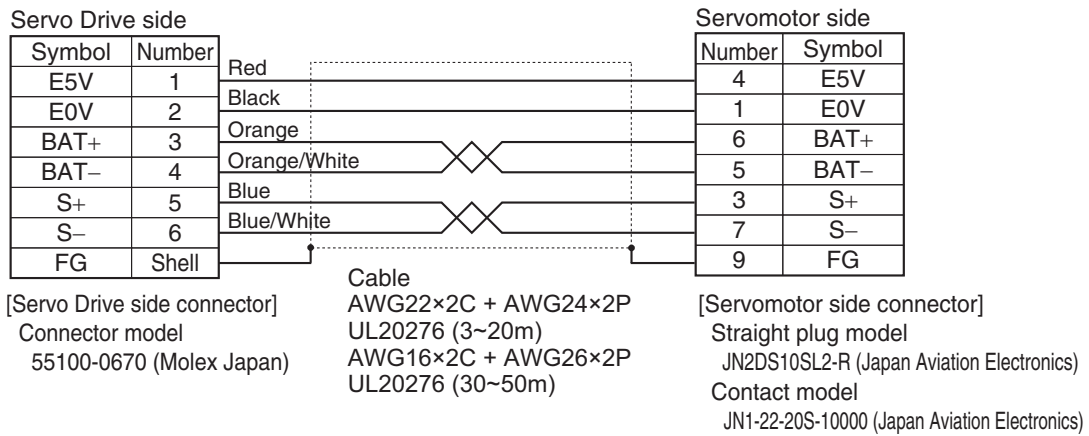
(For both absolute encoders and incremental encoders: [100 V and 200 V] For 3,000-r/min Servomotors of 1 kW or more, [400 V] 3,000-r/min Servomotors, 2,000-r/min Servomotors and 1,000-r/min Servomotors)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|----------------|
| R88A-CRKC003N | 3 m | ø6.8 | Approx. 0.2 kg |
| R88A-CRKC005N | 5 m | | Approx. 0.4 kg |
| R88A-CRKC010N | 10 m | | Approx. 0.7 kg |
| R88A-CRKC015N | 15 m | | Approx. 1.1 kg |
| R88A-CRKC020N | 20 m | | Approx. 1.4 kg |
| R88A-CRKC030N | 30 m | | Approx. 2.4 kg |
| R88A-CRKC040N | 40 m | | Approx. 3.2 kg |
| R88A-CRKC050N | 50 m | | Approx. 4.0 kg |

Connection configuration and external dimensions



Wiring



Encoder Cables (Robot Cable)

● R88A-CRKA□CR

Cable types

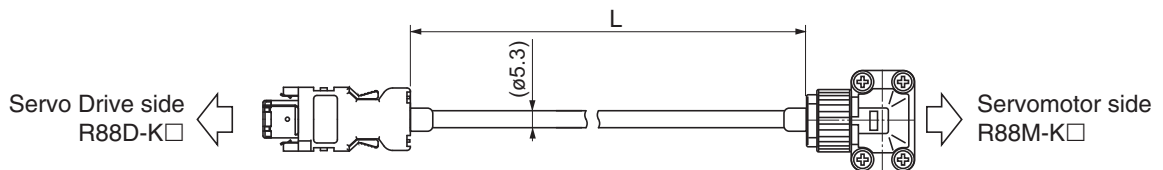
(For both absolute encoders and incremental encoders: [100 V and 200 V] For 3,000-r/min Servomotors of 50 to 750 W)

| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) ^{*1} | Weight |
|----------------|------------|--------------------------|--|----------------|
| R88A-CRKA003CR | 3m | ø5.3 | 33mm | Approx. 0.1 kg |
| R88A-CRKA005CR | 5m | | | Approx. 0.2 kg |
| R88A-CRKA010CR | 10m | | | Approx. 0.4 kg |
| R88A-CRKA015CR | 15m | | | Approx. 0.6 kg |
| R88A-CRKA020CR | 20m | | | Approx. 0.8 kg |
| R88A-CRKA030CR | 30m | ø7.7 | 48mm | Approx. 3.0 kg |
| R88A-CRKA040CR | 40m | | | Approx. 4.0 kg |
| R88A-CRKA050CR | 50m | | | Approx. 5.0 kg |

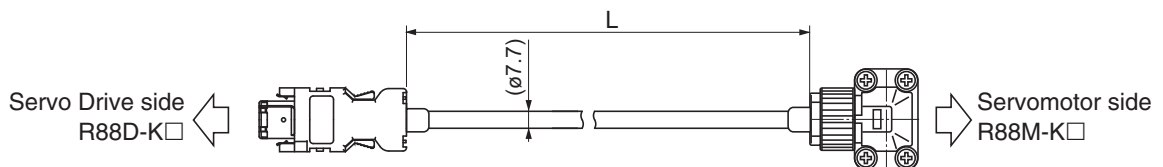
*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions

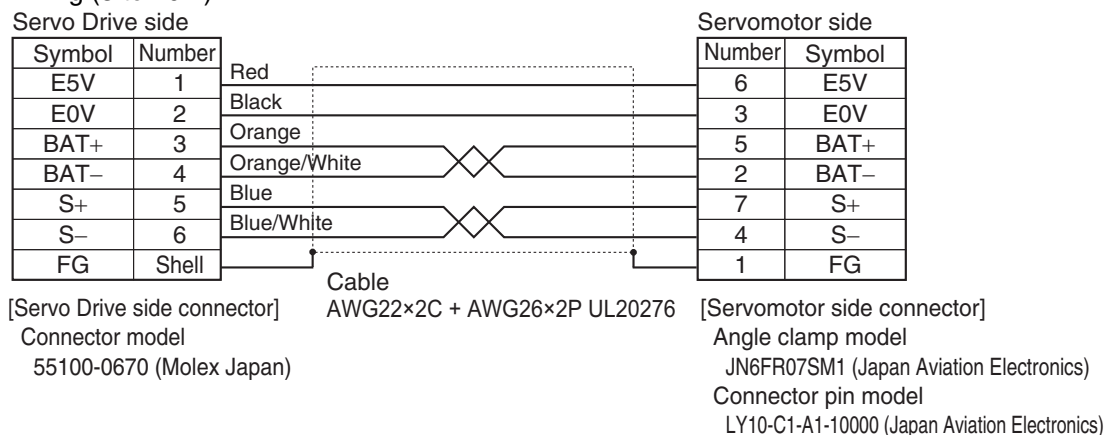
[R88A-CRKA□CR : 3 to 20m]



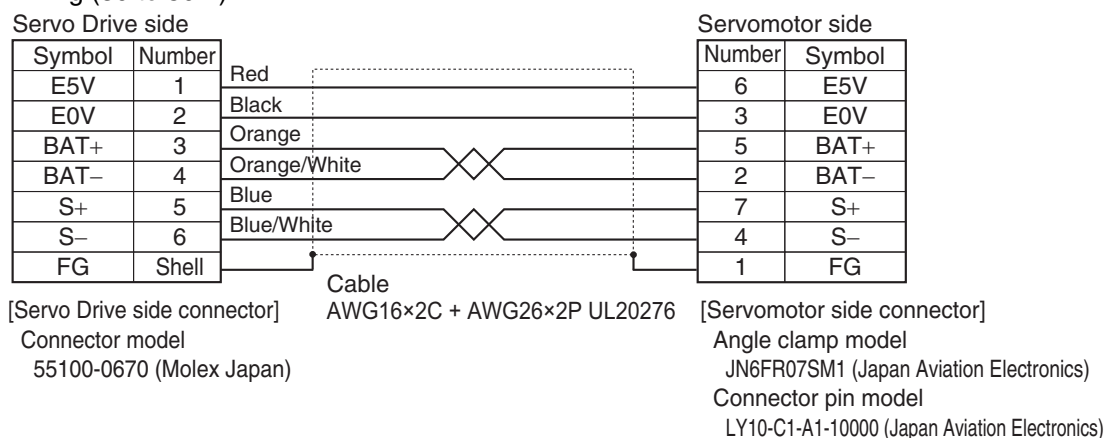
[R88A-CRKA□CR : 30 to 50m]



Wiring (3 to 20m)



Wiring (30 to 50m)



● R88A-CRKC□NR

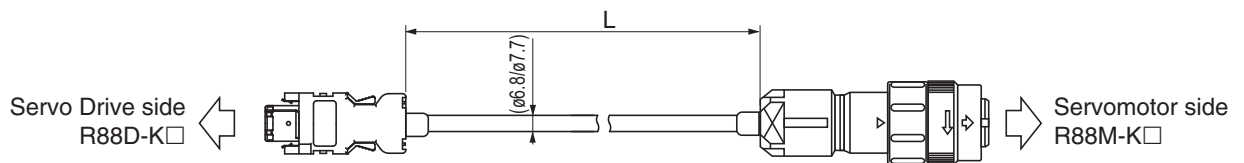
Cable types

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

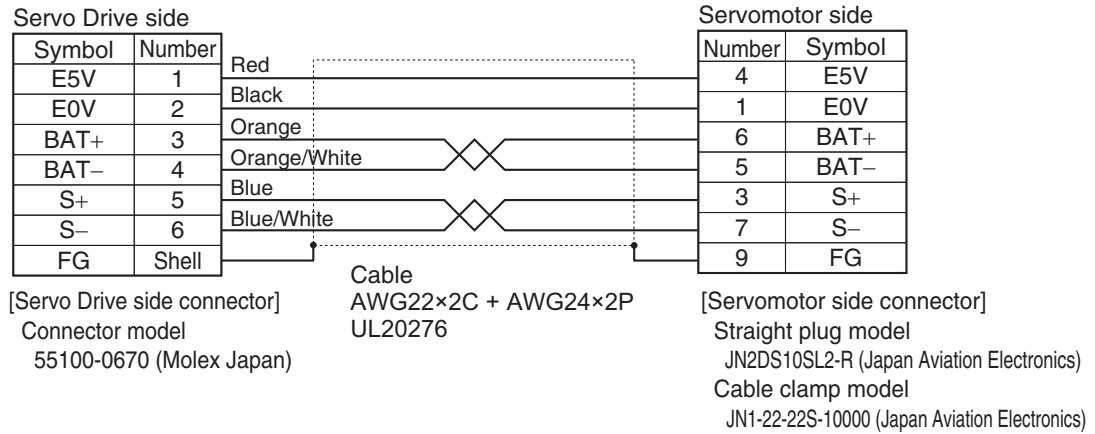
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) ^{*1} | Weight |
|----------------|------------|--------------------------|--|----------------|
| R88A-CRKC003NR | 3 m | ø6.8 | 42 mm | Approx. 0.2 kg |
| R88A-CRKC005NR | 5 m | | | Approx. 0.4 kg |
| R88A-CRKC010NR | 10 m | | | Approx. 0.7 kg |
| R88A-CRKC015NR | 15 m | | | Approx. 1.1 kg |
| R88A-CRKC020NR | 20 m | | | Approx. 5.0 kg |
| R88A-CRKC030NR | 30 m | ø7.7 | 48 mm | Approx. 3.0 kg |
| R88A-CRKC040NR | 40 m | | | Approx. 4.0 kg |
| R88A-CRKC050NR | 50 m | | | Approx. 5.0 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

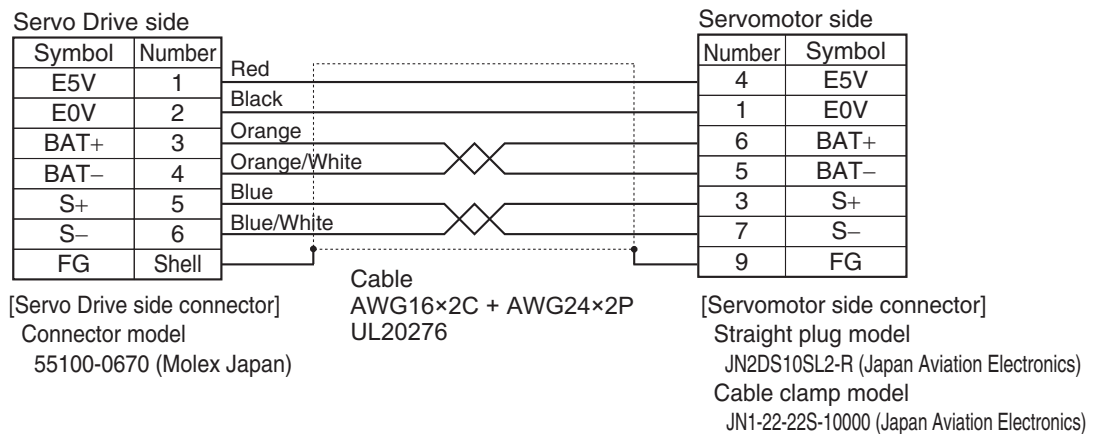
Connection configuration and external dimensions



Wiring (3 to 20m)



Wiring (30 to 50m)



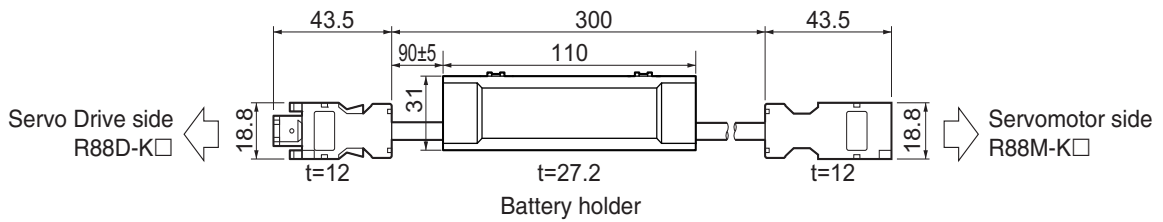
3-5-3 Absolute Encoder Battery Cable Specifications

Use the following Cable when using an absolute encoder.

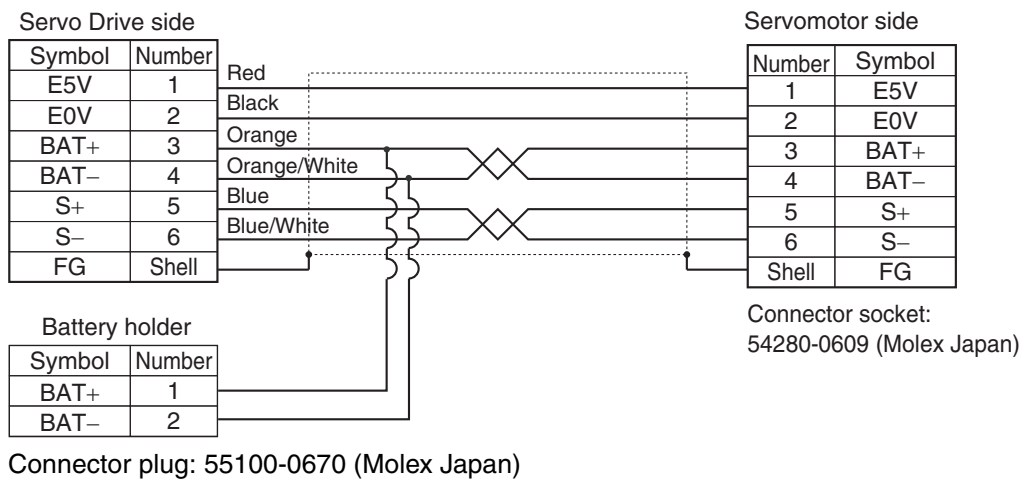
Cable Model

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

Connection Configuration and External Dimensions



Wiring



3-5-4 Motor Power Cable Specifications

These cables connect the Servo Drive and the Servomotor. Select the cable matching the Servomotor.



Precautions for Correct Use

If the cable is used at a moving part, use a robot cable.

Power Cables without Brakes (Standard Cable)

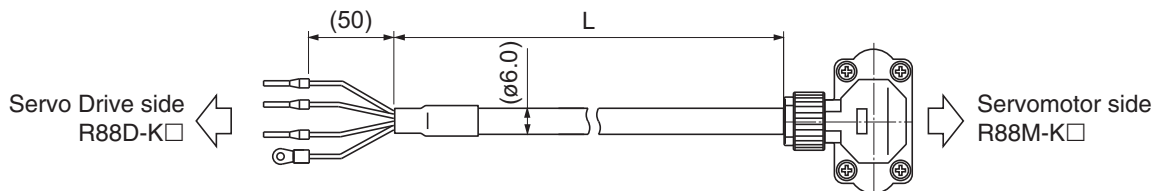
● R88A-CAKA□S

Cable types

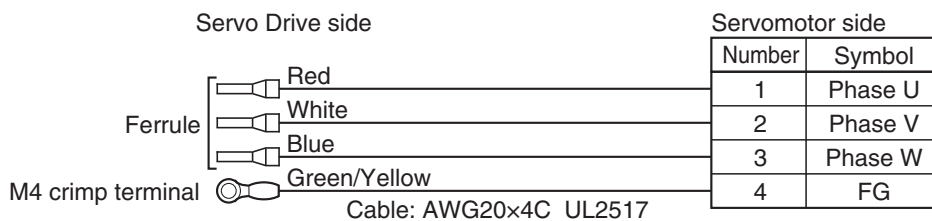
[100 V and 200 V] (For 3,000-r/min Servomotors of 50 to 750 W)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|----------------|
| R88A-CAKA003S | 3 m | ø6.0 | Approx. 0.2 kg |
| R88A-CAKA005S | 5 m | | Approx. 0.3 kg |
| R88A-CAKA010S | 10 m | | Approx. 0.5 kg |
| R88A-CAKA015S | 15 m | | Approx. 0.8 kg |
| R88A-CAKA020S | 20 m | | Approx. 1.1 kg |
| R88A-CAKA030S | 30 m | | Approx. 1.6 kg |
| R88A-CAKA040S | 40 m | | Approx. 2.1 kg |
| R88A-CAKA050S | 50 m | | Approx. 2.6 kg |

Connection configuration and external dimensions



Wiring



[Servomotor side connector]

Angle plug model

JN8FT04SJ1 (Japan Aviation Electronics)

Connector pin model

ST-TMH-S-C1B-3500-A534G (Japan Aviation Electronics)

● **R88A-CAGB□S**

Cable types

200 V:

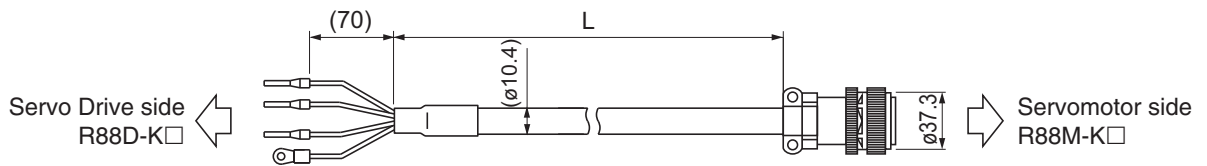
(For 3,000-r/min Servomotors of 1 to 2 kW, 2,000-r/min Servomotors of 1 to 2 kW, 1,000-r/min Servomotors of 900 W)

400 V:

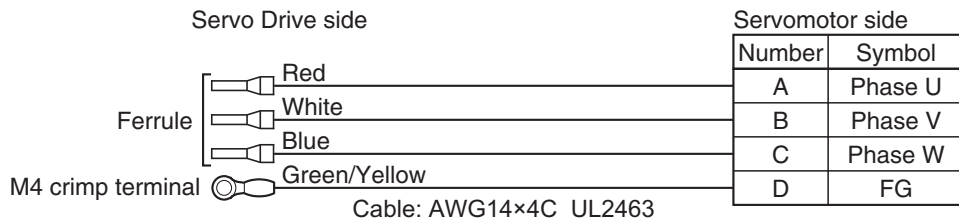
(For 3,000-r/min Servomotors of 750 W to 2 kW, 2,000-r/min Servomotors of 400 W to 2 kW, 1,000-r/min Servomotors of 900 W)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|----------------|
| R88A-CAGB003S | 3 m | ø10.4 | Approx. 0.7 kg |
| R88A-CAGB005S | 5 m | | Approx. 1.0 kg |
| R88A-CAGB010S | 10 m | | Approx. 2.0 kg |
| R88A-CAGB015S | 15 m | | Approx. 2.9 kg |
| R88A-CAGB020S | 20 m | | Approx. 3.8 kg |
| R88A-CAGB030S | 30 m | | Approx. 5.6 kg |
| R88A-CAGB040S | 40 m | | Approx. 7.4 kg |
| R88A-CAGB050S | 50 m | | Approx. 9.2 kg |

Connection configuration and external dimensions



Wiring



[Servomotor side connector]

Straight plug model

N/MS3106B20-4S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-12A (Japan Aviation Electronics)

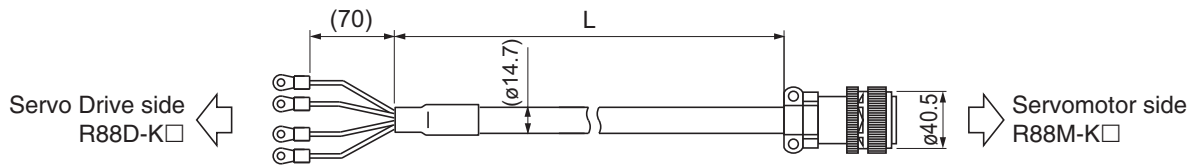
● **R88A-CAGD□S**

Cable types

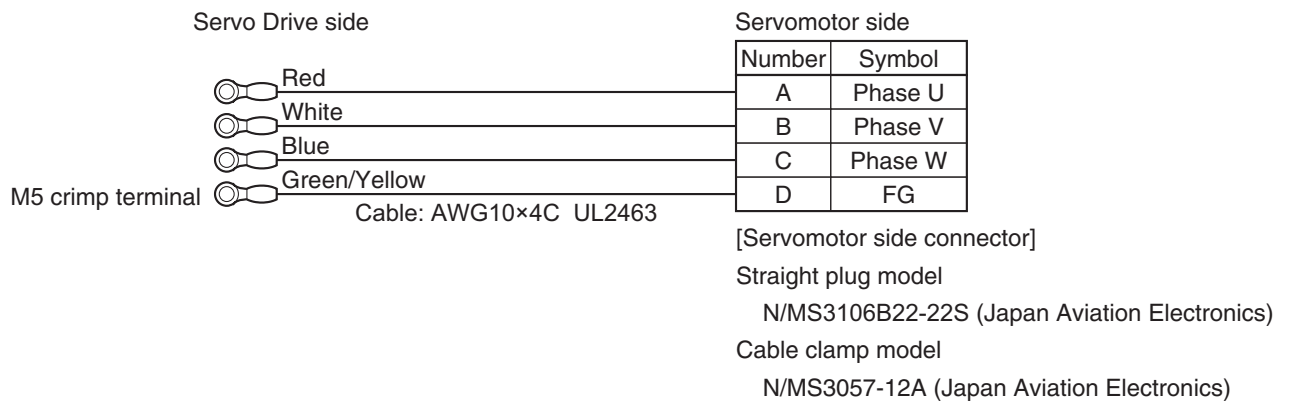
(For 3,000-r/min Servomotors of 3 to 5 kW, 2,000-r/min Servomotors of 3 to 5 kW, 1,000-r/min Servomotors of 2 to 4.5 kW)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|-----------------|
| R88A-CAGD003S | 3 m | ø14.7 | Approx. 1.3 kg |
| R88A-CAGD005S | 5 m | | Approx. 2.1 kg |
| R88A-CAGD010S | 10 m | | Approx. 4.0 kg |
| R88A-CAGD015S | 15 m | | Approx. 6.0 kg |
| R88A-CAGD020S | 20 m | | Approx. 8.0 kg |
| R88A-CAGD030S | 30 m | | Approx. 11.9 kg |
| R88A-CAGD040S | 40 m | | Approx. 15.8 kg |
| R88A-CAGD050S | 50 m | | Approx. 19.7 kg |

Connection configuration and external dimensions



Wiring



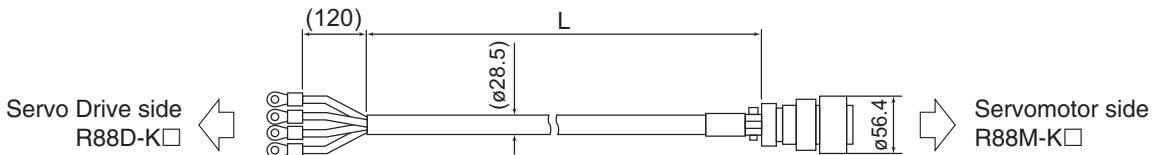
● **R88A-CAGE□S**

Cable types

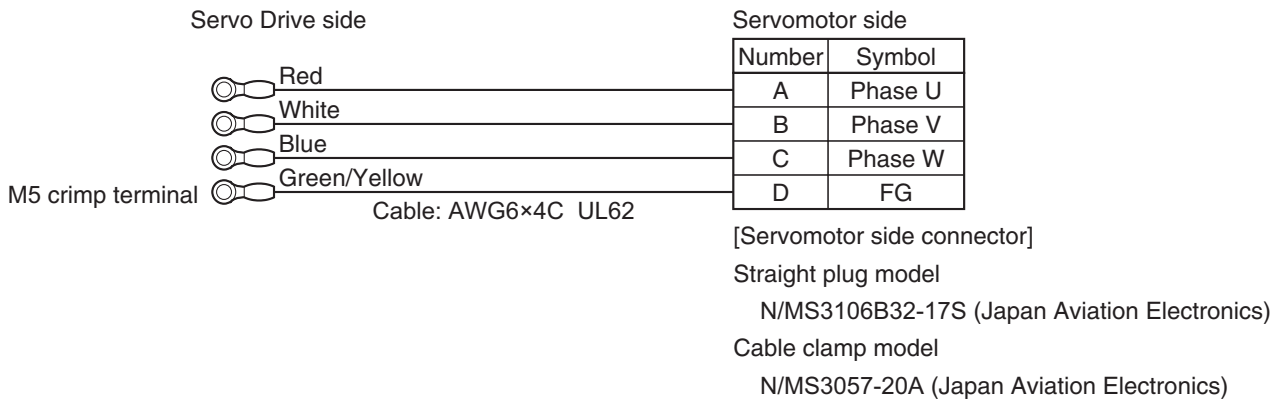
(For 2,000-r/min Servomotors of 7.5 kW, 1,000-r/min Servomotors of 6 kW)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|-----------------|
| R88A-CAGE003S | 3 m | ø28.5 | Approx. 4.0 kg |
| R88A-CAGE005S | 5 m | | Approx. 6.5 kg |
| R88A-CAGE010S | 10 m | | Approx. 12.6 kg |
| R88A-CAGE015S | 15 m | | Approx. 18.8 kg |
| R88A-CAGE020S | 20 m | | Approx. 24.9 kg |
| R88A-CAGE030S | 30 m | | Approx. 37.2 kg |
| R88A-CAGE040S | 40 m | | Approx. 49.5 kg |
| R88A-CAGE050S | 50 m | | Approx. 61.8 kg |

Connection configuration and external dimensions



Wiring



Power Cables without Brakes (Robot Cable)

● R88A-CAKA□SR

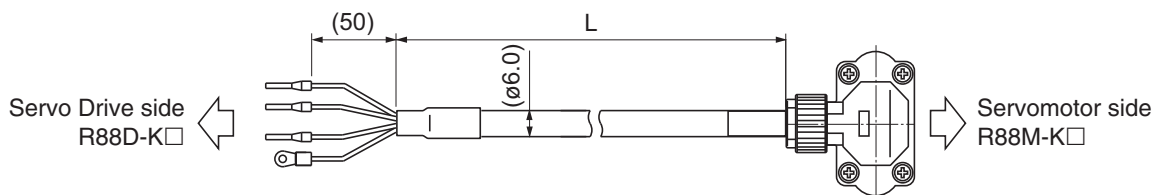
Cable types

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

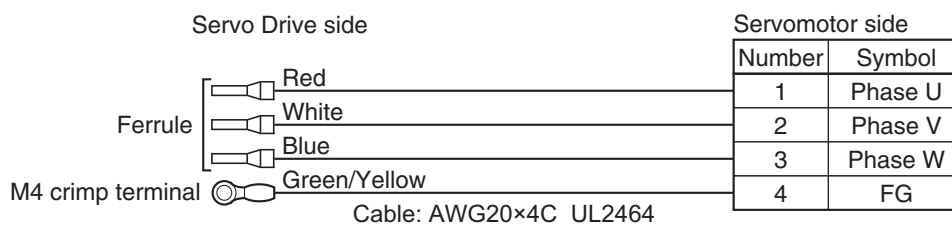
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|-------------------------------|----------------|
| R88A-CAKA003SR | 3 m | ø6.0 | 40 mm | Approx. 0.2 kg |
| R88A-CAKA005SR | 5 m | | | Approx. 0.3 kg |
| R88A-CAKA010SR | 10 m | | | Approx. 0.6 kg |
| R88A-CAKA015SR | 15 m | | | Approx. 0.9 kg |
| R88A-CAKA020SR | 20 m | | | Approx. 1.2 kg |
| R88A-CAKA030SR | 30 m | | | Approx. 1.7 kg |
| R88A-CAKA040SR | 40 m | | | Approx. 2.3 kg |
| R88A-CAKA050SR | 50 m | | | Approx. 2.9 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



[Servomotor side connector]

Angle plug model

JN8FT04SJ1 (Japan Aviation Electronics)

Connector pin model

ST-TMH-S-C1B-3500-A534G

(Japan Aviation Electronics)

● **R88A-CAGB□SR**

Cable types

200 V:

(For 3,000-r/min Servomotors of 1 to 2 kW, 2,000-r/min Servomotors of 1 to 2 kW, 1,000-r/min Servomotors of 900 W)

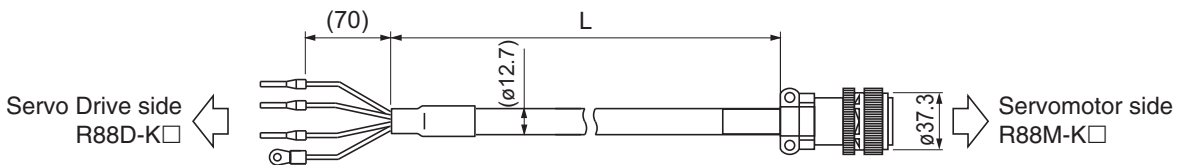
400 V:

(For 3,000-r/min Servomotors of 750W to 2 kW, 2,000-r/min Servomotors of 400 W to 2 kW, 1,000-r/min Servomotors of 900 W)

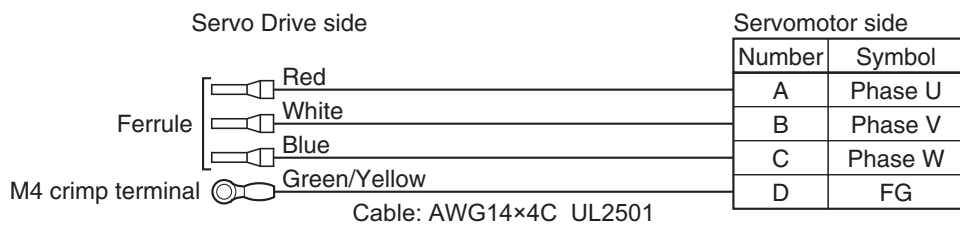
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|-------------------------------|-----------------|
| R88A-CAGB003SR | 3 m | ø12.7 | 90 mm | Approx. 0.8 kg |
| R88A-CAGB005SR | 5 m | | | Approx. 1.3 kg |
| R88A-CAGB010SR | 10 m | | | Approx. 2.4 kg |
| R88A-CAGB015SR | 15 m | | | Approx. 3.5 kg |
| R88A-CAGB020SR | 20 m | | | Approx. 4.6 kg |
| R88A-CAGB030SR | 30 m | | | Approx. 6.9 kg |
| R88A-CAGB040SR | 40 m | | | Approx. 19.2 kg |
| R88A-CAGB050SR | 50 m | | | Approx. 11.4 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



[Servomotor side connector]

Straight plug model

N/MS3106B20-4S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-12A (Japan Aviation Electronics)

● **R88A-CAGD□SR**

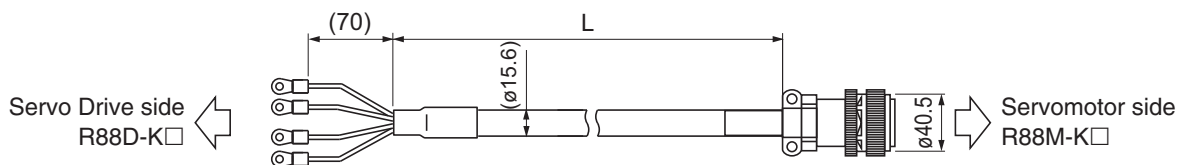
Cable types

(For 3,000-r/min Servomotors of 3 to 5 kW, 2,000-r/min Servomotors of 3 to 5 kW, 1,000-r/min Servomotors of 2 to 4.5 kW)

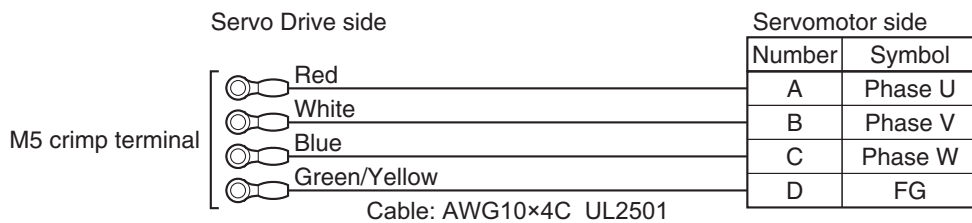
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|-------------------------------|-----------------|
| R88A-CAGD003SR | 3 m | ø15.6 | 100 mm | Approx. 1.4 kg |
| R88A-CAGD005SR | 5 m | | | Approx. 2.2 kg |
| R88A-CAGD010SR | 10 m | | | Approx. 4.2 kg |
| R88A-CAGD015SR | 15 m | | | Approx. 6.3 kg |
| R88A-CAGD020SR | 20 m | | | Approx. 8.3 kg |
| R88A-CAGD030SR | 30 m | | | Approx. 12.4 kg |
| R88A-CAGD040SR | 40 m | | | Approx. 16.4 kg |
| R88A-CAGD050SR | 50 m | | | Approx. 20.5 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



[Servomotor side connector]

Straight plug model

N/MS3106B22-22S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-12A (Japan Aviation Electronics)

Power Cables with Brakes (Standard Cable)

● R88A-CAGB□B

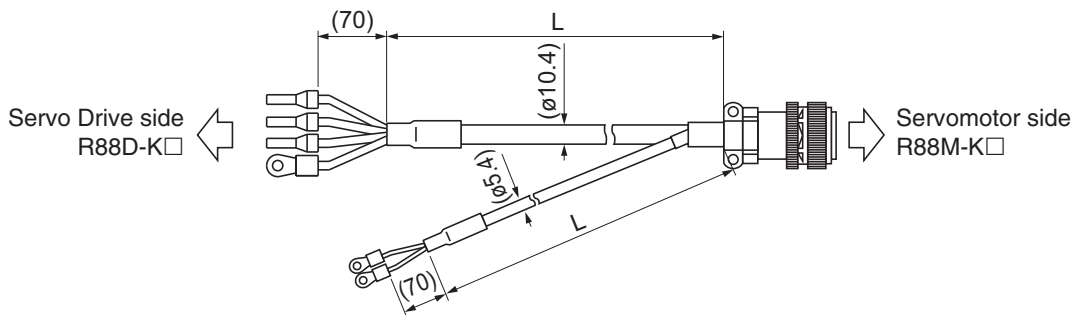
Cable types

200 V:

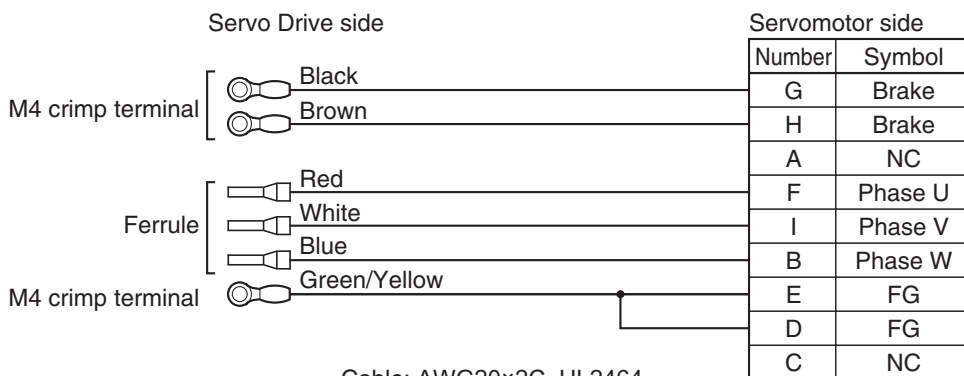
(For 3,000-r/min Servomotors of 1 to 2 kW, 2,000-r/min Servomotors of 1 to 2 kW, 1,000-r/min Servomotors of 900 W)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|-----------------|
| R88A-CAGB003B | 3 m | ø10.4/ø5.4 | Approx. 0.8 kg |
| R88A-CAGB005B | 5 m | | Approx. 1.3 kg |
| R88A-CAGB010B | 10 m | | Approx. 2.4 kg |
| R88A-CAGB015B | 15 m | | Approx. 3.5 kg |
| R88A-CAGB020B | 20 m | | Approx. 4.6 kg |
| R88A-CAGB030B | 30 m | | Approx. 6.8 kg |
| R88A-CAGB040B | 40 m | | Approx. 9.1 kg |
| R88A-CAGB050B | 50 m | | Approx. 11.3 kg |

Connection configuration and external dimensions



Wiring



Cable: AWG20×2C UL2464

Cable: AWG14×4C UL2463

[Servomotor side connector]

Straight plug model

N/MS3106B20-18S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-12A (Japan Aviation Electronics)

● **R88A-CAKF□B**

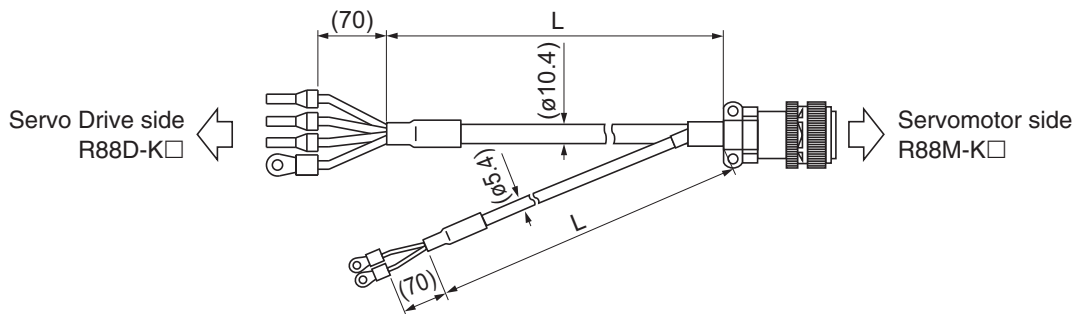
Cable types

400 V:

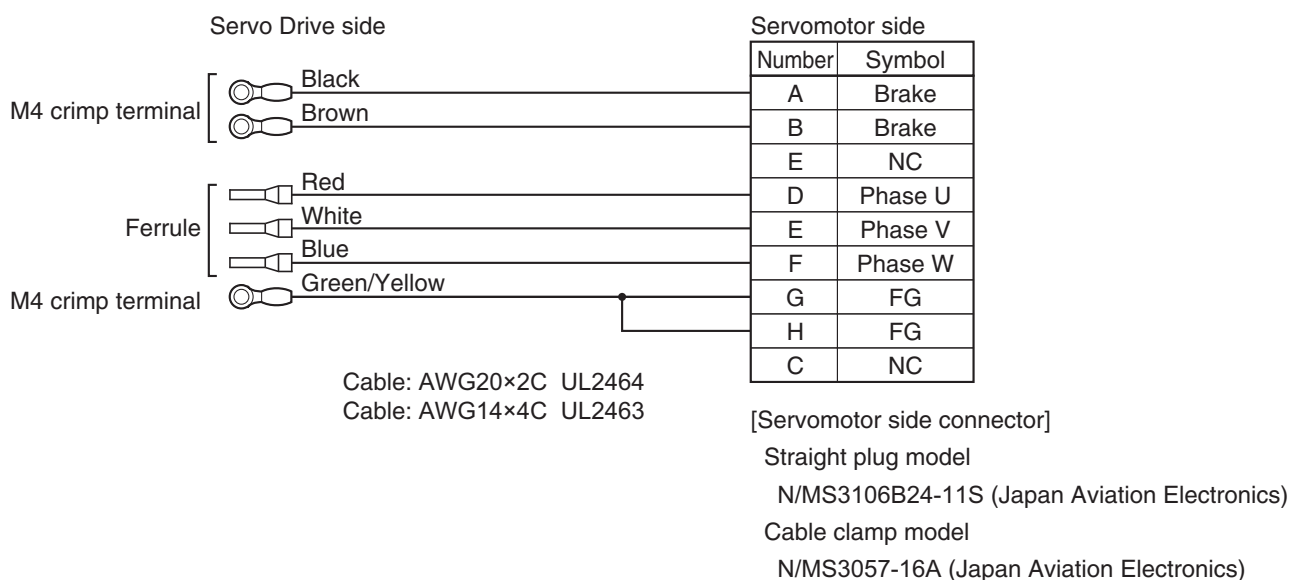
(For 3,000-r/min Servomotors of 750 W to 2 kW, 2,000-r/min Servomotors of 400 W to 2 kW, 1,000-r/min Servomotors of 900 W)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|-----------------|
| R88A-CAKF003B | 3 m | ø10.4/ø5.4 | Approx. 0.9 kg |
| R88A-CAKF005B | 5 m | | Approx. 1.3 kg |
| R88A-CAKF010B | 10 m | | Approx. 2.4 kg |
| R88A-CAKF015B | 15 m | | Approx. 3.6 kg |
| R88A-CAKF020B | 20 m | | Approx. 4.7 kg |
| R88A-CAKF030B | 30 m | | Approx. 6.9 kg |
| R88A-CAKF040B | 40 m | | Approx. 9.1 kg |
| R88A-CAKF050B | 50 m | | Approx. 11.4 kg |

Connection configuration and external dimensions



Wiring



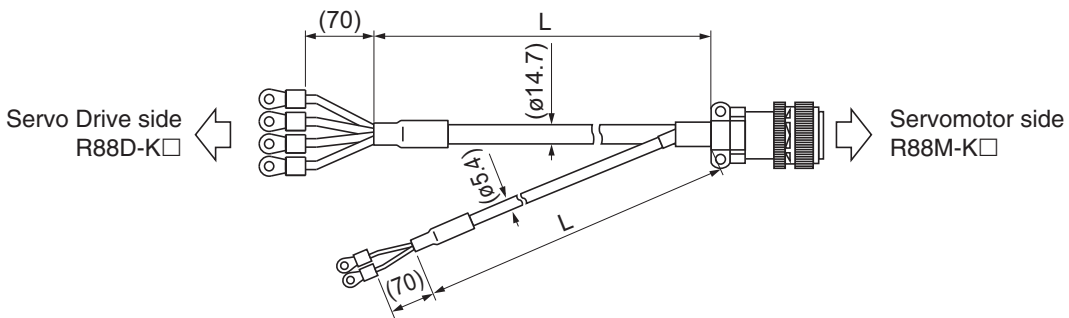
● **R88A-CAGD□B**

Cable types

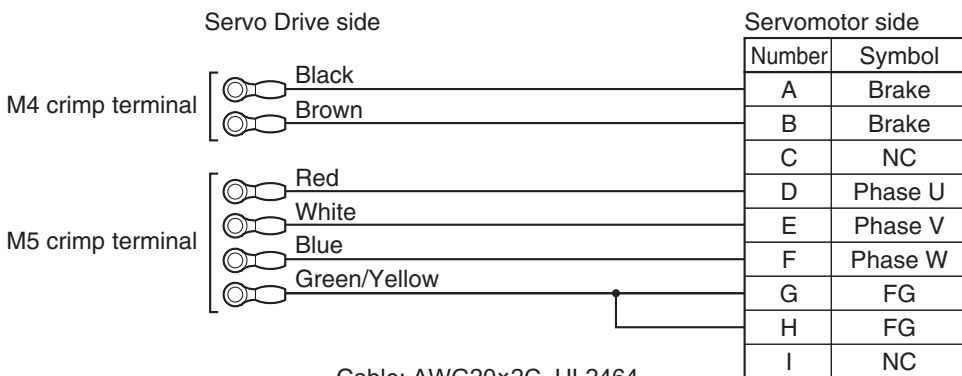
(For 3,000-r/min Servomotors of 3 to 5 kW, 2,000-r/min Servomotors of 3 to 5 kW, 1,000-r/min Servomotors of 2 to 4.5 kW)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|-----------------|
| R88A-CAGD003B | 3 m | ø14.7/ø5.4 | Approx. 1.5 kg |
| R88A-CAGD005B | 5 m | | Approx. 2.4 kg |
| R88A-CAGD010B | 10 m | | Approx. 4.5 kg |
| R88A-CAGD015B | 15 m | | Approx. 6.7 kg |
| R88A-CAGD020B | 20 m | | Approx. 8.8 kg |
| R88A-CAGD030B | 30 m | | Approx. 13.1 kg |
| R88A-CAGD040B | 40 m | | Approx. 17.4 kg |
| R88A-CAGD050B | 50 m | | Approx. 21.8 kg |

Connection configuration and external dimensions



Wiring



Cable: AWG20×2C UL2464
Cable: AWG10×4C UL2463

[Servomotor side connector]

Straight plug model

N/MS3106B24-11S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-16A (Japan Aviation Electronics)

Power Cables with Brakes (Robot Cable)

● R88A-CAGB□BR

Cable types

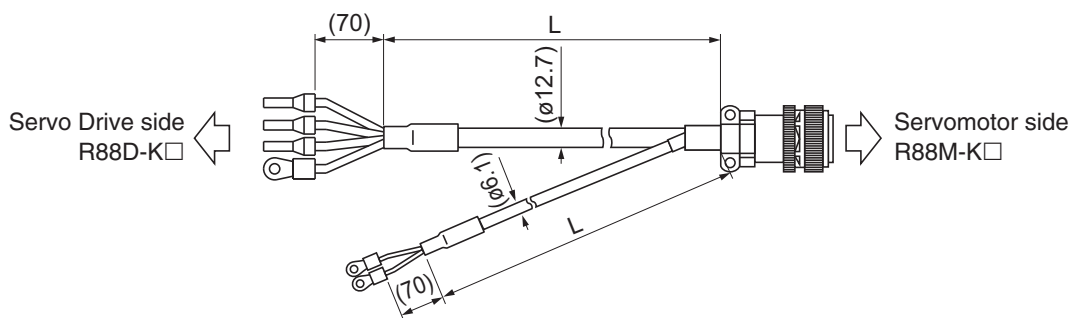
200 V:

(For 3,000-r/min Servomotors of 1 to 2 kW, 2,000-r/min Servomotors of 1 to 2 kW, 1,000-r/min Servomotors of 900 W)

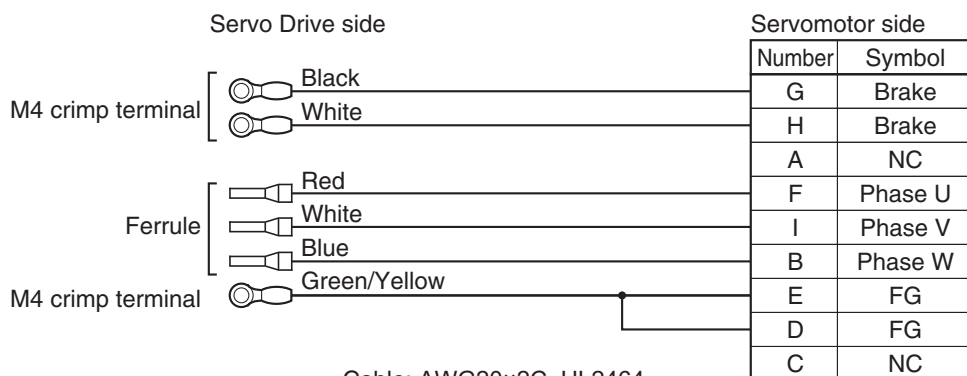
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|--|-----------------|
| R88A-CAGB003BR | 3 m | ø12.7/ø6.1 | Power cable part: 90 mm Brake cable part: 45 mm | Approx. 0.9 kg |
| R88A-CAGB005BR | 5 m | | | Approx. 1.5 kg |
| R88A-CAGB010BR | 10 m | | | Approx. 2.8 kg |
| R88A-CAGB015BR | 15 m | | | Approx. 4.2 kg |
| R88A-CAGB020BR | 20 m | | | Approx. 5.5 kg |
| R88A-CAGB030BR | 30 m | | | Approx. 8.2 kg |
| R88A-CAGB040BR | 40 m | | | Approx. 10.9 kg |
| R88A-CAGB050BR | 50 m | | | Approx. 13.6 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



Cable: AWG20×2C UL2464
Cable: AWG14×4C UL2501

[Servomotor side connector]

Straight plug model

N/MS3106B20-18S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-12A (Japan Aviation Electronics)

● **R88A-CAKF□BR**

Cable types

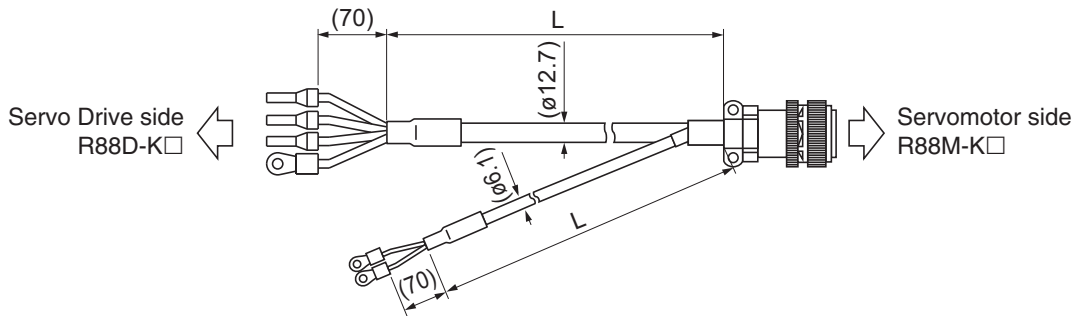
400 V:

(For 3,000-r/min Servomotors of 750 W to 2 kW, 2,000-r/min Servomotors of 400 W to 2 kW, 1,000-r/min Servomotors of 900 W)

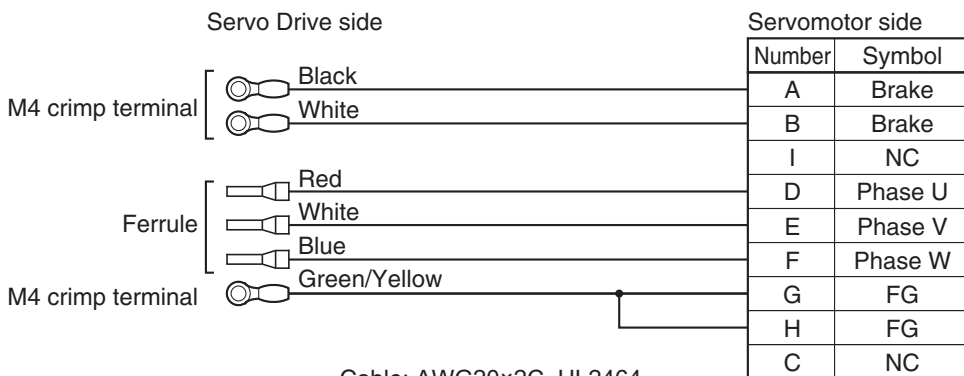
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|--|-----------------|
| R88A-CAKF003BR | 3 m | ø12.7/ø6.1 | Power cable part: 90 mm Brake cable part: 45 mm | Approx. 1.0 kg |
| R88A-CAKF005BR | 5 m | | | Approx. 1.6 kg |
| R88A-CAKF010BR | 10 m | | | Approx. 2.9 kg |
| R88A-CAKF015BR | 15 m | | | Approx. 4.3 kg |
| R88A-CAKF020BR | 20 m | | | Approx. 5.6 kg |
| R88A-CAKF030BR | 30 m | | | Approx. 8.3 kg |
| R88A-CAKF040BR | 40 m | | | Approx. 11.0 kg |
| R88A-CAKF050BR | 50 m | | | Approx. 13.7 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



Cable: AWG20×2C UL2464
Cable: AWG14×4C UL2501

[Servomotor side connector]

Straight plug model

N/MS3106B24-11S (Japan Aviation Electronics)

Cable clamp model

N/MS3057-16A (Japan Aviation Electronics)

● R88A-CAGD□BR

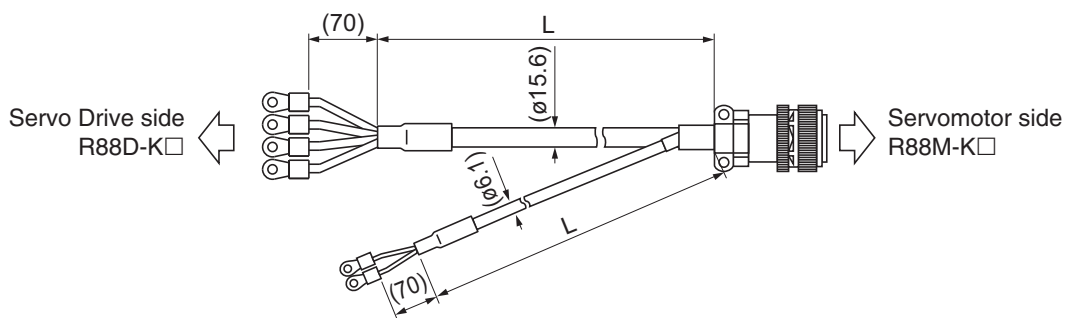
Cable types

(For 3,000-r/min Servomotors of 3 to 5 kW, 2,000-r/min Servomotors of 3 to 5 kW, 1,000-r/min Servomotors of 2 to 4.5 kW)

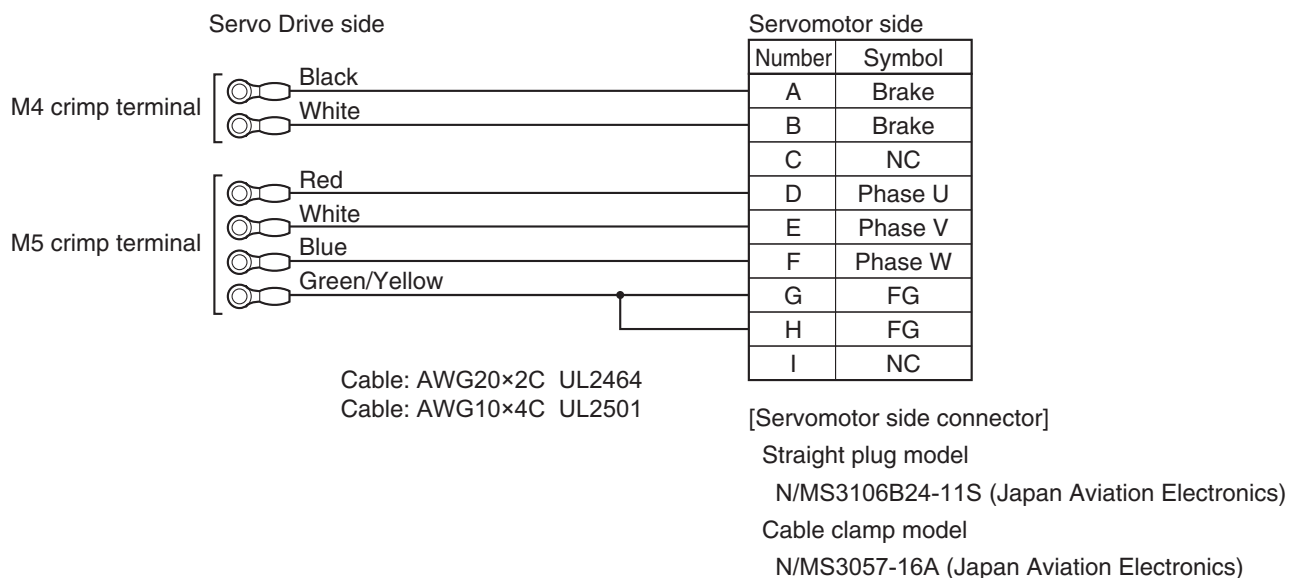
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|---|-----------------|
| R88A-CAGD003BR | 3 m | ø15.6/ø6.1 | Power cable part: 100 mm Brake cable part: 45 mm | Approx. 1.6 kg |
| R88A-CAGD005BR | 5 m | | | Approx. 2.5 kg |
| R88A-CAGD010BR | 10 m | | | Approx. 4.7 kg |
| R88A-CAGD015BR | 15 m | | | Approx. 7.0 kg |
| R88A-CAGD020BR | 20 m | | | Approx. 9.2 kg |
| R88A-CAGD030BR | 30 m | | | Approx. 13.7 kg |
| R88A-CAGD040BR | 40 m | | | Approx. 18.2 kg |
| R88A-CAGD050BR | 50 m | | | Approx. 22.7 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



Brake Cables (Standard Cable)

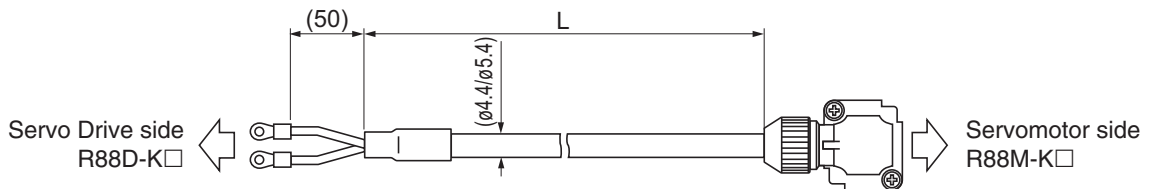
● R88A-CAKA□B

Cable types

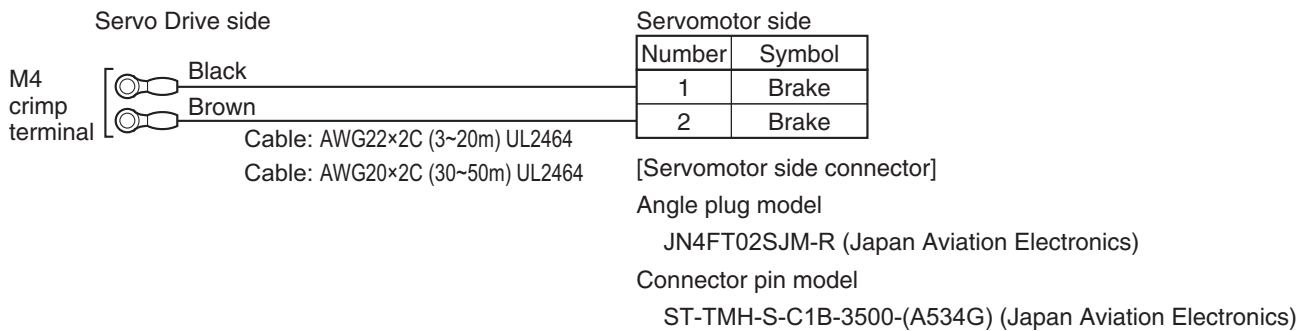
[100 V and 200 V] (For 3,000-r/min Servomotors of 50 to 750 W)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|----------------|
| R88A-CAKA003B | 3 m | ø4.4 | Approx. 0.1 kg |
| R88A-CAKA005B | 5 m | | Approx. 0.1 kg |
| R88A-CAKA010B | 10 m | | Approx. 0.3 kg |
| R88A-CAKA015B | 15 m | | Approx. 0.4 kg |
| R88A-CAKA020B | 20 m | | Approx. 0.5 kg |
| R88A-CAKA030B | 30 m | ø5.4 | Approx. 1.2 kg |
| R88A-CAKA040B | 40 m | | Approx. 1.7 kg |
| R88A-CAKA050B | 50 m | | Approx. 2.1 kg |

Connection configuration and external dimensions



Wiring



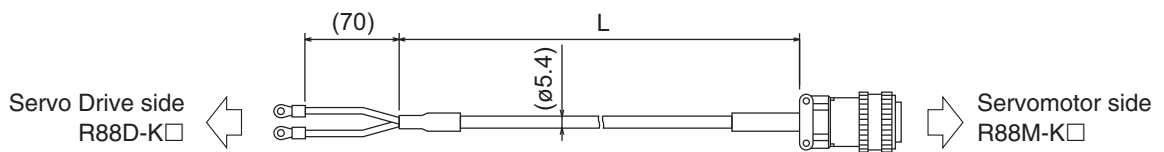
● **R88A-CAGE□B**

Cable types

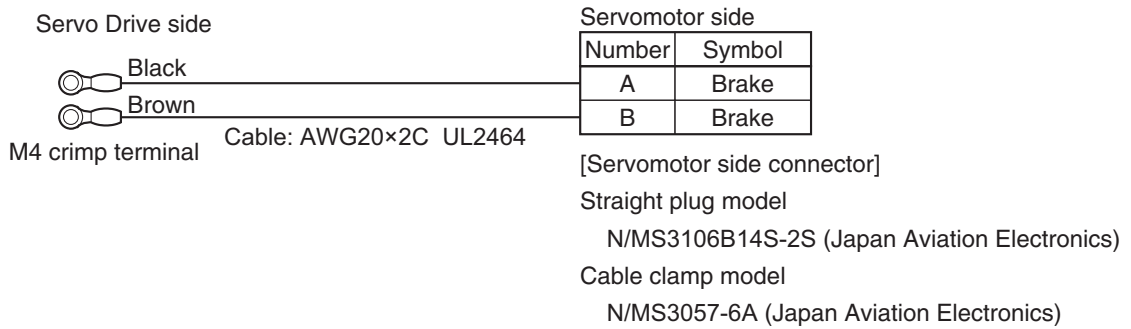
(For 1,500-r/min Servomotors of 7.5 to 15 kW, 1,000-r/min Servomotors of 6 kW)

| Model | Length (L) | Outer diameter of sheath | Weight |
|---------------|------------|--------------------------|----------------|
| R88A-CAGE003B | 3 m | ø5.4 | Approx. 0.2 kg |
| R88A-CAGE005B | 5 m | | Approx. 0.3 kg |
| R88A-CAGE010B | 10 m | | Approx. 0.5 kg |
| R88A-CAGE015B | 15 m | | Approx. 0.7 kg |
| R88A-CAGE020B | 20 m | | Approx. 0.9 kg |
| R88A-CAGE030B | 30 m | | Approx. 1.3 kg |
| R88A-CAGE040B | 40 m | | Approx. 1.7 kg |
| R88A-CAGE050B | 50 m | | Approx. 2.1 kg |

Connection configuration and external dimensions



Wiring



Brake Cables (Robot Cable)

● R88A-CAKA□BR

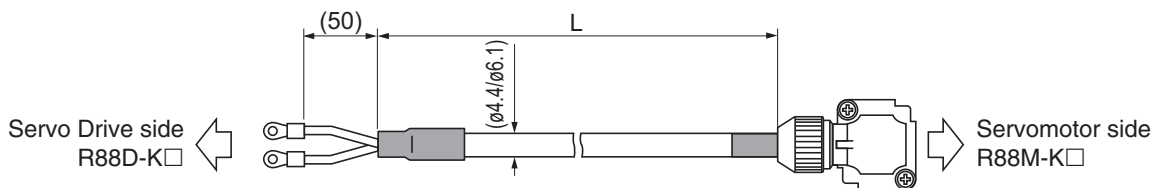
Cable types

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

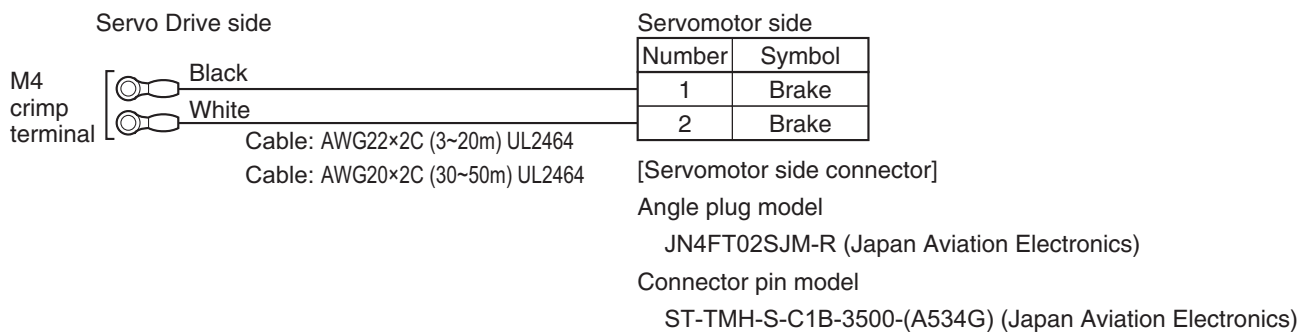
| Model | Length (L) | Outer diameter of sheath | Minimum bending radius (R) *1 | Weight |
|----------------|------------|--------------------------|-------------------------------|----------------|
| R88A-CAKA003BR | 3 m | ø4.4 | 30 mm | Approx. 0.1 kg |
| R88A-CAKA005BR | 5 m | | | Approx. 0.1 kg |
| R88A-CAKA010BR | 10 m | | | Approx. 0.3 kg |
| R88A-CAKA015BR | 15 m | | | Approx. 0.4 kg |
| R88A-CAKA020BR | 20 m | | | Approx. 0.5 kg |
| R88A-CAKA030BR | 30 m | ø6.1 | 45mm | Approx. 1.3 kg |
| R88A-CAKA040BR | 40 m | | | Approx. 1.8 kg |
| R88A-CAKA050BR | 50 m | | | Approx. 2.2 kg |

*1 For information on minimum bend radius, refer to 3-5-1 Bend Radius of Robot Cable on page 3-67.

Connection configuration and external dimensions



Wiring



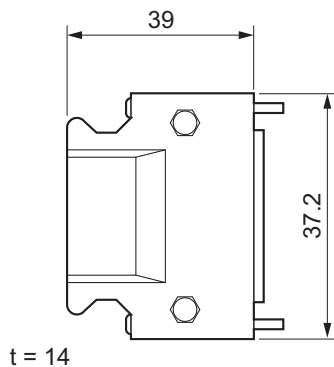
3-5-5 Connector Specifications

Control I/O Connector (R88A-CNW01C)

This is the connector to be connected to the drive's control I/O connector (CN1).

Use this connector when preparing a control cable by yourself.

● Dimensions



Connector plug model

10126-3000PE (Sumitomo 3M)

Connector case model

10326-52A0-008 (Sumitomo 3M)

Encoder Connectors

These connectors are used for encoder cables.

Use them when preparing an encoder cable by yourself.

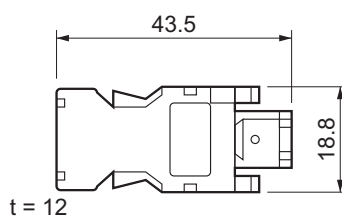
● Dimensions

R88A-CNW01R (Drive's CN2 side)

This connector is soldered.

Use the following cable.

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



Connector plug model

55100-0670 (Molex Japan)

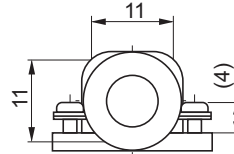
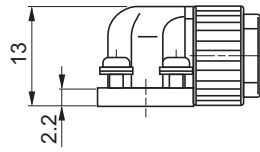
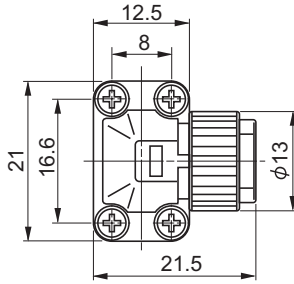
R88A-CNK02R (Servomotor side)

Use the following cable.

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

Applicable motors

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



For the angle plug, cable pulling out direction can be reversed.

Angle plug model JN6FR07SM1
(Japan Aviation Electronics)

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

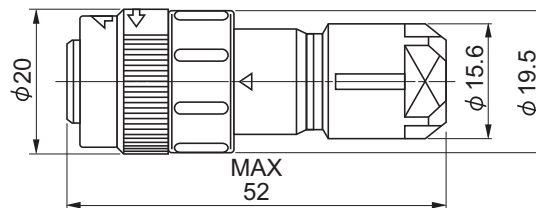
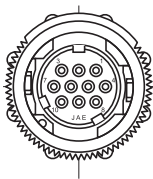
R88A-CNK04R (Servomotor side)

Use the following cable.

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

Applicable motors

- 200-V, 3,000-r/min Servomotors of all capacities
- 200-V, 2,000-r/min Servomotors of all capacities
- 200-V, 1,500-r/min Servomotors of all capacities
- 200-V, 1,000-r/min Servomotors of all capacities
- 400-V, 3,000-r/min Servomotors of all capacities
- 400-V, 2,000-r/min Servomotors of all capacities
- 400-V, 1,500-r/min Servomotors of all capacities
- 400-V, 1,000-r/min Servomotors of all capacities



Straight plug model JN2DS10SL2-R
(Japan Aviation Electronics)

Contact model JN1-22-22S-PKG100
(Japan Aviation Electronics)

Power Cable Connector (R88A-CNK11A)

This connector is used for power cables.

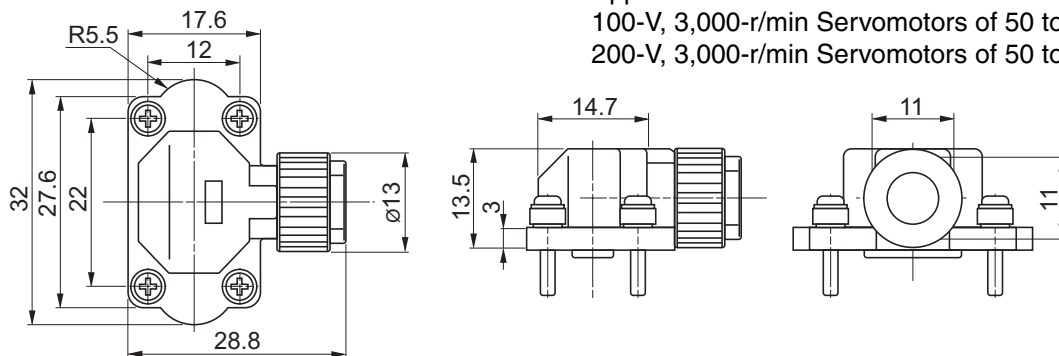
Use it when preparing a power cable by yourself.

For the angle plug, cable pulling out direction can be reversed.

Applicable motors

100-V, 3,000-r/min Servomotors of 50 to 400 W

200-V, 3,000-r/min Servomotors of 50 to 750 W



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.

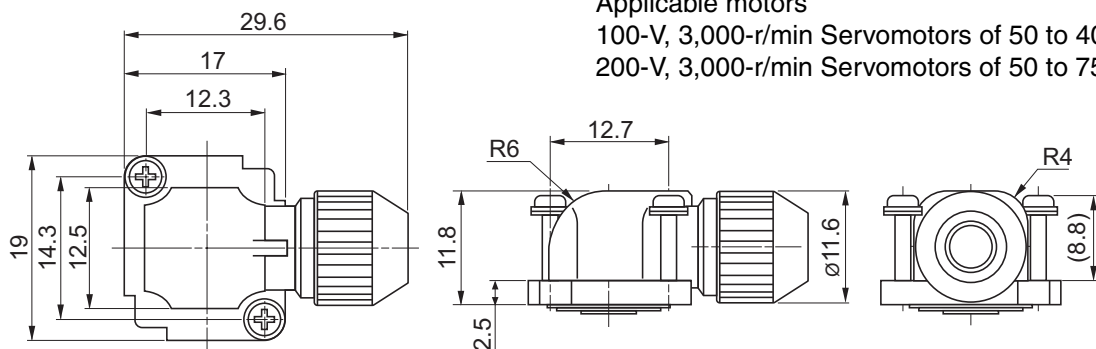
Use it when preparing a brake cable by yourself.

For the angle plug, cable pulling out direction can be reversed.

Applicable motors

100-V, 3,000-r/min Servomotors of 50 to 400 W

200-V, 3,000-r/min Servomotors of 50 to 750 W



Angle plug model JN4FT02SM-R
(Japan Aviation Electronics)

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

3-5-6 EtherCAT Communications Cable Specifications

For the EtherCAT communications cable, use an Ethernet Category 5 (100BASE-TX) or higher twisted-pair cable (with double, aluminum tape and braided shielding).

Recommended cable is shown below.

Recommended Cable

| Size x Number of cable cores (pairs) | Recommended manufacturer | Model |
|--------------------------------------|------------------------------|----------------------------|
| AWG24 x 4P | Tonichi kyosan Cable, Ltd. | NETSTAR-C5E SAB 0.5 x 4P |
| | Kuramo Electric Co. | KETH-SB |
| | SWCC Showa Cable Systems Co. | FAE-5004 |
| AWG22 x 2P | Kuramo Electric Co. | KETH-PSB-OMR ^{*1} |

*1 It is recommended that you use this cable in combination with the OMRON XS6G-T421-1 connector.



Precautions for Correct Use

The maximum length between nodes is 100 m. However, some cables are specified for less than 100 m. Generally speaking, if the conductors are twisted wire rather than solid wire, transmission performance will be lower, and reliable communications may not be possible at 100 m. Confirm details with the cable manufacturer.



Additional Information

If an Ethernet cable of Ethernet Category 5 (100BASE-TX) or higher is used, communications will be possible even if the cable is not shielded. However, we recommend a cable with double, aluminum tape and braided shielding to ensure sufficient noise immunity.

Recommended Connector (Modular Plug)

Use a shielded connector of Ethernet Category 5 (100BASE-TX) or higher.

Recommended connector is shown below.

| Size x Number of cable cores (pairs) | Recommended manufacturer | Model | Contacts |
|--------------------------------------|--------------------------|---------------------------|---|
| AWG24 x 4P | Panduit Corporation | MPS588 | Panduit Corporation Japan Branch Osaka Sales Office |
| AWG22 x 2P | OMRON Corporation | XS6G-T421-1 ^{*1} | OMRON Corporation Customer Support |

*1 It is recommended that you use this connector in combination with the Kuramo Electric Co. KETH-PSB-OMR cable.

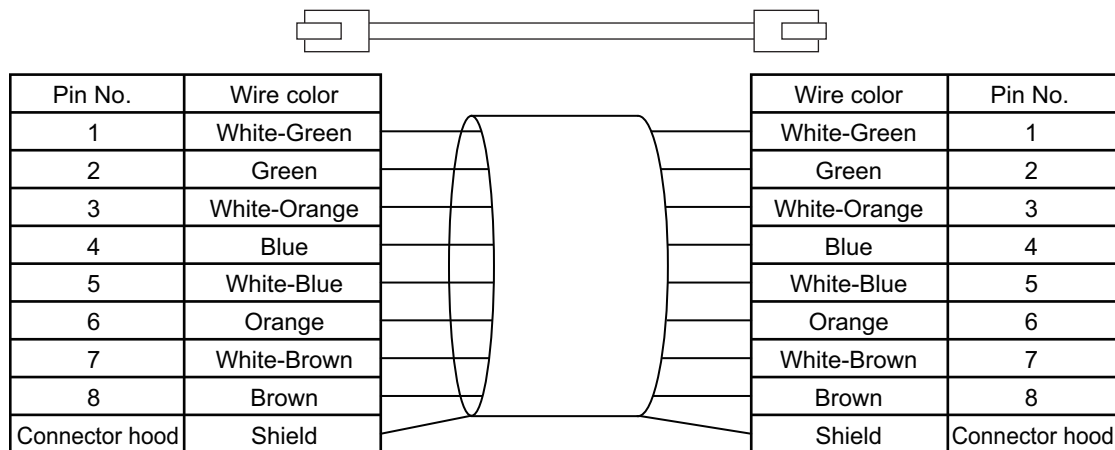


Precautions for Correct Use

When selecting a connector, confirm that it is applicable to the cable that will be used. Confirm the following items: Conductor size, conductor type (solid wire or twisted wire), number of twisted pairs (2 or 4), outer diameter, etc.

Attaching the Connectors to the Cable

Use straight wiring for the communications cable, as shown below.



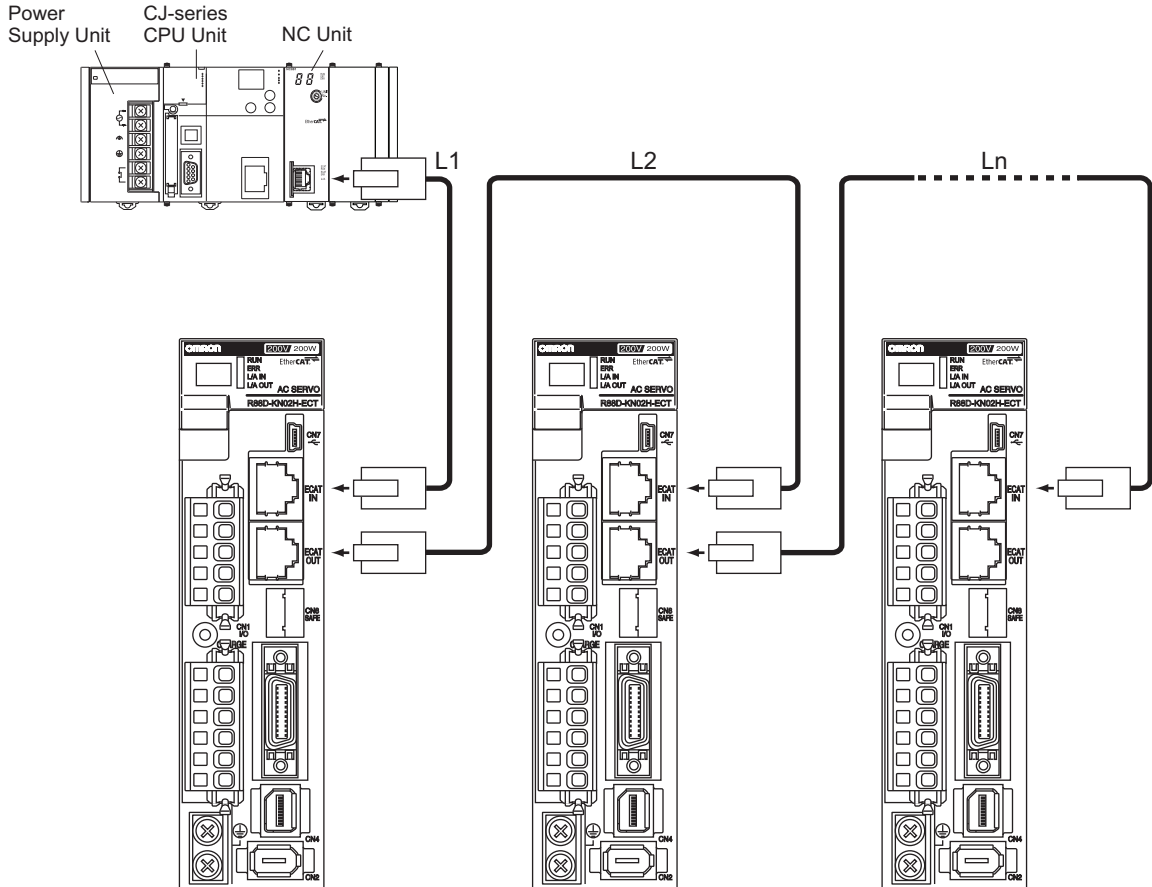
Note 1 Connect the cable shield to the connector hood at both ends of the cable.

2 There are two connection methods for Ethernet: T568A and T568B. The T568A connection method is shown above, but the T568B connection method can also be used.

Wiring

This example shows how to connect a CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882 Position Control Unit to Servo Drives using EtherCAT Communications Cables.

Connect the EtherCAT master to the ECAT IN connector on the first Servo Drive. Connect the ECAT OUT connector on the first Servo Drive to the ECAT IN connector on the next Servo Drive. Do not connect the ECAT OUT connector on the last Servo Drive.



Additional Information

- Always turn OFF the power supply to the Position Control Unit and Servo Drives before connecting or disconnecting the EtherCAT Communications Cables.
- The cable between the two nodes (L1, L2 ... Ln) must be 100 m or less.

3-5-7 Analog Monitor Cable Specifications

Analog Monitor Cable (R88A-CMK001S)

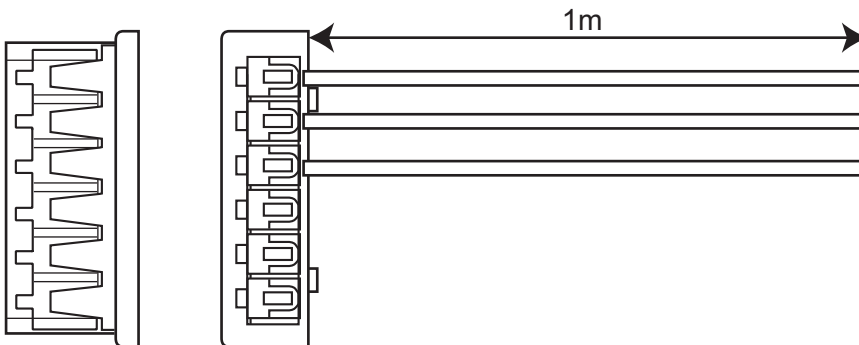
- Connection Configuration and External Dimensions

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

Cable: AWG24×3C UL1007

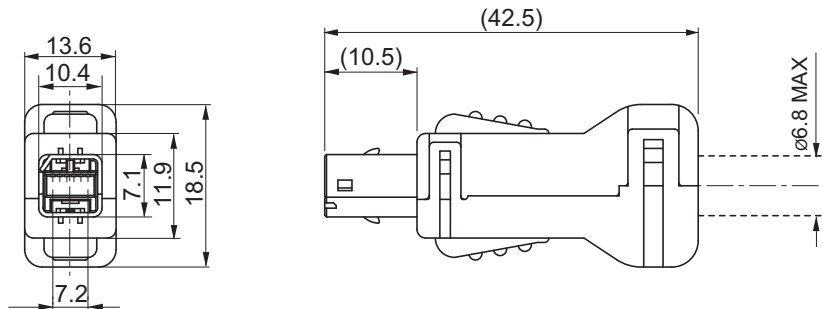
Connector housing: 51004-0600 (Molex Japan)

Connector terminal: 50011-8000 (Molex Japan)



External Encoder Connector (R88A-CNK41L)

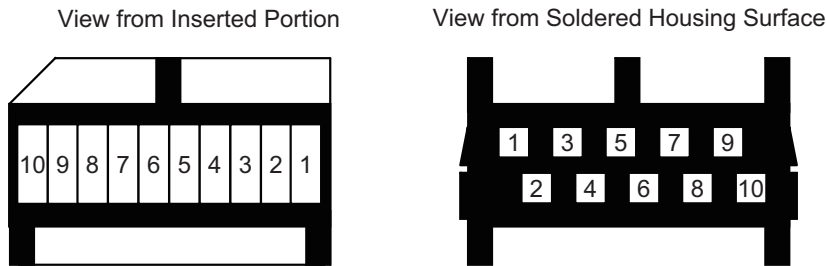
Use this connector to connect to an external encoder in fully-closed control.



Connector plug model

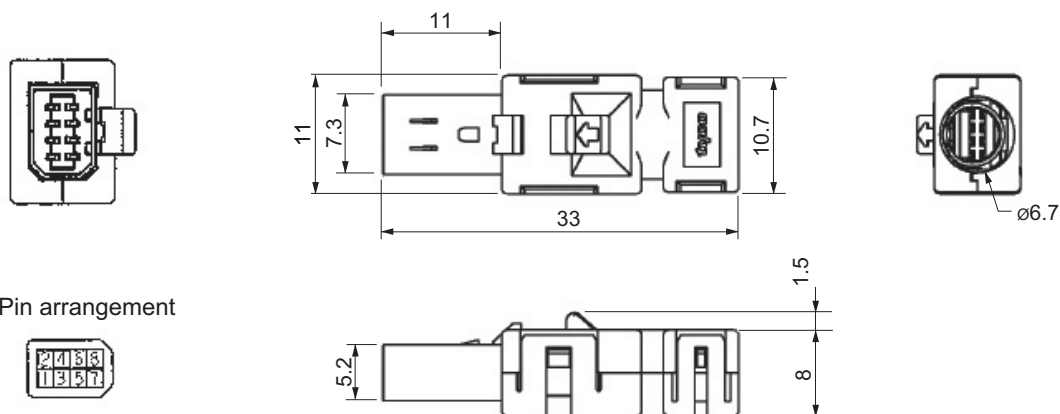
MUF-PK10K-X (J.S.T. Mfg. Co., Ltd.)

● Pin Arrangement



Safety I/O Signal Connector (R88A-CNK81S)

Use this connector to connect to a safety device.



Note The recommended cable is a 6-core shielded cable with a wire size of AWG30 to AWG26 and a finished outer diameter of 6.7 mm or less.

Note For information on wiring, refer to *Safety Connector Specifications (CN8)* on page 3-33.

3-5-8 Control Cable Specifications

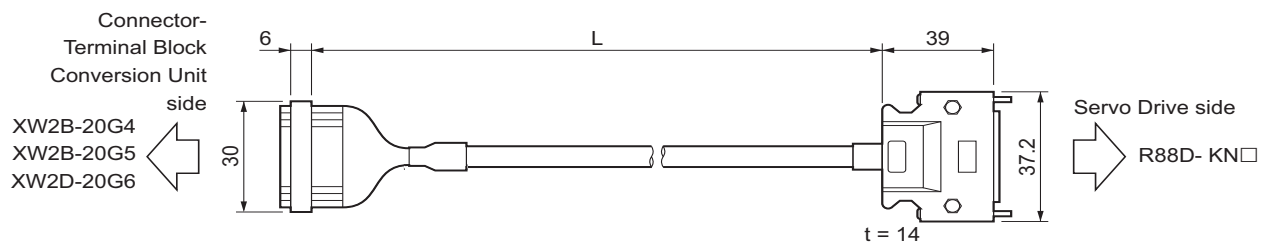
Cables for Servo Drives (XW2Z-□J-B34)

These cables connect to the connector terminal blocks on G5-series Servo Drives with Built-in EtherCAT Communications.

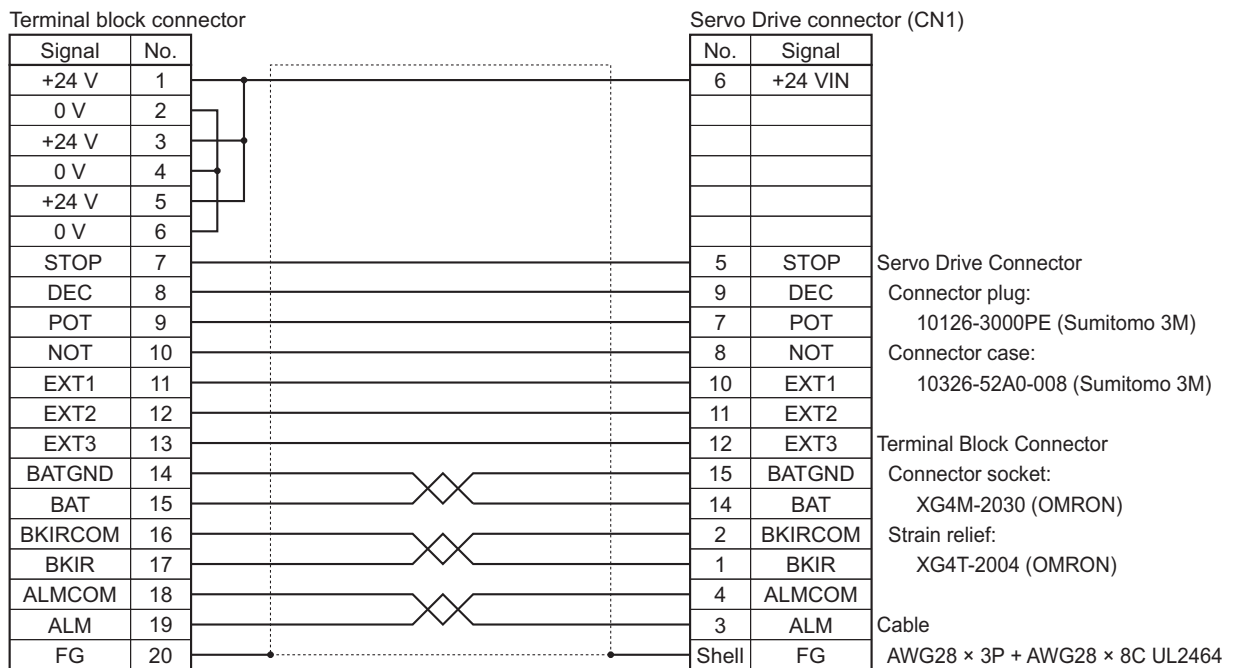
● Cable Models

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

● Connection Configuration and Dimensions



● Wiring



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

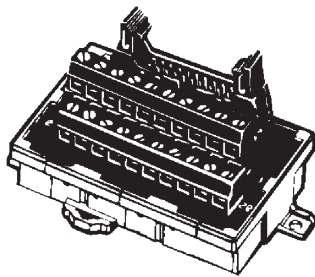
Connector-Terminal Block Conversion Unit (XW2B-20G□)

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

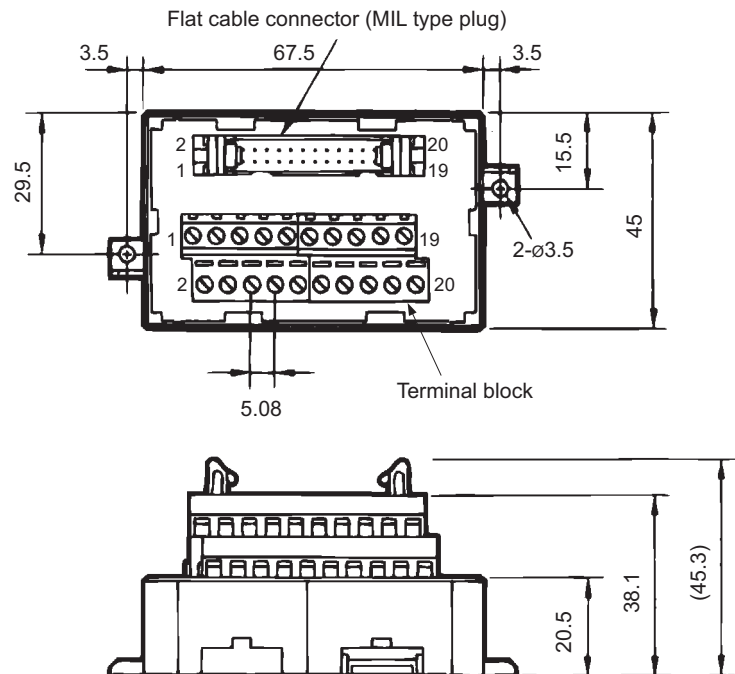
● Terminal Block Models

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

● XW2B-20G4

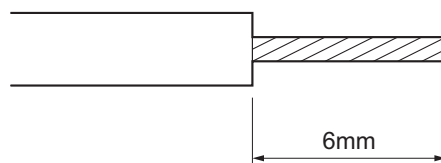


Dimensions

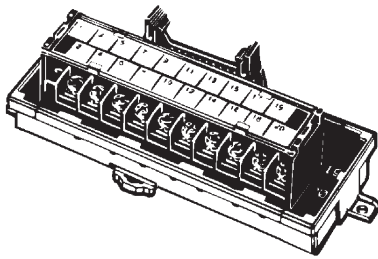


Precautions for Correct Use

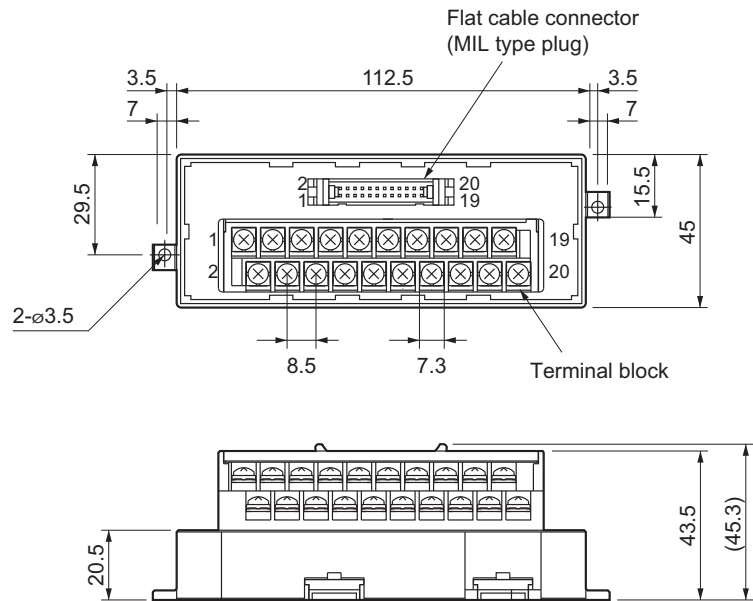
- Use 0.3 to 1.25 mm² wire (AWG22 to 16).
- The wire inlet of M3 screw terminal block is 1.8 mm (height) × 2.5 mm (width).
- Strip the insulation from the end of the wire for 6 mm as shown below.



● XW2B-20G5



Dimensions

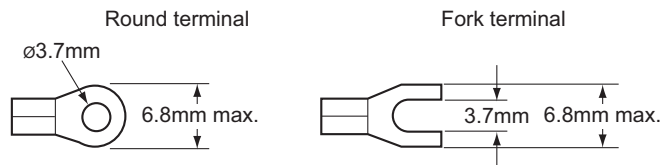


Note The pitch of terminals is 8.5 mm.



Precautions for Correct Use

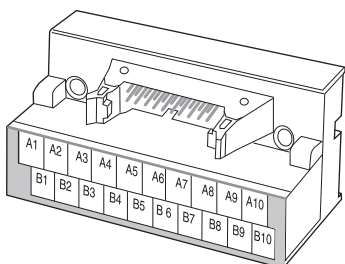
- When using crimp terminals, use crimp terminals with the following dimensions.



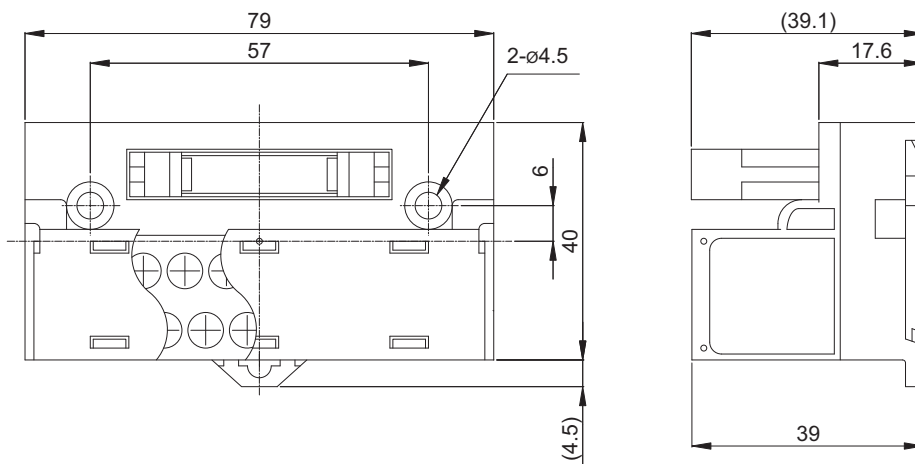
| Applicable crimp terminals | | Applicable wires |
|----------------------------|------------|---|
| Round terminals | 1.25 to 3 | AWG22 to 16 (0.30 to 1.25 mm ²) |
| | 2 to 3.5 | AWG16 to 14 (1.25 to 2.0 mm ²) |
| Fork terminals | 1.25Y to 3 | AWG22 to 16 (0.30 to 1.25 mm ²) |
| | 2 to 3.5 | AWG16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

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

● XW2D-20G6

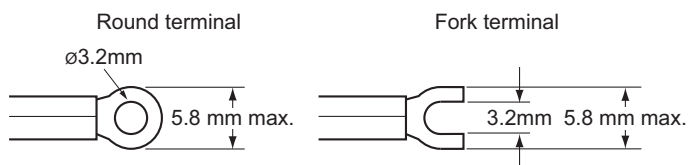


Dimensions



Precautions for Correct Use

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

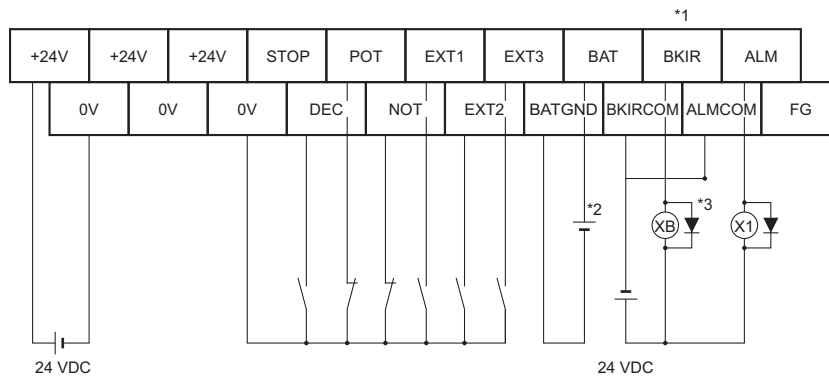


| Applicable crimp terminals | | Applicable wires |
|----------------------------|------------|---|
| Round terminals | 1.25 to 3 | AWG22 to 16 (0.30 to 1.25 mm ²) |
| Fork terminals | 1.25Y to 3 | AWG22 to 16 (0.30 to 1.25mm ²) |

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

Terminal Block Wiring Example

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



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

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

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

3-6 External Regeneration Resistor Specifications

3-6-1 External Regeneration Resistor Specifications

R88A-RR08050S

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

R88A-RR080100S

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

R88A-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 (resistive load) 250 VAC, 3 A max. |

R88A-RR22047S1

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

R88A-RR50020S

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

3-7 Reactor Specifications

Connect to the servo drive for Reduction of Harmonic Emission. Select the model by the servo drive model.

3-7-1 Specifications

| Servo drive | Reactor | | | | |
|--|--------------|---------------|------------|-----------------|------------------------|
| | Model | Rated current | Inductance | Weight | Reactor Specifications |
| R88D-KNA5L-ECT R88D-KN01H-ECT (For single-phase input) | 3G3AX-DL2002 | 1.6A | 21.4mH | Approx. 0.8 kg | DC reactor |
| R88D-KN01L-ECT R88D-KN02H-ECT (For single-phase input) | 3G3AX-DL2004 | 3.2A | 10.7mH | Approx. 1.0 kg | |
| R88D-KN02L-ECT R88D-KN04H-ECT (For single-phase input) | 3G3AX-DL2007 | 6.1A | 6.75mH | Approx. 1.3 kg | |
| R88D-KN04L-ECT R88D-KN08H-ECT R88D-KN10H-ECT (For single-phase input) | 3G3AX-DL2015 | 9.3A | 3.51mH | Approx. 1.6 kg | |
| R88D-KN15H-ECT (For single-phase input) | 3G3AX-DL2022 | 13.8A | 2.51mH | Approx. 2.1 kg | |
| R88D-KN08H-ECT R88D-KN10H-ECT R88D-KN15H-ECT (For 3-phase input) | 3G3AX-AL2025 | 10.0A | 2.8mH | Approx. 2.8 kg | AC reactor |
| R88D-KN20H-ECT R88D-KN30H-ECT | 3G3AX-AL2055 | 20.0A | 0.88mH | Approx. 4.0 kg | |
| R88D-KN50H-ECT | 3G3AX-AL2110 | 34.0A | 0.35mH | Approx. 5.0 kg | |
| R88D-KN75H-ECT R88D-KN150H-ECT | 3G3AX-AL2220 | 67.0A | 0.18mH | Approx. 10.0 kg | |
| R88D-KN06F-ECT R88D-KN10F-ECT R88D-KN15F-ECT | 3G3AX-AL4025 | 5.0A | 7.7mH | Approx. 2.7 kg | |
| R88D-KN02L-ECT R88D-KN04H-ECT | 3G3AX-AL4055 | 10.0A | 3.5mH | Approx. 4.0 kg | |
| R88D-KN50F-ECT | 3G3AX-AL4110 | 17.0A | 1.3mH | Approx. 6.0 kg | |
| R88D-KN75F-ECT R88D-KN150F-ECT | 3G3AX-AL4220 | 34.0A | 0.74mH | Approx. 10.0 kg | |

4

System Design

This chapter explains the installation conditions, wiring methods (including wiring conforming to EMC Directives), and regenerative energy calculation methods for the Servo Drive and Servomotor. It also explains the performance of External Regeneration Resistors.

4

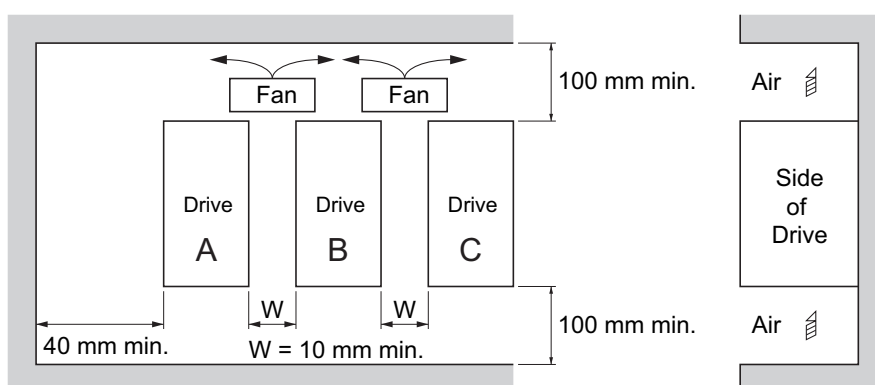
| | | |
|------------|--|-------------|
| 4-1 | Installation Conditions | 4-2 |
| 4-1-1 | Servo Drive Installation Conditions | 4-2 |
| 4-1-2 | Servomotor Installation Conditions | 4-3 |
| 4-1-3 | Decelerator Installation Conditions | 4-6 |
| 4-2 | Wiring | 4-10 |
| 4-2-1 | Power Cables for 1,500-r/min Servomotors | 4-10 |
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| 4-2-3 | Main Circuit and Motor Connections | 4-21 |
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4-1 Installation Conditions

4-1-1 Servo Drive Installation Conditions

Space Conditions around Servo Drives

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



- However, W is 50 mm min. when a Servo Drive of 7.5 kW or 15 kW is installed.
- To provide electrical conduction, remove any paint from the surface on which you are installing G5-series Servo Drives. Also, it is recommended that you apply conductive plating if you are making the mounting bracket yourself.

Mounting Direction

- Mount the drive perpendicular on the panel so that the model number reads normally.

● Environment Operating Conditions

- The environment in which drives are operated must meet the following conditions. Drives may malfunction if operated under any other conditions.

Ambient operating temperature: 0 to 55°C (Take into account the following temperature rises in the individual drives themselves.)

Operating humidity: 90% max. (with no condensation)

Operating atmosphere: No corrosive gases.

Altitude: 1,000 m max.

- Drives of 100 V or 200 V with a capacity of 750 W max. can be installed side by side with a 1-mm clearance (W in above illustration). However, the specifications for operating ambient temperature depends on the drive.

Drive A: 0 to 50°C

Drive B: 0 to 40°C

Drive C: 0 to 45°C

Ambient Temperature Control

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

Keeping Foreign Objects Out of Units

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

4-1-2 Servomotor Installation Conditions

Environment Operating Conditions

- The environment in which the motor is operated must meet the following conditions. Operating the motor outside of the following ranges may result in malfunction of the motor.

Ambient operating temperature: 0 to 40°C*¹

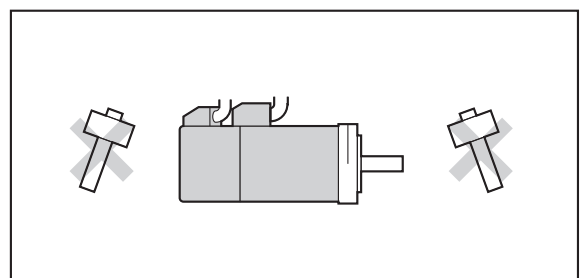
Operating humidity: 85% max. (with no condensation)

Operating atmosphere: No corrosive gases.

- *1 The ambient operating temperature is the temperature at a point 5 cm from the motor.

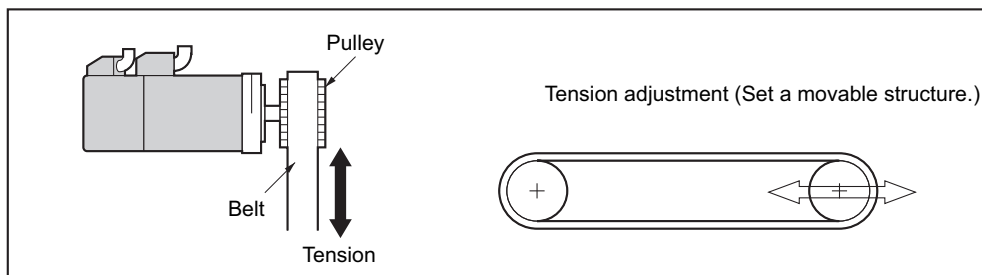
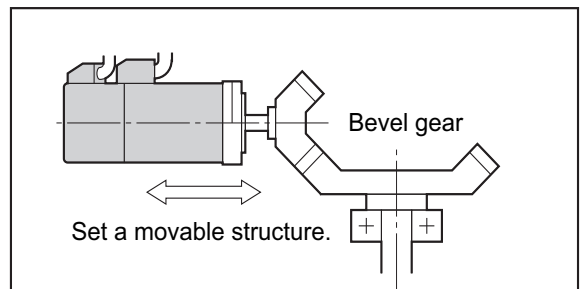
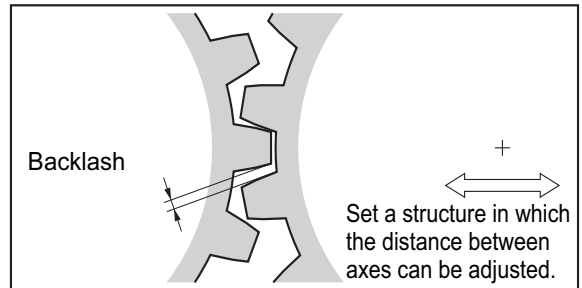
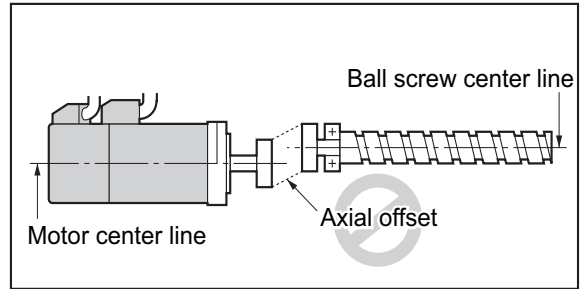
Impact and Load

- The motor is resistant to impacts of up to 98 m/s². Do not apply heavy impacts or loads during transport, installation, or removal of the motor.
- When transporting the motor, 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 *3-1-2 Characteristics* on page 3-3. If an axial load greater than that specified is applied to a motor, it may reduce the limit of the motor bearings and may break the motor shaft.
- When connecting to a load, use couplings that can sufficiently absorb mechanical eccentricity and declination.
- For spur gears, an extremely large radial load may be applied depending on the gear precision. Use spur gears with a high degree of precision (for example, JIS class 2: normal line pitch error of 6 μm max. for a pitch circle diameter of 50 mm).
- If the gear precision is not adequate, allow backlash to ensure that no radial load is placed on the motor shaft.
- When using bevel gears, a load is applied in the thrust direction depending on the structural precision, the gear precision, and temperature changes. Provide appropriate backlash or take other measures to ensure that a thrust load larger than the specified level is not applied.
- Do not put rubber packing on the flange surface. If the flange is mounted with rubber packing, the motor flange may crack under the tightening force.
- When connecting to a V-belt or timing belt, consult the manufacturer for belt selection and tension.
- A radial load twice as large as the belt tension will be placed on the motor shaft. Do not allow a load that exceeds the allowable radial load to be placed on the motor shaft. If an excessive radial load is applied, the motor shaft and bearings may be damaged.
- Set up a movable pulley in the middle of the motor shaft and the load shaft so that the belt tension can be adjusted.



Water and Drip Resistance

- The protective structure for the motors is as follows:
Equivalent to IP67 (except for through-shaft parts)

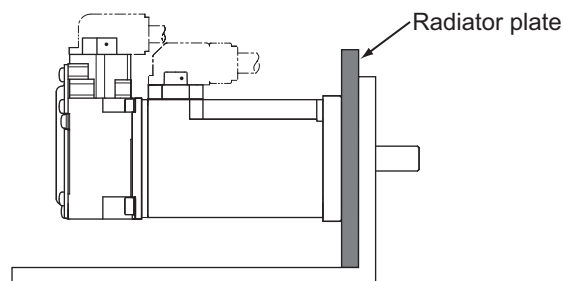
Oil-water Measures

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

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

Radiator Plate Installation Conditions

- When you mount a Servomotor onto a small device, be sure to provide enough radiation space on the mounting area. Otherwise the Servomotor temperature rises too high. One of the preventive measures is to install a radiator plate between the motor attachment area and the motor flange. (See below) Refer to *3-3 Servomotor Specifications* on page 3-36 for the radiator plate specifications.



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

Other Precautions

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

|  Caution | |
|--|--|
|  | Do not apply a commercial power supply directly to the motor. Failure to follow this guideline may result in fires. |
|  | Never repair the product by disassembling it. Failure to follow this guideline may result in electric shock or injury. |

4-1-3 Decelerator Installation Conditions

Installing the Reduction Gear

● Installing the R88G-HPG □□□ (3 Arcminutes type)

Follow the instructions below for installing this Reduction Gear and the Servomotor.

- 1** Fit the bolt head of the shaft fixing bolt to the rubber cap by turning the input coupling.
- 2** Apply the sealant on the side which the Servomotor is installed. (Recommended sealant: Loctite 515)
- 3** Gently insert the Servomotor into the reduction gear.

Put up the reduction gear vertically and let it slide into the input shaft coupling, so as not to fall, using the motor shaft as guide, as shown in the diagram on next page. When the reduction gear cannot be put up vertically, take care not to install the motor tilted by such as tightening a bolt uniformly.

- 4** Fix the Servomotor and the flange of the reduction gear with bolts.

Bolt tightening torque (for aluminum)

| | | | | | | |
|---|-----|-----|------|------|------|------|
| Size of the hexagon socket head cap screw | M4 | M5 | M6 | M8 | M10 | M12 |
| Tightening torque (N·m) | 3.2 | 6.3 | 10.7 | 26.1 | 51.5 | 89.9 |

- 5** Tighten the bolts of the input coupling.

Bolt tightening torque (for duralumin)

| | | | | | | |
|---|-----|-----|------|------|------|-----|
| Size of the hexagon socket head cap screw | M4 | M5 | M6 | M8 | M10 | M12 |
| Tightening torque (N·m) | 2.0 | 4.5 | 15.3 | 37.2 | 73.5 | 128 |

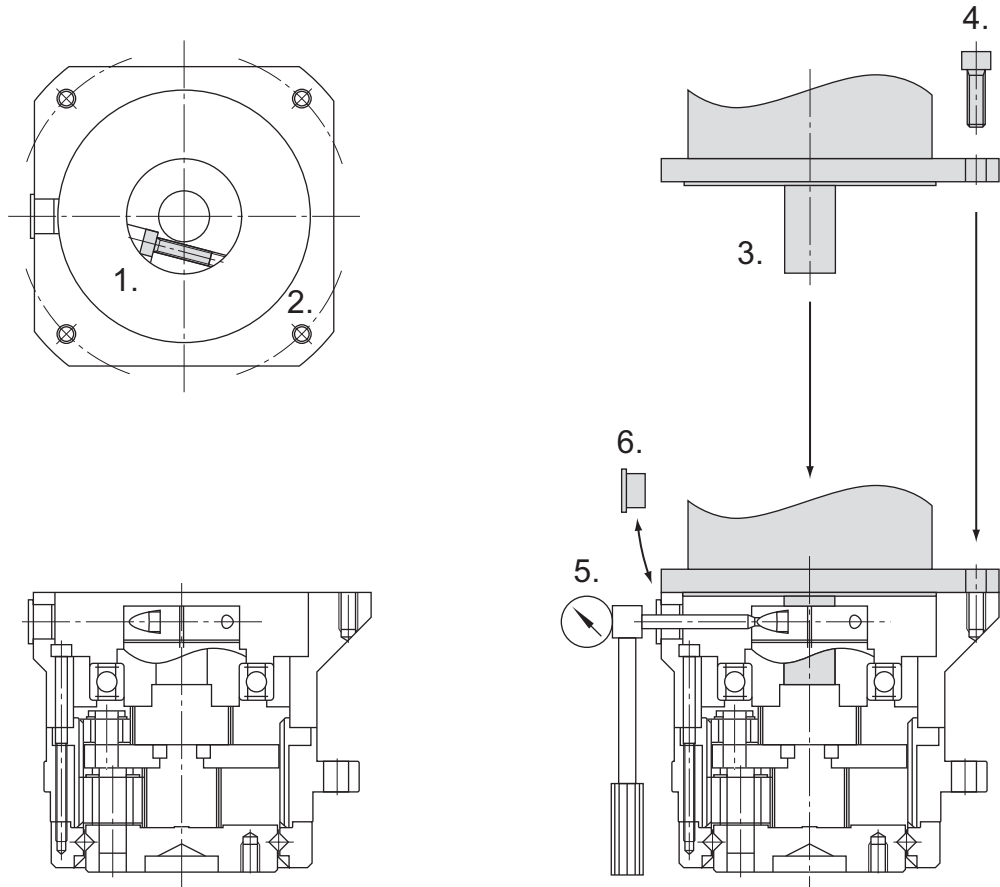
Note Tighten the bolts using the torque indicated on the above table. The problem such as slipping may occur when using the other unspecified torque.

2 screws have to be used as set screws when installing the R88G-HPG11A □.

| | |
|---|------|
| Size of the hexagon socket head cap screw | M3 |
| Tightening torque (N·m) | 0.69 |

- 6** Mount the rubber cap to complete the installation.

(Mount 2 gasketed screws when installing the R88G-HPG11A □.)



● **Installing the Reduction Gear into the machine.**

Confirm the mounting surface flatness and installation burr does not exist, and fix the mounting flange with bolts when installing R88G-HPG □□□.

Tightening torque of the bolt on the mounting flange (for aluminum)

| R88G-HPG | 11A | 14A | 20A | 32A | 50A | 65A |
|-------------------------|-----|-----|------|------|-----|-----|
| Number of bolts | 4 | 4 | 4 | 4 | 4 | 4 |
| Size of bolts | M3 | M5 | M8 | M10 | M12 | M16 |
| Mounting PCD (mm) | 46 | 70 | 105 | 135 | 190 | 260 |
| Tightening torque (N·m) | 1.4 | 6.3 | 26.1 | 51.5 | 103 | 255 |

Note If the key on a Servomotor with key is uninstalled, it is possible to use the reduction gear by installing the Servomotor without above mentioned key. Slipping does not occur.

● **Installing the R88G-VRSF □□□ (15 Arcminutes type)**

Follow the instructions below for installing this Reduction Gear and the Servomotor.

1 Fit the bolt head of the shaft fixing bolt to the rubber cap by turning the input coupling.
Confirm the set bolt is loose.

2 Gently insert the Servomotor into the reduction gear.

Put up the reduction gear vertically and let it slide into the input shaft coupling, so as not to fall, using the motor shaft as guide, as shown in the below diagrams. When the reduction gear cannot be put up vertically, take care not to install the motor tilted by such as tightening a bolt uniformly.

3 Fix the Servomotor and the flange of the reduction gear with bolts.

Bolt tightening torque

| | | | |
|---|-----|-----|-----|
| Size of the hexagon socket head cap screw | M4 | M5 | M6 |
| Tightening torque (N·m) | 3.0 | 5.8 | 9.8 |

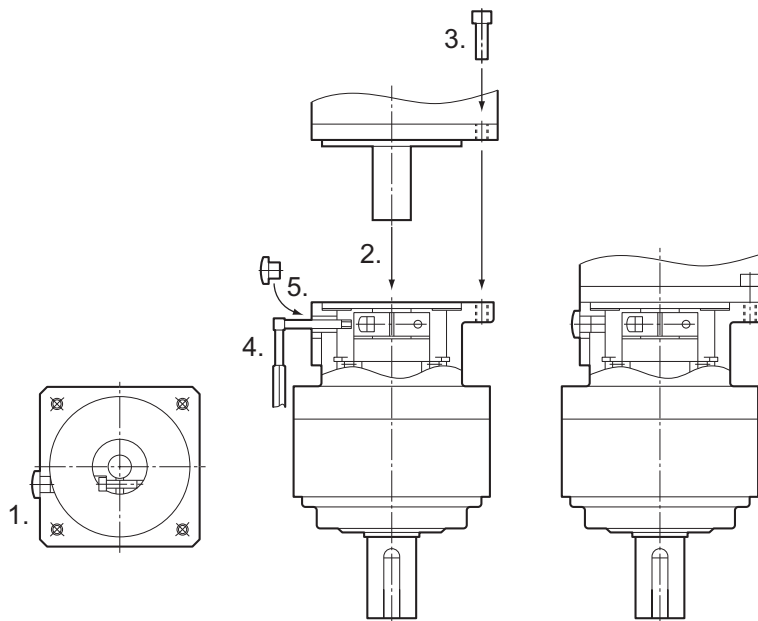
4 Tighten the bolts of the input coupling.

Bolt tightening torque (for duralumin)

| | | | |
|---|-----|-----|-----|
| Size of the hexagon socket head cap screw | M3 | M4 | M5 |
| Tightening torque (N·m) | 1.5 | 4.5 | 7.1 |

Note Tighten the bolts using the torque indicated on the above table. The problem such as slipping may occur when using the other unspecified torque.

5 Mount the rubber cap to complete the installation.



● Installing the Reduction Gear into the machine.

Confirm the mounting surface flatness and installation burr does not exist, and fix the mounting flange with bolts when installing R88G-VRSF □□□.

Tightening torque of the bolt on the mounting flange (for aluminum)

| R88G-VRSF | Frame B | Frame C | Frame D |
|-------------------------|---------|---------|---------|
| Number of bolts | 4 | 4 | 4 |
| Size of bolts | M5 | M6 | M8 |
| Mounting PCD (mm) | 60 | 90 | 115 |
| Tightening torque (N·m) | 5.8 | 9.8 | 19.6 |

Note If the key on a Servomotor with key is uninstalled, it is possible to use the reduction gear by installing the Servomotor without above mentioned key. Slipping does not occur.

Using Another Company's Decelerator (Reference)

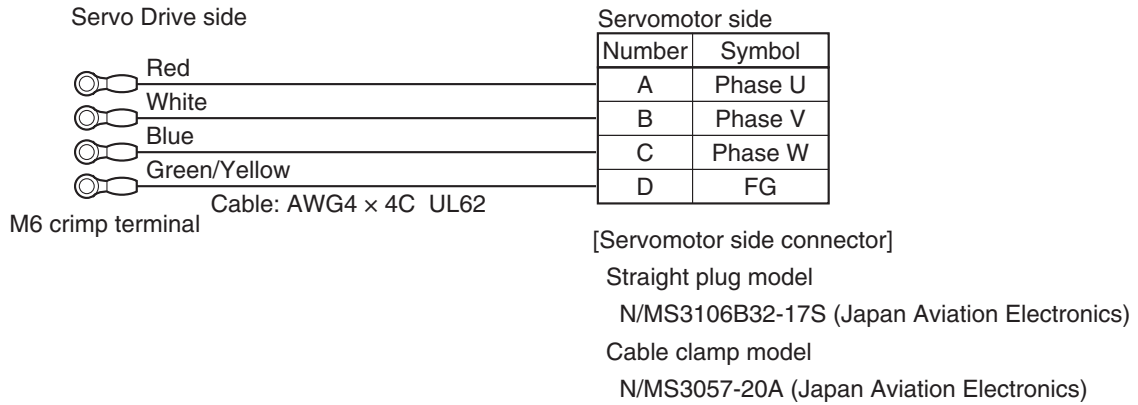
If the system configuration requires another company's decelerator to be used in combination with a G5-series Servomotor, select the decelerator so that the loads on the motor shaft (i.e., both the radial and thrust loads) are within the allowable ranges. (Refer to *3-1-2 Characteristics* on page 3-3 for details on the allowable loads for the motors.)

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

4-2 Wiring

4-2-1 Power Cables for 1,500-r/min Servomotors

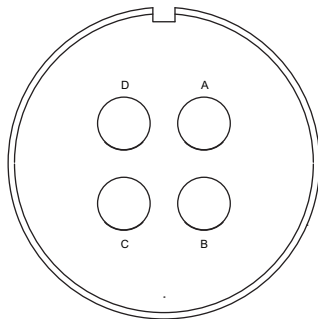
For a 1,500-r/min Servomotor with 11 kW or 15 kW, make the following cable yourself and use it to connect the Servomotor and Servo Drive.



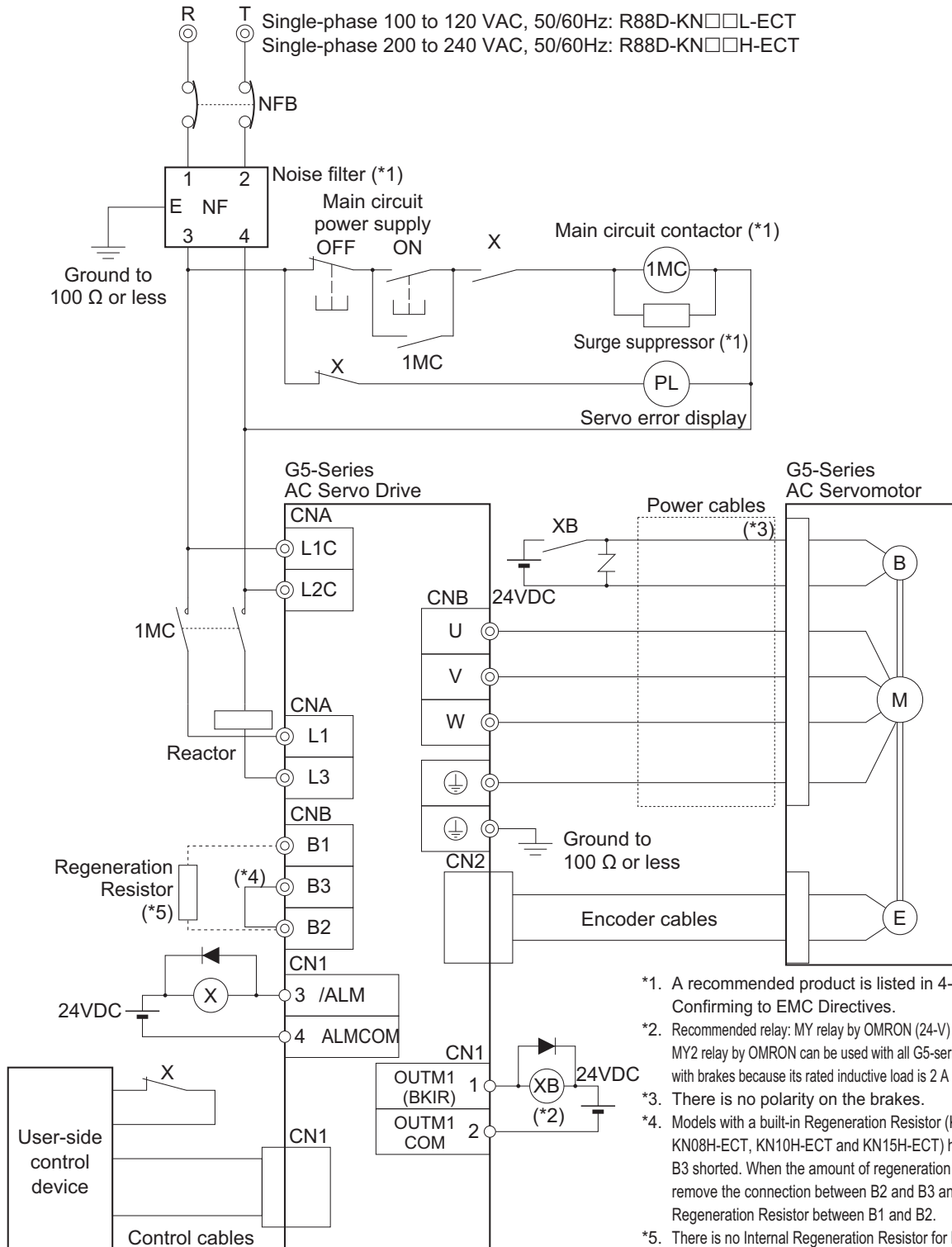
Note 1 The cable length between the Servomotor and Servo Drive must be 50 m or less.
Use wire lengths that match the positions of the U, V, W, and FG terminals on the Servo Driver (M6 crimp terminals).

2 The power connector and brake connector are separate for Servomotors with brakes.

- Servomotor Side Pin Arrangement (View from Soldered Side of Plug)

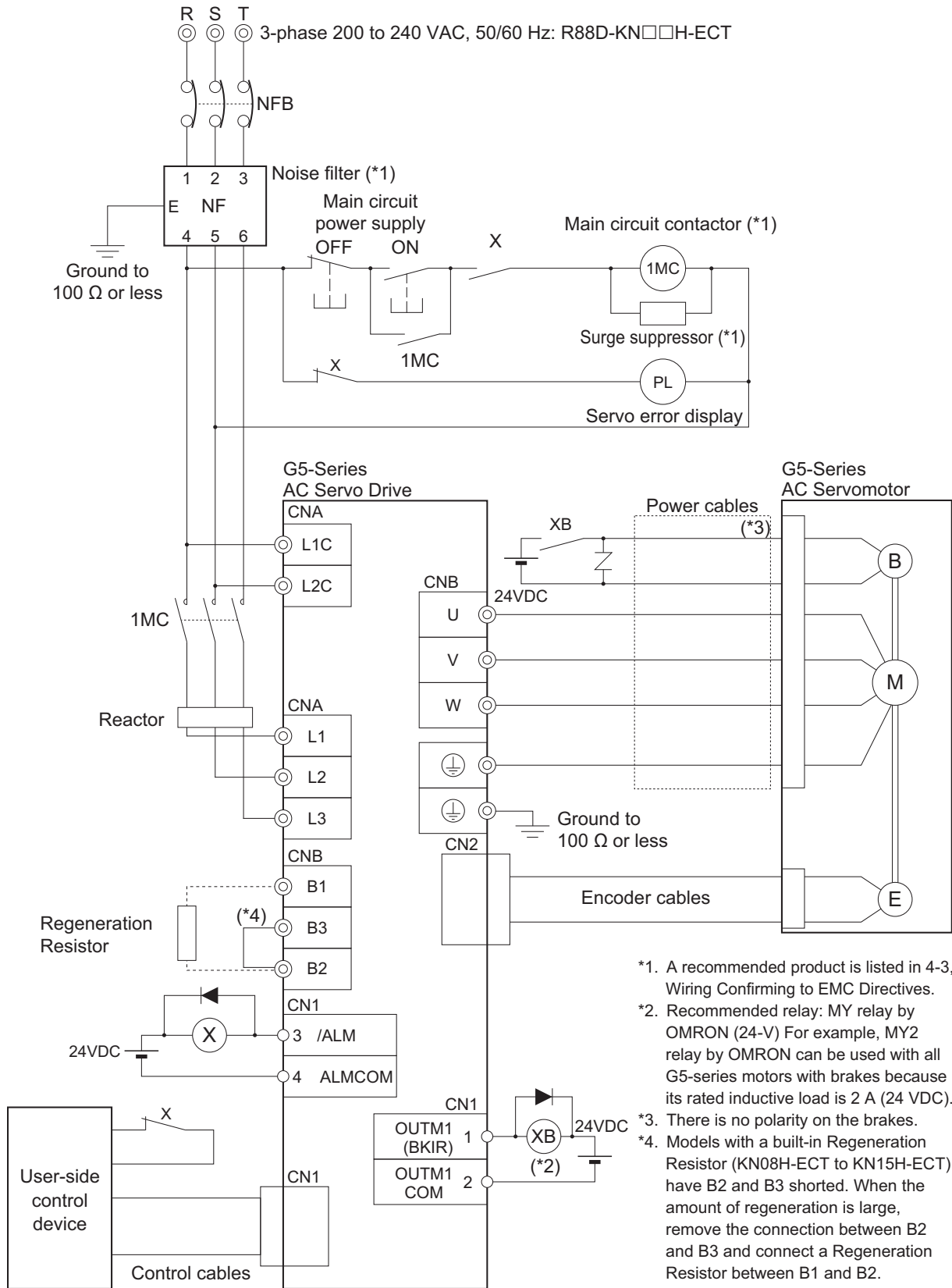


4-2-2 Peripheral Equipment Connection Examples

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


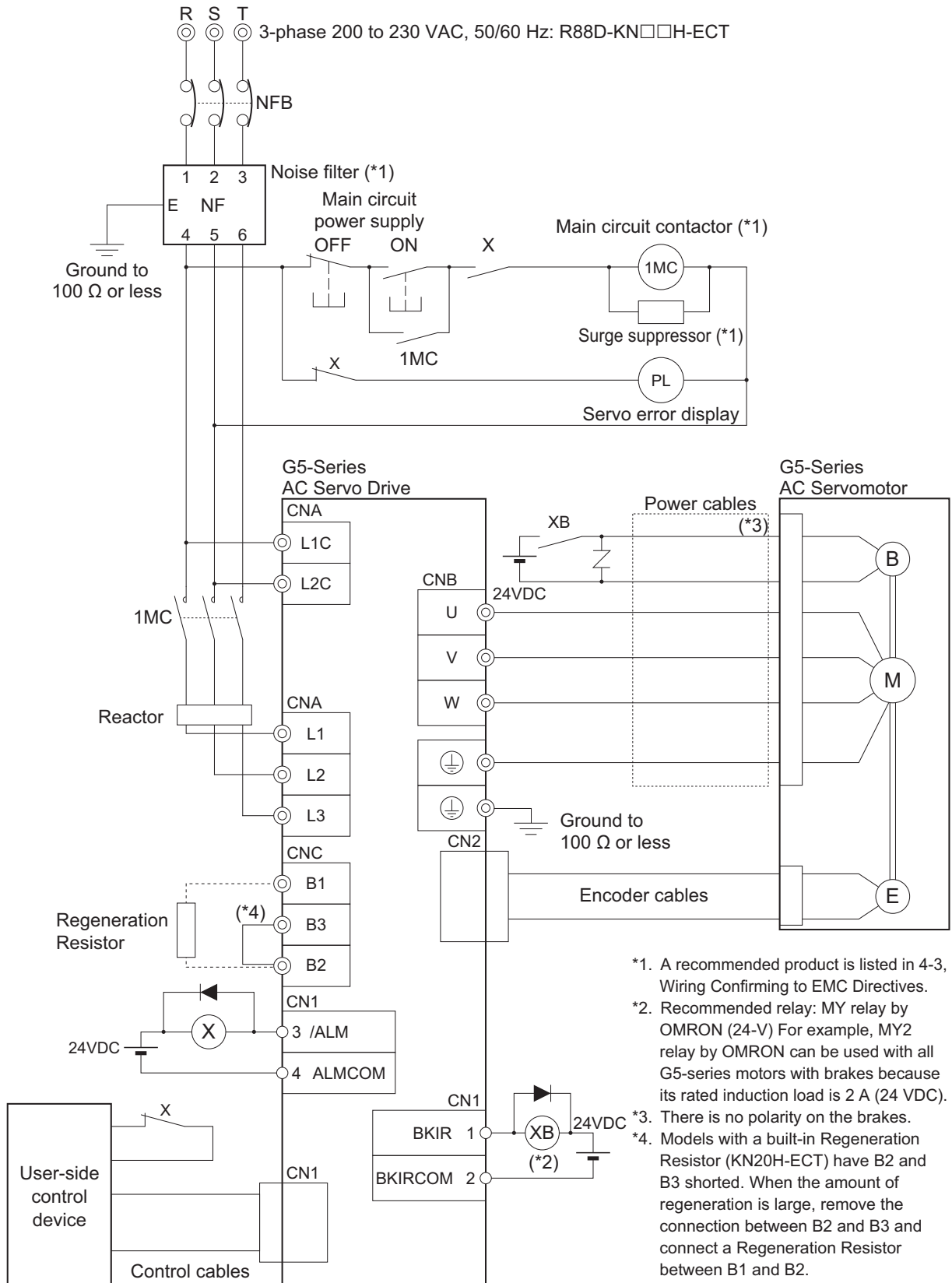
- *1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.
- *2. Recommended relay: MY relay by OMRON (24-V) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated inductive load is 2 A (24 VDC).
- *3. There is no polarity on the brakes.
- *4. Models with a built-in Regeneration Resistor (KN04L-ECT, KN08H-ECT, KN10H-ECT and KN15H-ECT) have B2 and B3 shorted. When the amount of regeneration is large, remove the connection between B2 and B3 and connect a Regeneration Resistor between B1 and B2.
- *5. There is no Internal Regeneration Resistor for KNA5L-ECT to KN02L-ECT, and KN01H-ECT to KN04H-ECT. When the amount of regeneration is large, connect the necessary Regeneration Resistor between B1 and B2.

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



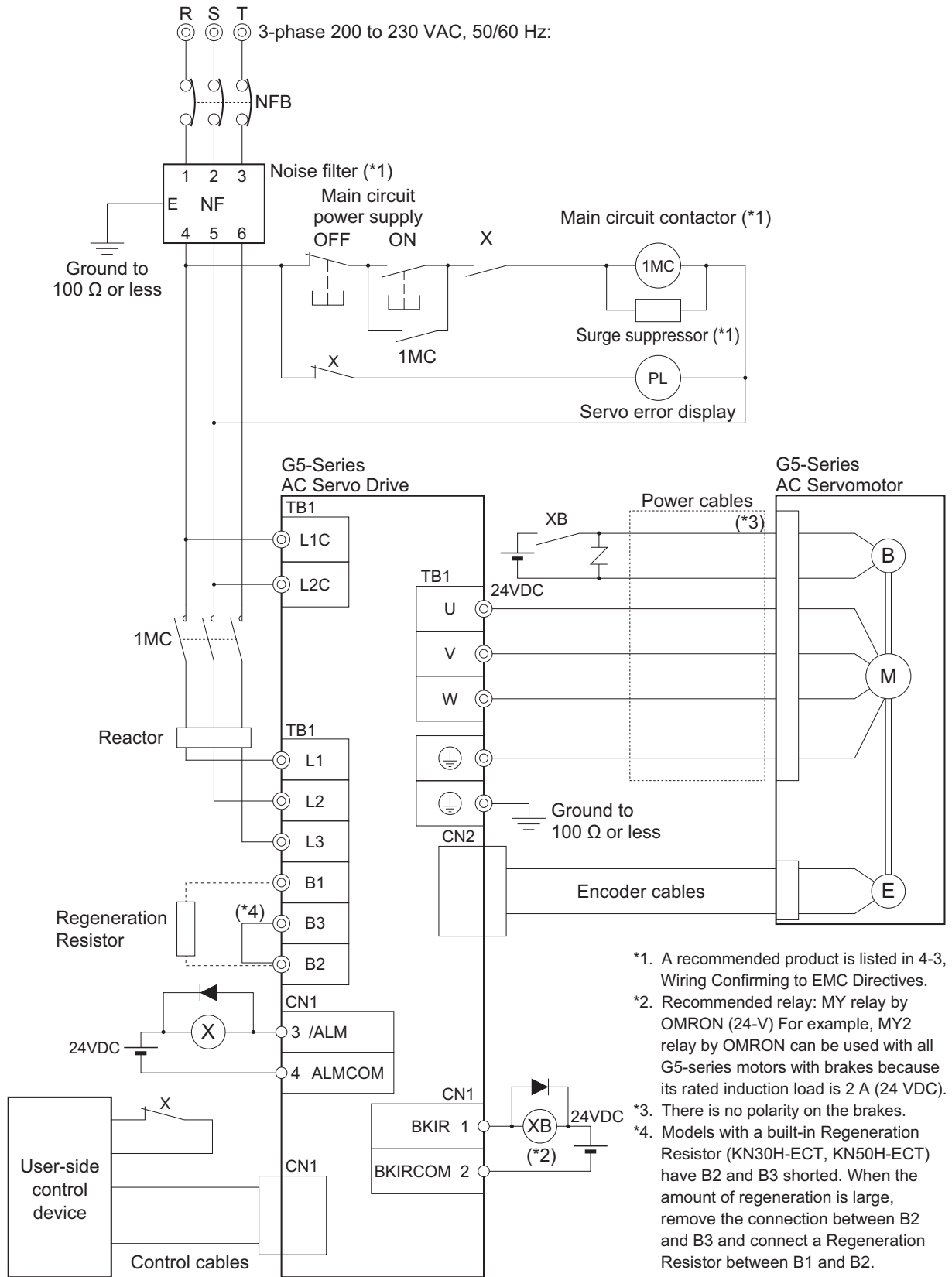
- *1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.
- *2. Recommended relay: MY relay by OMRON (24-V) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated inductive load is 2 A (24 VDC).
- *3. There is no polarity on the brakes.
- *4. Models with a built-in Regeneration Resistor (KN08H-ECT to KN15H-ECT) have B2 and B3 shorted. When the amount of regeneration is large, remove the connection between B2 and B3 and connect a Regeneration Resistor between B1 and B2.

R88D-KN20H-ECT

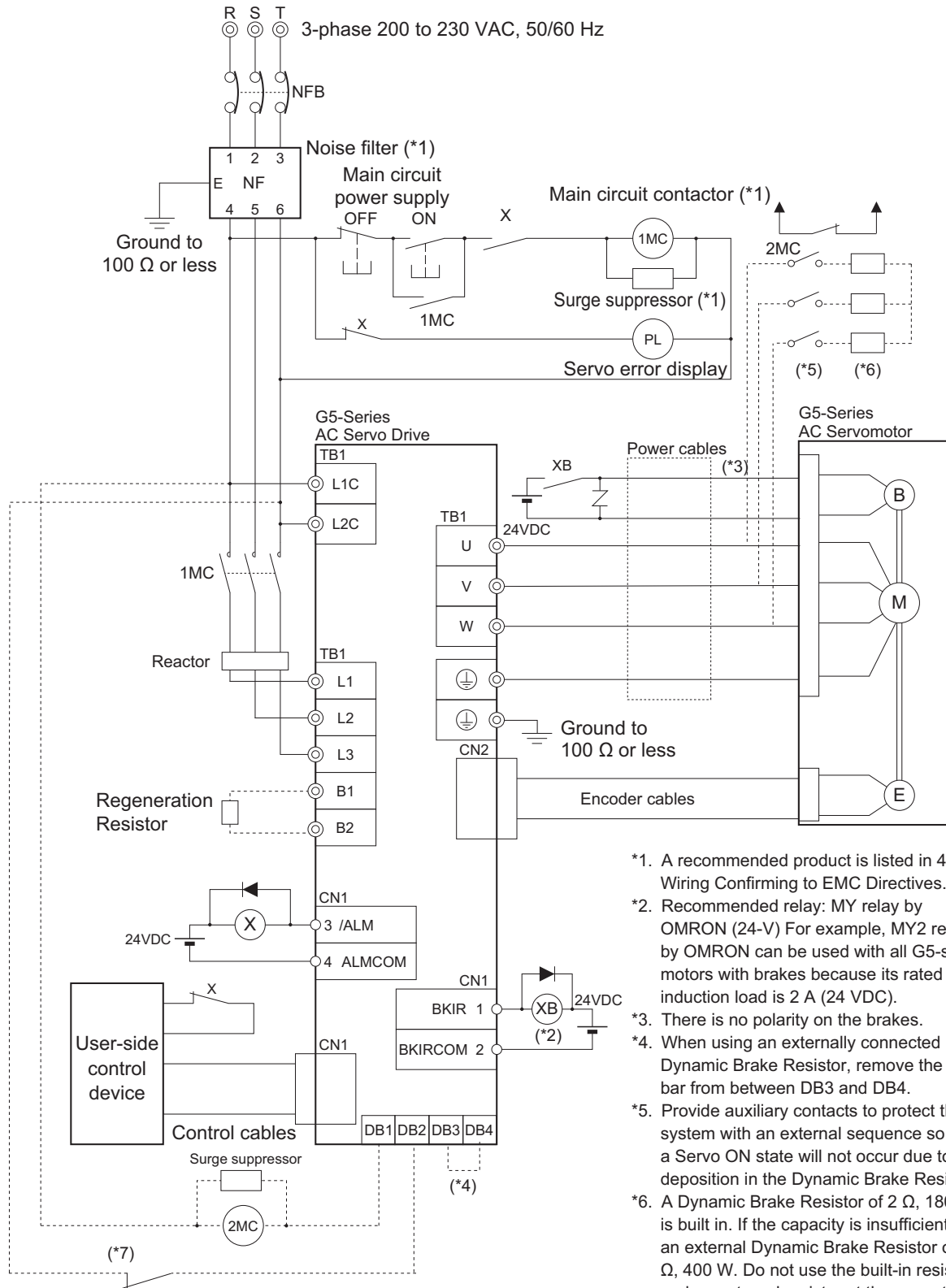


- *1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.
- *2. Recommended relay: MY relay by OMRON (24-V) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).
- *3. There is no polarity on the brakes.
- *4. Models with a built-in Regeneration Resistor (KN20H-ECT) have B2 and B3 shorted. When the amount of regeneration is large, remove the connection between B2 and B3 and connect a Regeneration Resistor between B1 and B2.

R88D-KN30H-ECT/-KN50H-ECT

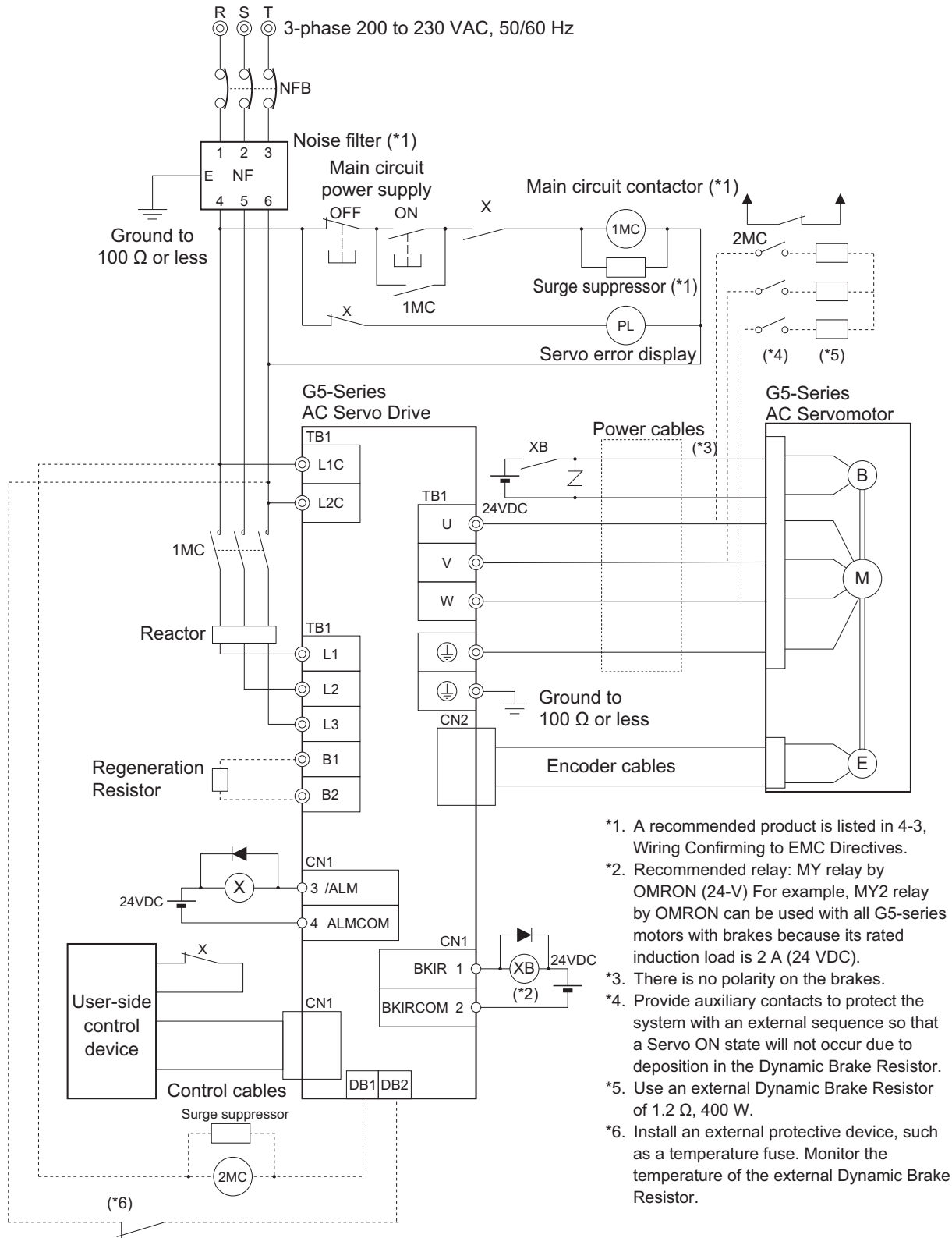


R88D-KN75H-ECT (AC power input)

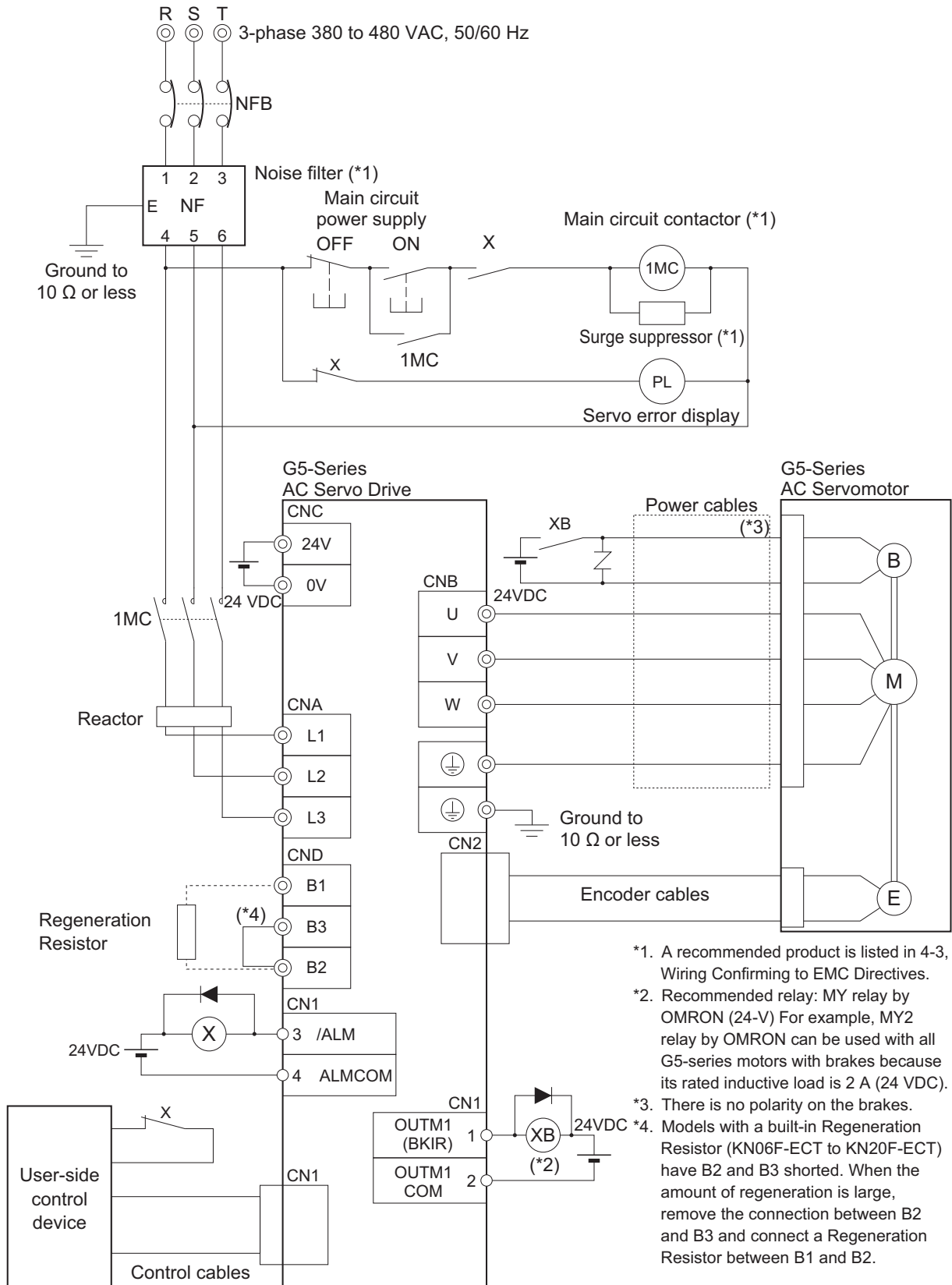


- *1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.
- *2. Recommended relay: MY relay by OMRON (24-V) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated induction load is 2 A (24 VDC).
- *3. There is no polarity on the brakes.
- *4. When using an externally connected Dynamic Brake Resistor, remove the short bar from between 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-KN150H-ECT (AC power input)

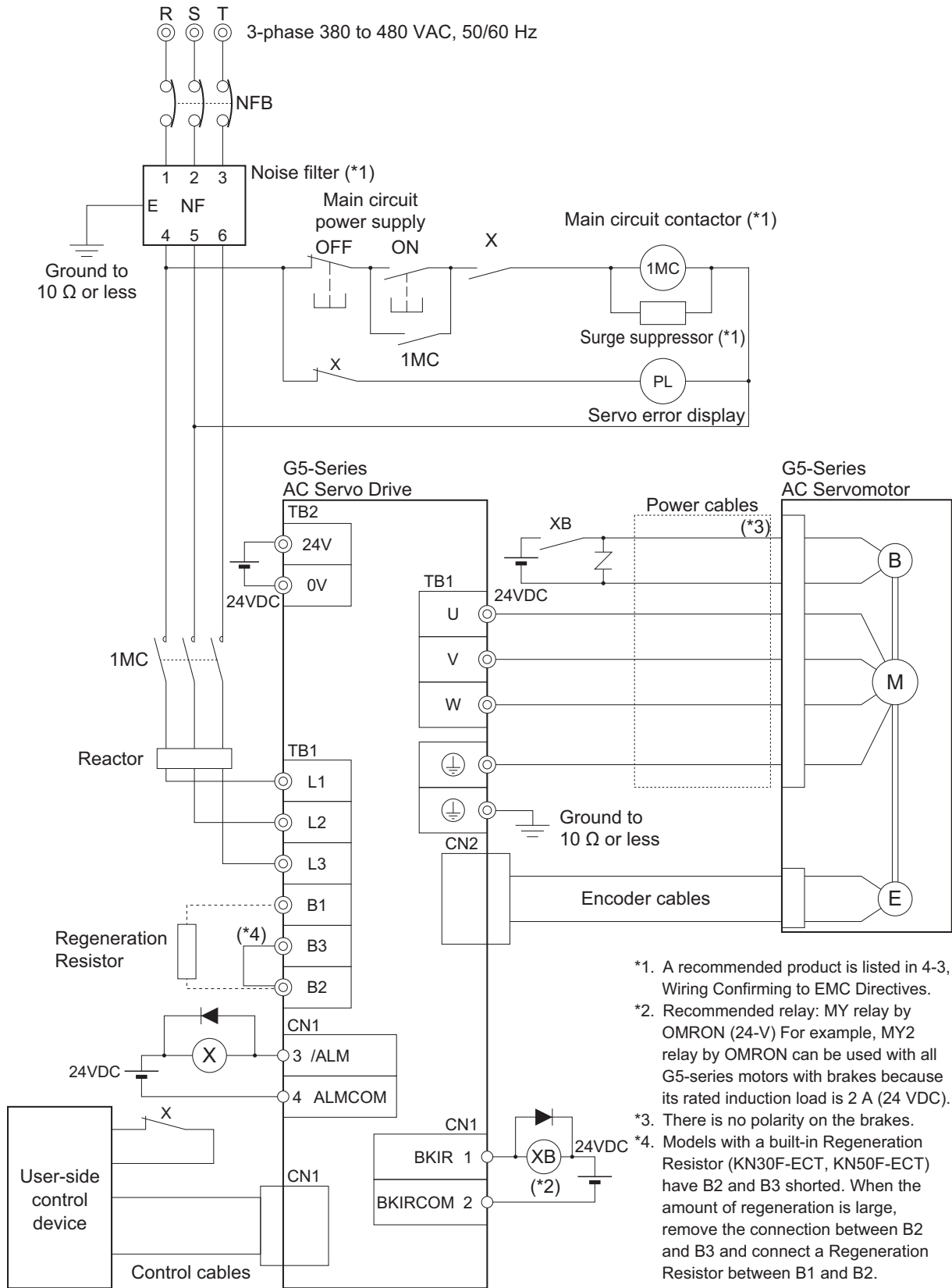


R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT/-KN20F-ECT

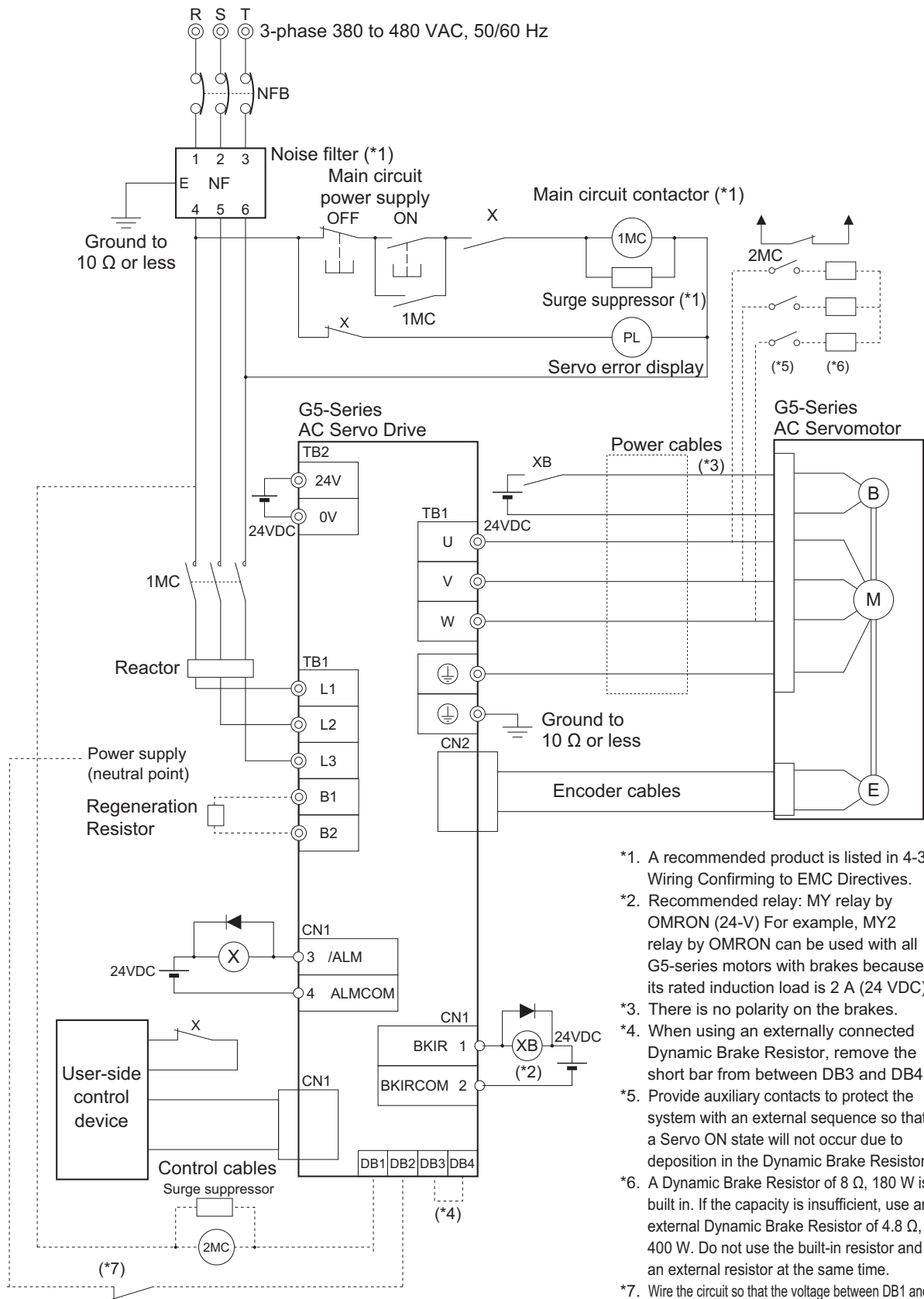


- *1. A recommended product is listed in 4-3, Wiring Confirming to EMC Directives.
- *2. Recommended relay: MY relay by OMRON (24-V) For example, MY2 relay by OMRON can be used with all G5-series motors with brakes because its rated inductive load is 2 A (24 VDC).
- *3. There is no polarity on the brakes.
- *4. Models with a built-in Regeneration Resistor (KN06F-ECT to KN20F-ECT) have B2 and B3 shorted. When the amount of regeneration is large, remove the connection between B2 and B3 and connect a Regeneration Resistor between B1 and B2.

R88D-KN30F-ECT/-KN50F-ECT

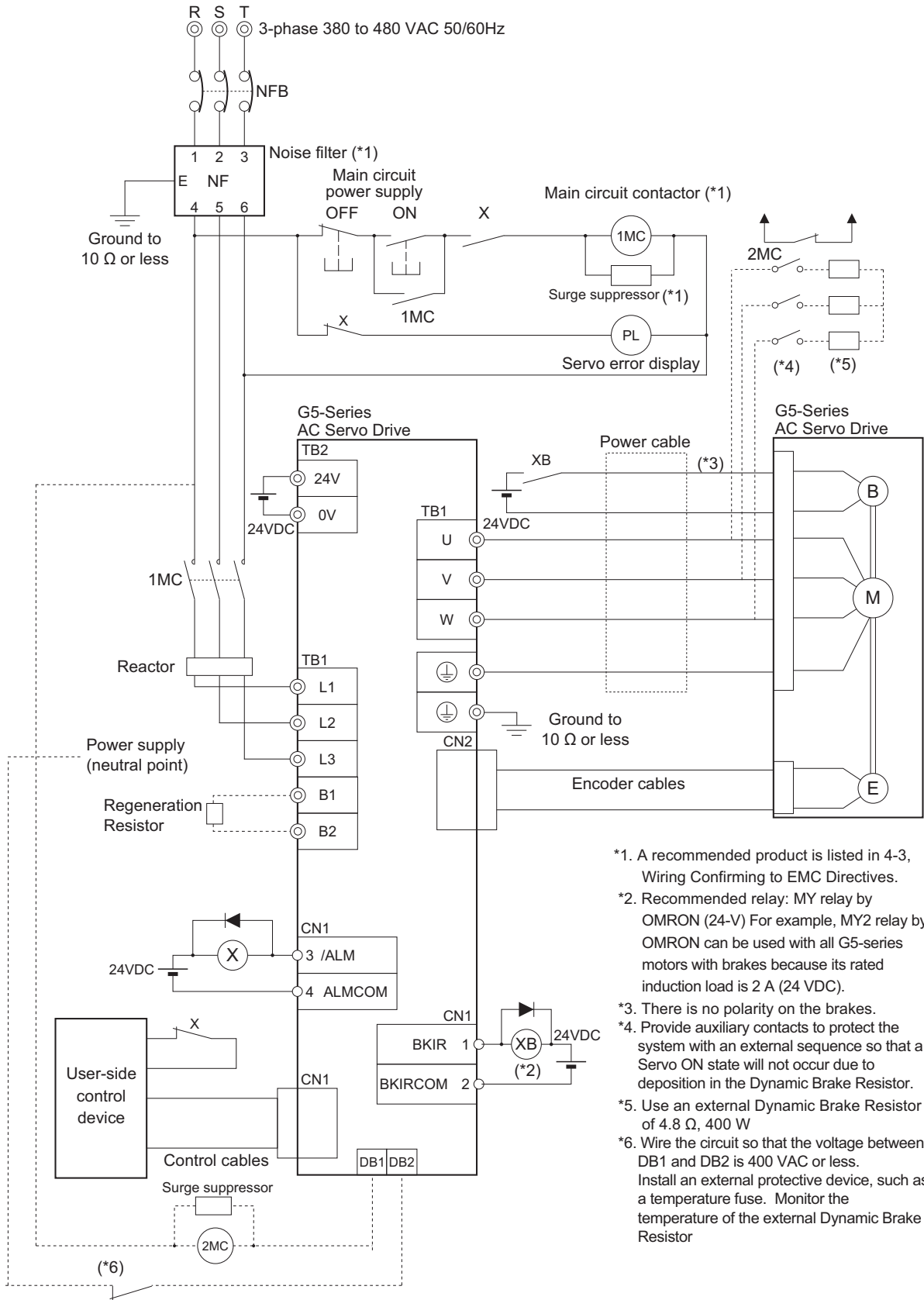


R88D-KN75F-ECT



- *1. A recommended product is listed in 4-3, Wiring Confirming 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, remove the short bar from between 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 the 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.

R88D-KN150F-ECT



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

4-2-3 Main Circuit and Motor Connections

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

R88D-KNA5L-ECT/-KN01L-ECT/-KN02L-ECT/-KN04L-ECT/ R88D-KN01H-ECT/-KN02H-ECT/-KN04H-ECT/-KN08H-ECT/ R88-KN10H-ECT/-KN15H-ECT

● Main Circuit Connector Specifications (CNA)

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

● Motor Connector Specifications (CNB)

| Symbol | Name | Function |
|--------|---|---|
| B1 | External Regeneration Resistor connection terminals | 50 to 400 W: Normally, do not short B1 and B2. Doing so may result in malfunctioning. If there is high regenerative energy, connect an External Regeneration Resistor between B1 and B2. 750 W to 1.5 kW: Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. If there is high regenerative energy, remove the short bar between B2 and B3 and connect an External Regeneration Resistor between B1 and B2. |
| B3 | | |
| B2 | | |
| U | Motor connection terminals | Red |
| V | | White |
| W | | Blue |
| ⊕ | | Green/ Yellow |
| ⊕ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

R88D-KN20H-ECT

● Main Circuit Connector Specifications (CNA)

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

● Motor Connector Specifications (CNB)

| Symbol | Name | Function |
|--------|----------------------------|---|
| U | Motor connection terminals | Red |
| V | | White |
| W | | Blue |
| ⊕ | | Green/ Yellow |
| ⊕ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

These are the output terminals to the Servomotor.
Be sure to wire them correctly.

● External Regeneration Resistor Connector Specifications (CNC)

| Symbol | Name | Function |
|--------|---|---|
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. 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 | | |
| B2 | | |
| NC | Do not connect. | |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN30H-ECT/-KN50H-ECT

● Terminal Block Specifications

| Symbol | Name | Function | |
|--------|---|--|---|
| L1 | Main circuit power supply input | R88D-KT□H-ECT (3 to 5 kW): 3-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz | |
| L2 | | | |
| L3 | | | |
| L1C | Control circuit power supply input | R88D-KT□H-ECT: Single-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz | |
| L2C | | | |
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. 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 | | | |
| 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. | |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN75H-ECT

● Terminal Block Specifications, Left Terminal Block (TB1)

| Symbol | Name | Function | |
|--------|---|--|--|
| L1 | Main circuit power supply input | R88D-KT□H-ECT (7.5 kW): 3-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VAC) | |
| L2 | | | |
| L3 | | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. | |
| B2 | | | |
| N*1 | | | |
| 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 | |

*1 The symbol "N" is found on G5-series AC Servo Drives with unit version 2.1 or later.



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and N (or NC).

● Terminal Block Specifications, Right Terminal Block (TB2)

| Symbol | Name | Function |
|--------|--|---|
| L1C | Control circuit power supply input | R88D-KT□H-ECT: Single-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VAC) |
| L2C | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |
| DB3 | | Normally DB3 and DB4 are shorted. |
| DB4 | | When using an externally connected Dynamic Brake Resistor, remove the short bar from between DB3 and DB4. |
| ⊕ | Frame ground | This is the ground terminal. Ground it to 100 Ω or less. |

R88D-KN150H-ECT

● Terminal Block Specifications, Top Terminal Block (TB1)

| Symbol | Name | Function |
|--------|--|---|
| L1C | Control circuit power supply input | R88D-KT□H-ECT: Single-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VAC) |
| L2C | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |

● Terminal Block Specifications, Bottom Terminal Block (TB2)

| Symbol | Name | Function |
|--------|---|--|
| L1 | Main circuit power supply input | R88D-KT□H-ECT (7.5 kW): 3-phase 200 to 230 VAC (170 to 253 VAC) 50/60 Hz 280 to 325 VDC (238 to 357 VAC) |
| L2 | | |
| L3 | | |
| B1 | External Regeneration Resistor connection terminals | Connect an External Regeneration Resistor between B1 and B2. |
| B2 | | |
| N*1 | | |
| U | Motor connection terminals | Red |
| V | | White |
| W | | Blue |
| ⊕ | | Green/ Yellow |
| ⊕ | Frame ground | This is the ground terminal. Ground to 100 Ω or less. |

*1 The symbol "N" is found on G5-series AC Servo Drives with unit version 2.1 or later.



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and N (or NC)

R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT/-KN20F-ECT

● Main Circuit Connector Specifications (CNA)

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

● Motor Connector Specifications (CNB)

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

● Control Circuit Connector Specifications (CNC)

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

● External Regeneration Resistor Connector Specifications (CND)

| Symbol | Name | Function |
|--------|---|---|
| B1 | External Regeneration Resistor connection terminals | Normally B2 and B3 are shorted. Do not short B1 and B2. Doing so may result in malfunctioning. 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 | | |
| B2 | | |
| NC | Do not connect. | |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN30F-ECT/-KN50F-ECT

● Terminal Block Specifications (TB1)

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

● Terminal Block Specifications (TB2)

| Symbol | Name | Function |
|--------|---|---|
| L1 | Main circuit power supply input | R88D-KN□F-ECT (3 to 5 kW): 3-phase 380 to 480 VAC (323 to 528 VAC) 50/60 Hz |
| L2 | | |
| L3 | | |
| B1 | External Regeneration Resistor connection terminals | A Regeneration Resistor is not built in. |
| B3 | | Connect an External Regeneration Resistor between B1 and B2, if necessary. Normally, do not short B1 and B2. Doing so may result in malfunctioning. |
| B2 | | |
| NC | Do not connect. | |
| U | Motor connection terminals | Red |
| V | | White |
| W | | Blue |
| ⊕ | | Green/ Yellow |
| ⊕ | | Frame ground |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

R88D-KN75F-ECT

● Terminal Block Specifications, Left Terminal Block (TB1)

| Symbol | Name | Function | |
|--------|---|---|--|
| L1 | Main circuit power supply input | R88D-KN□F-ECT (7.5 kW): 3-phase 380 to 480 VAC (323 to 528 VAC) 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 | |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

● Terminal Block Specifications, Right Terminal Block (TB2)

| Symbol | Name | Function |
|--------|--|---|
| 24 V | Control circuit power supply input | 24 VDC \pm 15% |
| 0 V | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |
| DB3 | | Normally DB3 and DB4 are shorted. |
| DB4 | | When using an externally connected Dynamic Brake Resistor, remove the short bar from between DB3 and DB4. |
| ⊕ | Frame ground | This is the ground terminal. Ground to 10 Ω or less. |

R88D-KN150F-ECT

● Terminal Block Specifications, Top Terminal Block (TB1)

| Symbol | Name | Function |
|--------|--|--|
| 24 V | Control circuit power supply input | 24 VDC \pm 15% |
| 0 V | | |
| DB1 | Dynamic Brake Resistor control terminals | These terminals are used to control the MC for externally connected dynamic brake resistance. The output contact specifications are 1 A max. at 300 VAC/100 VDC max. Connect them if required. |
| DB2 | | |

● Terminal Block Specifications, Bottom Terminal Block (TB2)

| Symbol | Name | Function |
|--------|---|--|
| L1 | Main circuit power supply input | R88D-KN□F-ECT (15 kW); 3-phase 380 to 480 VAC (323 to 528 VAC) 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 |
| V | | White |
| W | | Blue |
| ⊕ | | Green/ Yellow |
| ⊕ | Frame ground | This is the ground terminal. Ground to 10 Ω or less. |



Precautions for Correct Use

- Do not connect any External Regeneration Resistors between B1 and NC.

Terminal Block Wire Sizes

● 100-VAC Input Drive Wire Sizes: R88D-KN□□L-ECT

| Model (R88D-) | | Unit | KNA5L-ECT | KN01L-ECT | KN02L-ECT | KN04L-ECT |
|---|-------------------|------|--------------|-----------|-----------|-----------|
| Item | | | | | | |
| Power supply capacity | | kVA | 0.4 | 0.4 | 0.5 | 0.9 |
| Main circuit power supply input (L1 and L3, or L1, L2 and L3) | Rated current | A | 1.7 | 2.6 | 4.3 | 7.6 |
| | Wire size | – | AWG 14 to 18 | | | |
| Control circuit power supply input (L1C and L2C) | Wire size | – | AWG 18 | | | |
| Motor connection terminals (U, V, W, and FG) *1*2 | Rated current | A | 1.2 | 1.7 | 2.5 | 4.6 |
| | Wire size | – | AWG 14 to 18 | | | |
| Frame ground (FG) | Wire size | – | AWG 14 | | | |
| | Screw size | – | M4 | | | |
| | Tightening torque | N·m | 1.2 | | | |

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

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

● 200 VAC Input Drive Wire Sizes: R88D-KN□H-ECT

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

| Model (R88D-) | | KN15H-ECT | KN20H-ECT | KN30H-ECT | KN50H-ECT | KN75H-ECT | KN150H-ECT | |
|--|-------------------|-----------|------------------------|-----------|-----------|------------|------------|------------|
| 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 | | 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 | – | 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) ^{*2 *3} | Rated current | A | 9.4 | 13.4 | 18.7 | 33.0 | 44.0 | 66.1 |
| | 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 resistor control terminals | Wire size | – | – | | | AWG18 | | |
| | Screw size | – | | | | M5 | M6 | |
| | Tightening torque | N·m | | | | 1.3 to 1.5 | | 0.7 to 0.8 |

*1 The first value is for single-phase input power and the second value is for 3-phase input power.

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

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

● 400 VAC Input Drive Wire Sizes: R88D-KN□□F-ECT

| Model (R88D-) | | | KN06 | KN10 | KN15 | KN20 | KN30 | KN50 | KN75 | KN150 |
|---|-------------------|-------|-------------|-------|-------|-------|-------|-------|------------|------------|
| Item | Unit | F-ECT | F-ECT | F-ECT | F-ECT | F-ECT | F-ECT | F-ECT | F-ECT | F-ECT |
| Main circuit power supply input (L1 and L3, or L1, L2 and L3) | Rated current | A | 2.1 | 2.8 | 3.9 | 5.9 | 7.6 | 12.1 | 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 *2 | Rated current | A | 1.5 | 2.9 | 4.7 | 6.7 | 9.4 | 16.5 | 22.0 | 33.1 |
| | 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 resistor control terminals | Wire size | – | – | | | | | | AWG18 | |
| | Screw size | – | | | | | | | M5 | M6 |
| | Tightening torque | N·m | | | | | | | 1.3 to 1.5 | 0.7 to 0.8 |

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

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

Wire Sizes and Allowable Current (Reference)

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

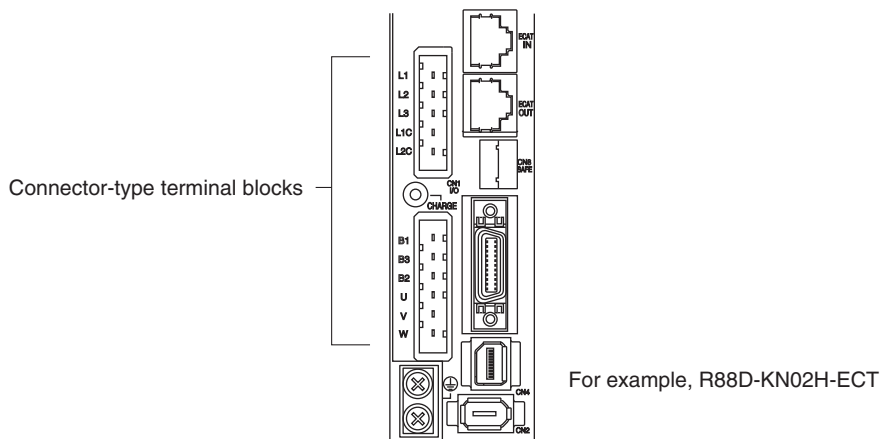
● 600-V Heat-resistant Vinyl Wire (HIV)

| AWG size | Nominal cross-sectional area (mm ²) | Configuration (wires/mm ²) | Conductive resistance (Ω/km) | Allowable current (A) for ambient temperature | | |
|----------|---|--|------------------------------|---|------|------|
| | | | | 30°C | 40°C | 50°C |
| 20 | 0.5 | 19/0.18 | 39.5 | 6.6 | 5.6 | 4.5 |
| – | 0.75 | 30/0.18 | 26.0 | 8.8 | 7.0 | 5.5 |
| 18 | 0.9 | 37/0.18 | 24.4 | 9.0 | 7.7 | 6.0 |
| 16 | 1.25 | 50/0.18 | 15.6 | 12.0 | 11.0 | 8.5 |
| 14 | 2.0 | 7/0.6 | 9.53 | 23 | 20 | 16 |
| 12 | 3.5 | 7/0.8 | 5.41 | 33 | 29 | 24 |
| 10 | 5.5 | 7/1.0 | 3.47 | 43 | 38 | 31 |
| 8 | 8.0 | 7/1.2 | 2.41 | 55 | 49 | 40 |
| 6 | 14.0 | 7/1.6 | 1.35 | 79 | 70 | 57 |
| 4 | 22.0 | 7/2.0 | 0.85 | 99 | 88 | 70 |

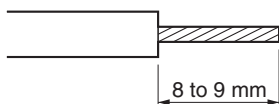
Terminal Block Wiring Procedure

On a Servo Drive with 2.0 kW or less, connector-type terminal blocks are used.

The procedure for wiring these terminal blocks is explained below.



- 1 Remove the terminal block from the Servo Drive before wiring.
The Servo Drive may be damaged if the wiring is done with the terminal block in place.
- 2 Strip off 8 to 9 mm of the covering from the end of each wire.
Refer to *Terminal Block Wire Sizes* on page 4-30 for applicable wire sizes.



3 Open the wire insertion slots in the terminal block using a tool.

There are 2 ways to open the wire insertion slots, as follows.

- Pry the slot open using the lever that comes with the Servo Drive. (Figure A)
- Insert a flat-blade screwdriver (end width: 3.0 to 3.5 mm) into the opening for the driver on the terminal block, and press down firmly to open the slot. (Figure B)

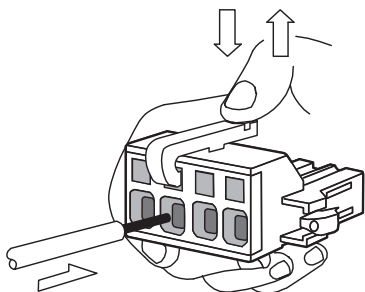


Figure A

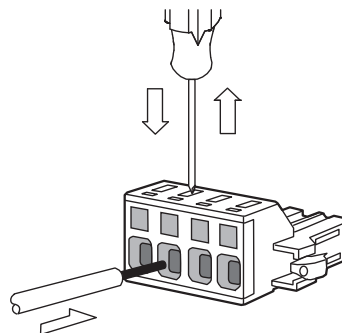


Figure B

4 With the wire insertion slot held open, insert the end of the wire.

After inserting the wire, let the slot close by releasing the pressure from the lever or the screwdriver.

5 Mount the terminal block to the Servo Drive.

After all of the terminals have been wired, return the terminal block to its original position on the Servo Drive.

Note The wire may not be inserted easily depending on the shape of the ferrule connected to it. If this occurs, perform one of the following methods before inserting the wire.

- Change the direction of inserting the connector by 90 degrees.
- Correct the shape of the ferrule with pliers.

4-3 Wiring Conforming to EMC Directives

Conformance to the EMC Directives (EN 55011 Class A Group 1 (EMI) and EN 61000-6-2 (EMS)) can be ensured by wiring under the conditions described in this section.

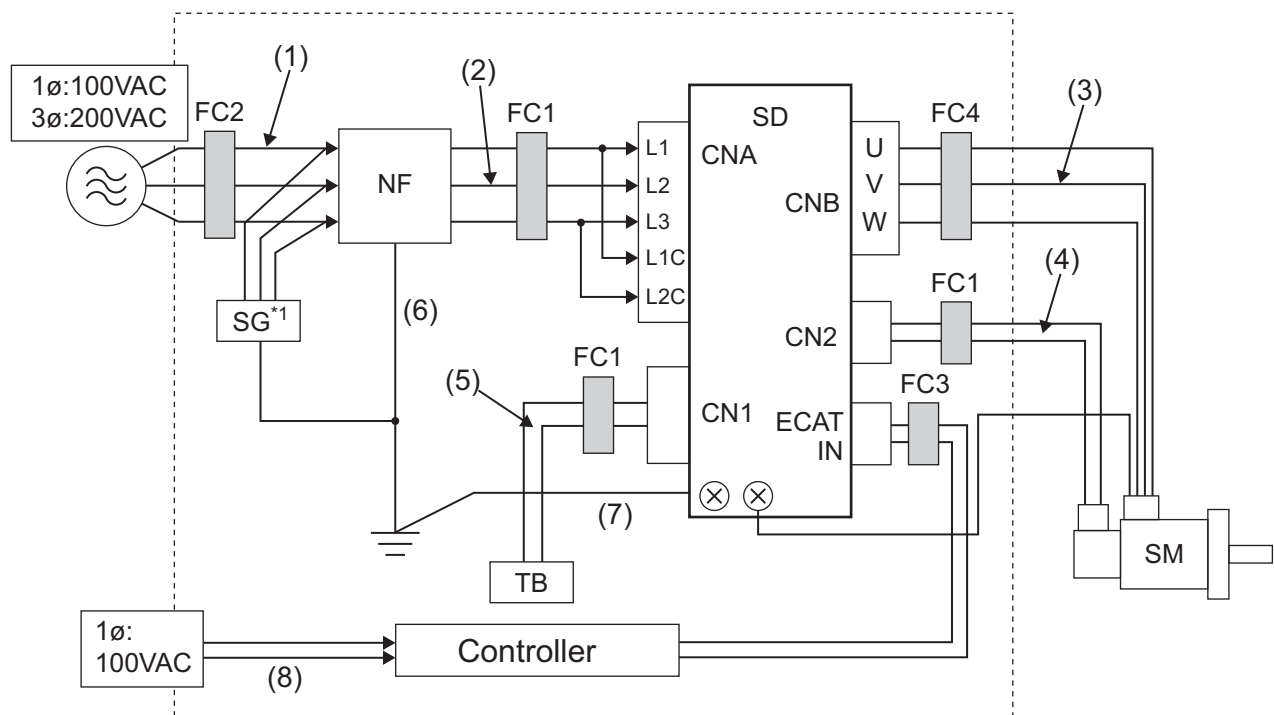
These conditions are for conformance of G5-series products to the EMC directives. EMC-related performance of these products, however, may be influenced by the configuration, wiring, and other conditions of the equipment in which the products are installed. The EMC conformance of the system as a whole must be confirmed by the customer.

The following are the requirements for EMC Directive conformance.

- The Servo Drive must be installed in a metal case (control panel). (The motor does not, however, have to be covered with a metal plate.)
- Noise filters and lightning 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 Servo Drive must have clamp cores installed.
- The shields of all cables must be directly connected to a ground plate.

4-3-1 Wiring Method

R88D-KNA5L-ECT/-KN01L-ECT/-KN02L-ECT/-KN04L-ECT/-KN01H-ECT/ -KN02H-ECT/-KN04H-ECT/-KN08H-ECT/-KN10H-ECT/-KN15H-ECT/ -KN20H-ECT/-KN30H-ECT/-KN50H-ECT/-KN75H-ECT/-KN150H-ECT



*1 Not required for single-phase models with a 100-VAC input.

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

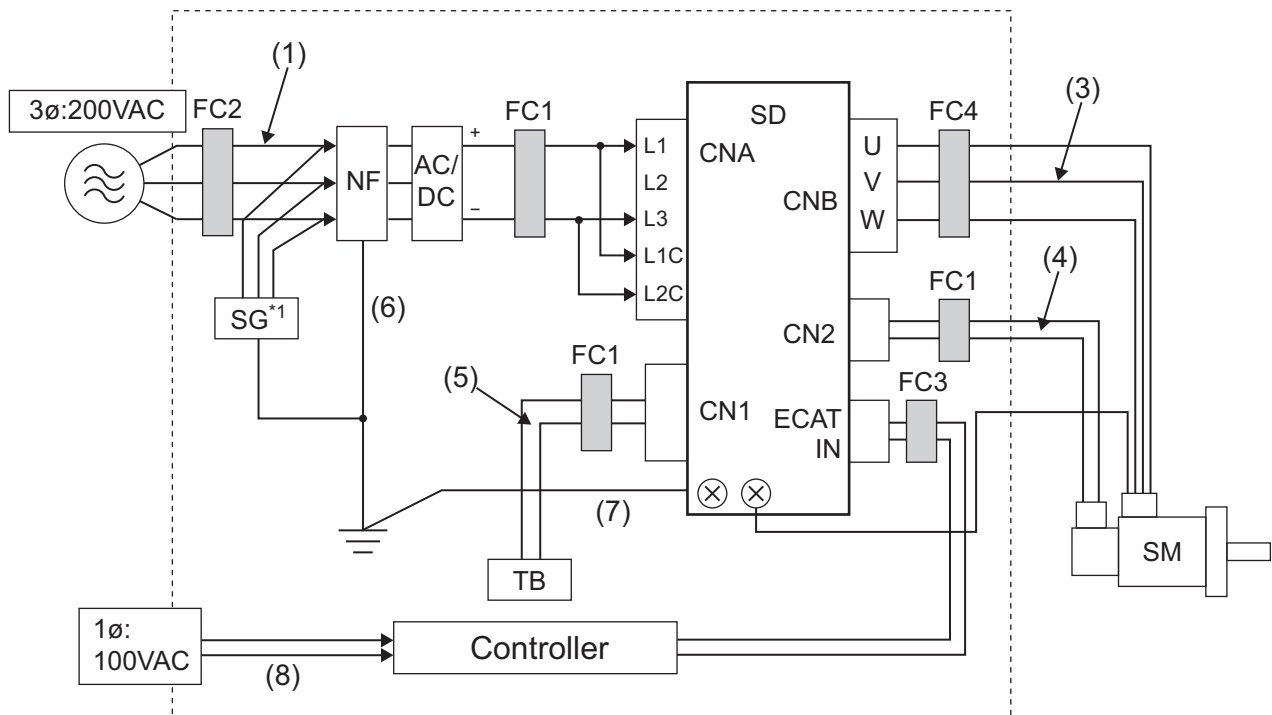
- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use a ground plate for the frame ground for each unit, as shown in the above diagrams, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm², and arrange the wiring so that the ground lines are as short as possible.
- A no-fuse breaker, surge absorber, and noise filter should be positioned near the input terminal block (ground plate), and I/O lines should be separated and wired at the shortest distance.

● Unit Details

| Symbol | Name | Manufacturer | Model | Comment |
|--------|----------------|-------------------------------------|-----------------|--------------------------------|
| SG | Surge absorber | Okaya Electric Industries Co., Ltd. | R·A·V-781BXZ-4 | 3-phase 200 VAC |
| NF | Noise filter | Okaya Electric Industries Co., Ltd. | SUP-EK5-ER-6 | Single-phase 100/200 VAC (5 A) |
| | | | 3SUP-HU10-ER-6 | 3-phase 200 VAC (10 A) |
| | | | 3SUP-HU30-ER-6 | 3-phase 200 VAC (30 A) |
| | | | 3SUP-HL50-ER-6B | 3-phase 200 VAC (50 A) |
| SD | Servo Drive | OMRON | – | *1 |
| SM | Servomotor | OMRON | – | *1 |
| FC1 | Clamp core | TDK | ZCAT3035-1330 | – |
| FC2 | Clamp core | Konno Kogyosho | RJ8035 | – |
| FC3 | Clamp core | NEC TOKIN Corporation | ESD-SR-250 | – |
| FC4 | Clamp core | MICROMETALS | T400-61D | R88D-KN75H-ECT/-KN150H-ECT |
| | | TDK | ZCAT3035-1330 | Except for the above |
| TB | Switch box | – | – | – |
| - | Controller | – | – | – |

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

R88D-KN75H-ECT/-KN150H-ECT (DC power input)



Note L1 and L3 are the main circuit power supply input terminals. Connect the positive wire to L1 and the negative wire to L3.

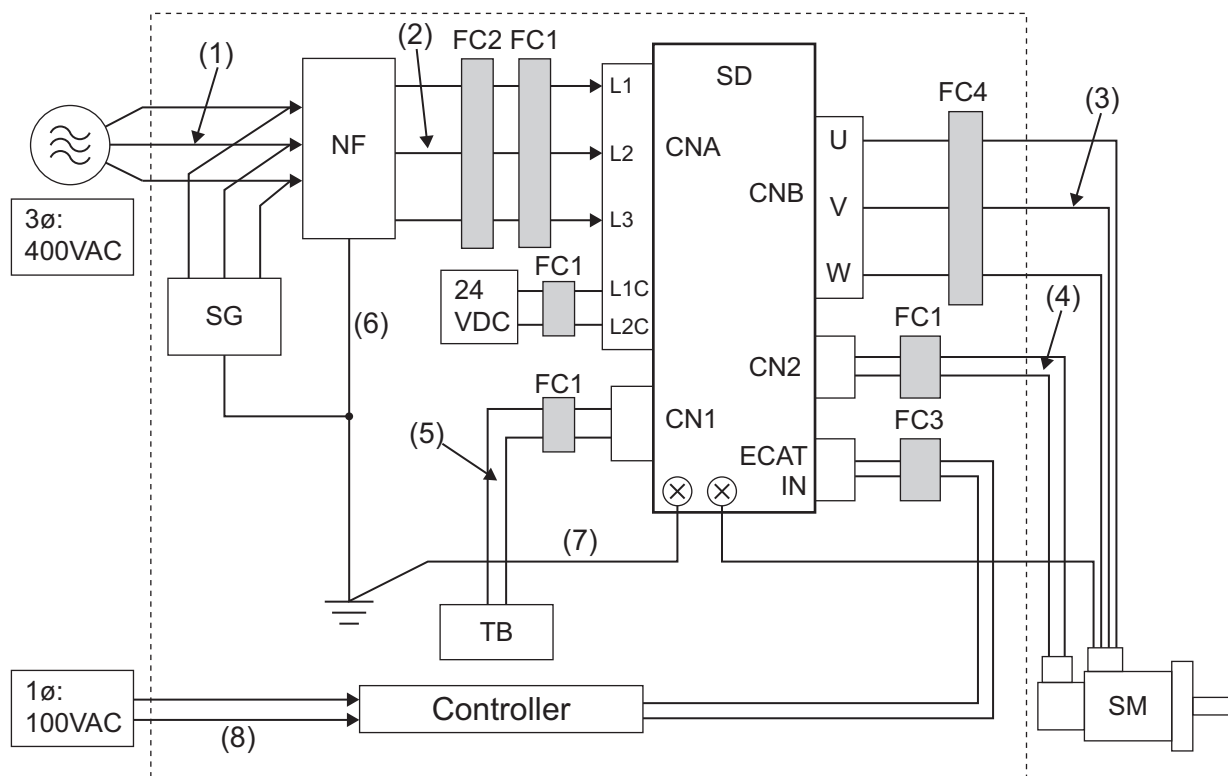
- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use a ground plate for the frame ground for each unit, as shown in the above diagrams, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm², and arrange the wiring so that the ground lines are as short as possible.
- A no-fuse breaker, surge absorber, and noise filter should be positioned near the input terminal block (ground plate), and I/O lines should be separated and wired at the shortest distance.

● Unit Details

| Symbol | Name | Manufacturer | Model | Comment |
|--------|----------------|-------------------------------------|-----------------|------------------------|
| SG | Surge absorber | Okaya Electric Industries Co., Ltd. | R·A·V-781BXZ-4 | 3 phase - 200 VAC |
| NF | Noise filter | Okaya Electric Industries Co., Ltd. | 3SUP-HU30-ER-6 | 3 phase 200 VAC (30 A) |
| | | | 3SUP-HL50-ER-6B | 3 phase 200 VAC (50 A) |
| SD | Servo Drive | OMRON | — | *1 |
| SM | Servomotor | OMRON | — | *1 |
| FC1 | Clamp core | TDK | ZCAT3035-1330 | — |
| FC2 | Clamp core | Konno Kogyosho | RJ8035 | — |
| FC3 | Clamp core | NEC TOKIN Corporation | ESD-SR-250 | — |
| FC4 | Clamp core | MICROMETALS | T400-61D | — |
| TB | Switch box | — | — | — |
| - | Controller | — | — | — |

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

**R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT/-KN20F-ECT/-KN30F-ECT/
-KN50F-ECT/-KN75F-ECT/-KN150F-ECT**



● Unit Details

| Symbol | Name | Manufacturer | Model | Comment |
|--------|----------------|-------------------------------------|-----------------|----------------------------|
| SG | Surge absorber | Okaya Electric Industries Co., Ltd. | R·A·V-801BXZ-4 | |
| NF | Noise filter | Okaya Electric Industries Co., Ltd. | 3SUP-HQ10-ER-6 | |
| | | | 3SUP-HL50-ER-6B | |
| | | Schaffner | FN258-42-07 | |
| SD | Servo Drive | OMRON | - | *1 |
| SM | Servomotor | OMRON | - | *1 |
| FC1 | Clamp core | TDK | ZCAT3035-1330 | - |
| FC2 | Clamp core | Konno Kogyosyo | RJ8035 | - |
| FC3 | Clamp core | NEC TOKIN Corporation | ESD-SR-250 | - |
| FC4 | Clamp core | MICROMETALS | T400-61D | R88D-KN75H-ECT/-KN150H-ECT |
| | | TDK | ZCAT3035-1330 | Except for the above |
| TB | Switch box | - | - | - |
| - | Controller | - | - | - |

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

● Cable Details

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

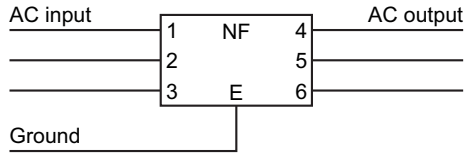
Noise Filter for Power Supply Input

We recommend using a noise filter for the Servo Drive.

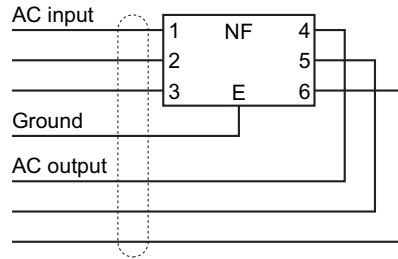
| Drive | | Noise filter for power supply input | | | |
|-----------------------|---------------|-------------------------------------|---------------|-----------------------------|-------------------------------------|
| Phase | Model | Model | Rated current | Leakage current (60 Hz) max | Manufacturer |
| Single-phase | R88D-K□A5L□□ | SUP-EK5-ER-6 | 5 A | 1.0 mA (at 250 VAC) | Okaya Electric Industries Co., Ltd. |
| | R88D-K□01L□□ | | | | |
| | R88D-K□02L□□ | | | | |
| Single-phase | R88D-K□04L□□ | 3SUP-HU10-ER-6 | 10 A | 3.5 mA (at 500 VAC) | |
| Single-phase | R88D-K□01H□ | SUP-EK5-ER-6 | 5 A | 1.0 mA (at 250 VAC) | |
| 3-phase | | 3SUP-HU10-ER-6 | 10 A | 3.5 mA (at 500 VAC) | |
| Single-phase | R88D-K□02H□□ | SUP-EK5-ER-6 | 5 A | 1.0 mA (at 250 VAC) | |
| 3-phase | | 3SUP-HU10-ER-6 | 10 A | 3.5 mA (at 500 VAC) | |
| Single-phase | R88D-K□04H□□ | SUP-EK5-ER-6 | 5 A | 1.0 mA (at 250 VAC) | |
| 3-phase | | 3SUP-HU10-ER-6 | 10 A | 3.5 mA (at 500 VAC) | |
| Single-phase, 3-phase | R88D-K□08H□□ | 3SUP-HU30-ER-6 | 30 A | 3.5 mA (at 500 VAC) | |
| | R88D-K□10H□□ | | | | |
| | R88D-K□15H□□ | | | | |
| 3-phase | R88D-K□20H□□ | 3SUP-HU50-ER-6 | 50 A | 8.0 mA (at 500 VAC) | |
| | R88D-K□30H□□ | 3SUP-HL50-ER-6B | 50 A | | |
| | R88D-K□50H□□ | | | | |
| | R88D-K□75H□□ | FS5559-60-34 | 60 A | 1.35 mA (at 480 VAC/50 Hz) | Schaffner |
| | | R88D-K□150H□□ | FS5559-80-34 | | |
| | R88D-K□06F□□ | FN258-16-07 | 16 A | 0.8 mA (at 440 VAC/50 Hz) | |
| | R88D-K□10F□□ | | | | |
| | R88D-K□15F□□ | | | | |
| | R88D-K□20F□□ | | | | |
| | R88D-K□30F□□ | FN258-30-07 | 30 A | 0.8 mA (at 440 VAC/50 Hz) | |
| | R88D-K□50F□□ | | | | |
| | R88D-K□75F□□ | | | | |
| | R88D-K□150F□□ | FN258-42-07 | 42 A | 25.8 mA (at 440 VAC/50 Hz) | |

- 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.

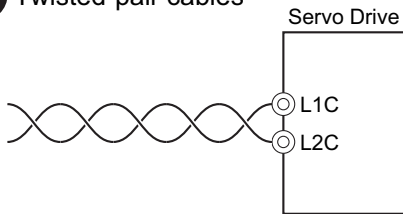


⊘ The effect of the noise filter is small.

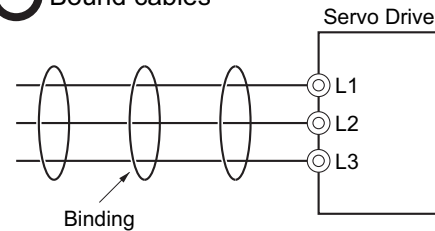


- Use twisted-pair cables for the power supply cables, or bind the cables.

○ Twisted-pair cables



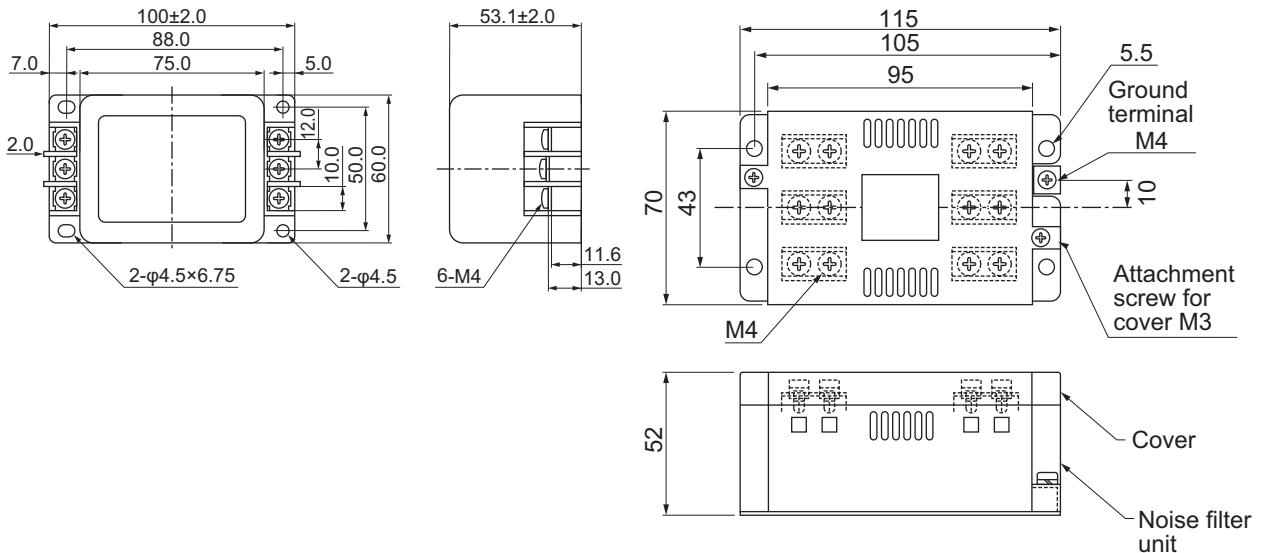
○ Bound cables



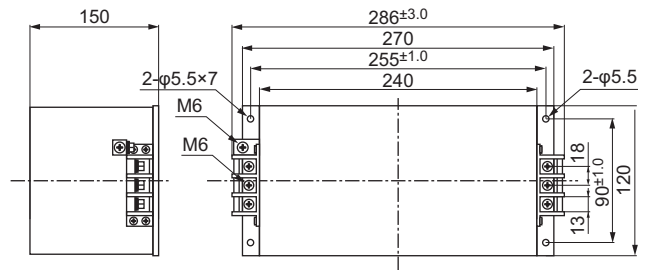
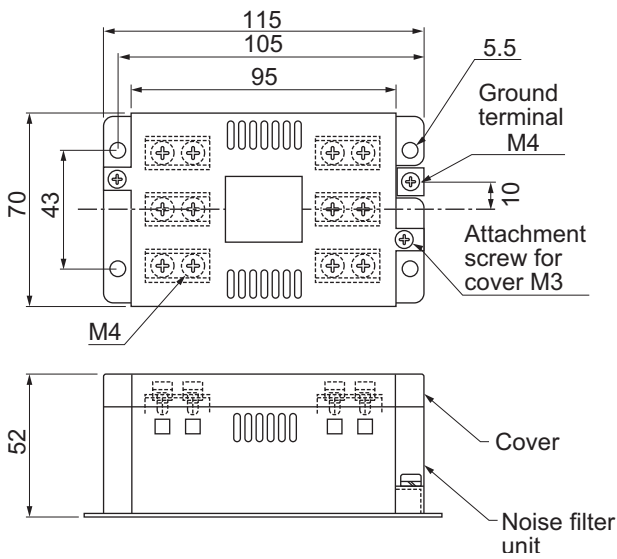
- Separate power supply lines and signal lines when wiring.

● External Dimensions

SUP-EK5-ER-6/3SUP-HQ10-ER-6

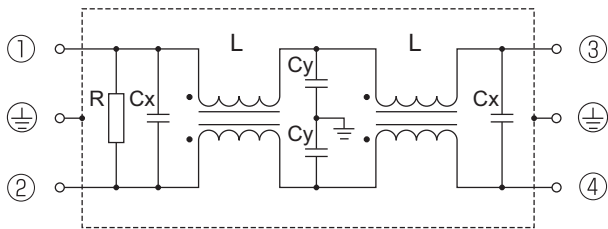


3SUP-HU30-ER-6/3SUP-HL50-ER-6B

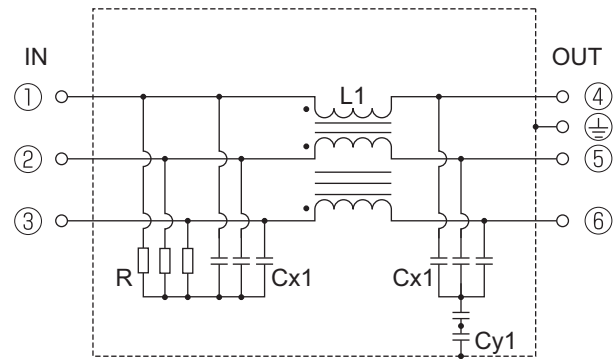


● Circuit Diagram

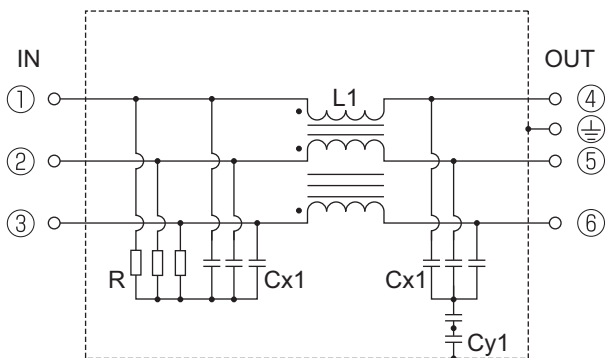
SUP-EK5-ER-6



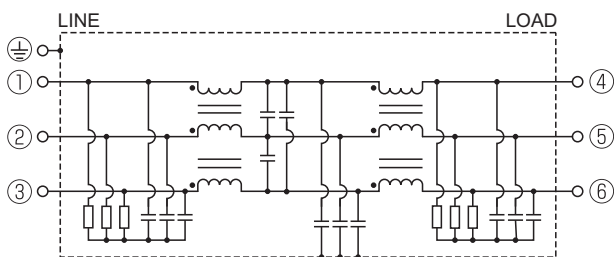
3SUP-HQ10-ER-6



3SUP-HU30-ER-6



3SUP-HL50-ER-6B



Control Panel Structure

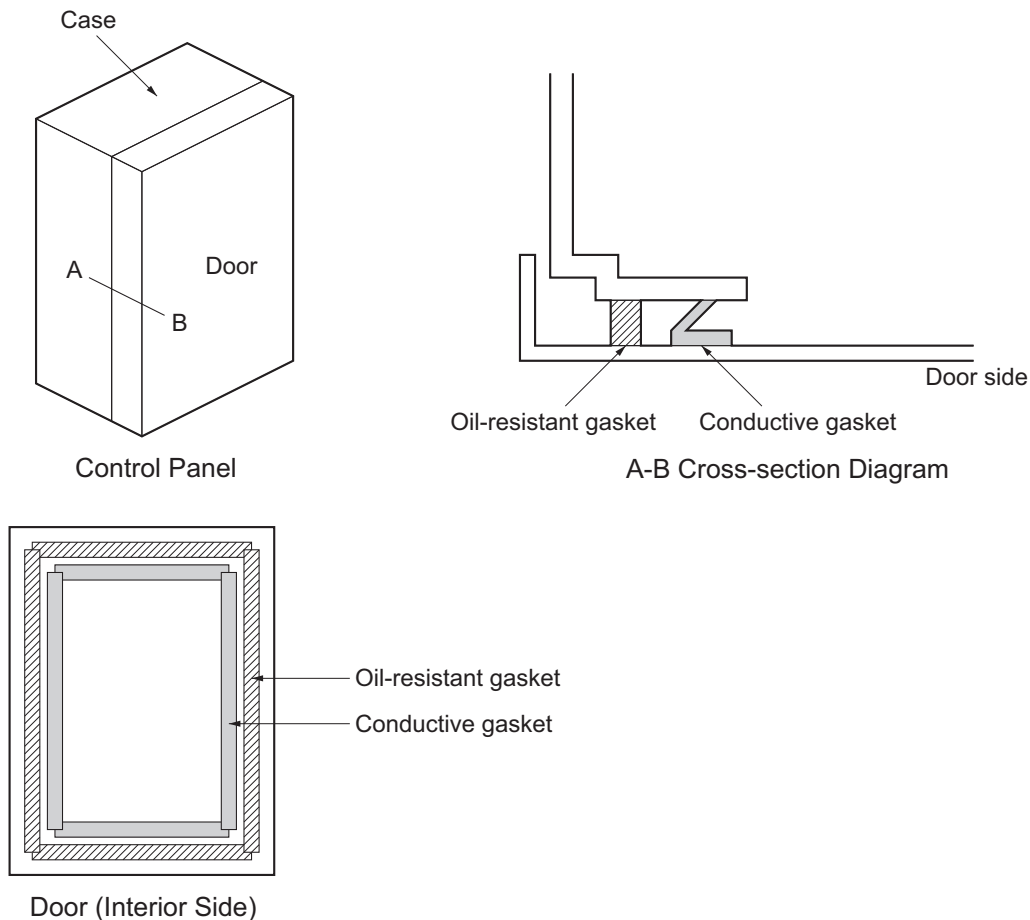
Openings in the control panel, such as holes for cables, panel mounting holes, and gaps around the door, may allow electromagnetic waves into the panel. To prevent this, observe the recommendations described below when designing or selecting a control panel.

● Case Structure

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

● Door Structure

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



4-3-2 Selecting Connection Component

This section explains the criteria for selecting the connection components required to improve noise resistance.

Understand each component's characteristics, such as its capacity, performance, and applicable range when selecting the connection components.

For more details, contact the manufacturers directly.

No-fuse Breaker (NFB)

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

● Maximum Input Current

- The momentary maximum output of Servo Drive is approx. 3 times the rated output, and can be output for up to 3 seconds.
Therefore, select no-fuse breakers with an operation time of at least 5 seconds at 300% of the rated current ratio. General and low-speed no-fuse breakers are generally suitable.
- Select a no-fuse breaker with a rated current greater than the total effective load current of all the motors (when multiple Servo Drives are used). (The rated current of the power supply input for each motor is provided in *Main Circuit and Motor Connections* on page 4-21.)
- Add the current consumption of other controllers, and any other components when selecting.

● Inrush Current

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

| Servo Drive model | Inrush current (Ao-p) | |
|-------------------|---------------------------|------------------------------|
| | Main circuit power supply | Control circuit power supply |
| R88D-KNA5L-ECT | 7 | 14 |
| R88D-KN01L-ECT | 7 | 14 |
| R88D-KN02L-ECT | 7 | 14 |
| R88D-KN04L-ECT | 15 | 14 |
| R88D-KN01H-ECT | 14 | 28 |
| R88D-KN02H-ECT | 14 | 28 |
| R88D-KN04H-ECT | 14 | 28 |
| R88D-KN08H-ECT | 29 | 28 |
| R88D-KN10H-ECT | 29 | 28 |
| R88D-KN15H-ECT | 29 | 28 |
| R88D-KN20H-ECT | 29 | 14 |
| R88D-KN30H-ECT | 22 | 14 |
| R88D-KN50H-ECT | 22 | 14 |
| R88D-KN75H-ECT | 66 | 15 |
| R88D-KN150H-ECT | 66 | 15 |
| R88D-KN06F-ECT | 28 | 48 |
| R88D-KN10F-ECT | 28 | 48 |

| Servo Drive model | Inrush current (Ao-p) | |
|-------------------|---------------------------|------------------------------|
| | Main circuit power supply | Control circuit power supply |
| R88D-KN15F-ECT | 28 | 48 |
| R88D-KN20F-ECT | 32 | 48 |
| R88D-KN30F-ECT | 32 | 48 |
| R88D-KN50F-ECT | 32 | 48 |
| R88D-KN75F-ECT | 32 | 48 |
| R88D-KN150F-ECT | 32 | 48 |

Leakage Breaker

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

| Servo Drive model | Input power supply | Leakage current (Cable: 3 m) | Increase per 10 m of cable |
|-------------------|--------------------|------------------------------|----------------------------|
| R88D-KNA5L-ECT | Single-phase 100 V | 0.38 mA | 0.1 mA |
| R88D-KN01L-ECT | Single-phase 100 V | 0.39 mA | |
| R88D-KN02L-ECT | Single-phase 100 V | 0.41 mA | |
| R88D-KN04L-ECT | Single-phase 100 V | 0.46 mA | 0.12 mA |
| R88D-KN01H-ECT | Single-phase 200 V | 0.83 mA | 0.23 mA |
| | 3-phase 200 V | 1.03 mA | |
| R88D-KN02H-ECT | Single-phase 200 V | 0.84 mA | 0.23 mA |
| | 3-phase 200 V | 1.02 mA | |
| R88D-KN04H-ECT | Single-phase 200 V | 0.96 mA | 0.3 mA |
| | 3-phase 200 V | 1.27 mA | |
| R88D-KN08H-ECT | Single-phase 200 V | 1.01 mA | 1.1 mA |
| | 3-phase 200 V | 1.39 mA | |
| R88D-KN10H-ECT | Single-phase 200 V | 0.88 mA | 0.93 mA |
| | 3-phase 200 V | 1.14 mA | |
| R88D-KN15H-ECT | Single-phase 200 V | 0.96 mA | 0.93 mA |
| | 3-phase 200 V | 1.18 mA | |
| R88D-KN20H-ECT | 3-phase 200 V | 1.53 mA | 1.23 mA |
| R88D-KN30H-ECT | 3-phase 200 V | 1.52 mA | |
| R88D-KN50H-ECT | 3-phase 200 V | 1.39 mA | |
| R88D-KN75H-ECT | 3-phase 200 V | 3.50 mA | 2.07 mA |
| R88D-KN150H-ECT | 3-phase 200 V | 5.30 mA | 1.13 mA |

| Servo Drive model | Input power supply | Leakage current (Cable: 3 m) | Increase per 10 m of cable |
|-------------------|--------------------|---------------------------------|-------------------------------|
| R88D-KN06F-ECT | 3-phase 400 V | 2.28 mA | 1.8 mA |
| R88D-KN10F-ECT | 3-phase 400 V | 2.20 mA | |
| R88D-KN15F-ECT | 3-phase 400 V | 2.55 mA | 2.03 mA |
| R88D-KN20F-ECT | 3-phase 400 V | 2.92 mA | 2.4 mA |
| R88D-KN30F-ECT | 3-phase 400 V | 3.92 mA | 3.23 mA |
| R88D-KN50F-ECT | 3-phase 400 V | 3.54 mA | 2.9 mA |
| R88D-KN75F-ECT | 3-phase 400 V | 6.70 mA | 3.73 mA |
| R88D-KN150F-ECT | 3-phase 400 V | 10.40 mA | 2.73 mA |

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

Surge Absorber

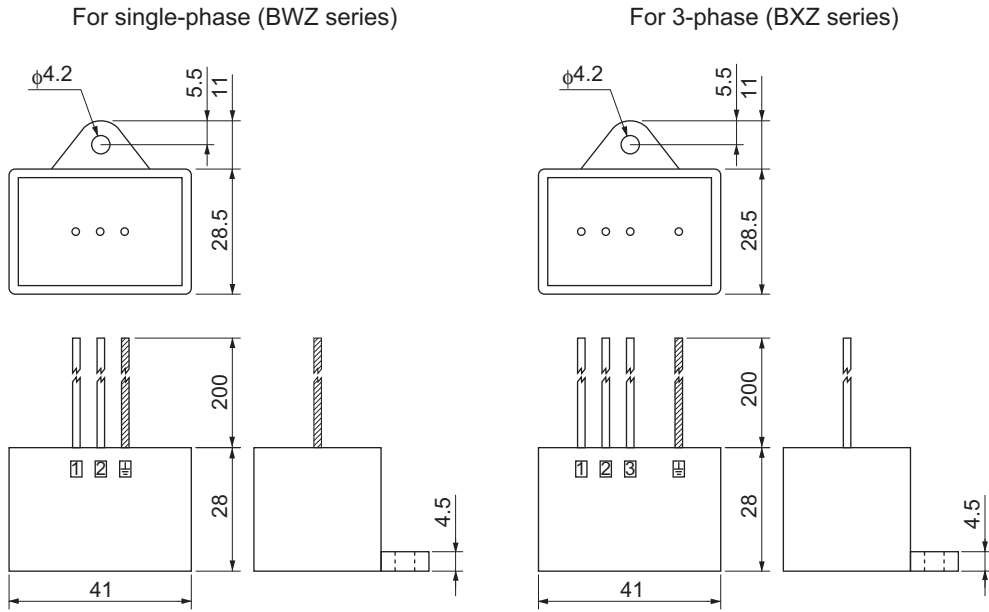
- Use surge absorbers to absorb lightning surge voltage and abnormal voltage from power supply input lines.
- When selecting surge absorbers, take into account the varistor voltage, the surge immunity and the energy tolerated dose.
- For 200-VAC systems, use surge absorbers with a varistor voltage of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

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

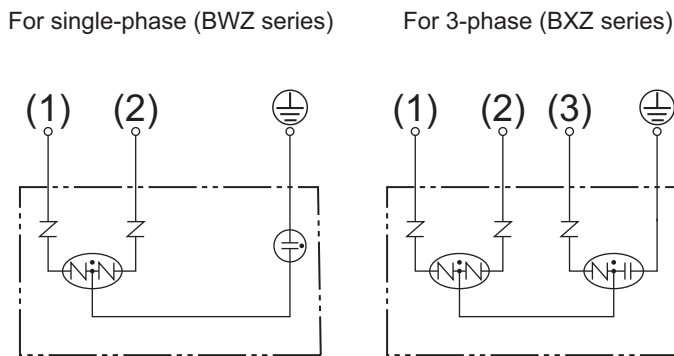
Note 1 Refer to the manufacturers' catalog for operating details.

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

● External Dimensions



● Equalizing Circuits



Noise Filter for the Brake Power Supply

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

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

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

Radio Noise Filter and Emission Noise Prevention Clamp Core

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

| Model | Manufacturer | Application |
|------------------|----------------|----------------------------------|
| 3G3AX-ZCL1 *1 | OMRON | For Drive output and power cable |
| 3G3AX-ZCL2 *2 | OMRON | For Drive output and power cable |
| ESD-R-47B *3 | NEC TOKIN | For Drive output and power cable |
| ZCAT3035-1330 *4 | TDK | For Encoder cable and I/O cable |
| RJ8035 | Konno Kogyosho | For power supply line |
| RJ8095 | Konno Kogyosho | For power supply line |
| T400-61D | MICROMETALS | For Drive output and power cable |

*1 Generally used for 1.5 kW or higher.

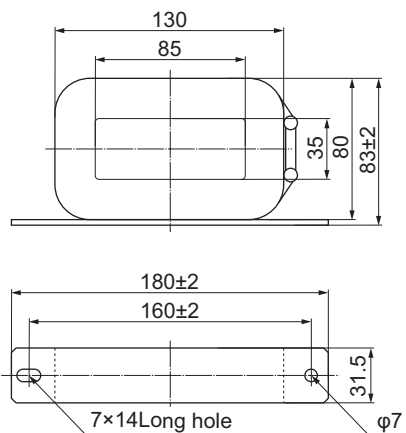
*2 Generally used for 1.5 kW or lower. The maximum number of windings is 3 turns.

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

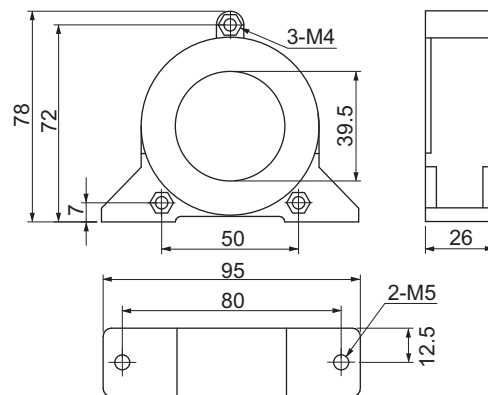
*4 Also used on the Drive output power lines to comply with the EMC Directives. Only a clamp is used. This clamp can also be used to reduce noise current on a FG line.

External Dimensions

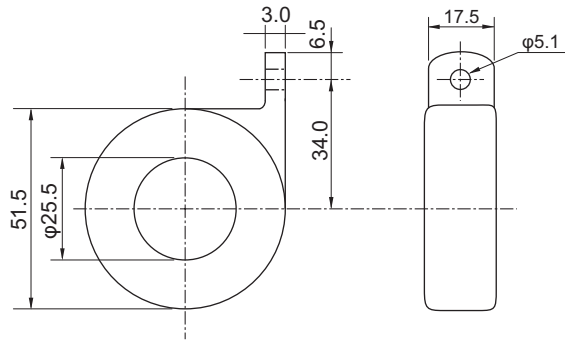
3G3AX-ZCL1



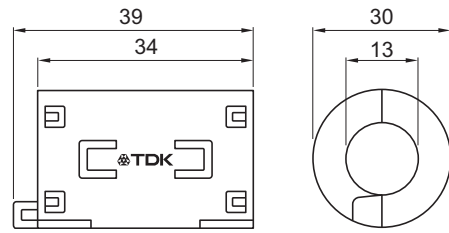
3G3AX-ZCL2



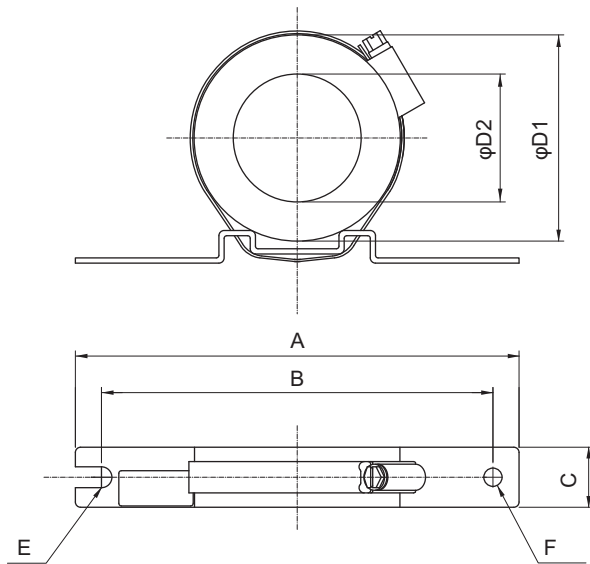
ESD-R-47B



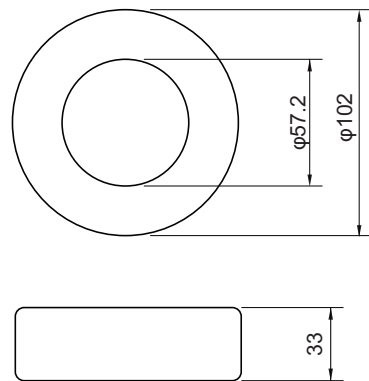
ZCAT3035-1330



RJ8035/RJ8095



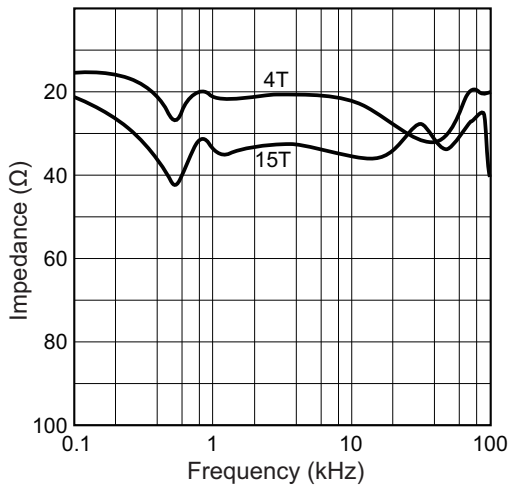
T400-61D



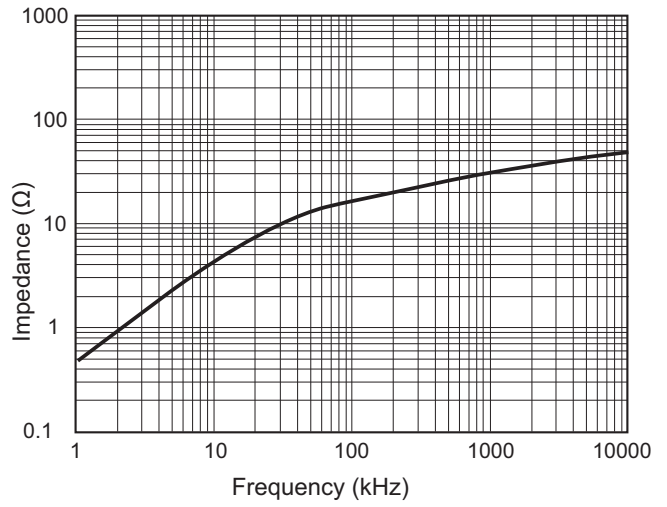
| Model | Rated current | Dimensions (mm) | | | | | | | |
|--------|---------------|-----------------|-----|----|-----|-----|----------------|------|---|
| | | A | B | C | D1 | D2 | Core thickness | E | F |
| RJ8035 | 35A | 170 | 150 | 23 | 80 | 53 | 24 | R3.5 | 7 |
| RJ8095 | 95A | 200 | 180 | 34 | 130 | 107 | 35 | R3.5 | 7 |

● Impedance Characteristics

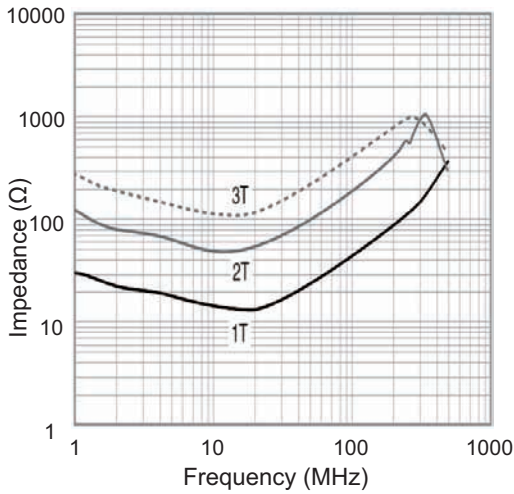
3G3AX-ZCL1



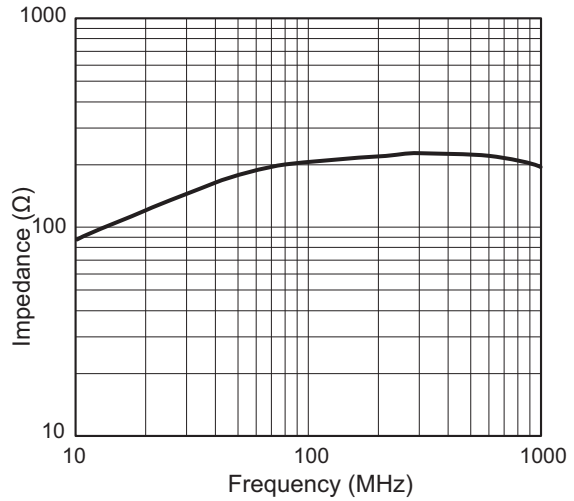
3G3AX-ZCL2



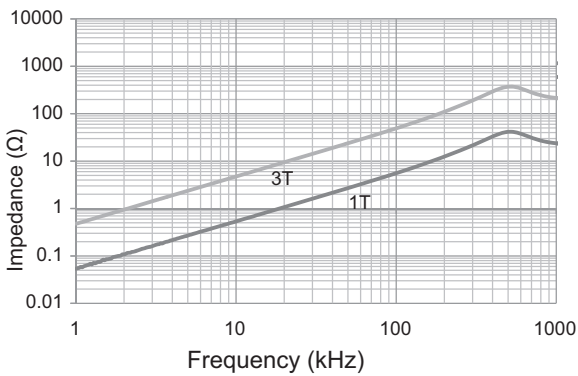
ESD-R-47B



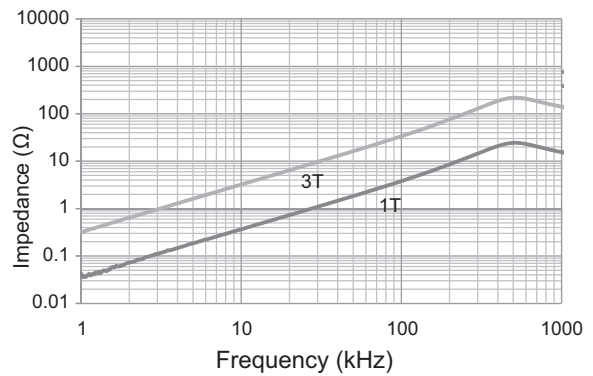
ZCAT3035-1330

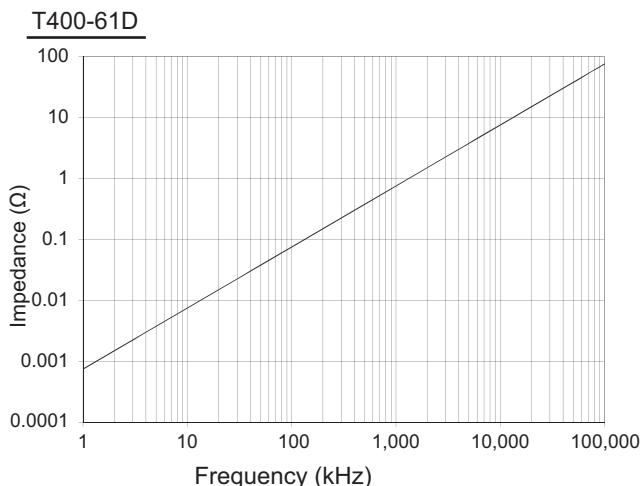


RJ8035



RJ8095





Surge Suppressors

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

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

- Thyristors and varistors are made by the following manufacturers. Refer to manufacturer's documentation for details on these components.

Thyristors: Ishizuka Electronics Co.

Varistor: Ishizuka Electronics Co., Panasonic Corporation

Contactors

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

Improving Encoder Cable Noise Resistance

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

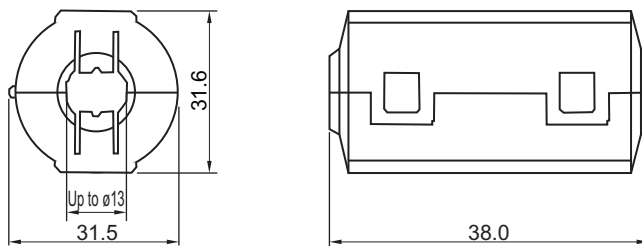
- Always use the specified encoder cables.
- If cables are joined midway, be sure to use connectors. And do not remove more than 50 mm of the cable insulation. In addition, always use shielded cables.
- Do not roll cables. If cables are long and are rolled, mutual induction and inductance will increase and cause malfunctions. Always use cables fully extended.
- When installing noise filters for encoder cables, use clamp cores.
- The following table shows the recommended clamp cores.

| Manufacturer | Product name | Model | Specifications |
|--------------|--------------|---------------|-----------------|
| NEC TOKIN | Clamp core | ESD-SR-250 | 13 mm dia. max. |
| TDK | Clamp core | ZCAT3035-1330 | 13 mm dia. max. |

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

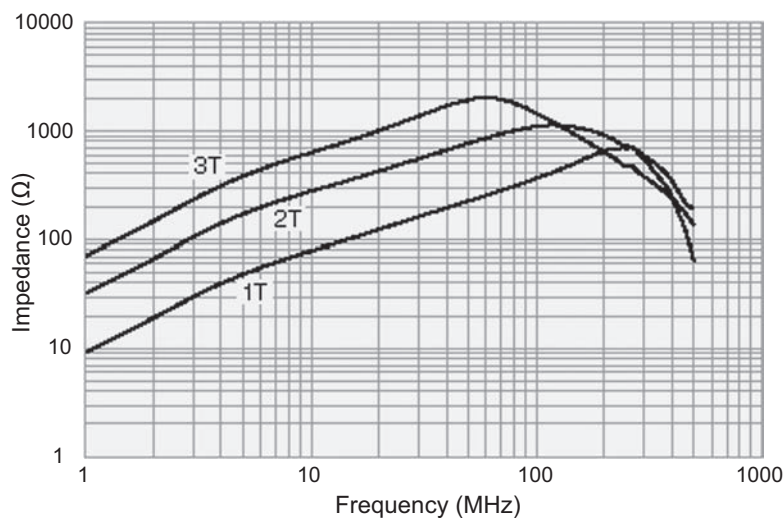
External Dimensions

ESD-SR-250



Impedance Characteristics

ESD-SR-250



For information on an external dimensions and impedance characteristics of ZCAT3035-1330, refer to *External Dimensions* on page 4-47 and *Impedance Characteristics* on page 4-49.

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.
- If the control power supply wiring is long, noise resistance can be improved by adding 1- μ F laminated ceramic capacitors between the control power supply and ground at the drive input section or the controller output section.

Reactor to Reduce Harmonic Current

● Harmonic Current Measures

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

| Servo Drive model | Reactor | | | |
|--|--------------|---------------|------------|--------------|
| | Model | Rated current | Inductance | Reactor type |
| R88D-KNA5L-ECT R88D-KN01H-ECT (For single-phase input) | 3G3AX-DL2002 | 1.6 A | 21.4 mH | DC reactor |
| R88D-KN01L-ECT R88D-KN02H-ECT (For single-phase input) | 3G3AX-DL2004 | 3.2 A | 10.7 mH | |
| R88D-KN02L-ECT R88D-KN04H-ECT (For single-phase input) | 3G3AX-DL2007 | 6.1 A | 6.75 mH | |
| R88D-KN04L-ECT R88D-KN08H-ECT R88D-KN10H-ECT (For single-phase input) | 3G3AX-DL2015 | 9.3 A | 3.51 mH | |
| R88D-KN15H-ECT (For single-phase input) | 3G3AX-DL2022 | 13.8 A | 2.51 mH | |
| R88D-KN08H-ECT R88D-KN10H-ECT R88D-KN15H-ECT (For 3-phase input) | 3G3AX-AL2025 | 10.0 A | 2.8 mH | |
| R88D-KN20H-ECT R88D-KN30H-ECT | 3G3AX-AL2055 | 20.0 A | 0.88 mH | |
| R88D-KN50H-ECT | 3G3AX-AL2110 | 34.0 A | 0.35 mH | |
| R88D-KN75H-ECT R88D-KN150H-ECT | 3G3AX-AL2220 | 67.0 A | 0.18 mH | |
| R88D-KN06F-ECT R88D-KN10F-ECT R88D-KN15F-ECT | 3G3AX-AL4025 | 5.0 A | 7.7 mH | |
| R88D-KN20F-ECT R88D-KN30F-ECT | 3G3AX-AL4055 | 10.0 A | 3.5 mH | |
| R88D-KN50F-ECT | 3G3AX-AL4110 | 17.0 A | 1.3 mH | |
| R88D-KN75F-ECT R88D-KN150F-ECT | 3G3AX-AL4220 | 34.0 A | 0.74 mH | |

Selecting Other Parts for Noise Resistance

This section explains the criteria for selecting the connection components required to improve noise resistance.

Understand each component's characteristics, such as its capacity, performance, and applicable range when selecting the connection components.

For more details, contact the manufacturers directly.

● Noise Filters for Motor Output

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

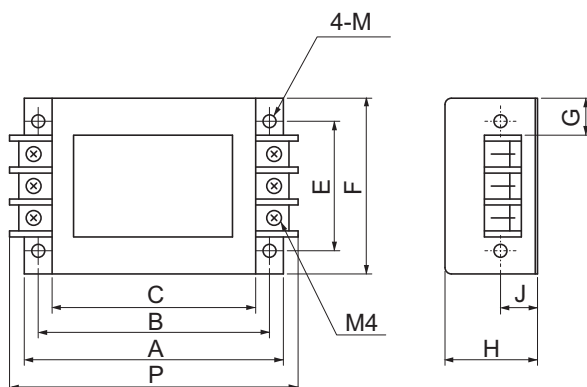
| Manufacturer | Model | Rated current | Comment |
|--------------|-------------|---------------|---------------------|
| OMRON | 3G3AX-NF001 | 6 A | For inverter output |
| | 3G3AX-NF002 | 12 A | |
| | 3G3AX-NF003 | 25 A | |
| | 3G3AX-NF004 | 50 A | |
| | 3G3AX-NF005 | 75 A | |
| | 3G3AX-NF006 | 100 A | |

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

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

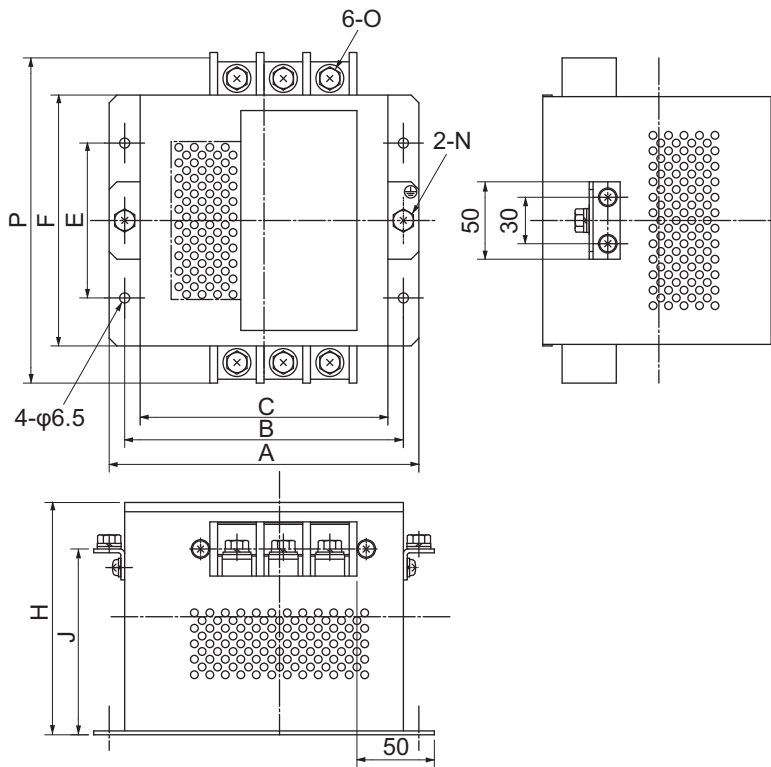
● External Dimensions

3G3AX-NF001/-NF002



| Model | Dimensions (mm) | | | | | | | | | |
|-------------|-----------------|-----|-----|----|-----|----|----|----|----------|-----|
| | A | B | C | E | F | G | H | J | M | P |
| 3G3AX-NF001 | 140 | 125 | 110 | 70 | 95 | 22 | 50 | 20 | 4.5 dia. | 156 |
| 3G3AX-NF002 | 160 | 145 | 130 | 80 | 110 | 30 | 70 | 25 | 5.5 dia. | 176 |

3G3AX-NF003/-NF004/-NF005/-NF006



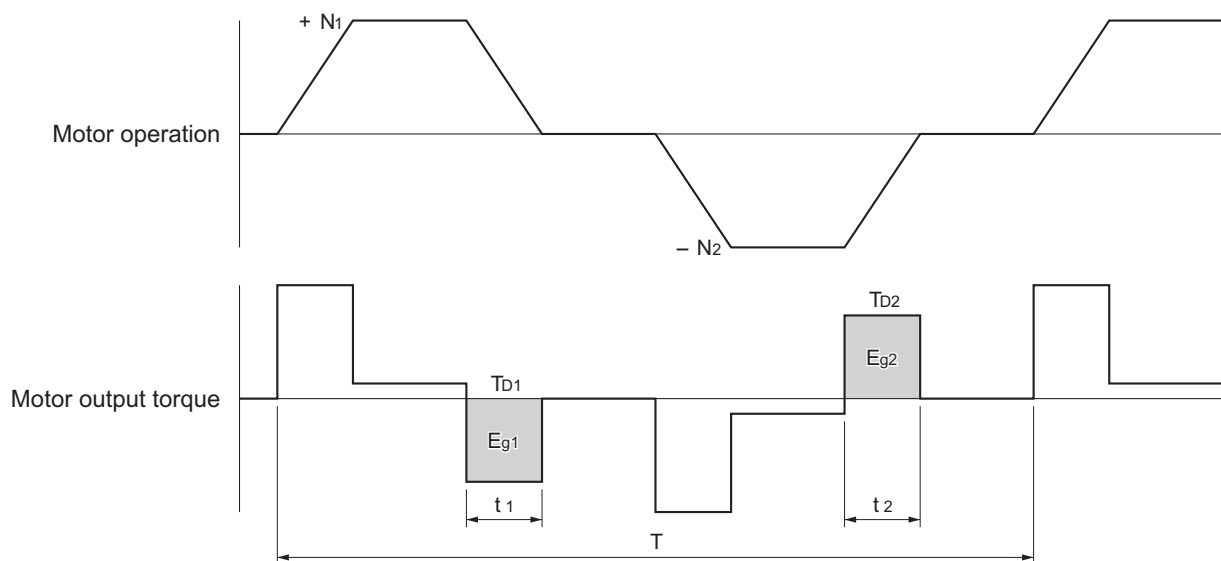
| Model | Dimensions (mm) | | | | | | | | | |
|-------------|-----------------|-----|-----|-----|-----|-----|-----|----|----|-----|
| | A | B | C | E | F | H | J | N | O | P |
| 3G3AX-NF003 | 160 | 145 | 130 | 80 | 112 | 120 | – | – | M4 | 154 |
| 3G3AX-NF004 | 200 | 180 | 160 | 100 | 162 | 150 | 120 | M5 | M5 | 210 |
| 3G3AX-NF005 | 220 | 200 | 180 | 100 | 182 | 170 | 140 | M6 | M6 | 230 |
| 3G3AX-NF006 | 220 | 200 | 180 | 100 | 182 | 170 | 140 | M8 | M8 | 237 |

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.

4-4-1 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.

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

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

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

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

t_1, t_2 : Deceleration time [s]

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

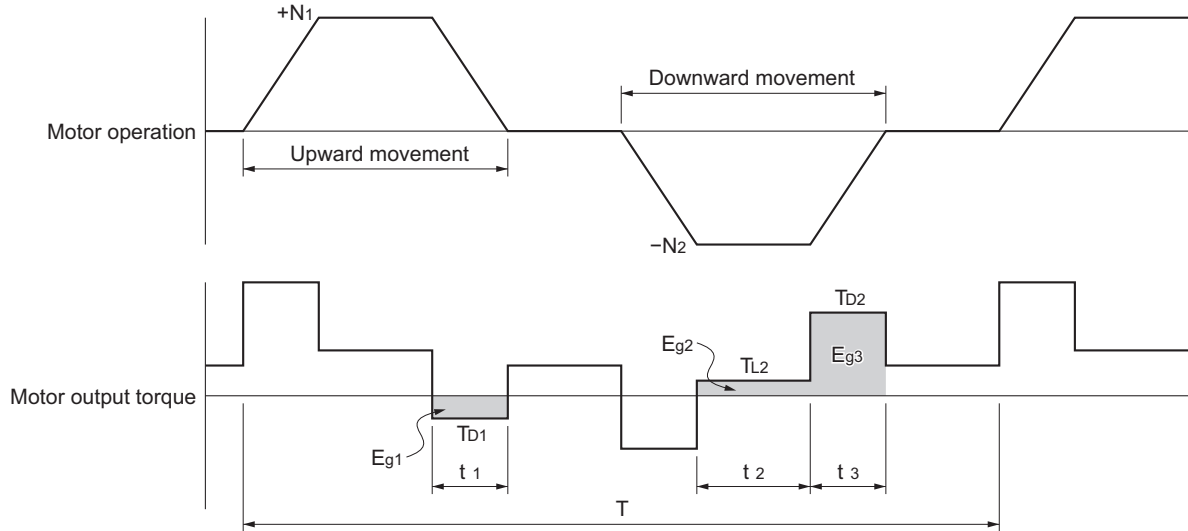
- For Servo Drive models with internal capacitors used for absorbing regenerative energy (i.e., Servo Drive models of 400 W or less), the values E_{g1} and E_{g2} (unit: J) must be lower than the drive's regeneration absorption capacity. (The capacity depends on the model. For details, refer to the next section.)
- For Servo Drive models with an Internal Regeneration Resistor used for absorbing regenerative energy (i.e., Servo Drive models of 500 W or more), the average amount of regeneration P_r (unit: W) must be calculated, and this value must be lower than the drive's regeneration absorption capacity. (The capacity depends on the model. For details, refer to the next section.)

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

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

T: Operation cycle [s]

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.

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

$$\cdot E_{g2} = \frac{2\pi}{60} \cdot N_2 \cdot T_{L2} \cdot t_2 \quad [J]$$

$$\cdot E_{g3} = \frac{1}{2} \cdot \frac{2\pi}{60} \cdot N_2 \cdot T_{D2} \cdot t_3 \quad [J]$$

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

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

T_{L2} : Torque during downward movement [N·m]

t_1, t_3 : Deceleration time [s]

t_2 : Constant-speed driving time during downward movement [s]

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

- For Servo Drive models with internal capacitors used for absorbing regenerative energy (i.e., Servo Drive models of 400 W or less), the values E_{g1} and $E_{g2} + E_{g3}$ (unit: J) must be lower than the drive's regeneration absorption capacity. (The capacity depends on the model. For details, refer to the next section.)
- For Servo Drive models with an Internal Regeneration Resistor used for absorbing regenerative energy (i.e., Servo Drive models of 500 W or more), the average amount of regeneration P_r (unit: W) must be calculated, and this value must be lower than the drive's regeneration absorption capacity. (The capacity depends on the model. For details, refer to the next section.)

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

$$P_r = (E_{g1} + E_{g2} + E_{g3}) / T [W]$$

T: Operation cycle [s]

4-4-2 Servo Drive Regeneration Absorption Capacity

Amount of Internal Regeneration Absorption in Servo Drives

This Servo Drive 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 drive can absorb. If these values are exceeded, take the following processes.

- Connect an External Regeneration Resistor. (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 absorbable by built-in capacitor (J) | Internal regeneration resistor | Allowable minimum regeneration resistance (Ω) |
|-------------------|--|--|--|
| | | Average amount of regenerative energy absorbable (W) | |
| R88D-KNA5L-ECT | 11 | – | 17 |
| R88D-KN01L-ECT | 11 | – | 17 |
| R88D-KN02L-ECT | 15 | – | 17 |
| R88D-KN04L-ECT | 22 | 17 | 13 |
| R88D-KN01H-ECT | 18 | – | 34 |
| R88D-KN02H-ECT | 18 | – | 34 |
| R88D-KN04H-ECT | 26 | – | 34 |
| R88D-KN08H-ECT | 46 | 12 | 25 |
| R88D-KN10H-ECT | 74 | 18 | 25 |
| R88D-KN15H-ECT | 74 | 18 | 25 |
| R88D-KN20H-ECT | 74 | 72 | 10 |
| R88D-KN30H-ECT | 113 | 60 | 7 |
| R88D-KN50H-ECT | 113 | 60 | 5 |
| R88D-KN75H-ECT | 282 | – | 4 |
| R88D-KN150H-ECT | 254 | – | 4 |
| R88D-KN06F-ECT | 64 | 21 | 100 |
| R88D-KN10F-ECT | 64 | 21 | 100 |
| R88D-KN15F-ECT | 64 | 21 | 100 |
| R88D-KN20F-ECT | 64 | 29 | 40 |
| R88D-KN30F-ECT | 106 | 60 | 40 |
| R88D-KN50F-ECT | 106 | 60 | 29 |
| R88D-KN75F-ECT | 273 | – | 14 |
| R88D-KN150F-ECT | 492 | – | 14 |

4-4-3 Regenerative Energy Absorption with an External Regeneration Resistor

If the regenerative energy exceeds the regeneration absorption capacity of the Servo Drive, connect an External Regeneration Resistor.

Connect the External Regeneration Resistor between B1 and B2 terminals on the Servo Drive.

Double-check the terminal names when connecting the resistor because the drive may be damaged if connected to the wrong terminals.

The surface of the External Regeneration Resistor will heat up to approx. 200°C. Do not place it near equipment and wiring that is easily affected by heat. Attach radiator plates suitable for the heat radiation conditions.

External Regeneration Resistor

● Characteristics

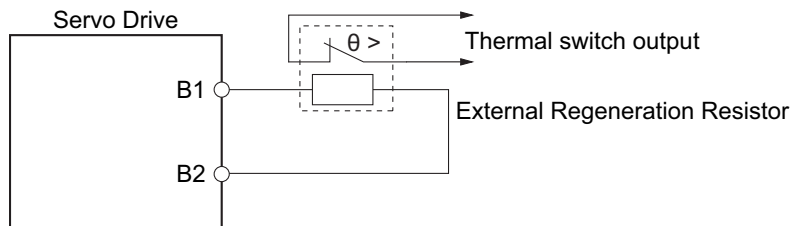
| Model | Resistance value | Nominal capacity | The amount of regeneration absorption for 120°C temperature rise | Heat radiation condition | Thermal switch output specifications |
|----------------|------------------|------------------|--|---|---|
| R88A-RR08050S | 50 Ω | 80 W | 20 W | Aluminum 350 × 350, Thickness: 3.0 | Operating temperature: 150°C ± 5% NC contact Rated output (resistive load): 125 VAC, 0.1 A max. 30 VDC, 0.1 A max. (minimum current: 1 mA) |
| R88A-RR080100S | 100 Ω | 80 W | 20 W | Aluminum 350 × 350, Thickness: 3.0 | Operating temperature: 150°C ± 5% NC contact Rated output (resistive load): 125 VAC, 0.1 A max. 30 VDC, 0.1 A max. (minimum current: 1 mA) |
| R88A-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, 3 A max. |
| R88A-RR22047S1 | 47 Ω | 220 W | 70 W | Aluminum 350 × 350, Thickness: 3.0 | Operating temperature: 150°C ± 5% NC contact Rated output (resistive load): 250 VAC, 0.2 A max. 42 VDC, 0.2 A max. (minimum current: 1 mA) |
| R88A-RR50020S | 20 Ω | 500 W | 180 W | Aluminum 600 × 600, Thickness: 3.0 | Operating temperature 200°C ± 7°C NC contact Rated output: 250 VAC, 0.2 A max. 42 VDC, 0.2 A max. (minimum current: 1 mA) |

4-4-4 Connecting an External Regeneration Resistor

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

Normally B2 and B3 are open.

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



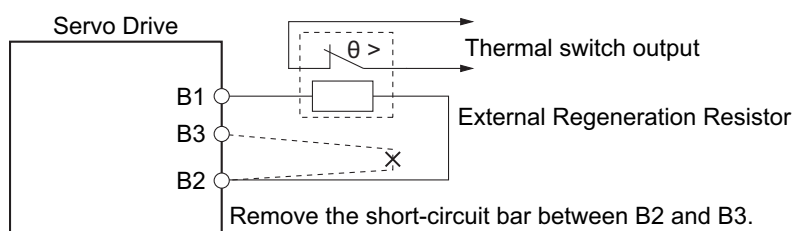
Precautions for Correct Use

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

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

Normally B2 and B3 are shorted.

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.

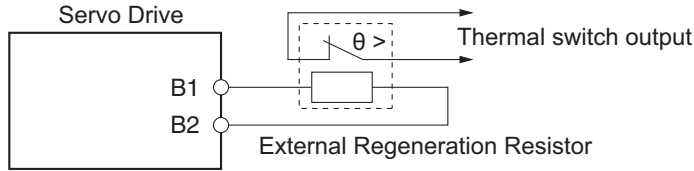


Precautions for Correct Use

- 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-KN75H-ECT/-KN150H-ECT/-KN75F-ECT/-KN150F-ECT

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




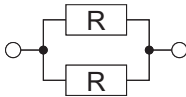
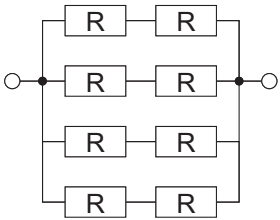
Precautions for Correct Use

- 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.

● 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-RR22047S1 | R88A-RR22047S R88A-RR22047S1 |
| Resistance value ^{*2} | 50 Ω/100 Ω | 25 Ω/50 Ω | 47 Ω | 94 Ω |
| Connection method | | | | |

| Regeneration absorption capacity ^{*1} | 140 W | 280 W | 560 W |
|--|---------------------------------|---------------------------------|---------------------------------|
| Model | R88A-RR22047S R88A-RR22047S1 | R88A-RR22047S R88A-RR22047S1 | R88A-RR22047S R88A-RR22047S1 |
| Resistance value ^{*2} | 23.5 Ω | 47 Ω | 23.5 Ω |
| Connection method | | | |

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

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

*2 Do not use a combination with resistance values lower than the allowable minimum regeneration resistance of each drive. For information on the allowable minimum regeneration resistance, refer to 4-4-2 *Servo Drive Regeneration Absorption Capacity* on page 4-57.



Precautions for Safe Use

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

4-5 Using DC Power Input

The following Servo Drive models allow you to use DC power input for the main circuit and control power supplies, in addition to AC power input.

- R88D-KN75H-ECT
- R88D-KN150H-ECT

No Servo Drive parameter change is necessary to switch from AC to DC power input, or vice versa.

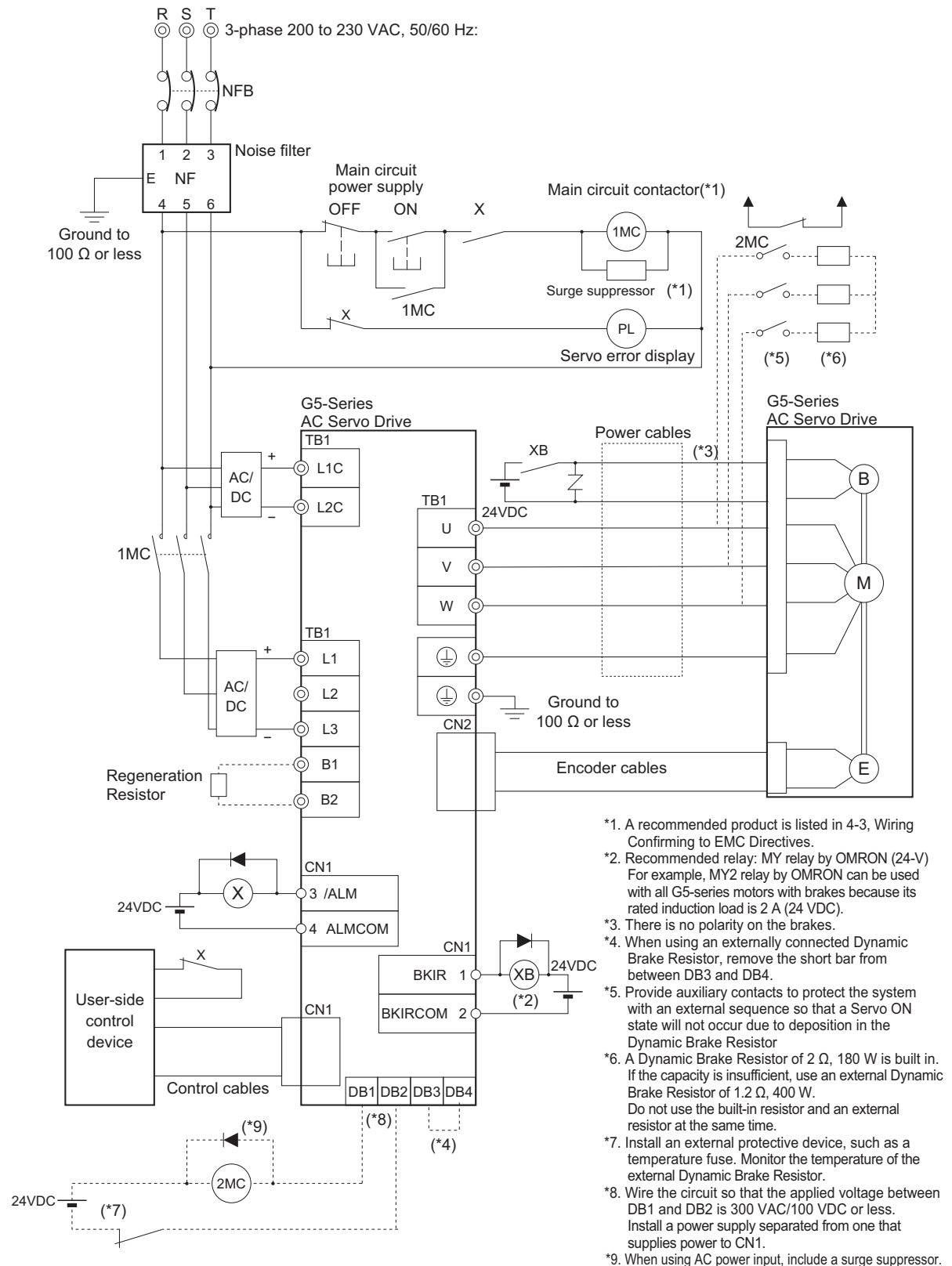


Precautions for Correct Use

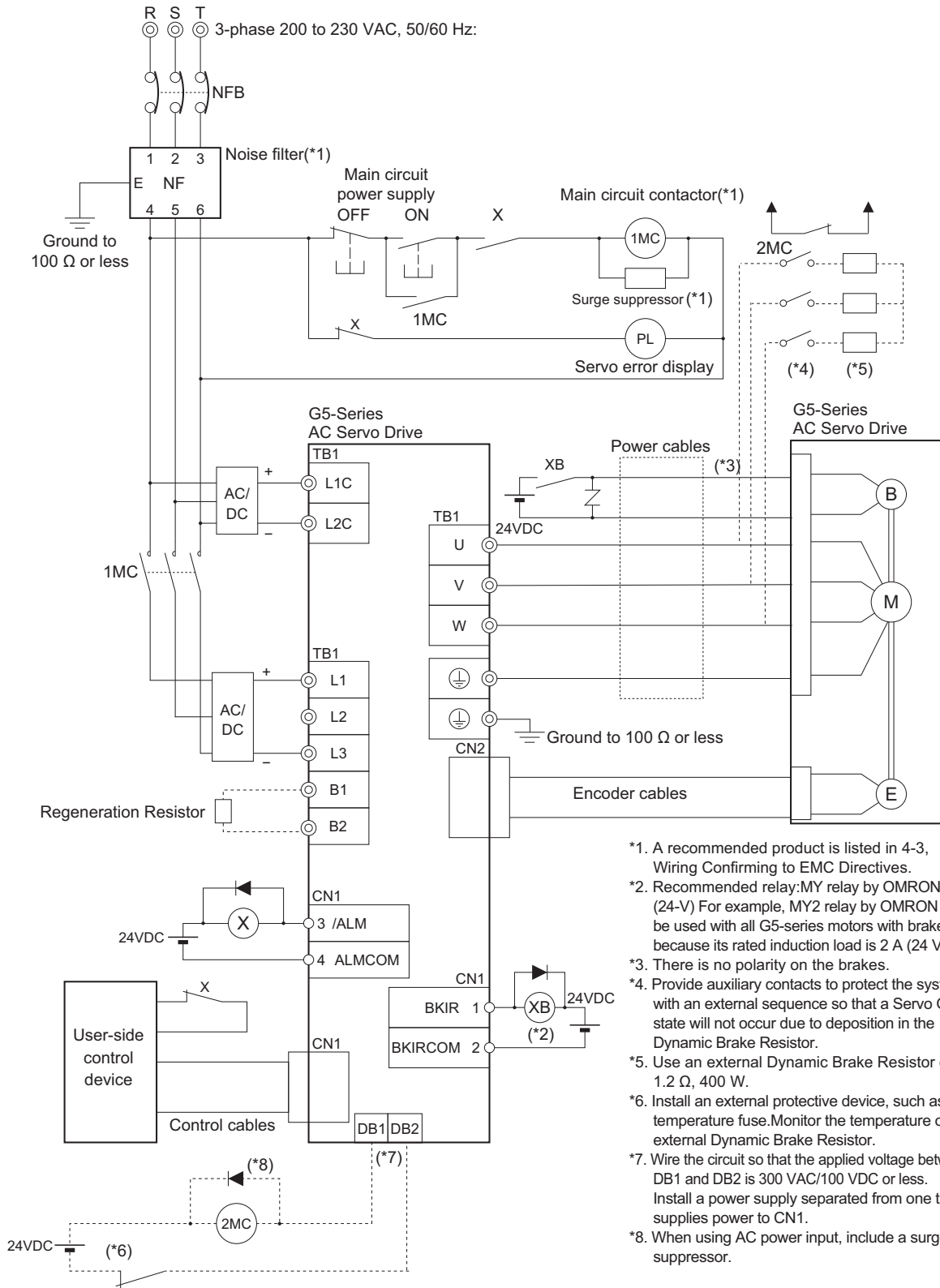
- To use DC power input for the main circuit and control power supplies, connect the positive wires to L1 and L1C and the negative wires to L3 and L3C of the terminal block (TB1).
 - Shutting off the main circuit power takes some time to discharge electricity. Beware of electrical shock because high voltage may remain in the Servo Drive after power shut OFF. Before carrying out wiring or inspection, turn OFF the main circuit power, and wait for at least 15 minutes.
 - Do not connect any power supply to B1 and N. Doing so may cause damage to internal elements.
 - Do not insert/remove the terminal block with the main circuit power supply ON. Doing so may cause an arc flash, resulting in burning.
-

4-5-1 Connection Example for Using DC power Input

R88D-KN75H-ECT (DC power input)



R88D-KN150H-ECT (DC power input)



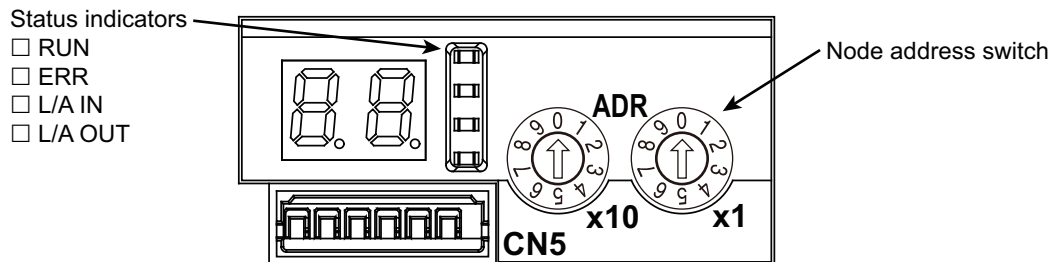
5

EtherCAT Communications

This chapter describes EtherCAT communications under the assumption that the G5-series Servo Drive is connected to an NJ501-1□-00 NJ-series Machine Automation Controller or CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882 Position Control Unit.

| | | |
|------------|--|-------------|
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| 5-2 | Structure of the CAN Application Protocol over EtherCAT | 5-4 |
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5-1 Display Area and Settings



5-1-1 Node Address Setting

The node address switches located in the display area are used to set the EtherCAT node address.

| Node address switch setting | Description |
|-----------------------------|--|
| | Connection to NJ501-1□00 or CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882 Position Control Unit |
| 00 | The controller sets the node address. |
| 01 to 99 | The node address switch setting is used as the node address. |



Precautions for Correct Use

- Do not change the Node address switch setting after the turning ON the power supply.
- The node address switches can be set to between 00 and 99.
The node address used over the network is determined by the value set on the node address switches.
If the node address is not between 00 and 99, a Node Address Setting Error (Error No. 88.0) will occur.



Additional Information

EtherCAT Slave Information File

Information on EtherCAT slave settings is stored in the ESI (EtherCAT Slave Information) file.

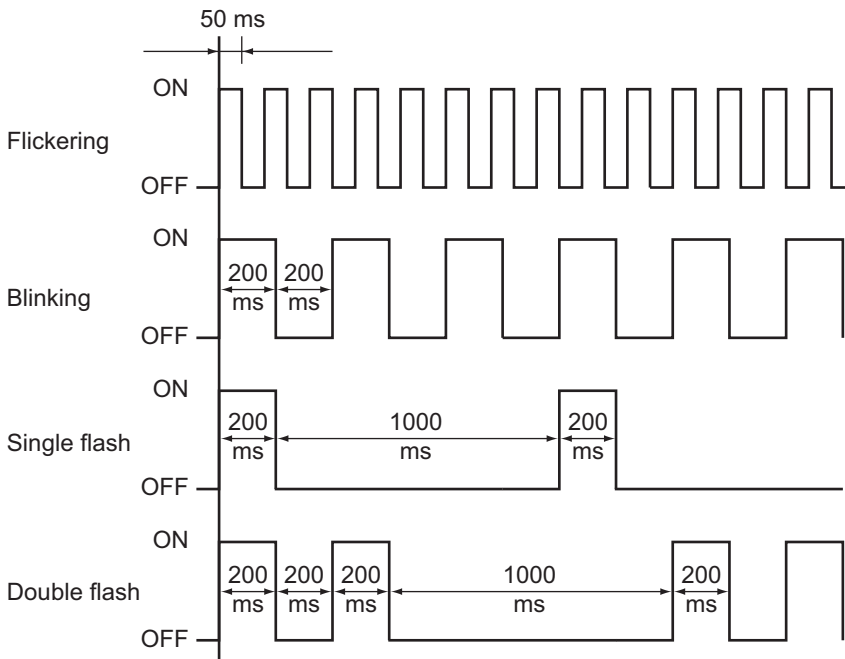
Information in this file is used by the master to configure the network and set communications parameters. This information is in an XML file.

5-1-2 Status Indicators

The following table shows the EtherCAT status indicators and their meaning.

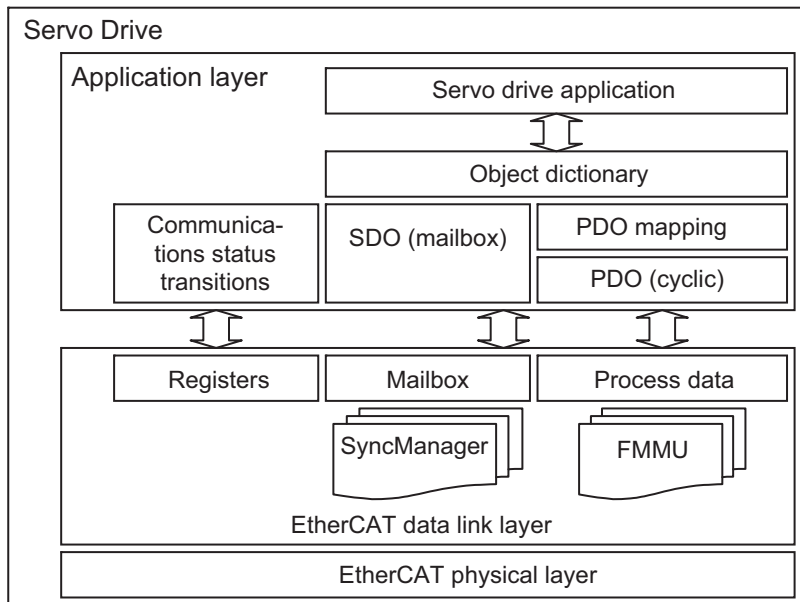
| Name | Color | Status | Description |
|---------|-------|--------------|--|
| RUN | Green | OFF | Init state |
| | | Blinking | Pre-Operational state |
| | | Single flash | Safe-Operational state |
| | | ON | Operational state |
| ERR | Red | OFF | No error |
| | | Blinking | Communications setting error |
| | | Single flash | Synchronization error or communications data error |
| | | Double flash | Application WDT timeout |
| | | Flickering | Boot error |
| | | ON | PDI WDT timeout |
| L/A IN | Green | OFF | Link not established in physical layer |
| | | ON | Link established in physical layer |
| | | Flickering | In operation after establishing link |
| L/A OUT | Green | OFF | Link not established in physical layer |
| | | ON | Link established in physical layer |
| | | Flickering | In operation after establishing link |

Indicator status is described below.



5-2 Structure of the CAN Application Protocol over EtherCAT

The structure of the CAN application protocol over EtherCAT (CoE) for a G5-series Servo Drive with built-in EtherCAT communications is described in this section.



Normally, multiple protocols can be transmitted using EtherCAT. The IEC 61800-7 (CiA 402) drive profile is used for G5-series Servo Drives with Built-in EtherCAT Communications.

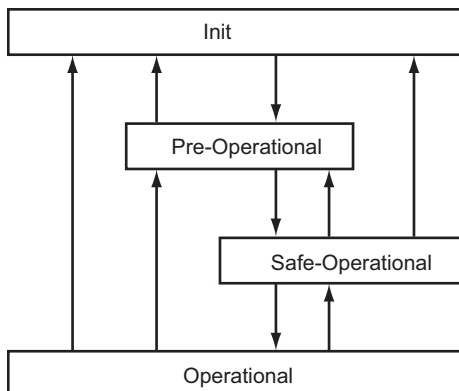
The object dictionary in the application layer contains parameters and application data as well as information on the PDO mapping between the process data servo interface and Servo Drive application.

The process data object (PDO) consists of objects in the object dictionary that can be mapped to the PDO. The contents of the process data are defined by the PDO mapping.

Process data communications cyclically reads and writes the PDO. Mailbox communications (SDO) uses asynchronous message communications where all objects in the object dictionary can be read and written.

5-3 EtherCAT State Machine

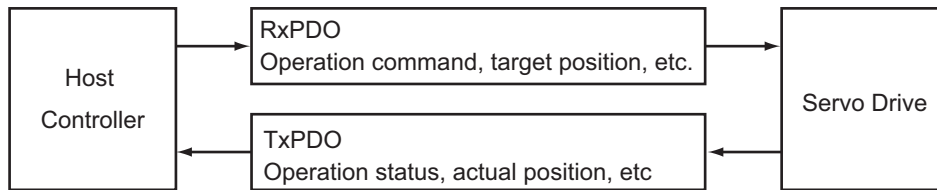
The EtherCAT State Machine (ESM) of the EtherCAT slave is controlled by the EtherCAT Master.



| State | SDO communications | PDO reception | PDO transmission | Description |
|----------------------------|--------------------|---------------|------------------|---|
| Init | Not possible. | Not possible. | Not possible. | Communications are being initialized. Communications are not possible. |
| Pre-Operational (Pre-Op) | Possible. | Not possible. | Not possible. | Only mailbox communications are possible in this state. This state is entered after initialization has been completed. It is used to initialize network settings. |
| Safe-Operational (Safe-Op) | Possible. | Not possible. | Possible. | In this state, PDO transmissions are possible in addition to mailbox communications. DC mode cyclic communications can be used to send information such as status from the Servo Drive. |
| Operational (Op) | Possible. | Possible. | Possible. | This is a normal operating state. DC mode cyclic communications can be used to control the motor. |

5-4 Process Data Objects (PDOs)

The process data objects (PDOs) are used to transfer data during cyclic communications in realtime. PDOs can be reception PDOs (RxPDOs), which receive data from the controller, or transmission PDOs (TxPDOs), which send status from the Servo Drive to the host controller.



The EtherCAT application layer can hold multiple objects to enable transferring Servo Drive process data. The contents of the process data are described in the PDO Mapping object and the Sync manager PDO assignment object.

G5-series Servo Drives support PDO mapping for position control.

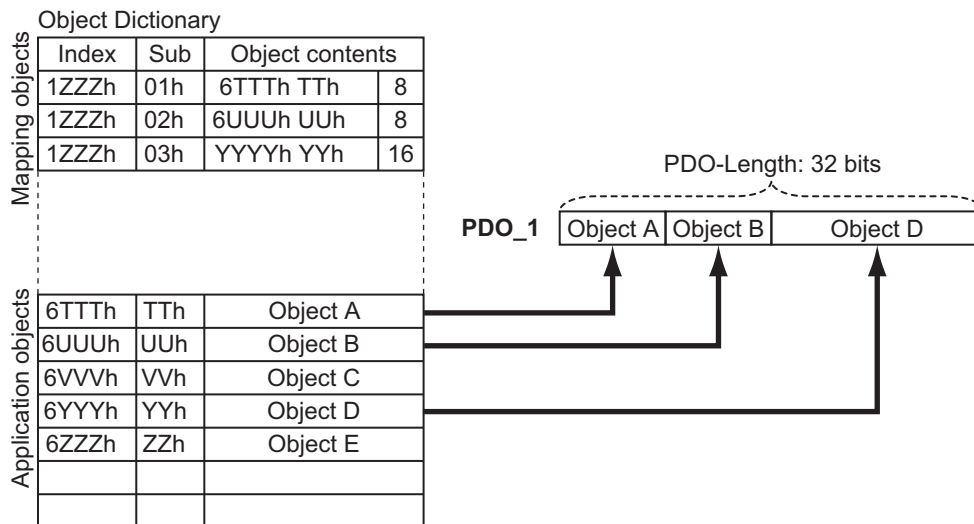
5-4-1 PDO Mapping Settings

The PDO mapping indicates the mapping for application objects (realtime process data) between the object dictionary and PDO.

The number of mapped objects is described in sub-index 00 hex of the mapping table. In this mapping table, 1600 hex to 17FF hex are for RxPDOs and 1A00 hex to 1BFF hex are for TxPDOs.

G5-series Servo Drives can use up to two mappings in 1600 hex and 1701 to 1705 hex for an RxPDO and in 1A00 hex, 1B01 to 1B04 hex, and 1BFF hex for a TxPDO, respectively.

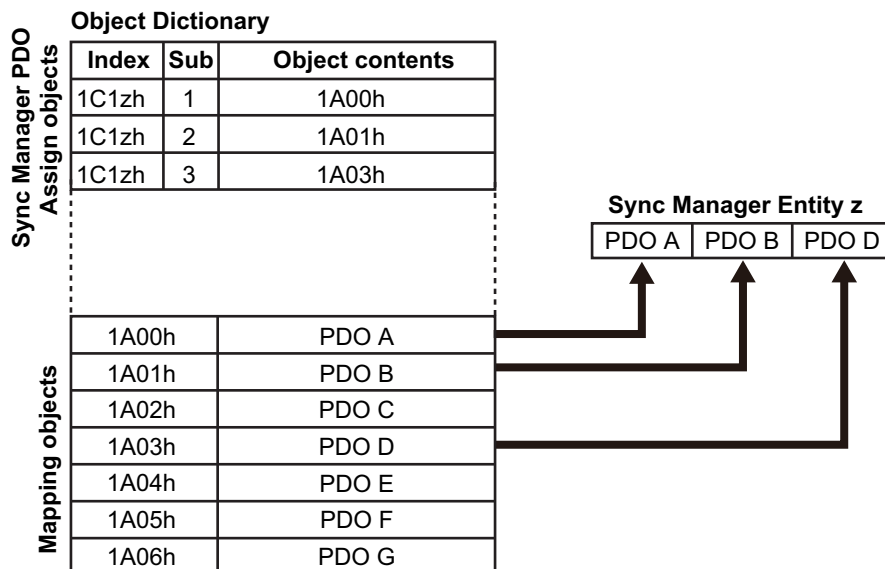
The following table is an example of PDO mapping.



5-4-2 Sync Manager PDO Assignment Settings

A Sync manager channel consists of several PDOs. The Sync manager PDO assignment objects describe how these PDOs are related to the Sync Manager. The number of PDOs is given in sub-index 00 hex of the Sync manager PDO assignment table. In this table, index 1C12 hex is for RxPDOs and 1C13 hex is for TxPDOs.

The following table is an example of sync manager PDO mapping.



5-4-3 Fixed PDO Mapping

This section describes the contents of fixed PDO mapping for G5-series Servo Drives. This contents cannot be changed.

The PDO mapping to be used is specified in Sync Manager 2 PDO Assignment (1C12 hex) and Sync Manager 3 PDO Assignment (1C13 hex).

Some typical examples of RxPDO and TxPDO combinations are provided below.

PDO Mapping 1 (Position Control and Touch Probe Function)

This object gives the mapping for an application that uses only cyclic synchronous position mode (csp). Touch probe function is available.

| | |
|----------------------|---|
| RxPDO (1701h) | Controlword (6040 hex), Target position (607A hex), Touch probe function (60B8 hex), and Digital outputs (60FE hex) |
| TxPDO (1B01h) | Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Torque actual value (6077 hex), Following error actual value (60F4 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Touch probe pos2 pos value (60BC hex), and Digital inputs (60FD hex) |

PDO Mapping 2 (Position Control, Speed Control, Torque Control, and Touch Probe Function)

This is the mapping for an application that uses one of the following modes: Cyclic synchronous position mode (csp), Cyclic synchronous velocity mode, and Cyclic synchronous torque mode. Touch probe function is available.

| | |
|--------------------------|---|
| RxPDO (1702h) | Controlword (6040 hex), Target position (607A hex), Target velocity (60FF hex), Target torque (6071 hex), Modes of operation (6060 hex), Touch probe function (60B8 hex), and Max profile velocity (607F hex) |
| TxPDO (1B02h) | Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Torque actual value (6077 hex), Modes of operation display (6061 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Touch probe pos2 pos value (60BC hex), and Digital inputs (60FD hex) |

PDO Mapping 3 (Position Control, Speed Control, Touch Probe Function, and Torque Limit)

This is the mapping for an application that switches between Cyclic synchronous position mode (csp) and Cyclic synchronous velocity mode. Touch probe function and torque limit can be used.

| | |
|--------------------------|--|
| RxPDO (1703h) | Controlword (6040 hex), Target position (607A hex), Target velocity (60FF hex), Modes of operation (6060 hex), Touch probe function (60B8 hex), Positive torque limit value (60E0 hex), and Negative torque limit value (60E1 hex) |
| TxPDO (1B03h) | Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Torque actual value (6077 hex), Following error actual value (60F4 hex), Modes of operation display (6061 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Touch probe pos2 pos value (60BC hex), and Digital inputs (60FD hex) |

PDO Mapping 4 (Position Control, Speed Control, Torque Control, Touch Probe Function, and Torque Limit)

This is the mapping for an application that uses one of the following modes: Cyclic synchronous position mode (csp), Cyclic synchronous velocity mode, and Cyclic synchronous torque mode. Touch probe function and torque limit can be used.

| | |
|--------------------------|---|
| RxPDO (1704h) | Controlword (6040 hex), Target position (607A hex), Target velocity (60FF hex), Target torque (6071 hex), Modes of operation (6060 hex), Touch probe function (60B8 hex), Max profile velocity (607F hex), Positive torque limit value (60E0 hex), and Negative torque limit value (60E1 hex) |
| TxPDO (1B02h) | Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Torque actual value (6077 hex), Modes of operation display (6061 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Touch probe pos2 pos value (60BC hex), and Digital inputs (60FD hex) |

PDO Mapping 5 (Position Control, Speed Control, Touch Probe Function, Torque Limit, and Torque FF)

This is the mapping for an application that switches between Cyclic synchronous position mode (csp) and Cyclic synchronous velocity mode. Touch probe function and torque limit can be used. The torque feed-forward amount can be specified by using the Torque offset (60B2 hex).

| | |
|--------------------------|---|
| RxPDO (1705h) | Controlword (6040 hex), Target position (607A hex), Target velocity (60FF hex), Modes of operation (6060 hex), Touch probe function (60B8 hex), Positive torque limit value (60E0 hex), Negative torque limit value (60E1 hex), and Torque offset (60B2 hex) |
| TxPDO (1B04h) | Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Torque actual value (6077 hex), Modes of operation display (6061 hex), Following error actual value (60F4 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Digital inputs (60FD hex), and Velocity actual value (606C hex) |

5-4-4 Variable PDO Mapping

G5-series Servo Drives with unit version 2.1 or later allow you to change the object mappings.

The PDO mappings for which you can change the mapped objects are the 1st receive PDO Mapping (1600 hex) and the 1st transmit PDO Mapping (1A00 hex).

To change the object mappings, set these values in Sync Manager 2 PDO Assignment (1C12 hex) and in Sync Manager 3 PDO Assignment (1C13 hex), respectively.

These object mappings can be changed only when the EtherCAT communications state is Pre-Operational (Pre-Op). Since the mappings you changed are not saved in EEPROM, you must specify objects each time you turn ON the power of the G5-series Servo Drive in order to use the mapping other than the default setting.

● Default Setting

| | |
|-----------------------------|--|
| RxPDO (1600 hex) | Controlword (6040 hex), Target position (607A hex), and Touch probe function (60B8 hex) |
| TxPDO (1A00 hex) | Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Touch probe pos2 pos value (60BC hex), and Digital inputs (60FD hex) |

● Maximum Number of Objects and Maximum Total Size Allowed in a PDO Mapping

| PDO Mapping Object | Max. No. of Objects | Max. Total Size of Objects |
|--------------------|---------------------|----------------------------|
| RxPDO (1600 hex) | 10 | 24 bytes |
| TxPDO (1A00 hex) | 10 | 30 bytes |

*1 When you assign the PDO mapping other than 1A00 hex simultaneously to TxPDO, total size must be 30 bytes or less. For example, if you assign 1BFF hex simultaneously, the total size of objects in 1A00 hex will be 29 bytes or less.



Precautions for Correct Use

- The communications cycle you can set varies depending on the total size of mapped objects. Refer to *A-1-3 Communications Cycles and Corresponding Modes of Operation* on page A-5 for details.
- If the size of the mapped objects exceeds the maximum total size, a Function Setting Error (Error No. 93.4) will occur.
- For information on the maximum number of objects allowed in a PDO Mapping, refer to *A-1-9 PDO Mapping Objects* on page A-30

5-4-5 Multiple PDO Mapping

G5-series Servo Drives with unit version 2.1 or later allow you to use combinations of up to two TxPDO mappings.

Select two PDO mappings in Sync manager 3 PDO assignment (1C13 hex).

This maps the object you selected with sub-index 01 (hex) at first and then the object you selected with sub-index 02 (hex).

If you map the same object more than once, the value of the last object will be enabled.

These object mappings can be changed only when the EtherCAT communications state is Pre-Operational (Pre-Op). Since the mappings you changed are not saved in EEPROM, you must specify objects each time you turn ON the power of the G5-series Servo Drive in order to use the mapping other than the default setting.

● Default Setting

Transmit PDO mapping (TxPDO)

- 1B01 hex

● Available PDO Mapping Combinations

Transmit PDO mapping (TxPDO) *1

- One of the mappings in 1B01 to 1B04 hex and another in 1BFF hex
- One mapping in 1A00 hex and another in 1BFF hex

*1 A maximum of 11 objects in total can be mapped to the Transmit PDO mapping.



Precautions for Correct Use

- The communications cycle you can set varies depending on the total size of mapped objects. Refer to *A-1-3 Communications Cycles and Corresponding Modes of Operation* on page A-5 for details.
- If the size of the mapped objects exceeds the maximum total size, a Function Setting Error (Error No. 93.4) will occur.
- If the number of the mapped objects exceeds the maximum allowed number, a Function Setting Error (Error No. 93.4) will occur.

5-5 Service Data Objects (SDOs)

G5-series Servo Drives support SDO communications. SDO communications are used for setting objects and monitoring the status of G5-series Servo Drives. Objects can be set and the status monitored by reading and writing data to the entries in the object dictionary of the host controller.

5-5-1 Abort Codes

The following table lists the abort codes for when an SDO communications error occurs.

| Code | Meaning |
|---------------|---|
| 0503 0000 hex | Toggle bit not changed |
| 0504 0000 hex | SDO protocol timeout |
| 0504 0001 hex | Client/Server command specifier not valid or unknown |
| 0504 0005 hex | Out of memory |
| 0601 0000 hex | Unsupported access to an object |
| 0601 0001 hex | Attempt to read a write only object |
| 0601 0002 hex | Attempt to write to a read only object |
| 0602 0000 hex | The object does not exist in the object directory |
| 0604 0041 hex | The object can not be mapped into the PDO. |
| 0604 0042 hex | The number and length of the objects to be mapped would exceed the PDO length. |
| 0604 0043 hex | General parameter incompatibility reason |
| 0604 0047 hex | General internal incompatibility in the device. |
| 0606 0000 hex | Access failed due to a hardware error. |
| 0607 0010 hex | Data type does not match, length of service parameter does not match |
| 0607 0012 hex | Data type does not match, length of service parameter too high |
| 0607 0013 hex | Data type does not match, length of service parameter too low |
| 0609 0011 hex | Subindex does not exist |
| 0609 0030 hex | Value range of parameter exceeded (only for write access) |
| 0609 0031 hex | Value of parameter written too high |
| 0609 0032 hex | Value of parameter written too low |
| 0609 0036 hex | Maximum value is less than minimum value |
| 0800 0000 hex | General error |
| 0800 0020 hex | Data cannot be transferred or stored to the application |
| 0800 0021 hex | Data cannot be transferred or stored to the application because of local control |
| 0800 0022 hex | Data cannot be transferred or stored to the application because of the present device state |
| 0800 0023 hex | Object dictionary dynamic generation fails or no object dictionary is present |

5-6 Synchronization with Distributed Clocks

A mechanism called a distributed clock (DC) is used to synchronize EtherCAT communications. The DC mode is used for G5-series Servo Drives to perform highly accurate control in a multi-axis system.

In DC mode, the master and slaves are synchronized by sharing the same clock. Interruptions (Sync0) are generated in the slaves at precise intervals based on this clock. Servo Drive control is carried out at this precise timing.

5-6-1 Communications Cycle (DC Cycle)

The communications cycle is determined by setting the Sync0 signal output cycle.

Setting range: 250 μ s/500 μ s/1 ms/2 ms/4 ms



Precautions for Correct Use

The communications cycle you can set varies depending on conditions such as the Servo Drive unit version or the modes of operation in use. For details on the communications cycle you can set, refer to *A-1-3 Communications Cycles and Corresponding Modes of Operation* on page A-5

5-7 Emergency Messages

When an error or warning occurs in a G5-series Servo Drive, an emergency message is sent to the master using mailbox communications. An emergency message is not sent for a communications error.

You can select whether to send emergency messages setting Diagnosis History (10F3 hex).

When the power supply is turned ON, this setting is set not to send emergency message (10F3 hex, Sub: 05 hex (Flags) = 0).

Set the sub-index 05 hex (Flags) in object 10F3 hex to 1 every time the power is turned ON to send emergency messages.

Emergency messages consist of 8 bytes of data.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|----------|------------------------------------|---|---------------------------|---|---|---|---|---|
| Contents | Emergency Error Code ^{*1} | | Error Register (1001 hex) | Manufacturer Specific Error Field ^{*2} | | | | |

*1 Error codes (FF00 hex to FFFF hex) in the manufacturer-specific area are used.

*2 For unit version 2.0, the third to seventh bytes are not used.

For unit version 2.1, the third byte is not used, with an error event code shown in the fourth to seventh bytes.
For details on error event codes, refer to *A-3 Sysmac Error Status Codes* on page A-93.

Note For details on errors and warnings of the Servo Drive, refer to *Chapter 12 Troubleshooting and Maintenance*.

5-8 Sysmac Device Features

The control device product designed according to standardized communications and user interface specifications for OMRON control devices are called a Sysmac Device.

And the features available with such a Device is called Sysmac Device Features.

This section describes the features the G5-series Servo Drive provides when combined with a Machine Automation Controller such as NJ series and automation software.

For G5-series Servo Drives with built-in EtherCAT communications, those Servo Drives with unit version 2.1 or later are Sysmac Devices.

● Sysmac Error Status

Because, in Sysmac Devices, errors that may occur in slaves are systematized, you can check the causes and remedies for errors with a common procedure.

The status of an error can be monitored in the Sysmac Error Status (2002-01 hex). To display the error status detected by the G5-series Servo Drive in Sysmac Studio, the Sysmac Error Status (2002-01 hex) must be mapped to the PDO. Sysmac Studio, by default, uses the 512th transmit PDO Mapping assignment to map the Sysmac Error Status (2002-01 hex) automatically to the PDO.



Additional Information

- For the Sysmac Error status (2002-01 hex), refer to *A-1-11 Manufacturer Specific Objects* on page A-48.
- For errors displayed in Sysmac Studio, refer to *A-3 Sysmac Error Status Codes* on page A-93.

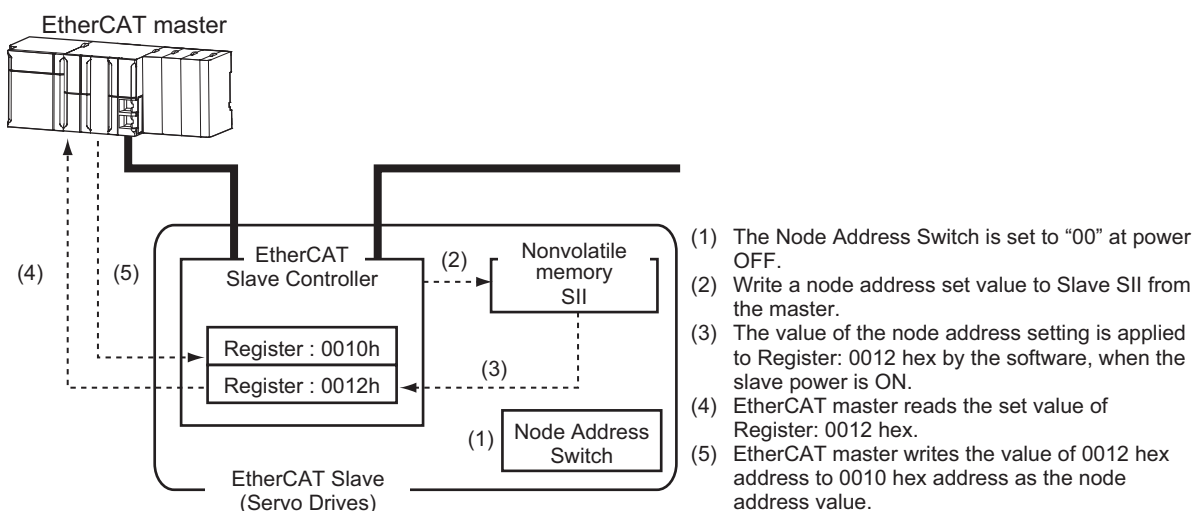
● Saving the Node Address Setting

When the node address switch setting is “00” (Software Setup mode), the node address value you set in Sysmac Studio is enabled.

In the Software Setup mode, in Sysmac Studio, execute [Write Slave Node Address] on the [EtherCAT Edit] screen to save the slave node address setting in the nonvolatile memory of the G5-series Servo Drive.

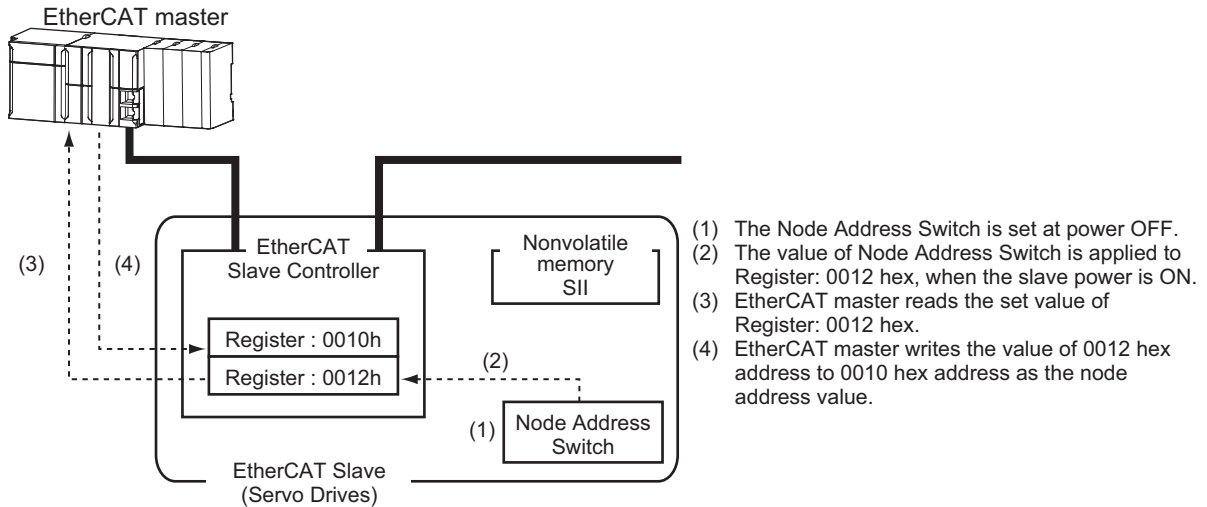
• Software Setting

The set value saved as Slave Information Interface (SII) information in the nonvolatile memory of the slave is the node address.



- Node Address Switch Setting

The value set on the node address switches is the node address.



- Serial Number Display

The serial number saved in the nonvolatile memory of the G5-series Servo Drive is displayed in the Serial Number (1018-04 hex). Controllers that support Sysmac Device Features can use this serial number to check the network configuration.

To enable this check, in Sysmac Studio, set [Serial No. Check Condition] to [Set Value = Actual Unit] on the [EtherCAT Edit] screen.

If the set condition is not met, a Network Configuration Check Error will occur.



Additional Information

This network configuration check detects any slave devices that have been replaced, which prevents you from forgetting to set parameters on those slaves.

- Compliance with ESI Specification (ETG.2000 S (R) V1.0.1)

The ESI Specification is a set of specifications that define the entries required in an EtherCAT Slave Information (ESI) file.

Controllers that support Sysmac Device Features can use the Option function defined in the ESI Specification to identify the backup parameters stored on slaves.

The backup parameters on an identified slave can be backed up and restored from Sysmac Studio.

For the parameters backed up with the G5-series Servo Drive, refer to *Store Parameters* on page A-26.

● SII Data Check

The Slave Information Interface (SII) is an interface area in the nonvolatile memory of an EtherCAT slave that stores the configuration information specific to that EtherCAT slave.

Sysmac Device EtherCAT slaves check the SII information from the slave side.

If one of these slaves finds that SII information with which it cannot operate was written, it generates an SII Check Error (Error No. 88.3). If this error persists even after turning OFF and then ON the power again, contact your OMRON sales representative.



Precautions for Correct Use

Do not use third-party or any other configuration tools to edit the SII information.

6

Basic Control Functions

This chapter explains an outline of basic control functions and explains the contents of setting.

| | | |
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| 6-1-1 | Related Objects | 6-3 |
| 6-1-2 | Block Diagram for Position Control Mode | 6-4 |
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| 6-2-2 | Objects Requiring Settings | 6-6 |
| 6-2-3 | Related Functions | 6-6 |
| 6-2-4 | Block Diagram for Speed Control Mode | 6-7 |
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| 6-3-2 | Objects Requiring Settings | 6-9 |
| 6-3-3 | Related Functions | 6-9 |
| 6-3-4 | Block Diagram for Torque Control Mode | 6-10 |
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| 6-6-2 | Objects Requiring Settings | 6-17 |
| 6-6-3 | Block Diagram for Fully-closed Control Mode | 6-22 |
| 6-7 | Connecting with OMRON Controllers | 6-23 |

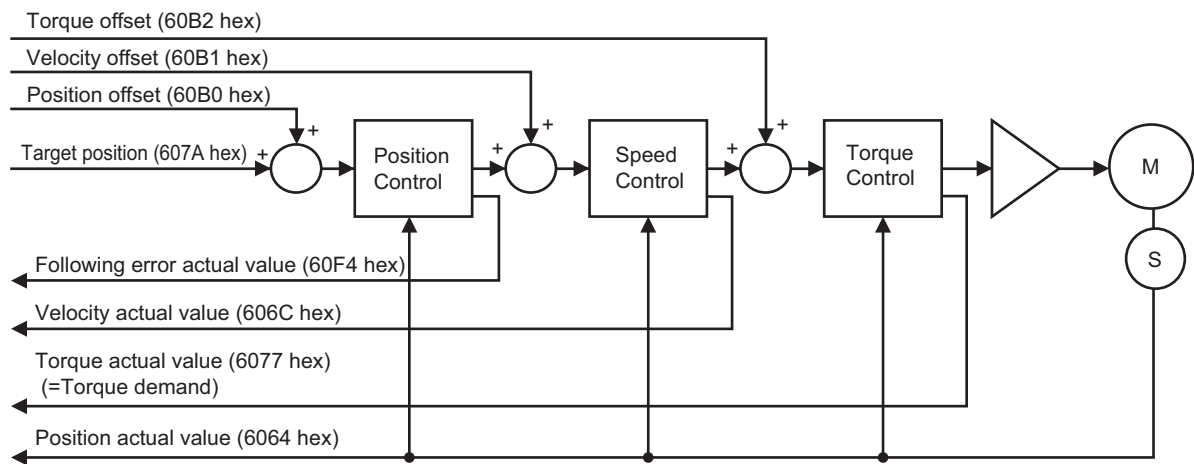
6-1 Cyclic Synchronous Position Mode

In this mode of operation, the controller has a path generation function (an operation profile calculation function) and it gives the target position to the Servo Drive using cyclic synchronization. Position control, speed control, and torque control are performed by the Servo Drive.

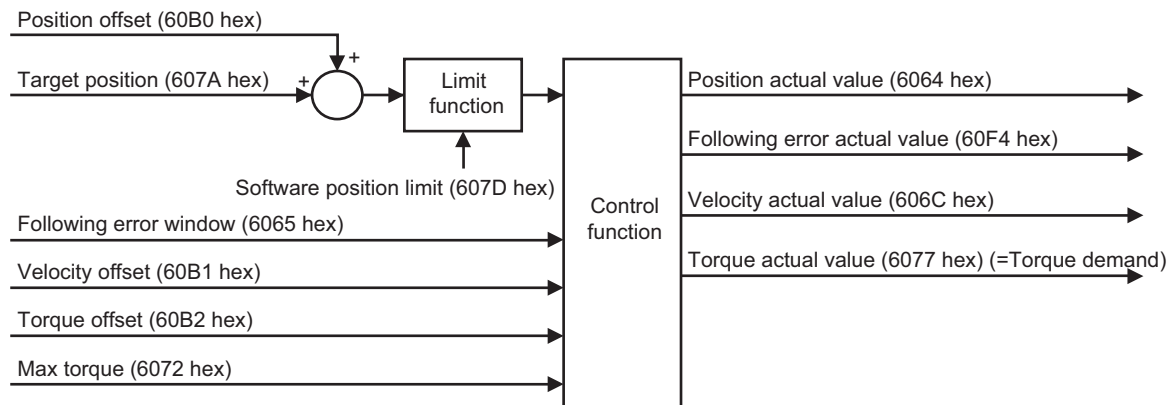
The Velocity offset (60B1 hex) and Torque offset (60B2 hex) can be used as speed feed-forward and torque feed-forward amounts.

Cyclic Synchronous Position Mode Configuration

The following diagram shows the configuration of the Cyclic synchronous position mode.



The following diagram shows the configuration of the control function of the Cyclic synchronous position mode.



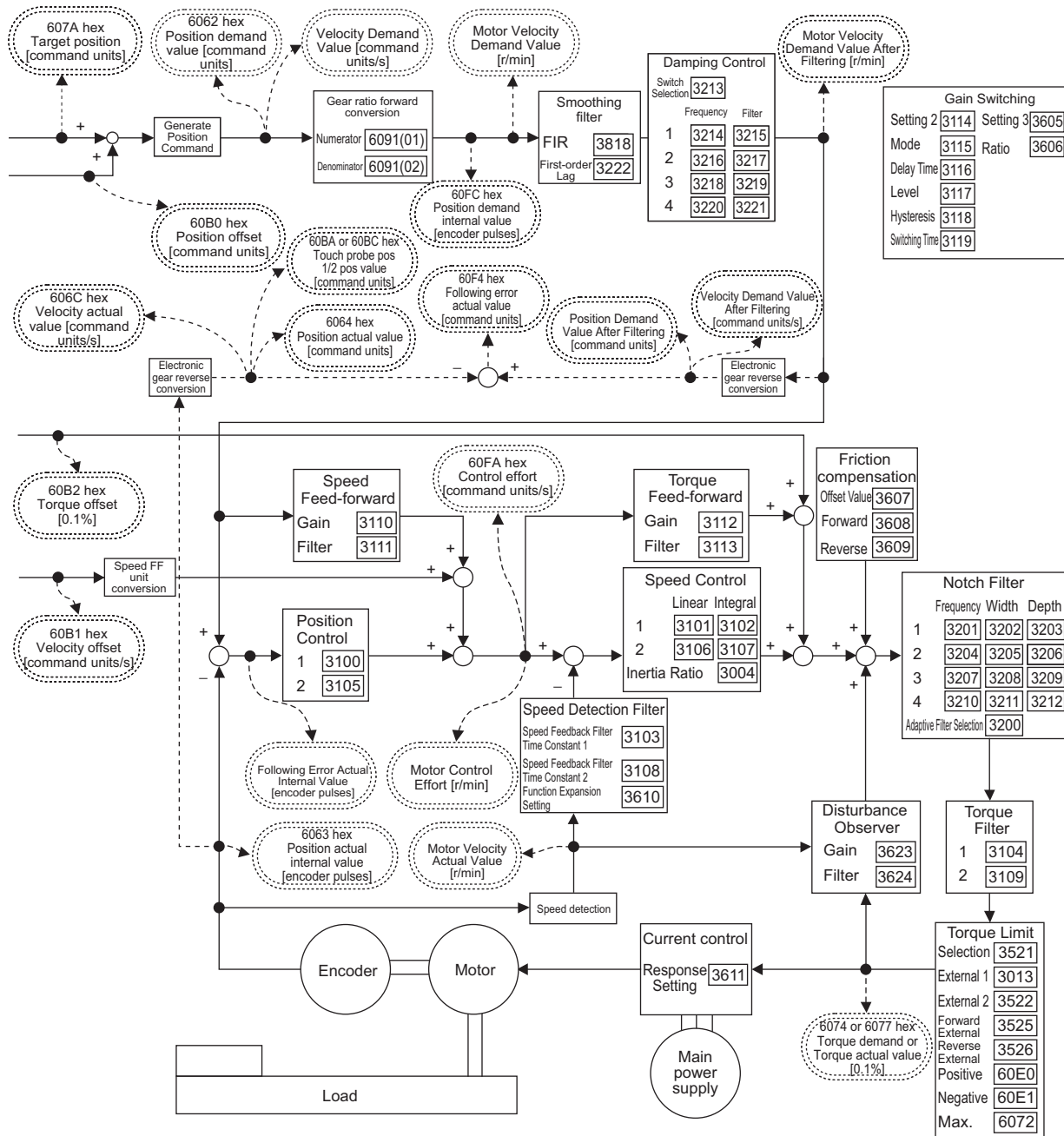
6-1-1 Related Objects

| Index | Sub-index | Name | Access | Size | Unit | Setting range | Default setting |
|------------------------|-----------|------------------------------|--------|-------|-----------------|------------------------------------|-----------------|
| 6040 hex | 00 hex | Controlword | RW | U16 | 0 to FFFF hex | – | 0000 hex |
| 6060 hex | 00 hex | Modes of operation | RW | INT8 | – | 0 to 10 | 0 |
| 607A hex | 00 hex | Target position | RW | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 6065 hex ^{*1} | 00 hex | Following error window | RW | U32 | Command units | 0 to 134,217,728, or 4,294,967,295 | 100000 |
| 6072 hex | 00 hex | Max torque | RW | U16 | 0.1% | 0 to 5,000 | 5000 |
| 60B0 hex | 00 hex | Position offset | RW | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 60B1 hex | 00 hex | Velocity offset | RW | INT32 | Command units/s | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 60B2 hex | 00 hex | Torque offset | RW | INT16 | 0.1% | –5,000 to 5,000 | 0 |
| 6041 hex | 00 hex | Statusword | RO | U16 | 0 to FFFF hex | – | 0000 hex |
| 6064 hex | 00 hex | Position actual value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 606C hex | 00 hex | Velocity actual value | RO | INT32 | Command units/s | –2,147,483,647 to 2,147,483,647 | 0000 hex |
| 6077 hex | 00 hex | Torque actual value | RO | INT16 | 0.1% | –5,000 to 5,000 | 0000 hex |
| 60F4 hex | 00 hex | Following error actual value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |

*1 The Following error window object can be set to between 0 and 134,217,728, or 4,294,967,295. If the object is set to 4,294,967,295, the detection of Following error will be disabled. If it is set to 0, a Following error will always occur. If the set value is between 134,217,729 and 4,294,967,294, it is set to 134,217,728. In this case, 134,217,728 will be returned when the object is read.

6-1-2 Block Diagram for Position Control Mode

The following block diagram is for position control using an R88D-KN□□□-ECT-series Servo Drive.



- Note 1** Numbers within parentheses are sub-index numbers.
Note 2 Numbers within boxes are hexadecimal index numbers.
Note 3 Profile position mode (pp) and Homing mode (hm) are also included in this block diagram.
Note 4 Profile position mode (pp) is supported for unit version 2.1 or later.
Note 5 The electronic gear function is not supported for unit version 2.0. For the Servo Drives with unit version 2.0, set the electronic gear ratio to 1.1.

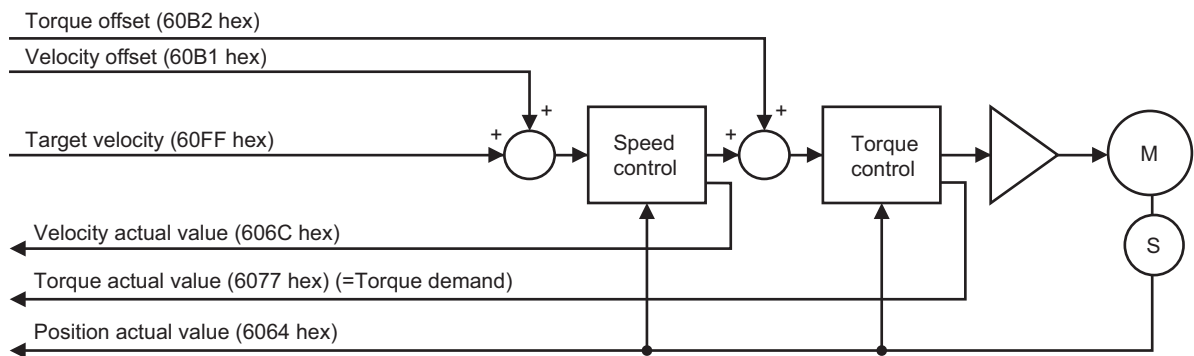
6-2 Cyclic Synchronous Velocity Mode

In this mode of operation, the controller has a path generation function (an operation profile calculation function) and it gives the target speed to the Servo Drive using cyclic synchronization. Speed control and torque control are performed by the Servo Drive.

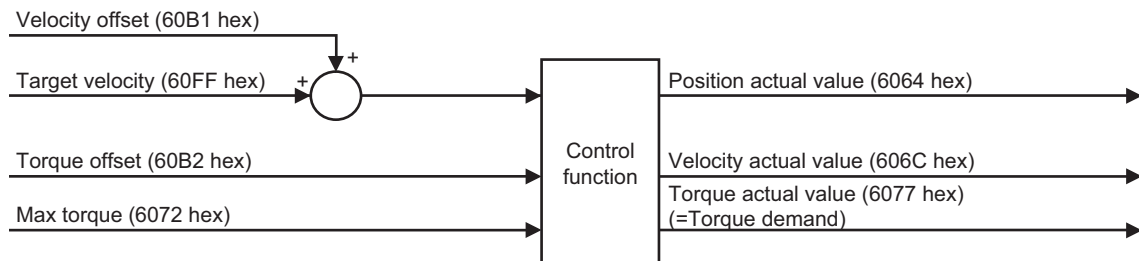
The Torque offset (60B2 hex) can be used as the torque feed-forward amount.

Cyclic Synchronous Velocity Mode Configuration

The following diagram shows the configuration of the Cyclic synchronous velocity mode.



The following diagram shows the control function configuration of the Cyclic synchronous velocity mode.



6-2-1 Related Objects

| Index | Sub-index | Name | Access | Size | Unit | Setting range | Default setting |
|----------|-----------|-----------------------|--------|-------|-----------------|---------------------------------|-----------------|
| 6040 hex | 00 hex | Controlword | RW | U16 | 0 to FFFF hex | – | 0000 hex |
| 6060 hex | 00 hex | Modes of operation | RW | INT8 | – | 0 to 10 | 0 |
| 60FF hex | 00 hex | Target velocity | RW | INT32 | Command units/s | –2,147,483,647 to 2,147,483,647 | 0000 hex |
| 6072 hex | 00 hex | Max torque | RW | U16 | 0.1% | 0 to 5,000 | 5000 |
| 60B1 hex | 00 hex | Velocity offset | RW | INT32 | Command units/s | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 60B2 hex | 00 hex | Torque offset | RW | INT16 | 0.1% | –5,000 to 5,000 | 0 |
| 6041 hex | 00 hex | Statusword | RO | U16 | 0 to FFFF hex | – | 0000 hex |
| 6064 hex | 00 hex | Position actual value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 606C hex | 00 hex | Velocity actual value | RO | INT32 | Command units/s | –2,147,483,647 to 2,147,483,647 | 0000 hex |
| 6077 hex | 00 hex | Torque actual value | RO | INT16 | 0.1% | –5,000 to 5,000 | 0000 hex |

6-2-2 Objects Requiring Settings

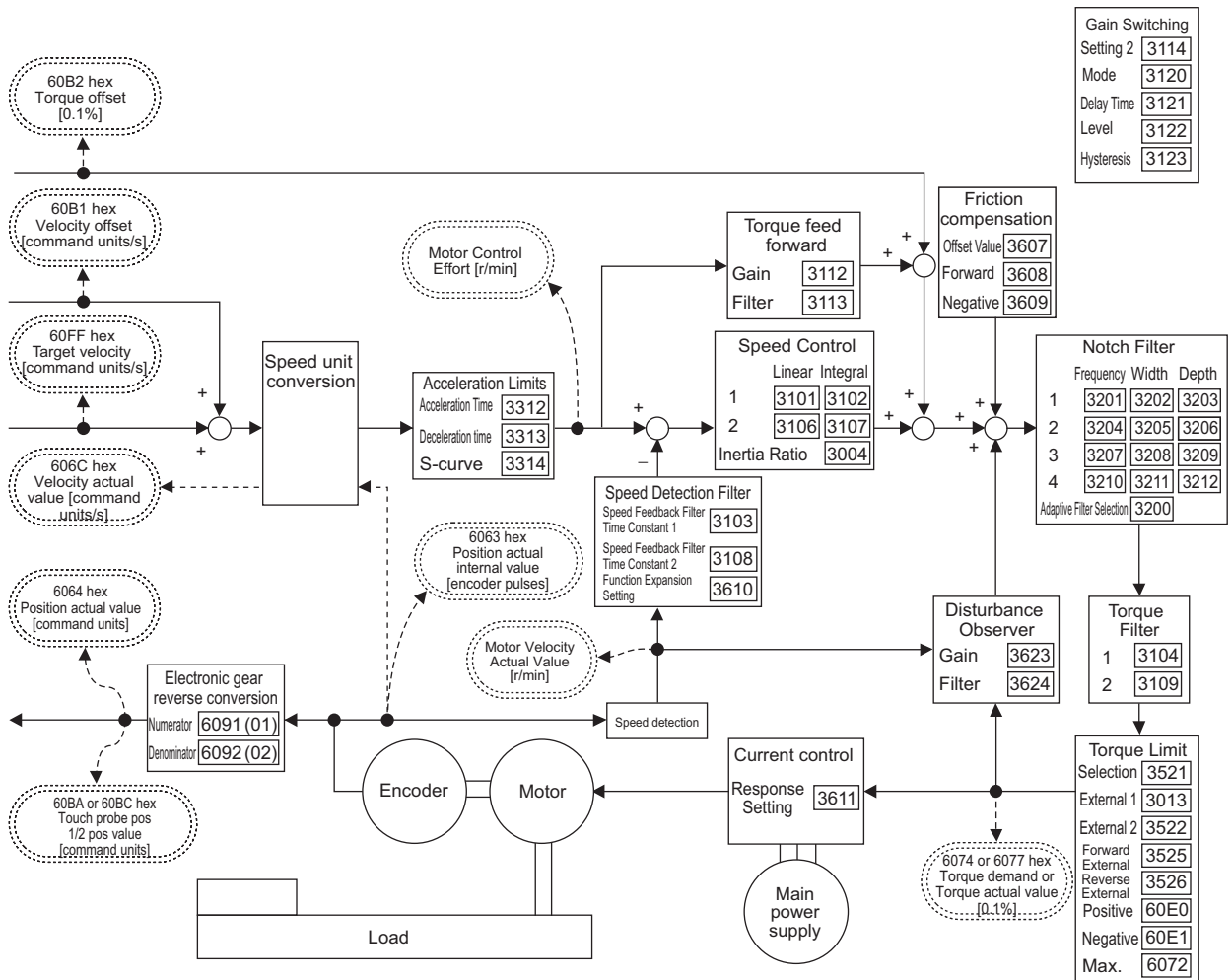
| Index | Name | Description | Reference |
|----------|--|---|-----------|
| 3312 hex | Soft Start Acceleration Time | Set the acceleration time for internally set speed control. Set the time until 1,000 r/min is reached. | page 9-26 |
| 3313 hex | Soft Start Deceleration Time | Set the deceleration time for internally set speed control. Set the time until 1,000 r/min is reached. | page 9-26 |
| 3314 hex | S-curve Acceleration/Deceleration Time Setting | Set the S-curve time in the time width centered on the inflection points for acceleration and deceleration. | page 9-27 |

6-2-3 Related Functions

| Index | Name | Description | Reference |
|----------|---|--|-----------|
| 3435 hex | Speed Conformity Detection Range | Set the detection threshold for speed conformity output. If the difference between the speed command and motor speed is within the set threshold, a speed conformity output is output. This setting has a hysteresis of 10 r/min for detection. | page 9-37 |
| 3436 hex | Rotation Speed for Motor Rotation Detection | Set the detection threshold for motor rotation detection output. A motor rotation detection output will be output when the motor speed has exceeded the set value. | page 9-37 |

6-2-4 Block Diagram for Speed Control Mode

The following block diagram is for speed control using an R88D-KN□□□-ECT-series Servo Drive.



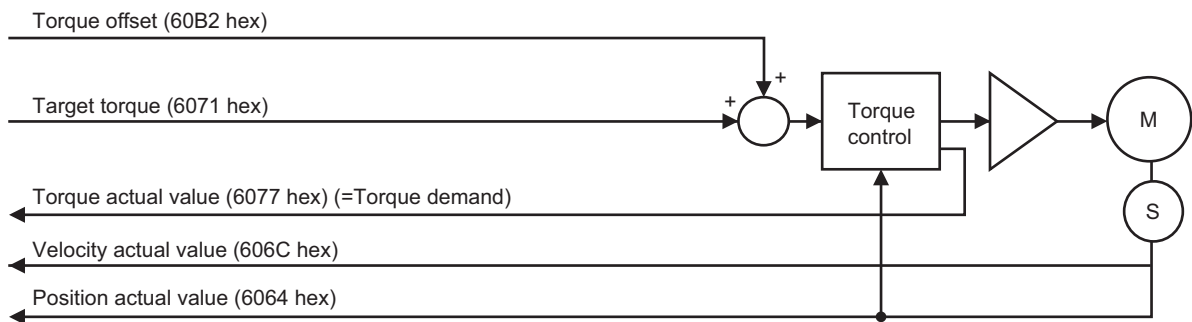
- Note 1** Numbers within parentheses are sub-index numbers.
- 2** Numbers within boxes are hexadecimal index numbers.
- 3** The electronic gear function is not supported for unit version 2.0. For the Servo Drives with unit version 2.0, set the electronic gear ratio to 1.1.

6-3 Cyclic Synchronous Torque Mode

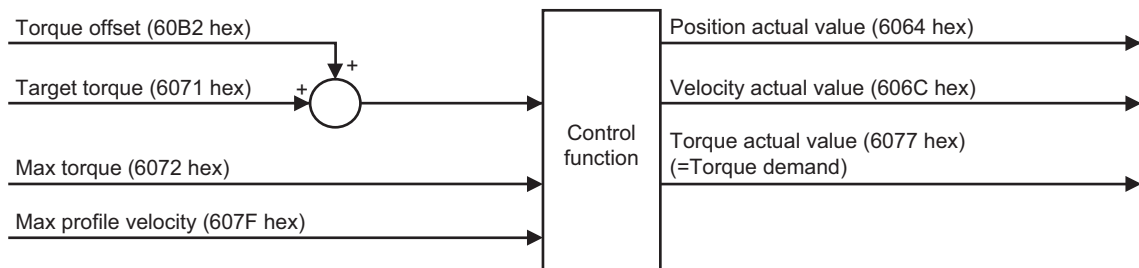
In this mode of operation, the controller has a path generation function (an operation profile calculation function) and it gives the target torque to the Servo Drive using cyclic synchronization. Torque control is performed by the Servo Drive.

Cyclic Synchronous Torque Mode Configuration

The following diagram shows the configuration of the Cyclic synchronous torque mode.



The following diagram shows the configuration of the Cyclic synchronous torque mode.



6-3-1 Related Objects

| Index | Sub-index | Name | Access | Size | Unit | Setting range | Default setting |
|----------|-----------|-----------------------|--------|-------|-----------------|---------------------------------|-----------------|
| 6040 hex | 00 hex | Controlword | RW | U16 | 0 to FFFF hex | – | 0000 hex |
| 6060 hex | 00 hex | Modes of operation | RW | INT8 | – | 0 to 10 | 0 |
| 6071 hex | 00 hex | Target torque | RW | INT16 | 0.1% | –5,000 to 5,000 | 0000 hex |
| 6072 hex | 00 hex | Max torque | RW | U16 | 0.1% | 0 to 5,000 | 5000 |
| 607F hex | 00 hex | Max profile velocity | RW | U32 | Command units/s | 0 to 2,147,483,647 | 0000 hex |
| 60B2 hex | 00 hex | Torque offset | RW | INT16 | 0.1% | –5,000 to 5,000 | 0 |
| 6041 hex | 00 hex | Statusword | RO | U16 | 0 to FFFF hex | – | 0000 hex |
| 6064 hex | 00 hex | Position actual value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 606C hex | 00 hex | Velocity actual value | RO | INT32 | Command units/s | –2,147,483,647 to 2,147,483,647 | 0000 hex |
| 6077 hex | 00 hex | Torque actual value | RO | INT16 | 0.1% | –5,000 to 5,000 | 0000 hex |

6-3-2 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|-----------------------|--|-----------|
| 3317 hex | Speed Limit Selection | Select the input location for the speed limit. | page 9-27 |

Speed Limit Selection (3317 hex)

Restricts the speed as the protection during torque control.

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

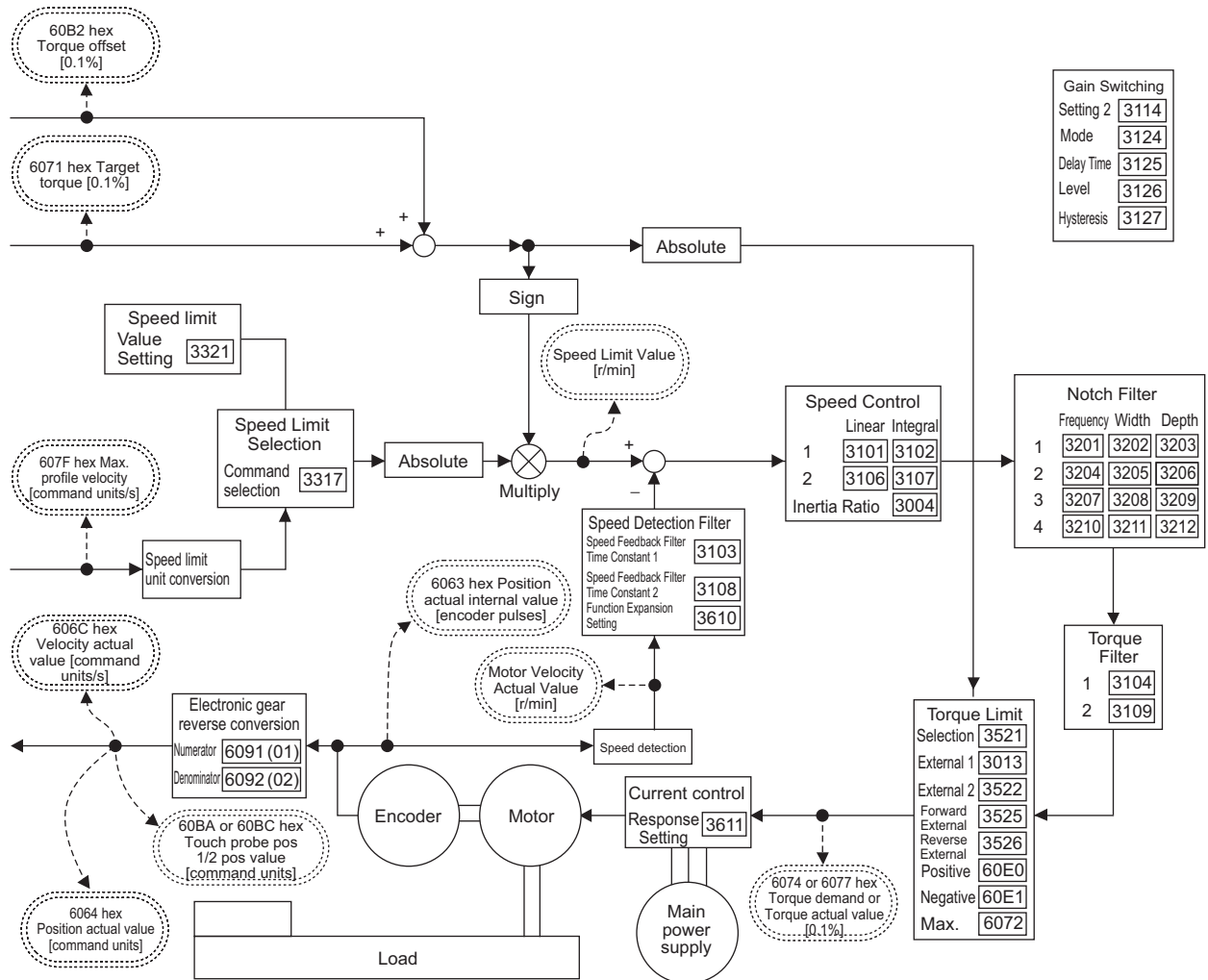
| Index | Name | Description | Setting range | Unit |
|----------|-----------------------|--|---------------|------|
| 3317 hex | Speed Limit Selection | Selects the input type of the Speed Limit during torque control. 0: Control the speed by the Speed Limit Value Setting (3321 hex). 1: Control the speed by either one of the smaller value: the Speed Limit Value (607F) by EtherCAT communications, or the Speed Limit Value Setting (3321 hex) | 0 to 1 | – |

6-3-3 Related Functions

| Index | Name | Description | Reference |
|----------|---------------------------|--|-----------|
| 3321 hex | 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. | page 9-27 |

6-3-4 Block Diagram for Torque Control Mode

The following block diagram is for torque control using an R88D-KN□□□-ECT-series Servo Drive.



- Note 1** Numbers within parentheses are sub-index numbers.
Note 2 Numbers within boxes are hexadecimal index numbers.
Note 3 The electronic gear function is not supported for unit version 2.0. For the Servo Drives with unit version 2.0, set the electronic gear ratio to 1.1.

6-4 Profile Position Mode

In this mode of operation, the controller uses the path generation function (an operation profile calculation function) inside the G5-series Servo Drive to perform PTP positioning operation. It executes path generation, position control, speed control, and torque control based on the target position, profile velocity, profile acceleration, profile deceleration, and other information.



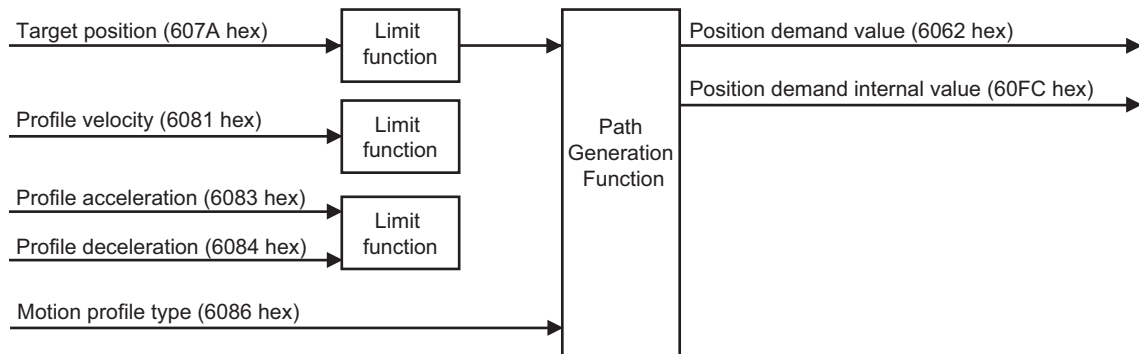
Precautions for Correct Use

Profile position mode is supported for unit version 2.1 or later.

For functional differences between unit versions, refer to *A-5 Functional Differences among Unit Versions* on page A-168.

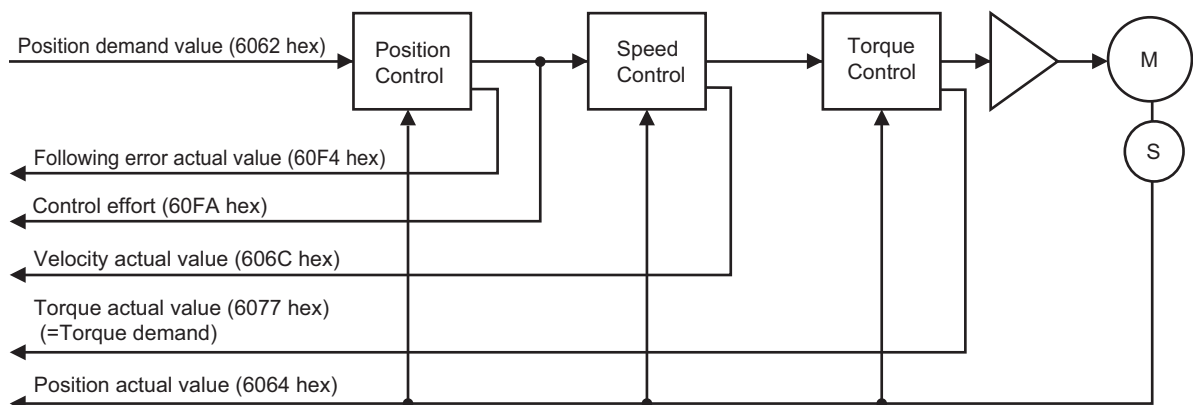


The configuration of the path generation function is as follows:

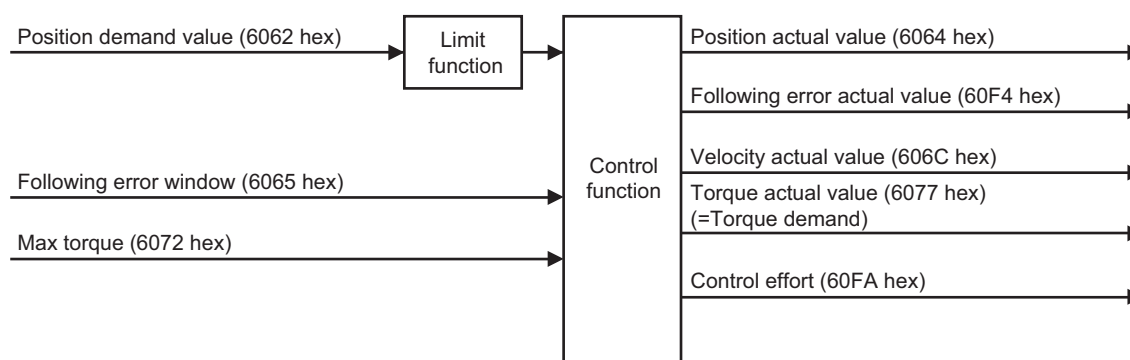


Profile Position Mode Configuration

The configuration of Profile position mode is as follows:



The following diagram shows the control function configuration of Profile position mode.



6-4-1 Related Objects

| Index | Sub-index | Name | Access | Size | Unit | Setting range | Default setting |
|------------------------|-----------|--------------------------------|--------|-------|------------------------------|------------------------------------|-----------------|
| 6040 hex | 00 hex | Controlword | RW | U16 | – | 0 to FFFF hex | 0000 hex |
| 6060 hex | 00 hex | Modes of operation | RW | INT8 | – | 0 to 10 | 0 |
| 6065 hex ^{*1} | 00 hex | Following error window | RW | U32 | Command units | 0 to 134,217,728, or 4,294,967,295 | 100000 |
| 6072 hex | 00 hex | Max torque | RW | U16 | 0.1% | 0 to 5000 | 5000 |
| 607A hex ^{*2} | 00 hex | Target position | RW | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 607D hex | 01 hex | Min position limit | RW | INT32 | Command units | –1,073,741,823 to 1,073,741,823 | –500000 |
| | 02 hex | Max position limit | RW | INT32 | Command units | –1,073,741,823 to 1,073,741,823 | 500000 |
| 6081 hex | 00 hex | Profile velocity | RW | U32 | Command units/s | 0 to 2,147,483,647 | 0000 hex |
| 6083 hex | 00 hex | Profile acceleration | RW | U32 | Command units/s ² | 1 to 655,350,000 | 1000000 |
| 6084 hex | 00 hex | Profile deceleration | RW | U32 | Command units/s ² | 1 to 655,350,000 | 1000000 |
| 6086 hex | 00 hex | Motion profile type | RW | INT16 | – | –1 to 0 | 0 |
| 6041 hex | 00 hex | Statusword | RO | U16 | – | 0 to FFFF hex | 0000 hex |
| 6062 hex | 00 hex | Position demand value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0 |
| 6064 hex | 00 hex | Position actual value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 606C hex | 00 hex | Velocity actual value | RO | INT32 | Command units/s | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 6077 hex | 00 hex | Torque actual value | RO | INT16 | 0.1% | –5,000 to 5,000 | 0000 hex |
| 60F4 hex | 00 hex | Following error actual value | RO | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0000 hex |
| 60FA hex | 00 hex | Control effort | RO | INT32 | Command units/s | –1,073,741,823 to 1073741823 | 0000 hex |
| 60FC hex | 00 hex | Position demand internal value | RO | INT32 | Encoder units | –2,147,483,647 to 2,147,483,647 | 0 |

^{*1} The Following error window object can be set to between 0 and 134,217,728, or 4,294,967,295. If the object is set to 4,294,967,295, the detection of Following error will be disabled. If it is set to 0, a Following error will always occur. If the set value is between 134,217,729 and 4,294,967,294, it is assumed that 134,217,728 is set. In this case, 134,217,728 will be returned when the object is read.

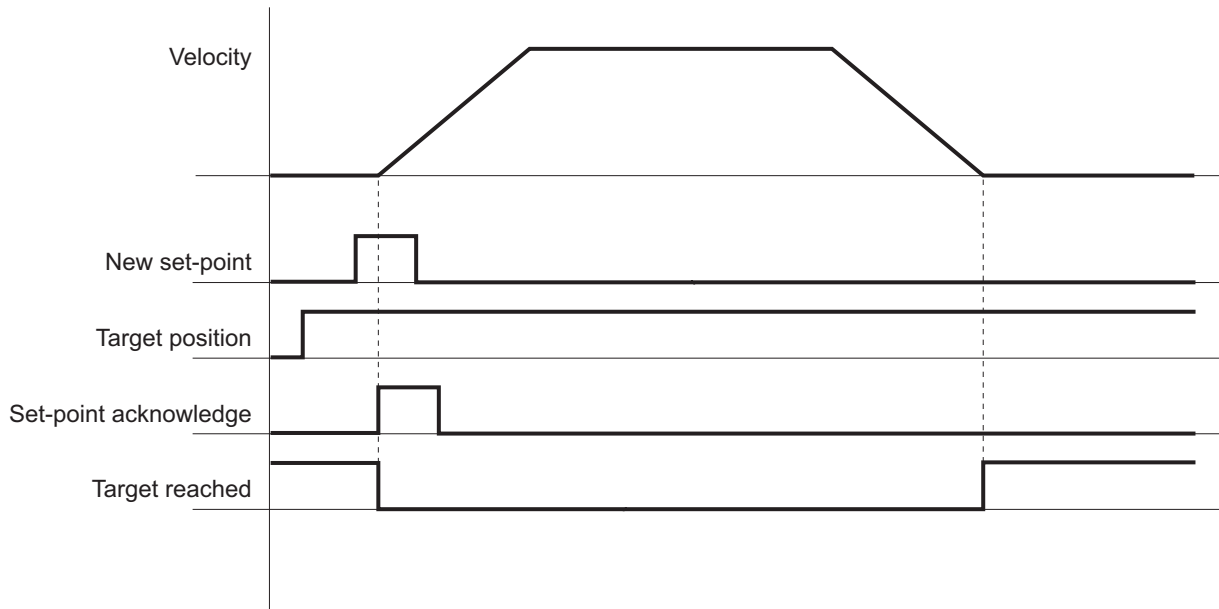
^{*2} For the Servo Drive to accept commands without fail, the object value must always be retained for two communications cycles or more.

6-4-2 Description of Function

The G5-series Servo Drive can perform PTP positioning operation.

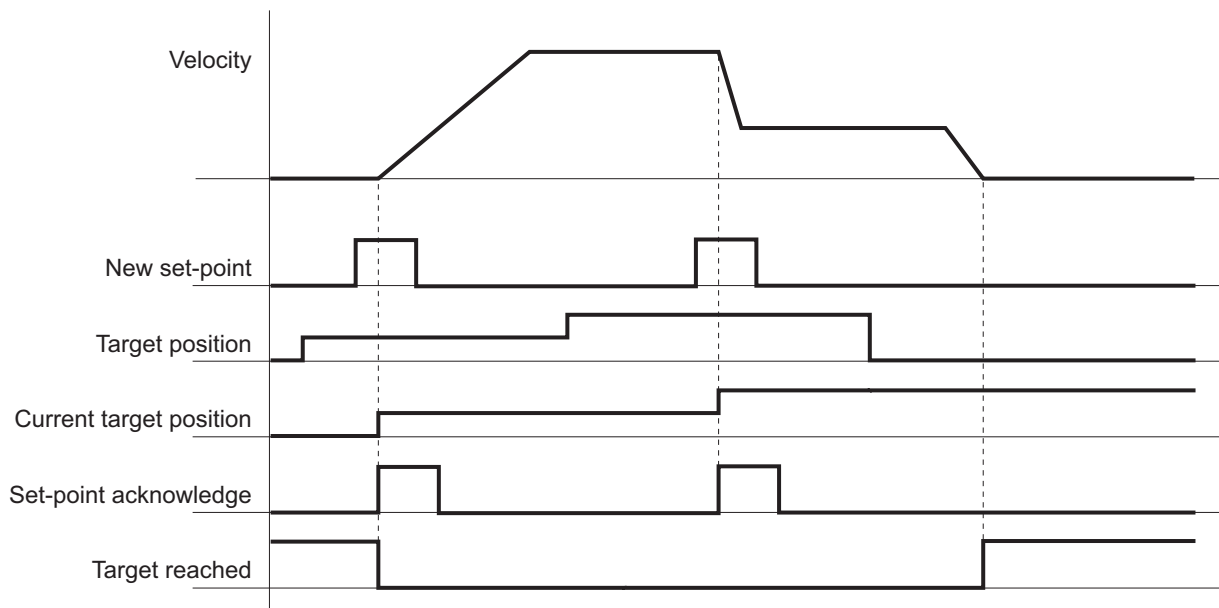
Set the Controlword (6040 hex) bit 5 (Change set immediately) to 1.

Setting the Target position (607A hex) and the Profile velocity (6081 hex) and then changing the Controlword (6040 hex) bit 4 (New set point) from 0 to 1 starts positioning to the set target position.



The Target value can be changed while PTP positioning is in progress.

During PTP positioning, changing the Target position (607A hex)/Profile velocity (6081 hex) value and then changing the Controlword (6040 hex) bit 4 (New set point) from 0 to 1 causes the G5-series Servo Drive to execute positioning with the changed value.



6-4-3 Controlword (6040 hex) in Profile Position Mode

| Bit | Name | Description |
|-----|------------------------|---|
| 4 | New set-point | Starts positioning at the rising edge, from 0 to 1, of the signal. In this timing, the Target position (607A hex) and Profile velocity (6081 hex) values are obtained. |
| 5 | Change set immediately | Always set to 1 (Change set immediately). If set to 0, positioning does not occur due to a Command warning. |
| 6 | abs/rel | Always set to 0 (abs). If set to 1 (rel), positioning does not occur due to a Command warning. |
| 8 | Halt | When set to 0, positioning starts or continues. When set to 1, positioning stops according to the Halt option code (605D hex) setting. |
| 9 | Change on Set-point | Unused for G5-series Servo Drives. |

6-4-4 Statusword (6041 hex) in Profile Position Mode

| Bit | Name | Value | Description |
|-----|-----------------------|-------|--|
| 10 | Target reached | 0 | Halt bit is 0:Positioning is not completed. Halt bit is 1:The axis is decelerating. |
| | | 1 | Halt bit is 0:Positioning is completed. Halt bit is 1:The axis speed is zero. |
| 12 | Set-point acknowledge | 0 | Waiting for a new Target position. |
| | | 1 | Ready to accept updates (overwriting) of the Target position. |
| 13 | Following error | 0 | No Following error occurred. |
| | | 1 | A Following error occurred. |

6-5 Homing Mode

In this mode of operation, the Servo Drive has a path generation function (an operation profile calculation function) and it executes the homing operation using the Homing method specified from the controller.

When a controller is connected, the following two homing procedures are available depending on the controller specifications.

- Procedure 1
Create a homing operation pattern in the controller, and provide the command to the Servo Drive using Cyclic synchronous position mode (csp).
- Procedure 2
Use the Homing mode of the Servo Drive. The controller specifies a homing method supported by the Servo Drive and commands the start of the homing operation.

When performing the homing operation using the controller in procedure 1, refer to the operating manual for the controller.

When performing the homing operation using the controller in procedure 2, refer to the operating manual for the controller, and to *Homing Mode Specifications* on page A-15 of this manual.



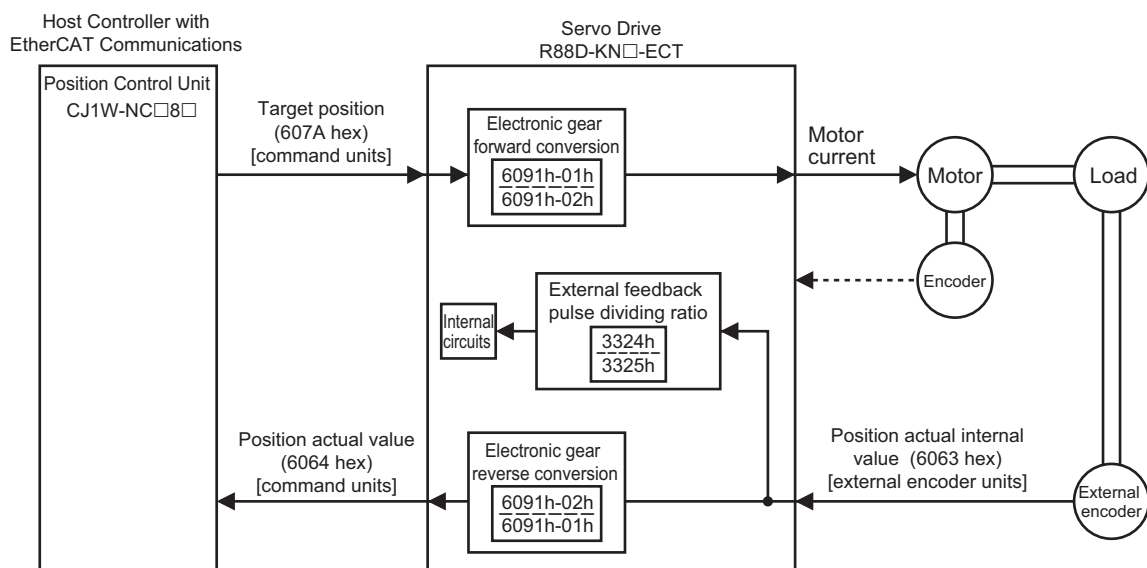
Additional Information

Procedure 1 is used for the OMRON Machine Automation Controller NJ-series (Model: NJ501-1□00) and the CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882 Position Control Units. Create a homing operation pattern in the Position Control Unit, provide the command to the Servo Drive using the Cyclic synchronous position mode (csp), and perform the homing operation.

6-6 Fully-closed Control

An externally provided encoder is used to directly detect the position of the control target and feedback the detected machine position to perform position control. This way, controls can be performed without being affected by ball screw error, temperature changes, etc. You can achieve highly accurate positioning by configuring a fully-closed control system.

6-6-1 Outline of Operation



Note The electronic gear function is not supported for unit version 2.0. For the Servo Drives with unit version 2.0, set the electronic gear ratio to 1.1.



Additional Information

- If the Gear ratio (6091-01 and 6091-02 hex) is 1:1, 1 command unit from the Target position (607A hex) is equivalent to a movement of 1 external encoder pulse.

Example for an External Encoder with a Resolution of 0.1 μm

Gear ratio (6091-01 and 6091-02 hex) of 1:1:

The external encoder executes positioning for 10 μm when 100 command units are applied as the Target position (607A hex).

$$100 \text{ [command units]} \times 1/1 \text{ (electronic gear ratio)} \times 0.1 \text{ } [\mu\text{m}] = 10 \text{ } [\mu\text{m}]$$

Here, 100 command units are returned to the host controller as the Position actual value (6064 hex).

Gear ratio (6091-01 and 6091-02 hex) of 1:2:

The external encoder executes positioning for 10 μm when 200 command units are applied as the Target position (607A hex).

$$200 \text{ [command units]} \times 1/2 \text{ (electronic gear ratio)} \times 0.1 \text{ } [\mu\text{m}] = 10 \text{ } [\mu\text{m}]$$

Here, 200 command units are returned to the host controller as the Position actual value (6064 hex).

- Set the External Feedback Pulse Dividing Ratio (3324 and 3325 hex) according to *External Feedback Pulse Dividing Ratio Setting (3324 Hex, 3325 Hex)* on page 6-20.
- Set the Hybrid Following Error Counter Overflow Level (3328 hex) and Hybrid Following Error Counter Reset (3329 hex) according to *Hybrid Error Setting (3328 Hex, 3329 Hex)* on page 6-21.

6-6-2 Objects Requiring Settings

| Index | Sub-index | Name | Description | Reference |
|----------|-----------|---|--|-----------|
| 3000 hex | 00 hex | Rotation Direction Switching | Set the relation between the command direction and the motor rotation direction. | page 9-2 |
| 3001 hex | 00 hex | Control Mode Selection | Select the control mode. | page 9-3 |
| 6091 hex | 01 hex | Motor revolutions | Set the numerator of the electronic gear ratio for the Target position (607A hex). | page A-91 |
| 6091 hex | 02 hex | Shaft revolutions | Set the denominator of the electronic gear ratio for the Target position (607A hex). | |
| 3323 hex | 00 hex | External Feedback Pulse Type Selection | Select the external encoder type. | page 9-28 |
| 3324 hex | 00 hex | External Feedback Pulse Dividing Numerator | Set the numerator of the external feedback pulse divider setting. | page 9-29 |
| 3325 hex | 00 hex | External Feedback Pulse Dividing Denominator | Set the denominator of the external feedback pulse divider setting. | page 9-29 |
| 3326 hex | 00 hex | External Feedback Pulse Direction Switching | Set the polarity of the external encoder feedback pulse. | page 9-29 |
| 3327 hex | 00 hex | External Feedback Pulse Phase-Z Setting | Set whether to enable or disable the disconnection detection function for phase Z when an external encoder with a 90° phase difference output is used. | page 9-30 |
| 3328 hex | 00 hex | Hybrid Following Error Counter Overflow Level | Set the threshold for the Excessive Hybrid Deviation Error (Error No. 25.0) in the command unit. | page 9-30 |
| 3329 hex | 00 hex | Hybrid Following Error Counter Reset | The hybrid error becomes 0 every time the motor rotates by the set value. | page 9-30 |

Rotation Direction Switching (3000 Hex)

Set the relation between the command direction and the motor rotation direction.

0: Counterclockwise when viewed from the end of the shaft for positive commands

1: Clockwise when viewed from the end of the shaft for positive commands

When object 3000 hex is set to 1, opposite directions will be used for the external encoder counting direction and the total external encoder feedback pulses and other monitor counts.

Control Mode Selection (3001 Hex)

Select the fully-closed control (set value: 6).

Electronic Gear Function (6091-01 Hex, 6091-02 Hex)

This function sets the position command for the position control part to the value that is calculated by multiplying the command from the Host Controller with the electronic gear ratio.

| Index | Name | Description | Setting range | Unit |
|-------------|-------------------|---|--------------------|------|
| 6091-01 hex | Motor revolutions | Set the numerator of the electronic gear ratio for the command pulse input. | 0 to 1,073,741,824 | – |
| 6091-02 hex | Shaft revolutions | Set the denominator of the electronic gear ratio for the command pulse input. | 1 to 1,073,741,824 | – |

- For details on the electronic gear function, refer to *Electronic Gear Function* on page 7-21.

External Feedback Pulse Type Selection (3323 Hex, 3326 Hex)

Set the external encoder output type and direction.

| Index | Name | Description | Setting range | Unit |
|----------|---|---|---------------|------|
| 3323 hex | External Feedback Pulse Type Selection | Select the type of the external encoder to be used. 0: Encoder with 90° phase difference output 1: Incremental encoder with serial communications 2: Absolute encoder with serial communications | 0 to 2 | – |
| 3326 hex | External Feedback Pulse Direction Switching | If the count directions of the external encoder feedback pulse and the encoder total feedback pulses do not match, reverse the external encoder feedback pulse direction in this setting. 0: Not reversed, 1: Reversed | 0 to 1 | – |

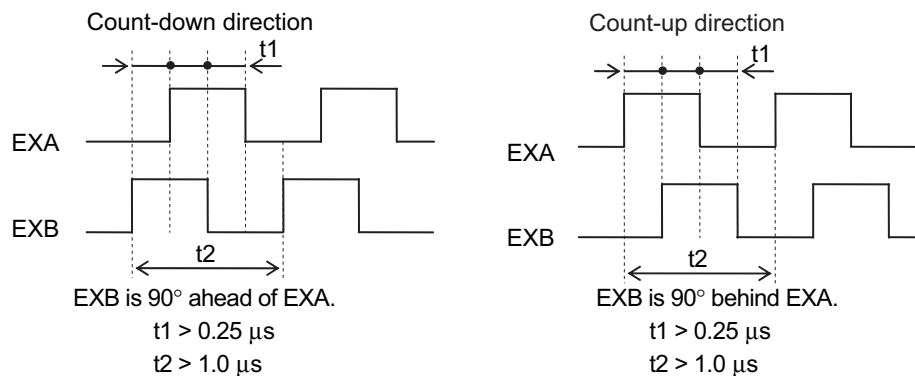
● Supported External Encoders

The corresponding external encoders for each output type are given in the following table.

| Set value of 3323 hex | External encoder type | Corresponding external encoder examples | Maximum input frequency ^{*1} |
|-----------------------|--|---|---------------------------------------|
| 0 | Encoder with 90° phase difference output ^{*2*3} | External encoder with phase-AB outputs | 0 to 4 Mpps (After x4) |
| 1 | Incremental encoder with serial communications ^{*3} | Sony Manufacturing Systems Corporation SR75, SR85 | 0 to 400 Mpps |
| 2 | Absolute encoder with serial communications ^{*3} | Mitutoyo Corporation AT573, ST771A, ST773A Sony Manufacturing Systems Corporation SR77, SR87 | 0 to 400 Mpps |

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

- *2 These are the directions in which the Servo Drive counts the pulses from an external encoder with a 90° phase difference outputs.



- *3 For the external encoder connection direction, set the direction so that count-up occurs when the motor shaft is rotating counterclockwise, and count-down occurs when the motor shaft is rotating clockwise. If the connection direction cannot be selected due to installation conditions or any other reason, the count direction can be reversed using External Feedback Pulse Direction Switching (3326 hex).



Precautions for Correct Use

- If 3000 hex = 1, the encoder count direction becomes opposite to the count direction used for monitoring, e.g., for the total external encoder feedback pulses. If 3000 hex = 0, the count direction matches the count direction for monitoring.
- Even when the speed command is within the Servo Drive's speed command range, an acceleration alarm will occur if the speed command exceeds the maximum speed of the motor.
- To confirm that the installation direction is correct, use the front-panel monitor or the CX-Drive monitor function to check the counting direction of the total external encoder feedback pulses and the total encoder feedback pulses. If the counting directions are the same, the connections are correct.



Additional Information

Maximum Input Frequency

- The maximum speed when an external encoder with a resolution of 0.01 μm is used for the serial communications is $0.01 \mu\text{m} \times (400 \times 10^6) \text{ pps} = 4.00 \text{ m/s}$. An overspeed error will occur, however, if the motor shaft rotation speed exceeds the maximum speed.

External Feedback Pulse Dividing Ratio Setting (3324 Hex, 3325 Hex)

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

| Index | Name | Description | Setting range | Unit |
|----------|--|---|----------------|------|
| 3324 hex | External Feedback Pulse Dividing Numerator | Set the numerator of the external feedback pulse 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 1,048,576 | – |
| 3325 hex | External Feedback Pulse Dividing Denominator | Set the denominator of the external feedback pulse divider setting. Normally, set the number of external encoder output pulses per motor rotation. | 1 to 1,048,576 | – |

Check the number of encoder feedback pulses and the number of external encoder output pulses per motor rotation, and set the External Feedback Pulse Dividing Numerator (3324 hex) and External Feedback Pulse Dividing Denominator (3325 hex) the so that the following equation is true.

$$\frac{\text{Object 3324 hex}}{\text{Object 3325 hex}} = \frac{\text{Encoder resolution per motor rotation [pulses]}}{\text{External encoder resolution per motor rotation [pulses]}}$$

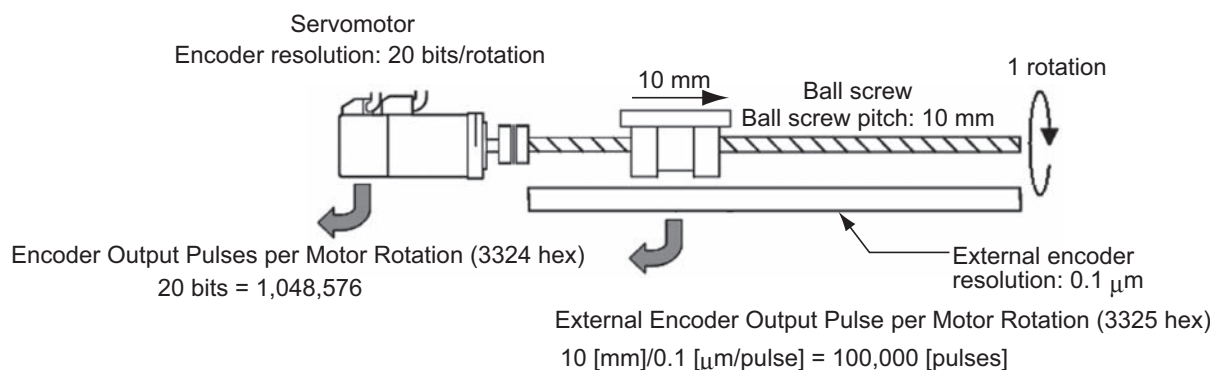


Precautions for Correct Use

- If this divider setting is wrong, there will be error between the position calculated from encoder pulses and the position calculated from external encoder pulses. If the movement distance is long, this error accumulates and causes a Excessive Hybrid Deviation Error (Error No. 25.0).
- The recommended divider setting is $1/40 \leq \text{External Feedback Pulse Ratio} \leq 160$. If the ratio is set too small, control to the unit of 1 external feedback pulse may be disabled. On the other hand, if the external feedback pulse ratio is increased, operating noise may increase.

● Setting Example

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



$$\frac{\text{Object 3324 hex}}{\text{Object 3325 hex}} = \frac{\text{Encoder resolution per motor rotation [pulses]}}{\text{External encoder resolution per motor rotation [pulses]}} = \frac{1048576}{100000}$$

Hybrid Error Setting (3328 Hex, 3329 Hex)

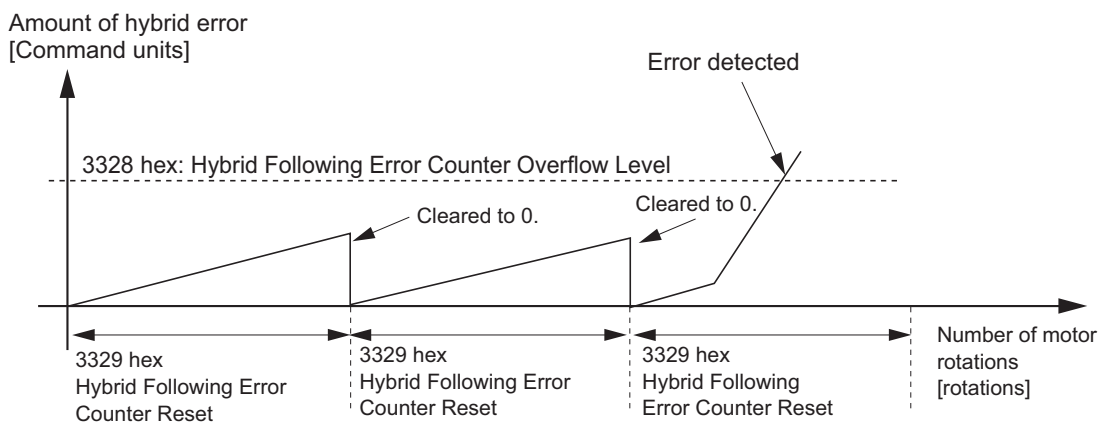
The difference between the encoder position and external encoder position is detected, and if the difference exceeds the value of Hybrid Following Error Counter Overflow Level (3328 hex), an error occurs.

| Index | Name | Description | Setting range | Unit |
|----------|---|--|---------------|---------------|
| 3328 hex | Hybrid Following Error Counter Overflow Level | Set the allowable difference (hybrid error) between the encoder-detected position and external encoder-detected position in command units. | 1 to 2^{27} | Command units |
| 3329 hex | Hybrid Following 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 | Rotations |

● 3329 Hex: Hybrid Following Error Counter Reset

The hybrid error is cleared every time the motor rotates by the amount set in object 3329 hex.

This function can be used when there is error between the position calculated from encoder pulses and the position calculated from external encoder because hybrid error accumulated due to slipping or other factors.

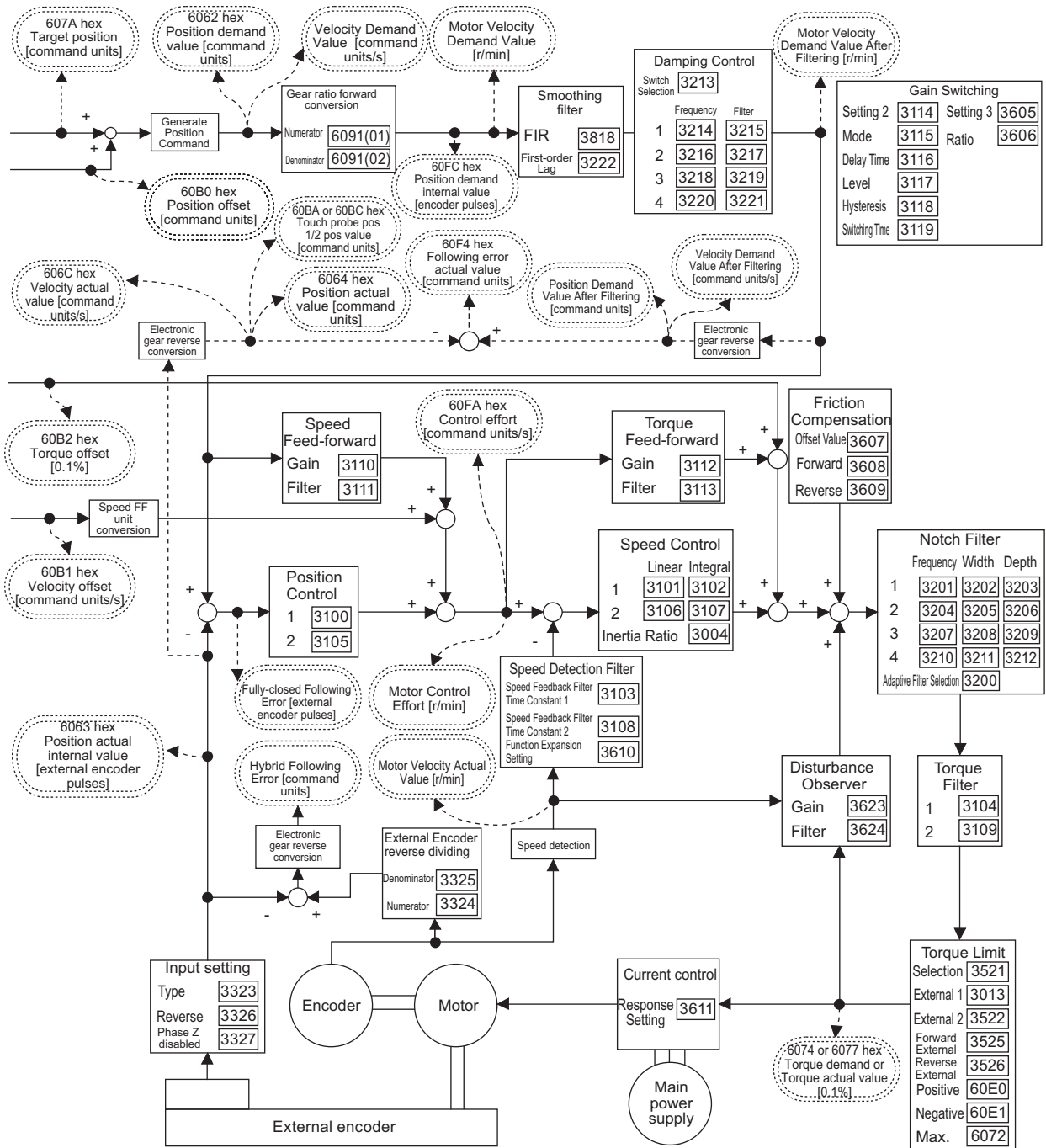


Precautions for Correct Use

- The machine may run out of control and be damaged if the external encoder breaks down or the motor or load coupling becomes disconnected. To prevent this from happening, set the Hybrid Following Error Counter Overflow Level (3328 hex) and Hybrid Following Error Counter Reset (3329 hex).
- If the Hybrid Following Error Counter Overflow Level (3328 hex) is set too high, detection is delayed and error detection will be ineffective. If an extremely small value is set, the amount of motor or machine torsion during normal operation may be detected as an error. Be sure to set an appropriate value.
- Take sufficient safety measures, such as installing limit sensors.

6-6-3 Block Diagram for Fully-closed Control Mode

The following is a block diagram for fully-closed control using an R88D-KN□□□-ECT-Series Servo Drive.



- Note 1** Numbers within parentheses are sub-index numbers.
2 Numbers within boxes are hexadecimal index numbers.
3 Profile position mode (pp) and Homing mode (hm) are also included in this block diagram.
4 Profile position mode (pp) is supported for unit version 2.1 or later.
5 The electronic gear function is not supported for unit version 2.0. For the Servo Drives with unit version 2.0, set the electronic gear ratio to 1.1.

6-7 Connecting with OMRON Controllers

This section describes the settings required to connect the G5-series Servo Drive with an OMRON controller.

Related Objects

Objects listed in the following table can be used without changing them from their default values. If you are changing these settings, read and understand the relevant specifications in advance and set appropriate values.

● Machine Automation Controller NJ-series (NJ501-1□00)

| Index | Sub-index | Name | Default setting | Description |
|----------|-----------|--|-----------------|---|
| 3013 hex | 00 hex | External Torque Limit 1 | 1388 hex | Default setting = 500.0% |
| 3015 hex | 00 hex | Operation Switch When Using Absolute Encoder | 0002 hex | Use absolute values and ignore multi-rotation counter overflow. |
| 3317 hex | 00 hex | Speed Limit Selection | 0001 hex | Speed Limit during torque control is done using Max profile velocity (607F hex) or Speed Limit Value Setting (3321 hex), whichever has the smaller value. |
| 3324 hex | 00 hex | External Feedback Pulse Dividing Numerator | 00000000 hex | Encoder resolution is set automatically. |
| 3401 hex | 00 hex | Input Signal Selection 2 | 00818181 hex | Forward Drive Prohibition Input (NC) |
| 3402 hex | 00 hex | Input Signal Selection 3 | 00828282 hex | Reverse Drive Prohibition Input (NC) |
| 3403 hex | 00 hex | Input Signal Selection 4 | 00222222 hex | Origin Proximity Input (NO) |
| 3404 hex | 00 hex | Input Signal Selection 5 | 002B2B2B hex | External Latch Signal 3 (NO) ^{*1} |
| 3405 hex | 00 hex | Input Signal Selection 6 | 00212121 hex | External Latch Signal 2 (NO) ^{*1} |
| 3406 hex | 00 hex | Input Signal Selection 7 | 00202020 hex | External Latch Signal 1 (NO) ^{*1} |
| 3504 hex | 00 hex | Drive Prohibition Input Selection | 0001 hex | The drive prohibition input is disabled in the servo and processed in the controller. |
| 3508 hex | 00 hex | Undervoltage Error Selection | 0001 hex | Stopping for undervoltage errors. |
| 3521 hex | 00 hex | Torque Limit Selection | 0006 hex | Use the 60E0 hex and 60E1 hex values to limit torque, with PCL and NCL OFF. |
| 3522 hex | 00 hex | External Torque Limit 2 | 1388 hex | Default setting = 500.0% |
| 3703 hex | 00 hex | Torque Limit Flag Output Setting | 0001 hex | Turn ON at torque limits excluding the torque command value. |
| 3801 hex | 00 hex | Software Position Limit Function | 0003 hex | Disable the software limits in both directions. |
| 3758 hex | 00 hex | Touch Probe Trigger Selection | 0100 hex | Touch probe1 = External Latch Signal 1 Touch probe2 = External Latch Signal 2 |
| 3759 hex | 00 hex | Warning Hold Selection | 0000 hex | Automatically cleared when the cause is removed. |
| 607C hex | 00 hex | Home offset | 00000000 hex | An offset value of 0 is used by the Servo Drive. |
| 6091 hex | 01 hex | Motor revolutions | 00000001 hex | Gear ratio used by the Servo Drive is 1:1, and user units are handled by the controller. |
| | 02 hex | Shaft revolutions | 00000001 hex | |

*1 Machine Automation Controller NJ-series (Model: NJ501-1□00) uses the latch signals as follows:
 External Latch Signal 1: Trigger signal from external Touch probe function (External Latch Input 1)
 External Latch Signal 2: Trigger signal from external Touch probe function (External Latch Input 2)
 External Latch Signal 3: Unused

● CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882 Position Control Units

| Index | Sub-index | Name | Default setting | Description |
|----------|-----------|--|-----------------|---|
| 3013 hex | 00 hex | External Torque Limit 1 | 1388 hex | Default setting = 500.0% |
| 3015 hex | 00 hex | Operation Switch When Using Absolute Encoder | 0002 hex | Use absolute values and ignore multi-rotation counter overflow. |
| 3324 hex | 00 hex | External Feedback Pulse Dividing Numerator | 00000000 hex | Encoder resolution is set automatically. |
| 3401 hex | 00 hex | Input Signal Selection 2 | 00818181 hex | Forward Drive Prohibition Input (NC) |
| 3402 hex | 00 hex | Input Signal Selection 3 | 00828282 hex | Reverse Drive Prohibition Input (NC) |
| 3403 hex | 00 hex | Input Signal Selection 4 | 00222222 hex | Origin Proximity Input (NO) |
| 3404 hex | 00 hex | Input Signal Selection 5 | 002B2B2B hex | External Latch Signal 3 (NO)*1 |
| 3405 hex | 00 hex | Input Signal Selection 6 | 00212121 hex | External Latch Signal 2 (NO)*1 |
| 3406 hex | 00 hex | Input Signal Selection 7 | 00202020 hex | External Latch Signal 1 (NO)*1 |
| 3504 hex | 00 hex | Drive Prohibition Input Selection | 0001 hex | The drive prohibition input is disabled in the servo and processed in the controller. |
| 3508 hex | 00 hex | Undervoltage Error Selection | 0001 hex | Stopping for undervoltage errors. |
| 3521 hex | 00 hex | Torque Limit Selection | 0006 hex | Both forward and reverse directions have two limits which are switched using PCL and NCL. |
| 3522 hex | 00 hex | External Torque Limit 2 | 1388 hex | Default setting = 500.0% |
| 3801 hex | 00 hex | Software Position Limit Function | 0003 hex | Disable the software limits in both directions. |
| 3758 hex | 00 hex | Touch Probe Trigger Selection | 0100 hex | Touch probe1 = External Latch Signal 1 Touch probe2 = External Latch Signal 2 |
| 3759 hex | 00 hex | Warning Hold Selection | 0000 hex | Automatically cleared when the cause is removed. |
| 607C hex | 00 hex | Home offset | 00000000 hex | An offset value of 0 is used by the Servo Drive. |
| 6091 hex | 01 hex | Motor revolutions | 00000001 hex | Gear ratio used by the Servo Drive is 1:1, and user units are handled by the controller. |
| | 02 hex | Shaft revolutions | 00000001 hex | |
| 60E0 hex | 00 hex | Positive torque limit value | 1388 hex | Default setting = 500.0% |
| 60E1 hex | 00 hex | Negative torque limit value | 1388 hex | Default setting = 500.0% |

*1 The CJ1W-NC□□8□ uses the latch signals as follows:

External Latch Signal 1: Origin Input
 External Latch Signal 2: Interrupt Input
 External Latch Signal 3: Not used.



Applied Functions

This chapter outlines the applied functions such as the electronic gear, gain switching and soft start, and explains the settings.

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7-1 Sequence I/O Signals

You can set sequences in various operating conditions.

For the connection of I/O signals and processing of external signals, refer to *3-1-6 Control I/O Connector Specifications (CN1)* on page 3-18.

7-1-1 Input Signals

You can allocate input signal functions to the input pins of the control I/O connector (CN1). In addition, you can change logic. Refer to *Input Signal Allocation Method* on page 7-3 for more information because some signals have allocation limitations.

If a G-series Servo Drive is being replaced with a G5-series Servo Drive, use the G5-series Servo Drive with the default settings.

Input Signal Default Settings

The allocations of the default input signals are as follows. Refer to *Input Signal Allocation Method* on page 7-3 to change the allocations.

| Index | Input signal | Default setting (hex) | Default setting state | | | | | |
|----------|--------------|-----------------------|--|----------|---------------|----------|----------------|----------|
| | | | Position control or fully-closed control | | Speed control | | Torque control | |
| | | | Signal name | Logic *1 | Signal name | Logic *1 | Signal name | Logic *1 |
| 3400 hex | IN1 | 0094 9494 hex | STOP | NC | STOP | NC | STOP | NC |
| 3401 hex | IN2 | 0081 8181 hex | POT | NC | POT | NC | POT | NC |
| 3402 hex | IN3 | 0082 8282 hex | NOT | NC | NOT | NC | NOT | NC |
| 3403 hex | IN4 | 0022 2222 hex | DEC | NO | DEC | NO | DEC | NO |
| 3404 hex | IN5 | 002B 2B2B hex | EXT3 | NO | EXT3 | NO | EXT3 | NO |
| 3405 hex | IN6 | 0021 2121 hex | EXT2 | NO | EXT2 | NO | EXT2 | NO |
| 3406 hex | IN7 | 0020 2020 hex | EXT1 | NO | EXT1 | NO | EXT1 | NO |
| 3407 hex | IN8 | 002E 2E2E hex | MON0 | NO | MON0 | NO | MON0 | NO |

*1 NO (normally open) and NC (normally close) in the table above refer to the following states.

- NO: Disabled (OFF) when signal input is open with COM–
Enabled (ON) when signal input is shorted with COM–
- NC: Disabled (OFF) when signal input is shorted with COM–
Enabled (ON) when signal input is open with COM–

Objects That Can Be Assigned

Use the following objects when changing the input signal allocations.

For the setting method, refer to *Input Signal Allocation Method* on page 7-3.

| Index | Name | Explanation | Reference |
|----------|--------------------------|---|-----------|
| 3400 hex | Input Signal Selection 1 | Set the IN1 input function allocation. This object is based on hexadecimal. (The display on the front panel is based on decimal.) | page 9-31 |
| 3401 hex | Input Signal Selection 2 | Set the IN2 input function allocation. | page 9-31 |
| 3402 hex | Input Signal Selection 3 | Set the IN3 input function allocation. | page 9-31 |
| 3403 hex | Input Signal Selection 4 | Set the IN4 input function allocation. | page 9-31 |
| 3404 hex | Input Signal Selection 5 | Set the IN5 input function allocation. | page 9-31 |
| 3405 hex | Input Signal Selection 6 | Set the IN6 input function allocation. | page 9-32 |
| 3406 hex | Input Signal Selection 7 | Set the IN7 input function allocation. | page 9-32 |
| 3407 hex | Input Signal Selection 8 | Set the IN8 input function allocation. | page 9-32 |

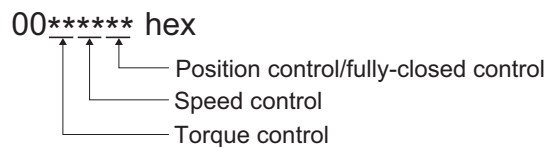
Input Signal Allocation Method

Input the setting for each control mode to any of the objects from 3400 to 3407 hex to allocate the signals.

Set the objects using hexadecimal.

Set the set value of the function for each control mode in “***” below.

Refer to the function number table provided later for the set value of each function. The logic setting is included in the function numbers.

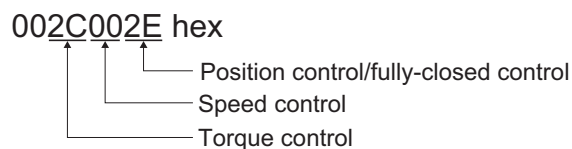


Example:

Position control or fully-closed control: Monitor Input 0 with NO (normally open) contacts (2E hex)

Speed control: Disabled (00 hex)

Torque control: Positive External Torque Limit Input with NO contacts (2C hex)



● Function Number Table

The set values to be used for allocations are as follows:

| Signal name | Symbol | Set value | |
|-------------------------------------|--------|-----------|-----------------------|
| | | NO | NC |
| Disabled | – | 00 hex | Setting not available |
| Forward Drive Prohibition Input | POT | 01 hex | 81 hex |
| Reverse Drive Prohibition Input | NOT | 02 hex | 82 hex |
| Immediate Stop Input | STOP | 14 hex | 94 hex |
| External Latch Input 1 | EXT1 | 20 hex | Setting not available |
| External Latch Input 2 | EXT2 | 21 hex | Setting not available |
| Origin Proximity Input | DEC | 22 hex | A2 hex |
| External Latch Input 3 | EXT3 | 2B hex | Setting not available |
| Forward External Torque Limit Input | PCL | 2C hex | AC hex |
| Reverse External Torque Limit Input | NCL | 2D hex | AD hex |
| Monitor Input 0 | MON0 | 2E hex | AE hex |
| Monitor Input 1 | MON1 | 2F hex | AF hex |
| Monitor Input 2 | MON2 | 30 hex | B0 hex |



Precautions for Correct Use

- Do not use any settings other than the settings listed.
- Do not allocate the same function to more than one input signal. If you allocate the same function to more than one input signal, and Interface Input Duplicate Allocation Error 1 (Error No. 33.0) or Interface Input Duplicate Allocation Error 2 (Error No. 33.1) will occur.
- The External Latch Inputs 1, 2, and 3 (EXT1, EXT2 and EXT3) can be allocated only to IN5 to IN7. If you allocate them to any other inputs, an External Latch Input Allocation Error (Error No. 33.8) will occur.
- If you use the External Latch Input 1, 2, or 3 (EXT1, EXT2 or EXT3), you must set it for all control modes. Otherwise, an External Latch Input Allocation Error (Error No. 33.8) will occur.
- The External Latch Inputs 1, 2, and 3 (EXT1, EXT2 and EXT3) can be set only to NO (normally open) contacts.
- The control input pins that are disabled do not affect the operation.
- The functions that are used by more than one control mode, such as Immediate Stop Input, and Origin Proximity Input, must be allocated to the same pin, in the same logic. If they are allocated to different pins, an Interface Input Duplicate Allocation Error 1 (Error No. 33.0) or an Interface Input Duplicate Allocation Error 2 (Error No. 33.1) will occur. If the logic is inconsistent, an Interface Input Function Number Error 1 (Error No. 33.2) or an Interface Input Function Number Error 2 (Error No. 33.3) will occur.

7-1-2 Output Signals

You can allocate output signal functions to the output pins for the control I/O connector (CN1).

If a G-series Servo Drive is being replaced with a G5-series Servo Drive, use the G5-series Servo Drive to with the default settings.

Output Signal Default Setting

The allocations of the default output signals are as follows. Refer to *Output Signal Allocation Method* on page 7-6 to change the allocations.

| Index | Output signal | Default setting (hex) | Default setting state | | | | | |
|----------|---------------|-----------------------|--|----------|---------------|----------|----------------|----------|
| | | | Position control or fully-closed control | | Speed control | | Torque control | |
| | | | Signal name | Logic *1 | Signal name | Logic *1 | Signal name | Logic *1 |
| 3410 hex | OUTM1 | 0003 0303 hex | BKIR | NO | BKIR | NO | BKIR | NO |
| 3411 hex | OUTM2 | 0002 0202 hex | READY | NO | READY | NO | READY | NO |

- *1 NO (normally open) and NC (normally close) refer to the following states.
 NO: When the function is disabled (OFF state), output transistor is OFF.
 When the function is enabled (ON state), output transistor is ON.
 NC: When the function is disabled, output transistor is ON.
 When the function is enabled, output transistor is OFF.

Objects That Can Be Assigned

Use the following objects when changing the output signal allocations.

For the setting method, refer to *Output Signal Allocation Method* on page 7-6.

| Index | Object name | Explanation | Reference |
|----------|---------------------------|--|-----------|
| 3410 hex | Output Signal Selection 1 | Set the OUTM1 output function allocation. This object is set in hexadecimal. Refer to the output signal function number table for details. | page 9-32 |
| 3411 hex | Output Signal Selection 2 | Set the OUTM2 output function allocation. | page 9-32 |

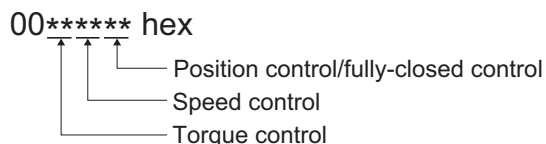
Output Signal Allocation Method

Input the setting for each control mode to objects 3410 and 3411 hex to allocate the signals.

Set the objects based on hexadecimal in the same manner as for the input signal allocations.

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. The logic setting is included in the function numbers.

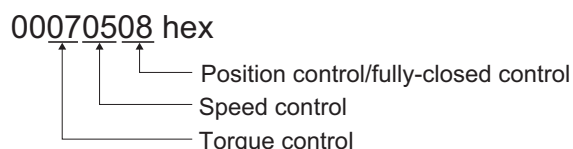


Example:

Position control or fully-closed control: Position command output (0B hex)

Speed control: Motor rotation speed detection output (05 hex)

Torque control: Zero speed detection signal (07 hex)



● Function Number Table

The set values to be used for allocations are as follows:

| Signal name | Symbol | Set value | |
|---------------------------------------|---------|-------------------------------|--------------------------------|
| | | NO (or normally open) contact | NC (or normally close) contact |
| Disabled | – | 00 hex | 00 hex |
| Servo Ready Completed Output | READY | 02 hex | 82 hex |
| Brake Interlock Output | BKIR | 03 hex | Setting not available |
| Positioning Completion Output | INP1 | 04 hex | 84 hex |
| Motor Rotation Speed Detection Output | TGON | 05 hex | 85 hex |
| Torque Limit Output | TLIMIT | 06 hex | 86 hex |
| Zero Speed Detection Output | ZSP | 07 hex | 87 hex |
| Speed Conformity Output | VCMP | 08 hex | 88 hex |
| Warning Output 1 | WARN1 | 09 hex | 89 hex |
| Warning Output 2 | WARN2 | 0A hex | 8A hex |
| Position Command Status Output | PCMD | 0B hex | 8B hex |
| Positioning Completion Output 2 | INP2 | 0C hex | 8C hex |
| Speed Limiting Output | VLIMIT | 0D hex | 8D hex |
| Error Clear Attribute Output | ALM-ATB | 0E hex | 8E hex |
| Remote Output 1 | R-OUT1 | 10 hex | Setting not available |
| Remote Output 2 | R-OUT2 | 11 hex | Setting not available |



Precautions for Correct Use

- Do not use any settings other than the settings listed.
 - You can allocate the same function to more than one output signal.
 - When you disable the control output pin, the output transistor always stays OFF.
 - If you use the Brake Interlock Output (BKIR), you must set the function in all control modes. Otherwise, an Interface Output Function Number Error 1 (Error No. 33.4) or an Interface Output Function Number Error 2 (Error No. 33.5) will occur.
 - The Brake Interlock Output (BKIR) can be set only to NO (normally open) contacts.
-

7-2 Forward and Reverse Drive Prohibition Functions

If the Forward Drive Prohibition Input (POT) or the Reverse Drive Prohibition Input (NOT) is turned OFF, the motor will stop rotating.

You can thus prevent the motor from rotation outside of the movement range of the device by using limit inputs from the device connected to the Servo Drive.

7-2-1 Objects Requiring Settings

| Index | Name | Explanation | Reference |
|----------------------|--|---|-----------|
| 3400 hex to 3407 hex | Input Signal Selection 1 to 8 | Set the input signal allocations and logic. | page 9-31 |
| 3504 hex | Drive Prohibition Input Selection | Set the operation to be performed upon forward and reverse drive prohibition input. | page 9-41 |
| 3505 hex | Stop Selection for Drive Prohibition Input | Set the deceleration and stop methods upon forward and reverse drive prohibition input. | page 9-42 |
| 3511 hex | Immediate Stop Torque | Set the torque limit for immediate stops. | page 9-43 |

Input Signal Selection Function (Default Settings: 3401 Hex, 3402 Hex)

In the default settings, the allocations are as follows.

| Index | Name | Default setting | |
|----------|--------------------------|-----------------|--|
| | | Set value | Position Control or fully-closed control |
| 3401 hex | Input Signal Selection 2 | 0081 8181 hex | POT (NC) |
| 3402 hex | Input Signal Selection 3 | 0082 8282 hex | NOT (NC) |

- Refer to 7-1 *Sequence I/O Signals* on page 7-2 for details on input signal selections 1 to 8.

Drive Prohibition Input Selection (3504 Hex)

Set the operation of the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT). Install limit switches at both ends of the axis to prohibit the Servomotor from driving in the direction specified by the switch. This can be used to prevent the workpiece from driving too far and thus prevent damage to the machine. Set the operation to be performed upon forward and reverse drive prohibition input.

| Drive Prohibition Input Selection (3504 hex) | Explanation |
|--|--|
| 0 | <p>Forward drive prohibition input and reverse drive prohibition input enabled.</p> <p>The operation when a signal is input is as follows:</p> <p>Forward drive prohibition input closed: Forward limit switch not operating and status normal.</p> <p>Forward drive prohibition input open: Forward direction prohibited and reverse direction permitted.</p> <p>Reverse drive prohibition input closed: Reverse limit switch not operating and status normal.</p> <p>Reverse drive prohibition input open: Reverse direction prohibited and forward direction permitted.</p> <p>The Servomotor decelerates and stops according to the sequence set in Stop Selection for Drive Prohibition Input (3505 hex).^{*1}</p> <p>If the forward and the reverse prohibition inputs are both open, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur because it is taken that Servo Drive is in error condition.</p> |
| 1 | Forward and reverse drive prohibition input disabled. |
| 2 | <p>Forward and reverse drive prohibition input enabled.</p> <p>If either the forward or the reverse prohibition input is open, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur.</p> |

*1 For details, refer to explanation for Stop Selection for Drive Prohibition Input (3505 hex).



Precautions for Correct Use

Both signals are disabled (in a state in which drive prohibition will not operation) in the default settings. If prohibiting the drive input is required, set the Drive Prohibit Input Selection (3504 hex) to either 0 or 2. The setting on the Input Signal Selection 1 to 10 (3400 to 3409 hex) can change the logic and allocation for the respective Input terminals (CN1 to 7 and 8).

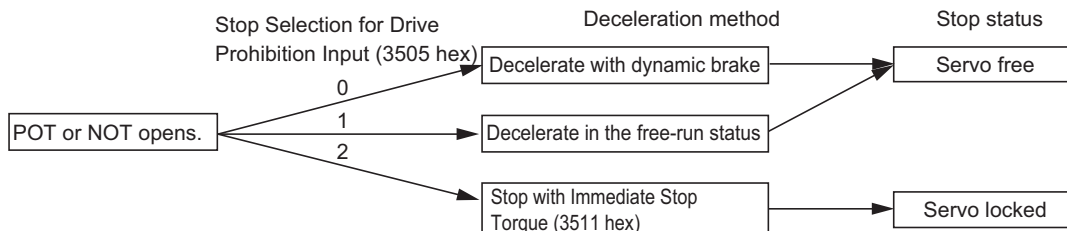
Stop Selection for Drive Prohibition Input (3505 Hex)

Set the deceleration and stop methods upon a forward or reverse drive prohibition is input.

| 3504 hex set value ^{*1} | 3505 hex set value | Decelerating ^{*2} | | After stopping | |
|----------------------------------|--------------------|------------------------------|---------------|--|--|
| | | Deceleration method | Error counter | Operation after stop | Error counter |
| 0 | 0 | Dynamic brake | Clear | Torque command = 0 for drive prohibition direction | Held |
| | 1 | Free-run | Clear | Torque command = 0 for drive prohibition direction | Held |
| | 2 | Immediate stop ^{*3} | Clear | Torque command and torque limit are as specified. | Cleared after deceleration completes, then held. |

*1 If the Drive Prohibition Input Selection (3504 hex) is set to 2, a Drive Prohibition Input Error (Error No. 38.0) will occur as soon as either the Forward or Reverse Drive Prohibition Input becomes open. The subsequent operation conforms not to the set value, but to the setting of the Fault reaction option code (605E hex). In the same way, the Fault reaction option code (605E hex) takes priority when any other error occurs.

- *2 The term “During deceleration” means the distance until the motor decreases its speed to 30 r/min or less from the normal operation. Once it decelerates to 30 r/min or lower, the operation conforms to the description for “post-stopping”, regardless of the actual motor speed.
- *3 “Immediate Stop” means that the Servomotor stops immediately by using controls while the servo is kept ON. The torque limit at this time is controlled by the Immediate Stop Torque (3511 hex) set value.



Precautions for Correct Use

- At an immediate stop, an Error Counter Overflow (Error No. 24.0) or an Overrun Limit Error (Error No. 34.0) may occur. This is because the immediate stop forces the motor to decelerate quickly, and the position control creates a large position error momentarily. If an error occurs, set the Following error window (6065 hex) and the Overrun Limit Setting (3514 hex) to appropriate values.
- A load on the vertical axis and so forth may fall due to its own weight in the drive prohibition input state. To prevent the load from falling, set deceleration with the immediate stop torque and stopping with a servo lock (set value: 2) in the Stop Selection for Drive Prohibition Input (3505 hex), or limit the operation using the Host Controller rather than using this function.
- A Command Warning (Warning No. B1 hex) will occur if a command is given in the drive prohibition direction while the Servomotor is stopped (i.e., decreases the speed to 30 r/min or lower) and the Drive Prohibition Input is open.



Additional Information

While the Forward Drive Prohibition Input (POT) is open, 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 open, the Servomotor cannot be driven in the reverse direction, but it can be driven in the forward direction.

Immediate Stop Torque (3511 Hex)

This is the torque limit when the Stop Selection for Drive Prohibition Input (3505 hex) is set to 2, and the Servomotor decelerates due to a drive prohibition input. The settable range is 0 to 500% in units of 0.1%. When it is set to 0%, the normal torque limit is used.

7-3 Overrun Protection

This function detects an Overrun Limit Error (Error No. 34.0) and stops the Servomotor if the motor exceeds the allowable operating range set for the Overrun Limit Setting (3514 hex) with respect to the position command input.

The function can also prevent the Servomotor from clash into the machine edge due to vibration.

7-3-1 Operating Conditions

The overrun limit works under the following conditions.

| | Conditions |
|----------------|---|
| Operating Mode | Position Control Mode, Fully-closed Control Mode |
| Others | <ul style="list-style-type: none"> Servo ON state The factors other than control objects must be set correctly. This includes the torque limit. The motor must operate normally without any failures. |

Conditions for Clearing the Position Command Input Range

The position command input range will be cleared to zero under any of the following conditions.

- When the power supply is turned ON,
- While the position error is cleared. This includes when the servo is OFF and when the error counter is cleared due to a deceleration stop for the drive prohibit input.
- When a trial operation via USB communications starts and when it ends.
- When the position data is initialized. This includes at a component setup request, at an origin return, when setting the coordinate system, at an adjustment command, and when clearing a multi-rotation data via USB.



Precautions for Correct Use

- This function is not intended to protect against incorrect position commands.
- When this function works, the Servomotor decelerates and stops according to the Fault reaction option code (605E hex). Take this deceleration operation into account when you set the Overrun Limit Setting (3514 hex). Otherwise, the load during deceleration may hit and cause damage to the machine edges.
- The overrun limit function is disabled for FFT analysis from the CX-Drive.

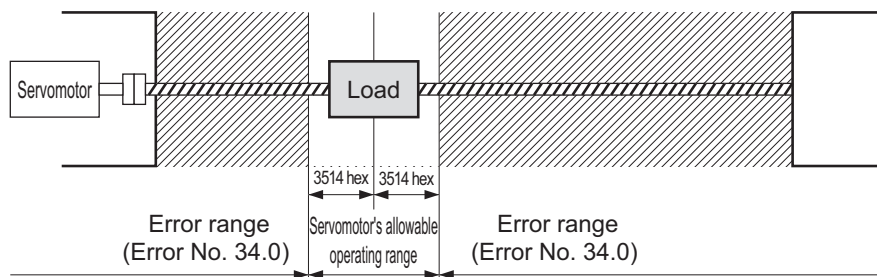
7-3-2 Objects Requiring Settings

| Index | Name | Description | Reference page |
|----------|-----------------------|---|----------------|
| 3514 hex | Overrun Limit Setting | Sets the Servomotor's allowable operating range for the position command input range. | page 9-43 |

7-3-3 Operation Example

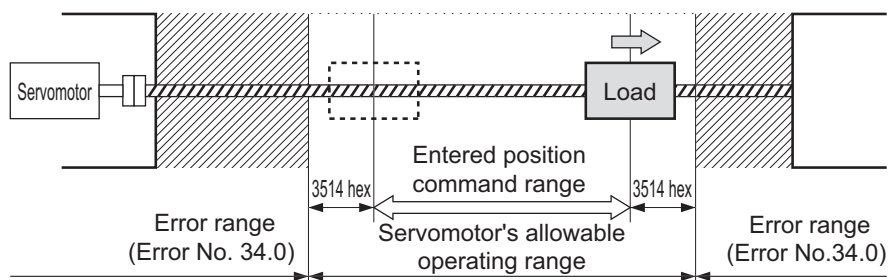
No Position Command Input (Servo ON)

No position command is entered. The Servomotor's allowable operating range is the range set in object 3514 hex on both the right and left. An overrun limit error will occur (Error No. 34.0) if the load enters the error range, or the shaded area in the drawing below, due to vibration.



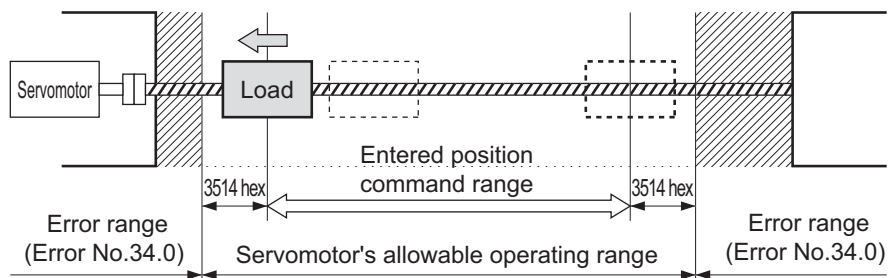
Right Side Operation (Servo ON)

When a rightward position command is entered, the Servomotor's allowable operating range increases for the commanded amount. The range will be the result where the rotation set for 3514 hex is added on both sides for the position command.



Left Side Operation (Servo ON)

When a leftward position command is entered, the Servomotor's allowable operating range further increases.



7-4 Backlash Compensation

The function compensates for backlash for position control and fully-closed control.

7-4-1 Objects Requiring Settings

| Index | Name | Description | Reference page |
|----------|-------------------------------------|---|----------------|
| 3704 hex | Backlash Compensation Selection | Select whether to enable or disable backlash compensation during position control. Set the compensation direction. | page 9-55 |
| 3705 hex | Backlash Compensation Amount | Set the compensation amount during position control. | page 9-55 |
| 3706 hex | Backlash Compensation Time Constant | Set the backlash compensation time constant during position control. | page 9-55 |

Backlash Compensation Selection (3704 Hex)

This object is used to select whether to enable or disable backlash compensation during position control, and to set the compensation direction.

| Set value | Description |
|-----------|--|
| 0 | Disable backlash compensation. |
| 1 | Compensate for backlash at the first forward operation after the servo is turned ON. |
| 2 | Compensate for backlash at the first reverse operation after the servo is turned ON. |

Setting Method

The backlash compensation works in different directions depending on the setting in the Backlash Compensation Selection (3704 hex) and on whether the set value for the Backlash Compensation Amount (3705 hex) is positive or negative.

| 3704 hex | 3705 hex contains a positive value | 3705 hex contains a negative value |
|----------|--|---|
| 1 | Compensate in positive direction when operation is in forward. | Compensate in negative direction when operation is in forward. |
| 2 | Compensate positive direction when it is in reverse operation. | Compensate in negative directions when operation is in reverse. |



Precautions for Correct Use

- To determine the actual position of the Servomotor, offset the Servomotor position data acquired via EtherCAT communications by the backlash compensation amount.
 - Backlash compensation is performed on the first position command in the set direction after the servo is turned ON. Any prior operations in the opposite direction are not compensated. But the first reverse operation after the initial backlash compensation is compensated. Backlash compensation is not performed again as long as the operation continues in the same direction.
 - When the Servo OFF status occurs while backlash compensation is performed, the backlash compensation amount is cleared. This is done by presetting the position command data of the Servo Drive to the Servomotor position data that includes the backlash compensation amount. When the servo is turned ON again, backlash compensation is performed as described above.
-



Additional Information

Conditions for Clearing Backlash Compensation

- When the position error is reset. This includes when the servo is turned OFF, and when the error counter is reset for the drive prohibition input.
 - When the position data is initialized, except for the homing operation in Homing mode (hm). This includes Config (4100 hex) and Absolute Encoder Setup (4102 hex).
-

7-5 Brake Interlock

This function lets you set the output timing for the brake interlock output (BKIR) that activates the holding brake when the servo is turned ON, an error occurs, or the servo is turned OFF.

It is also possible to use the controller's function to force the brake control via EtherCAT communications. However, it is not supported on the OMRON Machine Automation Controller NJ-series (Model: NJ501-1□00) and CJ1W-NC□81/□82 Position Control Unit.

7-5-1 Objects Requiring Settings

| Index | Sub-index | Bit | Name | Explanation | Reference |
|----------|-----------|-----|--|---|-----------|
| 3437 hex | – | – | Brake Timing when Stopped | Set the time after a servo OFF command is issued upon servo lock stop, until the brake interlock output (BKIR) turns OFF and power supply stops. | page 9-38 |
| 3438 hex | – | – | Brake Timing During Operation | Set the time after a servo OFF command is issued while the motor is rotating, until the brake interlock output (BKIR) turns OFF and power supply stops. If the speed drops to or below the value set in object 3439 hex before the time set here, BKIR will turn OFF. | page 9-39 |
| 3439 hex | – | – | Brake Threshold Speed During Operation | Set the speed at which to turn OFF power to the Servomotor when the Brake Interlock Output (BKIR) signal turns OFF after execution of a servo OFF command while the Servomotor is rotating. If the time set in object 3438 hex elapses before the Servomotor drops to the speed set here, BKIR will turn OFF. | page 9-39 |
| 60FE hex | 01 hex | 0 | | This is the Set Brake Bit for EtherCAT communications. 0: Brake released* ¹ 1: Brake engaged* ² | page A-92 |
| | 02 hex | 0 | | This is the Set Brake Mask Bit for enabling/disabling the Set Brake Bit for EtherCAT communications. 0: Set Brake Bit enabled. 1: Set Brake Bit disabled. | |

*1 The Brake Interlock Output (BKIR) is turned ON. The brake is released for a brake release command from either EtherCAT communications or the Servo Drive.

*2 The Brake Interlock Output (BKIR) is turned OFF. The brake is engaged only when a set brake command is received from both EtherCAT communications and the Servo Drive.

Applying the brake from EtherCAT communications is enabled only while the servo is OFF. If a Set Brake command is received while the servo is ON, a Command Warning (B1 hex) will occur.



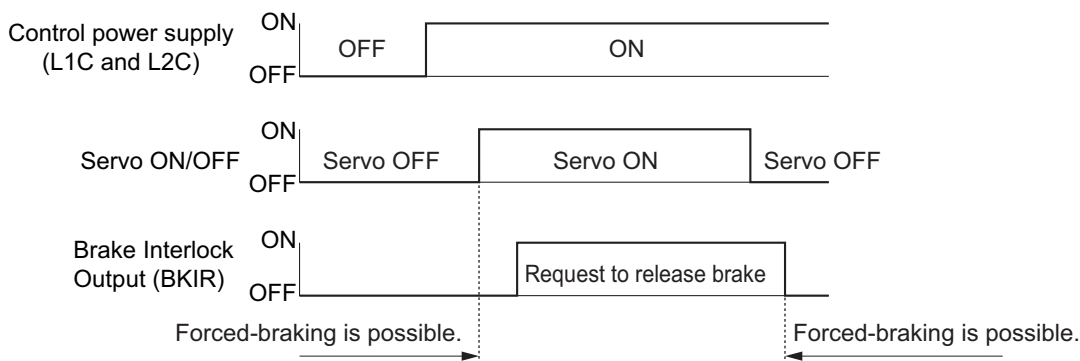
Precautions for Correct Use

- The brake on a Servomotor with a brake is a normally closed brake designed only to hold when the operation is stopped. Accordingly, set an appropriate time so that the brake actuates after the motor stops.
- If the brake is engaged while the Servomotor is rotating, the brake disc will wear abnormally or sustain damage, resulting in a bearing or encoder failure in the Servomotor.
- The workpiece may fall when the brake is released for a vertical axis. Carefully consider the timing of releasing the brake.

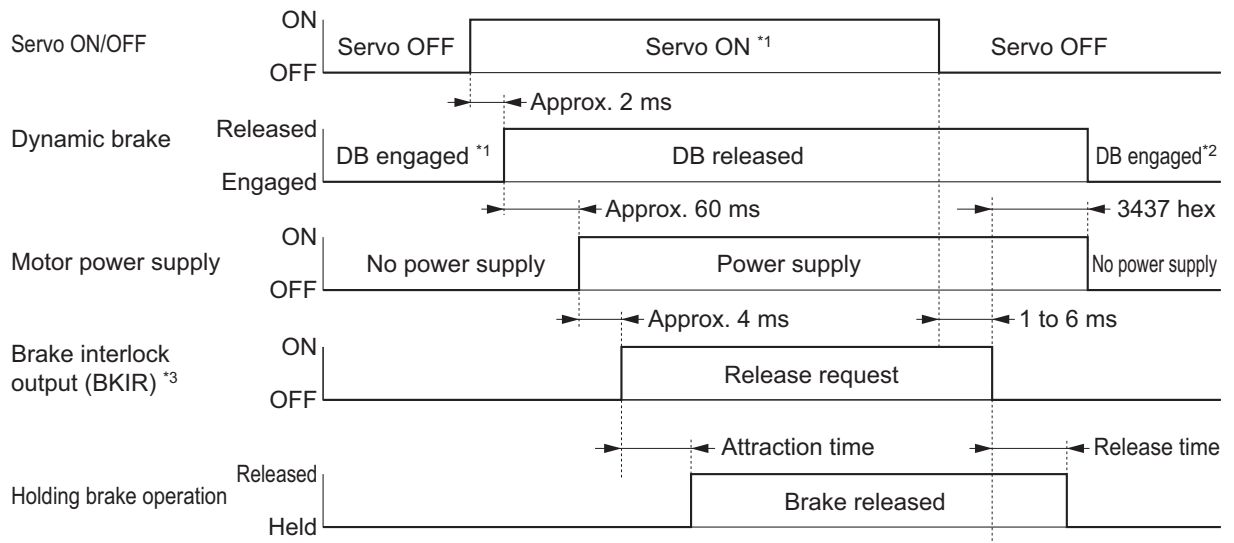
7-5-2 Operation Timing

This section shows the timing of the Brake Interlock Output (BKIR).

Basic Timing



Servo ON/OFF Operation Timing When Motor Is Stopped



*1 The servo does not turn ON until the motor rotation speed drops to approx. 30 r/min or below.

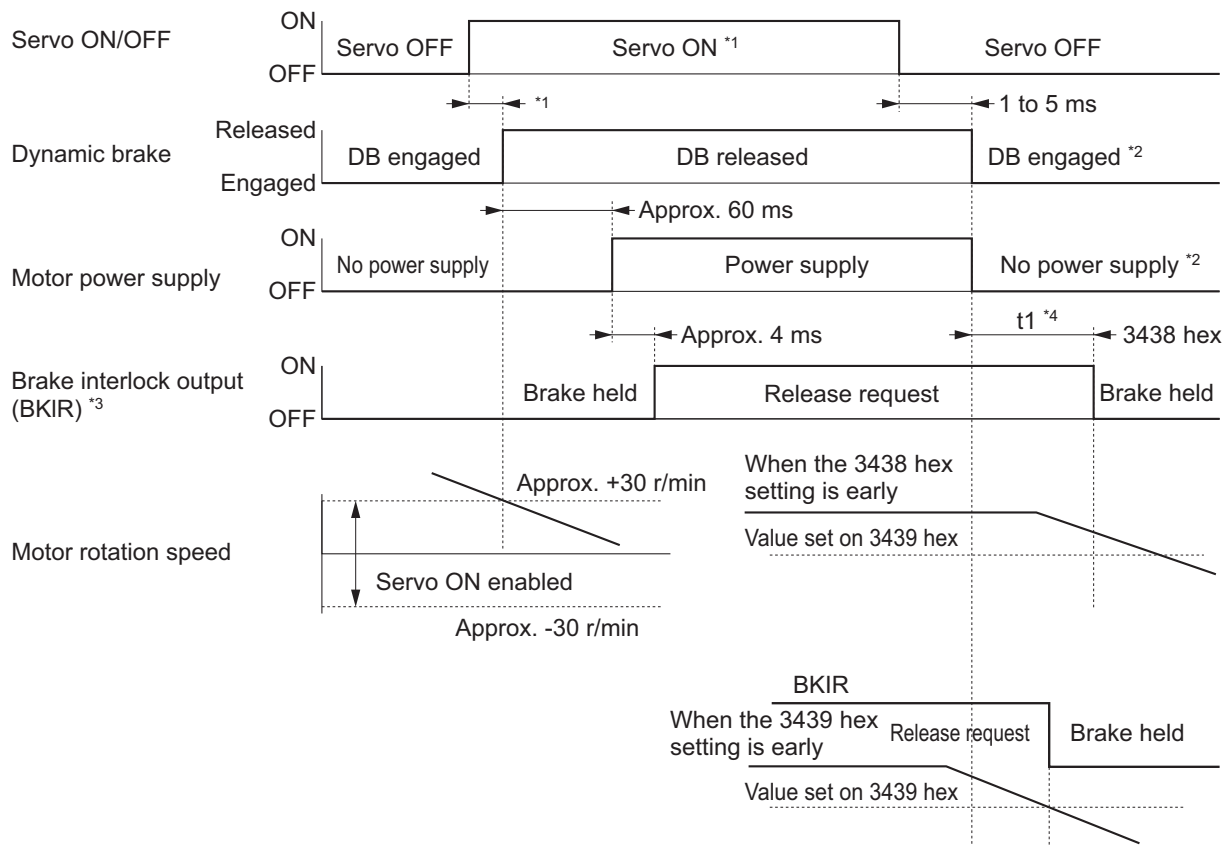
*2 The operation of the dynamic brake when the servo is OFF depends on the setting of the Disable operation option code (605C hex).

*3 The Brake Interlock Output (BKIR) signal is output either when a release request command is received via Servo controls or when a release request command is received via EtherCAT communications. The above example shows when there is no brake release request from EtherCAT communications. The BKIR is assigned to the general-purpose output (CN1).

Note The brake application time and release time vary depending on the Servomotor brake. For details, refer to 3-3 *Servomotor Specifications* on page 3-36.

Servo ON/OFF Operation Timing When Motor Is Operating

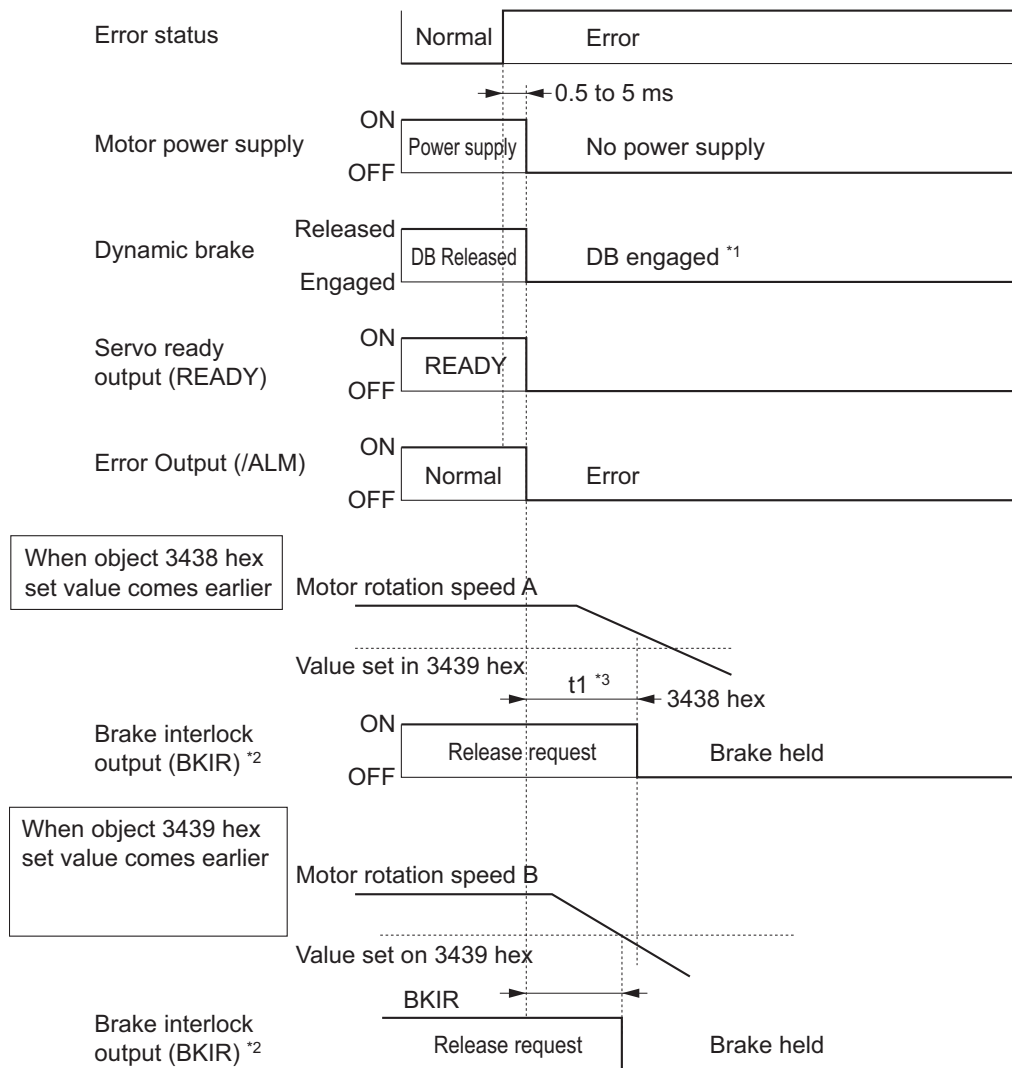
Based on these operation timings, regenerative energy is produced if the motor rotation stops abnormally. Accordingly, repeated operation cannot be performed. Provide a wait time of at least 10 minutes for the motor to cool down.



- *1 The servo does not turn ON until the motor rotation speed drops to 3439 hex set value or below. If a Servo ON is commanded during motor rotation, the Command Warning (Warning No. B1 hex) will occur. The Servo ON command is ignored.
- *2 The operation of the dynamic brake when the servo is OFF depends on the setting of the Disable operation option code (605C hex).
- *3 The Brake Interlock output (BKIR) signal is output when a release request command is received from Servo controls or from EtherCAT communications. In the above example, there is no release request command from EtherCAT communications. The BKIR signal is assigned to the general-purpose output (CN1).
- *4 “t1” is the period until the value becomes lower than the set value on the Brake Timing During Operation (3438 hex) or the Brake Threshold Speed During Operation (3439 hex), whichever is shorter.

Note Even when the Servo ON Input is turned ON again while the motor is decelerating, the system does not enter the servo ON state until the motor stops.

Operation Timing When an Error Occurs (Servo ON)



*1 The operation of the dynamic brake when there is an error depends on the setting of the Fault reaction option code (605E hex).

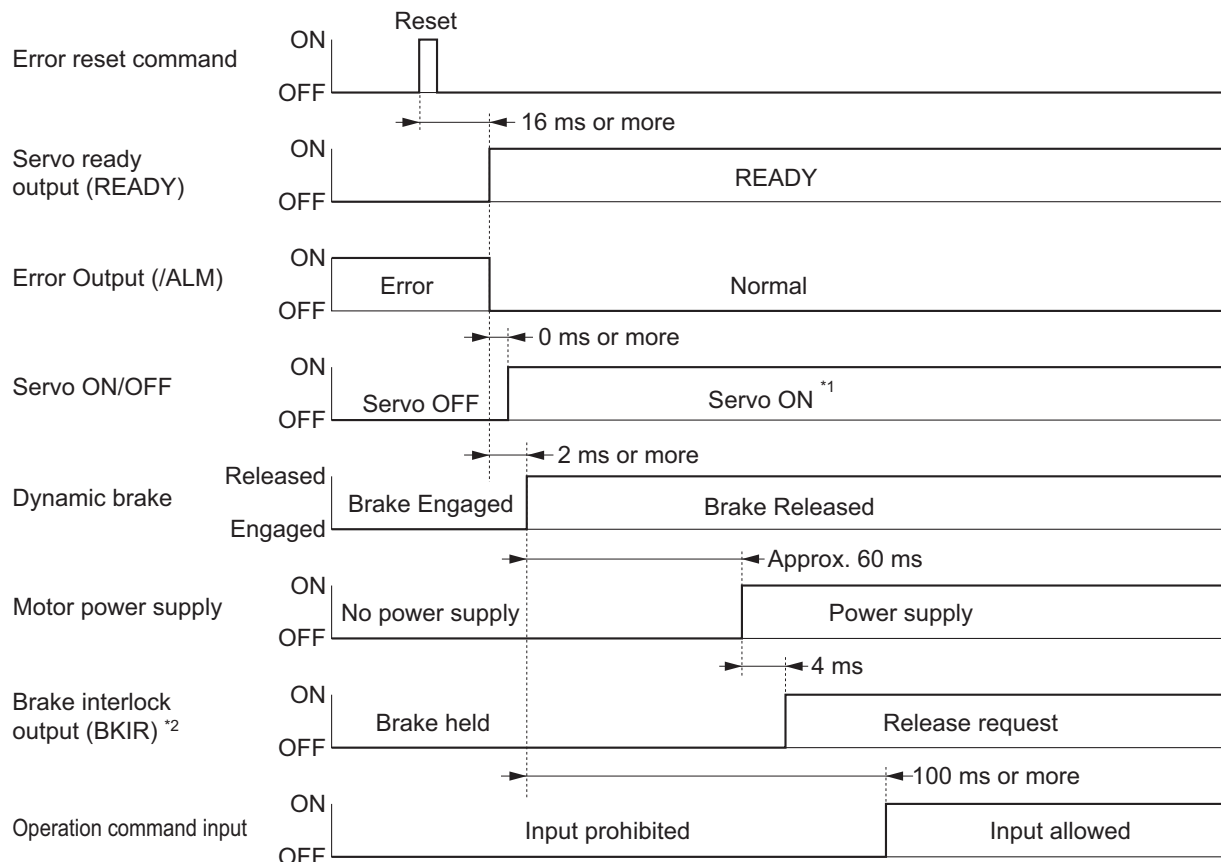
*2 The Brake Interlock Output (BKIR) signal is output either when a release request command is received via Servo controls or when a release request command is received via EtherCAT communications. The above example shows when there is no brake release request from EtherCAT communications. The BKIR signal is assigned to the general-purpose output (CN1).

*3 "t1" is the period until the value becomes lower than the set value on the Brake Timing During Operation (3438 hex) or the Brake Threshold Speed During Operation (3439 hex), whichever is shorter.

Note 1 Even when the servo ON input is turned ON again while the motor is decelerating, the system does not enter the servo ON state until the motor stops.

2 If the main circuit power supply turns OFF while the motor is operating, a phase loss error or main circuit voltage low error will occur, in which case this operation timing is applied.

Operation Timing When Resetting Errors



*1 The servo does not turn ON until the motor rotation speed drops to approx. 30 r/min or below.

*2 The Brake Interlock Output (BKIR) signal is output either when a release request command is received via Servo controls or when a release request command is received via EtherCAT communications. The above example shows when there is no brake release request from EtherCAT communications. The BKIR signal is assigned to the general-purpose output (CN1).

Note After the error has been reset, the system enters the servo OFF state (motor not energized). To turn ON the servo, send a servo ON command again after resetting the error, according to the above timing.

7-6 Electronic Gear Function

This function controls the position by using the value multiplied the position command entered on the Host Controller by the preset electronic gear ratio. The functions is used in the Position Control and Fully-closed Control modes. (This applies only when the communications cycle is 1, 2, or 4 ms.)

For communications cycles for which the electronic gear is not supported (250 or 500 μ s), a Function Setting Error (Error No. 93.4) will occur if the electronic gear is enabled.

When connected to an OMRON Machine Automation Controller NJ-series (Model: NJ501-1□00) or CJ1W-NC□81/□82 Position Control Unit, the electronic gear ratio is set in the Position Control Unit. Set the electronic gear ratio in the Servo Drive to 1:1.



Precautions for Correct Use

- The electronic gear function is not supported for unit version 2.0. For the Servo Drives with unit version 2.0, set the electronic gear ratio to 1.1.

7-6-1 Objects Requiring Settings

| Index | Sub-index | Name | Explanation | Reference |
|----------|-----------|---------------------------------|--|-----------|
| 6091 hex | 01 hex | Motor revolutions ^{*1} | Set the numerator of the electronic gear ratio. If the set value is 0, the encoder resolution is automatically set as the numerator. ^{*2} <ul style="list-style-type: none"> • 131072 for a 17-bit absolute encoder • 1048576 for a 20-bit incremental encoder | page A-91 |
| | 02 hex | Shaft revolutions ^{*1} | Set the denominator of the electronic gear ratio. | |

*1 The electronic gear ratio must be set between 1/1000 and 1000. If it is set outside the range, an Object Setting Error 1 (Error No. 93.0) will occur.

Whether the electronic gear is enabled is determined from the setting of the objects. If the gear ratio setting is 1:1, the electronic gear is disabled.

*2 If object 6091-01 hex is set to 0, the encoder resolution is set to the numerator during fully-closed control also.

Gear ratio Setting (6091-01 and 6091-02 Hex)

| Motor revolutions (6091-01 hex) | Shaft revolutions (6091-02 hex) | Description |
|---------------------------------|---------------------------------|---|
| 0 | 1 to 1073741824 | <p>When the Motor revolutions (6091-01 hex) is 0, the processing changes with the set value of Shaft revolutions (6091-01 hex).</p> <div style="text-align: center;"> </div> <p>Position command = Encoder resolution / Shaft revolutions (6091-02 hex)</p> |
| 1 to 1073741824 | | <p>When the Motor revolutions (6091-01 hex) is not 0, the processing changes with the set values of Motor revolutions (6091-01 hex) and Shaft revolutions (6091-02 hex).</p> <div style="text-align: center;"> </div> <p>Position command = Motor revolutions (6091-01 hex) / Shaft revolutions (6091-02 hex)</p> |

*1 The encoder resolution is set as the numerator for fully-closed control.



Precautions for Correct Use

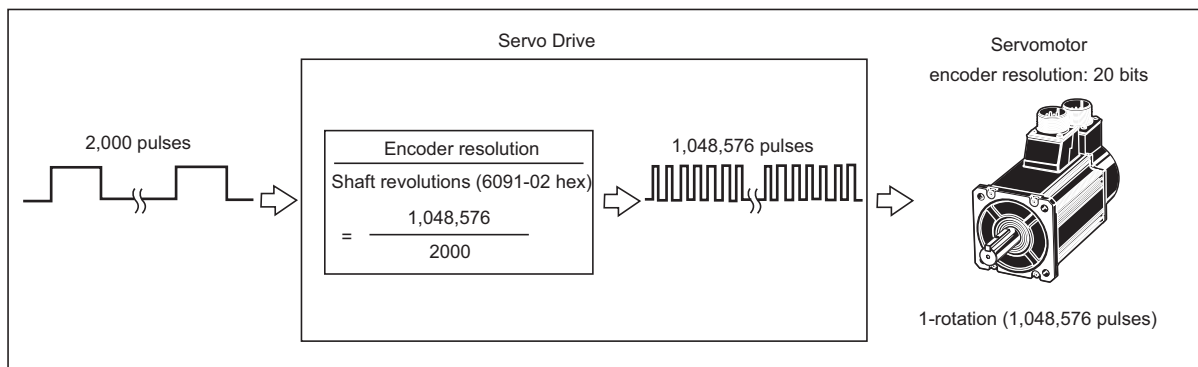
- To make the position command smoother after the electronic gear setting, adjust it by using the Position Command Filter Time Constant (3222 hex) or by the Position Command FIR Filter Time Constant (3818 hex).

7-6-2 Operation Example

The example uses a motor with a 20-bit encoder (1,048,576 pulses per rotation)

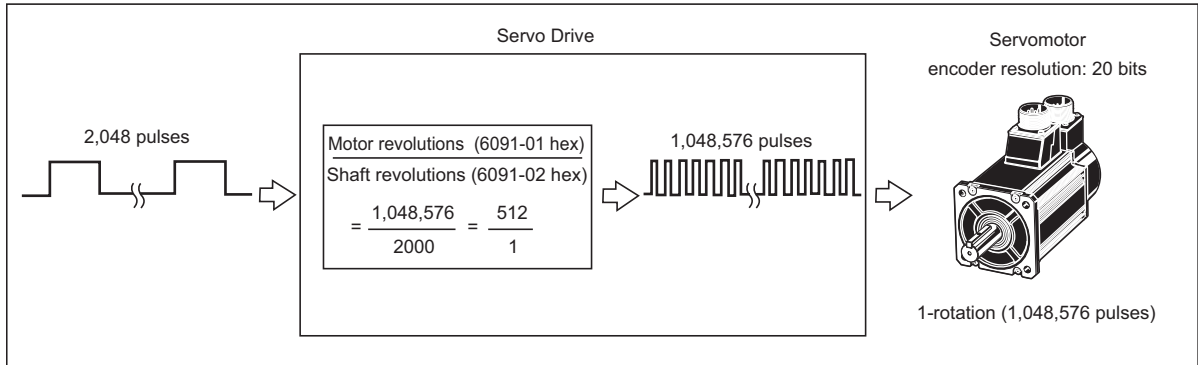
When the Motor Revolutions (6091-01 Hex) Is Set to 0

- If you set 6091-02 hex to 2,000, the operation is the same as the 2,000 (pulses/rotation) Servomotor.



When the Motor Revolutions (6091-01 Hex) Is Set to a Value Other Than 0

- If you set 6091-01 hex and 6091-02 hex to 1,048,576 and 2,048, respectively, the operation is the same as a 2,048-pulses/rotation Servomotor.



7-7 Torque Limit Switching

This function switches the torque limit according to the operation direction, and depending on the Forward External Torque Limit (PCL), the Reverse External Torque Limit (NCL), and the Forward/Reverse Torque Limit Input Commands from EtherCAT communications.

This function is used in the following conditions.

- When push-motion operation, such as pressing, is performed.
- When the torque at startup and during deceleration should be suppressed to protect the mechanical system, etc.

The Torque Limit Selection (3521 hex) is used to select a method to switch the torque limit.

7-7-1 Operating Conditions

The torque limit switching function works under the following conditions.

| | Conditions |
|----------------|---|
| Operation mode | Position Control Mode, Speed Control Mode, Torque Control Mode, or Fully-closed Control Mode |
| Others | <ul style="list-style-type: none"> • Servo ON state • The factors other than control objects must be set correctly. This includes the torque limit. The motor must operate normally without any failures. |

7-7-2 Objects Requiring Settings

| Index | Name | Explanation | Reference |
|----------|-------------------------------|---|-----------|
| 3521 hex | Torque Limit Selection | Select the torque limit based on the various objects and input signals. | page 9-45 |
| 60E0 hex | Positive torque limit value | Set the forward torque limit value. | page A-69 |
| 60E1 hex | Negative torque limit value | Set the reverse torque limit value. | page A-70 |
| 3525 hex | Forward External Torque Limit | Set the forward torque limit for a network signal. | page 9-46 |
| 3526 hex | Reverse External Torque Limit | Set the reverse torque limit for a network signal. | page 9-46 |

Torque Limit in Position, Speed, Torque, and Fully-Closed Controls

The term Torque FF refers to the torque feed-forward function.

| Set value | Position control/speed control/torque control/fully-closed control | | | |
|-----------|--|--------------------------------|--|--------------------------------|
| | Forward torque limit value ^{*1} | | Reverse torque limit value ^{*2} | |
| | PCL ON | PCL OFF | NCL ON | NCL OFF |
| 0,1 | 3013 hex | | | |
| 2 | 3013 hex | | 3522 hex | |
| 3 | 3522 hex | 3013 hex | 3522 hex | 3013 hex |
| 4 | 60E0 or 3013 hex ^{*3} | | 60E1 or 3522 hex ^{*4} | |
| 5 | 60E0 or 3013 hex ^{*3} | 3013 hex | 60E1 or 3522 hex ^{*4} | 3522 hex |
| 6 | 3525 hex | 60E0 or 3013 hex ^{*3} | 3526 hex | 60E1 or 3522 hex ^{*4} |
| 7 | 3013 hex | 3525 hex | 3522 hex | 3526 hex |

*1 PCL ON is the state in which either the external input signal (PCL) or the EtherCAT communications torque control command (P-CL) is ON; PCL OFF is the state in which both of these are OFF.

*2 NCL ON is the state in which either the external input signal (NCL) or the EtherCAT communications torque control command (N-CL) is ON; NCL OFF is the state in which both of these are OFF.

*3 The smaller of 60E0 hex or 3013 hex is used.

*4 The smaller of 60E1 hex or 3522 hex is used.



Precautions for Correct Use

- For the torque limit parameters, the objects that are specified are different for an R88D-KN□□□-ECT-R Servo Drive. Refer to the *G5 AC Servomotors/Servo Drives User's Manual* (Cat. No. I573) for details on R88D-KN□□□-ECT-R objects.

Torque Limit Settings by Servomotors

- The torque limit setting range is between 0% and 300%. The default setting is 300%. This is not the case when a Servo Drive and a Servomotor are used in the following combinations.

| Servo Drive | Applicable Servomotor | Maximum torque limit [%] |
|-----------------|-----------------------|--------------------------|
| R88D-KN15□-ECT | R88M-K90010□ | 225 |
| R88D-KN30□-ECT | R88M-K2K010□ | 250 |
| R88D-KN50□-ECT | R88M-K3K010□ | 250 |
| | R88M-K4K510□ | 263 |
| R88D-KN75□-ECT | R88M-K6K010□ | 272 |
| R88D-KN75H-ECT | R88M-K7K515T | 265 |
| R88D-KN75F-ECT | R88M-K7K515C | 267 |
| R88D-KN150□-ECT | R88M-K11K015□ | 265 |
| | R88M-K15K015□ | 253 |

7-8 Soft Start

This function is used to control the rotation speed. It sets the acceleration and deceleration against the rotation speed command in the Servo Drive.

The function can be used for step rotation speed commands, and allows soft starts. The S-curve Acceleration and Deceleration function is used to reduce any impacts by acceleration changes.

7-8-1 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|--|---|-----------|
| 3312 hex | Soft Start Acceleration Time | Sets the acceleration time for the rotation speed command input. | page 9-26 |
| 3313 hex | Soft Start Deceleration Time | Sets the deceleration time for the rotation speed command input. | page 9-26 |
| 3314 hex | S-curve Acceleration/Deceleration Time Setting | Sets the acceleration or deceleration processing S-curve time for the rotation speed command input. | page 9-27 |

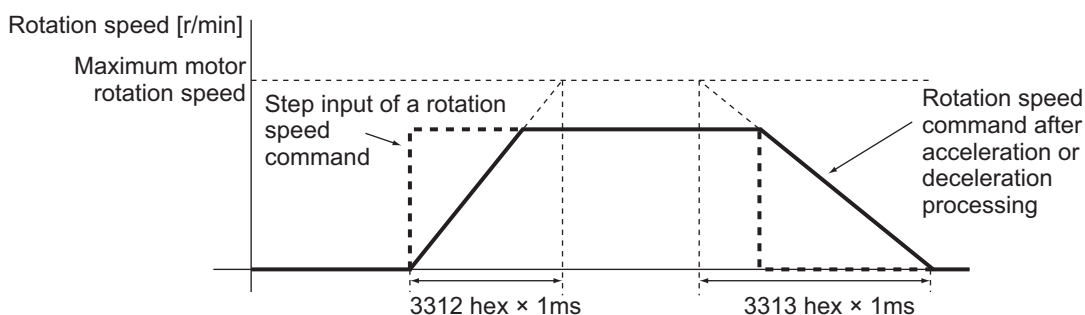
7-8-2 Soft Start Acceleration or Deceleration Time

Set the time required for a step speed command to reach the maximum motor rotation speed into the Soft Start Acceleration Time (3312 hex). In the same manner, set the time required for the command to decrease the speed from the maximum motor rotation speed to 0 r/min into the Soft Start Deceleration Time (3313 hex).

The time taken for acceleration or deceleration is calculated by the following formula, where V_c [r/min] is the target rotation speed of the speed command.

$$\text{Acceleration Time [ms]} = V_c / \text{Maximum motor rotation speed} \times 3312 \text{ hex} \times 1 \text{ ms}$$

$$\text{Deceleration Time [ms]} = V_c / \text{Maximum motor rotation speed} \times 3313 \text{ hex} \times 1 \text{ ms}$$

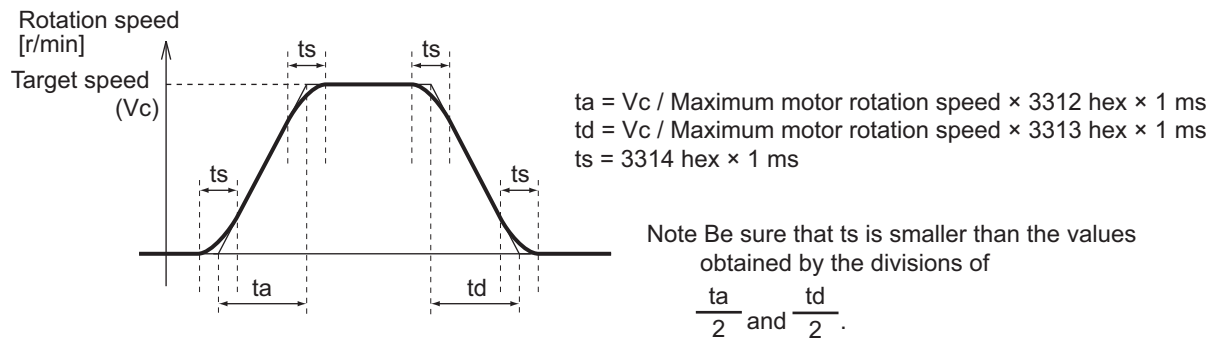


Precautions for Correct Use

- Do not set the Soft Start Acceleration Time and the Soft Start Deceleration Time when the position loop structure with a Host Controller is used.

7-8-3 S-curve Acceleration or Deceleration Time

The function sets the S-curve time for the acceleration and deceleration time set by the Soft Start Acceleration Time (3312 hex) and the Soft Start Deceleration Time (3313 hex). The S-curve time is a duration around an inflection point during acceleration and deceleration.



7-9 Gain Switching Function

This function switches the position loop and speed loop gain.

Select enable or disable using Gain Switching Input Operating Mode Selection (3114 hex). Set the switching condition using the gain switching setting.

If the load inertia changes or you want to change the responsiveness depending on whether the motor is stopping or operating, you can perform optimal control by using gain switching.

The function is used when the realtime autotuning does not work effectively, such as:

- When the load inertia fluctuates in 200 ms or less.
- When the motor rotation speed does not exceed 500 r/min, or load torque does not exceed 50% of the rated torque.
- When an external force is constantly applied, as with a vertical axis.



Precautions for Correct Use

- When Gain 2 has been selected, realtime autotuning does not operate normally. If using the gain switching, set the Realtime Autotuning to “Disabled” (3002 hex = 0).
-

7-9-1 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|---|--|-----------|
| 3002 hex | Realtime Autotuning Mode Selection | Set the operation mode for realtime autotuning. Realtime autotuning cannot be used if the gain switching function is being used. | page 9-3 |
| 3114 hex | Gain Switching Input Operating Mode Selection | Set whether to enable or disable the gain switching function. | page 9-11 |

Position Control Mode and Fully-closed Control Mode

| | | | |
|----------|---|--|-----------|
| 3115 hex | Switching Mode in Position Control | Set the condition for switching between Gain 1 and Gain 2. | page 9-11 |
| 3116 hex | Gain Switching Delay Time in Position Control | Set the delay time for switching from the Gain 2 to Gain 1. (Unit: 0.1 ms) | page 9-13 |
| 3117 hex | Gain Switching Level in Position Control | Set the judgment level for switching between the Gain 1 and Gain 2. | page 9-13 |
| 3118 hex | Gain Switching Hysteresis in Position Control | Set the hysteresis width to be used for the judgment level set in Gain Switching Level (3117 hex). | page 9-13 |
| 3119 hex | Position Gain Switching Time | Set the time to change from one position gain to the other one. (Unit: 0.1 ms) | page 9-14 |

Speed Control Mode

| | | | |
|----------|--|--|-----------|
| 3120 hex | Switching Mode in Speed Control | Set the condition for switching between gain 1 and gain 2. | page 9-15 |
| 3121 hex | Gain Switching Delay Time in Speed Control | Set the time to return from the gain 2 to gain 1. (Unit: 0.1 ms) | page 9-16 |
| 3122 hex | Gain Switching Level in Speed Control | Set the judgment level for switching between the gain 1 and gain 2. | page 9-16 |
| 3123 hex | Gain Switching Hysteresis in Speed Control | Set the hysteresis width to be provided in the judgment level set in Gain Switching Level in Speed Control (3122 hex). | page 9-17 |

Torque Control Mode

| | | | |
|----------|---|---|-----------|
| 3124 hex | Switching Mode in Torque Control | Set the condition for switching between gain 1 and gain 2. | page 9-17 |
| 3125 hex | Gain Switching Delay Time in Torque Control | Set the time to return from the gain 2 to gain 1. (Unit: 0.1 ms) | page 9-18 |
| 3126 hex | Gain Switching Level in Torque Control | Set the judgment level for switching between the gain 1 and gain 2. | page 9-18 |
| 3127 hex | Gain Switching Hysteresis in Torque Control | Set the hysteresis width to be provided in the judgment level set in Gain Switching Level in Torque Control (3126 hex). | page 9-19 |

7-9-2 Gain Switching Based on the Control Mode

The settable switching conditions vary depending on the control mode used. Set the objects for each control mode.

Refer to *Chapter 9 Details on Servo Parameter Objects* for details on gain-related objects.

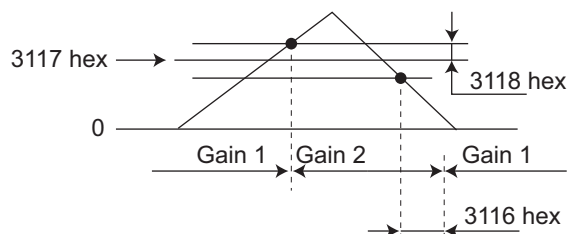
Position Control Mode and Fully-closed Control Mode

In the Position Control mode and Fully-closed Control Mode, operation varies as follows according to switching mode in Position Control (3115 hex).

| Set value of 3115 hex | Description | | | |
|-----------------------|--|--|---|--|
| | Gain switching conditions | Gain Switching Delay Time in Position Control (3116 hex) ^{*1} | Gain Switching Level in Position Control (3117 hex) | Gain Switching Hysteresis in Position Control (3118 hex) ^{*2} |
| 0 | Always Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 1 | Always Gain 2 (3105 to 3109 hex). | Disabled | Disabled | Disabled |
| 2 | Gain switching command input via EtherCAT communications ^{*3} | Disabled | Disabled | Disabled |
| 3 | Command torque value (Refer to Figure A.) | Enabled | Enabled ^{*4} (%) | Enabled ^{*4} (%) |
| 4 | Always Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 5 | Command speed (Refer to Figure B.) | Enabled | Enabled (r/min) | Enabled (r/min) |
| 6 | Pulse position error (Refer to Figure C.) | Enabled | Enabled ^{*5} (pulses) | Enabled ^{*5} (pulses) |
| 7 | Whether there is a position command (Refer to Figure D.) | Enabled | Disabled | Disabled |
| 9 | Actual motor speed (Refer to Figure B.) | Enabled | Enabled (r/min) | Enabled (r/min) |
| 10 | Combination of whether there is a position command and actual motor speed (Refer to Figure E.) | Enabled | Enabled ^{*6} (r/min) | Enabled ^{*6} (r/min) |

*1 The Gain Switching Delay Time in Position Control (3116 hex) becomes effective when the gain is switched from 2 to 1.

*2 The Gain Switching Hysteresis in Position Control (3118 hex) is defined in the drawing below.



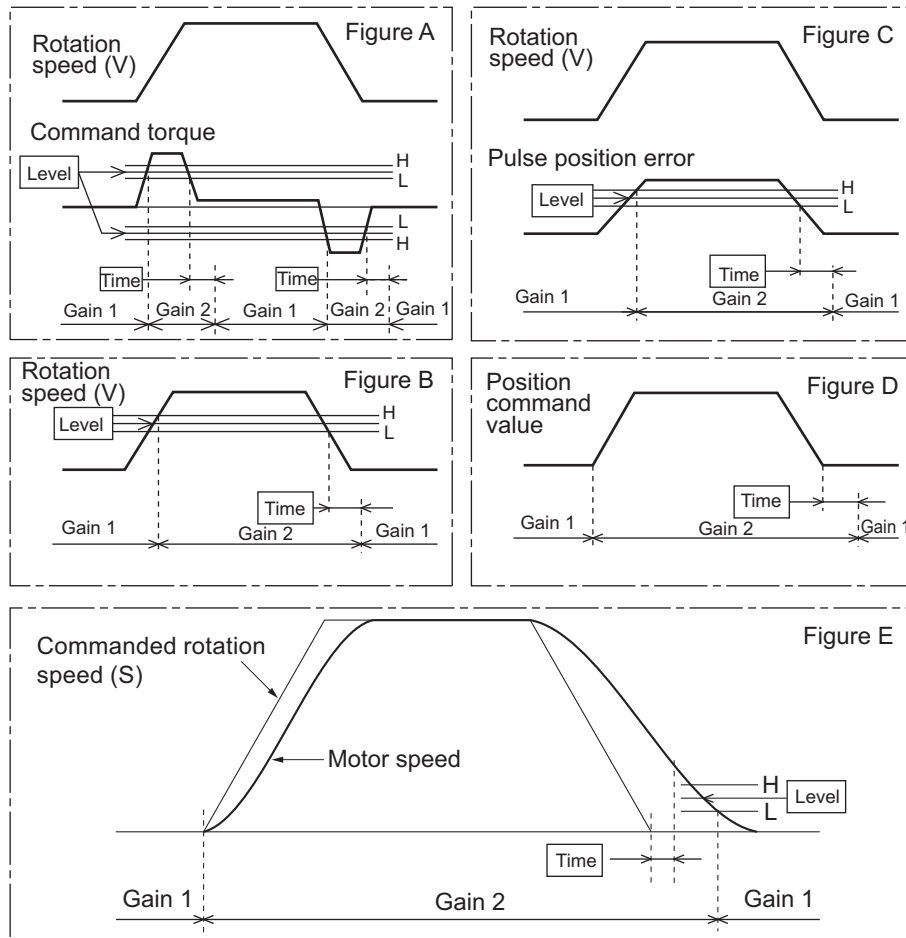
If object 3117 hex is less than object 3118 hex, object 3117 hex will automatically be set to the same value as object 3118 hex.

*3 When the Gain Switching command of EtherCAT communications (G-SEL) is 0, the gain switches to gain 1. When the command is 1, the gain switches to gain 2.

*4 Set the percentage of the rated torque.
Example: To set 10% of the rated torque, set the set value would be 10.

*5 The position error is set according to the encoder resolution (i.e., pulses) for position control and according to the external encoder resolution (i.e., pulses) for fully-closed control.

*6 When the set value is 10, the meanings of the Gain Switching Delay Time in Position Control, the Gain Switching Level in Position Control, and the Gain Switching Hysteresis in Position Control differ from the normal case. (Refer to Figure E.)



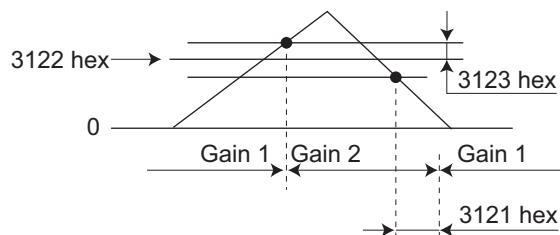
Speed Control Mode

In the Speed Control Mode, it varies as follows according to Switching Mode in Speed Control (3120 hex).

| 3120 hex set value | Description | | | |
|--------------------|--|---|--|---|
| | Gain switching conditions | Gain Switching Delay Time in Speed Control (3121 hex) ^{*1} | Gain Switching Level in Speed Control (3122 hex) | Gain Switching Hysteresis in Speed Control (3123 hex) ^{*2} |
| 0 | Always the Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 1 | Always the Gain 2 (3105 to 3109 hex). | Disabled | Disabled | Disabled |
| 2 | Gain switching command input via EtherCAT communications ^{*3} | Disabled | Disabled | Disabled |
| 3 | Torque command variation (Refer to Figure A.) | Enabled | Enabled ^{*4} (0.05%) | Enabled ^{*4} (0.05%) |
| 4 | Speed command change amount (Refer to Figure B.) | Enabled | Enabled ^{*5} (10r/min/s) | Enabled ^{*5} (10r/min/s) |
| 5 | Speed command (Refer to Figure C.) | Enabled | Enabled (r/min) | Enabled (r/min) |

*1 The Gain Switching Delay Time in Speed Control (3121 hex) becomes effective when the gain is switched from 2 to 1.

*2 The Gain Switching Hysteresis in Speed Control (3123 hex) is defined in the drawing below.

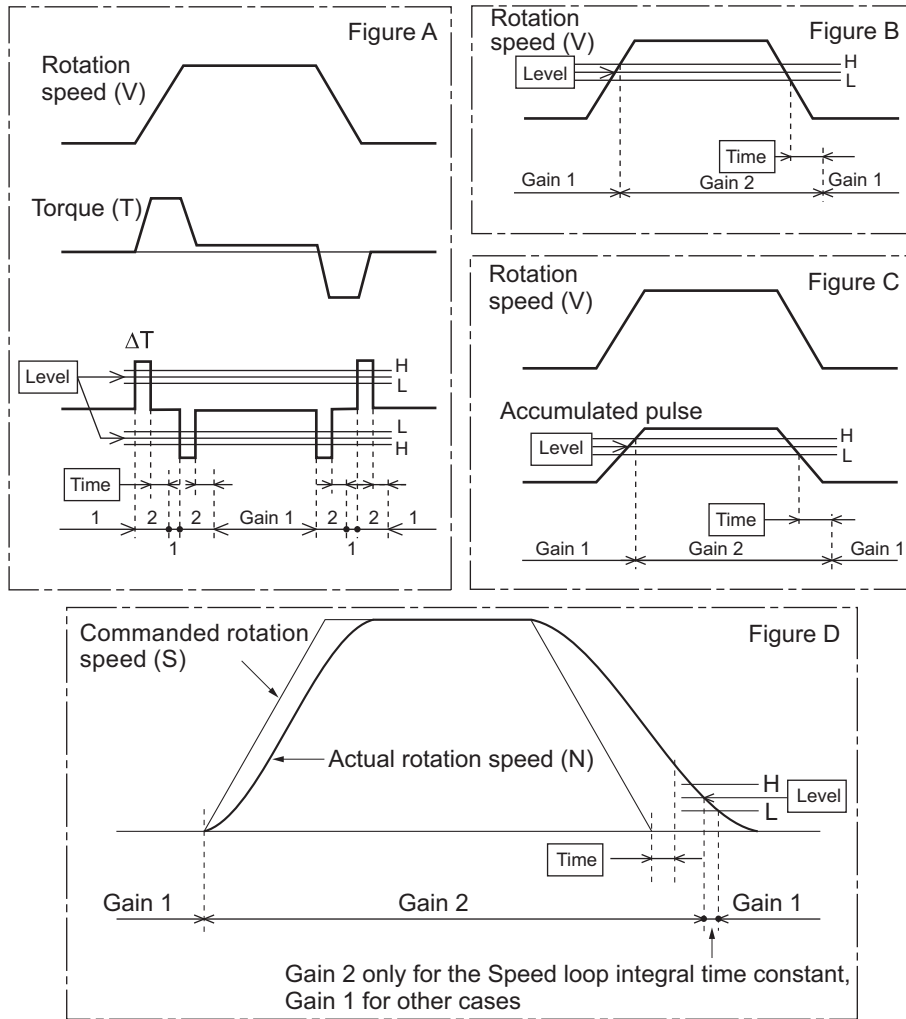


*3 When the Gain switching command of EtherCAT communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4 The variation means the change amount in a millisecond (ms).

E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.

- *5 When the set value is 10, meanings of the Gain Switching Delay Time in Speed Control (3121 hex), the Gain Switching Level in Speed Control (3122 hex), and the Gain Switching Hysteresis in Speed Control (3123 hex) differ from the normal case. (Refer to Figure D.)



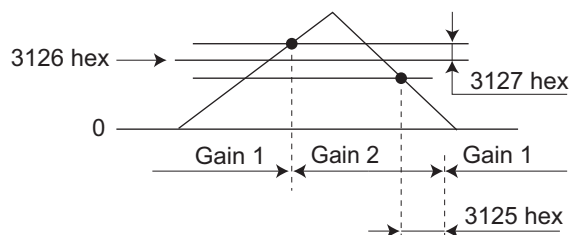
Torque Control Mode

In the Torque Control Mode, it varies as follows according to Switching Mode in Torque Control (3124 hex).

| 3124 hex set value | Description | | | |
|--------------------|--|--|---|--|
| | Gain switching conditions | Gain Switching Delay Time in Torque Control (3125 hex) ^{*1} | Gain Switching Level in Torque Control (3126 hex) | Gain Switching Hysteresis in Torque Control (3127 hex) ^{*2} |
| 0 | Always Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 1 | Always Gain 2 (3105 to 3109 hex). | Disabled | Disabled | Disabled |
| 2 | Gain switching command input via EtherCAT communications ^{*3} | Disabled | Disabled | Disabled |
| 3 | Torque command change amount (Refer to Figure A.) | Enabled | Enabled ^{*4} (0.05%) | Enabled ^{*4} (0.05%) |

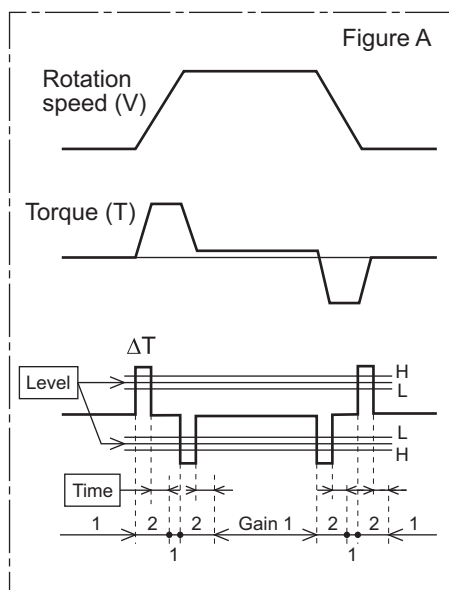
*1 The Gain Switching Delay Time in Torque Control (3125 hex) becomes effective when the gain is switched from 2 to 1.

*2 The Gain Switching Hysteresis in Torque Control (3127 hex) is defined in the drawing below.



*3 When the Gain switching command of EtherCAT communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4 The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.



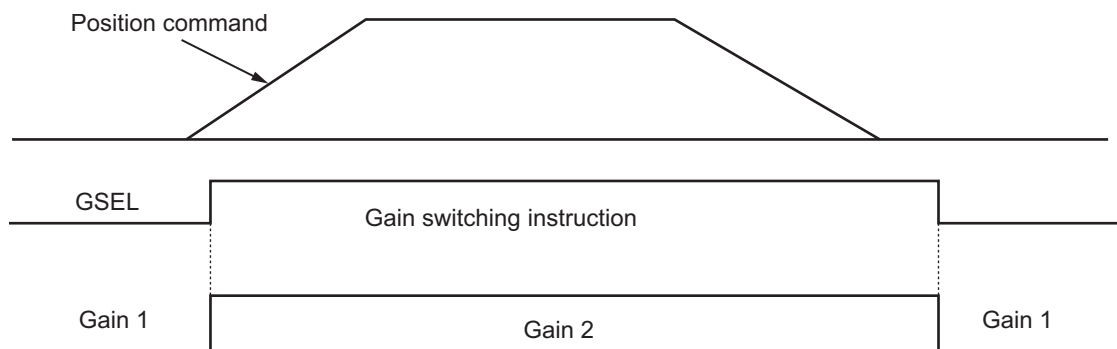
7-9-3 Diagrams of Gain Switching Setting

Switching between Gain 1 (3100 to 3104 hex) and Gain 2 (3105 to 3109 hex) occurs at the following timing. For the position loop gain, switching occurs based on the setting of 3119 hex.

The details of the gain switching settings vary depending on the control mode used. For the details of settings available in each mode, refer to *Gain Switching Based on the Control Mode* on page 7-30.

Gain Switching Mode = 2: Gain Switching (GSEL)

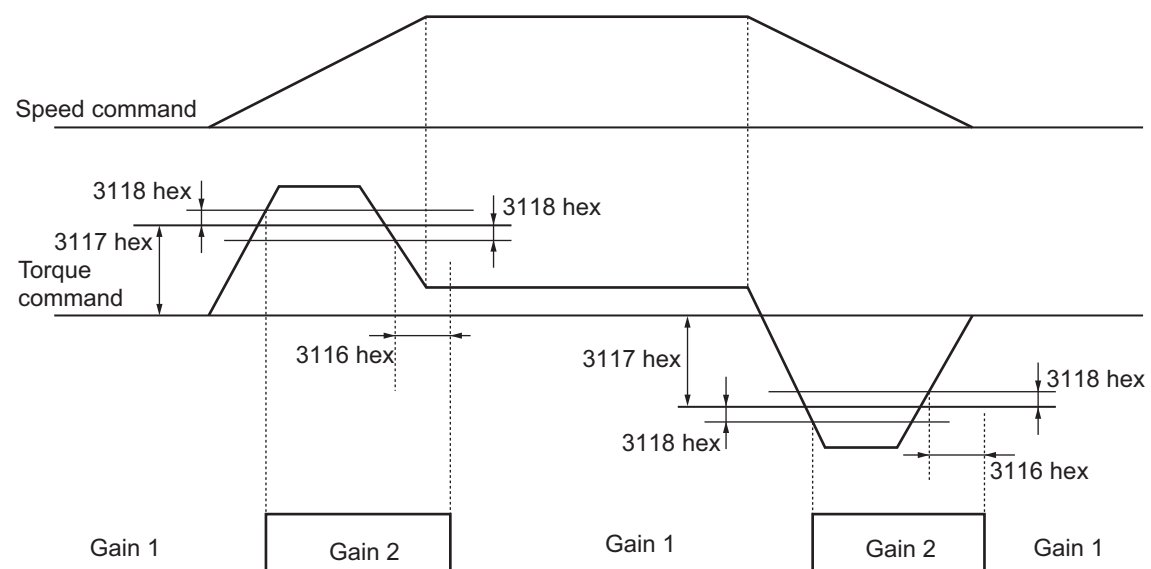
Instant switching occurs when a gain switching command is issued from the network.



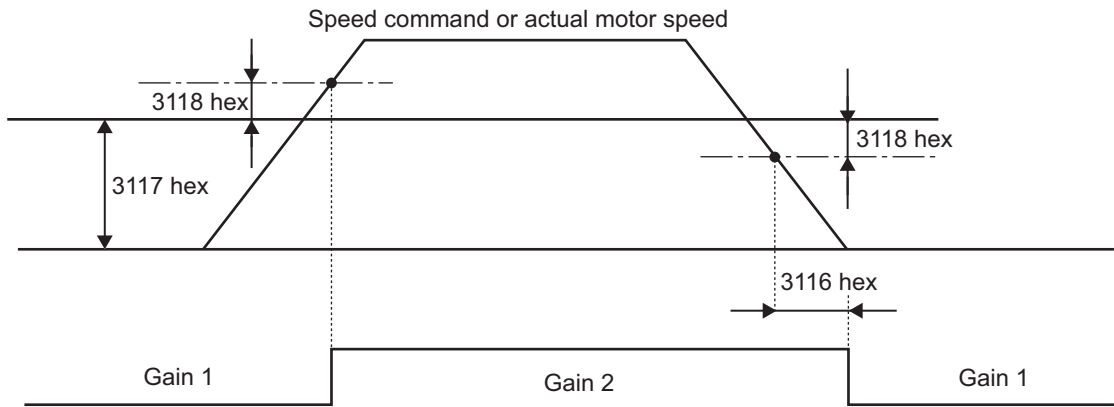
Gain Switching Mode = 3: Switching by Command Torque Value

If the absolute value of the command torque exceeds the sum of the Gain Switching Level in Position Control (3117 hex) plus the Gain Switching Hysteresis in Position Control (3118 hex), the gain switches to gain 2.

If the absolute value of the command torque exceeds the difference of the Gain Switching Level in Position Control (3117 hex) minus the Gain Switching Hysteresis in Position Control (3118 hex) for the time specified in the Gain Switching Delay Time in Position Control (3116 hex), the gain switches back to gain 1.



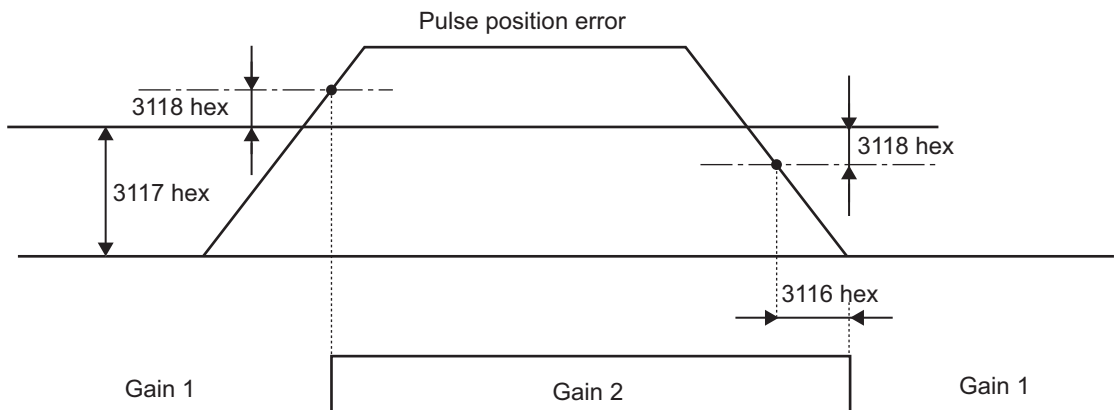
Gain Switching Mode = 5 or 9: Switching by Speed Command or Actual Motor Speed



Note The "speed command" is the Motor Control Effort (401A hex) [r/min].

Gain Switching Mode = 6: Switching by Pulse Position Error

The gain is switched according to the pulse position error [encoder pulses/external encoder pulses].



Gain Switching Mode = 7: Switching by Whether There Is a Position Command

The gain is switched according to whether there is a position command.

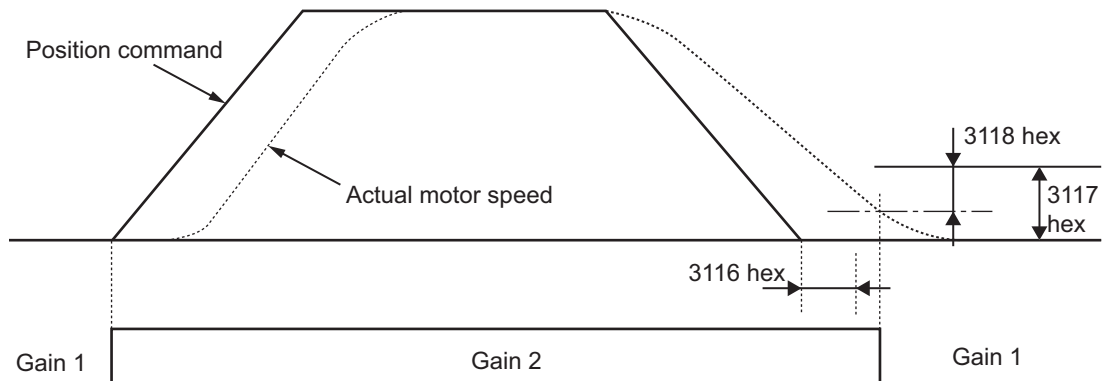


Note Whether there is a position command is determined by changes in the Target position (607A hex).

Gain Switching Mode = 10: Switching by Combination of Whether There Is a Position Command and Actual Motor Speed

Switching to the gain 2 occurs when a position command is received.

If there is no position command but the absolute value of the actual motor speed remains less than the difference of the Gain Switching Level in Position Control (3117 hex) minus the Gain Switching Hysteresis in Position Control (3118 hex) [r/min] for the time specified in the Gain Switching Delay Time in Position Control (3116 hex), the gain switches to gain 1.



Note Whether there is a position command is determined by changes in the Target position (607A hex).

7-9-4 Position Gain Switching Time (3119 Hex)

Torque fluctuations or vibration will occur if the position loop gain is changed too quickly during position control or fully-closed control.

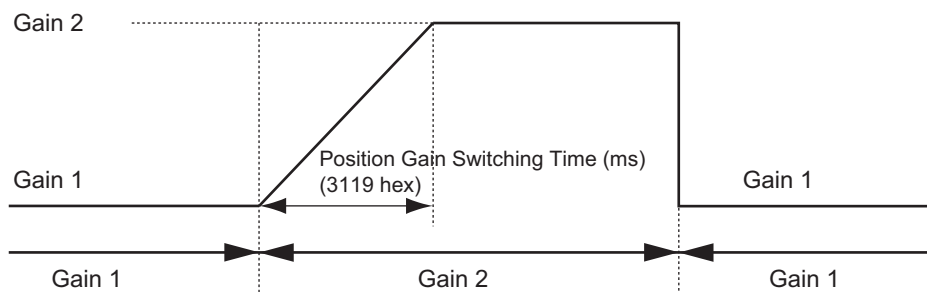
To suppress these, set a Position Gain Switching Time (3119 hex).

By setting the Position Gain Switching Time (3119 hex), the gain will be switched gradually when there is a large change in the position loop gain.

If there is a large difference between Position Loop Gain 1 (3100 hex) and Position Loop Gain 2 (3105 hex), set the Position Gain Switching Time (3119 hex).

When the position loop gain increases, the gain changes in the set time.

● Position Loop Gain 1 < Position Loop Gain 2



Precautions for Correct Use

When the position loop gain is switched to a smaller value (e.g., when switching from gain 2 to gain 1 in the above figure), Position Gain Switching Time (3119 hex) is ignored and the gain is switched immediately.

7-10 Gain Switching 3 Function

This function adds a new setting (gain 3) to the gain switching function of the Gain Switching Input Operating Mode Selection (3114 hex).

The positioning time can be reduced by keeping the gain immediately before the stop at a higher level for a certain period of time.

7-10-1 Operating Conditions

You can use the gain 3 switching function in the following situations for position control or fully-closed control.

| | Conditions |
|----------------|---|
| Operating mode | Position Control Mode or Fully-closed Control Mode |
| Others | <ul style="list-style-type: none"> Servo ON state. The factors other than control parameters must be set correctly. This includes the torque limit. The motor must operate normally without any failures. |

7-10-2 Objects Requiring Settings

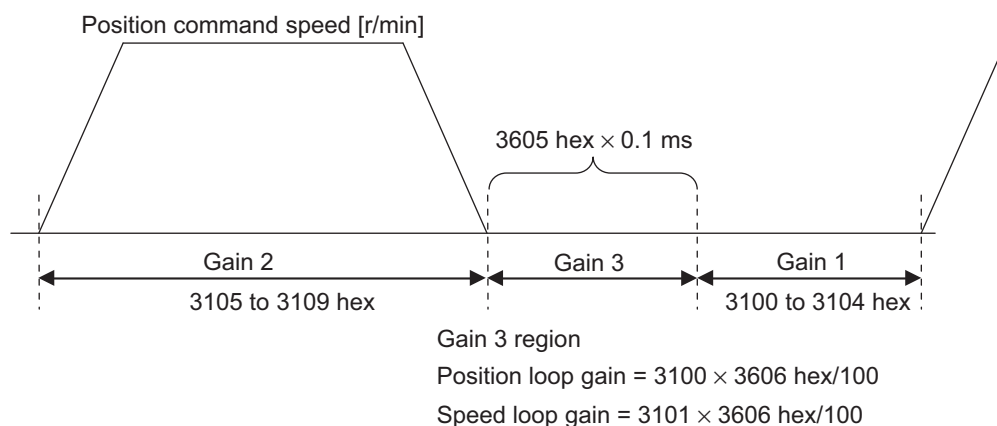
| Index | Name | Explanation | Reference |
|----------|-----------------------|-------------------------------------|-----------|
| 3605 hex | Gain 3 Effective Time | Set effective time of gain 3. | page 9-47 |
| 3606 hex | Gain 3 Ratio Setting | Set gain 3 as a multiple of gain 1. | page 9-47 |

7-10-3 Operation Example

When the conventional gain switching function works correctly, set the time to use Gain 3 in Gain 3 Effective Time (3605 hex), and the magnification of Gain 3 against Gain 1 in the Gain 3 Ratio Setting (3606 hex).

Operation Timings of Gain 1, 2 and 3

When the Switching Mode in Position Control (3115 hex) is set to 7, i.e., when the command pulses are received as the switching condition, the operation will be as shown below:



The gain 1 values are used 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 (3605 hex) to 0 and the Gain 3 Ratio Setting (3606 hex) to 100.
 - In the gain 3 region, only the position loop gain and the speed loop gain are treated as gain 3, and the gain 1 setting is applied for all other gains.
 - If the gain 2 switching condition is established in the gain 3 region, operation switches to gain 2.
 - If gain 2 is switching to gain 3, the Position Gain Switching Time (3119 hex) is enabled.
 - There is a gain 3 region even when gain 2 is switched to gain 1 due to an object change and so forth.
-

7-11 Touch Probe Function (Latch Function)

The latch function latches the position actual value when an external latch input signal or the encoder's phase-Z signal turns ON. G5-series Servo Drives can latch two positions.

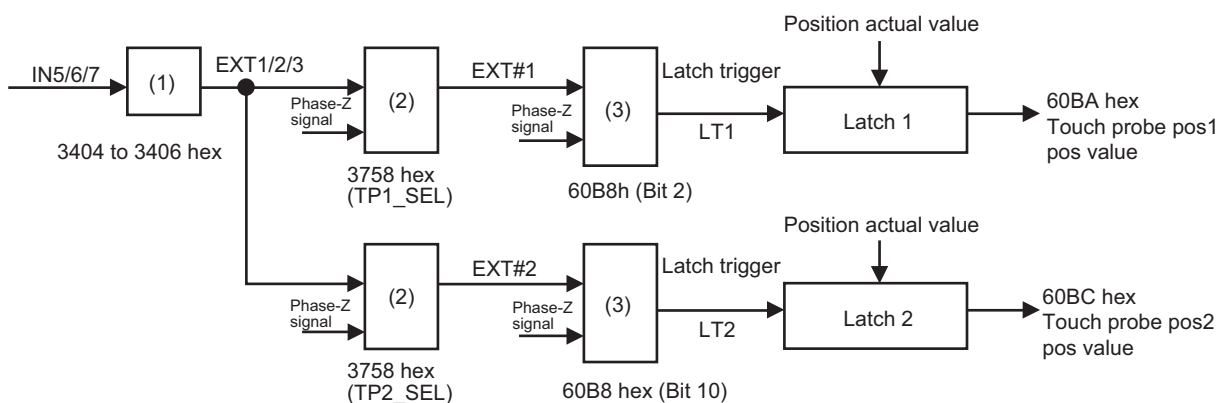
7-11-1 Related Objects

| Index | Name | Description |
|----------|-------------------------------|---|
| 60B8 hex | Touch probe function | Controls the latch function. |
| 60B9 hex | Touch probe status | Gives the state of latches 1 and 2. |
| 60BA hex | Touch probe pos1 pos value | Latch position of latch 1. |
| 60BC hex | Touch probe pos2 pos value | Latch position of latch 2. |
| 3404 hex | Input Signal Selection 5 | Set the function for general-purpose input 5 (IN5). |
| 3405 hex | Input Signal Selection 6 | Set the function for general-purpose input 6 (IN6). |
| 3406 hex | Input Signal Selection 7 | Set the function for general-purpose input 7 (IN7). |
| 3758 hex | Touch Probe Trigger Selection | Select the trigger signals for latch 1 and 2. |

7-11-2 Trigger Signal Settings

The latch trigger can be selected from general-purpose inputs 5 to 7 or the encoder's phase-Z signal. The functions of general-purpose signals 5 to 7 from the control I/O connector are set with the Input Signal Selection 5 to 7 (3404 to 3406 hex). External latch input signals used by Latches 1 and 2 are set with the Touch Probe Trigger Selection (3758 hex).

Bits 2 and 10 of the Touch probe function (60B8 hex) are used to specify weather to latch with an external signal or the phase-Z signal.



General-purpose Input Assignment in (1)

| Signal | Index | Assignment |
|--------|----------|------------------------------------|
| IN5 | 3404 hex | Select either EXT1, EXT2, or EXT3. |
| IN6 | 3405 hex | Select either EXT1, EXT2, or EXT3. |
| IN7 | 3406 hex | Select either EXT1, EXT2, or EXT3. |

*1 The same function cannot be assigned more than once.

Touch Probe Trigger Selection (3758 hex) in (2)

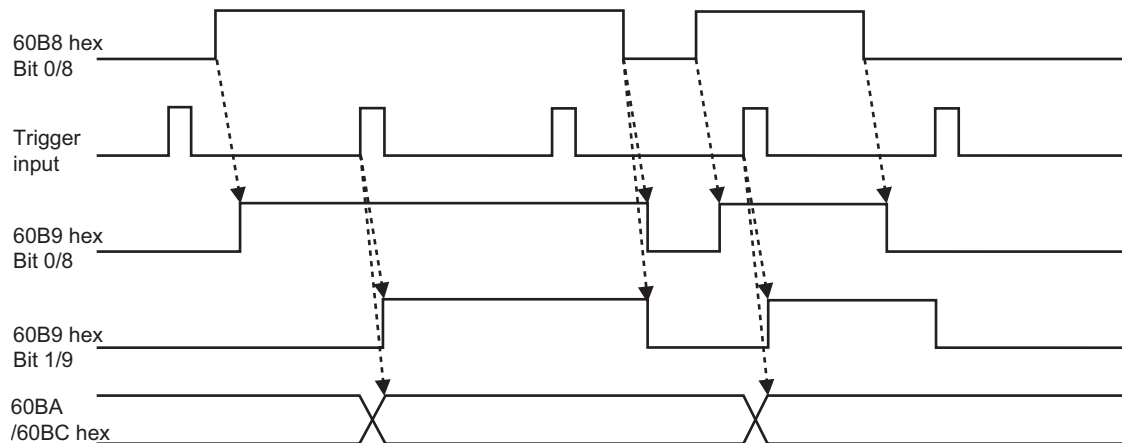
| Latch 1 | | | Latch 2 | | |
|---------|-------|----------------|---------|-------|----------------|
| TP1_SEL | | EXT#1 | TP2_SEL | | EXT#2 |
| Bit 0 | Bit 1 | | Bit 8 | Bit 9 | |
| 0 | 0 | EXT1 | 0 | 0 | EXT1 |
| 1 | 0 | EXT2 | 1 | 0 | EXT2 |
| 0 | 1 | EXT3 | 0 | 1 | EXT3 |
| 1 | 1 | Phase-Z signal | 1 | 1 | Phase-Z signal |

Touch probe function (60B8 hex) in (3)

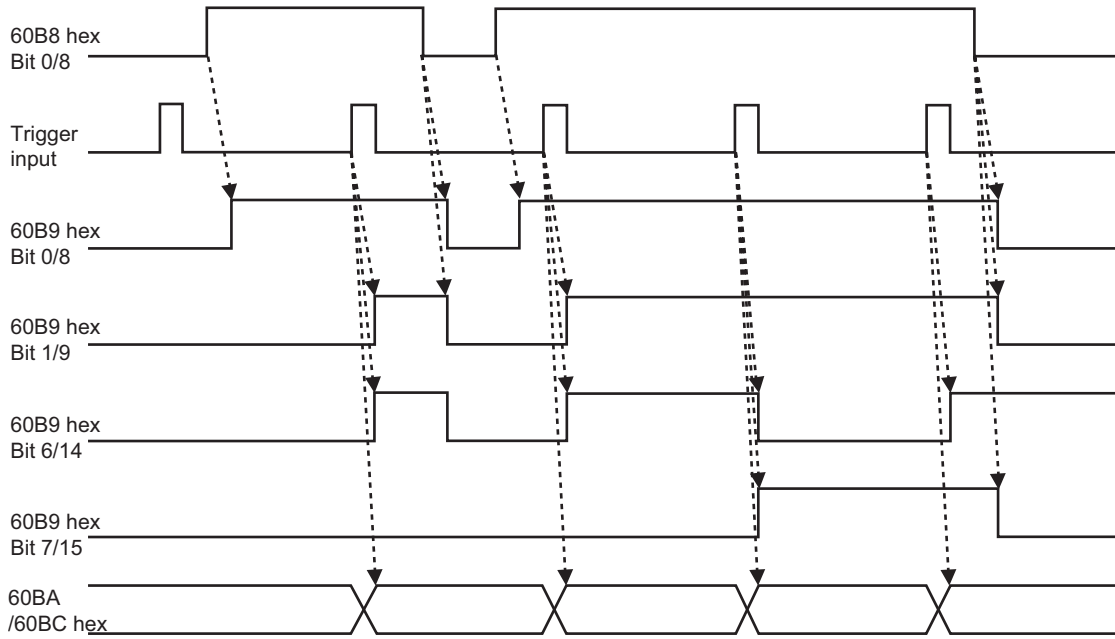
| Bit 2 | LT1 | Bit 10 | LT2 |
|-------|----------------|--------|----------------|
| 0 | EXT#1 | 0 | EXT#2 |
| 1 | Phase-Z signal | 1 | Phase-Z signal |

7-11-3 Operation Sequences

Trigger first event (60B8 Hex Bit 1/9 = 0: Trigger first event)



Continuous (60B8 Hex Bit 1/9 = 1: Continuous)





Safety Function

This function stops the Servomotor based on a signal from a safety controller or safety sensor. An outline of the function is given together with operation and connection examples.

| | |
|---|------------|
| 8-1 Safe Torque OFF Function | 8-2 |
| 8-1-1 I/O Signal Specifications | 8-3 |
| 8-2 Operation Example | 8-5 |
| 8-3 Connection Examples | 8-7 |

8-1 Safe Torque OFF Function

The safe torque OFF function (hereinafter referred to as STO according to IEC 61800-5-2) is used to cut off the motor current and stop the motor through the input signals from a safety device, such as a safety controller or safety sensor, that is connected to the safety connector (CN8).

When the STO function is operating, the Servo Drive turns OFF the servo ready completed output (READY) to go into the safety status.

- The PFH value is 2.30×10^{-8} .



Precautions for Safe Use

- When using the STO function, be sure to execute a risk assessment of the equipment to confirm that the system safety requirements are met.
 - There are the 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 an external force is present (e.g., force of gravity on a vertical axis). If holding is required, implement appropriate measures, such as providing external brakes. The brakes for a Servo Drive with brakes are used for holding only, and cannot be used for control.
 - Even if there is no external force, when the Fault reaction option code (605E hex) is set to free-run with the dynamic brake disabled, the motor uses free-run stopping and the stop distance is long.
 - In case of internal failure of components, the motor may operate in the range of up to 180 degrees of electrical angle.
 - The power supply to the motor is cut off by the STO function, but the power supply to the Servo Drive will not be cut off nor electrically isolated. For Servo Drive maintenance, cut off the power supply to the Servo Drive through another means.
 - Do not use the EDM output for any purpose other than the failure monitoring function. The EDM output signal is not a safety output.
 - The dynamic brake and external brake release signal outputs are not safety-related parts. Make sure to design the equipment not to be dangerous even if the external brake release fails during the STO status.
 - When using the STO function, connect equipment that meets the safety standards.
-

8-1-1 I/O Signal Specifications

Safety Input Signals

There are 2 safety input circuits to operate the STO function.

| Signal name | Symbol | Pin number | Description | Control mode | | | |
|----------------|--------|------------|---|--------------|-------|--------|--------------|
| | | | | Position | Speed | Torque | Fully-closed |
| Safety input 1 | SF+ | CN8-4 | • The upper arm drive signal of the power transistor inside the Servo Drive is cut off. | √ | √ | √ | √ |
| | SF- | CN8-3 | | √ | √ | √ | √ |
| Safety input 2 | SF2+ | CN8-6 | • The lower arm drive signal of the power transistor inside the Servo Drive is cut off. | √ | √ | √ | √ |
| | SF2- | CN8-5 | | √ | √ | √ | √ |

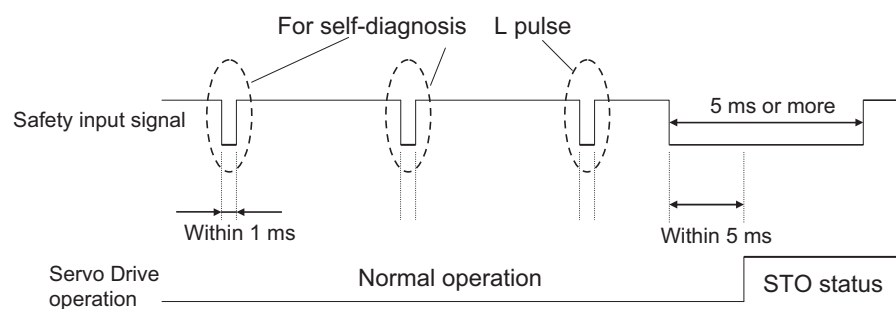
- When safety input 1 or 2 turns OFF, the STO function will start operating within 5 ms of the input, and the motor output torque will be reduced to 0.
- Connect the equipment so that the safety input circuit is turned OFF to operate the STO function.
- Set the operation when the safety input turns OFF in the Fault reaction option code (605E hex).



Precautions for Correct Use

- L pulses for self-diagnosis of safety equipment

When you are connecting a safety device, such as a safety controller or a safety sensor, the safety output signal of the device may include L pulses for self-diagnosis. To avoid malfunction due to the L pulses for self-diagnosis, a filter that removes the L pulses is built into the safety input circuit. If the OFF time of the safety input signal is 1 ms or less, the safety input circuit does not recognize it as OFF. To make sure that OFF is recognized, maintain the OFF status of safety input signal for at least 5 ms.



External Device Monitor (EDM) Output Signal

This is a monitor output signal that is used to monitor the status of safety input signals using an external device. Connect a safety device, such as a safety controller or a safety sensor. Connect the EDM output signal to the monitoring terminal on a safety device.

| Signal name | Symbol | Pin number | Description | Control mode | | | |
|-------------|--------|------------|---|--------------|-------|--------|--------------|
| | | | | Position | Speed | Torque | Fully-closed |
| EDM output | EDM+ | CN8-8 | <ul style="list-style-type: none"> Monitor signal is output to detect malfunctioning of the safety function. * This is not a safety output. | √ | √ | √ | √ |
| | EDM- | CN8-7 | | √ | √ | √ | √ |

● Relationship between Safety Input Signals and EDM Output Signal

Normally when both safety inputs 1 and 2 are OFF, i.e., when the STO function is activated for both safety input circuits, the EDM output is ON.

You can detect a failure of the safety input circuit and the EDM output circuit by monitoring all of the following 4 signal states using an external device.

These are the two cases of errors:

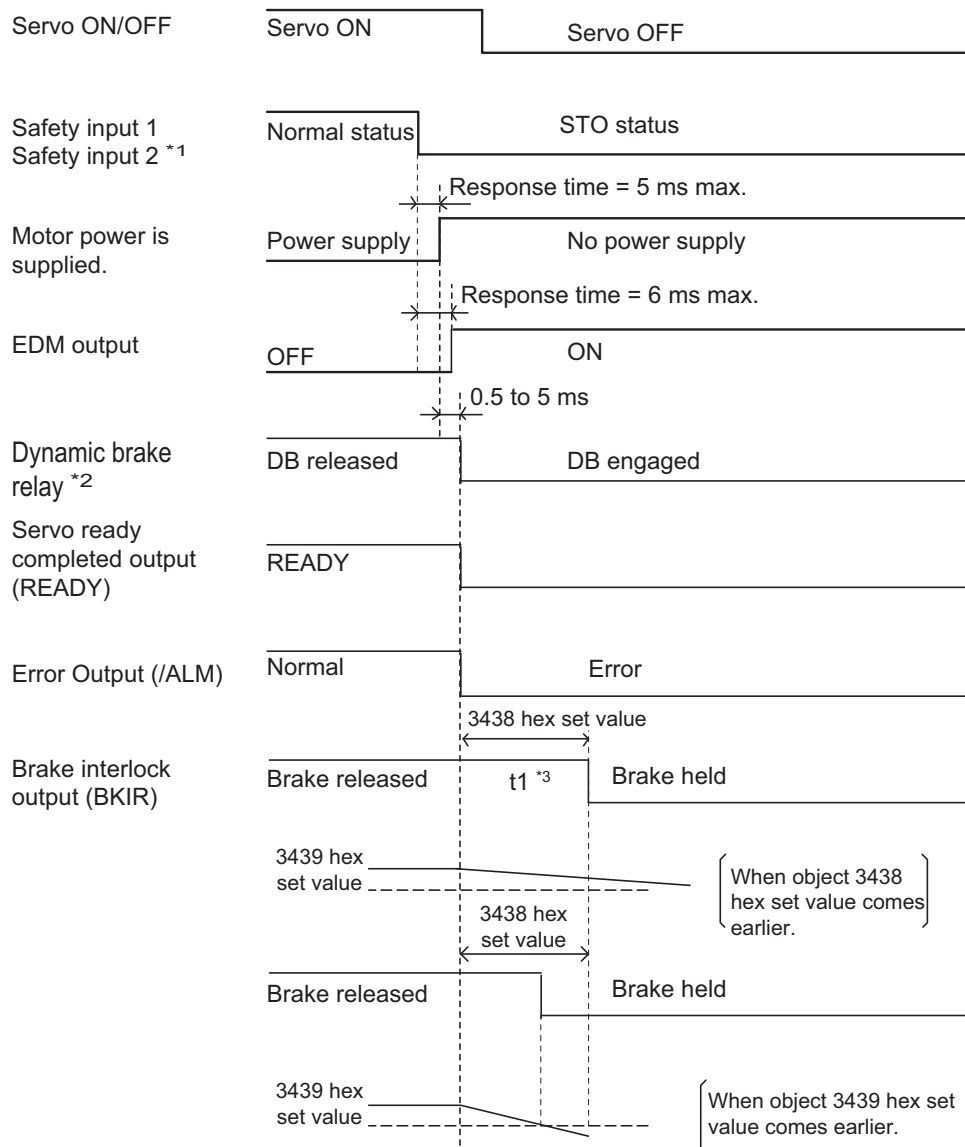
- Both safety inputs 1 and 2 are OFF, but the EDM output circuit signal does not turn ON.
- Either or both safety inputs 1 and 2 are ON, but the EDM output circuit signal is ON.

| Signal name | Symbol | Signal status | | | |
|----------------|--------|---------------|-----|-----|-----|
| | | ON | OFF | ON | OFF |
| 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 until the EDM output signal is output.

8-2 Operation Example

● Operation Timings to a Safety Status

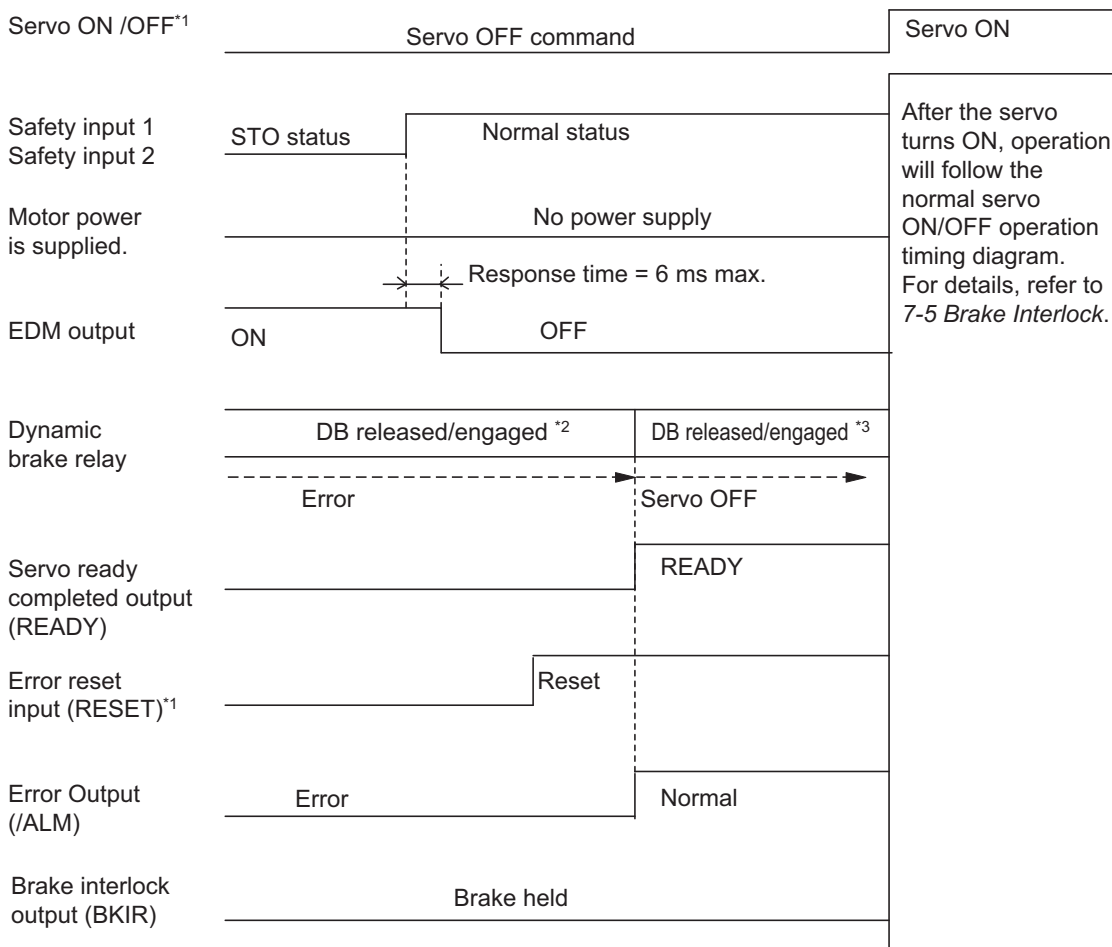


*1 STO status is entered when either safety input 1 or 2 turns OFF

*2 The dynamic brake operates according to the setting of the Fault reaction option code (605E hex).

*3 t1 is the set value of the Brake Timing During Operation (3438 hex), or the time needed for the motor rotation speed to drop to or below the Brake Threshold Speed During Operation (3439 hex), whichever occurs first.

● Timing of Return from Safety Status



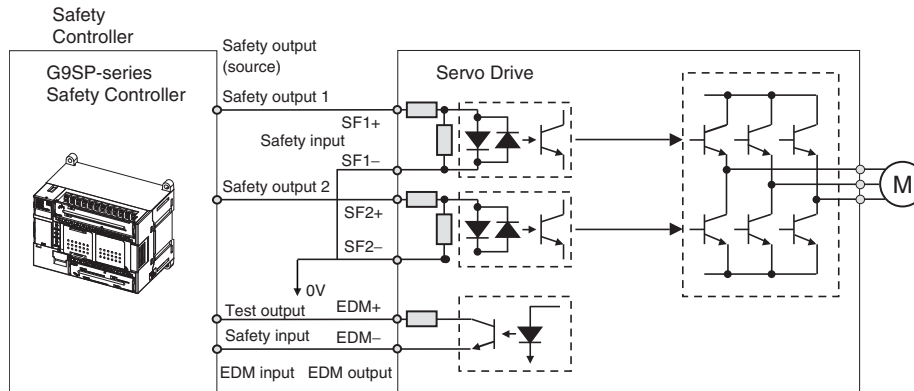
*1 Make sure that servo ON input is turned OFF when you return the input signals of safety inputs 1 and 2 to ON. If an error exists in this state, be sure to clear the error when both safety inputs 1 and 2 have returned to ON state. Also, depending on the execution timing, an Other Error (Error No. 99.9) may occur. If this error (Error No. 99.9) occurs, turn OFF and then ON the power again.

*2 An error exists in this state. The dynamic brake operates according to the Fault reaction option code (605E hex).

*3 An error exists in this state. The dynamic brake operates according to the Disable operation option code (605C hex).

8-3 Connection Examples

Connection with a Safety Controller



9

Details on Servo Parameter Objects

This chapter explains the settings of each object.

| | |
|---|-------------|
| 9-1 Basic Settings | 9-2 |
| 9-2 Gain Settings | 9-7 |
| 9-3 Vibration Suppression Settings | 9-20 |
| 9-4 Analog Control Objects | 9-26 |
| 9-5 Interface Monitor Settings | 9-31 |
| 9-6 Extended Objects | 9-41 |
| 9-7 Special Objects | 9-47 |

9-1 Basic Settings

This section describes objects specific to G5-series Servo Drives with built-in EtherCAT communications. G5-series Servo Drive parameters (Pn□□□) are allocated to objects 3000 to 3999 hex. Index 3□□□ hex correspond to G5-series Servo Drive parameters Pn□□□. For example, object 3504 hex is the same as parameter Pn504.



Precautions for Correct Use

Pn□□□ uses decimal numbers but object 3□□□ is a hexadecimal number.

- Some objects are enabled by turning the power supply OFF and then ON again. After changing these objects, 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 objects marked “reserved.” Also, do not change the set values that are indicted as being unused or reserved for the system.
- See below for the data attributes.

- A : Always enabled
- B : Prohibited to change during motor rotation or commands.
If it is changed during motor rotation or commands, the update timing will be unknown.
- C : Updated after the control power is reset, or after a Config command is executed via EtherCAT communications.
- D : Changeable only when the EtherCAT communications state is Pre-Operational (Pre-Op).
- R : Updated when the control power supply is reset.
It is not updated for a Config command via EtherCAT communications.
- : Write prohibited.

- The operation modes are shown as follows:

- All : All operation modes
- csp : Cyclic synchronous position mode
- csv : Cyclic synchronous velocity mode
- cst : Cyclic synchronous torque mode
- pp : Profile position mode
- hm : Homing mode
- (semi) : Only objects related to semi-closed control.
- (full) : Only objects related to fully-closed control.

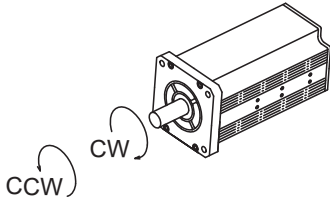
| 3000 hex | Rotation Direction Switching | | | | | | <input type="checkbox"/> All |
|---------------|------------------------------|------|--------|-----------------|---------|----------------|------------------------------|
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- This object switches the motor rotation direction for a position, speed, or torque command.

Explanation of Set Values

| Set value | Description |
|-----------|--|
| 0 | A forward direction command sets the motor rotation direction to clockwise. |
| 1 | A forward direction command sets the motor rotation direction to counterclockwise. |

- The motor rotation direction when viewing the shaft from the load side is called clockwise (CW) or counterclockwise (CCW).



| 3001 hex | Control Mode Selection | | | | | | All |
|---------------|------------------------|------|--------|-----------------|---------|----------------|-----|
| Setting range | 0 to 6 | Unit | – | Default setting | 0 | Data attribute | R |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the control mode to be used.

Explanation of Set Values

| Set value | Description |
|-----------|-----------------------------------|
| 0 to 5 | Semi-closed control ^{*1} |
| 6 | Fully-closed control |

*1 Set any value between 0 and 5 for semi-closed control.

| 3002 hex | Realtime Autotuning Mode Selection | | | | | | All |
|---------------|------------------------------------|------|--------|-----------------|---------|----------------|-----|
| Setting range | 0 to 6 | Unit | – | Default setting | 1 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the operating mode for realtime autotuning.
- Refer to *11-3 Realtime Autotuning* on page 11-7.

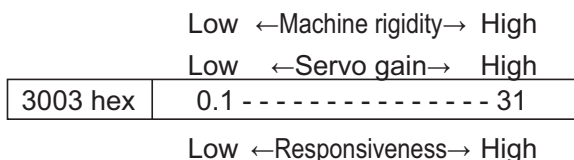
Explanation of Set Values

| Set value | Realtime autotuning | Description |
|-----------|---|--|
| 0 | Disabled | Realtime autotuning is disabled. |
| 1 | Focus on stability (default setting) | No unbalanced load, friction compensation, or gain switching. |
| 2 | Focus on position control | Used for a horizontal axis or other axes that have no unbalanced load, or for a ball screw drive with little friction. |
| 3 | Vertical axis | Used when an unbalanced load is present, such as a vertical axis. |
| 4 | Friction compensation and vertical axis | Used when friction is large (unbalanced load also calculated). Used for a belt-driving shaft with large friction. Variations in finalizing the positioning are suppressed. |
| 5 | Load characteristic estimation | Used only for estimating load characteristics. |
| 6 | Customization | This mode is used for customizing the realtime autotuning function by using the Realtime Autotuning Customization Mode Setting (3632 hex). |

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-----|
| 3003 hex | Realtime Autotuning Machine Rigidity Setting | | | | | | All |
| Setting range | 0 to 31 | Unit | – | Default setting | 13 *1 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 The default setting is 11 for a Drive with 200 V and 1 kW or greater, or for a Drive with 400 V.

- Set the machine rigidity to one of 32 levels when realtime autotuning is enabled.
- The higher the machine rigidity set value is, the higher the responsiveness is, however, the more vibration occurs.



- Refer to *11-3 Realtime Autotuning* on page 11-7.



Precautions for Correct Use

- If the set value is changed suddenly by a large amount, the gain may change rapidly, subjecting the machine to shock. Always start with a small setting, and gradually increase the setting while monitoring machine operation.

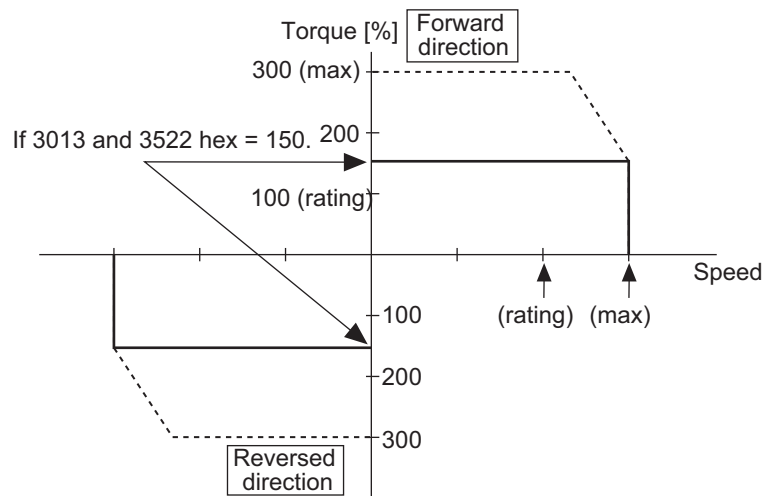
| | | | | | | | |
|-----------------|-----------------|------|--------|-----------------|---------|----------------|-----|
| 3004 hex | Inertia Ratio | | | | | | All |
| Setting range | 0 to 10000 | Unit | % | Default setting | 250 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the load inertia as a percentage of the motor rotor inertia.
- $3004 \text{ hex} = (\text{Load inertia} / \text{Rotor inertia}) \times 100\%$
- When realtime autotuning is enabled, the inertia ratio is continuously estimated and saved in EEPROM every 30 minutes.
- If the inertia ratio is set correctly, the setting unit for the Speed Loop Gain 1 (3101 hex) and Speed Loop Gain 2 (3106 hex) is Hz.
- If the Inertia Ratio (3004 hex) is set larger than the actual value, the setting for speed loop gain will increase. If the Inertia Ratio (3004 hex) is set smaller than the actual value, the setting for speed loop gain will decrease.

| | | | | | | | |
|-----------------|-------------------------|------|--------|-----------------|---------|----------------|------------|
| 3013 hex | External Torque Limit 1 | | | | | | All |
| Setting range | 0 to 5000 | Unit | 0.1 % | Default setting | 5000*1 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 It is limited by the maximum torque of the connected motor.

- Set the limit values for the motor output torques (3013 hex: External Torque Limit 1, 3522 hex: External Torque Limit 2).
- Refer to the Torque Limit Selection (3521 hex) for the torque limit selection.
- During torque control, it limits the maximum torque in forward and reverse directions. The settings on the Torque Limit Selection (3521 hex) and the External Torque Limit 2 (3522 hex) are ignored.
- Set the value in units of 0.1% of the rated voltage (100%).
E.g. When the set value is 1500, the maximum torque is limited to 150.0%.



- Refer to 7-7 Torque Limit Switching on page 7-24 for the torque control and the torque limit selection.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-------------------|
| 3015 hex | Operation Switch when Using Absolute Encoder | | | | | | All (semi) |
| Setting range | 0 to 2 | Unit | – | Default setting | 2 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the operating method for the 17-bit absolute encoder.

Explanation of Set Values

| Set value | Description |
|-----------|---|
| 0 | Use as absolute encoder. |
| 1 | Use as incremental encoder. |
| 2 | Use as absolute encoder but ignore multi-rotation counter overflow. |

| | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|----------------|----------------|------------------------------------|
| 3016 hex | Regeneration Resistor Selection | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 3 | Unit | – | Default setting | 3 ¹ | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 The default setting is 0 for a Drive with 100 V and 400 W, with 200 V and 750 W or greater, or with 400 V.

- The setting is different whether the Regeneration Resistor built in the Drive is directly used, or it is removed and replaced by an External Regeneration Resistor. In the latter case, the resistor is connected to the External Regeneration Resistor connection terminal.

Explanation of Set Values

| Set value | Description |
|-----------|--|
| 0 | Regeneration Resistor used: Built-in Resistor The regeneration processing circuit operates and the Regeneration Overload Error (Error No. 18.0) are enabled according to the Built-in Resistor (with approx. 1% duty). |
| 1 | Regeneration Resistor used: External Resistor The regeneration processing circuit operates, and Regeneration Overload Error (Error No. 18.0) cause a trip when the operating rate of the Regeneration Resistor exceeds 10%. |
| 2 | Regeneration Resistor used: External Resistor The regeneration processing circuit operates, but Regeneration Overload Error (Error No. 18.0) do not occur. |
| 3 | Regeneration Resistor used: None The regeneration processing circuit and Regeneration Overload Error (Error No. 18.0) do not operate, and all regenerative energy is processed by the built-in capacitor. |



Precautions for Correct Use

- Do not touch the External Regeneration Resistor. A burn injury may result.
- Always provide a temperature fuse or other protective measure when using an External Regeneration Resistor. Regardless of whether the regeneration overload error is enabled or disabled, the Regeneration Resistor can generate heat and may cause burning.
- To use the Built-in Regeneration Resistor, always set this object to 0.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------------------------------|
| 3017 hex | External Regeneration Resistor Setting | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 4 | Unit | – | Default setting | 0 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select the method to calculate the regeneration resistance load ratio, when the External Resistor is selected in the Regeneration Resistor Selection (3016 hex = 1 or 2).

Explanation of Set Values

| Set value | Description |
|-----------|---|
| 0 | Regeneration load ratio is 100% when operating rate of the External Regeneration Resistor is 10%. |
| 1 | Reserved |
| 2 | Reserved |
| 3 | Reserved |
| 4 | Reserved |

9-2 Gain Settings

Refer to 11-2 *Gain Adjustment* on page 11-5 for the settings for gain adjustment.

| 3100 hex | Position Loop Gain 1 | | | | | | csp | pp | hm |
|---------------|----------------------|------|--------|-----------------|-------------------|----------------|-----|----|----|
| Setting range | 0 to 30000 | Unit | 0.1/s | Default setting | 480 ^{*1} | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

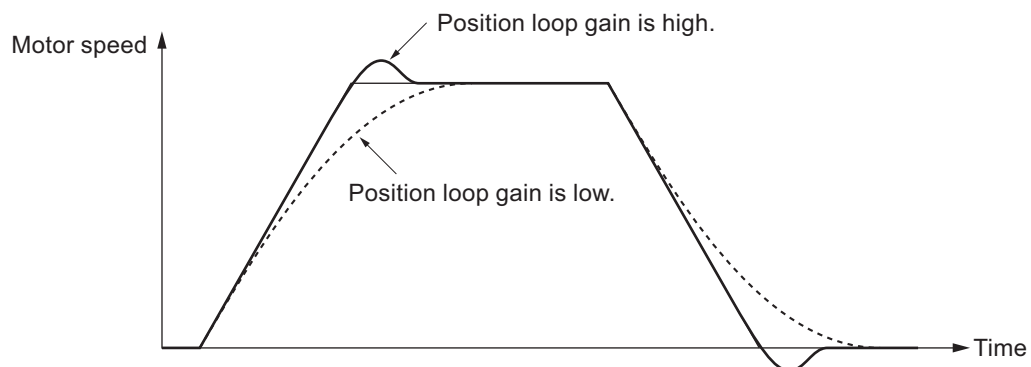
*1 The default setting is 320 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the position loop response in accordance with the machine rigidity.
- The responsiveness of the servo system is determined by the position loop gain.
- Servo systems with a high position loop gain have a high responsiveness and fast positioning.
- To increase the position loop gain, you must improve machine rigidity and increase the specific damping frequency. This should be 500 to 700 (0.1/s) for ordinary machine tools, 300 to 500 (0.1/s) for general-use and assembly machines, and 100 to 300 (0.1/s) for industrial robots. The default position loop gain is 480 (0.1/s), so be sure to lower the set value for machines with low machine rigidity.
- Increasing the position loop gain in systems with low machine rigidity or systems with low specific damping frequencies may cause machine resonance, resulting in an overload error.
- If the position loop gain is low, you can shorten the positioning time using feed-forward.
- This object is automatically changed by executing realtime autotuning. To set it manually, set the Realtime Autotuning Mode Selection (3002 hex) to 0.

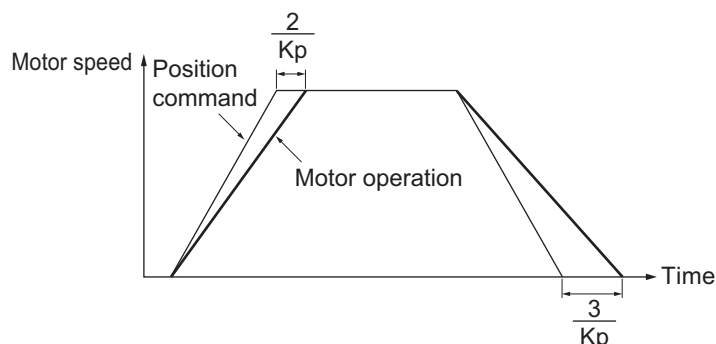
Position loop gain is generally expressed as follows:

$$\text{Position loop gain (Kp)} = \frac{\text{Command pulse frequency (pulses/s)}}{\text{Pulse position error (pulses)}} \quad (0.1/\text{s})$$

Response for Position Loop Gain Changes



- If the speed loop gain and position loop gain are optimally set, the motor operation for the command delays $2/K_p$ at acceleration and delays $3/K_p$ at deceleration.

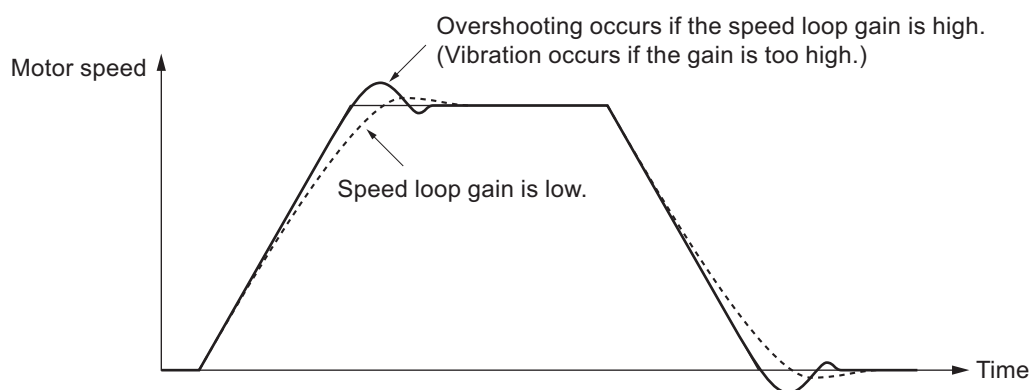


| | | | | | | | |
|-----------------|-------------------|------|--------|-----------------|-------------------|----------------|-----|
| 3101 hex | Speed Loop Gain 1 | | | | | | All |
| Setting range | 1 to 32767 | Unit | 0.1 Hz | Default setting | 270 ^{*1} | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 The default setting is 180 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- This object determines 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 3101 hex is Hz if the Inertia Ratio (3004 hex) is set correctly.

When the speed loop gain is changed, the response is as shown in the following diagram.

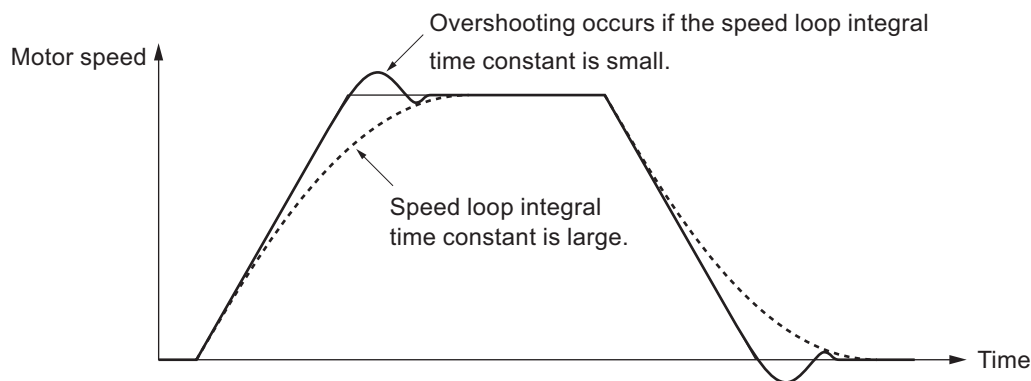


| | | | | | | | |
|-----------------|-------------------------------------|------|--------|-----------------|-------------------|----------------|-----|
| 3102 hex | Speed Loop Integral Time Constant 1 | | | | | | All |
| Setting range | 1 to 10000 | Unit | 0.1 ms | Default setting | 210 ^{*1} | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 The default setting is 310 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the speed loop integral time constant.
- The smaller the set value, the faster the error approaches 0 when stopping.

When the speed loop integral time constant is changed, the response is as shown in the following diagram.



| | | | | | | | | |
|-----------------|---------------------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3103 hex | Speed Feedback Filter Time Constant 1 | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 5 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- 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.

| | | | | | | | | |
|-----------------|---------------------------------------|------|---------|-----------------|---------|----------------|------------------------------------|--|
| 3104 hex | Torque Command Filter Time Constant 1 | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 2500 | Unit | 0.01 ms | Default setting | 84*1 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

*1 The default setting is 126 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the time constant for the first-order lag filter inserted into the torque command.
- This object may be effective in suppressing vibration due to torsion resonance.

| | | | | | | | | |
|-----------------|----------------------|------|--------|-----------------|---------|----------------|--|--|
| 3105 hex | Position Loop Gain 2 | | | | | | <input type="button" value="csp"/> <input type="button" value="pp"/> <input type="button" value="hm"/> | |
| Setting range | 0 to 30000 | Unit | 0.1/s | Default setting | 570*1 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

*1 The default setting is 380 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the responsiveness of the position control system for the second position loop.

| | | | | | | | | |
|-----------------|-------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3106 hex | Speed Loop Gain 2 | | | | | | <input type="button" value="All"/> | |
| Setting range | 1 to 32767 | Unit | 0.1 Hz | Default setting | 270*1 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

*1 The default setting is 180 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the responsiveness of the second speed loop.

| | | | | | | | | |
|-----------------|-------------------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3107 hex | Speed Loop Integral Time Constant 2 | | | | | | <input type="button" value="All"/> | |
| Setting range | 1 to 10000 | Unit | 0.1 ms | Default setting | 10000 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the second speed loop integral time constant.

| | | | | | | | | |
|-----------------|---------------------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3108 hex | Speed Feedback Filter Time Constant 2 | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 5 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the second speed feedback filter.

| | | | | | | | | |
|-----------------|---------------------------------------|------|---------|-----------------|------------------|----------------|------------------------------|--|
| 3109 hex | Torque Command Filter Time Constant 2 | | | | | | <input type="checkbox"/> All | |
| Setting range | 0 to 2500 | Unit | 0.01 ms | Default setting | 84 ^{*1} | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

*1 The default setting is 126 for a Drive with 200 V and 1 kW or greater, or with 400 V.

- Set the second torque filter time constant.
- The objects from 3105 to 3109 hex are the gain and time constants to be selected when the Gain Switching Input Operating Mode Selection (3114 hex) is enabled.
- The gain is switched according to the condition set in the Switching Mode (3115 hex, 3120 hex, and 3124 hex).
- 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 object is automatically changed by executing realtime autotuning function. To set it manually, set the Realtime Autotuning Mode Selection (3002 hex) to 0.

| | | | | | | | | |
|-----------------|-------------------------|------|--------|-----------------|---------|----------------|--|--|
| 3110 hex | Speed Feed-forward Gain | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 1000 | Unit | 0.1% | Default setting | 300 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the feed-forward gain.
- Increasing the set value decreases the position error and increases the responsiveness. Overshooting, however, will occur more easily.
- Refer to *11-11 Feed-forward Function* on page 11-30.

| | | | | | | | | |
|-----------------|-----------------------------------|------|---------|-----------------|---------|----------------|--|--|
| 3111 hex | Speed Feed-forward Command Filter | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 6400 | Unit | 0.01 ms | Default setting | 50 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the time constant for the first-order lag filter inserted into the feed-forward.
- Setting the filter may improve operation if speed overshooting occurs or the noise during operation is large when the feed-forward is set high.
- Refer to *11-11 Feed-forward Function* on page 11-30.

| | | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------|----------------|---|--|
| 3112 hex | Torque Feed-forward Gain | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> csv <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 1000 | Unit | 0.1% | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the feed-forward gain in torque control. Increasing the set value decreases the position error and increases the responsiveness. Overshooting, however, will occur more easily.
- Refer to *11-11 Feed-forward Function* on page 11-30.

| | | | | | | | | |
|-----------------|------------------------------------|------|---------|-----------------|---------|----------------|---|--|
| 3113 hex | Torque Feed-forward Command Filter | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> csv <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 6400 | Unit | 0.01 ms | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the time constant for the first-order lag filter inserted into the feed-forward.
- Setting the filter may improve operation if speed overshooting occurs or the noise during operation is large when the feed-forward is set high.
- Refer to *11-11 Feed-forward Function* on page 11-30.

| | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|------------------------------|--|
| 3114 hex | Gain Switching Input Operating Mode Selection | | | | | | <input type="checkbox"/> All | |
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select either PI/P operation switching or gain 1/gain 2 switching.
- The PI/P operation switching is performed with the Speed Loop PI/P Control command in EtherCAT communications.
- Refer to *7-10 Gain Switching 3 Function* on page 7-38 for the Gain 1/Gain 2 switching.

Explanation of Set Values

| Set value | Description |
|-----------|-----------------------------------|
| 0 | Gain 1 (PI/P switching enabled) |
| 1 | Gain 1/gain 2 switching available |

| | | | | | | | | |
|-----------------|------------------------------------|------|--------|-----------------|---------|----------------|--|--|
| 3115 hex | Switching Mode in Position Control | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp | |
| Setting range | 0 to 10 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

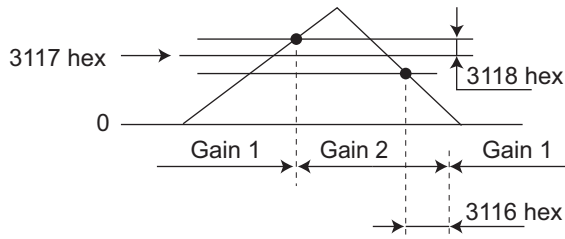
- Select the conditions for switching between gain 1 and gain 2 when the Gain Switching Input Operating Mode Selection (3114 hex) is set to 1.

Explanation of Settings

| 3115 hex set value | Description | | | |
|--------------------|--|--|---|--|
| | Gain switching conditions | Gain Switching Delay Time in Position Control (3116 hex) ^{*1} | Gain Switching Level in Position Control (3117 hex) | Gain Switching Hysteresis in Position Control (3118 hex) ^{*2} |
| 0 | Always Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 1 | Always Gain 2 (3105 to 3109 hex). | Disabled | Disabled | Disabled |
| 2 | Gain switching command input via EtherCAT communications ^{*3} | Disabled | Disabled | Disabled |
| 3 | Command torque value (Refer to Figure A.) | Enabled | Enabled ^{*4} (%) | Enabled ^{*4} (%) |
| 4 | Always Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 5 | Command speed (Refer to Figure B.) | Enabled | Enabled (r/min) | Enabled (r/min) |
| 6 | Pulse position error (Refer to Figure C.) | Enabled | Enabled ^{*5} (pulse) | Enabled ^{*5} (pulse) |
| 7 | Whether there is a position command (Refer to Figure D.) | Enabled | Disabled | Disabled |
| 9 | Actual motor speed (Refer to Figure B.) | Enabled | Enabled (r/min) | Enabled (r/min) |
| 10 | Combination of whether there is a position command and actual motor speed (Refer to Figure E.) | Enabled | Enabled ^{*6} (r/min) | Enabled ^{*6} (r/min) |

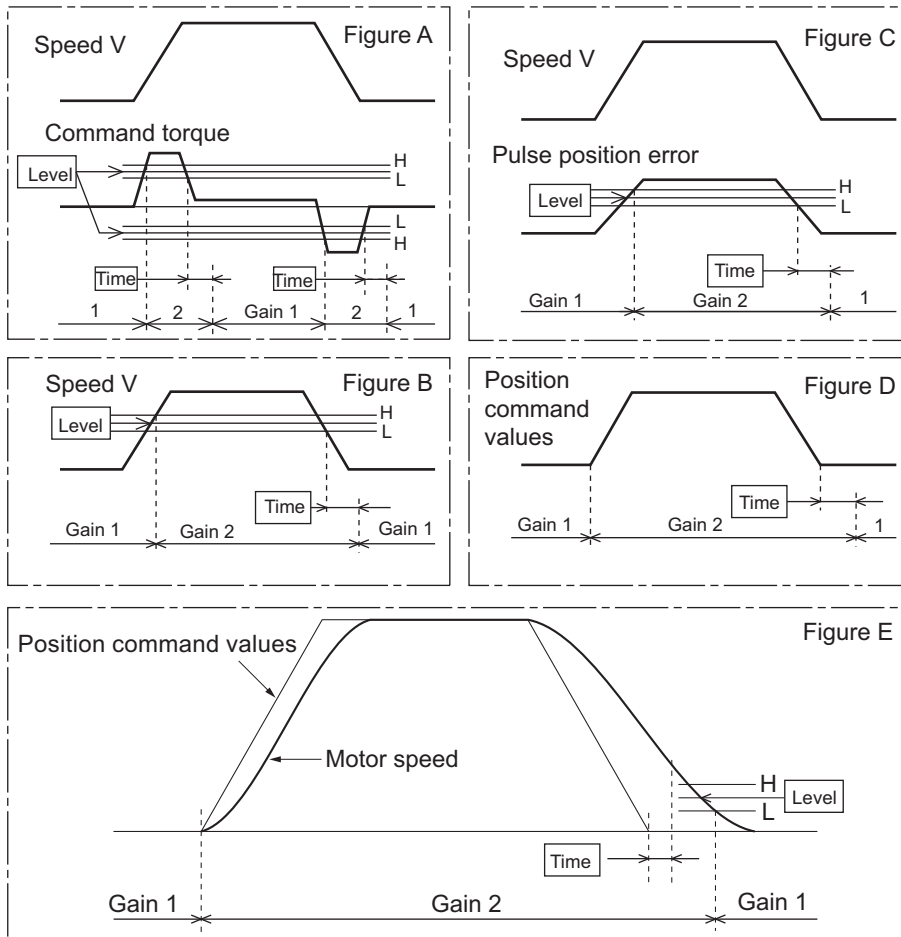
^{*1} The Gain Switching Delay Time in Position Control (3116 hex) becomes effective when the gain is switched from 2 to 1.

*2 The Gain Switching Hysteresis in Position Control (3118 hex) is defined in the drawing below.



If object 3117 hex is less than object 3118 hex, object 3117 hex will automatically be set to the same value as object 3118 hex.

- *3 When the Gain Switching command of EtherCAT communications is 0, the gain switches to gain 1. When the command is 1, the gain switches to gain 2.
- *4 Set the percentage of the rated torque.
Example: To set 10% of the rated torque, set the set value would be 10.
- *5 The position error is set according to the encoder resolution (i.e., pulses) for position control and according to the external encoder resolution (i.e., pulses) for fully-closed control.
- *6 When the set value is 10, meanings of the Gain Switching Delay Time in Position Control, the Gain Switching Level in Position Control, and the Gain Switching Hysteresis in Position Control differ from the normal case. (Refer to Figure E.)



| | | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3116 hex | Gain Switching Delay Time in Position Control | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 10000 | Unit | 0.1 ms | Default setting | 50 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

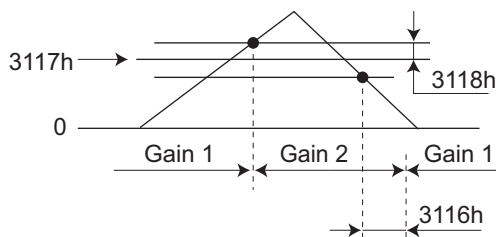
- Set the delay time when returning from gain 2 to gain 1 if the Switching Mode in Position Control (3115 hex) is set to 3 or 5 to 10.

| | | | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3117 hex | Gain Switching Level in Position Control | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 20000 | Unit | – | Default setting | 50 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- This object is enabled when the Switching Mode in Position Control (3115 hex) is 3, 5, 6, 9 or 10. It sets the judgment level for switching between gain 1 and gain 2.
- The unit depends on the Switching Mode in Position Control (3115 hex).

| | | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3118 hex | Gain Switching Hysteresis in Position Control | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 20000 | Unit | – | Default setting | 33 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set the hysteresis width above and below the judgment level set in the Gain Switching Level in Position Control (3117 hex).
- The unit depends on the setting of the Switching Mode in Position Control (3115 hex).
- The following shows the definitions for the Gain Switching Delay Time in Position Control (3116 hex), Gain Switching Level in Position Control (3117 hex), and Gain Switching Hysteresis in Position Control (3118 hex).

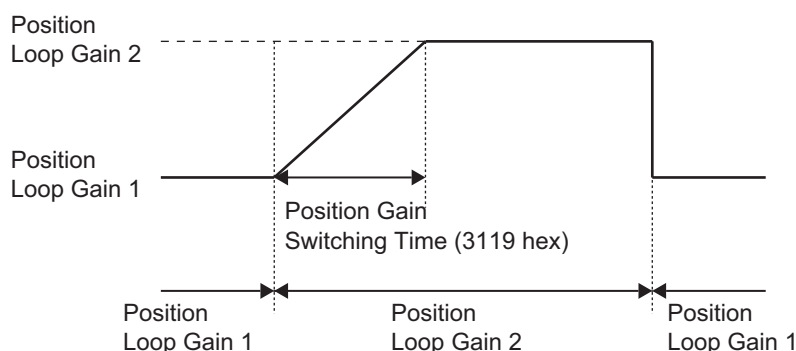


- The settings for the Gain Switching Level in Position Control (3117 hex) and the Gain Switching Hysteresis in Position Control (3118 hex) are enabled as absolute values (positive/negative).

| | | | | | | | |
|-----------------|------------------------------|------|--------|-----------------|---------|---|---|
| 3119 hex | Position Gain Switching Time | | | | | csp pp hm | |
| Setting range | 0 to 10000 | Unit | 0.1 ms | Default setting | 33 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Torque fluctuations or vibration will occur if the position loop gain is changed too quickly during position control or fully-closed control. To suppress these, set a Position Gain Switching Time (3119 hex).
- By setting the Position Gain Switching Time (3119 hex), the gain will be switched gradually when there is a large change in the position loop gain.
- If there is a large difference between Position Loop Gain 1 (3100 hex) and Position Loop Gain 2 (3105 hex), set the Position Gain Switching Time (3119 hex).
- When the position loop gain 1 increases, the gain changes in the set time.

Position Loop Gain 1 < Position Loop Gain 2



Precautions for Correct Use

When the position loop gain is switched to a smaller value (e.g., when switching from gain 2 to gain 1 in the above figure), Position Gain Switching Time (3119 hex) is ignored and the gain is switched immediately.

| | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|---------|----------------|------------|
| 3120 hex | Switching Mode in Speed Control | | | | | | CSV |
| Setting range | 0 to 5 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

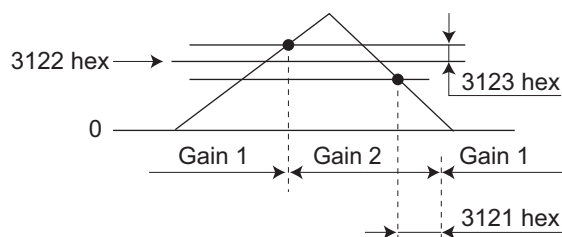
- Select the conditions for switching between gain 1 and gain 2 when the Gain Switching Input Operating Mode Selection (3114 hex) is set to 1.
- The gain is always gain 1 regardless of the gain input if the Switching Mode in Speed Control (3120 hex) is 2 and the Torque Limit Selection (3521 hex) is 3 or 6.

Explanation of Settings

| 3120 hex set value | Description | | | |
|--------------------|--|---|--|---|
| | Gain switching conditions | Gain Switching Delay Time in Speed Control (3121 hex) ^{*1} | Gain Switching Level in Speed Control (3122 hex) | Gain Switching Hysteresis in Speed Control (3123 hex) ^{*2} |
| 0 | Always the Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 1 | Always the Gain 2 (3105 to 3109 hex). | Disabled | Disabled | Disabled |
| 2 | Gain switching command input via EtherCAT communications ^{*3} | Disabled | Disabled | Disabled |
| 3 | Torque command variation (Refer to Figure A.) | Enabled | Enabled ^{*3} (0.05%) | Enabled ^{*3} (0.05%) |
| 4 | Speed command variation (Refer to Figure B.) | Enabled | Enabled ^{*4} (10 r/min/s) | Enabled ^{*4} (10 r/min/s) |
| 5 | Speed command (Refer to Figure C.) | Enabled | Enabled (r/min) | Enabled (r/min) |

*1 The Gain Switching Delay Time in Speed Control (3121 hex) becomes effective when the gain is switched from 2 to 1.

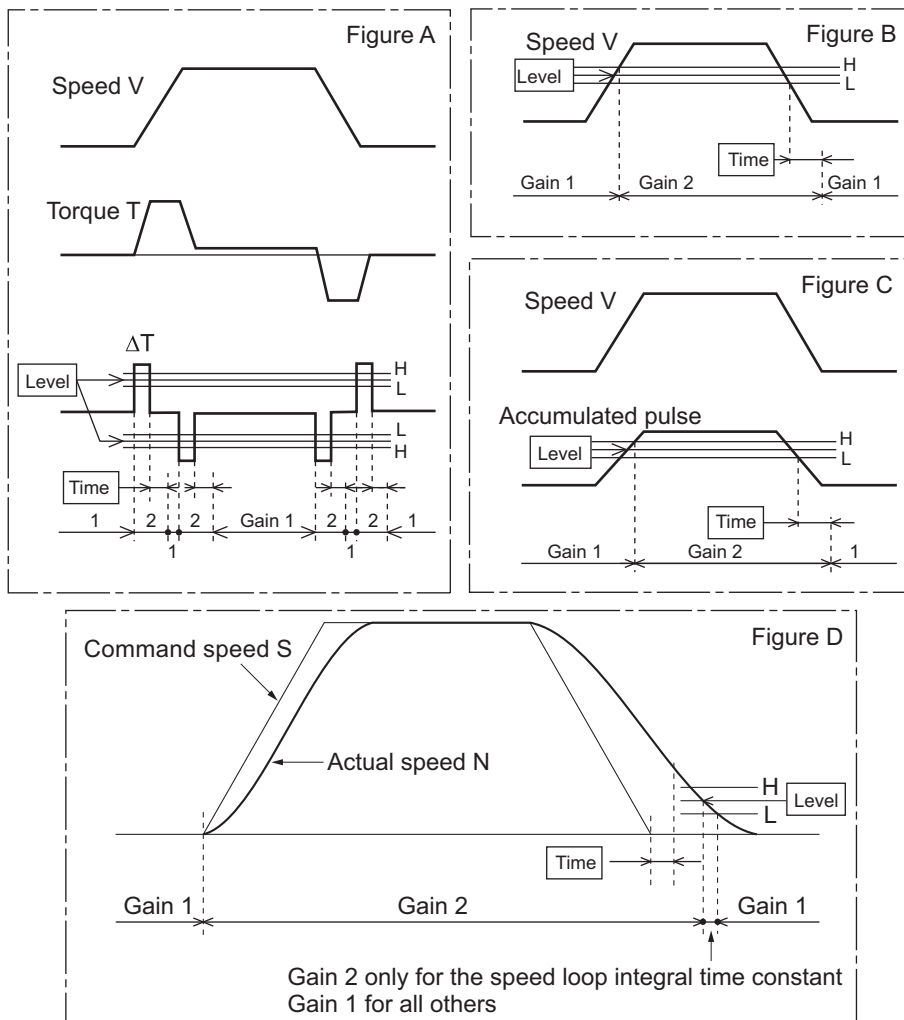
*2 The Gain Switching Hysteresis in Speed Control (3123 hex) is defined in the drawing below.



*3 When the Gain switching command of EtherCAT communications (G-SEL) is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.

*4 The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.

*5 When the set value is 10, meanings of the Gain Switching Delay Time in Speed Control (3121 hex), the Gain Switching Level in Speed Control (3122 hex), and the Gain Switching Hysteresis in Speed Control (3123 hex) differ from the normal case. (Refer to Figure D.)



| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------|
| 3121 hex | Gain Switching Delay Time in Speed Control | | | | | | CSV |
| Setting range | 0 to 10000 | Unit | 0.1 ms | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

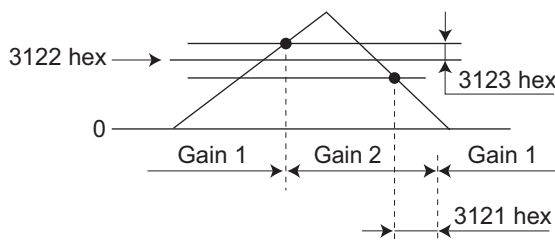
- Set the delay time when returning from gain 2 to gain 1 if the Switching Mode in Speed Control (3120 hex) is set to 3 to 5.

| | | | | | | | |
|-----------------|---------------------------------------|------|--------|-----------------|---------|----------------|------------|
| 3122 hex | Gain Switching Level in Speed Control | | | | | | CSV |
| Setting range | 0 to 20000 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- In Speed Control Mode, this is enabled when the Switching Mode in Speed Control (3120 hex) 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 (3120 hex).

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------|
| 3123 hex | Gain Switching Hysteresis in Speed Control | | | | | | CSV |
| Setting range | 0 to 20000 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the hysteresis width above and below the judgment level set in the Gain Switching Level in Speed Control (3122 hex).
- The unit depends on the setting of the Switching Mode in Speed Control (3120 hex).
- The following shows the definitions for the Gain Switching Delay Time in Speed Control (3121 hex), Gain Switching Level in Speed Control (3122 hex), and Gain Switching Hysteresis in Speed Control (3123 hex).



- The settings for the Gain Switching Level in Speed Control (3122 hex) and the Gain Switching Hysteresis in Speed Control (3123 hex) are enabled absolute values (positive/negative).

| | | | | | | | |
|-----------------|----------------------------------|------|--------|-----------------|---------|----------------|------------|
| 3124 hex | Switching Mode in Torque Control | | | | | | cst |
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

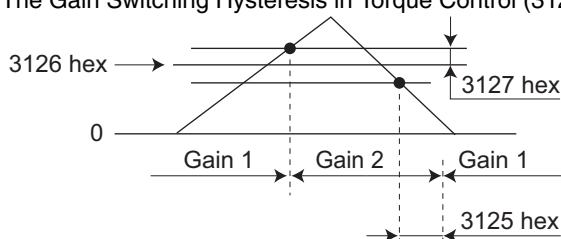
- Select the switching condition between gain 1 and gain 2 when the Gain Switching Input Operating Mode Selection (3114 hex) is set to 1.
- The gain is always gain 1 regardless of the gain input if the Switching Mode in Torque Control (3124 hex) is 2 and the Torque Limit Selection (3521 hex) is 3 or 6.

Explanation of Settings

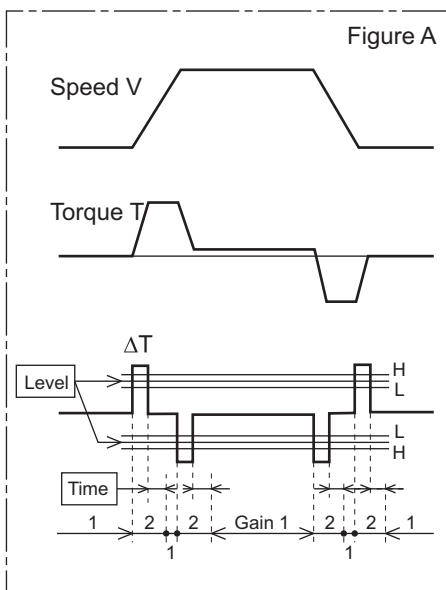
| 3124 hex set value | Description | | | |
|--------------------|--|--|---|--|
| | Gain switching conditions | Gain Switching Delay Time in Torque Control (3125 hex) ^{*1} | Gain Switching Level in Torque Control (3126 hex) | Gain Switching Hysteresis in Torque Control (3127 hex) ^{*2} |
| 0 | Always Gain 1 (3100 to 3104 hex). | Disabled | Disabled | Disabled |
| 1 | Always Gain 2 (3105 to 3109 hex). | Disabled | Disabled | Disabled |
| 2 | Gain switching command input via EtherCAT communications ^{*3} | Disabled | Disabled | Disabled |
| 3 | Torque command variation (Refer to Figure A.) | Enabled | Enabled ^{*4} (0.05%) | Enabled ^{*4} (0.05%) |

^{*1} The Gain Switching Delay Time in Toque Control (3125 hex) becomes effective when the gain is switched from 2 to 1.

^{*2} The Gain Switching Hysteresis in Torque Control (3127 hex) is defined in the drawing below.



- *3 When the Gain switching command of EtherCAT communications is 0, the gain switches to Gain 1. When the command is 1, the gain switches to Gain 2.
- *4 The variation means the change amount in a millisecond (ms).
E.g. The set value is 200 when the condition is a 10% change in torque in 1 millisecond.



| | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|------------|
| 3125 hex | Gain Switching Delay Time in Torque Control | | | | | | cst |
| Setting range | 0 to 10000 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

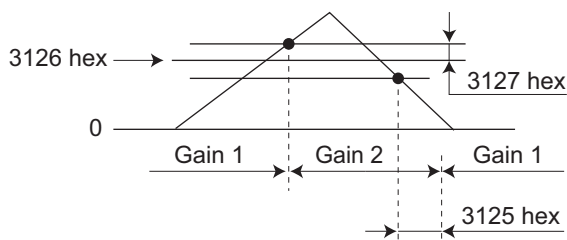
- Set the delay time when returning from gain 2 to gain 1 if the Switching Mode in Torque Control (3124 hex) is set to 3.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------|
| 3126 hex | Gain Switching Level in Torque Control | | | | | | cst |
| Setting range | 0 to 20000 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- This is enabled when the Switching Mode in Torque Control (3124 hex) 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 (3124 hex).

| | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|---|
| 3127 hex | Gain Switching Hysteresis in Torque Control | | | | | | cst |
| Setting range | 0 to 20000 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the hysteresis width above and below the judgment level set in the Gain Switching Level in Torque Control (3126 hex).
- The unit depends on the setting of Switching Mode in Torque Control (3124 hex).
- The following shows the definitions for the Gain Switching Delay Time in Torque Control (3125 hex), Gain Switching Level in Torque Control (3126 hex), and Gain Switching Hysteresis in Torque Control (3127 hex).



- The settings for the Gain Switching Level in Torque Control (3126 hex) and the Gain Switching Hysteresis in Torque Control (3127 hex) are enabled as absolute values (positive/negative).

9-3 Vibration Suppression Settings

| | | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|---|--|
| 3200 hex | Adaptive Filter Selection | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> csv <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 4 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the operation of the adaptive filter.
- Refer to *11-6 Adaptive Filter* on page 11-19.

Explanation of Set Values

| Set value | Description |
|-----------|---|
| 0 | Adaptive filter disabled |
| 1 | One adaptive filter is enabled. The objects related to notch filter 3 are automatically updated. |
| 2 | Two adaptive filters are enabled. The objects related to notch filters 3 and 4 are updated. |
| 3 | For use by manufacturer. Do not use this setting. |
| 4 | Adaptive result is cleared. Objects related to notch filters 3 and 4 are disabled and the adaptive result is cleared. |

| | | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|------------------------------|--|
| 3201 hex | Notch 1 Frequency Setting | | | | | | <input type="checkbox"/> All | |
| Setting range | 50 to 5000 | Unit | Hz | Default setting | 5000 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the frequency of resonance suppression notch filter 1.
- The notch filter function is disabled if this object is set to 5000.
- Refer to *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------|--|
| 3202 hex | Notch 1 Width Setting | | | | | | <input type="checkbox"/> All | |
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the width of resonance suppression notch filter 1 to one of 20 levels.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- Refer to *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------|--|
| 3203 hex | Notch 1 Depth Setting | | | | | | <input type="checkbox"/> All | |
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch depth of resonance suppression notch filter 1.
- Increasing the setting value shortens the notch depth and the phase lag.
- Refer to *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3204 hex | Notch 2 Frequency Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 50 to 5000 | Unit | Hz | Default setting | 5000 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch frequency of resonance suppression notch filter 2.
- The notch filter function is disabled if this object is set to 5000.
- Refer to *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3205 hex | Notch 2 Width Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select the notch width of resonance suppression notch filter 2.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- Refer to *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3206 hex | Notch 2 Depth Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch depth of resonance suppression notch filter 2.
- Increasing the setting value shortens the notch depth and the phase lag.
- Refer to *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3207 hex | Notch 3 Frequency Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 50 to 5000 | Unit | Hz | Default setting | 5000 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch frequency of resonance suppression notch filter 3.
- The notch filter function is disabled if this object is set to 5000.
- While the adaptive filter is enabled, the resonance frequency 1 that is assumed by the adaptive filter is automatically set. If no resonance point is found, the value 5000 is set.
- Refer to *11-6 Adaptive Filter* on page 11-19 and *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3208 hex | Notch 3 Width Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select the notch width of resonance suppression notch filter 3.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- While the adaptive filter is enabled, this object is set automatically.
- Refer to *11-6 Adaptive Filter* on page 11-19 and *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3209 hex | Notch 3 Depth Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch depth of resonance suppression notch filter 3.
- Increasing the setting value shortens the notch depth and the phase lag.
- While the adaptive filter is enabled, this object is set automatically.
- Refer to *11-6 Adaptive Filter* on page 11-19 and *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3210 hex | Notch 4 Frequency Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 50 to 5000 | Unit | Hz | Default setting | 5000 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch frequency of resonance suppression notch filter 4.
- The notch filter function is disabled if this object is set to 5000.
- While two adaptive filters are enabled, the resonance frequency 2 that is assumed by the adaptive filter is automatically set. If no resonance point is found, the value 5000 is set.
- Refer to *11-6 Adaptive Filter* on page 11-19 and *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3211 hex | Notch 4 Width Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 20 | Unit | – | Default setting | 2 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select the notch width of resonance suppression notch filter 4.
- Increasing the setting value widens the notch width. Normally, use the default set value.
- This object is automatically set when two adaptive filters are enabled.
- Refer to *11-6 Adaptive Filter* on page 11-19 and *11-7 Notch Filters* on page 11-22.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3212 hex | Notch 4 Depth Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 99 | Unit | – | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the notch depth of resonance suppression notch filter 4.
- Increasing the setting value shortens the notch depth and the phase lag.
- When two adaptive filters are enabled, this object is set automatically.
- Refer to *11-6 Adaptive Filter* on page 11-19 and *11-7 Notch Filters* on page 11-22.

| | | | | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------|----------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
| 3213 hex | Damping Filter Selection | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> csv | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Data attribute | B | | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | | |

- Set the method to switch among four damping control filters.

Explanation of Set Values

| Set value | Explanation |
|-----------|--|
| 0 | Up two damping filters, damping filters 1 and 2, can be used at the same time. |
| 1 | Reserved for manufacturer use *1 |
| 2 | Reserved for manufacturer use *1 |
| 3 | The damping filters are switched with position command direction. <ul style="list-style-type: none"> • Forward direction: Damping filters 1 / 3 enabled • Reverse direction: Damping filters 2 / 4 enabled |

*1 The set value 1 and 2 are for manufacturer's use only. Users are not allowed to set 1 and 2 for this object.

| | | | | | | | | | |
|-----------------|---------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3214 hex | Damping Frequency 1 | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 2000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set damping frequency 1 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- The range of setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to *11-5 Damping Control* on page 11-16.

| | | | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3215 hex | Damping Filter 1 Setting | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 1000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- First set Damping Frequency 1 (3214 hex). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- The upper limit of the set value is restricted to the smaller value of the corresponding damping frequency or (2000 – damping frequency).
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|---------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3216 hex | Damping Frequency 2 | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 2000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set damping frequency 2 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- Setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3217 hex | Damping Filter 2 Setting | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 1000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- First set Damping Frequency 2 (3216 hex). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- The upper limit of the set value is restricted to the smaller value of the corresponding damping frequency or (2000 – damping frequency).
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|---------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3218 hex | Damping Frequency 3 | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 2000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set damping frequency 3 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- Setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3219 hex | Damping Filter 3 Setting | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 1000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- First set Damping Frequency 3 (3218 hex). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- The upper limit of the set value is restricted to the smaller value of the corresponding damping frequency or (2000 – damping frequency).
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|---------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3220 hex | Damping Frequency 4 | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 2000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

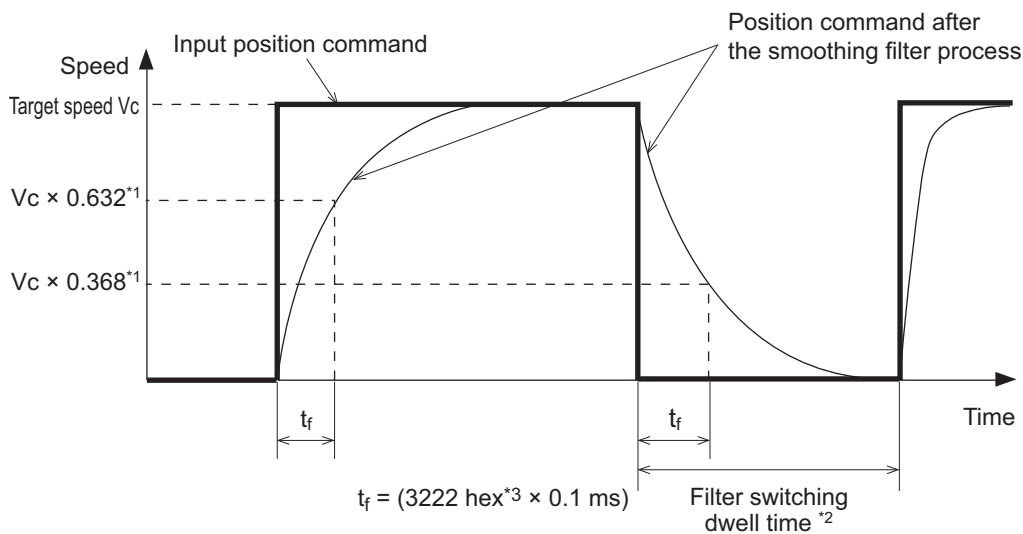
- Set damping frequency 4 to suppress vibration at the end of the load in damping control.
- Measure the frequency of vibration at the end of the load and make the setting in units of 0.1 Hz.
- Setting frequency is 1.0 to 200.0 Hz. The function is disabled if the setting is 0 to 0.9 Hz.
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3221 hex | Damping Filter 4 Setting | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 1000 | Unit | 0.1 Hz | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- First set Damping Frequency 4 (3220 hex). Then reduce the setting if torque saturation occurs or increase the setting to increase operation speed. Normally, use a setting of 0.
- The upper limit of the set value is restricted to the smaller value of the corresponding damping frequency or (2000 – damping frequency).
- Refer to *11-5 Damping Control* on page 11-16 for more information on settings.

| | | | | | | | | | |
|-----------------|---------------------------------------|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3222 hex | Position Command Filter Time Constant | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 10000 | Unit | 0.1 ms | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- The Position Command Filter Time Constant is the first-order lag filter that is inserted after the electronic gear ratio for the command input.
- This constant is used to reduce the stepping movement of the motor and achieve a smooth operation when the electronic gear ratio is set in 10 times or greater.
- It sets the first-order lag filter time constant, as shown below, for the square-wave command of target speed V_c .



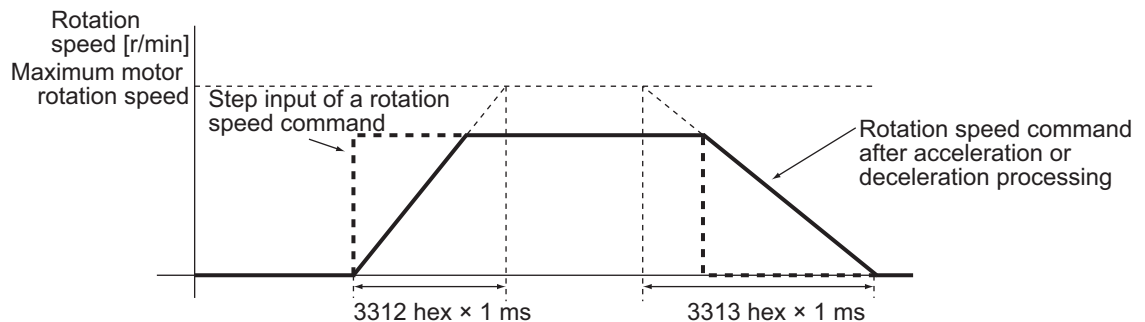
- *1 The error in the position command filter time constant is 0.4 max. (absolute error) for less than 100 ms and 0.2% max. (relative error) for 20 ms or greater for the set value times 0.1 ms.
- *2 The Position Command Filter Time Constant (3222 hex) is switched when the position command value per 0.250 ms changes from 0 to a value other than 0 while the positioning completed output is ON.
- *3 There is a delay from when the Position Command Filter Time Constant (3222 hex) is changed until the new value is applied in internal calculations. If the filter switch wait time expires during this delay, the change may be placed on hold.

9-4 Analog Control Objects

| 3312 hex | Soft Start Acceleration Time | | | | | | | CSV |
|---------------|------------------------------|------|------------------------|-----------------|---------|----------------|---|-----|
| Setting range | 0 to 10000 | Unit | ms/maximum motor speed | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

| 3313 hex | Soft Start Deceleration Time | | | | | | | CSV |
|---------------|------------------------------|------|------------------------|-----------------|---------|----------------|---|-----|
| Setting range | 0 to 10000 | Unit | ms/maximum motor speed | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Control the speed by setting acceleration/deceleration to the speed command inside the Servo Drive.
- A soft start can be set when inputting speed commands of stepping movement or when using internal speed setting.
- Do not set acceleration/deceleration time settings when using the Servo Drive in combination with an external position loop. (Set both 3312 and 3313 hex to 0.)
- Refer to 7-8 *Soft Start* on page 7-26.

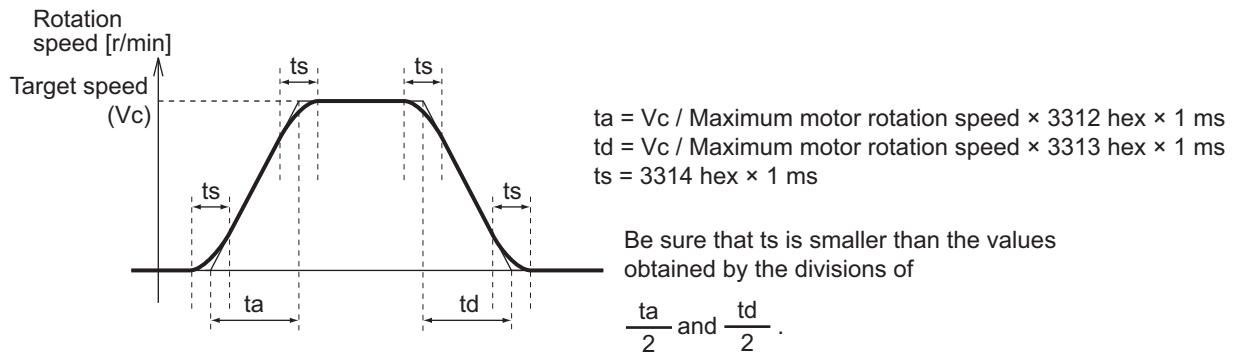


Precautions for Correct Use

- Do not set the Soft Start Acceleration Time and the Soft Start Deceleration Time when the position loop structure with a Host Controller is used.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------|
| 3314 hex | S-curve Acceleration/Deceleration Time Setting | | | | | | CSV |
| Setting range | 0 to 1000 | Unit | ms | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the pseudo-S-curve acceleration/deceleration value to add to the speed command to enable smooth operation. This is useful for applications where impact may occur due to a large change in acceleration or deceleration when starting or stopping with linear acceleration or deceleration.
- Refer to *7-8 Soft Start* on page 7-26.



| | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------|
| 3317 hex | Speed Limit Selection | | | | | | cst |
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select the speed limit.
- The speed limit is used as a protection during torque control.
- Refer to *6-3 Cyclic Synchronous Torque Mode* on page 6-8.

Explanation of Set Values

| Set value | Description |
|-----------|--|
| 0 | Select the value set on the Speed Limit Value Setting (3321 hex). |
| 1 | Select either the speed limit value (VLIM) via EtherCAT communications or the value set by the Speed Limit Value Setting (3321 hex), whichever is smaller. |

| | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|------------|
| 3321 hex | Speed Limit Value Setting | | | | | | cst |
| Setting range | 0 to 20000 | Unit | r/min | Default setting | 20000 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the speed limit value for torque control.
- It controls that the speed during torque control does not exceed the set value.
- Refer to *6-3 Cyclic Synchronous Torque Mode* on page 6-8.

| | | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|-------------------------------------|------------------------------------|------------------------------------|
| 3323 hex | External Feedback Pulse Type Selection | | | | | <input type="checkbox"/> csp (full) | <input type="checkbox"/> pp (full) | <input type="checkbox"/> hm (full) |
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Data attribute | R | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

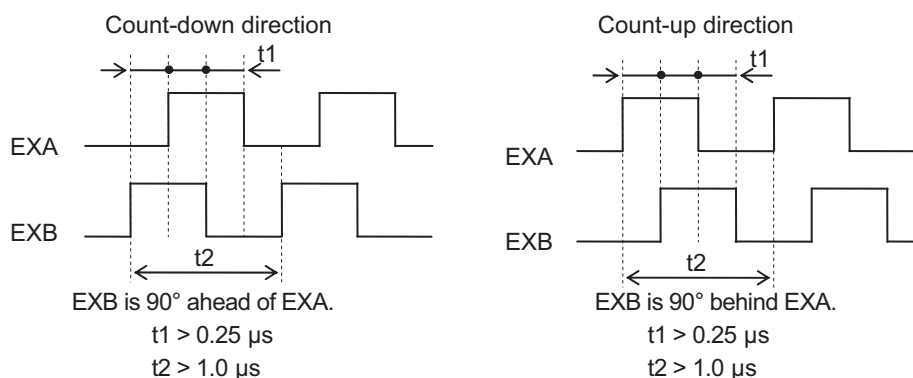
- Select the external encoder type. Be sure that the setting conforms to the external encoder which is actually used.
- Refer to 6-6 Fully-closed Control on page 6-16.

Explanation of Set Values

| Set value | Description | Maximum input frequency ^{*1} |
|-----------|--|---------------------------------------|
| 0 | 90° phase difference output type ^{*2*3} | 0 to 4 Mpps (Multiplication × 4) |
| 1 | Serial communications type (Incremental encoder specifications) ^{*3} | 0 to 400 Mpps |
| 2 | Serial communications type (Absolute encoder specifications) ^{*3} | 0 to 400 Mpps |

*1 The maximum input frequency is the feedback speed [pps] of the external encoder that can be processed by the Drive. Check the instruction manual of the external encoder for the maximum output frequency of the external encoder.

*2 These are the directions that the Drive counts a 90° phase difference output.



*3 For the external encoder connection direction, set the direction so that count-up occurs when the motor shaft is rotating in the CCW direction, and count-down occurs when the motor shaft is rotating in the CW direction. If the connection direction cannot be selected due to installation conditions, the count direction can be reversed using External Feedback Pulse Direction Switching (3326 hex).



Precautions for Correct Use

- If 3000 hex = 1, the encoder count direction will be opposite to the count direction used for monitoring the total external encoder feedback pulses. If 3000 hex = 0, the count direction matches the count direction for monitoring.
- Even when the speed command is within the Drive's speed command range, an acceleration error will occur if the speed command exceeds the maximum speed of motor shaft rotation.

| | | | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-------------------------------------|------------------------------------|------------------------------------|
| 3324 hex | External Feedback Pulse Dividing Numerator | | | | | | <input type="checkbox"/> csp (full) | <input type="checkbox"/> pp (full) | <input type="checkbox"/> hm (full) |
| Setting range | 0 to 1048576 | Unit | – | Default setting | 0 | Data attribute | R | | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | | | |

| | | | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-------------------------------------|------------------------------------|------------------------------------|
| 3325 hex | External Feedback Pulse Dividing Denominator | | | | | | <input type="checkbox"/> csp (full) | <input type="checkbox"/> pp (full) | <input type="checkbox"/> hm (full) |
| Setting range | 1 to 1048576 | Unit | – | Default setting | 10000 | Data attribute | R | | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | | | |

- Check the number of encoder pulses per motor rotation and number of external encoder pulses per motor rotation, and set External Feedback Pulse Dividing Numerator (3324 hex) and External Feedback Pulse Dividing Denominator (3325 hex).

$$\frac{3324 \text{ hex}}{3325 \text{ hex}} = \frac{\text{Encoder resolution per motor rotation [pulses]}}{\text{External encoder resolution per motor rotation [pulses]}}$$

- Set object 3324 hex to 0 to have the encoder resolution automatically set as the numerator.
- Refer to *6-6 Fully-closed Control* on page 6-16.



Precautions for Correct Use

- If this divider setting is wrong, there will be error between the position calculated from encoder pulses and the position calculated from external encoder pulses. If the movement distance is long, this error accumulates and causes a Excessive Hybrid Deviation Error (Error No. 25.0).
- The recommended divider setting is $1/40 \leq \text{External Feedback Pulse Ratio} \leq 160$. If the ratio is set too small, control to the unit of 1 external feedback pulse may be disabled. On the other hand, if the external feedback pulse ratio is increased, operating noise may increase.



Additional Information

In the example below, ball screw pitch is 10 mm, encoder is 0.1 μm/pulse, and encoder resolution is 20 bits (or 1,048,576 pulses)

$$\frac{3324 \text{ hex}}{3325 \text{ hex}} = \frac{\text{Encoder resolution per motor rotation [pulses]}}{\text{External encoder resolution per motor rotation [pulses]}} = \frac{1,048,576}{100,000}$$

| | | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|-------------------------------------|------------------------------------|------------------------------------|
| 3326 hex | External Feedback Pulse Direction Switching | | | | | | <input type="checkbox"/> csp (full) | <input type="checkbox"/> pp (full) | <input type="checkbox"/> hm (full) |
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Data attribute | R | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- The direction of external encoder feedback count can be reversed.
- Refer to *6-6 Fully-closed Control* on page 6-16.

Explanation of Set Values

| Set value | Description |
|-----------|--|
| 0 | External encoder feedback pulse count direction not reversed |
| 1 | External encoder feedback pulse count direction reversed |

| | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|-------------------|------------------|------------------|
| 3327 hex | External Feedback Pulse Phase-Z Setting | | | | | csp (full) | pp (full) | hm (full) |
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Data attribute | R | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set to enable or disable phase-Z disconnection detection when an external encoder with a 90° phase difference output is used.

Explanation of Set Values

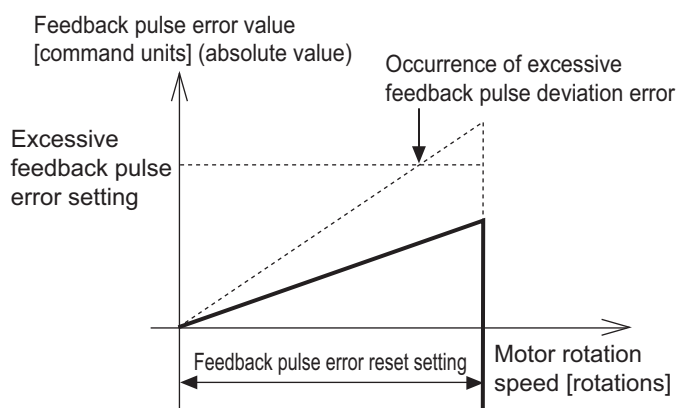
| Set value | Explanation |
|-----------|--|
| 0 | Phase-Z disconnection detection enabled |
| 1 | Phase-Z disconnection detection disabled |

| | | | | | | | | |
|-----------------|---|------|--------------|-----------------|---------|-------------------|------------------|------------------|
| 3328 hex | Hybrid Following Error Counter Overflow Level | | | | | csp (full) | pp (full) | hm (full) |
| Setting range | 1 to 134217728 | Unit | Command unit | Default setting | 16000 | Data attribute | C | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | | |

- Set the allowable difference (feedback pulse error) between the motor (encoder) position and load (external encoder) position in command units.
- Refer to 6-6 *Fully-closed Control* on page 6-16.

| | | | | | | | | |
|-----------------|--------------------------------------|------|----------|-----------------|---------|-------------------|------------------|------------------|
| 3329 hex | Hybrid Following Error Counter Reset | | | | | csp (full) | pp (full) | hm (full) |
| Setting range | 0 to 100 | Unit | Rotation | Default setting | 0 | Data attribute | C | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- The feedback pulse error is reset every time the motor rotates for the amount set by the Hybrid Following Error Counter Reset (3329 hex). This can be used for applications where feedback pulse error accumulates due to slippage.
- Refer to 6-6 *Fully-closed Control* on page 6-16.



- Ensure that an appropriate value is set to the Hybrid Following Error Counter Reset (3329 hex), before you use the feedback pulse error counter reset. When the set value is extremely small, the protective function may not work to prevent any erroneous operation due to improper connection of the external encoder.



Precautions for Correct Use

- Provide sufficient safety measures. This includes mounting limit sensors.

9-5 Interface Monitor Settings

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3400 hex | Input Signal Selection 1 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0094 9494 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 1 (IN1).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3401 hex | Input Signal Selection 2 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0081 8181 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 2 (IN2).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3402 hex | Input Signal Selection 3 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0082 8282 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 3 (IN3).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3403 hex | Input Signal Selection 4 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0022 2222 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 4 (IN4).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3404 hex | Input Signal Selection 5 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 002B 2B2B hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 5 (IN5).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3405 hex | Input Signal Selection 6 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0021 2121 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 6 (IN6).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3406 hex | Input Signal Selection 7 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0020 2020 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 7 (IN7).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|--------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3407 hex | Input Signal Selection 8 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 002E 2E2E hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function and logic for general-purpose input 8 (IN8).
- Refer to the Details of Control Inputs in *Control Input Details* on page 3-21, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3410 hex | Output Signal Selection 1 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0003 0303 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function assignment for general-purpose output 1 (OUTM1).
- Refer to the Details of Control Outputs in *Control Output Details* on page 3-24, as well as *7-1 Sequence I/O Signals* on page 7-2.

| | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------------|----------------|------------------------------------|
| 3411 hex | Output Signal Selection 2 | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 00FF FFFF hex | Unit | – | Default setting | 0002 0202 hex | Data attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the function assignment for general-purpose output 2 (OUTM2).
- Refer to the Details of Control Outputs in *Control Output Details* on page 3-24, as well as *7-1 Sequence I/O Signals* on page 7-2.

| 3416 hex | Analog Monitor 1 Selection | | | | | | All |
|---------------|----------------------------|------|--------|-----------------|---------|----------------|-----|
| Setting range | 0 to 21 | Unit | – | Default setting | 0 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Analog signals of various monitor values can be output from the analog monitor connector on the front panel.
- The monitor type to output and the scaling (or output gain) can be selected. These can be set for each object.
- Refer to *11-1 Analog Monitor* on page 11-2.

Explanation of Set Values

| Set value | Explanation | | |
|-----------|---------------------------------------|---------------------------------|--------------------------------------|
| | Monitor type | Unit | Output gain when object 3417 hex = 0 |
| 0 | Feedback Motor Speed | r/min | 500 |
| 1 | Internal Command Motor Speed | r/min | 500 |
| 2 | Filtered Internal Command Motor Speed | r/min | 500 |
| 3 | Motor Control Effort | r/min | 500 |
| 4 | Torque demand | % (rated torque ratio) | 33 |
| 5 | Position Error | pulses (command units) | 3000 |
| 6 | Pulse Position Error | pulses (encoder units) | 3000 |
| 7 | Fully-closed error | pulses (external encoder units) | 3000 |
| 8 | Hybrid error | pulses (command units) | 3000 |
| 9 | P-N voltage | V | 80 |
| 10 | Regeneration load ratio | % | 33 |
| 11 | Motor load ratio | % | 33 |
| 12 | Forward External Torque Limit | % (rated torque ratio) | 33 |
| 13 | Reverse External Torque Limit | % (rated torque ratio) | 33 |
| 14 | Speed limit value | r/min | 500 |
| 15 | Inertia ratio | % | 500 |
| 16 to 18 | Reserved | – | – |
| 19 | Encoder temperature | °C | 10 |
| 20 | Servo Drive temperature | °C | 10 |
| 21 | Encoder 1-rotation data | pulses (encoder units) | 110000 |

| 3417 hex | Analog Monitor 1 Scale Setting | | | | | | All |
|---------------|--------------------------------|------|-------------------------|-----------------|---------|----------------|-----|
| Setting range | 0 to 214748364 | Unit | 3416 hex monitor unit/V | Default setting | 0 | Data attribute | A |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | |

- Set the output gain for analog monitor 1.
- Refer to *11-1 Analog Monitor* on page 11-2.

| | | | | | | | | |
|-----------------|----------------------------|------|--------|-----------------|---------|----------------|---|------------------------------------|
| 3418 hex | Analog Monitor 2 Selection | | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 21 | Unit | – | Default setting | 4 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- In the same way as for Analog Monitor 1, analog signals of various monitors can be output from the analog monitor connector on the front panel.
- Refer to the Analog Monitor 1 Selection (3416 hex) for the method to set this object.

| | | | | | | | | |
|-----------------|--------------------------------|------|----------------------------|-----------------|---------|----------------|---|------------------------------------|
| 3419 hex | Analog Monitor 2 Scale Setting | | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 214748364 | Unit | Monitor unit of 3418 hex/V | Default setting | 0 | Data attribute | A | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | | |

- Set the output gain for analog monitor 2.
- Refer to the Analog Monitor 1 Scale Setting (3417 hex) for the method to set this object.

| | | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|---------|----------------|---|------------------------------------|
| 3421 hex | Analog Monitor Output Selection | | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select the analog monitor output voltage direction.
- These are the output voltage range and the output direction when the Analog Monitor 1 Selection or Analog Monitor 2 Selection is set to the Feedback Motor Speed, and the Analog Monitor 1 Scale Setting or the Analog Monitor 2 Scale Setting is set to 0 (i.e., 1V = 500 r/min).

| Set value | Output range | Data output |
|-----------|--------------------------------|-------------|
| 0 | -10 to 10 V | |
| 1 | 0 to 10 V | |
| 2 | 0 to 10 V (5 V as a center) | |

| | | | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------------------------|-----------------------------|-----------------------------|
| 3432 hex | Positioning Completion Condition Selection | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Data attribute | A | | |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible. | | | |

- Select the condition under which the positioning completion signal (INP) is output.

Explanation of Set Value

| Set value | Description |
|-----------|--|
| 0 | Turn ON when the position error is equal to or lower than 6067 hex (Position window). |
| 1 to 3 | Turn ON when there is no position command and the position error is equal to or lower than 6067 hex (Position window). |

| | | | | | | | | |
|-----------------|----------------------------------|------|--------|-----------------|---------|------------------------------|-----------------------------|-----------------------------|
| 3433 hex | Positioning Completion Hold Time | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Setting range | 0 to 30000 | Unit | ms | Default setting | 0 | Data attribute | A | |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible. | | |

- Set the hold time for when 3432 hex (Positioning Completion Condition Selection) is set to 3.

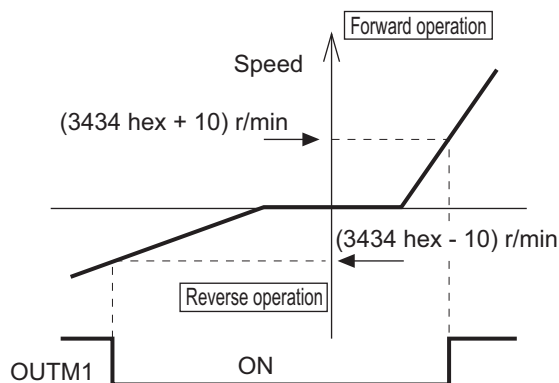
Explanation of Set Value

| Set value | Description |
|------------|--|
| 0 | The hold time will be an infinite time and the ON status will be held until the next position command is received. |
| 1 to 30000 | The ON status is held for the set time (ms). The output is turned OFF if a position command is received while the ON status is being held. |

- The setting of this parameter does not affect the detection condition for the Target reached flag in 6041 hex (Statusword).

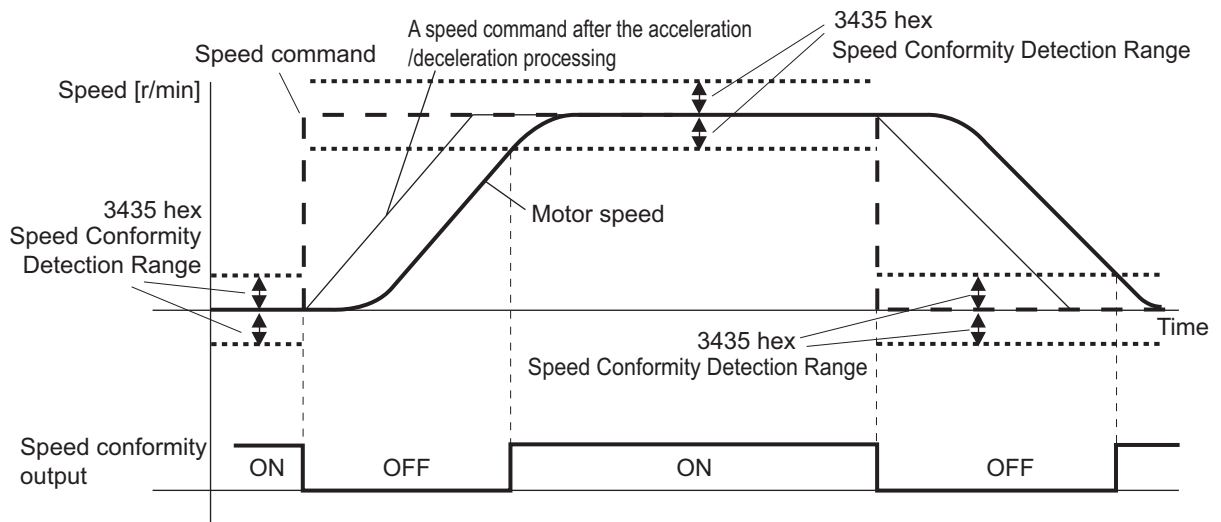
| | | | | | | | |
|-----------------|----------------------|------|--------|-----------------|---------|------------------------------|---|
| 3434 hex | Zero Speed Detection | | | | | <input type="checkbox"/> All | |
| Setting range | 10 to 20000 | Unit | r/min | Default setting | 50 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the output timing of the Zero Speed Detection Output (ZSP) as rotation speed [r/min].
- The Zero Speed Detection Output (ZSP) turns ON when the motor speed is lower than the set value of this object.
- The set value of this object is valid in both forward and reverse directions, regardless of the actual motor rotation direction. The setting has a hysteresis of 10 r/min.
- Refer to *Control Output Details* on page 3-24 for the Zero speed detection output (ZSP).



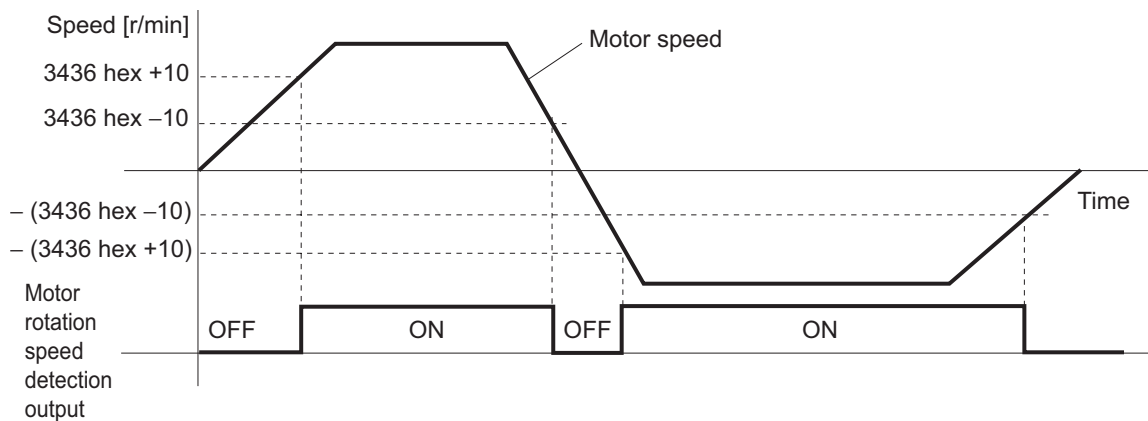
| | | | | | | | |
|-----------------|----------------------------------|------|--------|-----------------|---------|----------------|-----|
| 3435 hex | Speed Conformity Detection Range | | | | | | CSV |
| Setting range | 10 to 20000 | Unit | r/min | Default setting | 50 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- It outputs the Speed conformity output (VCMP) when the speed command conforms to the motor speed.
- It is regarded as conformed when the difference between the speed command before the acceleration or deceleration process inside the Drive and the motor speed is smaller than the set value on the Speed Conformity Detection Range (3435 hex).
- The setting has a hysteresis of 10 r/min.
- Refer to the Control Output Details in *Control Output Details* on page 3-24 for the Speed conformity output (VCMP).



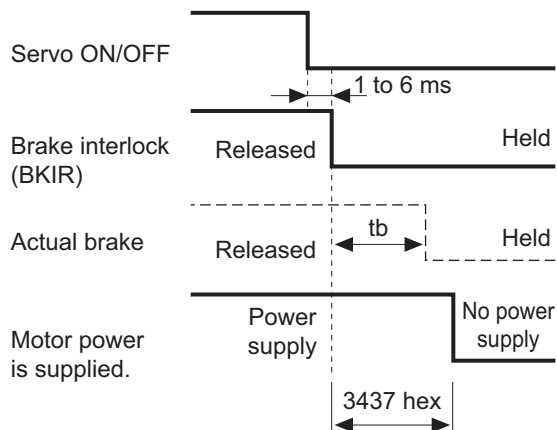
| | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|-----|
| 3436 hex | Rotation Speed for Motor Rotation Detection | | | | | | CSV |
| Setting range | 10 to 20000 | Unit | r/min | Default setting | 1,000 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- It outputs the Motor rotation speed detection output (TGON) when the motor speed reaches the set arrival speed.
- The setting has a hysteresis of 10 r/min.
- Refer to the Control Output Details in *Control Output Details* on page 3-24 for the Motor rotation speed detection output (TGON).



| | | | | | | | |
|-----------------|---------------------------|------|--------|-----------------|---------|----------------|-----|
| 3437 hex | Brake Timing when Stopped | | | | | | All |
| Setting range | 0 to 10000 | Unit | ms | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the time required for the Servomotor to be de-energized (servo free) after the brake interlock output (BKIR) turns OFF (i.e., brake held), when servo OFF status is entered while the Servomotor is stopped.
- When the servo is turned OFF while the Servomotor is stopped, the brake interlock output (BKIR) turns ON, and the servo is de-energized after waiting for the set time (set value × ms).



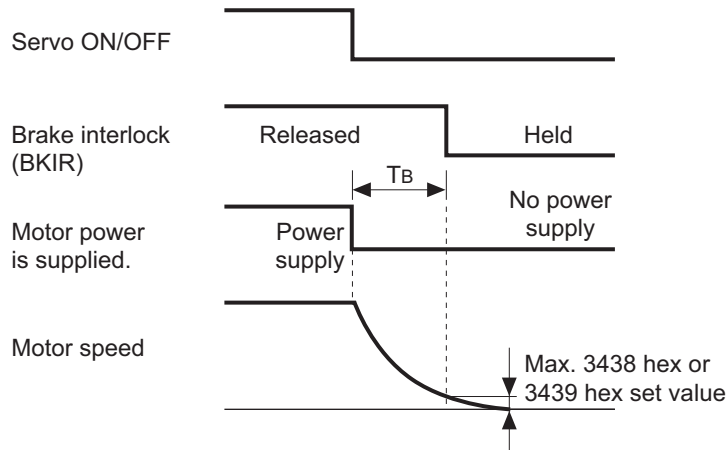
Make the setting as follows to prevent the machine (workpiece) from moving or falling due to the delay time in the brake operation (t_b).

Brake timing when stopped (set value × 1 ms) ≥ t_b

- For the operation time, refer to 7-5 Brake Interlock on page 7-15.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|-----------------|---------|----------------|-----|
| 3438 hex | Brake Timing During Operation | | | | | | All |
| Setting range | 0 to 10000 | Unit | ms | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the required time for the Brake Interlock Output (BKIR) to turn OFF after the operation command (RUN) is detected to be OFF, when servo OFF status is entered while the Servomotor is operating. When the servo is turned OFF while the Servomotor is operating, the motor decelerates to reduce rotation speed, and the brake interlock output (BKIR) turns ON after the set time (set value × 1 ms) has elapsed.

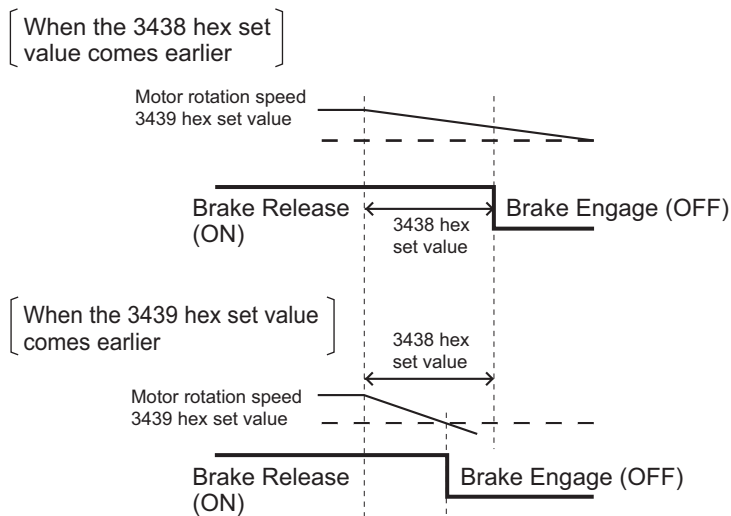


The time T_B in above drawing is either the brake timing during operation (i.e., the set value × 1 ms) or the time taken until it goes below the value set in the Brake Threshold Speed During Operation (3439 hex), whichever is shorter.

- For the operation time, refer to 7-5 Brake Interlock on page 7-15.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-----|
| 3439 hex | Brake Threshold Speed During Operation | | | | | | All |
| Setting range | 30 to 3000 | Unit | r/min | Default setting | 30 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the required rotation speed for the Brake Interlock Output (BKIR) to turn OFF after the servo OFF command is detected while the Servomotor is operating.
- For the operation time, refer to 7-5 Brake Interlock on page 7-15.



| | | | | | | | | |
|-----------------|----------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3440 hex | Warning Output Selection 1 | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 13 | Unit | – | Default setting | 0 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select the warning type to be output by Warning Output 1.
- Refer to *12-2 Warnings* on page 12-5.

Explanation of Set Values

| Set value | Description |
|-----------|---|
| 0 | Output by all types of warnings |
| 1 | Overload warning |
| 2 | Excessive regeneration warning |
| 3 | Battery warning |
| 4 | Fan warning |
| 5 | Encoder communications warning |
| 6 | Encoder overheating warning |
| 7 | Vibration warning |
| 8 | Service life warning |
| 9 | External encoder error warning |
| 10 | External encoder communications error warning |
| 11 | Data setting warning |
| 12 | Command warning |
| 13 | EtherCAT communications warning |

| | | | | | | | | |
|-----------------|----------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3441 hex | Warning Output Selection 2 | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 13 | Unit | – | Default setting | 0 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select the warning type to be output by Warning Output 2.
- Refer to the Warning Output Selection 1 (3440 hex) for the object setting method.
- Refer to *12-2 Warnings* on page 12-5.

| | | | | | | | | |
|-----------------|--------------------------------|------|--------------|-----------------|---------|----------------|--|--|
| 3442 hex | Positioning Completion Range 2 | | | | | | <input type="button" value="csp"/> <input type="button" value="pp"/> <input type="button" value="hm"/> | |
| Setting range | 0 to 262144 | Unit | Command unit | Default setting | 10 | Data attribute | A | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible. | | |

- Set the positioning completion range to output Positioning Completion Output 2 (INP2).
- The Positioning Completion Output 2 (INP2) is not affected by the position commands. It is ON as long as the position error is below the set value.
- The setting unit is command units. It can be changed to encoder units by the Position Setting Unit Selection (3520 hex). However, note that the unit for the Following error window (6065 hex) will change as well.

9-6 Extended Objects

| | | | | | | | |
|-----------------|-----------------------------------|------|--------|-----------------|---------|----------------|-----|
| 3504 hex | Drive Prohibition Input Selection | | | | | | All |
| Setting range | 0 to 2 | Unit | – | Default setting | 1 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the operation of the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT).
- Refer to *7-2 Forward and Reverse Drive Prohibition Functions* on page 7-8.

Explanation of Set Values

| Set value | Explanation |
|-----------|---|
| 0 | An error will occur if both the forward and reverse drive prohibition inputs are open at the same time. |
| 1 | Forward drive prohibition input and reverse drive prohibition input disabled. |
| 2 | An error will occur if either the forward or the reverse drive prohibition input is open. |

- Install limit switches at both ends of the axis to prohibit the motor from traveling in the direction where one of the switches operates. This can be used to prevent the workpiece from traveling too far and thus prevent damage to the machine.
- When the object is set to 0, the operation is as follows:
 - Forward Drive Prohibition Input (POT) closed: Forward limit switch not operating and status normal.
 - Forward Drive Prohibition Input (POT) open: Forward direction prohibited and reverse direction permitted.
 - Reverse Drive Prohibition Input (NOT) closed: Reverse limit switch not operating and status normal.
 - Reverse Drive Prohibition Input (NOT) open: Reverse direction prohibited and forward direction permitted.
- If this object is set to 0, the Servomotor decelerates and stops according to the sequence set in the Stop Selection for Drive Prohibition Input (3505 hex). For details, refer to explanation for Stop Selection for Drive Prohibition Input (3505 hex).



Precautions for Correct Use

- If this object is set to 0 and the forward and reverse prohibition inputs are both open, a Drive Prohibition Input Error (Error No. 38.0) will occur because it is taken that Servo Drive is in error condition.
- If this object is set to 2, a Drive Prohibition Input Error (Error No. 38.0) 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 decreases, and there may be repeated vertical movement of the workpiece. If this occurs, set the Stop Selection for Drive Prohibition Input (3505 hex) to 2 or perform limit processing using the host controller.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|------------------------------------|
| 3505 hex | Stop Selection for Drive Prohibition Input | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the drive conditions during deceleration and after stopping, when the Forward or Reverse Drive Prohibition Input is enabled.
- Refer to 7-2 *Forward and Reverse Drive Prohibition Functions* on page 7-8.

Explanation of Set Values

| Set value of 3504 hex ^{*1} | Set value of 3505 hex | Decelerating ^{*2} | | After stopping |
|-------------------------------------|-----------------------|------------------------------|---------------|--|
| | | Deceleration method | Error counter | Operation after stopping |
| 0 | 0 | Dynamic brake | Cleared | Torque command in drive-prohibited direction = 0 |
| | 1 | Free-run | Cleared | Torque command in drive-prohibited direction = 0 |
| | 2 | Immediate stop ^{*3} | Cleared | The torque command and torque limits will be as specified. |

- *1 If the Drive Prohibition Input Selection (3504 hex) is set to 2, a Drive Prohibition Input Error (Error No. 38.0) will occur as soon as either the Forward or Reverse Drive Prohibition Input turns ON. The subsequent operation conforms not to the set value, but to the setting of the Fault reaction option code (605E hex). In the same way, the Fault reaction option code (605E hex) takes priority when any other error occurs.
- *2 The term “During deceleration” means the distance until the motor decreases its speed to 30 r/min or less from the normal operation. Once it decelerates to 30 r/min or lower speed, the operation conforms to the description for “after stopping”, regardless of the actual speed.
- *3 “Immediate Stop” means that the Servomotor stops immediately by using controls while the servo is kept ON. The torque limit at this time is controlled by the Immediate Stop Torque (3511 hex) set value.



Precautions for Correct Use

- At an immediate stop, an Error Counter Overflow Error (Error No. 24.0) or an Overrun Limit Error (Error No. 34.0) may occur. This is because the immediate stop forces the motor to decelerate quickly, and the position control creates a large position error momentarily. If an error occurs, set the Following error window (6065 hex) and the Overrun Limit Setting (3514 hex) to appropriate values.
- A Command Warning (Warning No. B1 hex) will occur if a command is given in the drive prohibition direction while the Servomotor is stopped (or decreased the speed to 30 r/min or lower) and the Drive Prohibition Input is ON.

| | | | | | | | |
|-----------------|------------------------------|------|--------|-----------------|---------|----------------|------------------------------------|
| 3508 hex | Undervoltage Error Selection | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 1 | Unit | – | Default setting | 1 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select whether to turn OFF the servo or stop operation with an error when the main circuit power supply is shut OFF.

Explanation of Set Values

| Set value | Explanation |
|-----------|--|
| 0 | The servo is turned OFF based on the setting of the Shutdown option code (605B hex). The servo is then turned back ON when the main power supply is turned ON. |
| 1 | A Main Power Supply Undervoltage Error (Error No. 13.1) occurs and operation stops. |

| | | | | | | | | |
|-----------------|---------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3509 hex | Momentary Hold Time | | | | | | <input type="button" value="All"/> | |
| Setting range | 70 to 2000 | Unit | ms | Default setting | 70 | Data attribute | C | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the Main Power Supply Undervoltage Error detection time.
- The main power supply OFF detection is disabled if this object is set to 2000.

| | | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3511 hex | Immediate Stop Torque | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 5000 | Unit | 0.1% | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the torque limit for immediate stops.
- Set the torque limit for the following cases.
 - Drive prohibition deceleration with the Stop Selection for Drive Prohibition Input (3505 hex) set to 2.
 - When decelerating and the Disable operation option code (605C hex) is 8 or 9
 - When decelerating and the Shutdown option code (605B hex) is 8 or 9
- The normal torque limit is applied if this object is set to 0.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | | |
|-----------------|----------------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3512 hex | Overload Detection Level Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 500 | Unit | % | Default setting | 0 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the overload detection level.
- When the object is set to 0, the setting is 115%.
- If 115 or higher is set, a value of 115% will be used.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | | |
|-----------------|-----------------------------------|------|--------|-----------------|---------|----------------|------------------------------------|--|
| 3513 hex | Overspeed Detection Level Setting | | | | | | <input type="button" value="All"/> | |
| Setting range | 0 to 20000 | Unit | r/min | Default setting | 0 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the overspeed detection level.
- The overspeed detection level setting is 1.2 times the maximum motor rotation speed if this object is set to 0.
- This object should normally be set to 0. The setting should be changed only when it is necessary to lower the overspeed detection level.
- The set value of this object is limited to 1.2 times the maximum motor rotation speed.
- The detection margin of error for the set value is ± 3 r/min for a 5-core absolute encoder and ± 36 r/min for a 5-core incremental encoder.

| | | | | | | | | |
|-----------------|-----------------------|------|--------------|-----------------|---------|----------------|--|--|
| 3514 hex | Overrun Limit Setting | | | | | | <input type="button" value="csp"/> <input type="button" value="pp"/> <input type="button" value="hm"/> | |
| Setting range | 0 to 1000 | Unit | 0.1 rotation | Default setting | 10 | Data attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the allowable operating range for the position command input range.
- If the set value is exceeded, and Overrun Limit Error (Error No. 34.0) will occur.
- Refer to *7-3 Overrun Protection* on page 7-11.

| | | | | | | | |
|-----------------|-----------------------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3515 hex | Control Input Signal Read Setting | | | | | | <input type="checkbox"/> All |
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select the signal read cycle for control input (digital input).
- The External Latch Inputs 1, 2 and 3 (EXT1, 2, and 3) are excluded.

Explanation of Set Values

| Set value | Description |
|-----------|-------------|
| 0 | 0.250 ms |
| 1 | 0.500 ms |
| 2 | 1.5 ms |
| 3 | 2.5 ms |

| | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|---------|----------------|--|
| 3520 hex | Position Setting Unit Selection | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm |
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select the setting unit of Position Completion Range 2 (3442 hex) and Following error window (6065 hex).

Explanation of Set Values

| Set value | Description |
|-----------|--|
| 0 | Command units |
| 1 | Encoder units (External encoder units) |



Precautions for Correct Use

- Detection of the Positioning Completed status in EtherCAT communications is always performed using command units, regardless of the setting on this object.
- Normally, use the default setting of 0 (command units).

| | | | | | | | |
|-----------------|------------------------|------|--------|-----------------|---------|----------------|------------------------------------|
| 3521 hex | Torque Limit Selection | | | | | | <input type="button" value="All"/> |
| Setting range | 0 to 7 | Unit | – | Default setting | 6 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select the method to set the forward and reverse torque limits.
- Refer to *7-7 Torque Limit Switching* on page 7-24.

Explanation of Set Values

| Set value | Position control/speed control/torque control/fully-closed control | | | |
|-----------|--|--------------------------------|---|--------------------------------|
| | Positive torque limit value ^{*1} | | Negative torque limit value ^{*2} | |
| | PCL ON | PCL OFF | NCL ON | NCL OFF |
| 0,1 | 3013 hex | | | |
| 2 | 3013 hex | | 3522 hex | |
| 3 | 3522 hex | 3013 hex | 3522 hex | 3013 hex |
| 4 | 60E0 or 3013 hex ^{*3} | | 60E1 or 3522 hex ^{*4} | |
| 5 | 60E0 or 3013 hex ^{*3} | 3013 hex | 60E1 or 3522 hex ^{*4} | 3522 hex |
| 6 | 3525 hex | 60E0 or 3013 hex ^{*3} | 3526 hex | 60E1 or 3522 hex ^{*4} |
| 7 | 3013 hex | 3525 hex | 3522 hex | 3526 hex |

*1 PCL ON is the state in which either the external input signal (PCL) or the EtherCAT communications torque control command (P-CL) is ON; PCL OFF is the state in which both of these are OFF.

*2 NCL ON is the state in which either the external input signal (NCL) or the EtherCAT communications torque control command (N-CL) is ON; NCL OFF is the state in which both of these are OFF.

*3 The smaller of 60E0 hex or 3013 hex is used.

*4 The smaller of 60E1 hex or 3522 hex is used.

- When this object is set to 0 or 1, the Forward and Reverse Torque Limit Inputs are restricted by the Positive torque limit value (60E0 hex).



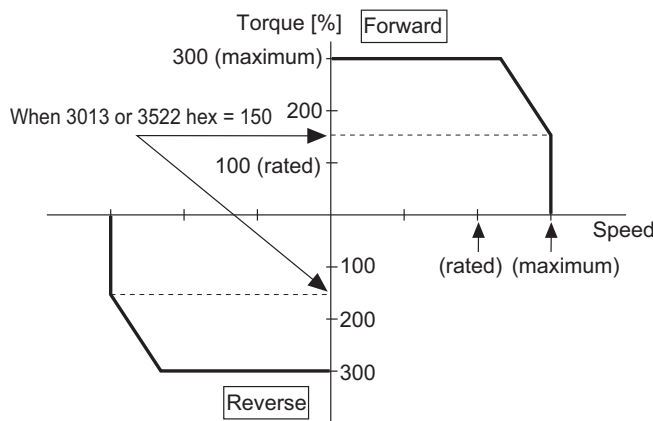
Precautions for Correct Use

For the torque limit parameters, the objects that are specified are different for an R88D-KN□□□-ECT-R Servo Drive. Refer to the *G5 AC Servomotors/Servo Drives User's Manual* (Cat. No. I573) for details on R88D-KN□□□-ECT-R objects.

| | | | | | | | |
|-----------------|-------------------------|------|--------|-----------------|--------------------|----------------|------------|
| 3522 hex | External Torque Limit 2 | | | | | | All |
| Setting range | 0 to 5000 | Unit | 0.1% | Default setting | 5000 ^{*1} | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 It is limited by the maximum torque of the connected motor.

- Set the limit value for the output torque (3013 hex: External Torque Limit 1, 3522 hex: External Torque Limit 2) of the motor.
- Refer to information on the Torque Limit Selection (3521 hex) to select the torque limits.
- During torque control, maximum torques for both forward and reverse directions are limited. Settings in Torque Limit Selection (3521 hex) and External Torque Limit 2 (3522 hex) is ignored.
- Make the settings as a percentage of the rated torque.
[Example] Maximum torque is limited to 150%



- Refer to 7-7 *Torque Limit Switching* on page 7-24 for more information on torque limits and the torque limit selection.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|-----------------|--------------------|----------------|------------|
| 3525 hex | Forward External Torque Limit | | | | | | All |
| Setting range | 0 to 5000 | Unit | 0.1% | Default setting | 5000 ^{*1} | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 It is limited by the maximum torque of the connected motor.

- Set the forward external torque limit for the torque limit switching input.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|-------------------------------|------|--------|-----------------|--------------------|----------------|------------|
| 3526 hex | Reverse External Torque Limit | | | | | | All |
| Setting range | 0 to 5000 | Unit | 0.1% | Default setting | 5000 ^{*1} | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

*1 It is limited by the maximum torque of the connected motor.

- Set the reverse external torque limit for the torque limit switching input.
- Set the value in units of 0.1% of the rated voltage (100%).

9-7 Special Objects

| | | | | | | | | | |
|-----------------|-------------------------------|------|--------|-----------------|---------|----------------|-------------------------------------|------------------------------------|------------------------------------|
| 3602 hex | Excessive Speed Error Setting | | | | | | <input type="checkbox"/> csp (semi) | <input type="checkbox"/> pp (semi) | <input type="checkbox"/> hm (semi) |
| Setting range | 0 to 20000 | Unit | r/min | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set the value for an Excessive Speed Deviation Error (Error No. 24.1).
If the set value is 0, excessive speed errors will not be detected.

| | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3605 hex | Gain 3 Effective Time | | | | | | <input type="checkbox"/> csp |
| Setting range | 0 to 10000 | Unit | 0.1 ms | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set effective time of gain 3 of 3-step gain switching.
- Refer to *7-10 Gain Switching 3 Function* on page 7-38.

| | | | | | | | |
|-----------------|----------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3606 hex | Gain 3 Ratio Setting | | | | | | <input type="checkbox"/> csp |
| Setting range | 50 to 1000 | Unit | % | Default setting | 100 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set gain 3 as a multiple of gain 1.
- Refer to *7-10 Gain Switching 3 Function* on page 7-38.

| | | | | | | | |
|-----------------|-----------------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3607 hex | Torque Command Value Offset | | | | | | <input type="checkbox"/> All |
| Setting range | -100 to 100 | Unit | % | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the offset torque to add to torque commands.
- Refer to *11-9 Friction Torque Compensation Function* on page 11-27.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3608 hex | Forward Direction Torque Offset | | | | | | <input type="checkbox"/> All |
| Setting range | -100 to 100 | Unit | % | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the value to add to a torque command for forward operation.
- Refer to *11-9 Friction Torque Compensation Function* on page 11-27.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3609 hex | Reverse Direction Torque Offset | | | | | | <input type="checkbox"/> All |
| Setting range | -100 to 100 | Unit | % | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

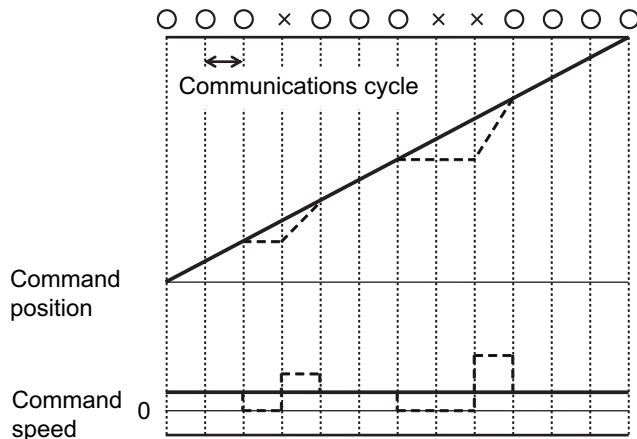
- Set the value to add to a torque command for reverse operation.
- Refer to *11-9 Friction Torque Compensation Function* on page 11-27.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|-----------------------------|------|--------|-----------------|---------|----------------|-----|
| 3610 hex | +Function Expansion Setting | | | | | | All |
| Setting range | 0 to 127 | Unit | – | Default setting | 64 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the functions by bit.
- Set the decimal value that has been converted from the bits.
- In the default settings, only the command compensation for communications errors for CSP is enabled. The number 64 decimal is 1000 000 when represented as bits.
- Refer to *11-8 Disturbance Observer Function* on page 11-25 and *11-12 Instantaneous Speed Observer Function* on page 11-33.

| Bit | Function | Set value | |
|-------|--|---------------------|------------------------------|
| | | 0 | 1 |
| bit 0 | Instantaneous speed observer function | Disabled | Enabled |
| bit 1 | Disturbance observer function | Disabled | Enabled |
| bit 2 | Disturbance observer operation setting | Enabled at all time | Only when gain 1 is selected |
| bit 3 | Reserved for manufacturer use | Fixed to 0. | |
| bit 4 | Electric current response improvement function | Disabled | Enabled |
| bit 5 | Reserved for manufacturer use | Fixed to 0. | |
| bit 6 | Command compensation for communications errors for CSP | Disabled | Enabled |

- If the command compensation for communications errors for CSP is enabled and a communications error occurs, the Servo Drive will compensate and control the internal command based on the value of the Target position (607A hex) that was most recently received normally.



- Solid line: Command compensation enabled.
- Dashed line: Command compensation disabled.
- O: Normal communications
- x: Communications error

**Additional Information****Example**

- Instantaneous speed observer function: enabled
 - Disturbance observer function: enabled
 - Disturbance observer operation setting: enabled at all time
 - Electric current response improvement function: enabled
 - Command compensation for communications errors for CSP: Disabled
- If the settings are as described above, the bit will be 0010011, and the decimal value 19. Therefore, the set value will be 19.

| | | | | | | | |
|-----------------|-----------------------------------|------|--------|-----------------|---------|----------------|-----|
| 3611 hex | Electric Current Response Setting | | | | | | All |
| Setting range | 50 to 100 | Unit | % | Default setting | 100 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Make fine adjustment to electric current response. The default setting is 100%.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-----|
| 3614 hex | Error Detection Allowable Time Setting | | | | | | All |
| Setting range | 0 to 1000 | Unit | ms | Default setting | 200 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the allowable time until stopping if an immediate stop is executed when an error is detected.
- When the time exceeds the set value, the operation forcibly turns to an error state.
- When the object is set to 0, the protection for the allowable time does not function.
- Refer to the *Immediate Stop Operation* on page 12-13.

| | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|-----|
| 3615 hex | Overspeed Detection Level Setting at Immediate Stop | | | | | | All |
| Setting range | 0 to 20000 | Unit | r/min | Default setting | 0 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- If the motor speed exceeds the set value during an immediate stop resulting from an error, an Overspeed 2 Error (Error No. 26.1) will occur.
- The overspeed detection level setting is 1.2 times the maximum motor rotation speed if this object is set to 0.
- This object should normally be set to 0. The setting should be changed only when it is necessary to lower the overspeed detection level.
- Refer to *Immediate Stop Operation* on page 12-13.

| | | | | | | | |
|-----------------|-------------------------------------|------|--------|-----------------|---------|----------------|-----|
| 3618 hex | Power Supply ON Initialization Time | | | | | | All |
| Setting range | 0 to 100 | Unit | 0.1 s | Default setting | 0 | Data attribute | R |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the initialization time after turning ON the power supply to the standard 1.5 seconds plus the specified value.
- Refer to the Control Output Sequence in *3-1 Servo Drive Specifications* on page 3-2 for the details at power ON.

| | | | | | | | | | | |
|-----------------|--------------------------------------|------|--------|-----------------|---------|----------------|-------------------------------------|------------------------------|------------------------------------|------------------------------------|
| 3623 hex | Disturbance Torque Compensation Gain | | | | | | <input type="checkbox"/> csp (semi) | <input type="checkbox"/> csv | <input type="checkbox"/> pp (semi) | <input type="checkbox"/> hm (semi) |
| Setting range | -100 to 100 | Unit | % | Default setting | 0 | Data attribute | B | | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | | |

- Set the compensation gain for the disturbance torque.
- Refer to *11-8 Disturbance Observer Function* on page 11-25.

| | | | | | | | | | | |
|-----------------|-------------------------------------|------|---------|-----------------|---------|----------------|-------------------------------------|------------------------------|------------------------------------|------------------------------------|
| 3624 hex | Disturbance Observer Filter Setting | | | | | | <input type="checkbox"/> csp (semi) | <input type="checkbox"/> csv | <input type="checkbox"/> pp (semi) | <input type="checkbox"/> hm (semi) |
| Setting range | 10 to 2500 | Unit | 0.01 ms | Default setting | 53 | Data attribute | B | | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | | |

- Set the filter time constant for disturbance torque compensation.
- Refer to *11-8 Disturbance Observer Function* on page 11-25.

| | | | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|------------------------------|--|--|--|
| 3631 hex | Realtime Autotuning Estimated Speed Selection | | | | | | <input type="checkbox"/> All | | | |
| Setting range | 0 to 3 | Unit | – | Default setting | 0 | Data attribute | B | | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | | |

- Set the speed to estimate the load characteristic while the realtime autotuning is enabled.
- The higher the set value is, the earlier the load characteristic change is followed, but the estimated variation against the disturbance becomes greater.
- The estimated results is updated in every 30 minutes and saved in EEPEOM.
- Refer to *11-3 Realtime Autotuning* on page 11-7.

Explanation of Set Values

| Set value | Mode | Description |
|-----------|----------------|--|
| 0 | No change | Stops load estimation. |
| 1 | Little change | Estimates every minute from the load characteristic changes. |
| 2 | Gradual change | Estimates every second from the load characteristic changes. |
| 3 | Sharp change | Estimates the optimum from the load characteristic changes. |

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|----------------------------------|
| 3632 hex | Realtime Autotuning Customization Mode Setting | | | | | | <input type="text" value="All"/> |
| Setting range | -32768 to 32767 | Unit | – | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the details of the autotuning function when the Realtime Autotuning Mode Selection (3002 hex) is set to 6.
- Refer to *11-3 Realtime Autotuning* on page 11-7.

Explanation of Set Values

| Bit | Name | Description |
|---------|--|---|
| 0 to 1 | Load characteristic estimation ^{*1} | Select to enable or disable load characteristic estimation. 0: Disable 1: Enable |
| 2 to 3 | Inertia ratio updating | Select whether to update the present set value of the Inertial Ratio (3004 hex) with the load characteristic estimation result. 0: Use the present set value. 1: Update with the estimation result. |
| 4 to 6 | Torque compensation | Select whether to update three objects, Torque Command Value Offset (3607 hex), Forward Direction Torque Offset (3608 hex), and Reverse Direction Torque Offset (3609 hex), with the load characteristic estimation result. 0: Use the present set value. 1: Disable the torque compensation. Clear the above three objects to zero. 2: Vertical mode. Update 3607 hex. Clear 3608 hex and 3609 hex to zero. 3: Friction compensation (small). Update 3607 hex. Set a small compensation to 3608 hex and 3609 hex. 4: Friction compensation (intermediate). Update 3607 hex. Set an intermediate compensation in 3608 hex and 3609 hex. 5: Friction compensation (large). Update 3607 hex. Set a large compensation in 3608 hex and 3609 hex. |
| 7 | Rigidity setting | Select to enable or disable the basic gain setting by the Realtime Autotuning Machine Rigidity Setting (3003 hex). 0: Disable 1: Enable |
| 8 | Fixed object settings | Select whether to allow changes to the objects that normally are fixed. 0: Use the present settings. 1: Set to fixed values. |
| 9 to 10 | Gain switch setting | Select the method to set the objects that relate to gain switching while the realtime autotuning is enabled. 0: Use the present settings. 1: Disable gain switching. 2: Enable gain switching. |

*1 When load characteristic estimation is disabled, inertial ratio updating is also disabled, even if the latter is set to be updated with the estimation result. When torque compensation is updated with the estimation result, load characteristic estimation is disabled.

**Precautions for Safe Use**

- This object must be set in units of bits. Users must be fully aware that proper operation of your system is not guaranteed, if you have incorrect object settings. Pay a particular attention when you set them.

**Additional Information****Procedure to Set the Object Bit by Bit**

Follow these steps and calculate the set values, when you make any setting other than 0.

- (1) Confirm the least significant bit (LSB) in each set value.

E.g. LSB of Torque compensation function: 4

- (2) Multiply the set value by 2 to the power of the bit number of the LSB.

E.g. To set the torque compensation to Friction compensation (small): The set value is 3. The exponent is 4.

$$2^4 \times 3 = 48$$

- (3) Repeat Step (1) and (2) for all bit settings. Add all results and set the outcome to 3632 hex.

E.g. When all of the Load characteristic estimation, the Inertia ratio updating, the Rigidity setting, and the Gain switch setting are enabled, the Torque compensation is set to Friction compensation (small), and the Fixed object setting is set to a Fixed value:

$$2^0 \times 1 + 2^2 \times 1 + 2^4 \times 3 + 2^7 \times 1 + 2^8 \times 1 + 2^9 \times 2 = 1461$$

| | | | | | | | | | |
|-----------------|-----------------------------------|------|--------|-----------------|---------|----------------|---|--|--|
| 3634 hex | Hybrid Vibration Suppression Gain | | | | | | <input type="text" value="csp (semi)"/> | <input type="text" value="pp (semi)"/> | <input type="text" value="hm (semi)"/> |
| Setting range | 0 to 30000 | Unit | 0.1/s | Default setting | 0 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set the hybrid vibration suppression gain during fully-closed control.
- In general, set it to the same value as the position loop gain, and finely adjust it based on the situation.
- Refer to *11-10 Hybrid Vibration Suppression Function* on page 11-29.

| | | | | | | | | | |
|-----------------|-------------------------------------|------|---------|-----------------|---------|----------------|---|--|--|
| 3635 hex | Hybrid Vibration Suppression Filter | | | | | | <input type="text" value="csp (semi)"/> | <input type="text" value="pp (semi)"/> | <input type="text" value="hm (semi)"/> |
| Setting range | 0 to 6400 | Unit | 0.01 ms | Default setting | 10 | Data attribute | B | | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | | |

- Set the hybrid vibration suppression filter.
- Refer to *11-10 Hybrid Vibration Suppression Function* on page 11-29.

| | | | | | | | | |
|-----------------|-------------------------------|------|--------|-----------------|---------|----------------|----------------------------------|--|
| 3637 hex | Vibration Detection Threshold | | | | | | <input type="text" value="All"/> | |
| Setting range | 0 to 1000 | Unit | 0.1% | Default setting | 0 | Data attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the vibration detection threshold.
- If torque vibration that exceeds this setting is detected, a vibration detection warning occurs.
- Refer to *12-2 Warnings* on page 12-5.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|----------------------|------|--------|-----------------|---------|----------------|------------------------------|
| 3638 hex | Warning Mask Setting | | | | | | <input type="checkbox"/> All |
| Setting range | -32768 to 32767 | Unit | – | Default setting | 4 | Data attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the warning detection mask setting.
- If you set the corresponding bit to 1, the corresponding warning detection is disabled.
- Refer to the *General Warnings* on page 12-6.

| Warning number | Warning name | Warning condition | Warning Mask Setting (3638 hex) ^{*1} |
|----------------|---|---|---|
| A0 | Overload warning | The load ratio is 85% or more of the protection level. | Bit 7 |
| A1 | Excessive regeneration warning | The regeneration load ratio is 85% or more of the level. | Bit 5 |
| A2 | Battery warning | Battery voltage is 3.2 V or less. | Bit 0 |
| A3 | Fan warning | The fan stops for 1 second. | Bit 6 |
| A4 | Encoder communications warning | Encoder communications errors occurred in series more than the specified value. | Bit 4 |
| A5 | Encoder overheating warning | The encoder temperature exceeded the specified value. | Bit 3 |
| A6 | Vibration detection warning | Vibration is detected. | Bit 9 |
| A7 | Life expectancy warning | The life expectancy of the capacitor or the fan is shorter than the specified value. | Bit 2 |
| A8 | External encoder error warning | The external encoder detects a warning. | Bit 8 |
| A9 | External encoder communications warning | The external encoder has more communications errors in series than the specified value. | Bit 10 |

*1 Each warning detection can be masked with the Warning Mask Setting (3638 hex). The table above shows the corresponding bits. When a bit is set to 1, the warning detection is masked.

| | | | | | | | |
|-----------------|-----------------------|------|--------|-----------------|---------|----------------|----------------------------------|
| 3700 hex | LED Display Selection | | | | | | <input type="text" value="All"/> |
| Setting range | 0 to 32767 | Unit | – | Default setting | 0 | Data attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select a data type to display on the 7-segment display on the front panel.

Explanation of Set Value

| Set value | Indicated item | Description |
|-----------|--|--|
| 0 | Normal state | Displays “– –” during Servo-OFF, and “00” during Servo ON. |
| 1 | Mechanical angle | Displays a value between 0 and FF hex. The value 0 indicates the zero position of the encoder. The value increments when the motor rotates in the counterclockwise (CCW) direction. The value returns to 0 when it exceeds FF, but the count continues. When an incremental encoder is used, it indicates “nF” (i.e., not fixed) is displayed until the zero position of the encoder is detected after the control power is turned ON. |
| 2 | Electric angle | Displays a value between 0 and FF hex. The value 0 indicates the position when the U-phase electro-motive force shows the positive peak. The value increments when the motor rotates in the counterclockwise (CCW) direction. The value returns to 0 when it exceeds FF, but the count continues. |
| 3 | Total number of EtherCAT communications errors ^{*1} | Displays a value between 0 and FF hex. The cumulative count is saturated when it reaches the maximum value (FFFF hex). In this case, only the lowest order byte is shown. The value returns to 00 when it exceeds FF, but the count continues. |
| 4 | Rotary switch setting (node address) | Displays the rotary switch setting (i.e. node address) read at power-ON. The displayed value is in decimal. The value is not altered by any changes to the rotary switch setting after the power-ON. |
| 5 | Total number of encoder communications errors ^{*1} | Displays a value between 0 and FF hex. The cumulative count is saturated when it reaches the maximum value (FFFF hex). In this case, only the lowest order byte is shown. |
| 6 | Total number of external encoder communications errors ^{*1} | The value returns to 00 when it exceeds FF, but the count continues. |
| 7 | Z-phase counter ^{*2} | Displays the Z-phase count value read from the external encoder when an incremental external encoder is used during fully-closed control. The value between 0 and FF hex is displayed. |
| 8 or over | Unused | Do not set anything. |

*1 The cumulative count of communication errors is cleared when the control power is cut OFF.

*2 The value read from the encoder is indicated directly, regardless of the External Feedback Pulse Direction Switching (3326 hex).

| | | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|------------------------------|--|
| 3701 hex | Power ON Address Display Duration Setting | | | | | | <input type="checkbox"/> All | |
| Setting range | 0 to 1000 | Unit | 100 ms | Default setting | 0 | Data Attribute | R | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the time to indicate the node address when the control power is turned ON.

| | | | | | | | | |
|-----------------|----------------------------------|------|--------|-----------------|---------|----------------|------------------------------|--|
| 3703 hex | Torque Limit Flag Output Setting | | | | | | <input type="checkbox"/> cst | |
| Setting range | 0 to 1 | Unit | – | Default setting | 0 | Data Attribute | A | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the condition for torque limit output during torque control.

Explanation of Set Value

| Set value | Description |
|-----------|--|
| 0 | On by the torque limit value including the torque command value. |
| 1 | On by the torque limit value excluding the torque command value. |

| | | | | | | | | |
|-----------------|---------------------------------|------|--------|-----------------|---------|----------------|--|--|
| 3704 hex | Backlash Compensation Selection | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 2 | Unit | – | Default setting | 0 | Data Attribute | C | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Select to enable or disable the backlash compensation during position control. Set the compensation direction when compensation is enabled.
- Refer to *7-4 Backlash Compensation* on page 7-13.

Explanation of Set Value

| Set value | Description |
|-----------|--|
| 0 | Disable backlash compensation. |
| 1 | Compensate for backlash at first forward operation after the servo turns ON. |
| 2 | Compensate for backlash at first reverse operation after the servo turns ON. |

| | | | | | | | | |
|-----------------|------------------------------|------|--------------|-----------------|---------|----------------|--|--|
| 3705 hex | Backlash Compensation Amount | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | –32768 to 32767 | Unit | Command unit | Default setting | 0 | Data Attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the backlash compensation amount during position control.
- Refer to *7-4 Backlash Compensation* on page 7-13.

| | | | | | | | | |
|-----------------|-------------------------------------|------|---------|-----------------|---------|----------------|--|--|
| 3706 hex | Backlash Compensation Time Constant | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm | |
| Setting range | 0 to 6400 | Unit | 0.01 ms | Default setting | 0 | Data Attribute | B | |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | | |

- Set the backlash compensation time constant for position control.
- Refer to *7-4 Backlash Compensation* on page 7-13.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|-----------------|----------|----------------|------------------------------------|
| 3758 hex | Touch Probe Trigger Selection | | | | | | <input type="button" value="All"/> |
| Setting range | 0000 to FFFF hex | Unit | – | Default setting | 0100 hex | Data Attribute | B |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible. | |

- Select EXT1, EXT2, EXT3, or phase Z at the external latch trigger for the latch function.
- For details on the latch function, refer to *7-11 Touch Probe Function (Latch Function)* on page 7-40.

Bit Descriptions

| Latch 1 | | | Latch 2 | | |
|---------|-------|------------------|---------|-------|------------------|
| Bit 0 | Bit 1 | Trigger signal 1 | Bit 8 | Bit 9 | Trigger signal 2 |
| 0 | 0 | EXT1 | 0 | 0 | EXT1 |
| 1 | 0 | EXT2 | 1 | 0 | EXT2 |
| 0 | 1 | EXT3 | 0 | 1 | EXT3 |
| 1 | 1 | Phase-Z signal | 1 | 1 | Phase-Z signal |

| | | | | | | | |
|-----------------|------------------------|------|--------|-----------------|----------|----------------|------------------------------------|
| 3759 hex | Warning Hold Selection | | | | | | <input type="button" value="All"/> |
| Setting range | 0000 to FFFF hex | Unit | – | Default setting | 0000 hex | Data Attribute | R |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible. | |

- Select whether to hold communications-related and general warning status.

Bit Descriptions

| Bit | Function | Set value | Warning status | Resetting warning status |
|-----|---|-----------|----------------|--|
| 0 | Holding Communications-related Warning Status | 0 | Do not hold | The warnings are automatically cleared when the cause of the warning is eliminated. However, warnings are held for at least 1 s. |
| | | 1 | Hold | Remove the cause of the warning and then send a warning reset command. |
| 1 | Holding General Warning Status ^{*1} | 0 | Do not hold | The warnings are automatically cleared when the cause of the warning is eliminated. However, warnings are held for at least 1 s. |
| | | 1 | Hold | Remove the cause of the warning and then send a warning reset command. |

*1 The warning state for the Battery Warning (A2 hex) and Life Expectancy Warning (A7 hex) will be held independent of this setting.

| | | | | | | | |
|-----------------|--|------|--------|-----------------|---------|----------------|-----|
| 3781 hex | Data Setting Warning Detection Setting | | | | | | All |
| Setting range | 0 to 15 | Unit | Times | Default setting | 1 | Data Attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set how many times the EtherCAT communications data setting warning should be detected continuously without an error.
- If a Data Setting Warning (Warning No. B0 hex) occurs more than this setting, a Command Error (Error No. 91.1) will occur.
- It can be set to between 0 and 15. The error will occur when the number of detected Data Setting Warning exceeds this set value + 1.



Additional Information

- This object is supported for unit version 2.1 or later.
- In the default setting, the data setting warning (Warning No. B0 hex) will not occur because the Communications Control (3800 hex) bit 14 is 1, and therefore no Command Error (Error No. 91.1) will occur.
- To enable this setting, set the Communications Control (3800 hex) bit 14 to 0.
- When you enable this setting and do not change the default setting value (default: 1), a Command Error will occur if the data setting warning is detected twice in a row.

| | | | | | | | |
|-----------------|------------------------|------|--------|-----------------|---------------------------|----------------|-----|
| 3800 hex | Communications Control | | | | | | All |
| Setting range | -32768 to 32767 | Unit | – | Default setting | Refer to the description. | Data Attribute | C |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the error and warning masks for EtherCAT communications.



Precautions for Correct Use

This function is for debugging. For normal operation, leave this object at the default setting.

- Bit Descriptions

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|-------------|----|----|----|----|---|---|---|---------------|---|---|-------------|---|---|---|
| Function | | Error masks | | | | | | | | Warning masks | | | Error masks | | | |

- Error masks
The following table shows the error you can mask by setting each error mask bit of the Communications Control object (3800 hex).
To mask an error, set the corresponding error bit to 1.

| Communications Control (3800 hex) | Error | |
|-----------------------------------|-----------------|--------------------------------------|
| | Error No. (hex) | Error name |
| Bit 1 | 83.1 | EtherCAT state change error |
| Bit 2 | 83.2 | EtherCAT illegal state change error |
| Bit 3 | 83.3 | Communications synchronization error |
| Bit 12 | 83.4 | Synchronization error |
| Bit 13 | 83.5 | Sync Manager WDT Error |
| Bit 14 ^{*1} | 91.1 | Command Error |

*1. Only Command Errors (Error No. 91.1) due to the data setting warning (B0 hex) are masked. Command Errors (Error No. 91.1) due to other causes are not masked.
For details on the causes of a Command Error (Error No. 91.1), refer to *Command error* on page 12-27.

- Warning masks

The following table shows the warning you can mask by setting each warning mask bit of the Communications Control object (3800 hex).

To mask a warning, set the corresponding warning bit to 1.

| Communications Control (3800 hex) | Warning | | |
|-----------------------------------|----------------|---------------------------------|--|
| | Warning number | Warning name | Warning occurrence conditions |
| Bit 4 | B0 hex | Data setting warning | <ul style="list-style-type: none"> The set value in the command argument is out of the specified range. Object write processing failed. The command set value is incorrect. |
| Bit 5 | B1 hex | Command warning | <ul style="list-style-type: none"> The command transmission conditions are not met. The sub-command transmission conditions are not met. An operation command is given in the prohibited direction after the motor made an emergency stop due to a drive prohibition input. |
| Bit 6 | B2 hex | EtherCAT communications warning | EtherCAT communications errors occurred one or more times. |

- Default setting

The following table shows the default setting for each unit version.

| Unit version | Default setting | Description |
|--------------|-----------------|---|
| Ver. 2.0 | 0 | The above masks are disabled. Bit 14 is reserved for system use. Do not change the default setting. |
| Ver. 2.1 | 16384 | Because bit 14 is 1 in the default setting, only Command Errors (Error No. 91.1) due to the data setting warning (B0 hex) are masked. |

| 3801 hex | Software Position Limit Function | | | | | | All |
|---------------|----------------------------------|------|--------|-----------------|---------|----------------|-----|
| Setting range | 0 to 3 | Unit | – | Default setting | 3 | Data Attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Select whether to enable or disable the software position limit function.
- When it is enabled, set the software limit values in the Max position limit (607D-02 hex) and the Min position limit (607D-01 hex).

Explanation of Set Value

| Set value | Description |
|-----------|--|
| 0 | Enable the software limits in both directions. |
| 1 | Disable the forward software limit, but enable the reverse software limit. |
| 2 | Enable the forward software limit, but disable the reverse software limit. |
| 3 | Disable the software limits in both directions. |



Precautions for Correct Use

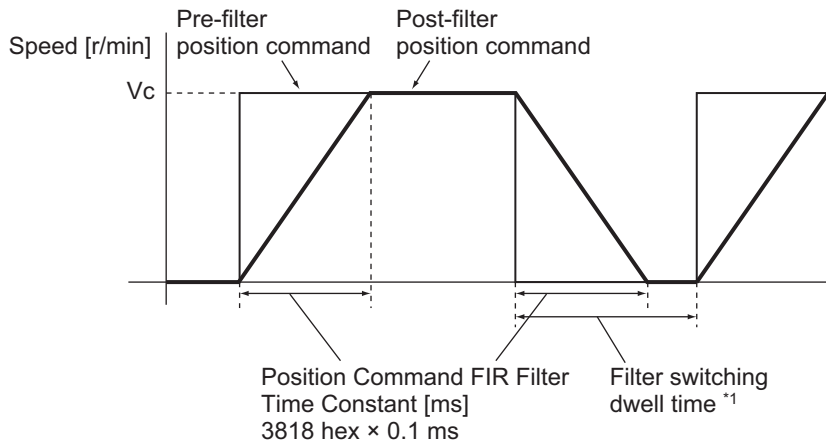
EtherCAT communications status will be 0 for limit signals that are disabled. The status will also be 0 if an origin return has not been performed.

| | | | | | | | |
|-----------------|-----------------|------|--------------|-----------------|---------|----------------|------------------------------|
| 3803 hex | Origin Range | | | | | | <input type="checkbox"/> All |
| Setting range | 0 to 250 | Unit | Command unit | Default setting | 10 | Data Attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the threshold for detecting the origin as an absolute value.

| | | | | | | | |
|-----------------|---|------|--------|-----------------|---------|----------------|--|
| 3818 hex | Position Command FIR Filter Time Constant | | | | | | <input type="checkbox"/> csp <input type="checkbox"/> pp <input type="checkbox"/> hm |
| Setting range | 0 to 10000 | Unit | 0.1 ms | Default setting | 0 | Data attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible. | |

- Set the time constant of FIR filter for the position command.
- The Position command FIR filter can be selected to enable or disable, by the position command filter switch input via EtherCAT communications.
- Enable and disable the position command FIR filter in the Motion profile type (6086 hex). It can be set only when the Communications synchronization is 1 ms or more.
- It sets the time to arrive at the target speed V_c , as shown below, for the square-wave command of V_c .



- *1 Change the setting on 3818 hex only after you stop the command pulse and the filter switching dwell time elapses. The dwell time is calculated by the following formulas depending on the value set on 3818 hex.
 If 3818 hex set value ≤ 10 ms, the set value $\times 0.1$ ms + 0.25 ms.
 If 3818 hex set value > 10 ms, the set value $\times 0.1$ ms $\times 1.05$.



Precautions for Correct Use

- If the set value on 3818 hex is changed during the position command is entered, the change is not reflected immediately. It is updated only after the subsequent state of no position command persists for the filter switching dwell time.
- There is some time lag from when the 3818 hex is change and to when the change is applied. If the filter switching dwell time elapses during the lag, the change may be suspended.

| | | | | | | | |
|-----------------|----------|--------|---|-----------------|---|----------------|---|
| 3822 hex | Reserved | | | | | | |
| Setting range | – | Unit | – | Default setting | – | Data attribute | – |
| Size | – | Access | – | PDO map | – | | |

- This is a reserved parameter. Do not set any value.

10

Operation

This chapter explains the operating procedures and how to operate in each mode.

| | |
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| 10-2 Preparing for Operation | 10-3 |
| 10-2-1 Items to Check Before Turning ON the Power Supply | 10-3 |
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10-1 Operational Procedure

Turn ON the power supply after the correct installation and wiring to check the operation of the individual motor and drive.

Then make the function settings as required according to the use of the motor and drive.

If the user objects are set incorrectly, there is a risk of unexpected motor operation, which can be dangerous. Set the objects accurately according to the setting methods in this manual.

| Item | Contents | Reference |
|---------------------------|--|------------------|
| Mounting and installation | Install the motor and drive according to the installation conditions. (Do not connect the motor to the mechanical system before checking no-load operation.) | Chapter 4, 4-1 |
| ↓ | | |
| Wiring and connections | Connect the motor and drive to the power supply and peripheral equipment. Specified installation and wiring conditions must be satisfied, particularly for models conforming to the EC Directives. | Chapter 4, 4-2 |
| ↓ | | |
| Preparing for operation | Check the necessary items and then turn ON the power supply. Check on the display to see whether there are any internal errors in the drive. If using a motor with an absolute encoder, first set up the absolute encoder. | Chapter 10, 10-2 |
| ↓ | | |
| Function settings | Set the objects related to the functions required for application conditions. | Chapter 9 |
| ↓ | | |
| Trial operation | First, check motor operation with no-load. Then turn the power supply OFF and connect the motor to the mechanical system. When using a Servomotor with an absolute encoder, set up the absolute encoder. Turn ON the power supply again, and check to see whether protective functions, such as the immediate stop and operational limits, are functioning properly. Check operation at both low speed and high speed using the system without a workpiece, or with dummy workpieces. | Chapter 10, 10-3 |
| ↓ | | |
| Adjustment | Manually adjust the gain if necessary. Further adjust the various functions to improve the control performance. | Chapter 11 |
| ↓ | | |
| Operation | Operation can now be started. If any problems should occur, refer to <i>Chapter 12 Troubleshooting and Maintenance</i> . | Chapter 12 |

10-2 Preparing for Operation

This section explains the procedure to prepare the mechanical system for operation following installation and wiring of the motor and drive. It explains items to check both before and after turning ON the power supply.

It also explains the setup procedure required if using a motor with an absolute encoder.

10-2-1 Items to Check Before Turning ON the Power Supply

Checking Power Supply Voltage

- Check to be sure that the power supply voltage is within the ranges shown below.

R88D-KNA5L-ECT/-KN01L-ECT/-KN02L-ECT/-KN04L-ECT (Single-phase 100-VAC input)

Main circuit power supply: Single-phase 100 to 120 VAC (85 to 132) 50/60 Hz

Control circuit power supply: Single-phase 100 to 120 VAC (85 to 132) 50/60 Hz

R88D-KN01H-ECT/-KN02H-ECT/-KN04H-ECT/-KN08H-ECT/-KN10H-ECT/-KN15H-ECT
(Single-phase or single-phase/3-phase 200-VAC input)

Main circuit power supply: Single-phase or single-phase/3-phase 200 to 240 VAC (170 to 264) 50/60 Hz

Control circuit power supply: Single-phase 200 to 240 VAC (170 to 264) 50/60 Hz

R88D-KN20H-ECT/-KN30H-ECT/-KN50H-ECT/-KN75H-ECT/-KN150H-ECT
(3-phase 200 VAC input)

Main circuit power supply: 3-phase 200 to 230 VAC (170 to 253) 50/60 Hz

Control circuit power supply: Single-phase 200 to 230 VAC (170 to 253) 50/60 Hz

R88D-KN06F-ECT/-KN10F-ECT/-KN15F-ECT/-KN20F-ECT/-KN30F-ECT/-KN50F-ECT/-KN75F-ECT/
-KN150F-ECT (3-phase 400 VAC input)

Main circuit power supply: 3-phase 380 to 480 VAC (323 to 528) 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 red (U), white (V), and blue (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

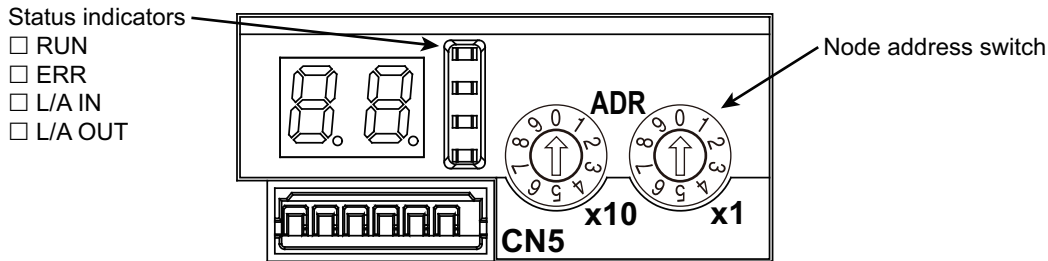
- The encoder cable must be securely connected to the encoder connector (CN2) at the drive.
- The encoder cable must be securely connected to the encoder connector at the motor.

Checking the EtherCAT Communications Connectors

- The EtherCAT Communications Cables must be connected securely to the EtherCAT Communications Connectors (ECAT IN and ECAT OUT).

Checking the Node Address Setting

Make sure that the node address is correctly set on the node address switches.



| Node address switch setting | Contents |
|-----------------------------|--|
| | |
| 00 | The controller sets the node address. |
| 01 to 99 | The Node Address switch setting is used as the node address. |



Precautions for Correct Use

- Do not change the setting on the Node Address switches after the power supply has been turned ON.
- The node address switches can be set to between 00 and 99. The node address used over the network is determined by the value set on the Node Address switches. If the node address is not between 00 and 99, a Node Address Setting Error (Error No. 88.0) will occur.

10-2-2 Turning ON the Power Supply

- Turn ON the control circuit power after you conduct the pre-power-ON checking. You may turn ON the main circuit power, but it is not a required.

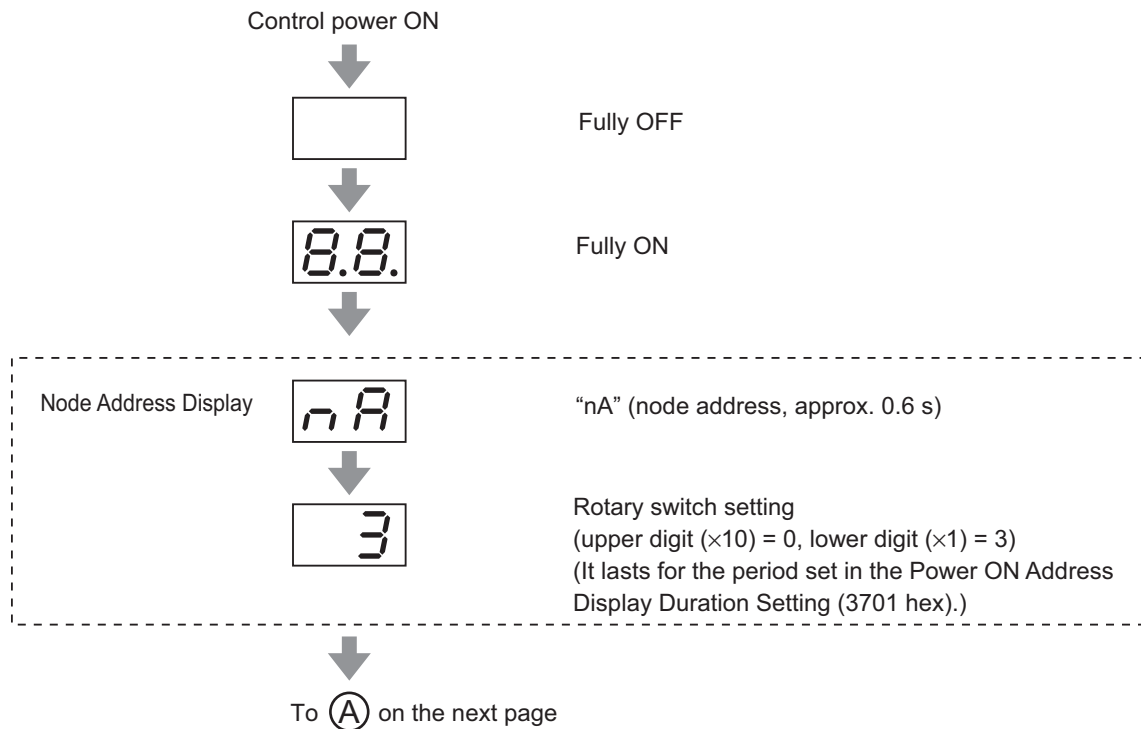
10-2-3 Checking the Displays

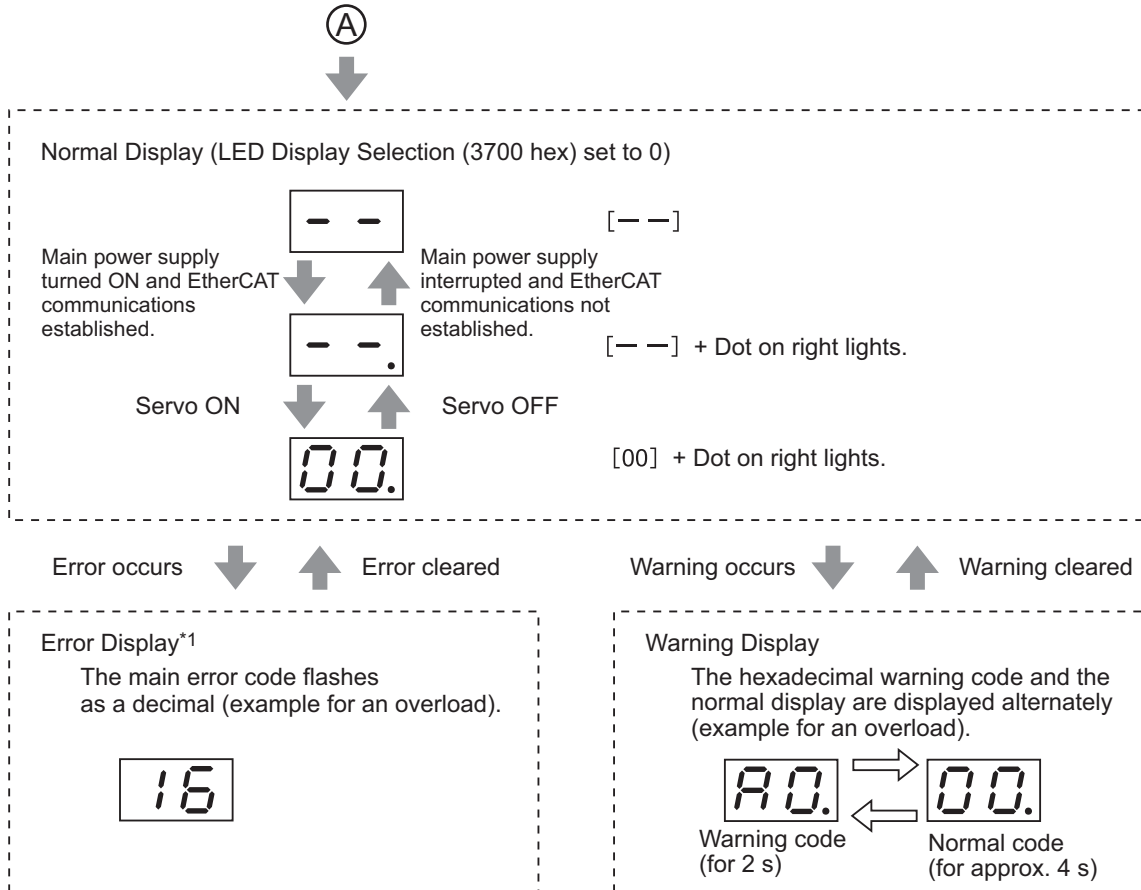
7-Segment Display

The 7-segment display is on the front panel.

When the power is turned ON, it shows the node address that is set by the rotary switches. Then the display changes according to the setting of the LED Display Selection (3700 hex).

An error code is displayed if an error occurs. A warning code is displayed if a warning occurs.





*1 : “SE” will flash when a Safety Input Error (Error No. 30.0) occurs.
 “30” does not flash on the display.

EtherCAT Status Indicators

Check the status of the status indicators.

If the RUN indicator will not turn ON or the ERR indicator will not turn OFF, refer to *Status Indicators* on page 5-3 and check the status.

10-2-4 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 (Error No. 40.0) occurs, or when the encoder cable is disconnected and then connected again.

To use an absolute encoder, set the Operation Switch when Using Absolute Encoder (3015 hex) to 0 or 2 (factory setting).

Refer to the *CJ1W-NC281/NC481/NC881/NCF81/NC482/NC882 Position Control Unit Operation Manual* (Cat. No. W487) and to information on Absolute Encoder Setup (4102 hex) to set up the absolute encoder.

For information on setup using the CX-Drive, refer to “CX-Drive Operation Manual (W453-E1)” or Setting Up an Absolute Encoder from the CX-Drive described below.

10-2-5 Setting Up an Absolute Encoder from the CX-Drive

1 Start the CX-Drive and go online with the Servo Drive via EtherCAT or USB communications.

2 Select *Absolute Encoder* from the *Tuning* Menu of the CX-Drive.

3 Select *Multi-Turn Data and Encoder Error Clear* from the *Absolute Encoder* Dialog Box.

The following error will occur after execution has been completed.

EtherCAT communications: Absolute Value Cleared (Error No. 27.1)

USB communications: Position Data Initialized (Error No. 27.7)

4 Turn the power supply to the Servo Drive OFF and then ON again.

10-3 Trial Operation

When you have finished installation, wiring, and switch settings, and have confirmed that status is normal after turning ON the power supply, perform trial operation. The main purpose of trial operation is to confirm that the servo system is electrically correct.

If an error occurs during trial operation, refer to *Chapter 12 Troubleshooting and Maintenance* to eliminate the cause. Then check for safety, and retry trial operation.

10-3-1 Preparations for Trial Operation

Inspections before Trial Operation

Check the following items.

- **Wiring**

- Make sure that there are no wiring errors (especially for 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.
- Is the voltage stable?

- **Motor Installation**

- Make sure that the Servomotor is securely installed.

- **Disconnection from Mechanical System**

- If necessary, make sure that the load has been disconnected from the mechanical system.

- **Brake Released**

- Make sure that the brake has been released.

- **Connections to the Mechanical System**

- Are the load and Servomotor shaft properly aligned?
- Is the load on the Servomotor shaft within specifications?

10-3-2 Test Operation via USB Communications from the CX-Drive

- 1** Use the Connector CN1.
- 2** Supply 12 to 24 VDC to the control signal connector pins +24 VIN and COM.
- 3** Turn ON the Servo Drive power.
- 4** Connect a USB cable to the USB connector (CN7).
- 5** Start the CX-Drive and go online with the Servo Drive via USB communications.
- 6** Select *Test Run* from the *Tuning* Menu of the CX-Drive.
- 7** Select *Servo ON* to servo-lock the Servomotor.
- 8** Select *Forward* or *Reverse* and start the Servomotor.
The Servomotor will rotate until *Stop* is selected.



Precautions for Correct Use

The test operation function via USB communications from the CX-Drive cannot be used while EtherCAT communications are established.

Adjustment Functions

This chapter explains the functions, setting methods, and items to note regarding various gain adjustments.

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11-1 Analog Monitor

Two types of analog signals can be output from the analog monitor connector on the front panel.

They are used when the monitoring is required for adjustment.

The monitor items to be output and the scaling (output gain) can be set as required for each of the objects.

The refresh period of the analog monitor is 1 ms. The analog monitor is not synchronized with another axes in the EtherCAT system.

11-1-1 Objects Requiring Settings

| Index | Name | Explanation | Reference |
|----------|--------------------------------|--|-----------|
| 3416 hex | Analog Monitor 1 Selection | Select the monitoring item for the analog monitor 1. | page 9-33 |
| 3417 hex | Analog Monitor 1 Scale Setting | Set the output gain for the analog monitor 1. | page 9-33 |
| 3418 hex | Analog Monitor 2 Selection | Select the monitoring item for the analog monitor 2. | page 9-34 |
| 3419 hex | Analog Monitor 2 Scale Setting | Set the output gain for the analog monitor 2. | page 9-34 |
| 3421 hex | Analog Monitor Output Setting | Select the analog monitor output method. | page 9-34 |

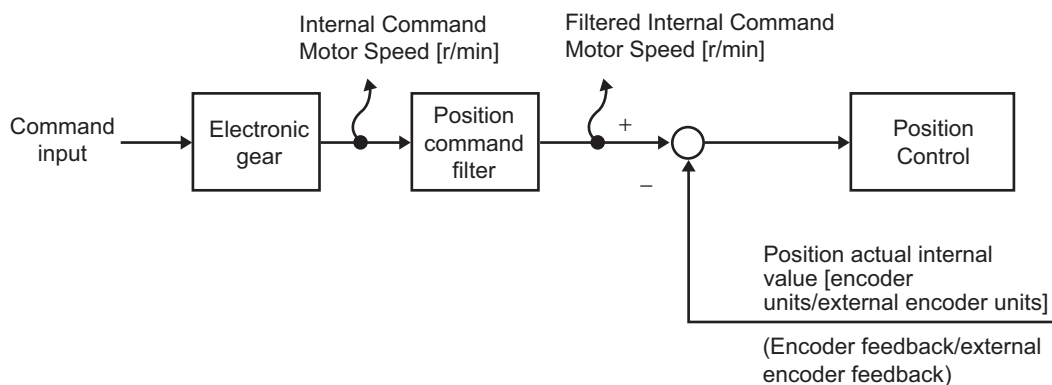
Analog Monitor Objects (3416, 3417, 3418 and 3419 Hex)

The analog monitor scales (3417 hex and 3419 hex) are set in units for 1 V. When the objects are set to 0, the values shown in the table below are automatically set.

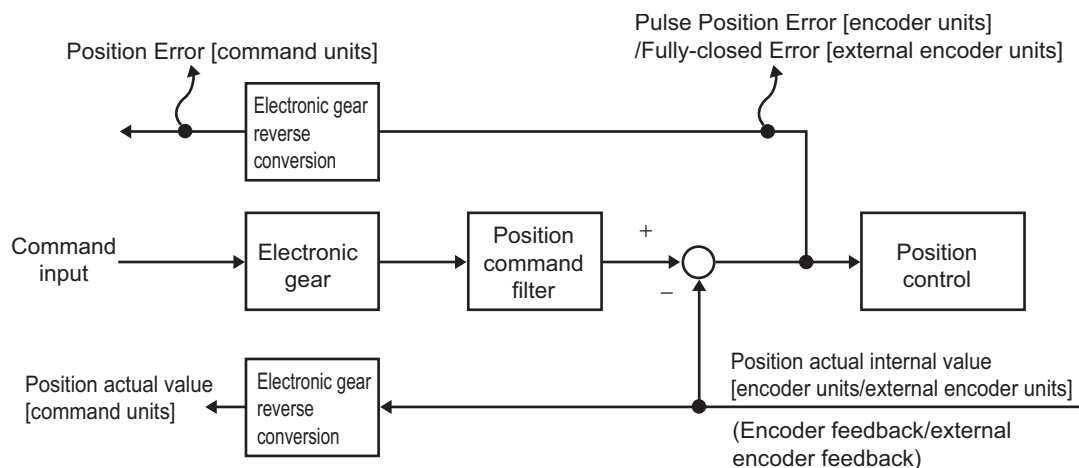
| 3416 hex and 3418 hex set value | Description | | |
|---------------------------------|--|--------------------------------|---|
| | Monitoring item | Unit | Output gain when 3417 hex and 3419 hex are set to 0 |
| 0 | Feedback Motor Speed | r/min | 500 |
| 1 | Internal Command Motor Speed * ¹ | r/min | 500 |
| 2 | Filtered Internal Command Motor Speed * ¹ | r/min | 500 |
| 3 | Motor Control Effort | r/min | 500 |
| 4 | Torque demand | % | 33 |
| 5 | Position Error * ² | pulses (command units) | 3,000 |
| 6 | Pulse Position Error * ² | pulses (encoder units) | 3,000 |
| 7 | Fully-closed Error * ² | pulses (external encoder unit) | 3,000 |
| 8 | Hybrid Error | pulses (command units) | 3,000 |
| 9 | P-N Voltage | V | 80 |
| 10 | Regeneration Load Ratio | % | 33 |
| 11 | Motor Load Ratio | % | 33 |
| 12 | Forward Torque Limit | % | 33 |
| 13 | Reverse Torque Limit | % | 33 |
| 14 | Speed Limit Value | r/min | 500 |
| 15 | Inertia Ratio | % | 500 |

| 3416 hex and 3418 hex set value | Description | | |
|---------------------------------|----------------------------|------------------------|---|
| | Monitoring item | Unit | Output gain when 3417 hex and 3419 hex are set to 0 |
| 16 to 18 | Reserved | — | — |
| 19 | Encoder Temperature *3 | °C | 10 |
| 20 | Servo Drive Temperature | °C | 10 |
| 21 | Encoder 1-rotation Data *4 | pulses (encoder units) | 110,000 |

*1 The Internal Command Motor Speed is the speed before the command input passes through the command filter (the position command filter time constant and the smoothing filter time constant). The Filtered Internal Command Motor Speed is the speed after the command input passes through the command filter.



*2 The position error is calculated for the command input after processing for the position command filter. The pulse position error or fully-closed position error is reversely converted to command input for application. The pulse position error or fully-closed error is the error for the position control input.



*3 The encoder temperature is indicated only for a 20-bit incremental encoder. The value is not stable for other types of encoders.

*4 The direction of monitor data, either forward or reverse, is the direction set in the Rotation Direction Switching (3000 hex). However, CCW is the forward direction for the absolute encoder 1-rotation data. A normal value is output from the incremental encoder after the first phase Z.

Analog Monitor Output Setting (3421 Hex)

Select the direction for analog monitor output voltage.

These are the output voltage range and the output direction when the Analog Monitor 1 Selection or Analog Monitor 2 Selection is set to the feedback motor speed, and the Analog Monitor 1 Scale Setting or the Analog Monitor 2 Scale Setting is set to 0 (i.e., 1V = 500 r/min).

| Set value | Output range | Data output |
|-----------|----------------------------------|-------------|
| 0 | -10 to 10 V | |
| 1 | 0 to 10 V | |
| 2 | 0 to 10 V (5 V as the center) | |

11-2 Gain Adjustment

G5-Series Servo Drives provide a realtime autotuning function.

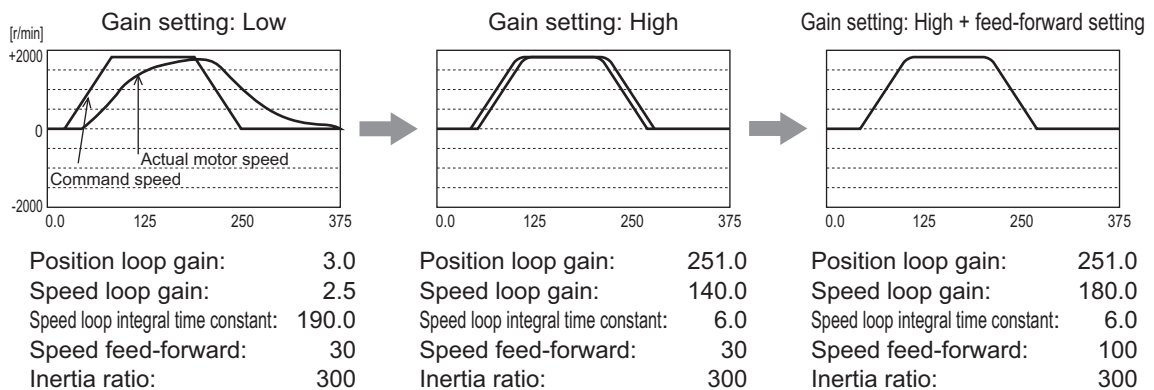
With this function, gain adjustments can be made easily even by those using a servo system for the first time.

If you cannot obtain the desired responsiveness with autotuning, use manual tuning.

11-2-1 Purpose of the Gain Adjustment

The Servo Drive must operate the motor in response to commands from the host system with minimal time delay and maximum reliability. The gain is adjusted to bring the actual operation of the motor as close as possible to the operation specified by the commands, and to maximize the performance of the machine.

Example: Ball screw



11-2-2 Gain Adjustment Methods

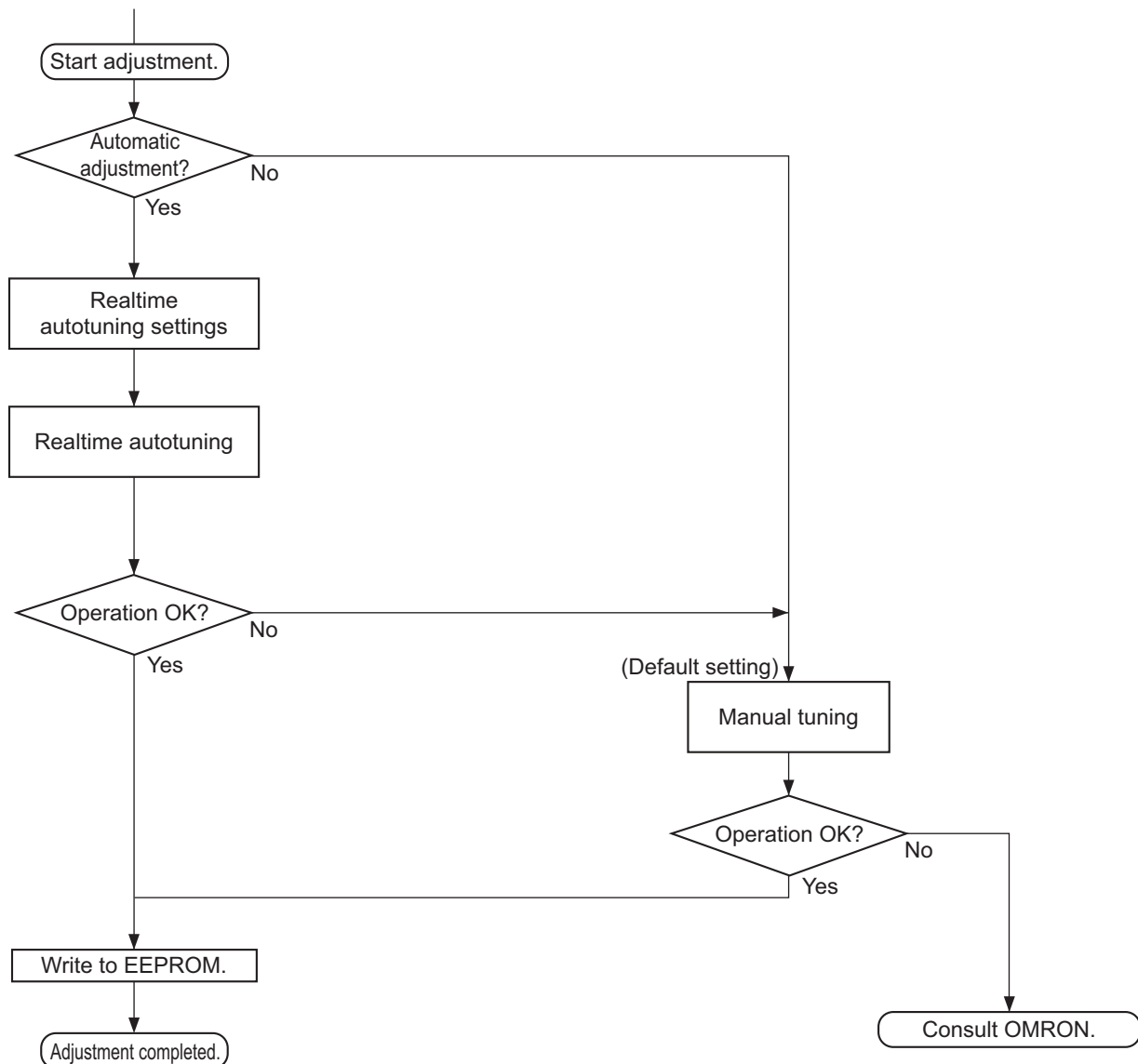
| Function | | Description | Reference page |
|----------------------|---------------------|--|----------------|
| Automatic adjustment | Realtime autotuning | Realtime autotuning estimates the load inertia of the machine in realtime and automatically sets the optimal gain according to the estimated load inertia. | page 11-7 |
| 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 that the maximum responsiveness matches each load is required. | page 11-14 |
| | Basic procedure | Position Control/Fully-closed Control Mode adjustment | page 11-15 |



Precautions for Safe Use

- Take sufficient measures to ensure safety.
- If vibration occurs (unusual noise or vibration), immediately turn OFF the power supply or turn OFF the servo.

11-2-3 Gain Adjustment Procedure



Gain Adjustment and Machine Rigidity

To improve machine rigidity:

- Install the machine on a secure base so that it does not have 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.
- Use gears with small backlash.

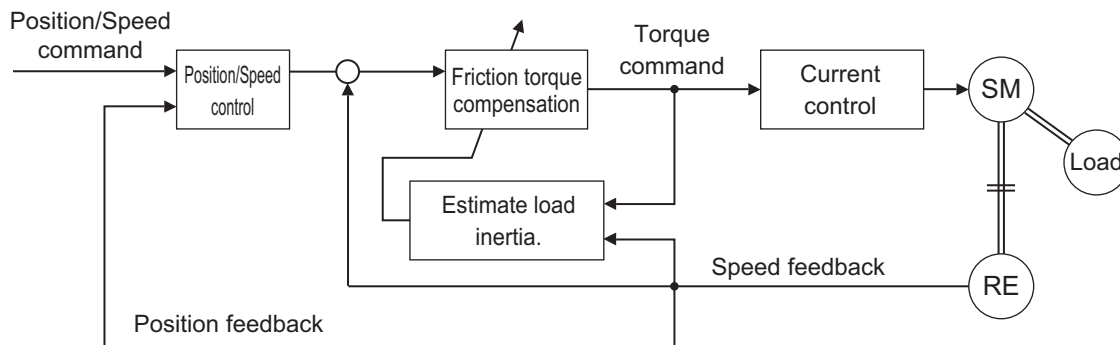
The specific vibration (resonance frequencies) of the mechanical system has a large impact on the gain adjustment of the servo. The servo system responsiveness cannot be set high for machines with a low resonance frequency (low machine rigidity).

11-3 Realtime Autotuning

Realtime autotuning estimates the load inertia of the machine in realtime, and operates the machine by automatically setting the gain according to the estimated load inertia. At the same time, it can lower the resonance and vibration if the adaptive filter is enabled.

Refer to *11-6 Adaptive Filter* on page 11-19 for details about adaptive filters.

Realtime autotuning is enabled for any control to adjust the speed loop PI control.



Precautions for Correct Use

- Realtime autotuning may not function properly under the conditions described in the following table. In such cases, use manual tuning.

| | Conditions under which realtime autotuning does not operate properly |
|-------------------|--|
| Load inertia | <ul style="list-style-type: none"> If the load inertia is too small or too large compared with the rotor inertia (less than 3 times, more than 20 times, or more than the applicable load inertia ratio). If the load inertia changes quickly. |
| Load | <ul style="list-style-type: none"> If the machine rigidity is extremely low. If there is a non-linear element (play), such as a backlash. |
| Operation pattern | <ul style="list-style-type: none"> If the speed continues at below 100 r/min. If the acceleration/deceleration is below 2,000 r/min in 1 s. If the acceleration/deceleration torque is too small compared with the unbalanced load and the viscous friction torque. If either a speed of 100 r/min or higher, or an acceleration/deceleration of 2,000 r/min/s does not last for at least 50 ms. |

- With realtime autotuning, each object 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 integral time constant are altered. Doing this for each pattern can cause vibration, so the estimation value is set conservatively.
- The torque feed-forward function cannot be used when realtime autotuning is being used. Set both the Torque Feed-forward Gain (3112 hex) and Torque Feed-forward Command Filter (3113 hex) to 0.

11-3-1 Objects Requiring Settings

| Index | Name | Explanation | Reference |
|----------|--|---|-----------|
| 3002 hex | Realtime Autotuning Mode Selection | Set the operation mode for the realtime autotuning. | page 9-3 |
| 3003 hex | Realtime Autotuning Machine Rigidity Setting | Set the responsiveness when the realtime autotuning is enabled. | page 9-4 |
| 3631 hex | Realtime Autotuning Estimated Speed Selection | Set the speed to estimate the load characteristic when the realtime autotuning is enabled. | page 9-50 |
| 3632 hex | Realtime Autotuning Customization Mode Setting | Make detailed settings for the autotuning function, when the customized mode (3002 hex = 6) is selected in the Realtime Autotuning Mode Selection (3002 hex). | page 9-51 |

11-3-2 Setting Realtime Autotuning

- 1** When setting realtime autotuning, turn the servo OFF.
- 2** Set Realtime Autotuning mode Selection (3002 hex) depending on the load.

Normally, set the object to 1 or 2.

Use a setting of 3 or 4 when a vertical axis is used.

A setting of 5 is used in combination with a software tool. Do not use it for normal operation.

Gain switching function is enabled for set values 2 to 6.

| Set value | Realtime autotuning | Description |
|-----------|---|--|
| 0 | Disabled | Realtime autotuning is disabled. |
| 1 | Focus on stability (default setting) | No unbalanced load or friction compensation, nor gain switching. |
| 2 | Focus on positioning | Used for a horizontal axis or others that have no unbalanced load, or for a ball screw drive with little friction. |
| 3 | Vertical axis | Used when unbalanced load is present, i.e., with a vertical axis, etc. |
| 4 | Friction compensation and vertical axis | Used when a vertical axis or other unbalanced load is present and when friction is large. Used for a belt-driving shaft with large friction. Variations in finalizing the positioning are suppressed. |
| 5 | Load characteristic estimation | Used only for estimating load characteristics. |
| 6 | Customization | Detailed customization can be set in the Realtime Autotuning Customization Mode Setting (3632 hex). |

11-3-3 Setting Machine Rigidity

- 1 Set the Realtime Autotuning Machine Rigidity Setting (3003 hex) 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 Setting (3003 hex) |
|--|---|
| Ball screw direct coupling | 12 to 24 |
| Ball screw and timing belt | 8 to 20 |
| Timing belt | 4 to 16 |
| Gears, rack and pinion drive | 4 to 16 |
| Other machines with low rigidity | 1 to 8 |
| Stacker cranes | 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, lower the machine rigidity number.
- 3 If there are no problems with the operation, turn the servo OFF and set the Realtime Autotuning Mode Selection (3002 hex) to 0 (disabled).

The adaptive filter can be left enabled even if realtime autotuning is disabled after the completion of adjustments. Even if the adaptive filter is disabled, the settings of notch filters 3 and 4 are held.



Precautions for Correct Use

- After startup, immediately after the first servo ON, or when the Realtime Autotuning Machine Rigidity Setting (3003 hex) is increased, unusual noise or vibration may occur until the load inertia is estimated or the adaptive filter stabilizes. 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 objects used during normal operation to the EEPROM.
 - Lower the Realtime Autotuning Machine Rigidity Setting (3003 hex).
 - Manually set the notch filter.
- Once unusual noise or vibration occurs, Inertia Ratio (3004 hex), Torque Command Value Offset (3607 hex), Forward Direction Torque Offset (3608 hex), and Reverse Direction Torque Offset (3609 hex) 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 (3004 hex), Torque Command Value Offset (3607 hex), Forward Direction Torque Offset (3608 hex) and Reverse Direction Torque Offset (3609 hex) are automatically saved to the EEPROM every 30 minutes. Realtime autotuning uses this saved data as the default settings when the power supply is turned ON again.
- The object is automatically set based on the Realtime Autotuning Machine Rigidity Setting (3003 hex) if realtime autotuning is enabled.

● Realtime Autotuning (RTAT) Object Table

| Index | Name | AT Machine Rigidity Setting (3003 hex) | | | | | | | |
|---------------------------|---|--|-------|-------|-------|-------|-------|-------|-------|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3004 hex | Inertia Ratio | Estimated load inertia ratio | | | | | | | |
| 3100 hex | Position Loop Gain 1 | 20 | 25 | 30 | 40 | 45 | 55 | 75 | 95 |
| 3101 hex | Speed Loop Gain 1 | 15 | 20 | 25 | 30 | 35 | 45 | 60 | 75 |
| 3102 hex | Speed Loop Integral Time Constant 1 | 3700 | 2800 | 2200 | 1900 | 1600 | 1200 | 900 | 700 |
| 3103 hex | Speed Feedback Filter Time Constant 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3104 hex | Torque Command Filter Time Constant 1* ¹ | 1500 | 1100 | 900 | 800 | 600 | 500 | 400 | 300 |
| 3105 hex | Position Loop Gain 2 | 25 | 30 | 40 | 45 | 55 | 70 | 95 | 120 |
| 3106 hex | Speed Loop Gain 2 | 15 | 20 | 25 | 30 | 35 | 45 | 60 | 75 |
| 3107 hex | Speed Loop Integral Time Constant 2 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| 3108 hex | Speed Feedback Filter Time Constant 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3109 hex | Torque Command Filter Time Constant 2* ¹ | 1500 | 1100 | 900 | 800 | 600 | 500 | 400 | 300 |
| 3110 hex | Speed Feed-forward Gain | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| 3111 hex | Speed Feed-forward Command Filter | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3112 hex | Torque Feed-forward Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3113 hex | Torque Feed-forward Command Filter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3114 hex | Gain Switching Input Operating Mode Selection | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3115 hex | Switching Mode in Position Control | Gain Switching Enable Mode: 10 Gain Switching Disable Mode: 0 | | | | | | | |
| 3116 hex | Gain Switching Delay Time in Position Control | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 3117 hex | Gain Switching Level in Position Control | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3118 hex | Gain Switching Hysteresis in Position Control | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3119 hex | Position Gain Switching Time | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3607 hex | Torque Command Value Offset | Estimated torque command additional value | | | | | | | |
| 3608 hex | Forward Direction Torque Offset | Estimated positive torque compensation value | | | | | | | |
| 3609 hex | Reverse Direction Torque Offset | Estimated negative torque compensation value | | | | | | | |
| 3610 hex.0, 3610 hex.1 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3623 hex | Disturbance Torque Compensation Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3624 hex | Disturbance Observer Filter Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*1 This is limited to a minimum value of 10 if a 17-bit absolute encoder is used.

| Index | Name | AT Machine Rigidity Setting (3003 hex) | | | | | | | |
|---------------------------|---|--|-------|-------|-------|-------|-------|-------|-------|
| | | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 3004 hex | Inertia Ratio | Estimated load inertia ratio | | | | | | | |
| 3100 hex | Position Loop Gain 1 | 115 | 140 | 175 | 320 | 390 | 480 | 630 | 720 |
| 3101 hex | Speed Loop Gain 1 | 90 | 110 | 140 | 180 | 220 | 270 | 350 | 400 |
| 3102 hex | Speed Loop Integral Time Constant 1 | 600 | 500 | 400 | 310 | 250 | 210 | 160 | 140 |
| 3103 hex | Speed Feedback Filter Time Constant 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3104 hex | Torque Command Filter Time Constant 1 ^{*1} | 300 | 200 | 200 | 126 | 103 | 84 | 65 | 57 |
| 3105 hex | Position Loop Gain 2 | 140 | 175 | 220 | 380 | 460 | 570 | 730 | 840 |
| 3106 hex | Speed Loop Gain 2 | 90 | 110 | 140 | 180 | 220 | 270 | 350 | 400 |
| 3107 hex | Speed Loop Integral Time Constant 2 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| 3108 hex | Speed Feedback Filter Time Constant 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3109 hex | Torque Command Filter Time Constant 2 ^{*1} | 300 | 200 | 200 | 126 | 103 | 84 | 65 | 57 |
| 3110 hex | Speed Feed-forward Gain | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| 3111 hex | Speed Feed-forward Command Filter | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3112 hex | Torque Feed-forward Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3113 hex | Torque Feed-forward Command Filter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3114 hex | Gain Switching Input Operating Mode Selection | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3115 hex | Switching Mode in Position Control | Gain Switching Enable Mode: 10 Gain Switching Disable Mode: 0 | | | | | | | |
| 3116 hex | Gain Switching Delay Time in Position Control | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 3117 hex | Gain Switching Level in Position Control | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3118 hex | Gain Switching Hysteresis in Position Control | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3119 hex | Position Gain Switching Time | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3607 hex | Torque Command Value Offset | Estimated torque command additional value | | | | | | | |
| 3608 hex | Forward Direction Torque Offset | Estimated positive torque compensation value | | | | | | | |
| 3609 hex | Reverse Direction Torque Offset | Estimated negative torque compensation value | | | | | | | |
| 3610 hex.0, 3610 hex.1 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3623 hex | Disturbance Torque Compensation Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3624 hex | Disturbance Observer Filter Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*1 This is limited to a minimum value of 10 if a 17-bit absolute encoder is used.

| Index | Name | AT Machine Rigidity Setting (3003 hex) | | | | | | | |
|---------------------------|---|--|-------|-------|-------|-------|-------|-------|-------|
| | | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 3004 hex | Inertia Ratio | Estimated load inertia ratio | | | | | | | |
| 3100 hex | Position Loop Gain 1 | 900 | 1080 | 1350 | 1620 | 2060 | 2510 | 3050 | 3770 |
| 3101 hex | Speed Loop Gain 1 | 500 | 600 | 750 | 900 | 1150 | 1400 | 1700 | 2100 |
| 3102 hex | Speed Loop Integral Time Constant 1 | 120 | 110 | 90 | 80 | 70 | 60 | 50 | 40 |
| 3103 hex | Speed Feedback Filter Time Constant 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3104 hex | Torque Command Filter Time Constant 1 ^{*1} | 45 | 38 | 30 | 25 | 20 | 16 | 13 | 11 |
| 3105 hex | Position Loop Gain 2 | 1050 | 1260 | 1570 | 1880 | 2410 | 2930 | 3560 | 4400 |
| 3106 hex | Speed Loop Gain 2 | 500 | 600 | 750 | 900 | 1150 | 1400 | 1700 | 2100 |
| 3107 hex | Speed Loop Integral Time Constant 2 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| 3108 hex | Speed Feedback Filter Time Constant 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3109 hex | Torque Command Filter Time Constant 2 ^{*1} | 45 | 38 | 30 | 25 | 20 | 16 | 13 | 11 |
| 3110 hex | Speed Feed-forward Gain | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| 3111 hex | Speed Feed-forward Command Filter | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3112 hex | Torque Feed-forward Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3113 hex | Torque Feed-forward Command Filter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3114 hex | Gain Switching Input Operating Mode Selection | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3115 hex | Switching mode in Position Control | Gain Switching Enable Mode: 10 Gain Switching Disable Mode: 0 | | | | | | | |
| 3116 hex | Gain Switching Delay Time in Position Control | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 3117 hex | Gain Switching Level in Position Control | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3118 hex | Gain Switching Hysteresis in Position Control | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3119 hex | Position Gain Switching Time | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3607 hex | Torque Command Value Offset | Estimated torque command additional value | | | | | | | |
| 3608 hex | Forward Direction Torque Offset | Estimated positive torque compensation value | | | | | | | |
| 3609 hex | Reverse Direction Torque Offset | Estimated negative torque compensation value | | | | | | | |
| 3610 hex.0, 3610 hex.1 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3623 hex | Disturbance Torque Compensation Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3624 hex | Disturbance Observer Filter Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*1 This is limited to a minimum value of 10 if a 17-bit absolute encoder is used.

| Index | Name | AT Machine Rigidity Setting (3003 hex) | | | | | | | |
|---------------------------|---|--|-------|-------|-------|-------|-------|-------|-------|
| | | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 3004 hex | Inertia Ratio | Estimated load inertia ratio | | | | | | | |
| 3100 hex | Position Loop Gain 1 | 4490 | 5000 | 5600 | 6100 | 6600 | 7200 | 8100 | 9000 |
| 3101 hex | Speed Loop Gain 1 | 2500 | 2800 | 3100 | 3400 | 3700 | 4000 | 4500 | 5000 |
| 3102 hex | Speed Loop Integral Time Constant 1 | 40 | 35 | 30 | 30 | 25 | 25 | 20 | 20 |
| 3103 hex | Speed Feedback Filter Time Constant 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3104 hex | Torque Command Filter Time Constant 1* ¹ | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 5 |
| 3105 hex | Position Loop Gain 2 | 5240 | 5900 | 6500 | 7100 | 7700 | 8400 | 9400 | 10500 |
| 3106 hex | Speed Loop Gain 2 | 2500 | 2800 | 3100 | 3400 | 3700 | 4000 | 4500 | 5000 |
| 3107 hex | Speed Loop Integral Time Constant 2 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| 3108 hex | Speed Feedback Filter Time Constant 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3109 hex | Torque Command Filter Time Constant 2* ¹ | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 5 |
| 3110 hex | Speed Feed-forward Gain | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| 3111 hex | Speed Feed-forward Command Filter | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3112 hex | Torque Feed-forward Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3113 hex | Torque Feed-forward Command Filter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3114 hex | Gain Switching Input Operating Mode Selection | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3115 hex | Switching mode in Position Control | Gain Switching Enable Mode: 10 Gain Switching Disable Mode: 0 | | | | | | | |
| 3116 hex | Gain Switching Delay Time in Position Control | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 3117 hex | Gain Switching Level in Position Control | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3118 hex | Gain Switching Hysteresis in Position Control | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3119 hex | Position Gain Switching Time | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 3607 hex | Torque Command Value Offset | Estimated torque command additional value | | | | | | | |
| 3608 hex | Forward Direction Torque Offset | Estimated positive torque compensation value | | | | | | | |
| 3609 hex | Reverse Direction Torque Offset | Estimated negative torque compensation value | | | | | | | |
| 3610 hex.0, 3610 hex.1 | Function Expansion Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3623 hex | Disturbance Torque Compensation Gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3624 hex | Disturbance Observer Filter Setting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*1 This is limited to a minimum value of 10 if a 17-bit absolute encoder is used.

11-4 Manual Tuning

As described before, the G5-series have a realtime autotuning function. Readjustment, however, is required if realtime autotuning cannot adjust the gain properly for same reasons: there is a restriction by load conditions, or a necessity to ensue optimum responsiveness and stability for each load.

This section describes how to perform manual tuning.

11-4-1 Basic Settings

Before Manual Setting

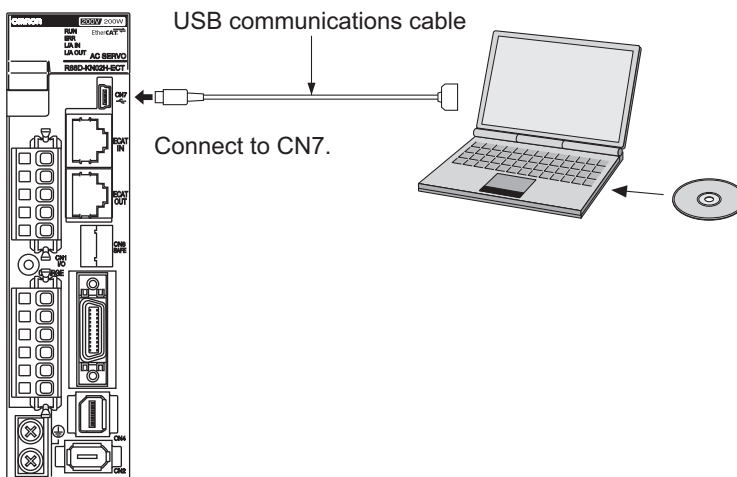
More reliable adjustment can be performed quickly by using waveform monitoring with the data tracing function of the CX-Drive or by measuring the analog voltage waveform with the monitor function.

● Analog Monitor Output

The feedback motor speed, internal command motor speed, command torque, and position error can be measured as an 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 (3416 hex) and Analog Monitor 2 Selection (3418 hex) settings. For details, refer to *11-1 Analog Monitor* on page 11-2.

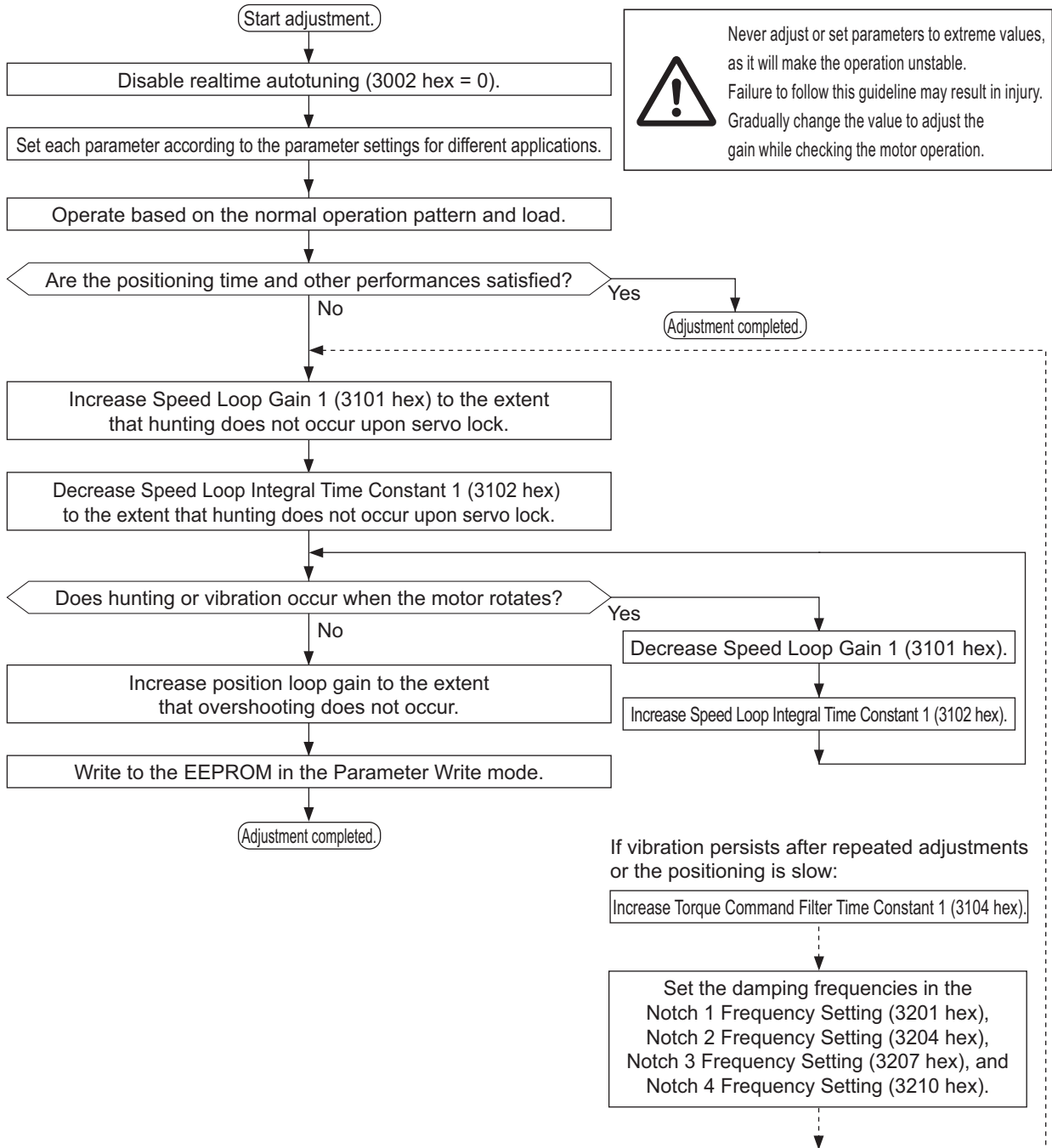
● CX-Drive Data Tracing Function

Commands to the motor and motor operation (speed, command torque, and position error) can be displayed on a computer as waveforms. Refer to the *CX-Drive Operation Manual* (Cat. No. W453).



Position Control/Fully-closed Control Mode Adjustment

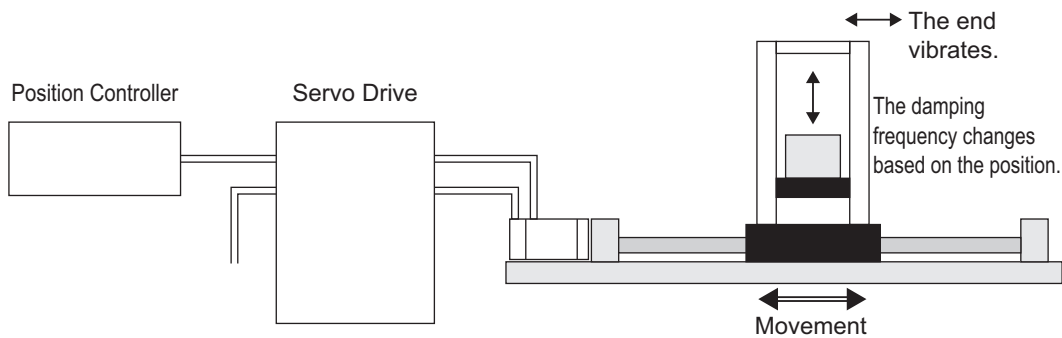
Use the following procedure to perform the adjustment in position control for the Servo Drive.



11-5 Damping Control

If the tip of the mechanical unit vibrates, you can use the damping control function to reduce vibration. This is effective on vibration generated by a machine of low rigidity. The applicable frequencies are from 1 to 200 Hz.

You can set four frequencies, and use two of them at the same time.



11-5-1 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|--------------------------|--|-----------|
| 3213 hex | Damping Filter Selection | Select the Damping Filter Switching Mode according to the condition of the unit. 0: Up to two filters can be used simultaneously. 3: Switching with command direction. | page 9-23 |
| 3214 hex | Damping Frequency 1 | Set damping frequency 1 to suppress vibration at the end of the load in damping control. If the damping control function is not used, set the damping frequency to a value between 0 and 0.9 [Hz]. | page 9-23 |
| 3215 hex | Damping Filter 1 Setting | When Damping Frequency 1 (3214 hex) is set, reduce this setting if torque saturation occurs or increase this setting to increase operation speed. Normally 0 is set. If damping filter 1 is disabled, this object is also disabled. | page 9-23 |
| 3216 hex | Damping Frequency 2 | The function is the same with 3214 hex. | page 9-23 |
| 3217 hex | Damping Filter 2 Setting | The function is the same with 3215 hex. | page 9-24 |
| 3218 hex | Damping Frequency 3 | The function is the same with 3214 hex. | page 9-24 |
| 3219 hex | Damping Filter 3 Setting | The function is the same with 3215 hex. | page 9-24 |
| 3220 hex | Damping Frequency 4 | The function is the same with 3214 hex. | page 9-24 |
| 3221 hex | Damping Filter 4 Setting | The function is the same with 3215 hex. | page 9-24 |



Precautions for Correct Use

- Stop operation before changing the objects or switching with DFSEL.
- Damping control may not function properly or the effect may not be apparent under the following conditions.

| Item | Conditions under which the effect of damping control is inhibited |
|----------------|---|
| Load condition | <ul style="list-style-type: none"> • If forces other than position commands, such as external forces, cause vibration. • If the damping frequency is outside the range of 1.0 to 200 Hz. • If the ratio of the resonance frequency to anti-resonance frequency is large. |

11-5-2 Operating Procedure

- 1 Adjust the position loop gain and speed loop gain.

Adjust Position Loop Gain 1 (3100 hex), Speed Loop Gain 1 (3101 hex), Speed Loop Integral Time Constant 1 (3102 hex), and Torque Command Filter Time Constant 1 (3104 hex).

If no problem occurs in realtime autotuning, you can continue to use the settings.

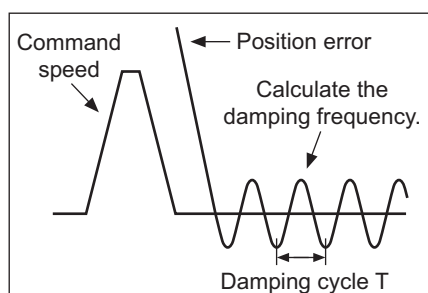
- 2 Measure the damping frequency at the tip of the mechanical unit.

Measure the damping frequency by using a measurement device such as a laser displacement sensor, servo acceleration meter, or acceleration pick-up.

Set the measured damping frequency in one of Damping Frequency 1 to Damping Frequency 4 (1: 3214 hex, 2: 3216 hex, 3: 3218 hex, 4: 3220 hex) according to the operation.

Also set the Switching Mode using Damping Filter Selection (3213 hex).

If the measurement device cannot be used, use CX-Drive tracing function, and read the residual damping frequency (Hz) from the position error waveform as shown in the following figure.



- The damping frequency in the figure is calculated with the following formula:

$$f \text{ (Hz)} = \frac{1}{T \text{ (s)}}$$

Since the object unit is 0.1 Hz:

(3214 hex, 3216 hex, 3218 hex, 3220 hex) = 10 × f

- Application example

If the damping cycle is 100 ms or 20 ms, set 100 or 500 in the object so that the damping frequency becomes 10 Hz or 50 Hz.

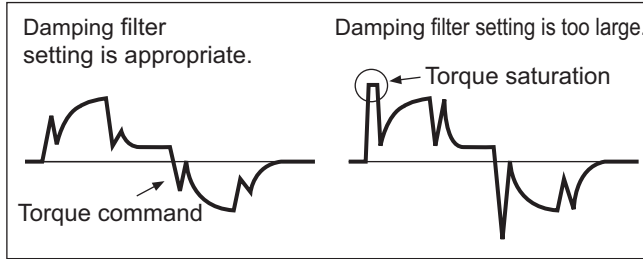
If vibration persists after setting the frequency, increase or decrease the resonance frequency to find a proper one with minimum vibration.

3 Make the damping filter settings.

Make damping filter settings (1: 3215 hex, 2: 3217 hex, 3: 3219 hex, 4: 3221 hex).

First, set the filter to 0 and check the torque waveform during operation.

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 setting the damping frequencies, reduce the setting if the torque become saturated and increase the setting to make operation faster. Normally 0 is set.

The setting range is as follows:

$$\begin{aligned} &\text{Damping filter setting range: Damping filter setting} \leq \text{Damping frequency} \\ &100 \leq (\text{Damping frequency} + \text{Damping filter setting}) \end{aligned}$$

4 Set the Damping Filter Selection (3213 hex).

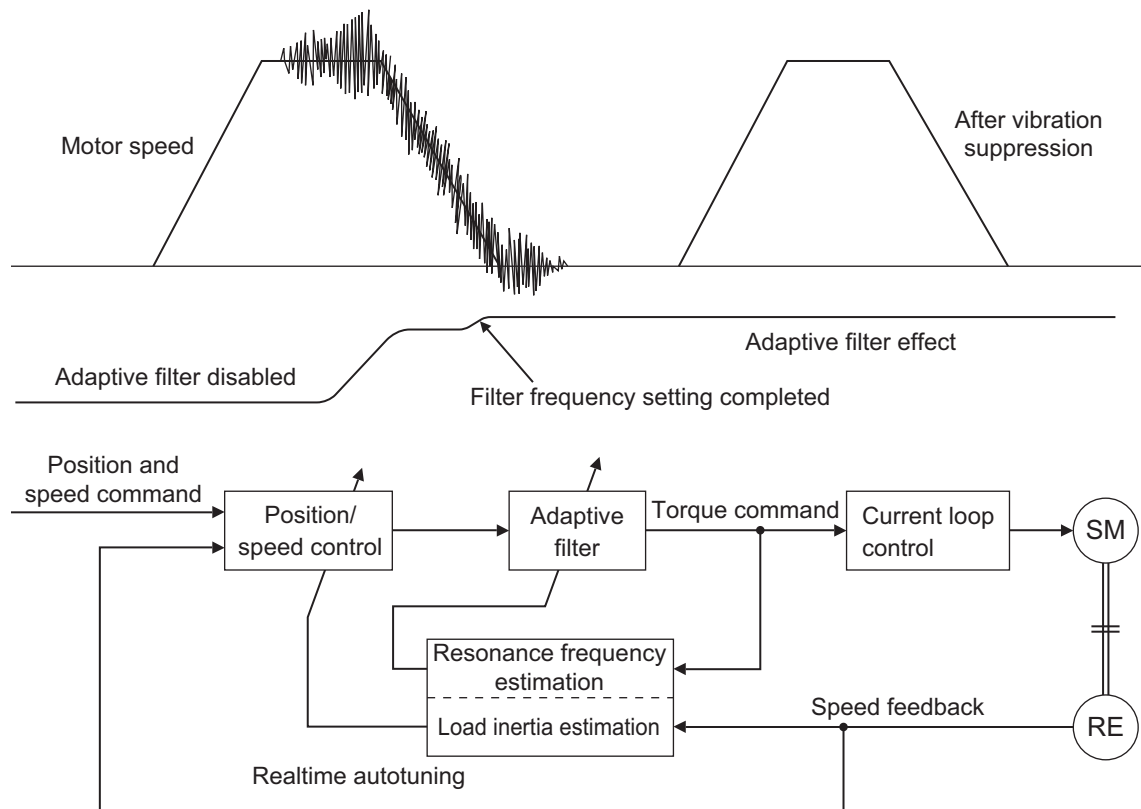
Damping filters 1 to 4 can be switched according to the conditions of the machine vibration.

| Set value | Switching mode |
|-----------|--|
| 0 | Up to two filters, Damping Filter 1 and Damping Filter 2, can be used simultaneously. |
| 1, 2 | For use by manufacturer. Do not use this setting. |
| 3 | Switching with command direction Forward: Damping filter 1 and 3 enabled Reverse: Damping filter 2 and 4 enabled |

11-6 Adaptive Filter

The adaptive filter reduces resonance point vibration by estimating the resonance frequency from the vibration component that appears in the motor speed during actual operation and automatically sets the frequency of the notch filter, which removes the resonance component from the torque command.

The automatically set notch filter frequency is set in Notch 3 (3207 to 3209 hex) or Notch 4 (3210 to 3212 hex). Refer to *11-7 Notch Filters* on page 11-22 for information on notch filter.



11-6-1 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|---------------------------|--|-----------|
| 3200 hex | Adaptive Filter Selection | <p>Set the number of resonance frequencies to be estimated by the adaptive filter and the operation to be performed after estimation.</p> <p>0: Adaptive filter disabled.</p> <p>1: One adaptive filter enabled. The objects related to notch filter 3 are automatically updated.</p> <p>2: Two adaptive filters enabled. The objects related to notch filters 3 and 4 are automatically updated.</p> <p>3: For use by manufacturer. Do not use this setting.</p> <p>4: Adaptive result is cleared.</p> <p>Objects related to notch filters 3 and 4 are disabled and the adaptive result is cleared.</p> | page 9-20 |



Precautions for Correct Use

- Adaptive filter may not operate correctly under the following conditions.

| Item | Conditions that interfere with the adaptive filter |
|------------------|---|
| Resonance points | <ul style="list-style-type: none"> If the resonance frequency is 300 Hz or lower. If the resonance peak or control gain is too low to affect the motor speed. If there are three or more resonance points. |
| Load | <ul style="list-style-type: none"> If the motor speed with high-frequency components changes due to backlash or other non-linear elements. |
| Command pattern | <ul style="list-style-type: none"> If the acceleration/deceleration is 3,000 r/min/s or higher. |

- If the adaptive filter does not operate properly, use Notch 1 (3201 to 3203 hex) or Notch 2 (3204 to 3206 hex) to reduce resonance according to the manual adjustment procedure. Refer to *11-7 Notch Filters* on page 11-22 for information on notch filter.

11-6-2 Operating Procedure

1 Set the Adaptive Filter Selection (3200 hex).

Select adaptive filter 1 or 2 in the Adaptive Filter Selection (3200 hex).

2 Start actual operation.

Enter an operation command and start the actual operation.

3 The Notch Filters 3 and 4 are automatically set.

When the influence of a resonance point appears in the motor speed, the Notch Filters 3 and 4 objects are set automatically according to the number of adaptive filters.



Precautions for Correct Use

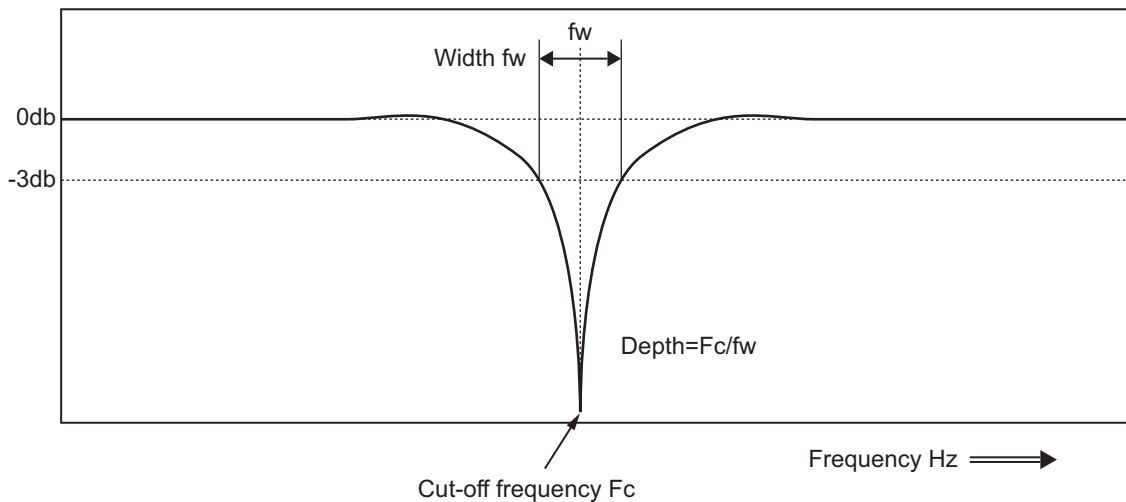
- An unusual noise or vibration may occur until the adaptive filter stabilizes after startup, immediately after the first servo ON, or when the Realtime Autotuning Machine Rigidity Selection (3003 hex) is increased. This is not a problem if it disappears right away. If the vibration or unusual noise, however, continues for three or more reciprocating operations, take the following measures in the possible order.
 - Write the objects used during normal operation to the EEPROM.
 - Lower the Realtime Autotuning Machine Rigidity Setting (3003 hex).
 - Disable the adaptive filter by setting the Adaptive Filter Selection (3200 hex) to 0. (Resetting of inertial estimation and adaptive operation)
 - Manually set the notch filter.
- If unusual noise or vibration occurs, the setting of Notch 3 (3207 to 3209 hex) or Notch 4 (3210 to 3212 hex) may have changed to an extreme value. In this case, set Adaptive Filter Selection (3200 hex) to 0 to disable the object and then set the Notch 3 Frequency Setting (3207 hex) and Notch 4 Frequency Setting (3210 hex) to 5,000 (disabled). Next, enable Adaptive Filter Selection again.
- The Notch 3 Frequency Setting (3207 hex) and Notch 4 Frequency Setting (3210 hex) are written to the EEPROM every 30 minutes. When the power supply is turned OFF and then turned ON again, this data is used as the default settings to perform adaptive operation.

11-7 Notch Filters

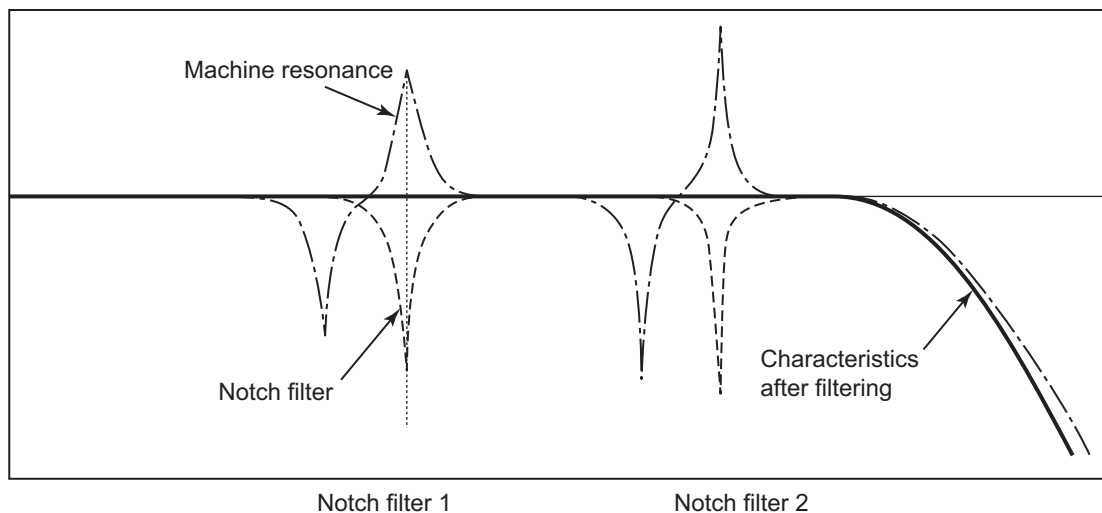
When the machine rigidity is low, axis torsion may produce resonance which results in vibration and noise. Thus you may not be able to set a high gain. The notch filter can restrict the resonance peak, and allows a high gain setting and vibration reduction.

The G5-series Servo Drives provide four notch filters that can be used for adjusting frequency, width and depth. If a ball screw or other controlled device causes resonance at a 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.



11-7-1 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|------------------------------|---|-----------|
| 3201 hex | Notch 1 Frequency Setting | Set the center frequency of notch filter 1. The notch filter is enabled at 50 to 4,999 Hz, and disabled if 5,000 Hz is set. | page 9-20 |
| 3202 hex | Notch 1 Width Setting | Select the width of the notch filter 1 frequency. Increasing the value widens the notch width. (Setting range: 0 to 20) | page 9-20 |
| 3203 hex | Notch 1 Depth Setting | Select the depth of the notch filter 1 center frequency. Increasing the value decreases the notch depth and thereby reduces the phase delay. The notch filter is disabled if 100 is set. (Setting range: 0 to 99) | page 9-20 |
| 3204 hex | Notch 2 Frequency Setting | Set the center frequency of the notch filter 2. The details are the same with the notch filter 1 frequency. | page 9-21 |
| 3205 hex | Notch 2 Width Setting | Select the width of the notch filter 2 frequency. The details are the same with the notch filter 1 width. | page 9-21 |
| 3206 hex | Notch 2 Depth Setting | Select the depth of the notch filter 2 center frequency. The details are the same with the notch filter 1 depth. | page 9-21 |
| 3207 hex | Notch 3 Frequency Setting *1 | Set the center frequency of the notch filter 3. The details are the same with the notch filter 1 frequency. | page 9-21 |
| 3208 hex | Notch 3 Width Setting *1 | Select the width of the notch filter 3 frequency. The details are the same with the notch filter 1 width. | page 9-21 |
| 3209 hex | Notch 3 Depth Setting *1 | Select the depth of the notch filter 3 center frequency. The details are the same with the notch filter 1 depth. | page 9-22 |
| 3210 hex | Notch 4 Frequency Setting *1 | Set the center frequency of the notch filter 4. The details are the same with the notch filter 1 frequency. | page 9-22 |
| 3211 hex | Notch 4 Width Setting *2 | Select the width of the notch filter 4 frequency. The details are the same with the notch filter 1 width. | page 9-22 |
| 3212 hex | Notch 4 Depth Setting *2 | Select the depth of the notch filter 4 center frequency. The details are the same with the notch filter 1 depth. | page 9-22 |

*1 If an adaptive filter is used, these objects are set automatically.

*2 These objects are set automatically when two adaptive filters are enabled.



Precautions for Correct Use

- Identify the resonance frequency using the FFT analysis function or operation waveform of the waveform graphics function of CX-Drive and set the identified frequency as the notch filter frequency.

11-7-2 Notch Filter Width and Depth

Width Setting

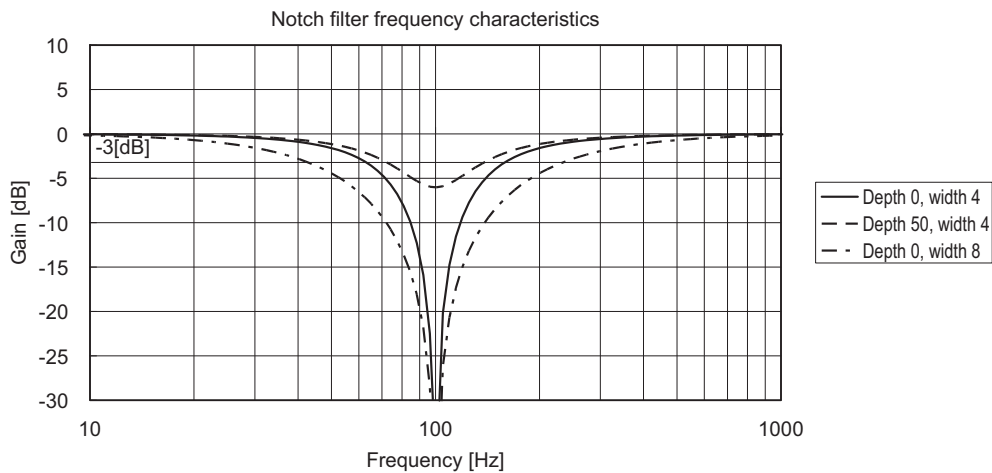
This is the ratio of the frequency bandwidth at a damping factor of -3 [dB] relative to the center frequency when the depth is 0. This value should conform to the left column in the table below.

Depth Setting

This is the I/O ratio at which the center frequency input is completely cut off at a set value of 0 and completely passed at a set value of 100. If the indication unit is [dB], this value should conform to the right column in the table below.

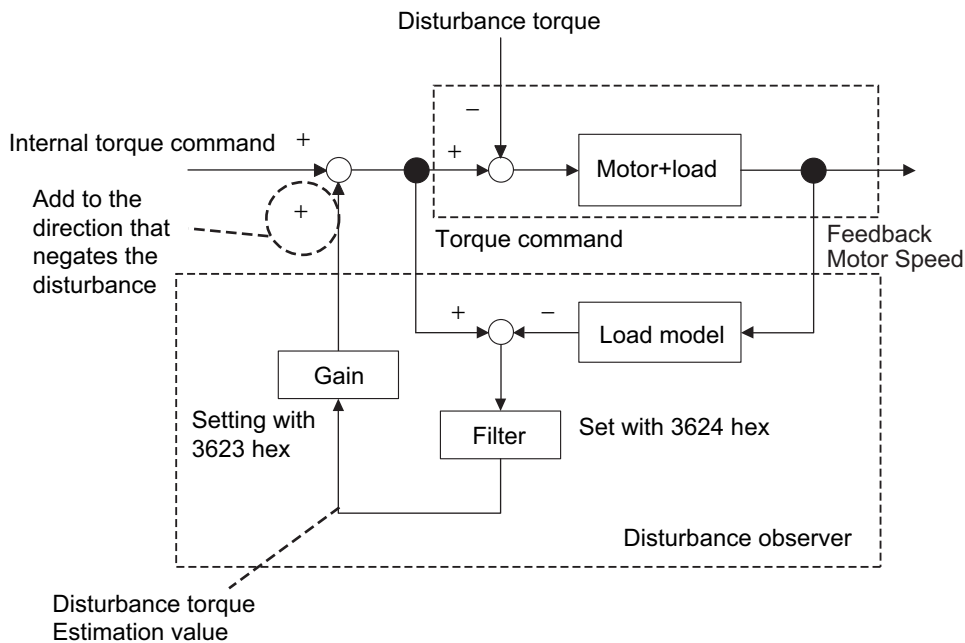
| Width | |
|-----------|----------------------------|
| Set value | Bandwidth/center frequency |
| 0 | 0.50 |
| 1 | 0.59 |
| 2 | 0.71 |
| 3 | 0.84 |
| 4 | 1.00 |
| 5 | 1.19 |
| 6 | 1.41 |
| 7 | 1.68 |
| 8 | 2.00 |
| 9 | 2.38 |
| 10 | 2.83 |
| 11 | 3.36 |
| 12 | 4.00 |
| 13 | 4.76 |
| 14 | 5.66 |
| 15 | 6.73 |
| 16 | 8.00 |
| 17 | 9.51 |
| 18 | 11.31 |
| 19 | 13.45 |
| 20 | 16.00 |

| Depth | | |
|-----------|---------------|---------------------|
| Set value | I/O ratio (%) | Damping factor (dB) |
| 0 | 0 (Cut off) | $-\infty$ |
| 1 | 1 | -40.0 |
| 2 | 2 | -34.0 |
| 3 | 3 | -30.5 |
| 4 | 4 | -28.0 |
| 5 | 5 | -26.0 |
| 10 | 10 | -20.0 |
| 15 | 15 | -16.5 |
| 20 | 20 | -14.0 |
| 25 | 25 | -12.0 |
| 30 | 30 | -10.5 |
| 35 | 35 | -9.1 |
| 40 | 40 | -8.0 |
| 45 | 45 | -6.9 |
| 50 | 50 | -6.0 |
| 60 | 60 | -4.4 |
| 70 | 70 | -3.1 |
| 80 | 80 | -1.9 |
| 90 | 90 | -0.9 |
| 100 | 100 (Passed) | 0.0 |



11-8 Disturbance Observer Function

You can lower the effect of the disturbance torque and reduce vibration by using the estimated disturbance torque value.



11-8-1 Operating Conditions

You can use the disturbance observer in the following situations.

| | Conditions |
|----------------|--|
| Operating mode | Position control (semi-closed control), speed control |
| Others | <ul style="list-style-type: none"> • When Servo is ON. • When elements other than control parameters, such as the torque limit, are set correctly and there is no trouble with the motor's normal rotation. • When realtime autotuning function is disabled (3002 hex = 0). • When instantaneous speed observer function is disabled (3610 hex bit 0 = 0). |



Precautions for Correct Use

- If there is a resonance point below the cut-off frequency estimated by the disturbance observer or if a large amount of high-frequency elements is found in the disturbance torque, the disturbance observer may not be effective.

11-8-2 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|--------------------------------------|---|-----------|
| 3610 hex | Function Expansion Settings | Set the bits related to the disturbance observer. | page 9-48 |
| 3623 hex | Disturbance Torque Compensation Gain | Set the compensation gain for disturbance torque. | page 9-50 |
| 3624 hex | Disturbance Observer Filter Setting | Set the filter time constant for disturbance torque compensation. | page 9-50 |

11-8-3 Operating Procedure

1 Set the Function Expansion Setting (3610 hex).

Set whether to enable or disable the disturbance observer in bit 1.

0: Disabled

1: Enabled

Set the operating conditions for enabling the function in bit 2.

0: Enabled at all time

1: Enabled only when gain 1 is selected

2 Set the Disturbance Observer Filter Setting (3624 hex).

Set a small value for the Disturbance Torque Compensation Gain (3623 hex). Change the value in the Disturbance Observer Filter Setting (3624 hex) from a large value gradually to a smaller one. The smaller the value set of the Disturbance Observer Filter Setting (3624 hex) is, the lesser disturbance torque lag can be estimated, and the more effective control over the disturbance influence can be obtained. But the smaller the value is, the larger the operation noise can be. You must consider the balance of these advantage and disadvantage to set a value.

3 Set the Disturbance Torque Compensation Gain (3623 hex).

After you set the Disturbance Observer Filter Setting (3624 hex), increase the value of the Disturbance Torque Compensation Gain (3623 hex) from a small value to a large value. The larger the value set on the Disturbance Torque Compensation Gain (3623 hex) is, the more effective control over the disturbance influence can be obtained. But the larger the value is, the larger the operation noise will be. Set this object in combination with the Disturbance Observer Filter Setting (3624 hex) to achieve balanced settings.

11-9 Friction Torque Compensation Function

Two types of friction torque compensations can be set to reduce the influence of mechanical frictions. One is the unbalanced load compensation that offsets the constantly applied unbalance torque. The other is the dynamic friction compensation that changes the offset direction in accordance with the operating direction.

11-9-1 Operating Conditions

You can use the function under the following conditions:

| Conditions |
|---|
| <ul style="list-style-type: none"> When Servo is ON. When elements other than control parameters, such as the torque limit, are set correctly and there is no trouble with the motor's normal rotation. |

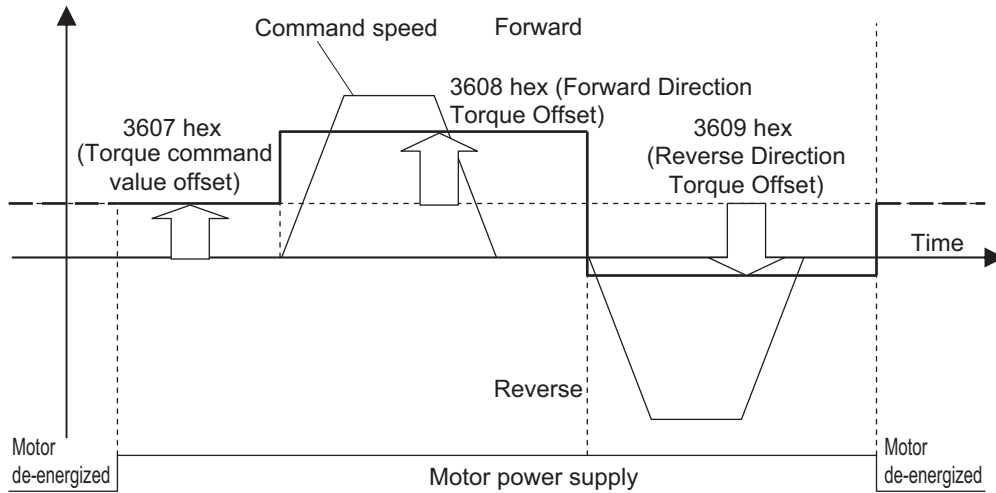
11-9-2 Objects Requiring Settings

The torque compensation function needs the combined settings of following three objects.

| Index | Name | Description | Reference |
|----------|---------------------------------|---|-----------|
| 3607 hex | Torque Command Value Offset | Set the unbalanced load compensation value that is always added to the internal torque command in the control mode other than torque control. | page 9-47 |
| 3608 hex | Forward Direction Torque Offset | Set the dynamic friction compensation value that is added to the internal torque command when a forward position command is input for position control or fully-closed control. | page 9-47 |
| 3609 hex | Reverse Direction Torque Offset | Set the dynamic friction compensation value that is added to the internal torque command when a reverse position command is input for position control or fully-closed control. | page 9-47 |

11-9-3 Operation Example

The friction torque compensation is applied in the input direction of the position command as shown in the drawing below.



The Torque Command Value Offset (3607 hex) reduces the variations of positioning operations due to the movement directions when a certain amount of unbalanced load torque is always applied to the motor at the vertical axis by setting the torque command.

By setting the friction torque for each rotation direction in the Forward Direction Torque Offset (3608 hex) and Reverse Direction Torque Offset (3609 hex), you can reduce the deterioration of and inconsistencies in the positioning stabilization time due to dynamic friction for loads that require a large amount of dynamic friction torque due to a radial load, such as the belt-driven shaft.



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 are 0 regardless of the object setting.
- When servo is OFF during speed control
The unbalanced load compensation is enabled based on 3607 hex. The dynamic friction compensation will be 0 regardless of the object setting.
- When the Servo Is Turned ON during Position Control or Fully-closed Control
The unbalanced load compensation and the dynamic friction compensation values are held until the first position command is input. When the position command is input, the unbalanced load compensation is updated based on 3607 hex. Also, based on the command direction, the dynamic friction compensation value is updated according to objects 3608 and 3609 hex.

11-10 Hybrid Vibration Suppression Function

This function suppresses the vibration that is caused by the amount of the torsion between the motor and the load in the Fully-closed Control Mode. You can use this function to increase the gain setting.

11-10-1 Operating Conditions

The hybrid vibration suppression function can be used in the following situations.

| | Conditions |
|----------------|---|
| Operating mode | Fully-closed Control mode |
| Others | <ul style="list-style-type: none"> When Servo is ON. When elements other than control parameters, such as the torque limit, are set correctly and there is no trouble with the motor's normal rotation. |

11-10-2 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|-------------------------------------|--|-----------|
| 3634 hex | 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. | page 9-52 |
| 3635 hex | Hybrid Vibration Suppression Filter | Set the hybrid vibration suppression filter. | page 9-52 |

11-10-3 Operating Procedure

- 1 Set the Hybrid Vibration Suppression Gain (3634 hex) to the same value as the position loop gain.
- 2 Gradually increase the set value of the Hybrid Vibration Suppression Filter (3635 hex) while driving with fully-closed control and check the changes in the response.

If the response improves, find the combination of 3634 hex and 3635 hex 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. It may be less effective when the amount of torsion is small.

11-11 Feed-forward Function

The feed-forward function come in 2 types: speed feed-forward and torque feed-forward.

The speed feed-forward can minimize the position error and increase the responsiveness during position or fully-closed control.

Responsiveness is improved by adding the speed feed-forward value calculated from the internal position command and related objects (3110 hex and 3111 hex) to the speed command calculated by comparing the internal position command and the position feedback.

If the Velocity offset (60B1 hex) is set, both the set value and the speed feed-forward valued are added to the Control effort (60FA hex).

The torque feed-forward can increase the responsiveness of the speed control system.

Responsiveness is improved by adding the torque feed-forward value calculated from the Control effort (60FA hex) and related objects (3112 hex and 3113 hex) to the torque command calculated by comparing the Control effort (60FA hex) and the speed feedback.

If the Torque offset (60B2 hex) is set, both the set value and the torque feed-forward valued are added to the torque command.

11-11-1 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|------------------------------------|---|-----------|
| 3110 hex | Speed Feed-forward Gain | The speed command from position control processing is added to the product of the Control effort (60FA hex) that is calculated from the internal position command times the ratio in this object. | page 9-10 |
| 3111 hex | Speed Feed-forward Command Filter | Set the time constant for the first-order lag filter that is applied to speed feed-forward input. | page 9-10 |
| 3112 hex | Torque Feed-forward Gain | The torque command from speed control processing is added to the product of the Control effort (60FA hex) times the ratio in this object. | page 9-10 |
| 3113 hex | Torque Feed-forward Command Filter | Set the time constant for the first-order lag filter that is applied to torque feed-forward input. | page 9-10 |
| 60B1 hex | Velocity offset | Set the offset for the speed command. It will be added to the Control effort (60FA hex). | page A-67 |
| 60B2 hex | Torque offset | Set the offset for the torque command. It will be added to the torque command value. | page A-67 |

11-11-2 Operating Procedure

Speed Feed-forward Operating Method

- 1 Set the Speed Feed-forward Command Filter (3111 hex).
Set it to approx. 50 (0.5 ms).

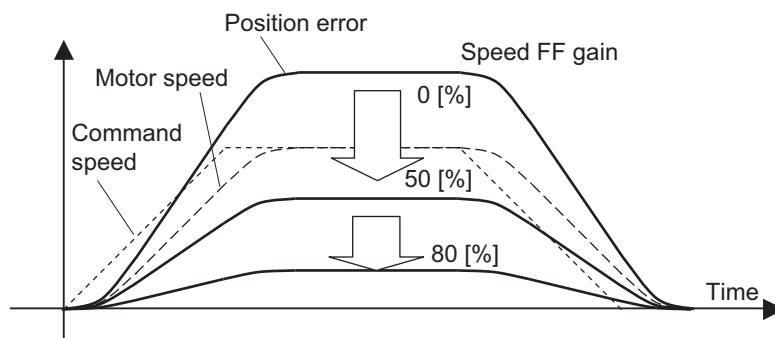
- 2 Adjust the Speed Feed-forward Gain (3110 hex).

Gradually increase the value of the Speed Feed-forward Gain (3110 hex) and finely adjust it to avoid overshooting during acceleration/deceleration.

If the speed feed-forward gain is set to 100%, the position error is calculated at 0. However, large overshooting will occur during acceleration/deceleration.

The position error during an operation at a certain speed will decrease based on the following formula according to the speed feed-forward gain value.

$$\text{Position error [command units]} = \text{Command speed [command units/s]} / \text{Position loop gain [1/s]} \times (100 - \text{Speed feed-forward gain [\%]}) / 100$$



The position error in the range of constant speed becomes smaller as the speed feed-forward gain increases.



Precautions for Correct Use

- If the updating cycle of the position command input is longer than the Servo Drive control cycle, or if the input command frequency is not uniform, the operating noise may increase while the speed feed-forward is enabled. Apply the position command filter (first-order lag or FIR smoothing) or increase the speed feed-forward filter setting.

Torque Feed-forward Operating Method

1 Set the Inertia Ratio (3004 hex).

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.

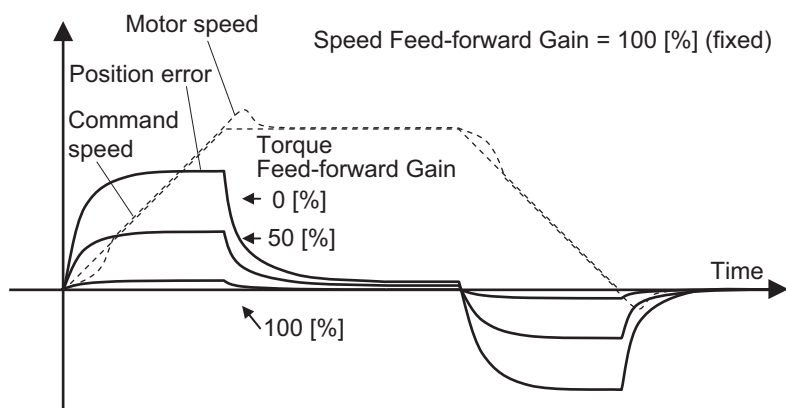
2 Set the Torque Feed-forward Command Filter (3113 hex).

Set it to approx. 50 (0.5 ms).

3 Adjust the Torque Feed-forward Gain (3112 hex).

Gradually increase the value of the Torque Feed-forward Gain (3112 hex).

Since the position error during acceleration/deceleration at a constant speed can be brought close to 0, it can be controlled almost to 0 throughout the entire operation range during a trapezoidal speed pattern under ideal conditions where no disturbance torque is working. In reality, disturbance torque is always applied and, therefore, the position error cannot be completely 0.



Torque feed-forward can reduce the position error in a range of constant acceleration/deceleration.

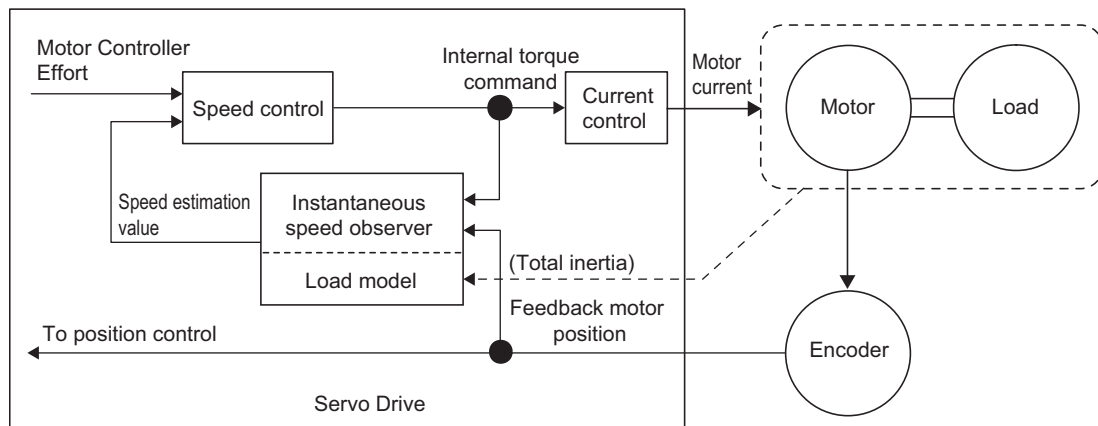


Precautions for Correct Use

- If you increase the torque feed-forward filter time constant, the operation noise will be reduced. However, the position error where the acceleration changes will become larger.
- The torque feed-forward function cannot be used when realtime autotuning is being used. Set both the Torque Feed-forward Gain (3112 hex) and Torque Feed-forward Command Filter (3113 hex) to 0.

11-12 Instantaneous Speed Observer Function

This function uses a load model to estimate the motor speed. It improves the speed detection accuracy and can provide both high responsiveness and minimum vibration when stopping.



11-12-1 Operating Conditions

The instantaneous speed observer function can be used in the following situations.

| | Conditions |
|----------------|--|
| Operating mode | Position control (semi-closed control) |
| Others | <ul style="list-style-type: none"> • When Servo is ON. • When elements other than control parameters, such as the torque limit, are set correctly and there is no trouble with the motor's normal rotation. • When realtime autotuning function is disabled (3002 hex = 0). |

11-12-2 Objects Requiring Settings

| Index | Name | Description | Reference |
|----------|-----------------------------|---|-----------|
| 3610 hex | Function Expansion Settings | Set whether to enable or disable the instantaneous observer function. | page 9-48 |
| 3004 hex | Inertia Ratio | Set the inertia ratio. | page 9-4 |
| 3100 hex | Position Loop Gain 1 | Set the position loop gain. | page 9-7 |
| 3101 hex | Speed Loop Gain 1 | Set the speed loop gain. | page 9-8 |

11-12-3 Operating Procedure

1 Set the Inertia Ratio (3004 hex).

Set the inertia ratio as correctly as possible.

- If the Inertia Ratio (3004 hex) is obtained in realtime auto gain tuning, use the set value.
- If the inertia ratio is calculated for the selected motor, input the calculated value.
- If the inertia ratio is not known, perform autotuning and set the inertia ratio.

2 Adjust the position loop gain and speed loop gain.

Adjust Position Loop Gain 1 (3100 hex), Speed Loop Gain 1 (3101 hex), Speed Loop Integral Time Constant 1 (3102 hex), and Torque Command Filter Time Constant 1 (3104 hex).

If no problem occurs in realtime autotuning, you can continue to use the settings.

3 Set the Function Expansion Setting (3610 hex).

- Set whether to enable or disable the instantaneous speed observer function in bit 0.
If you set this to 1 (enabled), the speed detection method switches to instantaneous speed observer.
- If the machine operation noise or vibration increases, or fluctuations in the torque monitor waveform increase significant enough to cause a problem, return the setting to 0 and make sure that the inertia ratio or the adjustment objects are correct.
- If the machine operation noise or vibration decreases, or fluctuations in the torque monitor waveform decrease, make small adjustments to the Inertia Ratio (3004 hex) to find the setting that makes the smallest fluctuations while monitoring the position error waveform and the actual speed waveform.
- If Position Loop Gain 1 (3100 hex), Speed Loop Gain 1 (3101 hex), or Speed Loop Integral Time Constant 1 (3102 hex) is changed, the optimal value for the Inertia Ratio (3004 hex) may change, so make small adjustments to the value of the Inertia Ratio (3004 hex) again to set a value that makes the smallest fluctuations.



Precautions for Correct Use

This function may not function properly or the effect may not be apparent under the following conditions.

- If there is a large resonance point at a 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 there is a large disturbance torque with high-frequency elements applied.
- If the setting range for positioning is small.

12

Troubleshooting and Maintenance

This chapter describes the items to check when problems occur, troubleshooting using the error displays, troubleshooting based on the operating conditions, and periodic maintenance.

| | |
|--|--------------|
| 12-1 Troubleshooting | 12-2 |
| 12-1-1 Preliminary Checks When a Problem Occurs | 12-2 |
| 12-1-2 Precautions When a Problem Occurs | 12-3 |
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12-1 Troubleshooting

12-1-1 Preliminary Checks When a Problem Occurs

This section explains the preliminary checks and analytical software 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 Terminals (L1, L2, L3)

| | | |
|---------------|-------------------|--|
| R88D-KN□L-ECT | (50 W to 400 W) | :Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz |
| R88D-KN□H-ECT | (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 kW to 15 kW) | :3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| R88D-KN□F-ECT | (750 W to 15 kW) | :3-phase 380 to 480 VAC (323 to 528 V) 50/60 Hz |

Control Circuit Power Supply Input Terminals (L1C, L2C)

| | | |
|---------------|-------------------|--|
| R88D-KN□L-ECT | (50 W to 400 W) | :Single-phase 100 to 120 VAC (85 to 132 V) 50/60 Hz |
| R88D-KN□H-ECT | (100 W to 1.5 kW) | :Single-phase 200 to 240 VAC (170 to 264 V) 50/60 Hz |
| | (2 kW to 15 kW) | :3-phase 200 to 230 VAC (170 to 253 V) 50/60 Hz |
| R88D-KN□F-ECT | (750 W to 15 kW) | :24 VDC (21.6 to 26.4 V) |

If the voltage is out of range, there is a risk of operation failure. Be sure that the power supply is within the specified range.

- Check the voltage of the sequence input power supply (+24 VIN terminal (CN1 pin 7)). It must be between 11 and 25 VDC.
If the voltage is out of range, there is a risk of operation failure. Be sure that the power supply is within the specified range.

Checking Whether an Error Has Occurred

- Make an analysis using the 7-segment display on the front of the Servo Drive or using CX-Drive tools.
- When an Error Has Occurred
 - ... Check the error display (□□) and make an analysis based on the error that is indicated.
- When an Error Has Not Occurred
 - ... Make an analysis according to the error conditions.
- In either case, refer to *12-4 Troubleshooting* on page 12-14 for details.

12-1-2 Precautions When a Problem Occurs

When checking and verifying I/O after a problem has occurred, the Servo Drive may suddenly start to operate or suddenly stop, so always take the following precautions.

You should assume that anything not described in this manual is not possible with this product.

Precautions

- Disconnect the wiring before checking for cable breakage. 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 GND (CN1 pin 16). 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 in case the machine runs out of control.

12-1-3 Replacing the Servomotor or Servo Drive

Use the following procedure to replace the Servomotor or Servo Drive.

Replacing the Servomotor

- 1** Replace the motor.
- 2** Perform origin adjustment (for position control).
 - When the motor is replaced, the motor's origin position (phase Z) may deviate, so origin adjustment must be performed.
 - Refer to the position controller's manual for details on performing origin adjustment.
- 3** Set up the absolute encoder.
 - If a motor with an absolute encoder is used, the absolute value data in the absolute encoder is cleared when the motor is replaced, so setup is again required. The multi-rotation data will be different from before it was replaced, so initialize the Motion Control Unit settings.
 - For details, refer to *10-2-4 Absolute Encoder Setup* on page 10-7.

Replacing the Servo Drive

1 Take a record of all object settings.

Use the CX-Drive or other software and take a record of the settings of all objects.

2 Replace the Servo Drive.

3 Set the objects.

Use the CX-Drive or other software and set all of the objects.

4 Set up the absolute encoder.

- If a motor with an absolute encoder is used, the absolute value data in the absolute encoder is cleared when the Servo Drive is replaced, so setup is again required. The multi-rotation data will be different from before it was replaced, so initialize the Motion Control Unit settings.
- For details, refer to *10-2-4 Absolute Encoder Setup* on page 10-7.

12-2 Warnings

This function outputs a warning signal and notifies state such as an overload before an error occurs. Set whether to hold warning state by setting the Warning Hold Selection (3759 hex).

If not holding warnings is selected, a warning will be cleared automatically when the cause of the warning has been eliminated. If holding warnings is selected, the normal procedure to clear errors must be performed after removing the cause of the error.

Battery warnings, however, are held in the encoder. The error will be cleared once the hold state has been cleared in the encoder.

12-2-1 Related Objects

| Index | Name | Description | Reference |
|----------|----------------------------|---|-----------|
| 3440 hex | Warning Output Selection 1 | Select the warning for Warning Output 1 (WARN1). 0: Output for all warnings. 1 or higher: Refer to <i>12-2-2 Warning List</i> on page 12-6. | page 9-40 |
| 3441 hex | Warning Output Selection 2 | Select the warning for Warning Output 2 (WARN2). 0: Output for all warnings. 1 or higher: Refer to <i>12-2-2 Warning List</i> on page 12-6. | page 9-40 |
| 3638 hex | Warning Mask Setting | Set a mask for warning detection. If you set the corresponding bit to 1, the detection of the corresponding warning is disabled. Refer to <i>12-2-2 Warning List</i> on page 12-6. | page 9-53 |
| 3759 hex | Bit 0 | Warning Hold Selection for Communications-related Warnings | page 9-56 |
| | Bit 1 | Warning Hold Selection for General Warnings | |
| 3800 hex | Communications Control | Controls errors and warnings related to EtherCAT communications. If you set the corresponding bit to 1, the detection of the corresponding warning is disabled. | page 9-57 |

12-2-2 Warning List

General Warnings

| Warning number | Warning name | Warning condition | Warning Hold Selection (3759 hex) ^{*1} | Warning Output Selection (3440 hex, 3441 hex) ^{*2} | Warning Mask Setting (3638 hex) ^{*3} |
|----------------|---|--|---|---|---|
| A0 hex | Overload Warning | The load ratio is 85% or more of the protection level. | √ | 1 | Bit 7 |
| A1 hex | Excessive Regeneration Warning | The regeneration load ratio is 85% or more of the level. | √ | 2 | Bit 5 |
| A2 hex | Battery Warning | The battery voltage is 3.2 V or less. | Fixed to latch mode | 3 | Bit 0 |
| A3 hex | Fan Warning | The fan stop state continues for 1 second. | √ | 4 | Bit 6 |
| A4 hex | Encoder Communications Warning | The encoder communications errors occurred in series more frequently than the specified value. | √ | 5 | Bit 4 |
| A5 hex | Encoder Overheating Warning ^{*4} | The encoder detects the overheat warning. | √ | 6 | Bit 3 |
| A6 hex | Vibration Detection Warning | Vibrating is detected. | √ | 7 | Bit 9 |
| A7 hex | Life Expectancy Warning | The life expectancy of the capacitor or the fan is shorter than the specified value. | Fixed to latch mode | 8 | Bit 2 |
| A8 hex | External Encoder Error Warning | The external encoder detects a warning. | √ | 9 | Bit 8 |
| A9 hex | External Encoder Communications Warning | The external encoder has communications errors in series more than the specified value. | √ | 10 | Bit 10 |

*1 The √ in above column means that you can switch between Latch and Non-latch modes based on the Warning Hold Selection (3759 hex). Battery Warning, Life Expectancy Warning, etc. are fixed to Latch mode only.

*2 Set the Warning Output Selection 1 (3440 hex) to the warning type to output to Warning Output 1 (WARN1), and set the Warning Output Selection 2 (3441 hex) to the warning type to output to the Warning Output 2 (WARN2). If you set these objects to 0, all warning types are output.

*3 Detection of general warnings can be masked with the Warning Mask Setting (3638 hex) and detection of EtherCAT communications-related warnings can be masked with the Communications Control (3800 hex). When the bit is set to 1, the warning detection is masked.

*4 The encoder overheating warning is enabled only when using a 20-bit incremental encoder. It is disabled for all other types of encoders.

**Precautions for Correct Use**

- Do not use any settings for Error Output Selection 1 (3440 hex) and Error Output Selection 2 (3441 hex) other than those given in the above table.
- You can clear these warnings by executing the error rest command. The command does clear the warning even if the cause of the warning is not removed, but the same warning will occur again.

Warnings Related to EtherCAT Communications

| Warning number | Warning name | Warning condition | Warning Hold Selection (3759 hex) *1 | Warning Output Selection (3440 hex, 3441 hex) *1 | Warning Mask Setting (3800 hex) *2 |
|----------------|---------------------------------|---|--------------------------------------|--|------------------------------------|
| B0 hex | Data Setting Warning | <ul style="list-style-type: none"> • An object setting is out of range. | √ | 11 | Bit 4 |
| B1 hex | Command Warning | <p>Object operating conditions are not satisfied.</p> <ul style="list-style-type: none"> • A forced brake operation request was sent while the servo was ON. • A Switch ON command was sent when the main circuit power supply was OFF and object 3508 hex = 0. • An Enable Operation command was sent to request turning ON the servo when the Servomotor was operating at 30 r/min or higher. • An Enable Operation command was sent to request turning ON the servo when Modes of operation (6060 hex) was not set. <p>A latch operation was started under the following conditions.</p> <ul style="list-style-type: none"> • An absolute external encoder was used and phase Z was selected as the trigger for fully-closed control. • During Homing mode • The absolute multi-rotation data is being cleared or the Config operation is being performed. • The Statusword (6041 hex) bit 9 (remote) is 0 (local). <p>An operation command was applied in the drive-prohibited direction after an immediate stop for a drive prohibition input.</p> | √ | 12 | Bit 5 |
| B2 hex | EtherCAT Communications Warning | EtherCAT communications errors occurred one or more times. | √ | 13 | Bit 6 |

*1 Set the Warning Output Selection (3440 hex) to the warning type to output to Warning Output 1 (WARN1), and set Warning Output Selection 2 (3441 hex) to the warning type to output to Warning Output 2 (WARN2). If you set these objects to 0, all warning types are output.

- *2 Detection of general warnings can be masked with the Warning Mask Setting (3638 hex) and detection of EtherCAT communications-related warnings can be masked with the Communications Control (3800 hex). The warning detection is masked when you set the corresponding bit to 1.



Precautions for Correct Use

Do not use any settings for Error Output Selection 1 (3440 hex) and Error Output Selection 2 (3441 hex) other than those given in the above table.

12-3 Errors

If the Servo Drive detects an abnormality, it outputs an error (ALM), turns OFF the power drive circuit, and displays the main error number on the front panel.



Precautions for Correct Use

- Refer to *12-4-1 Troubleshooting with Error Displays* on page 12-14 for troubleshooting errors.
- Reset the error using one of the following methods. Remove the cause of the error first.
 - Turn OFF the power supply, then turn it ON again.
 - Reset the error via EtherCAT communications or from the CX-Drive via USB communications.

However, some errors can only be reset by turning the power supply OFF then ON again. Refer to the *12-3-1 Error List* on page 12-9.

- An Overload Error (Error No. 16.0) cannot be reset for 10 seconds after it occurs.
- If “hh,” “FF,” or “HH” is displayed as the error number, the internal MPU has malfunctioned. Turn OFF the power immediately if one of these error numbers is displayed.

12-3-1 Error List

| Error No. (hex) | | Error detection function | Attribute | | |
|-----------------|-----|---|-----------|-----------------|------------------------------|
| Main | Sub | | History | Can be reset | Immediate stop ^{*1} |
| 11 | 0 | Control Power Supply Undervoltage | – | √ | – |
| 12 | 0 | Overvoltage | √ | √ | – |
| 13 | 0 | Main Power Supply Undervoltage (insufficient voltage between P and N) | – | √ | – |
| | 1 | Main Power Supply Undervoltage (AC cutoff detected) | – | √ | – |
| 14 | 0 | Overcurrent | √ | – | – |
| | 1 | IPM Error | √ | – | – |
| 15 | 0 | Servo Drive Overheat | √ | – | √ |
| 16 | 0 | Overload | √ | √ ^{*2} | – |
| 18 | 0 | Regeneration Overload | √ | – | √ |
| | 1 | Regeneration Tr Error | √ | – | – |
| 21 | 0 | Encoder Communications Disconnection Error | √ | – | – |
| | 1 | Encoder Communications Error | √ | – | – |
| 23 | 0 | Encoder Communications Data Error | √ | – | – |
| 24 | 0 | Error Counter Overflow | √ | √ | √ |
| | 1 | Excessive Speed Deviation Error | √ | √ | √ |
| 25 | 0 | Excessive Hybrid Deviation Error | √ | – | √ |
| 26 | 0 | Overspeed | √ | √ | √ |
| | 1 | Overspeed 2 | √ | √ | – |

| Error No. (hex) | | Error detection function | Attribute | | |
|-----------------|--------|--|-----------|-----------------|------------------------------|
| Main | Sub | | History | Can be reset | Immediate stop ^{*1} |
| 27 | 1 | Absolute Value Cleared ABS | √ | – | – |
| | 4 | Command Error | √ | – | – |
| | 5 | Command Generation Error | √ | – | – |
| | 6 | Operation Command Duplicated | √ | √ | – |
| | 7 | Position Data Initialized | – | √ | – |
| 29 | 1 | Error Counter Overflow 1 ABS | √ | – | – |
| | 2 | Error Counter Overflow 2 | √ | – | – |
| 30 (st) | 0 | Safety Input Error | – | √ | – |
| 33 | 0 | Interface Input Duplicate Allocation Error 1 | √ | – | – |
| | 1 | Interface Input Duplicate Allocation Error 2 | √ | – | – |
| | 2 | Interface Input Function Number Error 1 | √ | – | – |
| | 3 | Interface Input Function Number Error 2 | √ | – | – |
| | 4 | Interface Output Function Number Error 1 | √ | – | – |
| | 5 | Interface Output Function Number Error 2 | √ | – | – |
| | 8 | External Latch Input Allocation Error | √ | – | – |
| 34 | 0 | Overrun Limit Error | √ | √ | – |
| 36 | 0 to 2 | Object Error | – | – | – |
| 37 | 0 to 2 | Object Corrupted | – | – | – |
| 38 | 0 | Drive Prohibition Input Error 1 | – | √ | – |
| | 1 | Drive Prohibition Input Error 2 | – | √ | – |
| 40 | 0 | Absolute Encoder System Down Error ABS | √ | √ ^{*3} | – |
| 41 | 0 | Absolute Encoder Counter Overflow Error ABS | √ | – | – |
| 42 | 0 | Absolute Encoder Overspeed Error ABS | √ | √ ^{*3} | – |
| 43 | 0 | Encoder Initialization Error | √ | – | – |
| 44 | 0 | Absolute Encoder 1-rotation Counter Error ABS | √ | – | – |
| 45 | 0 | Absolute Encoder Multi-rotation Counter Error ABS | √ | – | – |
| 47 | 0 | Absolute Encoder Status Error ABS | √ | – | – |
| 48 | 0 | Encoder Phase-Z Error | √ | – | – |
| 49 | 0 | Encoder CS Signal Error | √ | – | – |
| 50 | 0 | External Encoder Connection Error | √ | – | – |
| | 1 | External Encoder Communications Data Error | √ | – | – |
| 51 | 0 | External Encoder Status Error 0 | √ | – | – |
| | 1 | External Encoder Status Error 1 | √ | – | – |
| | 2 | External Encoder Status Error 2 | √ | – | – |
| | 3 | External Encoder Status Error 3 | √ | – | – |
| | 4 | External Encoder Status Error 4 | √ | – | – |
| | 5 | External Encoder Status Error 5 | √ | – | – |
| 55 | 0 | Phase-A Connection Error | √ | – | – |
| | 1 | Phase-B Connection Error | √ | – | – |
| | 2 | Phase-Z Connection Error | √ | – | – |

| Error No. (hex) | | Error detection function | Attribute | | |
|-----------------|--------|---|-----------|-----------------|------------------------------|
| Main | Sub | | History | Can be reset | Immediate stop ^{*1} |
| 83 | 1 | EtherCAT State Change Error | √ | √ ^{*4} | – |
| | 2 | EtherCAT Illegal State Change Error | √ | √ ^{*4} | – |
| | 3 | Communications Synchronization Error | √ | √ ^{*5} | – |
| | 4 | Synchronization Error | √ | √ ^{*4} | – |
| | 5 | Sync Manager WDT Error | √ | √ ^{*4} | – |
| 87 | 0 | Immediate Stop Input Error | – | √ | – |
| 88 | 0 | Node Address Setting Error | √ | – | – |
| | 1 | ESC Initialization Error | √ | – | – |
| | 2 | Interruptions Error | √ | – | – |
| | 3 | SII Verification Error | √ | – | – |
| 90 | 0 | Communications Setting Error | √ | √ ^{*4} | – |
| 91 | 0 | Command Error | √ | √ | – |
| 92 | 0 | Encoder Data Restoration Error | √ | – | – |
| | 1 | External Encoder Data Restoration Error | √ | – | – |
| 93 | 0 | Object Setting Error 1 | √ | – | – |
| | 2 | Object Setting Error 2 | √ | – | – |
| | 3 | External Encoder Connection Error | √ | – | – |
| | 4 | Function Setting Error | √ | √ | – |
| 95 | 0 to 4 | Motor Non-conformity | – | – | – |
| Other numbers | | Other errors | √ | – | – |

*1 An immediate stop error is displayed if an immediate stop is performed when –4 to –7 is set for the Fault reaction option code (605E hex). Refer to the description of object 605E hex on page A-59.

*2 This error cannot be reset for 10 seconds after it occurs.

*3 The error cannot be reset unless the absolute value is cleared.

*4 This error cannot be reset until the cause of the error is removed by performing an operation from the master. When resetting the error via a USB connection, remove the cause of the error beforehand via the master.

*5 This error cannot be reset until the cause of the error is removed by performing an operation from the master. Reset the error from the CX-Drive connected to the PLC and from the ladder diagram. The error cannot be reset from the CX-Drive via USB communications.

Note 1 If an error that cannot be reset occurs, remove the error factor and turn OFF the control power to reset the error.

2 If a resettable error occurs, reset the error via EtherCAT communications or on the CX-Drive.

3 If “hh,” “FF,” or “HH” is displayed as the error number, the internal MPU has malfunctioned. Turn OFF the power immediately if one of these error numbers is displayed.

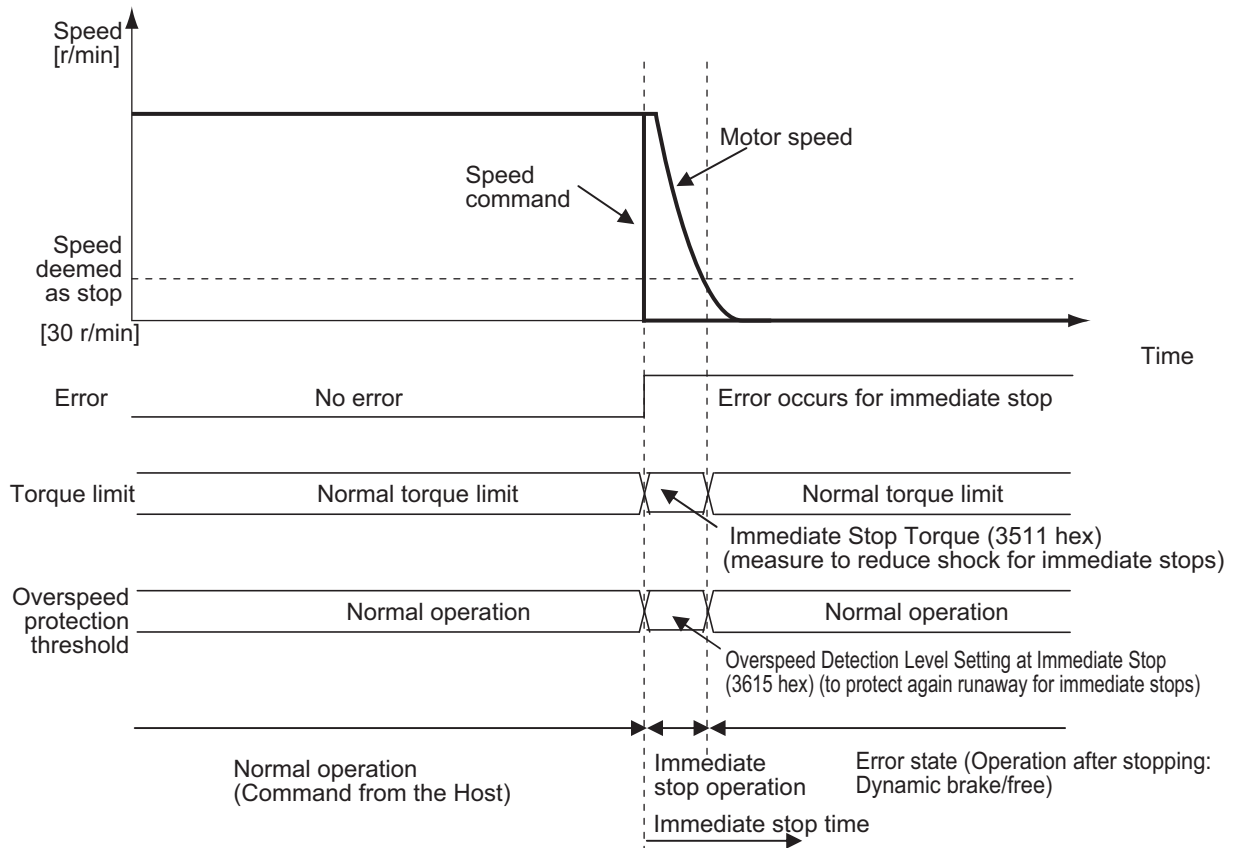
12-3-2 Immediate Stop Operation at Errors

The immediate stop function controls the motor and stop it immediately if an error that supports for immediate stopping occurs.

Related Objects

| Index | Name | Explanation | Reference |
|----------|---|--|-----------|
| 605E hex | Fault reaction option code | Set the state during deceleration and after stopping for when an error occurs. | page A-59 |
| 3511 hex | Immediate Stop Torque | Set the torque limit for immediate stops. | page 9-43 |
| 3513 hex | Overspeed Detection Level Setting | If the motor rotation speed exceeds the set value, an Overspeed Error (Error No. 26.0) will occur. | page 9-43 |
| 3614 hex | Error Detection Allowable Time Setting | Set the allowable time until stopping if an immediate stop is executed when an error is detected. | page 9-49 |
| 3615 hex | Overspeed Detection Level Setting at Immediate Stop | If the motor speed exceeds the set value during an immediate stop resulting from an error, an Overspeed 2 Error (Error No. 26.1) will occur. | page 9-49 |

Immediate Stop Operation



Precautions for Correct Use

- To prevent operation from running out of control for an immediate stop, set the allowable Overspeed Detection Level Setting at Immediate Stop (3615 hex). An Overspeed 2 Error (Error No. 26.1) does not support immediate stopping. If it occurs, an error trip will occur immediately.
- Set a higher value for the Overspeed Detection Level Setting at Immediate Stop (3615 hex) than for the Overspeed Detection Level Setting (3513 hex). If a value lower than the Overspeed Detection Level Setting (3513 hex) is set, an Overspeed 2 Error (Error No. 26.1) will occur before an Overspeed Error (Error No. 26.0). Thus an immediate stop will not occur. If an Overspeed Error (Error No. 26.0) and an Overspeed 2 error (Error No. 26.1) occur at the same time, the immediate stop will not occur, either.
- If the actual rotation speed is not lower than 30 r/min after the time set on the Error Detection Allowable Time Setting (3614 hex) elapses from when an error that supports immediate stopping occurs, an error state will occur immediately.
- If an error that does not support immediate stopping occurs during an immediate stop, an error state will occur immediately.

12-4 Troubleshooting

If an error occurs in the machine, determine the error conditions from the error displays and operation state, identify the cause of the error, and take appropriate measures.

12-4-1 Troubleshooting with Error Displays

Error List

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|-----------------------------------|---|--|
| Main | Sub | | | |
| 11 | 0 | Control Power Supply Undervoltage | <p>The voltage between the positive and negative terminals in the control power supply converter dropped below the specified value.</p> <p>100-V products: Approx. 70 VDC (Approx. 30 VAC) 200-V products: Approx. 145 VDC (Approx. 100 VAC) 400-V products: Approx. 15 VDC</p> <ul style="list-style-type: none"> • The power supply voltage is low. A momentary power interruption occurred. • Insufficient power supply capacity: the power supply voltage dropped because there was inrush current when the main power supply was turned ON. • The Servo Drive is faulty (circuit fault). | <p>Measure the voltage between the L1C and L2C lines on the connectors and the terminal block.</p> <ul style="list-style-type: none"> • Increase the power supply voltage. Change the power supply. • Increase the power supply capacity. • Replace the Servo Drive. |
| 12 | 0 | Overvoltage | <p>The power supply voltage exceeded the allowable input voltage range, causing the voltage between the positive and negative terminals in the converter to exceed the specified value. The power supply voltage is high. The voltage was suddenly increased by the phase advance capacitor or the uninterruptible power supply (UPS).</p> <p>100-V products: Approx. 200 VDC (Approx. 140 VAC) 200-V products: Approx. 400 VDC (Approx. 280 VAC) 400-V products: Approx. 800 VDC (Approx. 560 VAC)</p> <ul style="list-style-type: none"> • The Regeneration Resistor wiring is broken. • The External Regeneration Resistor is inappropriate and cannot absorb all of the regenerative energy. The load inertia is too large, gravitational torque on the vertical axis is too large, or there is some other problem to absorb the regenerative energy. • The Servo Drive is faulty (circuit fault). | <p>Measure the voltage between the connector (L1, L2, and L3) lines. Input the correct voltage. Remove the phase advance capacitor.</p> <ul style="list-style-type: none"> • Use a tester to measure the resistance of the external resistor between the B1 and B2 terminals on the Servo Drive. If the resistance is infinite, the wiring is broken. Replace the external resistor. • Change the regeneration resistance and wattage to the specified values. (Calculate the regenerative energy and connect an External Regeneration Resistor with the required regeneration absorption capacity. Reduce the descent speed.) • Replace the Servo Drive. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|---|---|--|
| Main | Sub | | | |
| 13 | 0 | Main Circuit Power Supply Undervoltage (Undervoltage between positive and negative terminals) | <p>If the Undervoltage Error Selection (3508 hex) is set to 1, a momentary power interruption occurred between L1 and L3 for longer than the value specified for the Momentary Hold Time (3509 hex). Alternatively, the voltage between the positive and negative terminals in the main power supply converter dropped below the specified value while the servo was ON.</p> <p>100-V products: Approx. 80 VDC (Approx. 55 VAC) 200-V products: Approx. 110 VDC (Approx. 75 VAC) 400-V products: Approx. 180 VDC (Approx. 125 VAC)</p> <ul style="list-style-type: none"> The power supply voltage is low. | <p>Measure the voltage between the connector (L1, L2, and L3) lines.</p> <ul style="list-style-type: none"> Increase the power supply voltage. Change the power supply. Eliminate the cause of the failure of the electromagnetic contactor on the main circuit power supply, and then turn ON the power again. |
| | 1 | Main Power Supply Undervoltage (AC interruption detected) | <ul style="list-style-type: none"> A momentary power interruption occurred. Insufficient power supply capacity: the power supply voltage dropped because there was inrush current when the main power supply was turned ON. Phase-failure: a Servo Drive with 3-phase input specifications was operated with single-phase power supply. The Servo Drive is faulty (circuit fault). | <ul style="list-style-type: none"> Check the setting of the Momentary Hold Time (3509 hex). Set each phase of the power supply correctly. Increase the power supply capacity. Refer to 2-3-1 <i>Servo Drive Model Table</i> on page 2-8 for information on the power supply capacity. Connect each phase (L1, L2, and L3) of the power supply correctly. Use L1 and L3 for single-phase 100 V and single-phase 200 V. Replace the Servo Drive. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|----------------------|---|---|
| Main | Sub | | | |
| 14 | 0 | Overcurrent | <p>The current flowing through the converter exceeded the specified value.</p> <ul style="list-style-type: none"> The Servo Drive is faulty (faulty circuit, faulty IGBT part, etc.). The Servomotor cable is short-circuited between phases U, V, and W. The Servomotor cable is ground-faulted. Motor windings are burned out. | <ul style="list-style-type: none"> Disconnect the Servomotor cable, and turn ON the servo. If the problem immediately recurs, replace the Servo Drive with a new one. Check to see if the Servomotor cable is short-circuited between phases U, V and W by checking for loose wire strands on the connector lead. Connect the Servomotor cable correctly. Check the insulation resistance between phases U, V, and W of the Servomotor cable and the grounding wire of the Servomotor. If the insulation is faulty, replace the Servomotor. Check the balance between the resistance of each wire of the Servomotor. If resistance is unbalanced, replace the Servomotor. Check for missing connector pins in Servomotor connections U, V, and W. If any loose or missing connector pins are found, secure them firmly. Replace the Servo Drive. Do not turn the servo ON for 3 minutes after using the dynamic brake. Check model (capacity) of the Servomotor and the Servo Drive on the nameplates. Replace the Servomotor with a Servomotor that matches the Servo Drive. Wait at least 100 ms after the servo has been turned ON, then input commands. Connect an External Regeneration Resistor whose resistance is more than the minimum allowable value. |
| | 1 | IPM Error | <ul style="list-style-type: none"> The Servomotor wiring contacts are faulty. The relay for the dynamic brake has been welded due to frequent servo ON/OFF operations. The Servomotor is not suitable for the Servo Drive. The command input timing is the same as or earlier than the Servo ON timing. The resistance of the connected External Regeneration Resistor is less than the minimum allowable value. | |
| 15 | 0 | Servo Drive Overheat | <p>The temperature of the Servo Drive radiator or power elements exceeded the specified value.</p> <ul style="list-style-type: none"> The ambient temperature of the Servo Drive exceeded the specified value. Overload | <ul style="list-style-type: none"> Improve the ambient temperature and the cooling conditions of the Servo Drive. Increase the capacities of the Servo Drive and the Servomotor. Set longer acceleration and deceleration times. Reduce the load. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|-----------------------|--|---|
| Main | Sub | | | |
| 16 | 0 | Overload | <p>When the feedback value for torque command exceeds the overload level specified in the Overload Detection Level Setting (3512 hex), overload protection is performed according to the overload characteristics.</p> <ul style="list-style-type: none"> The load was heavy, the effective torque exceeded the rated torque, and operation continued too long. Vibration or hunting occurred due to faulty gain adjustment. The Servomotor vibrates or makes unusual noise. The Inertia Ratio (3004 hex) setting is faulty. The Servomotor wiring is incorrect or broken. The machine was hit by an object, or the machine load suddenly became heavy. The machine was distorted. The electromagnetic brake remains ON. When multiple machines were wired, the wiring was incorrect and the Servomotor cable to was connected to a Servomotor for another axis. | <p>Check if torque (current) waveforms oscillate or excessively oscillates vertically during analog output or communications. Check the overload warning display and the load rate through communications.</p> <ul style="list-style-type: none"> Increase the capacities of the Servo Drive and the Servomotor. Set longer acceleration and deceleration times. Reduce the load. Readjust the gain. Connect the Servomotor cable as shown in the wiring diagram. Replace the cable. Remove the distortion from the machine. Reduce the load. Measure the voltage at the brake terminals. Turn OFF the brake. Wire the Servomotor and the encoder correctly so that the wiring matches the axes. |
| | | | Refer to <i>3-2 Overload Characteristics (Electronic Thermal Function)</i> on page 3-35 for information on overload characteristics. | |
| 18 | 0 | Regeneration Overload | <p>The regenerative energy exceeds the processing capacity of the Regeneration Resistor.</p> <ul style="list-style-type: none"> The regenerative energy during deceleration caused by a large load inertia increased the converter voltage, and then insufficient energy absorption by the Regeneration Resistor further increased the voltage. The Servomotor rotation speed is too high to absorb the regenerative energy within the specified deceleration time. The operating limit of the external resistor is limited to a 10% duty. | <p>Check the load rate of the Regeneration Resistor through communications. This Regeneration Resistor cannot be used for continuous regenerative braking.</p> <ul style="list-style-type: none"> Check the operation pattern (speed monitor). Check the load rate of the Regeneration Resistor and check for the excessive regeneration warning display. Increase the capacities of the Servo Drive and the Servomotor, and lengthen the deceleration time. Use an External Regeneration Resistor. Check the operation pattern (speed monitor). Check the load rate of the Regeneration Resistor and the excessive regeneration warning display. Increase the capacities of the Servo Drive and the Servomotor, and lengthen the deceleration time. Reduce the Servomotor rotation speed. Use an External Regeneration Resistor. Set the Regeneration Resistor Selection (3016 hex) to 2. |
| | | | <p>Precautions for Correct Use</p> <p>Always provide a temperature fuse or other protective measure when setting the External Regeneration Resistor Setting (3017 hex) to 2. Otherwise, the Regeneration Resistor will not be protected, generate excessive heat, and be burnt.</p> | |
| | 1 | Regeneration Tr Error | The Servo Drive regeneration drive Tr is faulty. | Replace the Servo Drive. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|--|--|--|
| Main | Sub | | | |
| 21 | 0 | Encoder Communications Disconnection Error | A disconnection was detected because communications between the encoder and the Servo Drive were stopped more frequently than the specified value. | Wire the encoder correctly as shown in the wiring diagram. Correct the connector pin connections. |
| | 1 | Encoder Communications Error | There was a communications error in data from the encoder. There was a data error mainly due to noise. The encode cable is connected, but a communications data error occurred. | <ul style="list-style-type: none"> • Provide the required encoder power supply voltage 5 VDC \pm5% (4.75 to 5.25 V). Be careful especially when the encode cable is long. • If the Servomotor cable and the encoder cable are bundled together, separate them. • Connect the shield to FG. |
| 23 | 0 | Encoder Communications Data Error | No communications error occurred with the data from the encoder, but there is an error in the contents of the data. There was a data error mainly due to noise. The encode cable is connected, but a communications data error occurred. | <ul style="list-style-type: none"> • Provide the required encoder power supply voltage 5 VDC \pm5% (4.75 to 5.25 V). Be careful especially when the encode cable is long. • If the Servomotor cable and the encoder cable are bundled together, separate them. • Connect the shield to FG. |
| 24 | 0 | Error Counter Overflow | <p>Position error pulses exceeded the setting of the Following error window (6065 hex).</p> <ul style="list-style-type: none"> • Motor operation does not follow the command. <p>• The value of the Following error window (6065 hex) is small.</p> | <ul style="list-style-type: none"> • Check to see if the Servomotor rotates according to the position command pulse. Check on the torque monitor to see if the output torque is saturated. Adjust the gain. Maximize the set values on the Positive torque limit value (60E0 hex) and the Negative torque limit value (60E1 hex). Wire the encoder as shown in the wiring diagram. Lengthen the acceleration and deceleration times. Reduce the load and the speed. • Increase the set value of object 6065 hex. |
| | 1 | Excessive Speed Deviation Error | <p>The difference (speed deviation) between Motor Velocity Demand Value After Filtering and actual speed has exceeded the set value of the Excessive Speed Deviation Setting (3602 hex).</p> <p>Note When Motor Velocity Demand Value After Filtering is forced to 0 during an immediate stop due to halt or forward/reverse drive prohibition input, the speed deviation immediately increases. The speed deviation also increases when the Motor Velocity Demand Value After Filtering starts. Therefore, provide enough margin when making the settings.</p> | <ul style="list-style-type: none"> • Increase the set value of object 3602 hex. • Lengthen the acceleration time of the Motor Velocity Demand Value After Filtering. Alternatively, improve the tracking (following) performance by adjusting the gain. • Disable the Excessive Speed Deviation Setting. (3602 hex = 0) |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|--------------------------------------|--|---|
| Main | Sub | | | |
| 25 | 0 | Excessive Hybrid Deviation Error | During fully-closed control, the difference between the load position from the external encoder and the Servomotor position from the encoder was larger than the number of pulses set as the Hybrid Following Error Counter Overflow Level (3328 hex). | <ul style="list-style-type: none"> • Check the Servomotor and load connection. • Check the external encoder and Servo Drive connection. • When moving the load, check to see if the change in the Servomotor position (encoder feedback value) has the same sign as the change in the load position (external encoder feedback value). Check to see if the External Feedback Pulse Dividing Numerator and Denominator (3324 hex and 3325 hex), and External Feedback Pulse Direction Switching (3326 hex) are set correctly. |
| 26 | 0 | Overspeed | The Servomotor rotation speed exceeded the value set on the Overspeed Detection Level Setting (3513 hex). | <ul style="list-style-type: none"> • Do not give excessive speed commands. • Check the input frequency, dividing ratio, and multiplication ratio of the command pulse. |
| | 1 | Overspeed 2 | The Servomotor rotation speed exceeded the value set for the Overspeed Detection Level Setting at Immediate Stop (3615 hex). | <ul style="list-style-type: none"> • If overshooting occurred due to faulty gain adjustment, adjust the gain. • Wire the encoder as shown in the wiring diagram. |
| 27 | 1 | Absolute Value Cleared ABS | The multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive. | <ul style="list-style-type: none"> • Check to see if the multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive. <p>Note This operation is performed for safety and is not an error.</p> |
| | 4 | Command Error | The position command variation after the electronic gear is higher than the specified value. | <ul style="list-style-type: none"> • Check to see if the position command variation is large. • Check the electronic gear ratio. • Check to see if the backlash compensation amount is too large. |
| | 5 | Command Generation Error | During position command processing, an error such as an “over the calculation range” error occurred. | Check to see if the electronic gear ratio, and the acceleration and deceleration rates meet the restrictions. |
| | 6 | Operation Command Duplicated | An attempt was made to establish EtherCAT communications (change from Init to Pre-Operational state) or to turn ON the servo from the controller (enable operation) while executing an FFT that operates with the Servo Drive alone or a trial run. | Check to see if EtherCAT communications is established or the servo is turned ON (enable operation) while an FFT or a trial run was being conducted. |
| | 7 | Position Data Initialized | A Config operation was performed or the multi-rotation counter was cleared for the absolute encoder during EtherCAT communications. | Check to see if Config operation was performed or the multi-rotation counter was cleared for the absolute encoder during EtherCAT communications. Note: This operation is performed for safety and is not an error. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|--|--|---|
| Main | Sub | | | |
| 29 | 1 | Error Counter Overflow 1 ABS | The value that is obtained by dividing the absolute encoder position (in pulses) by the electronic gear ratio exceeded $\pm 2^{31}$ (2,147,483,648) during the initialization of position data, after the control power was turned ON in absolute value mode, after a Config operation, after FFT was executed, or after a trial run was executed. | Review the operation range of the absolute external encoder position and the electronic gear ratio. |
| | 2 | Error Counter Overflow 2 | The position error in pulses exceeded $\pm 2^{29}$ (536,870,912). Alternatively, the position error in command units exceeded $\pm 2^{30}$ (1,073,741,824). | <ul style="list-style-type: none"> • Check to see if the Servomotor rotates according to the position command. • Check on the torque monitor to see if the output torque is saturated. • Adjust the gain. • Maximize the set values on the Positive torque limit value (60E0 hex) and the Negative torque limit value (60E1 hex). • Wire the encoder as shown in the wiring diagram. |
| 30 (st) | 0 | Safety Input Error | At least one of the input photocouplers for safety inputs 1 and 2 turned OFF. | Check the input wiring of safety inputs 1 and 2. |
| 33 | 0 | Interface Input Duplicate Allocation Error 1 | There is a duplicate setting in the input signal (IN1, IN2, IN3, and IN4) function allocations. | Allocate the functions to the connector pins correctly. |
| | 1 | Interface Input Duplicate Allocation Error 2 | There is a duplicate setting in the input signal (IN5, IN6, IN7, and IN8) function allocations. | |
| | 2 | Interface Input Function Number Error 1 | There is an undefined number specification in the input signal (IN1, IN2, IN3, and IN4) function allocations. Alternatively, a logic setting error was detected. | |
| | 3 | Interface Input Function Number Error 2 | There is an undefined number specification in the input signal (IN5, IN6, IN7, and IN8) function allocations. Alternatively, a logic setting error was detected. | |
| | 4 | Interface Output Function Number Error 1 | There is an undefined number specification in the output signal (OUTM1) function allocation. | |
| | 5 | Interface Output Function Number Error 2 | There is an undefined number specification in the output signal (OUTM2) function allocation. | |
| | 8 | External Latch Input Allocation Error | There is an error in the latch input function allocation. <ul style="list-style-type: none"> • The function was allocated to input signals other than IN5, IN6, or IN7. • The function was allocated to NC. • The function was not allocated for all control modes. | |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|---|---|---|
| Main | Sub | | | |
| 34 | 0 | Overrun Limit Error | The Servomotor exceeded the allowable operating range set in the Overrun Limit Setting (3514 hex) with respect to the position command input range. <ul style="list-style-type: none"> The gain is not appropriate. The set value of object 3514 hex is too small. | <ul style="list-style-type: none"> Check the gains (the balance between position loop gain and speed loop gain) and the inertia ratio. Increase the set value of object 3514 hex. Alternatively, set object 3514 hex to 0 to disable the protection function. |
| 36 | 0 | Object Error | Data in the Object Save Area was corrupted when the power supply was turned ON and data was read from the EEPROM. | <ul style="list-style-type: none"> Reset all of the objects. If this error occurs repeatedly, the Servo Drive may be faulty. In this case, replace the Servo Drive. Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair. |
| | 1 | | | |
| | 2 | | | |
| 37 | 0 | Object Corrupted | EEPROM write verification data was corrupted when the power supply was turned ON and data was read from the EEPROM. | The Servo Drive is faulty. Replace the Servo Drive. Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair. |
| | 1 | | | |
| | 2 | | | |
| 38 | 0 | Drive Prohibition Input Error 1 | When the Drive Prohibition Input Selection (3504 hex) was set to 0, both the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT) turned ON. When object 3504 hex was set to 2, either the Forward Drive Prohibition input or the Reverse Drive Prohibition input turned ON. | Check for any problems with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. In particular, check to see if the control signal power supply (12 to 24 VDC) turned ON too slowly. |
| | 1 | Drive Prohibition Input Error 2 | When object 3504 hex was set to 0, EtherCAT communications were interrupted and either POT or NOT was ON, an operation command (such as a trial run or FFT) was received from the CX-Drive. Conversely, POT or NOT turned ON while operation was being performed for a CX-Drive operation command. | |
| 40 | 0 | Absolute encoder system down error ABS | The voltage of the built-in capacitor dropped below the specified value because the power supply to the encoder or the battery power supply was down. | Connect the battery power supply, and then clear the absolute encoder. Unless the absolute encoder is cleared, the error cannot be reset. |
| 41 | 0 | Absolute Encoder Counter Overflow Error ABS | The multi-rotation counter of the encoder exceeded the specified value. | <ul style="list-style-type: none"> Set the Operation Switch When Using Absolute Encoder (3015 hex) to an appropriate value. Make sure that the traveling distance from the origin of the machine is no more than 32,767 revolutions. |
| 42 | 0 | Absolute Encoder Overspeed Error ABS | The Servomotor rotation speed exceeded the specified value when only the battery power supply was used during a power interruption. | <ul style="list-style-type: none"> Check the power supply voltage (5V ±5%) on the encoder side. Check the connections to connector CN2. Unless the absolute encoder is cleared, the error cannot be reset. |
| 43 | 0 | Encoder Initialization Error | An encoder initialization error was detected. | Replace the Servomotor. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|---|---|--|
| Main | Sub | | | |
| 44 | 0 | Absolute Encoder 1-rotation Counter Error ABS | The encoder detected a 1-rotation counter error. | Replace the Servomotor. |
| 45 | 0 | Absolute Encoder Multi-rotation Counter Error ABS | The encoder detected a multi-rotation counter error. | Replace the Servomotor. |
| 47 | 0 | Absolute Encoder Status Error ABS | The rotation of the encoder was higher than the specified value when the power supply was turned ON. | Do not let the Servomotor move when the power supply is turned ON. |
| 48 | 0 | Encoder Phase-Z Error | A missing serial incremental encoder phase-Z pulse was detected. The encoder is faulty. | Replace the Servomotor. |
| 49 | 0 | Encoder CS Signal Error | A logic error was detected in the CS signal for serial incremental encoder. The encoder is faulty. | Replace the Servomotor. |
| 50 | 0 | External Encoder Connection Error | A disconnection was detected because communications between the external encoder and the Servo Drive were interrupted more than the specified number of times. | Wire the external encoder correctly as shown in the connection diagram. Correct the connector pin connections. |
| | 1 | External Encoder Communications Data Error | There was a communications error in data from external encoder. There was a data error mainly due to noise. The external encoder connection cable is connected, but a communications data error occurred. | <ul style="list-style-type: none"> • Provide the required external encoder power supply voltage 5 VDC \pm5% (4.75 to 5.25 V). Be careful especially when the external encoder connection cable is long. • If the Servomotor cable and the external encoder connection cable are bundled together, separate them. • Connect the shield to FG. Refer to the external encoder connection diagram. |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|--|--|--|
| Main | Sub | | | |
| 51 | 0 | External Encoder Status Error 0 | Bit 0 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications. | Eliminate the cause of the error and then clear the external encoder error. Then, temporarily turn OFF the control power supply to reset. |
| | 1 | External Encoder Status Error 1 | Bit 1 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications. | |
| | 2 | External Encoder Status Error 2 | Bit 2 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications. | |
| | 3 | External Encoder Status Error 3 | Bit 3 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications. | |
| | 4 | External Encoder Status Error 4 | Bit 4 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications. | |
| | 5 | External Encoder Status Error 5 | Bit 5 of the external encoder error code (ALMC) was set to 1. Refer to the external encoder specifications. | |
| 55 | 0 | Phase-A Connection Error | An error such as broken wiring was detected in the external encoder phase-A connection. | Check the external encoder phase A connection. |
| | 1 | Phase-B Connection Error | An error such as broken wiring was detected in the external encoder phase-B connection. | Check the external encoder phase-B connection. |
| | 2 | Phase-Z Connection Error | An error such as broken wiring was detected in the external encoder phase-Z connection. | Check the external encoder phase-Z connection. |
| 83 | – | Refer to <i>Troubleshooting Errors Related to EtherCAT Communications</i> on page 12-26. | | |
| 87 | 0 | Immediate Stop Input Error | An Immediate Stop (STOP) signal was entered. | Check the Immediate Stop (STOP) signal wiring. |
| 88 | – | Refer to <i>Troubleshooting Errors Related to EtherCAT Communications</i> on page 12-26. | | |
| 90 | – | | | |
| 91 | – | | | |

| Error No. (hex) | | Name | Cause | Measures |
|-----------------|-----|---|---|--|
| Main | Sub | | | |
| 92 | 0 | Encoder Data Restoration Error | Initialization of internal position data was not processed correctly in semi-closed control mode and absolute value mode. | <ul style="list-style-type: none"> • Provide the required encoder power supply voltage 5 VDC \pm5% (4.75 to 5.25 V). Be careful especially when the encode cable is long. • If the Servomotor cable and the encoder cable are bundled together, separate them. • Connect the shield to FG. |
| | 1 | External Encoder Data Restoration Error | Initialization of internal position data was not processed correctly in fully-closed control mode and absolute value mode. | <ul style="list-style-type: none"> • Provide the required external encoder power supply voltage 5 VDC \pm5% (4.75 to 5.25 V). Be careful especially when the external encoder connection cable is long. • If the Servomotor cable and the external encoder connection cable are bundled together, separate them. • Connect the shield to FG. Refer to the external encoder connection diagram. |
| 93 | 0 | Object Setting Error 1 | Electronic gear ratio exceeded the allowable range. | Check the object settings. The electronic gear ratio must be set between 1/1000 and 1000. |
| | 2 | Object Setting Error 2 | External encoder ratio exceeded the allowable range. | Check the object settings. The external encoder ratio must be set between 1/40 and 160. |
| | 3 | External Encoder Connection Error | The set value of the External Feedback Pulse Type Selection (3323 hex) differs from the external encoder type that is actually connected for serial communications. Electronic gear ratio exceeded the allowable range. | Set object 3323 hex to conform with the external encoder type that is actually connected. |

| Error No. (hex) | | Name | Cause | Measures |
|-------------------|--------|------------------------|---|---|
| Main | Sub | | | |
| 93 (continued) | 4 | Function Setting Error | <p>The function that was set does not support the communications cycle.</p> <ul style="list-style-type: none"> The electronic gear object ratio was not 1:1 when the communications cycle was set to 250/500 μs. Fully-closed Control Mode was selected when the communications cycle was set to 250 μs. Homing mode (hm) was set in Modes of operation (6060 hex) when the communications cycle was set to 250 or 500 μs. A mapping exceeding 20 bytes was set in an RxPDO when the communications cycle was set to 250 μs. A mapping exceeding 12 bytes was set in an RxPDO during Fully-closed Control Mode. Profile position mode (pp) or Homing mode (hm) was set in Modes of operation (6060 hex) when the communications cycle was set to 1 ms, Fully-closed Control Mode was selected, and the electronic gear object ratio was not 1:1. The number of bytes (objects) mapped to RxPDO is 0. 11 or more objects were mapped to RxPDO. 12 or more objects were mapped to TxPDO. Reference Position for CSP (4020 hex) was mapped to TxPDO when the communications cycle was set to 250/500 μs or when the electronic gear object ratio was not 1:1. | <ul style="list-style-type: none"> Check the communications cycle settings or the electronic gear object. Check the communications cycle settings or control mode settings. Check the communications cycle settings or the mode of operation. Check the communications cycle settings or the number of bytes of mapping. Check the number of bytes of mapping or the parameters for the control mode settings. Check the number of mapped objects. Check the mapped objects. |
| 95 | 0 to 4 | Motor mismatch | The Servomotor does not match the Servo Drive. | Replace the Servomotor with a Servomotor that matches the Servo Drive. |
| Other numbers | | Other errors | The control circuit malfunctioned due to excess noise or some other problem. The self-diagnosis function of the Servo Drive was activated, and an error occurred in the Servo Drive. | <ul style="list-style-type: none"> Turn OFF the power once, and turn it ON again. If the error is displayed even after the power is turned ON again, the system may be faulty. Stop using the system, and replace the Servomotor and/or the Servo Drive. Return the Servo Drive to the dealer that it was purchased from and ask for investigation and repair. |

Troubleshooting Errors Related to EtherCAT Communications

| Error number | | Name | Error timing | Cause | Measures |
|--------------|-----|-------------------------------------|--|--|---|
| Main | Sub | | | | |
| 83 | 1 | EtherCAT state change error | Occurs during operation. | A communications state change command was received for which the current communications state could not be changed. | Check the specifications of the communications state change command for the host controller. |
| | 2 | EtherCAT illegal state change error | Occurs during operation. | An undefined communications state change command was received. | Check the specifications of the communications state change command for the host controller. |
| | 3 | Communications sync error | Occurs during operation. | The number of consecutive errors in receiving data during the communication sync time exceeded the value specified for the Communications Control Setting. | <ul style="list-style-type: none"> • Connect the EtherCAT communications cable correctly. • Check to see if the EtherCAT communications cable is exposed to excessive noise. • Check that the host controller completed communications before an interruption is generated in the synchronous cycle (SYNC0 cycle). |
| | 4 | Sync Error | Occurs during operation. | Control PCB error | Replace the Servo Drive. |
| | 5 | Sync Manager WDT Error | Occurs during operation. | PDO communications were stopped for more than the specified period of time. | <ul style="list-style-type: none"> • Check the operation of the host controller. • Connect the EtherCAT communications cable correctly. |
| 88 | 0 | Node address setting error | Occurs when the power supply is turned ON. | The node address that was read from the rotary switches was not between 00 and 99. | <ul style="list-style-type: none"> • Turn OFF the power supply, then turn it ON again. • Replace the Servo Drive. |
| | 1 | ESC initialization error | Occurs when the power supply is turned ON. | Control PCB error | <ul style="list-style-type: none"> • Turn OFF the power supply, then turn it ON again. • Replace the Servo Drive. |
| | 2 | Interruptions Error | Occurs when the power supply is turned ON. | Control PCB error | <ul style="list-style-type: none"> • Turn OFF the power supply, then turn it ON again. • Replace the Servo Drive. |
| | 3 | SII verification error | Occurs when the power supply is turned ON. | Control PCB error | <ul style="list-style-type: none"> • Turn OFF the power supply, then turn it ON again. • Replace the Servo Drive. |

| Error number | | Name | Error timing | Cause | Measures |
|--------------|-----|------------------------------|--|---|--|
| Main | Sub | | | | |
| 90 | 0 | Communications setting error | Occurs when the power supply is turned ON. | <ul style="list-style-type: none"> An out-of-range value was set from the host controller. A command that changes the communications state to an unsupported state was received. | <ul style="list-style-type: none"> Make EtherCAT communications settings such as the synchronous cycle (SYNC0 cycle) correctly. Check the specifications of the communications state change command for the host controller. |
| 91 | 1 | Command error | Occurs during operation. | <ul style="list-style-type: none"> When bit 9 (Remote) of the Statusword (6041 hex) was set to 1 (remote), and the Servo Drive was in operation enabled state (Servo ON), a command that changes the communications state from Operational to another state (Init, Pre-Operational, Safe-Operational) was received. An unsupported number was set in Modes of operation (6060 hex). CSV or CST was set in Modes of operation (6060 hex) during fully-closed control. The Modes of operation (6060 hex) was switched in less than 2 ms. The homing operation was started when the Homing method (6098 hex) was set to a value other than 8, 12, 19, 20, 33, 34, or 35. The data setting warning (Warning No. B0 hex) occurred in a row, exceeding the Data Setting Warning Detection Setting (3781 hex) value. | Check the command specifications of the host controller. |

12-4-2 Troubleshooting Using the Operation State

| Symptom | Probable cause | Items to check | Measures |
|--|--|---|--|
| The 7-segment display does not light. | The control power is not supplied. | Check to see if the power supply input is within the allowed power supply voltage range. | Supply the correct power supply voltage. |
| | | Check to see if the power supply input is wired correctly. | Wire correctly. |
| The ERR indicator flashes or lights. | A communications-related error occurred. | Refer to <i>Troubleshooting Errors Related to EtherCAT Communications</i> on page 12-26. | |
| The L/A IN and the L/A OUT indicators are OFF. | A link in the EtherCAT physical communications layer has not been established yet. | Check to see if the communications cable is connected correctly. | Connect the communications cable correctly. |
| | | Check to see if the host controller has started. | Start the host controller. |
| An error occurred. | Read the error number and the error log. | Check the cause listed in <i>12-4-1 Troubleshooting with Error Displays</i> on page 12-14. | Take appropriate measures against the cause of the error that are listed in <i>12-4-1 Troubleshooting with Error Displays</i> on page 12-14. |
| The servo does not lock. | The power cable is not connected correctly. | Check to see if the Servomotor power cable is connected properly. | Wire the Servomotor power cable correctly. |
| | The Servomotor power supply is not ON. | Check the main circuit wiring and power voltage. | Input the correct power and voltage for the main circuit. |
| | The Forward or Reverse Drive Prohibition Input (POT or NOT) is OFF. | <ul style="list-style-type: none"> Check to see if the input for Forward or Reverse Drive Prohibition Input (POT or NOT) is OFF. Check the input of +24 VIN to CN1. | <ul style="list-style-type: none"> Turn ON POT and NOT. Input +24 VIN to CN1. |
| | The torque limit is set to 0. | Check to see if the torque limits in the Positive torque limit value (60E0 hex) and the Negative torque limit value (60E1 hex) are set to 0. | Set the maximum torque to be used for each of these objects. |
| | The Servo Drive has broken down. | – | Replace the Servo Drive. |

| Symptom | Probable cause | Items to check | Measures |
|---|---|---|---|
| The servo locks but the Servomotor does not rotate. | The host controller does not give a command. | For a position command, check to see if the speed and position are set to 0. | Enter position and speed data. Start the Servomotor. |
| | The Servo Drive received a command but it is not accepted. | Check to see if the Servo Drive retains the object value for two communications cycles or more in Profile position mode (pp). | Set the Servo Drive so that it retains the object value for two communications cycles or more. |
| | It is hard to determine if the Servomotor is rotating | Check to see if the speed command given by the host controller is too small. | Check the speed command from the host controller. |
| | The holding brake is operating. | Check the brake interlock output (BKIR) signal and the +24 VDC power supply. | Check to see if the holding brake on a Servomotor with brake is released when the servo is locked. |
| | The torque limits set in the Positive torque limit value (60E0 hex) and the Negative torque limit value (60E1 hex) are too small. | Check to see if the torque limits in objects 60E0 hex and 60E1 hex are set to a value close to 0. | Set the maximum torque to be used for each of these objects. |
| | The Servo Drive has broken down. | – | Replace the Servo Drive. |
| | The Forward or Reverse Drive Prohibition Input (POT or NOT) is OFF. | Check the ON/OFF state of the POT and NOT signals from the CX-Drive. | <ul style="list-style-type: none"> • Turn ON the POT and NOT signals. • Disable them in the settings when the POT and NOT signals are not used. |
| | The control mode does not conform to the command. | Check the set value of the Control Mode Selection (3001 hex). | Set the control mode according to the command. |
| | The Servomotor power cable is wired incorrectly. | Check the wiring. | Wire correctly. |
| | The encoder cable is wired incorrectly. | | |
| Power is not supplied. | Check the power supply and the 7-segment display. | Turn ON the power. | |
| | Check the voltage between the power terminals. | Wire the power-ON circuit correctly. | |
| The Servo Drive has broken down. | – | Replace the Servo Drive. | |
| The Servomotor operates momentarily, but then it does not operate after that. | The position commands given are too little. | Check the position data and the electronic gear ratio at the host controller. | Set the correct data. |
| | The Servomotor power cable is wired incorrectly. | Check the wiring of the Servomotor 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 Servomotor rotates without a command. | There are inputs of small values in speed control mode. | Check if there is an input in speed control mode. | Set the speed command to 0. Alternatively, change the mode to position control mode. |
| | The Servo Drive has broken down. | – | Replace the Servo Drive. |

| Symptom | Probable cause | Items to check | Measures |
|---|--|--|---|
| The Servomotor rotates in the reverse direction from the command. | The value set in the Rotation Direction Switching (3000 hex) is incorrect. | Check the set value of object 3000 hex. | Change the set value of object 3000 hex. |
| | The command given by the host controller is incorrect. | <ul style="list-style-type: none"> The size of the absolute command is set incorrect. The polarity of an incremental command is set incorrect. | <ul style="list-style-type: none"> Check the actual and target values. Check the rotation direction. |
| The holding brake does not work. | Power is supplied to the holding brake. | Check to see if power is supplied to the holding brake. | <ul style="list-style-type: none"> Check the brake interlock output (BKIR) signal and the relay circuit. Check to see if the holding brake is worn down. |
| Motor rotation is unstable. | The Servomotor power cable or encoder cable is wired incorrectly. | Check the wiring of the Servomotor power cable's phases U, V, and W and check the encoder cable's wiring. | Wire correctly. |
| | Low rigidity is causing vibration. | Measure the vibration frequency of the load. | Enable the damping control. Set the damping filter frequency. |
| | The load's moment of inertia exceeds the Servo Drive's allowable value. | Calculate the load inertia. | <ul style="list-style-type: none"> Check if manual tuning can achieve proper adjustment. Increase the Servomotor capacity. |
| | Loose joint and/or large clearance with the machine | Check the joint with the machine. | Remove the joint looseness with the machine. |
| | The load and gain do not match. | Check the response waveforms for speed and torque. | Adjust the speed loop gain to stabilize the rotation. |
| The Servomotor is overheating. | The ambient temperature is too high. | Check to see if the ambient temperature around the Servomotor is over 40°C. | <ul style="list-style-type: none"> Lower the ambient temperature around the Servomotor to 40°C or less. (Use a fan or air conditioner.) Lower the load ratio. |
| | The heat radiation condition for the Servomotor is inappropriate. | <ul style="list-style-type: none"> Check to see if the specified radiation conditions are observed. For a Servomotor with a brake, check the load ratio. | <ul style="list-style-type: none"> Improve the radiation conditions. Reduce the load. Improve ventilation. |
| | The Servomotor is overloaded. | Measure the torque on the analog monitor on the front panel or from the CX-Drive. | Decrease the acceleration and deceleration rates. |
| | The Servomotor vibrates during rotation. | | Lower the speed and check the load. |
| The machine position is misaligned. | The coupling of the Servomotor axis and the machine is abnormal. | Check to see if the coupling of the Servomotor and the machine is misaligned. | <ul style="list-style-type: none"> Tighten the coupling again. Replace the coupling with a coupling that has no looseness. |
| | The host controller gave a deceleration stop command. | Check the control ladder program in the host controller. | Review the control in the host controller. |

| Symptom | Probable cause | Items to check | Measures |
|---|--|--|---|
| The Servomotor does not stop or is hard to stop even if the servo is turned OFF while the Servomotor is rotating. | The load inertia is too large. | <ul style="list-style-type: none"> Check the load inertia. Check the Servomotor rotation speed. The dynamic brake resistance is disconnected. | <ul style="list-style-type: none"> Review the load inertia. Replace the Servomotor and Servo Drive with proper ones. |
| | The dynamic brake is disabled. | Check if the dynamic brake is disabled or broken. | <ul style="list-style-type: none"> Enable the dynamic brake, if it is disabled. Replace the brake if it is broken or if the resistor is disconnected. |
| The Servomotor or the load generates abnormal noise or vibration. | Vibration occurs due to improper mechanical installation. | Check to see if the Servomotor's mounting screws are loose. | Retighten the mounting screws. |
| | | Check the load for eccentricity. | Eliminate the eccentricity. It results in torque fluctuation and noise. |
| | | Check to see if the coupling with the load is unbalanced. | Balance the rotation. |
| | | Check to see if the decelerator is generating any abnormal noise. | Check the decelerator specifications. Check the decelerator for malfunctions. |
| | Vibration occurs due to low mechanical rigidity. | Check to see if the vibration frequency is 100 Hz or lower. | If the frequency is 100 Hz or lower, set the correct damping frequency for the damping filter to eliminate the vibration. |
| | Vibration occurs due to machine resonance. | Check to see if the resonance frequency is high or low. | If the resonance frequency is high, set the adaptive filter to eliminate the resonance. Alternatively, measure the resonance frequency and set Notch Filter 1 and 2. |
| | There is a problem with the bearings. | Check for noise or vibration around the bearings. | Check to see if the bearings are mounted properly, and adjust them if necessary. |
| | The gain is wrong. | – | Check if manual tuning can achieve proper adjustment. |
| | The Speed Feedback Filter Time Constant 1 (3103 hex) is wrong. | Check the set value of object 3103 hex. Normally set 0. | Return the setting to the default value of 0. Alternatively, set a large value and operate the Servomotor. |
| The Torque Command Filter Time Constant 1 (3104 hex) does not match the load. | Review the set value of object 3104 hex. | Set a larger value for object 3104 hex to eliminate the vibration. | |

| Symptom | Probable cause | Items to check | Measures |
|---|---|---|---|
| The Servomotor or the load generates abnormal noise or vibration. | The Position Loop Gain 1 (3100 hex) is too large. | Review the setting of object 3100 hex. | Use the CX-Drive or the analog monitor to measure the response and adjust the gain. |
| | The Speed Loop Gain 1 (3101 hex) and the Speed Loop Integral Time Constant 1 (3102 hex) are balanced incorrectly. | Review the set values of objects 3101 hex and 3102 hex. | |
| | Noise is entering into the control I/O signal cable because the cable does not meet specifications. | Check to see if the cable is a twisted-pair cable or shielded twisted-pair cable with core wires that are at least 0.08 mm dia. | Use a control I/O signal cable that meets specifications. |
| | Noise is entering into 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 into the cable because the encoder cable does not meet specifications. | Check to see if it is a shielded twisted-pair cable with core wires that are at least 0.12 mm dia. | Use an encoder cable that meets specifications. |
| | Noise is entering into 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 into 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. |
| | Excessive noise on encoder cable. | Check to see if 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 current 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 Servomotor installation (such as the precision of the mounting surface, attachment, or axial offset). | Reduce the mechanical vibration or correct the Servomotor's installation. |
| Overshooting at startup or when stopping | The Position Loop Gain 1 (3100 hex) is too large. | Review the setting of object 3100 hex. | Adjust the gain to prevent overshooting. |
| | The Speed Loop Gain 1 (3101 hex) and the Speed Loop Integral Time Constant 1 (3102 hex) are balanced incorrectly. | Review the set values of objects 3101 hex and 3102 hex. | Use the CX-Drive or the analog monitor to measure the response and adjust the gain. |
| | The machine rigidity set by realtime autotuning is incorrect. | Review the setting of the machine rigidity. | Match the machine rigidity setting to the load rigidity. |
| | The set inertia ratio differs from the load. | Review the set value of the Inertial Ratio (3004 hex). | Adjust the set value of object 3004 hex with the load. |

| Symptom | Probable cause | Items to check | Measures |
|---|--|--|---|
| Vibration is occurring at the same frequency as the power supply. | Inductive noise is occurring. | Check to see if the drive control signal lines are too long. | Shorten the control signal lines. |
| | | Check to see if the control signal lines and power supply lines are bound together. | <ul style="list-style-type: none"> Separate control signal lines from power supply lines. Use a low-impedance power supply for control signals. |
| The position is misaligned. (Position misalignment occurs without an error being output.) | There is an error in the coupling of the mechanical system and the Servomotor. | Check to see if the coupling of the mechanical system and the Servomotor is misaligned. | Correct the coupling between the mechanical system and the Servomotor. |
| | The gain is wrong. | – | Check if manual tuning can achieve proper adjustment. |
| | The load inertia is too large. | <ul style="list-style-type: none"> Check the load inertia. Check the Servomotor rotation speed. The dynamic brake resistance is disconnected. | <ul style="list-style-type: none"> Review the load inertia. Replace the Servomotor and Servo Drive with proper ones. |

12-5 Periodic Maintenance



Caution



After replacing the unit, transfer to the new unit all data needed to resume operation, before restarting the operation. Equipment damage may result.



Never repair the product by disassembling it. Electric shock or injury may result.

Servomotors and Servo Drives contain many components and will operate properly only when each of the individual components is operating properly. Some of the electrical and mechanical components require maintenance depending on application conditions. Periodic inspection and replacement are necessary to ensure proper long-term operation of Servomotors and Servo Drives. (Quoted 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 given below for Servomotors and Servo Drives. Use these for reference in periodic maintenance.

12-5-1 Servomotor Life Expectancy

- The lifetimes for the different motor parts are listed below.

Bearings: 20,000 hours

Decelerator: 20,000 hours

Oil seal: 5,000 hours

Encoder: 30,000 hours

These values assume an ambient motor operating temperature of 40°C, a shaft load within the specified value, operation within the rated values (rated torque and rated rotation speed), and proper installation as described in this manual.

The bearings, decelerator, oil seal, and encoder can be replaced for repair.

- The radial load during Servomotor operation on timing pulleys and other components contacting belts is two or more times the static load or more. 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 be damaged.

12-5-2 Servo Drive Life Expectancy

- The lifetimes for the different drive parts are given below.
 Aluminum electrolytic capacitors: 28,000 hours
 (at an ambient drive operating temperature of 55°C, constant output at rated torque, constant output at rated rotation speed, and installation as described in this manual)
 Axial-flow fan: 10,000 to 30,000 hours (The limit depends on the operating conditions.)
 Inrush current prevention relay: Approx. 20,000 operations (The limit depends on the operation conditions.)
- When using the Servo Drive in continuous operation, use fans or air conditioners to maintain the ambient temperature below 40°C.
- We recommend that the ambient temperature and the power supply ON time be reduced as much as possible to lengthen the service life of the Servo Drive.
- The limit of aluminum electrolytic capacitors is greatly affected by the ambient operating temperature. Generally, an increase of 10°C in the operating ambient temperature will reduce capacitor service life by 50%.
 For example, when the ambient operating temperature is 25°C, the life expectancy will be as follows:

$$\begin{aligned} \text{Life expectancy at 25°C} &= \text{Life expectancy at 55°C} \times 2^{\frac{55-25}{10}} \\ &= 224,000 \text{ hours} \end{aligned}$$

- The aluminum electrolytic capacitors deteriorate even when the Servo Drive is stored with no power supplied. If the Servo Drive is not used for a long time, we recommend periodic inspection and a part replacement period 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 period of 5 years is recommended.
- Upon request, OMRON will inspect the Servo Drive and Servomotor and determine if part replacement is required.

12-5-3 Replacing the Absolute Encoder Battery **ABS**

Replace the Absolute Encoder Backup Battery Unit if it has been used for more than 3 years or if an Absolute Encoder System Down Error (Error No. 40.0) 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 Unit

● Mounting the Battery Unit for the First Time

Connect the Absolute Encoder Backup Battery Unit to the motor, then set up the absolute encoder. Refer to *10-2-4 Absolute Encoder Setup* on page 10-7.

After the Absolute Encoder Backup Battery Unit is attached, it is recommended that the control power supply be turned ON and OFF once a day to refresh the battery.

If you do not refresh the battery, battery errors may occur due to voltage delay in the battery.

● Replacing the Battery Unit

If a battery warning occurs, the absolute encoder power supply must be replaced.

Replace the Battery Unit with the control power supply of the Servo Drive turned ON. If the Battery Unit is replaced with the control power supply of the Servo Drive OFF, data held in the encoder will be lost.

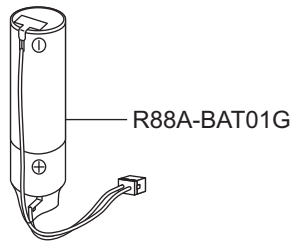


Precautions for Correct Use

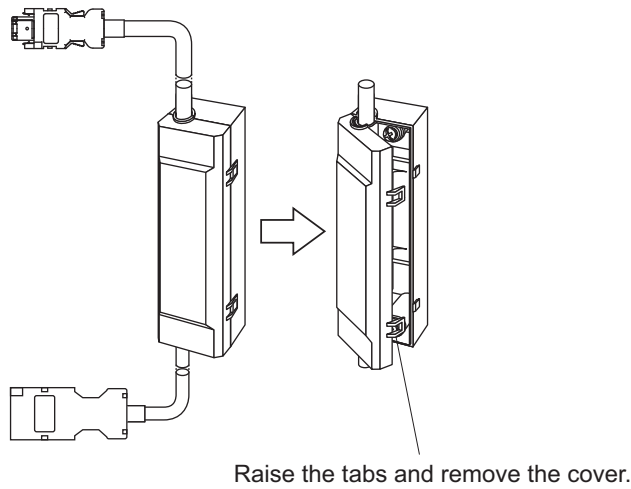
- If the absolute encoder is cleared using the front panel or the absolute value is cleared using communications, all error and multi-rotation data will be lost and the absolute encoder must be set up again. Refer to *10-2-4 Absolute Encoder Setup* on page 10-7.

● **Battery Unit Mounting Method**

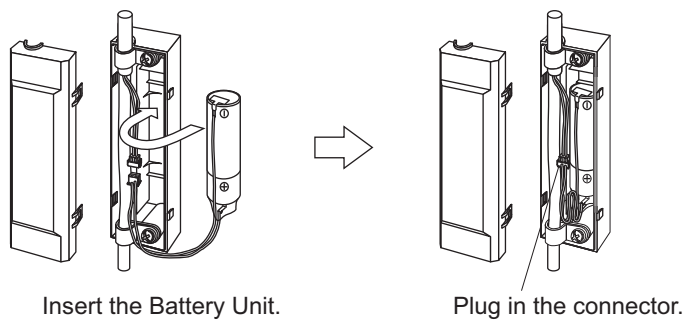
- 1** Prepare the replacement Battery Unit (R88A-BAT01G).



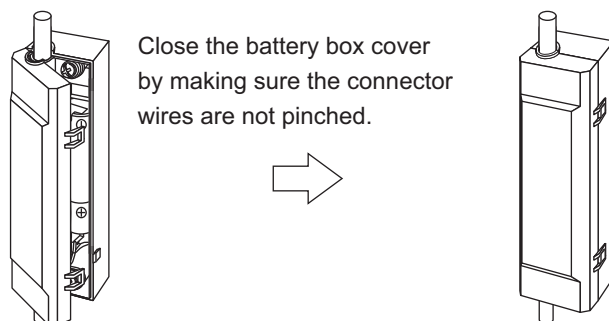
- 2** Remove the Battery Unit box cover.



- 3** Put the Battery Unit into the battery box.



- 4** Close the cover to the battery box.





Appendices

The appendix provides explanation for the profile that is used to control the Servo Drive, lists of objects, Sysmac Error Status codes, and other information.

| | | |
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A-1 CiA402 Drive Profile

This section describes the profile that is used to control the Servo Drive.

A-1-1 Controlling the State Machine of the Servo Drive

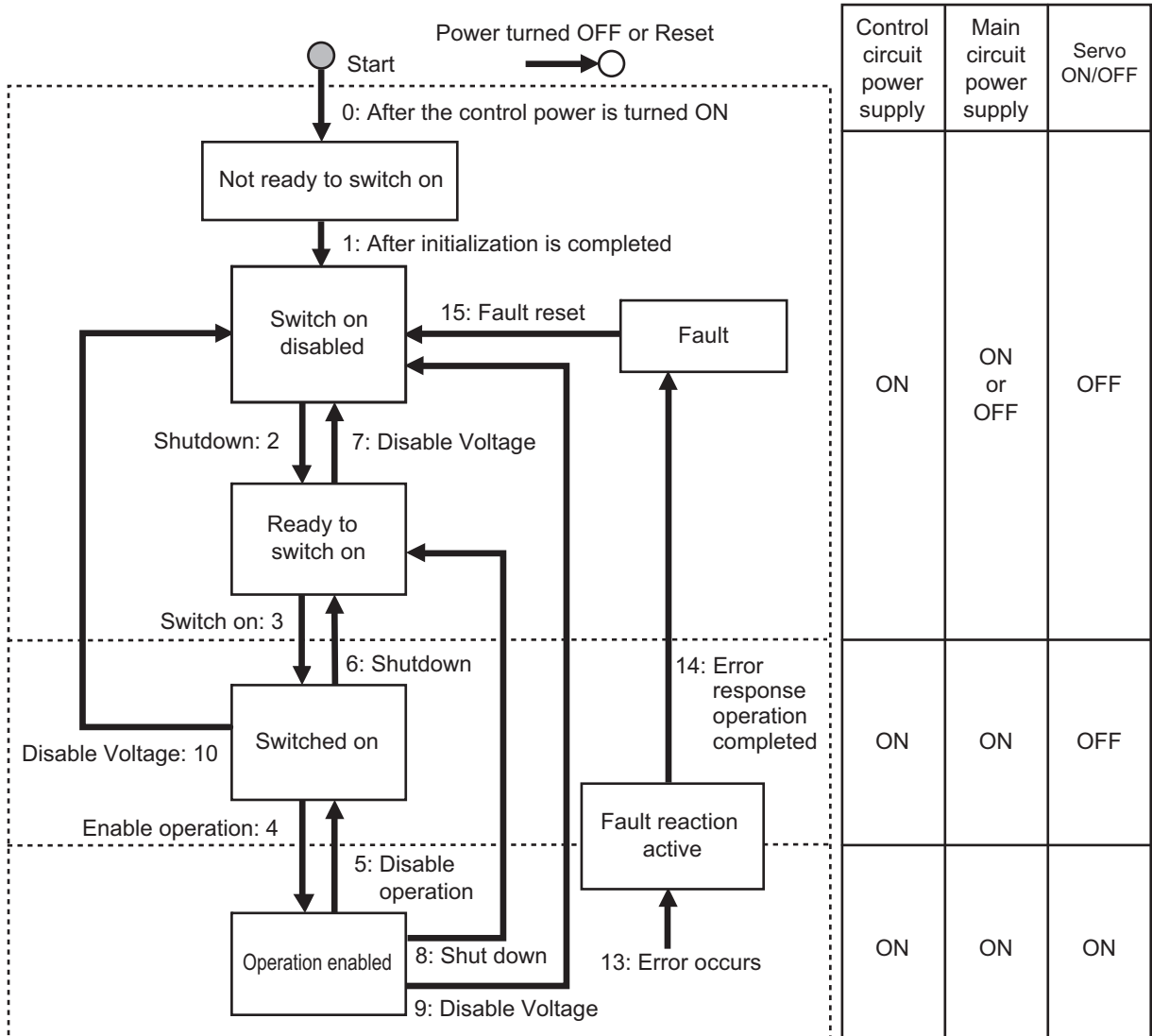
The state of G5-series Servo Drives with built-in EtherCAT communications is called "PDS state." The PDS state is controlled by the Controlword (6040 hex).

State Machine

The state of an G5-series Servo Drive changes as shown below.

Each box indicates a state, while numbers 2 to 10 and 15 indicate the state control commands.

For details on the states, refer to *State Descriptions* on page A-3 and *Command Coding* on page A-3.



Note 1 Quick stop active state is not supported. Even if a Quick stop command is received, it will be ignored.

- 2 The operation to perform when the main circuit power is turned OFF while the Servo is ON can be set using the Undervoltage Error Selection (3508 hex).
 3508h=0: Moves to a state where the main circuit power supply is turned OFF and stops according to the setting of the Shutdown option code (605B hex).
 3508h=1: Moves to an error processing state and stops according to the setting of the Fault reaction option code (605E hex).

State Descriptions

| States | Description |
|------------------------|--|
| Not ready to switch on | The control circuit power supply is turned ON and initialization is being executed. |
| Switch on disabled | Initialization has been completed. Servo Drive parameters can be set. |
| Ready to switch on | The main circuit power supply can be turned ON. Servo Drive parameters can be set. |
| Switched on | The main circuit power supply is ON. Servo Drive parameters can be set. |
| Operation enabled | The Servo is ON. Servo Drive parameters can be set. |
| Fault reaction active | There was an error in the Servo Drive and the cause is being determined. Servo Drive parameters can be set. |
| Fault | There is an error in the Servo Drive. Servo Drive parameters can be set. |

Command Coding

State is controlled by combining the bits in the Controlword (6040 hex) as shown in the following table.
 fr = fault reset, eo = enable operation, qs = quick stop, ev = enable voltage, so = switch on

| Command | Controlword Bit | | | | | Move to |
|------------------------------|-----------------------|-------------|-------------|-------------|-------------|-----------------------------|
| | Bit 7 fr | Bit 3 eo | Bit 2 qs | Bit 1 ev | Bit 0 so | |
| Shutdown | x | x | 1 | 1 | 0 | 2, 6, 8 |
| Switch on | x | 0 | 1 | 1 | 1 | 3 |
| Switch on + enable operation | x | 1 | 1 | 1 | 1 | 3 + 4 ^{*1} |
| Disable voltage | x | x | x | 0 | x | 7, 9, 10 |
| Quick stop | x | x | 0 | 1 | x | Not supported ^{*2} |
| Disable operation | x | 0 | 1 | 1 | 1 | 5 |
| Enable operation | x | 1 | 1 | 1 | 1 | 4 |
| Fault reset | 0 → 1 ^{*3*4} | x | x | x | x | 15 |

- *1 The state automatically moves to Operation enabled state after Switched on state.
 *2 Quick stop commands are not supported. Even if a quick stop command is received, it will be ignored.
 *3 Bit 7: Operation when Fault reset bit turns ON.
 Fault state: Errors are reset and the Servo Drive returns to its initialized state.
 If there are any warnings (Warning (6041 hex: Statusword bit 7), they are reset.
 State other than Fault state: If there are any warnings (Warning (6041 hex: Statusword bit 7), they are reset.
 The state will change according to command bits 0 to 3.
 *4 When an error reset is executed with bit 7, set the bit back to 0 before giving the next command.

State Coding

State is indicated by the combination of bits in Statusword (6041 hex), as shown in the following table.

| State | Bit 6 sod ^{*1} | Bit 5 qs ^{*2} | Bit 4 ve ^{*3} | Bit 3 f ^{*4} | Bit 2 oe ^{*5} | Bit 1 so ^{*6} | Bit 0 rtso ^{*7} |
|------------------------|----------------------------|---------------------------|---------------------------|--------------------------|---------------------------|---------------------------|-----------------------------|
| Not ready to switch on | 0 | 0 | × | 0 | 0 | 0 | 0 |
| Switch on disabled | 1 | 1 | × | 0 | 0 | 0 | 0 |
| Ready to switch on | 0 | 1 | × | 0 | 0 | 0 | 1 |
| Switched on | 0 | 1 | × | 0 | 0 | 1 | 1 |
| Operation enabled | 0 | 1 | × | 0 | 1 | 1 | 1 |
| Fault reaction active | 0 | 1 | × | 1 | 1 | 1 | 1 |
| Fault | 0 | 1 | × | 1 | 0 | 0 | 0 |

- *1 sod = switch on disabled
- *2 qs = quick stop
- *3 ve = voltage enabled
- *4 f = fault
- *5 oe = operation enabled
- *6 so = switched on
- *7 rtso = ready to switch on

A-1-2 Modes of Operation

G5-series Servo Drives with built-in EtherCAT communications support the following Modes of operation.

- csp: Cyclic synchronous position mode
- csv: Cyclic synchronous velocity mode
- cst: Cyclic synchronous torque mode
- pp: Profile position mode
- hm: Homing mode

The operation mode is set in Modes of operation (6060 hex). It is also given in Modes of operation display (6061 hex).

The operation modes supported by the Servo Drive can be checked in Supported drive modes (6502 hex).

If an unsupported operation mode is specified, a Function Setting Error (Error No. 93.4) will occur.



Precautions for Correct Use

- Cyclic synchronous velocity mode, Cyclic synchronous torque mode, and Homing mode are supported for unit version 2.0 or later.
- Profile position mode (pp) is supported for unit version 2.1 or later.

A-1-3 Communications Cycles and Corresponding Modes of Operation

This section describes the Modes of operation that can be used for each combination of communications cycle and PDO mapping set in the RxPDO.

When the RxPDO is set to 1600 hex, the combination of the communications cycle and the available Modes of operation varies depending on the total size of mapped objects. In the table below, the total size of mapped objects is shown in parentheses. For details on the RxPDO (1600 hex), refer to 5-4-4 Variable PDO Mapping.

- Semi-closed Control
Any of 1701 to 1705 hex or 1600 hex can be set in the RxPDO when 0 to 5 (semi-closed control) is set for the Control Mode Selection (3001 hex). The following table shows the Modes of operation that can be used for each combination of communications cycle and RxPDO.

| Communications cycle (μs) ^{*1} | RxPDO | | |
|---|---|---|---|
| | When electronic gear ratio is 1:1 | | When electronic gear ratio is not 1:1 |
| | 1701, 1702, 1703, 1705, 1600 hex (20 bytes or less) | 1704, 1600 hex (20 to 24 bytes) ^{*3} | 1701, 1702, 1703, 1704, 1705, 1600 hex (24 bytes or less) ^{*3} |
| 250 | csp, csv, cst | _ ^{*2} | _ ^{*2} |
| 500 | csp, csv, cst | csp, csv, cst | _ ^{*2} |
| 1000 | csp, csv, cst, pp, hm | csp, csv, cst, pp, hm | csp, csv, cst, pp, hm |
| 2000 | csp, csv, cst, pp, hm | csp, csv, cst, pp, hm | csp, csv, cst, pp, hm |
| 4000 | csp, csv, cst, pp, hm | csp, csv, cst, pp, hm | csp, csv, cst, pp, hm |

*1 The communications cycle is set in the controller. Refer to the manual of the controller that is connected for the setting procedure.

*2 The Function Setting Error (Error No. 93.4) will occur if a setting labeled “– (Not supported)” is set.

*3 If the total size of mapped objects exceeds 24 bytes, a Function Setting Error (Error No. 93.4) will occur.

Note For unit version 2.0, the electronic gear ratio can be set only to 1:1. A Function Setting Error (Error No. 93.4) does not occur even when a value other than 1:1 is set.
Profile position mode (pp) and an object 1600 hex are supported for unit version 2.1 or later.

- Fully-closed Control
Only 1701 hex can be set in the RxPDO when 6 (fully-closed control) is set for the Control Mode Selection (3001 hex). The following table shows the Modes of operation that can be used for each combination of communications cycle and RxPDO.

| Communications cycle (μs) ^{*1} | RxPDO ^{*3} | | | |
|---|-----------------------------------|---------------------------------------|---------------------------------------|---|
| | When electronic gear ratio is 1:1 | | When electronic gear ratio is not 1:1 | |
| | 1701, 1600 hex (12 bytes or less) | 1702, 1705, 1600 hex (13 to 24 bytes) | 1701, 1600 hex (12 bytes or less) | 1702, 1705, 1600 hex (13 to 24 bytes) ^{*3} |
| 250 | _ ^{*2} | _ ^{*2} | _ ^{*2} | _ ^{*2} |
| 500 | csp | _ ^{*2} | _ ^{*2} | _ ^{*2} |
| 1000 | csp, pp, hm | _ ^{*2} | csp | _ ^{*2} |
| 2000 | csp, pp, hm | _ ^{*2} | csp, pp, hm | _ ^{*2} |
| 4000 | csp, pp, hm | _ ^{*2} | csp, pp, hm | _ ^{*2} |

*1 The communications cycle is set in the controller. Refer to the manual of the controller that is connected for the setting procedure.

*2 The Function Setting Error (Error No. 93.4) will occur if a setting labeled “– (Not supported)” is set.

*3 If the total size of mapped objects exceeds 24 bytes, a Function Setting Error (Error No. 93.4) will occur.

Note For unit version 2.0, the electronic gear ratio can be set only to 1:1. A Function Setting Error (Error No. 93.4) does not occur even when a value other than 1:1 is set.
 Profile position mode (pp) and an object 1600 hex are supported for unit version 2.1 or later.



Additional Information

For functional differences between unit versions, refer to *A-5 Functional Differences among Unit Versions* on page A-168.

A-1-4 Modes of Operation and Applied Functions

The relationships between the modes of operation of G5-series Servo Drives with built-in EtherCAT communications and the application functions are shown below.

○: Supported, –: Not supported

| Function | Mode of operation | | | | Supported specifications ^{*2*3} | | |
|---|--------------------------------|-----|-----|----------------------------|--|----|----|
| | csp pp ^{*10} hm | csv | cst | Fully-closed ^{*1} | | | |
| Notch filter (notch 1 to notch 4) ^{*4} | ○ | ○ | ○ | ○ | 4 | | |
| Damping filter | ○ | – | – | ○ | 2 | | |
| Speed feed-forward | ○ | – | – | ○ | ○ | | |
| Torque feed-forward function ^{*5} | ○ | ○ | – | ○ | – | ○ | ○ |
| Position command FIR filter ^{*6} | ○ | – | – | ○ | – | | |
| Position command smoothing filter | ○ | – | – | ○ | ○ | ○ | ○ |
| Realtime Autotuning (RTAT) ^{*7} | ○ | ○ | ○ | ○ | ○ | – | – |
| Instantaneous speed observer ^{*8} | ○ | ○ | – | – | – | ○ | – |
| Disturbance Observer ^{*9} | ○ | ○ | – | – | – | – | ○ |
| | | | | | *5 | *8 | *9 |

- *1 The fully-closed modes of operation are csp, pp and hm.
- *2 ○ in the Supported specifications column depends on the applicable range of the related control mode.
- *3 The PDO mapping conditions depend on Rx and Tx (number of bytes of the PDOs) values given above in the control mode correspondence table.
- *4 When one adaptive filter is enabled, notch 3 is set automatically. When two adaptive filters are enabled, notch 3 and notch 4 are set automatically.
- *5 When RTAT is enabled, you cannot use the torque feed-forward function. (They are in an exclusive relationship.)
- *6 The FIR filter is enabled only in hm, pp and csp mode when the communications cycle is set to 1 ms or above.
- *7 When Realtime Autotuning (RTAT) is enabled, the instantaneous speed observer and disturbance observer are automatically disabled. RTAT must be disabled to enable the instantaneous speed observer.
- *8 When the instantaneous speed observer is enabled, the disturbance observer is automatically disabled.
- *9 RTAT and the instantaneous speed observer must be disabled to enable the disturbance observer.
- *10 Profile position mode (pp) is supported for unit version 2.1 or later.

A-1-5 Changing the Mode of Operation

The operation mode of the G5-series Servo Drives with built-in EtherCAT communications is changed as described below.

● Changing the Mode of Operation

By setting a mode of operation from the controller, the Servomotor can be operated while switching the control mode of the Servo Drive.

The mode of operation is changed by changing the set value of Modes of operation (6060 hex).

When changing the mode of operation, also change the command value of the object mapped to the RxPDO. For example, in the Cyclic synchronous position mode (csp), which is a position control mode, the Target position (607A hex) is enabled as the command value, whereas in the Cyclic synchronous velocity mode (csv), which is a speed control mode, the Target velocity (60FF hex) is enabled as the command value. Therefore, when the mode of operation is changed from the position control mode to the speed control mode, the enabled command value is set to the Target velocity (60FF hex) at the same time.

The actual mode of operation of the Servo Drive can be checked from the Modes of operation display (6061 hex).

Note 1 Change the operation mode while the Servomotor is stopped.

If you change the operation mode while the Servomotor is running, shock may occur in the operation of the Servomotor.

- 2 Wait at least 2 ms before changing the mode of operation again. If you change the mode of operation again within 2 ms, a Command Error (Error No. 91.1) will occur.

● Changing to an Unsupported Control Mode

- If 6060 hex is set to a value other than 0 (nma), 1 (pp), 6 (hm), 8 (csp), 9 (csv), or 10 (cst), a Command Error (Error No. 91.1) will occur.
- If 6060 hex is set to 9 (csv) or 10 (cst) during fully-closed control mode, a Command Error (Error No. 91.1) will occur.
- If 6060 hex is set to 6 (hm) when the communications cycle is set to 250 or 500 μ s, a Function Setting Error (Error No. 93.4) will occur.

Note Profile position mode (pp) is supported for unit version 2.1 or later. If pp is specified for unit version 2.0, a Command Error (Error No. 91.1) will occur.

● Changing the Control Mode under Warning Conditions

The operation when there is a warning for the related data (Data setting warning or Command warning) is different depending on the control mode.

- Changing to csp, csv, or cst
If there is a warning for the related data, you cannot change to csp, csv, or cst. The current operation mode is maintained.
- Changing to hm and pp
The operation mode changes even when there is a warning for the related data. For the hm mode, a homing error occurs instead of a warning.

Note Profile position mode (pp) is supported for unit version 2.1 or later. If pp is specified for unit version 2.0, operating mode will not change to Profile position mode (pp).

● **Changing the Control Mode to pp or hm Mode When the Motor Is Running**

- When the Halt bit is OFF, the Servomotor comes to an immediate stop if the rising edge of 6040 hex bit 4 (start bit) is not detected when the control mode is changed to pp or hm mode while the motor is running.
- When the Halt bit is ON, the Servomotor performs the stop operation according to the setting of the Halt option code (605D hex) if the rising edge of 6040 hex bit 4 (start bit) is not detected when the control mode is changed to pp or hm mode while the motor is running.

Note Profile position mode (pp) is supported for unit version 2.1 or later.

● **Precautions in hm Mode**

- To disable the stop process using drive prohibition when the control mode changes to hm mode during Servomotor operation, the Servomotor is momentarily set to an immediate stop regardless of the detection of the rising edge of 6040 hex bit 4 (start bit). However, when the Halt bit is ON, the Servomotor stops according to the setting of 605D hex.
- When you change to another operation mode while the motor is running in hm mode (during homing operation), the operation continues for approx. 2 ms, and the stop operation for drive prohibition is not executed. Therefore, change the control mode when the Servomotor has stopped after homing is attained.

● **Modes of Operation Display**

The actual mode of operation can be checked from the Modes of operation display (6061 hex). The display is as follows depending on the state of the Servo Drive:

| Servo Drive status | | Modes of Operation Display (6061 hex) |
|---|---|--|
| Servo OFF (not operation enabled state) | | 0: Not specified |
| Servo ON (operation enabled state) | | The value that is shown depends on the setting of Modes of operation (6060 hex). |
| Not following commands in the Controlword (6060 hex) when the servo is ON | Drive prohibition *1 | The value that is shown depends on the setting of Modes of operation (6060 hex). (The stop process is executed inside the Servo Drive using a deceleration stop command generated within the Servo Drive.) |
| | Deceleration stop in progress due to main circuit power OFF | |
| | Deceleration stop in progress due to Servo OFF | |
| Deceleration stop in progress due to an error | | 0: Not specified (Fault reaction active state or Fault state during an error) |

*1 When Drive Prohibition Input Selection (3504 hex) = 0.

*2 When Undervoltage Error Selection (3508 hex) = 0.

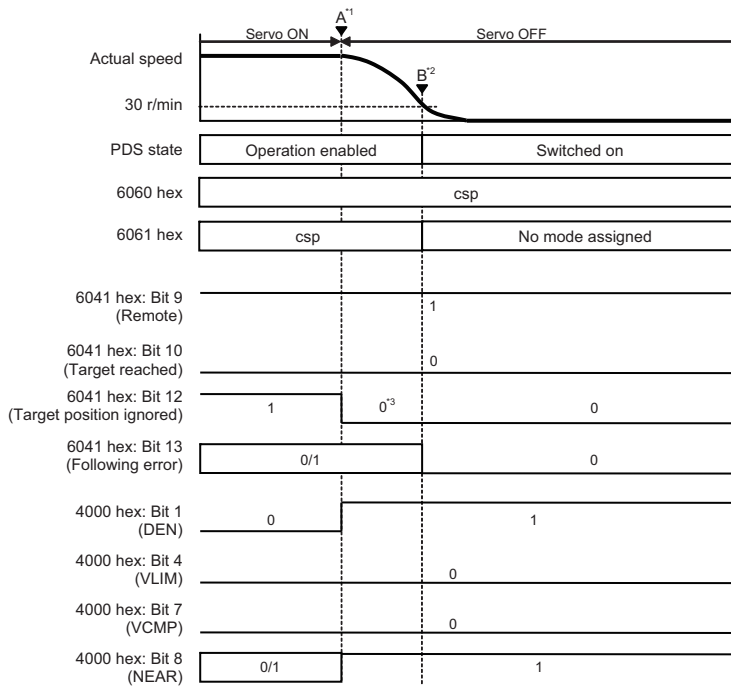
● **Bit Displays According to Modes of Operation Display (6061 Hex)**

Some of the bits in the Statusword (6041 hex) and Statusword 1 (4000 hex) are dependent on the control mode. Their relationship with Modes of operation display is shown in the following table:

| Object | Bit | 6061: Modes of Operation Display | | | | | |
|----------|-----|---------------------------------------|------------------|-----------------------------|---------------|---------------------------------------|-------------------------------------|
| | | Position control mode | | | | Speed Control Mode | Torque Control Mode |
| | | csp | pp ^{*4} | hm | Not specified | csv | cst |
| 6041 hex | 10 | 0 | Target reached | Target reached | 0 | 0 | 0 |
| | 12 | Target position ignored ^{*1} | Acknowledge | Home attained ^{*3} | 0 | Target velocity ignored ^{*1} | Target torque ignored ^{*1} |
| | 13 | Following error | Following error | Homing error ^{*3} | 0 | 0 | 0 |
| 4000 hex | 1 | DEN | DEN | DEN | 1 | 0 | 0 |
| | 4 | 0 | 0 | 0 | 0 | 0 | VLIM ^{*2} |
| | 7 | 0 | 0 | 0 | 0 | VCMP ^{*2} | 0 |
| | 8 | NEAR | NEAR | NEAR | 1 | 0 | 0 |

- *1 When commands in the Controlword (6040 hex) are not followed when the servo is ON, this bit will be 0 (ignored). For details, see figures 1) to 3) below.
- *2 When commands in the Controlword (6040 hex) are not followed when the servo is ON, this bit will be 0. For details, see figures 2) and 3) below.
- *3 When commands in the Controlword (6040 hex) are not followed when the servo is ON, the preceding value is retained. For details, see figure 4) below.
- *4 Profile position mode (pp) is supported for unit version 2.1 or later.

1) Example of Servo OFF during Operation in csp



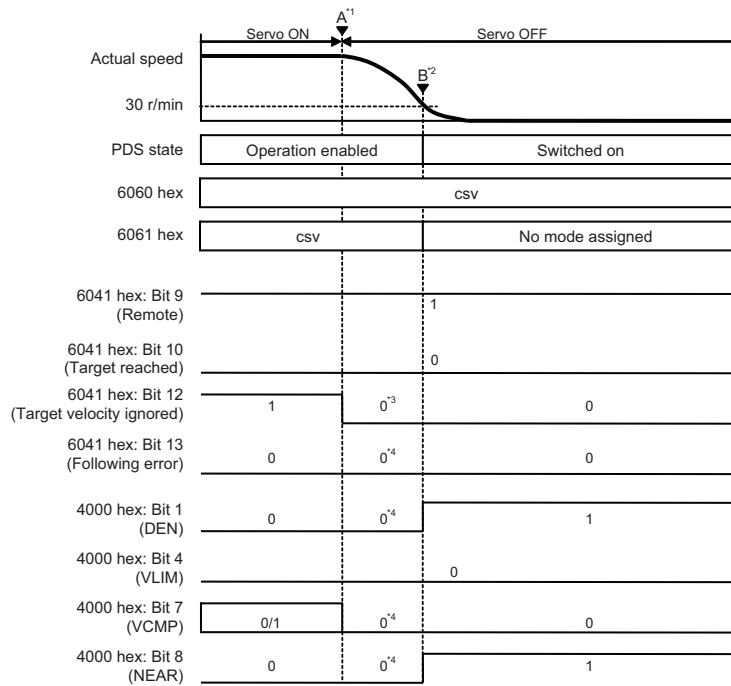
*1 When the servo is turned OFF, a deceleration stop starts and 6061 hex continues to show the same mode as the mode of operation (csp) specified in 6060 hex.

*2 After the motor stops, No mode assigned is shown by 6061 hex.

*3 Bit 12 will be 0 during a deceleration due to servo OFF.

Note The operation during the interval from A to B for drive prohibition and main circuit power OFF is the same as when the servo is turned OFF.

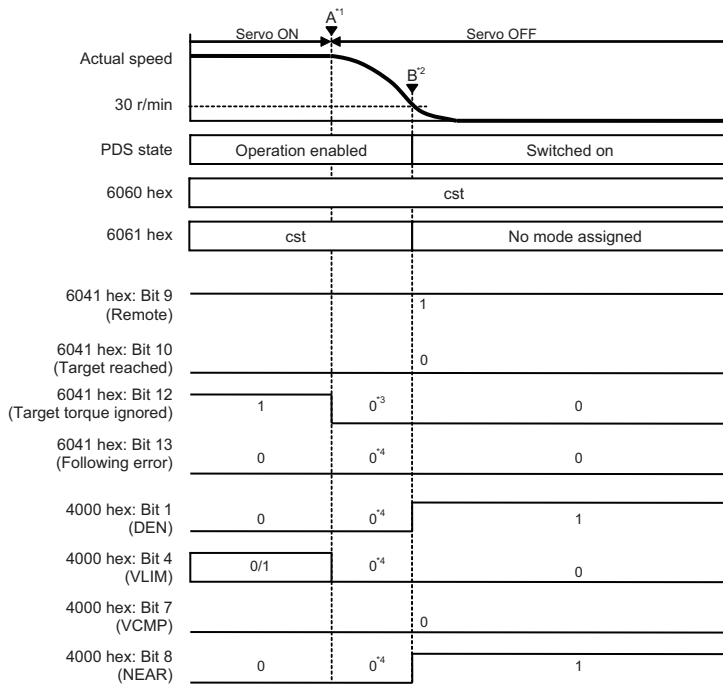
2) Example of Servo OFF during Operation in csv



- *1 When the servo is turned OFF, a deceleration stop starts and 6061 hex continues to show the same mode as the mode of operation (csv) specified in 6060 hex.
- *2 After the motor stops, No mode assigned is shown by 6061 hex.
- *3 Bit 12 will be 0 during a deceleration due to servo OFF.
- *4 The mode shown in 6061 hex is forced to 0 because the mode shown in 6061 hex is different from the mode of operation.

Note The operation during the interval from A to B for drive prohibition and main circuit power OFF is the same as when the servo is turned OFF.

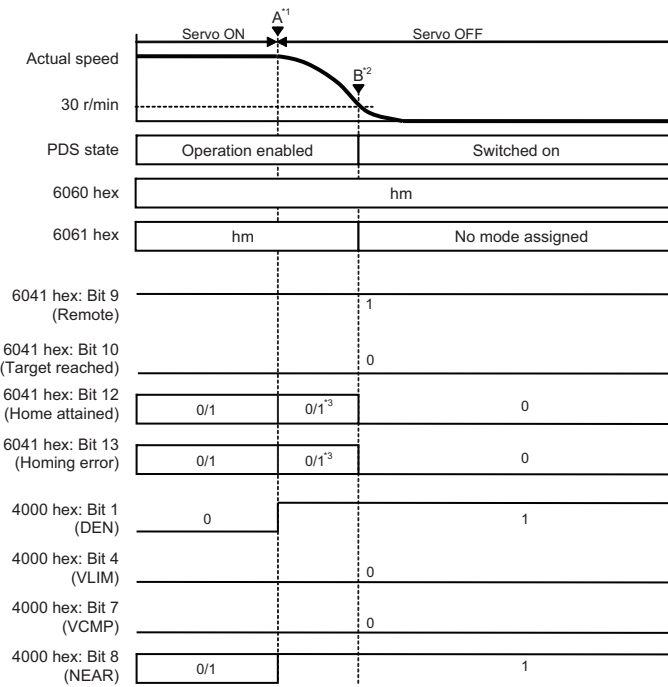
3) Example of Servo OFF during Operation in cst



- *1 When the servo is turned OFF, a deceleration stop starts and 6061 hex continues to show the same mode as the mode of operation (cst) specified in 6060 hex.
- *2 After the motor stops, No mode assigned is shown by 6061 hex.
- *3 Bit 12 will be 0 during a deceleration due to servo OFF.
- *4 The mode shown in 6061 hex is forced to 0 because the mode shown in 6061 hex is different from the mode of operation.

Note The operation during the interval from A to B for drive prohibition and main circuit power OFF is the same as when the servo is turned OFF.

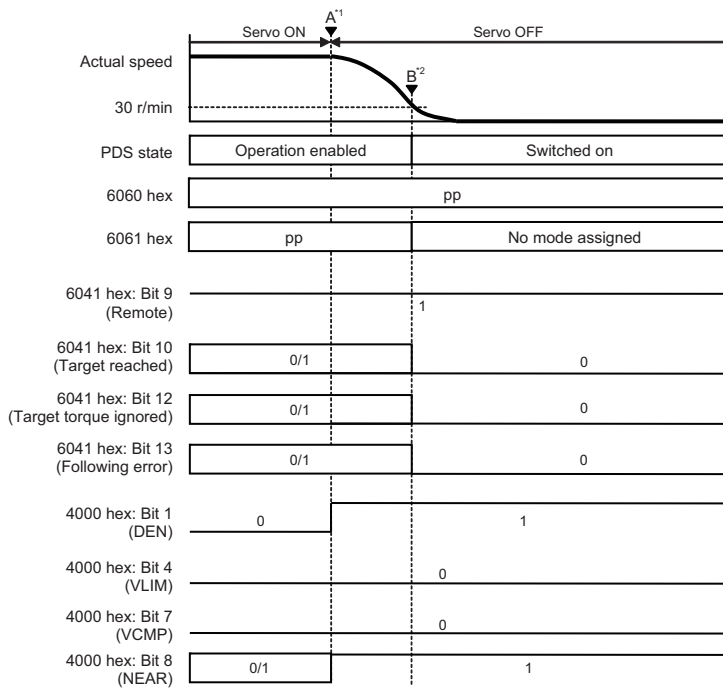
4) Example of Servo OFF during Operation in hm



- *1 When the servo is turned OFF, a deceleration stop starts and 6061 hex continues to show the same mode as the mode of operation (hm) specified in 6060 hex.
- *2 After the motor stops, No mode assigned is shown by 6061 hex.
- *3 Bits 12 and 13 will retain the preceding values during deceleration when the servo is turned OFF.

Note The operation during the interval from A to B for main circuit power OFF is the same as when the servo is turned OFF. The stop function due to drive prohibition is disabled during the homing operation in hm mode.

5) Example of Servo OFF during Operation in pp (Unit version 2.1 or later)



*1 When the servo is turned OFF, a deceleration stop starts and 6061 hex continues to show the same mode as the mode of operation (pp) specified in 6060 hex.

*2 After the motor stops, No mode assigned is shown by 6061 hex.

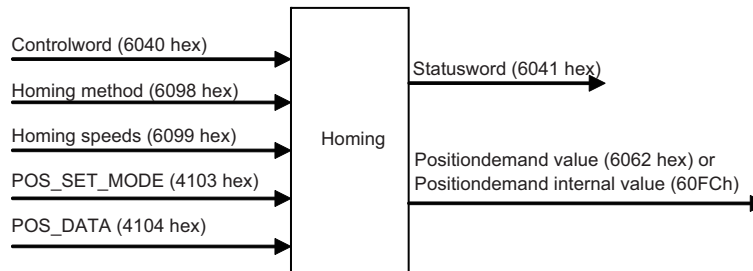
Note The operation during the interval from A to B for drive prohibition and main circuit power OFF is the same as when the servo is turned OFF.

A-1-6 Homing Mode Specifications

This section describes the Homing mode of the G5-series Servo Drives with built-in EtherCAT communications.

Homing Mode Configuration

The configuration of the Homing mode is as follows:



Supported Homing Methods

The following homing methods are supported by G5-series Servo Drives with built-in EtherCAT communications:

| Homing method | Explanation | Reference page |
|---------------|--|----------------|
| 0 | Not specified | - |
| 8 | Homing by Origin Proximity Input and origin signal (forward operation start) | page A-18 |
| 12 | Homing by Origin Proximity Input and origin signal (reverse operation start) | page A-18 |
| 19 | Homing without origin signal (forward operation start) | page A-19 |
| 20 | Homing without origin signal (reverse operation start) | page A-19 |
| 33 | Homing with origin signal (reverse operation start) | page A-20 |
| 34 | Homing with origin signal (forward operation start) | page A-20 |
| 35 | Present home preset | page A-20 |

The homing methods supported by the Servo Drive can be checked in Supported homing method (60E3 hex).

Related Objects

| Index | Sub-index | Object name | Access | Size | Unit | Setting range | Default setting |
|----------|-----------|------------------------------------|--------|-------|------------------------------|---------------------------------|-----------------|
| 6040 hex | 00 hex | Controlword | RW | U16 | 0 to FFFF hex | – | 0000 hex |
| 6060 hex | 00 hex | Modes of operation | RW | INT8 | – | 0 to 10 | 0000 hex |
| 6098 hex | 00 hex | Homing method | RW | INT8 | – | –128 to 127 | 0 |
| 6099 hex | 01 hex | Speed during search for switch | RW | U32 | Command units/s | 100 to 3,276,700 | 5,000 |
| 6099 hex | 02 hex | Speed during search for zero | RW | U32 | Command units/s | 100 to 3,276,700 | 5,000 |
| 4103 hex | 00 hex | Coordinate System Setting Mode | RW | U16 | – | 0000 to FFFF hex | 0 |
| 4104 hex | 00 hex | Coordinate System Setting Position | RW | INT32 | Command units | –2,147,483,648 to 2,147,483,647 | 0 |
| 6041 hex | 00 hex | Statusword | RO | U16 | 0 to FFFF hex | – | 0000 hex |
| 6083 hex | 00 hex | Profile acceleration | RW | U32 | Command units/s ² | 1 to 655,350,000 | 1,000,000 |
| 6084 hex | 00 hex | Profile deceleration | RW | U32 | Command units/s ² | 1 to 655,350,000 | 1,000,000 |
| 6086 hex | 00 hex | Motion profile type | RW | INT16 | – | –1 to 0 | 0 |

Controlword (6040 hex) in Homing Mode

| Bit | Name | Code | Description |
|-----|------------------------|------|--|
| 4 | Homing operation start | 0 | Do not start homing procedure. |
| | | 1 | Start or continue homing procedure. |
| 8 | Halt | 0 | Enable bit 4 |
| | | 1 | Stop axis according to halt option code (605D hex) |

Bit 6 is not used.

For details on other bits, refer to *Controlword (6040 hex)*.

Statusword (6041 hex) in Homing Mode

| Bit | Name | Explanation |
|-----|-----------------|---|
| 10 | Target reached | The status of the homing operation is indicated by the combination of these bits. |
| 12 | Homing attained | |
| 13 | Homing error | The status based on the combination of the bits are shown in the following table. |

| Bit 13 | Bit 12 | Bit 10 | Explanation |
|--------|--------|--------|---|
| 0 | 0 | 0 | Homing procedure is in progress. |
| 0 | 0 | 1 | Homing procedure is interrupted or not started. |
| 0 | 1 | 0 | Homing is attained, but target is not reached. |
| 0 | 1 | 1 | Homing procedure is completed successfully. |
| 1 | 0 | 0 | Homing error occurred, velocity is not 0. |
| 1 | 0 | 1 | Homing error occurred, velocity is 0. |
| 1 | 1 | 0 | Reserved |
| 1 | 1 | 1 | Reserved |

Homing Operation

This section describes the operation of the supported homing methods.

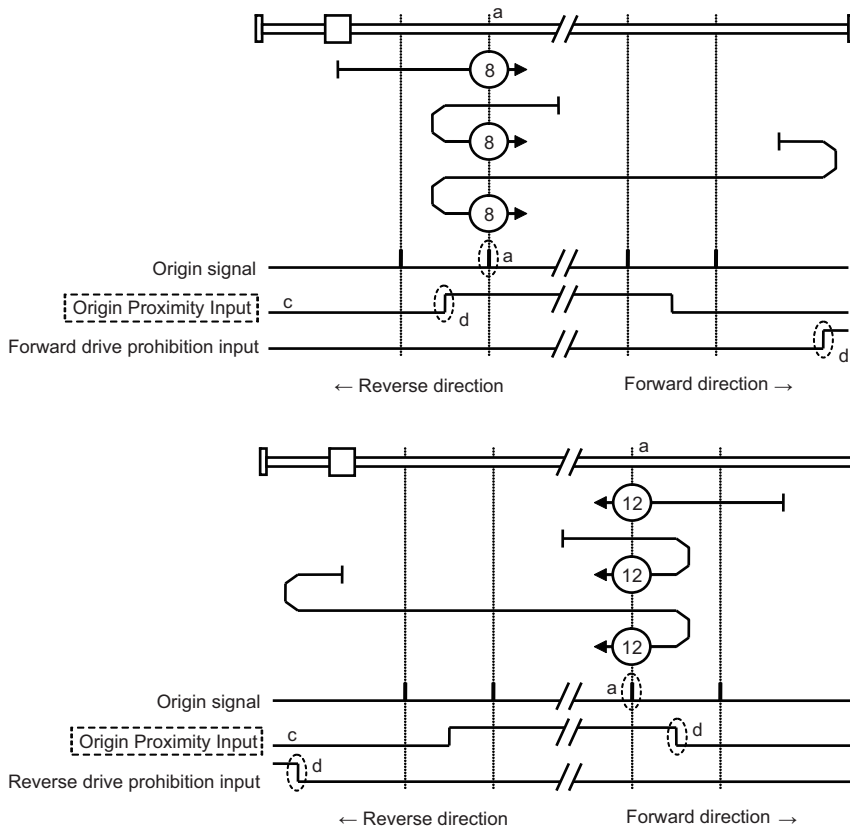
● Homing Methods 8 and 12: Homing by Origin Proximity Input and Origin Signal

These Homing methods use the Origin Proximity Input that is enabled only in some parts of the drive range, and stops when an origin signal is detected.

An origin signal is detected in the forward direction for Homing method 8 and in the reverse direction for Homing method 12.

The operation start direction of the homing operation is the same as the direction of detection of the origin signal when the Origin Proximity Input is OFF, and the reverse direction when the Origin Proximity Input is ON.

The operation direction reverses for the forward drive prohibition input.



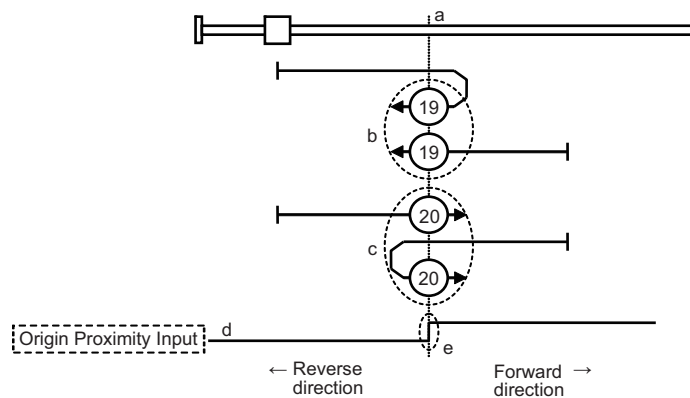
A homing error occurs in the following cases.

- When the drive prohibition inputs on both sides are ON at the same time.
- When the drive prohibition input of one side is ON, and the drive prohibition input of the other side is turned ON without detecting the rising edge of the Origin Proximity Input.
- When the homing operation is started with a sensor without an origin signal (Z phase), such as an absolute scale, during fully-closed control.

- Note 1** If an origin signal exists near the point where the Origin Proximity Input turns ON or OFF, the first origin signal after the Origin Proximity Input is turned ON or OFF may not be detected. Set the Origin Proximity Input so that the origin signal occurs away from the point where the Origin Proximity Input turns ON or OFF.
- 2 During the homing operation, the stop function for the Stop Selection for Drive Prohibition Input is disabled.
 - 3 When the Drive Prohibition Input Selection (3504 hex) is set to 0, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur if the drive prohibition input is detected on both sides.
 - 4 When the Drive Prohibition Input Selection (3504 hex) is set to 1, a homing error (Home error = 1) will occur when the drive prohibition input is detected on both sides. If this Homing method is used without using the drive prohibition input, do not assign the drive prohibition input to a general-purpose input. For details on assigning the general-purpose input signals, refer to 7-1 *Sequence I/O Signals* on page 7-2.
 - 5 When the Drive Prohibition Input Selection (3504 hex) is set to 2, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur if the drive prohibition input is detected on one side. When using this Homing method, set the Drive Prohibition Input Selection (3504 hex) to a value other than 2.

● **Homing Methods 19 and 20: Homing without an Origin Signal**

In these homing methods, only the Origin Proximity Input is used. Homing method 19 stops when the Origin Proximity Input turns OFF, and Homing method 20 stops when the Origin Proximity Input turns ON. The operation start direction of the homing operation is the forward direction for an OFF Origin Proximity Input, and the reverse direction for an ON Origin Proximity Input.



A homing error occurs in the following cases.

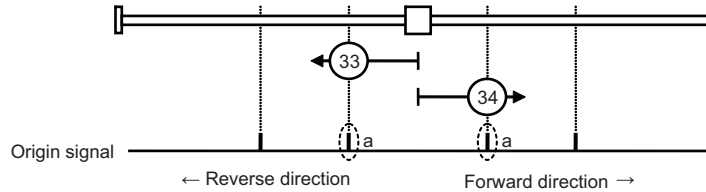
- When the drive prohibition inputs on both sides are ON at the same time.
- When an ON or OFF Origin Proximity Input is not detected before the drive prohibition input in the drive direction turns ON.

- Note 1** During the homing operation, the stop function for the Stop Selection for Drive Prohibition Input is disabled.
- 2 When the Drive Prohibition Input Selection (3504 hex) is set to 0, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur if the drive prohibition input is detected on both sides.
 - 3 When the Drive Prohibition Input Selection (3504 hex) is set to 1, a homing error (Home error = 1) will occur when the drive prohibition input is detected on both sides. If this Homing method is used without using the drive prohibition input, do not assign the drive prohibition input to a general-purpose input. For details on assigning the general-purpose input signals, refer to 7-1 *Sequence I/O Signals* on page 7-2.
 - 4 When the Drive Prohibition Input Selection (3504 hex) is set to 2, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur if the drive prohibition input is detected on one side. When using this Homing method, set the Drive Prohibition Input Selection (3504 hex) to a value other than 2.

● Homing Methods 33 and 34: Homing with an Origin Signal

In these Homing methods, only the origin signal is used.

The operation start direction of the homing operation is the reverse direction in Homing method 33 and the forward direction in Homing method 34.



A homing error occurs in the following cases.

- When the drive prohibition inputs on both sides are ON at the same time.
- If no origin signal is detected before the drive prohibition input of the drive direction turns ON.
- When the homing operation is started with a sensor without an origin signal (Z phase), such as an absolute scale, during fully-closed control.

Note 1 During the homing operation, the stop function for the Stop Selection for Drive Prohibition Input is disabled.

2 When the Drive Prohibition Input Selection (3504 hex) is set to 0, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur if the drive prohibition input is detected on both sides.

3 When the Drive Prohibition Input Selection (3504 hex) is set to 1, a homing error (Home error = 1) will occur when the drive prohibition input is detected on both sides.

If this Homing method is used without using the drive prohibition input, do not assign the drive prohibition input to a general-purpose input.

For details on assigning the general-purpose input signals, refer to 7-1 *Sequence I/O Signals* on page 7-2.

4 When the Drive Prohibition Input Selection (3504 hex) is set to 2, a Drive Prohibition Input Error 1 (Error No. 38.0) will occur if the drive prohibition input is detected on one side.

When using this Homing method, set the Drive Prohibition Input Selection (3504 hex) to a value other than 2.

● Homing Method 35: Present Home Presetting

In this Homing method, the present position is considered as the origin.

Set the mode in Coordinate System Setting Mode (4103 hex). By using the Coordinate System Setting Position (4104 hex), you can specify the value of the present position.

You can use this method even when you are using an absolute encoder, but the position is not saved in the Home offset (607C hex). When the control power is turned OFF or when Config (4100 hex) is executed, the origin set by this Homing method is disabled.

This Homing method can be executed only when the mode of operation is set to Homing mode (hm) and the servo is ON. If this Homing method is executed during the latch operation, the latch operation is disabled.

A homing error occurs in the following cases.

- During the Cyclic synchronous velocity mode (csv) or Cyclic synchronous torque mode (cst)
- When backlash compensation is not completed.

Coordinate System Setting Mode (4103 hex)

| Index | Sub | Name | R/W | Data type | Unit | Min | Max | Default |
|----------|--------|--|-----|-----------|------|----------------------|-----|---------|
| 4103 hex | 00 hex | POS_SET_MODE (Coordinate System Setting Mode) | rw | U16 | – | See following table. | | 83 hex |

| Bit | 15 | ... | 8 | 7 | 6 | 5 | 4 | 3 | ... | 0 |
|-----|---------------|-----|---|------|---|---|---|---------|-----|---|
| | Reserved("0") | | | REFE | 0 | 0 | 0 | POS_SEL | | |

[POS_SEL]

3: Set the value of the Coordinate System Setting Position (4104 hex) to the Position Demand Value (6062 hex) and Position Demand Value After Filtering (4018 hex).

For the Position actual value (6064 hex), set the value obtained by subtracting the Following error actual value (60F4 hex) from the Position Demand Value After Filtering (4018 hex).

Other than 3: A homing error (Homing error = 1) will occur.

[REFE]

0: The Homing not attained state is reached when this Homing method ends normally.

1: The Homing attained state is reached when this Homing method ends normally.

Note The REFE bits are enabled only when an incremental encoder is used.
An absolute encoder is always in a Homing attained state.

Set Value of the Coordinate System Setting Position (4104 hex) and Position Actual Value

| Index | Sub | Name | R/W | Data type | Unit | Min | Max | Default |
|----------|--------|--|-----|-----------|---------------|------------------------------|-------------------------------|---------|
| 4104 hex | 00 hex | POS_DATA (Coordinate System Setting Position) | rw | INT32 | Command units | -2^{31} (8000 0000 hex) | $2^{31}-1$ (7FFF FFFF hex) | 0 |

A-1-7 Object Dictionary

Object Dictionary Area

CAN application protocol over EtherCAT (CoE) uses the object dictionary as its base. All objects are assigned four-digit hexadecimal numbers in the areas shown in the following table.

| Index | Area | Description |
|------------------|------------------------------|---|
| 0000 to 0FFF hex | Data Type Area | Definitions of data types. |
| 1000 to 1FFF hex | CoE Communication Area | Definitions of variables that can be used by all servers for designated communications. |
| 2000 to 2FFF hex | Manufacturer Specific Area 1 | Variables with common definitions for all OMRON products. |
| 3000 to 5FFF hex | Manufacturer Specific Area 2 | Variables with common definitions for all G5-series Servo Drives (servo parameters). |
| 6000 to 9FFF hex | Device Profile Area | Variables defined in the Servo Drive's CiA402 drive profile. |
| A000 to FFFF hex | Reserved Area | Area reserved for future use. |

Data Types

Data types shown in the following table are used in this profile.

| Data Types | Code | Size | Range |
|----------------|-------|---------|---------------------------------|
| Boolean | BOOL | 1 bit | 0 or 1 |
| Unsigned 8 | U8 | 1 byte | 0 to 255 |
| Unsigned 16 | U16 | 2 bytes | 0 to 65,535 |
| Unsigned 32 | U32 | 4 bytes | 0 to 4,294,967,295 |
| Integer 8 | INT8 | 1 byte | -128 to 127 |
| Integer 16 | INT16 | 2 bytes | -32,768 to 32,767 |
| Integer 32 | INT32 | 4 bytes | -2,147,483,648 to 2,147,483,647 |
| Visible string | VS | - | - |
| Octet string | OS | - | - |

Object Description Format

In this manual, objects are described in the following format.

● Object Description Format

The object format is shown below.

| <i><Index></i> | <i><Object name></i> | | | | | <i>Modes of Operation</i> | |
|----------------------|----------------------------|------|---------------------|-----------------------|------------------------|--------------------------------------|--------------------------|
| Range | <i><Range></i> | Unit | <i><Unit></i> | Default | <i><Default></i> | Attribute | <i><Attribute></i> |
| Size | <i><Size></i> | | Access | <i><Access></i> | PDO map | <i><Possible/Not possible></i> | |

Data is indicated in pointed brackets <>.

Possible data are listed below.

- Index: Object index given by a four-digit hexadecimal number.
- Object name: The object name.
- Modes of Operation: Related operation modes.
 - Common: All operation modes
 - csp: Cyclic synchronous position mode
 - csv: Cyclic synchronous velocity mode
 - cst: Cyclic synchronous torque mode
 - pp: Profile position mode
 - hm: Homing mode
 - (Semi): Only operation modes related to semi-closed control.
 - (Full): Only operation modes related to fully-closed control.
- Range: The possible range of settings.
- Unit: Physical units.
- Default: Default value set before shipment.
- Attribute: The timing when a change in the contents is updated for a writable object.
 - A: Always updated
 - B: Changing prohibited during motor rotation or commands.
If a change is made during motor rotation or commands, the update timing is unknown.
 - C: Updated after the control power is reset, or after a Config command is executed via EtherCAT communications.
 - D: Changeable only when the EtherCAT communications state is Pre-Operational (Pre-Op).
 - R: Updated after the control power is reset.
It is not updated for a Config command via EtherCAT communications.
 - : Write prohibited.
- Size: The object size is given in bytes.
- Access: Indicates whether the object is read only, or read and write.
 - RO: Read only.
 - RW: Read and write.
- PDO map: Indicates the PDO mapping attribute.
 - Possible (RxPDO): Reception PDOs can be mapped.
 - Possible (TxPDO): Transmission PDOs can be mapped.
 - Not possible: PDOs cannot be mapped.

● **Format When There Is Sub-indexing**

The object description format with subindices is shown below.

| | | | | | | | | | |
|----------------------|----------------------------|-------------------|--------|----------|-----------|-------------------------|---------------------------|--|--|
| <Index> | <Object name> | | | | | | Modes of Operation | | |
| Sub-index 00 hex | | Number of entries | | | | | | | |
| Range | <Range> | Unit | <Unit> | Default | <Default> | Attribute | <Attribute> | | |
| Size | <Size> | | Access | <Access> | PDO map | <Possible/Not possible> | | | |
| Sub-index 01 hex | | <Sub-index name> | | | | | | | |
| Range | <Range> | Unit | <Unit> | Default | <Default> | Attribute | <Attribute> | | |
| Size | <Size> | | Access | <Access> | PDO map | <Possible/Not possible> | | | |
| Sub-index 02 hex | | <Sub-index name> | | | | | | | |
| Range | <Range> | Unit | <Unit> | Default | <Default> | Attribute | <Attribute> | | |
| Size | <Size> | | Access | <Access> | PDO map | <Possible/Not possible> | | | |
| : | | | | | | | | | |
| Sub-index NN hex | | <Sub-index name> | | | | | | | |
| Range | <Range> | Unit | <Unit> | Default | <Default> | Attribute | <Attribute> | | |
| Size | <Size> | | Access | <Access> | PDO map | <Possible/Not possible> | | | |

The data remains the same even with sub-indexing.

A-1-8 Communication Objects

| | | | | | | | | |
|-----------------|--------------------|------|--------|---------|---------------|--------------|------------|--|
| 1000 hex | Device Type | | | | | | All | |
| Range | – | Unit | – | Default | 0002 0192 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- Gives the CoE device profile number.

Description of Set Values

| Bit | Name | Contents |
|----------|-----------------------|------------------------------|
| 0 to 15 | Device profile number | 402 (192 hex): Drive Profile |
| 16 to 23 | Type | 02: Servo Drive |
| 25 to 31 | Mode | 0: Manufacturer specific |

| | | | | | | | |
|-----------------|----------------|------|--------|---------|---------|--------------|------------|
| 1001 hex | Error Register | | | | | | All |
| Range | – | Unit | – | Default | 0 | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |

- Gives the error type that has occurred in the Servo Drive.

Description of Set Values

| Bit | Description | Bit | Description |
|-----|-------------------|-----|-------------------------------|
| 0 | Generic error | 4 | Communication error |
| 1 | Current error | 5 | Device profile specific error |
| 2 | Voltage error | 6 | (Reserved) |
| 3 | Temperature error | 7 | Manufacturer specific error |

| | | | | | | | |
|-----------------|--------------------------|------|--------|---------|---------|--------------|------------|
| 1008 hex | Manufacturer Device Name | | | | | | All |
| Range | – | Unit | – | Default | *1 | Attribute | – |
| Size | 20 bytes (VS) | | Access | RO | PDO map | Not possible | |

*1 The following table shows the default settings.

| Specifications | | Model |
|------------------------------|--------|-----------------|
| Single-phase 100 VAC | 50 W | R88D-KNA5L-ECT |
| | 100 W | R88D-KN01L-ECT |
| | 200 W | R88D-KN02L-ECT |
| | 400 W | R88D-KN04L-ECT |
| Single-phase/3-phase 200 VAC | 100 W | R88D-KN01H-ECT |
| | 200 W | R88D-KN02H-ECT |
| | 400 W | R88D-KN04H-ECT |
| | 750 W | R88D-KN08H-ECT |
| | 1 kW | R88D-KN10H-ECT |
| | 1.5 kW | R88D-KN15H-ECT |
| 3-phase 200 VAC | 2 kW | R88D-KN20H-ECT |
| | 3 kW | R88D-KN30H-ECT |
| | 5 kW | R88D-KN50H-ECT |
| | 7.5 kW | R88D-KN75H-ECT |
| | 15 kW | R88D-KN150H-ECT |
| 3-phase 400 VAC | 600 W | R88D-KN06F-ECT |
| | 1 kW | R88D-KN10F-ECT |
| | 1.5 kW | R88D-KN15F-ECT |
| | 2 kW | R88D-KN20F-ECT |
| | 3 kW | R88D-KN30F-ECT |
| | 5 kW | R88D-KN50F-ECT |
| | 7.5 kW | R88D-KN75F-ECT |
| | 15 kW | R88D-KN150F-ECT |

- Gives the Servo Drive model number.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|---------|---------|--------------|------------|
| 1009 hex | Manufacturer Hardware Version | | | | | | All |
| Range | – | Unit | – | Default | – | Attribute | – |
| Size | 20 bytes (VS) | | Access | RO | PDO map | Not possible | |

- Gives the version of the Servo Drive hardware.
- This is not used by G5-series Servo Drives.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|---------|---------|--------------|------------|
| 100A hex | Manufacturer Software Version | | | | | | All |
| Range | – | Unit | – | Default | *1 | Attribute | – |
| Size | 20 bytes (VS) | | Access | RO | PDO map | Not possible | |

1 The version number is saved in “V.***”.

- Gives the version of the Servo Drive software.

| | | | | | | | |
|------------------|------------------|-------------------|--------|---------|---------------|--------------|------------|
| 1010 hex | Store Parameters | | | | | | All |
| Sub-index 00 hex | | Number of entries | | | | | |
| Range | – | Unit | – | Default | 01 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | Store Parameters | | | | | |
| Range | – | Unit | – | Default | 0000 0001 hex | Attribute | A |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- All savable parameters are saved in the Servo Drive EEPROM.
- Saving is executed only when a specific value is written to sub-index 01 hex. This prevents parameter values from being accidentally overwritten.
- The specific value means “save”.

| | | | |
|--------|--------|--------|--------|
| MSB | | LSB | |
| e | v | a | s |
| 65 hex | 76 hex | 61 hex | 73 hex |

- A value of 0000 0001 hex (command valid) is given when reading.
- Nothing can be saved to the EEPROM while there is a Control Power Supply Undervoltage Error (Error No. 11.0).
- Objects with attribute C are enabled for Config (4100 hex) or when the control power supply is reset.
- Objects with attribute R are enabled when the control power supply is reset.
- In the following cases, an ABORT code is returned.
 Writing with CompleteAccess.
 Writing a value other than 6576 6173 hex.
 Writing when there is a Control Power Supply Undervoltage Error (Error No. 11.0).
- Writing to the EEPROM may take up to 10 seconds. (This is when all objects are changed.)
- There is a limit to the number of times you can write to the EEPROM.
- The following objects are saved.

| Index | Sub-index | Description |
|------------------|-----------|--------------------------------------|
| 2200 hex | 00 hex | Communications Error Setting |
| 3000 to 3999 hex | 00 hex | All G5-series Servo Drive parameters |
| 605B hex | 00 hex | Shutdown option code |
| 605C hex | 00 hex | Disable operation option code |
| 605E hex | 00 hex | Fault reaction option code |

| Index | Sub-index | Description |
|----------|-----------|-----------------------------|
| 6065 hex | 00 hex | Following error window |
| 607C hex | 00 hex | Home offset |
| 607D hex | 01 hex | Min position limit |
| 607D hex | 02 hex | Max position limit |
| 6091 hex | 01 hex | Motor revolutions |
| 6091 hex | 02 hex | Shaft revolutions |
| 60E0 hex | 00 hex | Positive torque limit value |
| 60E1 hex | 00 hex | Negative torque limit value |

| | | | | | | | | | |
|------------------|----------------------------|--------------------------------|--------|---------|--------------|--------------|------------------|--|--|
| 1011 hex | Restore Default Parameters | | | | | | All | | |
| Sub-index 00 hex | | Number of entries | | | | | | | |
| Range | – | Unit | – | Default | 01 hex | Attribute | – | | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 01 hex | | Restore all default parameters | | | | | | | |
| Range | – | Unit | – | Default | 000 0001 hex | Attribute | A | | |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | | | |

- Parameters are returned to their default values.
- A restoration operation is executed only when a specific value is written to sub-index 01 hex. This prevents parameter values from being accidentally overwritten.
- The specific value means “load.”

| MSB | | LSB | |
|--------|--------|--------|--------|
| d | a | o | l |
| 64 hex | 61 hex | 6F hex | 6C hex |

- A value of 0000 0001 hex (command valid) is given when reading.
- EEPROM contents cannot be reset to default values if there is a Control Power Supply Undervoltage Error (Error No. 11.0).
- Reset the control power supply to enable the objects.
- In the following cases, an ABORT code is returned.
 - Writing with CompleteAccess.
 - Writing a value other than 6461 6F6C hex.
 - Writing when there is a Control Power Supply Undervoltage Error (Error No. 11.0).
 - Writing in operation enabled state.
- Writing to the EEPROM may take up to 10 seconds. (This is when all objects are changed.)
- There is a limit to the number of times you can write to the EEPROM.

| 1018 hex | | Identity Object | | | | | | All |
|------------------|---------------|-------------------|--------|---------|---------------------------|--------------|---|-----|
| Sub-index 00 hex | | Number of entries | | | | | | |
| Range | – | Unit | – | Default | 04 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | Vendor ID | | | | | | |
| Range | – | Unit | – | Default | 0000 0083 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | Product Code | | | | | | |
| Range | – | Unit | – | Default | Refer to the table. | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | Revision Number | | | | | | |
| Range | – | Unit | – | Default | Refer to the table. | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | Serial Number | | | | | | |
| Range | – | Unit | – | Default | Refer to the description. | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This object contains device information.
- Sub-index 01 hex (Vendor ID) gives the manufacturer identifier.
- Sub-index 02 hex (Product Code) gives the value assigned to each device.

| Specifications | | Model | Product Code |
|------------------------------|--------|----------------|---------------|
| Single-phase 100 VAC | 50 W | R88D-KNA5L-ECT | 0000 0001 hex |
| | 100 W | R88D-KN01L-ECT | 0000 0002 hex |
| | 200 W | R88D-KN02L-ECT | 0000 0003 hex |
| | 400 W | R88D-KN04L-ECT | 0000 0004 hex |
| Single-phase/3-phase 200 VAC | 100 W | R88D-KN01H-ECT | 0000 0005 hex |
| | 200 W | R88D-KN02H-ECT | 0000 0006 hex |
| | 400 W | R88D-KN04H-ECT | 0000 0007 hex |
| | 750 W | R88D-KN08H-ECT | 0000 0008 hex |
| | 1 kW | R88D-KN10H-ECT | 0000 0009 hex |
| | 1.5 kW | R88D-KN15H-ECT | 0000 000A hex |
| 3-phase 400 VAC | 600 W | R88D-KN06F-ECT | 0000 000B hex |
| | 1 kW | R88D-KN10F-ECT | 0000 000C hex |
| | 1.5 kW | R88D-KN15F-ECT | 0000 000D hex |

- Sub-index 03 hex (Revision Number) gives the device revision number.

| Bits | Description |
|----------|--------------------------------|
| 0 to 15 | Device's minor revision number |
| 16 to 31 | Device's major revision number |

- Sub-index 04 hex (Serial Number) gives the device serial number controlled by OMRON. For unit version 2.0, 0000 0000 hex is always displayed.

| | | | | | | | |
|------------------|---|------|--------|---------|---------|--------------|---|
| 10F0 hex | Backup Parameters Mode All | | | | | | |
| Sub-index 00 hex | Number of entries | | | | | | |
| Range | – | Unit | – | Default | 02 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | Backup Parameter Checksum | | | | | | |
| Range | – | Unit | – | Default | – | Attribute | – |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |
| Sub-index 02 hex | Backup Parameter Changed | | | | | | |
| Range | – | Unit | – | Default | 0 | Attribute | A |
| Size | 1 bit (BOOL) | | Access | RW | PDO map | Not possible | |

- This object gives the state of EEPROM changes.
- Sub-index 01 hex (Backup Parameter Checksum) gives the EEPROM's checksum value. The checksum value is calculated based on objects saved for Store parameters (1010 hex).
- Sub-index 02 hex (Backup Parameter Changed) gives 1 when the EEPROM is changed. After you have checked that it is 1, write 0 to it from the Master.

| | | | | | | | |
|--------------------------|--|------|--------|---------|----------|--------------|---|
| 10F3 hex | Diagnosis History All | | | | | | |
| Sub-index 00 hex | Number of entries | | | | | | |
| Range | – | Unit | – | Default | 13 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | Maximum Messages | | | | | | |
| Range | 00 to 0E hex | Unit | – | Default | 00 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 02 hex | Newest Message | | | | | | |
| Range | 06 to 13 hex | Unit | – | Default | 06 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 05 hex | Flags | | | | | | |
| Range | 0000 to 0001 hex | Unit | – | Default | 0000 hex | Attribute | A |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | |
| Sub-indexes 06 to 13 hex | Diagnosis Messages 1 to 14 | | | | | | |
| Range | – | Unit | – | Default | – | Attribute | – |
| Size | 16 bytes (VS) | | Access | RO | PDO map | Not possible | |

- This object gives up to 14 error history items. It also enables/disables emergency messages.
- Sub-index 01 hex (Maximum Messages) gives the number of error messages.
- Sub-index 02 hex (Newest Message) gives the sub index where the latest error history is saved.
- Sub-index 05 hex (Flags) sets whether or not to notify the error history as an emergency message. It is set to Emergency Message Disabled (0000 hex) when power is turned ON. Write 0001 hex from the master to enable this function.
- Sub-indexes 06 to 13 hex (Diagnosis Messages 1 to 14) give the error history. The error history is saved in Diagnosis Messages 1 to 14 in ascending order. When the 15th error is reached, it is saved as Diagnosis Message 1 and the sequence starts again.

A-1-9 PDO Mapping Objects

Indexes 1600 to 17FF hex are used for Receive PDO mapping and indexes 1A00 to 1BFF hex are used for Transmit PDO mapping. Sub-indexes after sub-index 01 hex provide information about the application object being mapped.

| | | | | | |
|-------|----|-----------|-----|------------|---|
| 31 | 16 | 15 | 8 | 7 | 0 |
| Index | | Sub-index | | Bit length | |
| MSB | | | LSB | | |

Bits 0 to 7: Bit length of the mapped object. (For example, for 32 bits, 20 hex is given.)

Bits 8 to 15: Sub-index of the mapped object.

Bits 16 to 31: Index of the mapped object.

| 1600 hex | 1st receive PDO Mapping | | | | | | All |
|------------------|-------------------------|--|--------|-----------------|---------------|---------------|-----|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | |
| Setting range | 00 to 0A hex | Unit | – | Default setting | 03 hex | Attribute | D |
| Size | 1 byte (U8) | | Access | RW | PDO map | Not possible. | |
| Sub-index 01 hex | | PDO entry 1 (1st Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 6040 0010 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 02 hex | | PDO entry 2 (2nd Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 607A 0020 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 03 hex | | PDO entry 3 (3rd Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 60B8 0010 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 04 hex | | PDO entry 4 (4th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 05 hex | | PDO entry 5 (5th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 06 hex | | PDO entry 6 (6th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 07 hex | | PDO entry 7 (7th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 08 hex | | PDO entry 8 (8th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 09 hex | | PDO entry 9 (9th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |
| Sub-index 0A hex | | PDO entry 10 (10th Output Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | |

- These object mappings can be changed only when the EtherCAT communications state is Pre-Operational (Pre-Op).

- Since the mappings you changed are not saved in EEPROM, you must specify objects each time you turn ON the power of the G5-series Servo Drive in order to use the mapping other than the default setting.
- You can map up to 10 objects in a PDO mapping. If you attempt to map 11 or more objects, a Function Setting Error (Error No. 93.4) will occur.
- The communications cycle you can set varies depending on the total size of mapped objects. Refer to *A-1-3 Communications Cycles and Corresponding Modes of Operation* on page A-5. If the number of the mapped objects is 0, a Function Setting Error (Error No. 93.4) will occur.
- If you map the same object more than once, the value of the last object will be enabled.
- If any of the following operations is attempted, an ABORT code will be returned.
 - Writing when the EtherCAT communications state is Safe-Operational (Safe-Op) or Operational (Op)
 - Writing with non-existent objects specified
 - Writing with incorrect object size specified
 - Writing with objects that cannot be mapped in the PDO mapping specified
- The following objects can be mapped to the Receive PDO mapping.

| Index | Sub-Index | Bit length | Object name |
|----------|-----------|------------|------------------------------------|
| 4103 hex | 00 hex | 10 hex | Coordinate System Setting Mode |
| 4104 hex | 00 hex | 20 hex | Coordinate System Setting Position |
| 6040 hex | 00 hex | 10 hex | Controlword |
| 6060 hex | 00 hex | 08 hex | Modes of operation |
| 6071 hex | 00 hex | 10 hex | Target torque |
| 6072 hex | 00 hex | 10 hex | Max torque |
| 607A hex | 00 hex | 20 hex | Target position |
| 607F hex | 00 hex | 20 hex | Max profile velocity |
| 6081 hex | 00 hex | 20 hex | Profile velocity |
| 6086 hex | 00 hex | 10 hex | Motion profile type |
| 60B0 hex | 00 hex | 20 hex | Position offset |
| 60B1 hex | 00 hex | 20 hex | Velocity offset |
| 60B2 hex | 00 hex | 10 hex | Torque offset |
| 60B8 hex | 00 hex | 10 hex | Touch probe function |
| 60E0 hex | 00 hex | 10 hex | Positive torque limit value |
| 60E1 hex | 00 hex | 10 hex | Negative torque limit value |
| 60FE hex | 01 hex | 20 hex | Physical outputs |
| 60FF hex | 00 hex | 20 hex | Target velocity |

| | | | | | | | |
|------------------|---------------------------|--|--------|---------|---------------|--------------|------------|
| 1701 hex | 258th receive PDO Mapping | | | | | | All |
| Sub-index 00 hex | | Number of objects in this PDO | | | | | |
| Range | – | Unit | – | Default | 04 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | PDO entry 1 (1st Output Object to be mapped) | | | | | |
| Range | – | Unit | – | Default | 6040 0010 hex | Attribute | – |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |
| Sub-index 02 hex | | PDO entry 2 (2nd Output Object to be mapped) | | | | | |
| Range | – | Unit | – | Default | 607A 0020 hex | Attribute | – |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |
| Sub-index 03 hex | | PDO entry 3 (3rd Output Object to be mapped) | | | | | |
| Range | – | Unit | – | Default | 60B8 0010 hex | Attribute | – |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |
| Sub-index 04 hex | | PDO entry 4 (4th Output Object to be mapped) | | | | | |
| Range | – | Unit | – | Default | 60FE 0020 hex | Attribute | – |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |

- This object gives the mapping for an application that uses only cyclic synchronous position control (csp).
- Touch probe function is available.
- The following objects are mapped.

Controlword (6040 hex), Target position (607A hex), Touch probe function (60B8 hex), and Digital outputs (60FE hex)

| | | | | | | | | |
|------------------|---------------------------|--|--------|---------|---------------|--------------|------------|--|
| 1702 hex | 259th receive PDO Mapping | | | | | | All | |
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 07 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6040 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 607A 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FF 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6071 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6060 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B8 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 607F 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that uses one of the following modes: Cyclic synchronous position mode (csp), Cyclic synchronous velocity mode (csv), and Cyclic synchronous torque mode (cst).
- Touch probe function is available.

| 1703 hex | | 260th receive PDO Mapping | | | | | | All |
|------------------|---------------|--|--------|---------|---------------|--------------|---|-----|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 07 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6040 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 607A 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FF 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6060 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B8 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60E0 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60E1 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that switches between Cyclic synchronous position mode (csp) and Cyclic synchronous velocity mode (csv).
- Touch probe and torque control are available.

| | | | | | | | | |
|------------------|---------------------------|--|--------|---------|---------------|--------------|------------|--|
| 1704 hex | 261th receive PDO Mapping | | | | | | All | |
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 09 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6040 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 607A 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FF 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6071 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6060 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B8 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 607F 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 08 hex | | PDO entry 8 (8th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60E0 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 09 hex | | PDO entry 9 (9th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60E1 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that uses one of the following modes: Cyclic synchronous position mode (csp), Cyclic synchronous velocity mode (csv), and Cyclic synchronous torque mode (cst).
- Touch probe and torque control are available.

| 1705 hex | | 262th receive PDO Mapping | | | | | | All |
|------------------|---------------|--|--------|---------|---------------|--------------|---|-----|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 08 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6040 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 607A 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FF 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6060 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B8 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60E0 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60E1 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 08 hex | | PDO entry 8 (8th Output Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B2 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that switches between Cyclic synchronous position mode (csp) and Cyclic synchronous velocity mode (csv).
- Touch probe and torque control are available.
- The torque feed-forward amount can be specified using the Torque offset (60B2 hex).

| 1A00 hex | | 1st transmit PDO Mapping | | | | | All | |
|------------------|--------------|---|--------|-----------------|---------------|---------------|-----|--|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Setting range | 00 to 0A hex | Unit | – | Default | 07 hex | Attribute | D | |
| Size | 1 byte (U8) | | Access | RW | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 6041 0010 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 6064 0020 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 60B9 0010 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 04 hex | | PDO entry 4 (4th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 60BA 0020 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 05 hex | | PDO entry 5 (5th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 60BC 0020 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 06 hex | | PDO entry 6 (6th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 603F 0010 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 07 hex | | PDO entry 7 (7th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 60FD 0020 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 08 hex | | PDO entry 8 (8th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 09 hex | | PDO entry 9 (9th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |
| Sub-index 0A hex | | PDO entry 10 (10th Input Object to be mapped) | | | | | | |
| Setting range | – | Unit | – | Default setting | 0000 0000 hex | Attribute | D | |
| Size | 4 byte (U32) | | Access | RW | PDO map | Not possible. | | |

- These object mappings can be changed only when the EtherCAT communications state is Pre-Operational (Pre-Op).
- Since the mappings you changed are not saved in EEPROM, you must specify objects each time you turn ON the power of the G5-series Servo Drive in order to use the mapping other than the default setting.
- You can map up to 10 objects in a PDO mapping. If you attempt to map 11 or more objects, a Function Setting Error (Error No. 93.4) will occur.
- The communications cycle you can set varies depending on the total size of mapped objects. Refer to *A-1-3 Communications Cycles and Corresponding Modes of Operation* on page A-5.
- If the number of the mapped objects is 0, a Function Setting Error (Error No. 93.4) will occur.
- If you map the same object more than once, the value of the last object will be enabled.
- If any of the following operations is attempted, an ABORT code will be returned.
 - Writing when the EtherCAT communications state is Safe-Operational (Safe-Op) or Operational (Op)
 - Writing with non-existent objects specified
 - Writing with incorrect object size specified
 - Writing with objects that cannot be mapped in the PDO mapping specified

- The following objects can be mapped to the Receive PDO mapping.

| Index | Sub-Index | Bit length | Object name |
|------------------------|-----------|------------|--------------------------------|
| 2002 hex | 01 hex | 08 hex | Sysmac Error Status |
| 4000 hex | 00 hex | 10 hex | Statusword1 |
| 4001 hex | 00 hex | 10 hex | Sub Error Code |
| 4020 hex ^{*1} | 00 hex | 20 hex | Reference Position for CSP |
| 603F hex | 00 hex | 10 hex | Error code |
| 6041 hex | 00 hex | 10 hex | Statusword |
| 6061 hex | 00 hex | 08 hex | Modes of operation display |
| 6062 hex | 00 hex | 20 hex | Position demand value |
| 6063 hex | 00 hex | 20 hex | Position actual internal value |
| 6064 hex | 00 hex | 20 hex | Position actual value |
| 606C hex | 00 hex | 20 hex | Velocity actual value |
| 6074 hex | 00 hex | 10 hex | Torque demand |
| 6077 hex | 00 hex | 10 hex | Torque actual value |
| 60B9 hex | 00 hex | 10 hex | Touch probe status |
| 60BA hex | 00 hex | 20 hex | Touch probe pos1 pos value |
| 60BC hex | 00 hex | 20 hex | Touch probe pos2 pos value |
| 60F4 hex | 00 hex | 20 hex | Following error actual value |
| 60FA hex | 00 hex | 20 hex | Control effort |
| 60FC hex | 00 hex | 20 hex | Position demand internal value |
| 60FD hex | 00 hex | 20 hex | Digital inputs |

*1 If you map 4020 hex when the communications cycle is set to 250/500 μs or when the electronic gear object ratio is not 1:1, a Function Setting Error (Error No. 93.4) will occur.

| 1B01 hex | | 258th transmit PDO Mapping | | | | | | All | |
|------------------|---------------|---|--------|---------|---------------|--------------|---|-----|--|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | | |
| Range | – | Unit | – | Default | 09 hex | Attribute | – | | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 01 hex | | PDO entry 1 (1st Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 603F 0010 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 6041 0010 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 6064 0020 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 04 hex | | PDO entry 4 (4th Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 6077 0010 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 05 hex | | PDO entry 5 (5th Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 60F4 0020 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 06 hex | | PDO entry 6 (6th Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 60B9 0010 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 07 hex | | PDO entry 7 (7th Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 60BA 0020 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 08 hex | | PDO entry 8 (8th Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 60BC 0020 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 09 hex | | PDO entry 9 (9th Input Object to be mapped) | | | | | | | |
| Range | – | Unit | – | Default | 60FD 0020 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |

- This object gives the mapping for an application that uses only cyclic synchronous position control (csp).
- Touch probe status is available.
- The following objects are mapped.

Error code (603F hex), Statusword (6041 hex), Position actual value (6064 hex), Torque actual value (6077 hex), Following error actual value (60F4 hex), Touch probe status (60B9 hex), Touch probe pos1 pos value (60BA hex), Touch probe pos2 pos value (60BC hex), and Digital inputs (60FD hex)

| 1B02 hex | | 259th transmit PDO Mapping | | | | | | All |
|------------------|---------------|---|--------|---------|---------------|--------------|---|-----|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 09 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 603F 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6041 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6064 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6077 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6061 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B9 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60BA 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 08 hex | | PDO entry 8 (8th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60BC 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 09 hex | | PDO entry 9 (9th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FD 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that uses different modes of operation.
- Touch probe status is available.

| 1B03 hex | | 260th transmit PDO Mapping | | | | | | All |
|------------------|---------------|---|--------|---------|---------------|--------------|---|-----|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 0A hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 603F 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6041 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6064 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6077 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60F4 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6061 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B9 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 08 hex | | PDO entry 8 (8th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60BA 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 09 hex | | PDO entry 9 (9th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60BC 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 0A hex | | PDO entry 10 (10th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FD 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that uses different modes of operation.
- Touch probe status is available.
- Following error actual value (60F4 hex) is provided.

| 1B04 hex | | 261th transmit PDO Mapping | | | | | | All |
|------------------|---------------|---|--------|---------|---------------|--------------|---|-----|
| Sub-index 00 hex | | Number of objects in this PDO | | | | | | |
| Range | – | Unit | – | Default | 0A hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | PDO entry 1 (1st Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 603F 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | PDO entry 2 (2nd Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6041 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 03 hex | | PDO entry 3 (3rd Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6064 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | PDO entry 4 (4th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6077 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | PDO entry 5 (5th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 6061 0008 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | PDO entry 6 (6th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60F4 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 07 hex | | PDO entry 7 (7th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60B9 0010 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 08 hex | | PDO entry 8 (8th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60BA 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 09 hex | | PDO entry 9 (9th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 60FD 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 0A hex | | PDO entry 10 (10th Input Object to be mapped) | | | | | | |
| Range | – | Unit | – | Default | 606C 0020 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |

- This is the mapping for an application that uses different modes of operation.
- Touch probe status is available. Only one latch position is supported.
- The Following error actual value (60F4 hex) and Velocity actual value (606C hex) are provided.

| | | | | | | | |
|------------------|----------------------------|---|--------|---------|--------------|--------------|------------|
| 1BFF hex | 512th transmit PDO Mapping | | | | | | All |
| Sub-index 00 hex | | Number of objects in this PDO | | | | | |
| Setting range | – | Unit | – | Default | 01 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | PDO entry 1 (1st Input Object to be mapped) | | | | | |
| Setting range | – | Unit | – | Default | 20020108 hex | Attribute | – |
| Size | 4 byte (U32) | | Access | RO | PDO map | Not possible | |

- This object mapping is for notifying that the G5-series Servo Drive has detected an error.
- Sysmac Error Status (2002-01 hex) is mapped.
- If you are connecting the G5-series Servo Drive with an NJ501-1□00-series Machine Automation Controller, map this object to Sync Manager 3 PDO Assignment (1C13 hex). Sysmac Studio, by default, automatically maps this object to Sync Manager 3 PDO Assignment (1C13 hex).

A-1-10 Sync Manager Communication Objects

Objects 1C00 to 1C33 hex set how to use the EtherCAT communications memory.

| | | | | | | | |
|------------------|---------------------------------|---------------------------------------|--------|---------|---------|--------------|------------|
| 1C00 hex | Sync Manager Communication Type | | | | | | All |
| Sub-index 00 hex | | Number of used Sync Manager channels | | | | | |
| Range | – | Unit | – | Default | 04 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | Communication type Synchron Manager 0 | | | | | |
| Range | – | Unit | – | Default | 01 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 02 hex | | Communication type Synchron Manager 1 | | | | | |
| Range | – | Unit | – | Default | 02 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 03 hex | | Communication type Synchron Manager 2 | | | | | |
| Range | – | Unit | – | Default | 03 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 04 hex | | Communication type Synchron Manager 3 | | | | | |
| Range | – | Unit | – | Default | 04 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |

- The sync manager has the following settings.
 - SM0: Mailbox receive (Master to Slave)
 - SM1: Mailbox send (Slave to Master)
 - SM2: Process data output (Master to Slave)
 - SM3: Process data input (Slave to Master)

| | | | | | | | | |
|------------------|-------------------------------|-------------------------|--------|---------|---------|--------------|---|------------|
| 1C10 hex | Sync Manager 0 PDO Assignment | | | | | | | All |
| Sub-index 00 hex | | Number of assigned PDOs | | | | | | |
| Range | – | Unit | – | Default | 00 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |

- The PDO mapping used by this sync manager is given. Mailbox reception sync manager does not have PDOs.

| | | | | | | | | |
|------------------|-------------------------------|-------------------------|--------|---------|---------|--------------|---|------------|
| 1C11 hex | Sync Manager 1 PDO Assignment | | | | | | | All |
| Sub-index 00 hex | | Number of assigned PDOs | | | | | | |
| Range | – | Unit | – | Default | 00 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |

- The PDO mapping used by this sync manager is given. Mailbox reception sync manager does not have PDOs.

| | | | | | | | | |
|------------------|-------------------------------|--|--------|---------|----------|--------------|---|------------|
| 1C12 hex | Sync Manager 2 PDO Assignment | | | | | | | All |
| Sub-index 00 hex | | Number of assigned PDOs | | | | | | |
| Range | – | Unit | – | Default | 01 hex | Attribute | D | |
| Size | 1 byte (U8) | | Access | RW | PDO map | Not possible | | |
| Sub-index 01 hex | | 1st PDO Mapping Object Index of assigned PDO | | | | | | |
| Range | 0000 to FFFF hex | Unit | – | Default | 1701 hex | Attribute | D | |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | | |
| Sub-index 02 hex | | 2nd PDO Mapping Object Index of assigned PDO | | | | | | |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | D | |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | | |

- The reception PDOs used by this sync manager are given.
- These object mappings can be changed only when the EtherCAT communications state is Pre-Operational (Pre-Op).
- Since the mappings you changed are not saved in EEPROM, you must specify objects each time you turn ON the power of the G5-series Servo Drive in order to use the mapping other than the default setting.
- If any of the following operations is attempted, an ABORT code for SDO mailbox communications will be returned.
 Writing when the EtherCAT communications state is other than Pre-Operational (Pre-Op)
 Writing to other than 1600 hex and 1701 to 1705 hex
 Data written to 1C13 hex is not between 1A00/1B01 hex and 1B04/1BFF hex

| | | | | | | | |
|------------------|---|--|--------|---------|----------|--------------|---|
| 1C13 hex | Sync Manager 3 PDO Assignment All | | | | | | |
| Sub-index 00 hex | | Number of assigned PDOs | | | | | |
| Range | – | Unit | – | Default | 01 hex | Attribute | D |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | 1st PDO Mapping Object Index of assigned PDO | | | | | |
| Range | 0000 to FFFF hex | Unit | – | Default | 1B01 hex | Attribute | D |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | |
| Sub-index 02 hex | | 2nd PDO Mapping Object Index of assigned PDO | | | | | |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | D |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | |

- The transmission PDOs used by this sync manager are given.
- These object mappings can be changed only when the EtherCAT communications state is Pre-Operational (Pre-Op).
- Since the mappings you changed are not saved in EEPROM, you must specify objects each time you turn ON the power of the G5-series Servo Drive in order to use the mapping other than the default setting.
- If any of the following operations is attempted, an ABORT code for SDO mailbox communications will be returned.
 Writing when the EtherCAT communications state is other than Pre-Operational (Pre-Op)
 Writing to other than 1A00 hex and 1B01 to 1B04 hex and 1BFF hex

| 1C32 hex | | Sync Manager 2 Synchronization | | | | | | All |
|------------------|---------------|--------------------------------------|--------|---------|---------------|--------------|---|-----|
| Sub-index 00 hex | | Number of Synchronization Parameters | | | | | | |
| Range | – | Unit | – | Default | 20 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | Synchronization Type | | | | | | |
| Range | – | Unit | – | Default | 0002 hex | Attribute | A | |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | | |
| Sub-index 02 hex | | Cycle Time | | | | | | |
| Range | – | Unit | – | Default | 0000 0000 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 04 hex | | Synchronization Types supported | | | | | | |
| Range | – | Unit | – | Default | 0004 hex | Attribute | – | |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | | |
| Sub-index 05 hex | | Minimum Cycle Time | | | | | | |
| Range | – | Unit | – | Default | 0000 4268 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 06 hex | | Calc and Copy Time | | | | | | |
| Range | – | Unit | – | Default | 0007 A120 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 09 hex | | Delay Time | | | | | | |
| Range | – | Unit | – | Default | 0000 0000 hex | Attribute | – | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | |
| Sub-index 20 hex | | Sync Error | | | | | | |
| Range | – | Unit | – | Default | 0 | Attribute | – | |
| Size | 1 bit (BOOL) | | Access | RO | PDO map | Not possible | | |

- The Synchronization Type indicates the synchronization mode of Sync Manager 2.
0002 hex: DC mode 0
- The Cycle Time indicates the sync 0 event cycle in nanoseconds.
- The Synchronization Types supported indicates the types of synchronization supported.
0004 hex: DC mode 0
- The Sync Error is 1 when there is a synchronization error.

| 1C33 hex | | Sync Manager3 Synchronization | | | | | | All | |
|------------------|---------------|--------------------------------------|--------|---------|---------------|--------------|---|-----|--|
| Sub-index 00 hex | | Number of Synchronization Parameters | | | | | | | |
| Range | – | Unit | – | Default | 20 hex | Attribute | – | | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 01 hex | | Synchronization Type | | | | | | | |
| Range | – | Unit | – | Default | 0002 hex | Attribute | A | | |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 02 hex | | Cycle Time | | | | | | | |
| Range | – | Unit | ns | Default | 0000 0000 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 04 hex | | Synchronization Types supported | | | | | | | |
| Range | – | Unit | – | Default | 0004 hex | Attribute | – | | |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 05 hex | | Minimum Cycle Time | | | | | | | |
| Range | – | Unit | ns | Default | 0000 4268 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 06 hex | | Calc and Copy Time | | | | | | | |
| Range | – | Unit | ns | Default | 0006 06F8 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 09 hex | | Delay Time | | | | | | | |
| Range | – | Unit | – | Default | 0000 0000 hex | Attribute | – | | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | | | |
| Sub-index 20 hex | | Sync Error | | | | | | | |
| Range | – | Unit | – | Default | 0 | Attribute | – | | |
| Size | 1 bit (BOOL) | | Access | RO | PDO map | Not possible | | | |

- The Synchronization Type indicates the synchronization mode of Sync Manager 3.
0002 hex: DC mode 0
- The Cycle time indicates the sync 0 event cycle in nanoseconds.
- The Synchronization Types supported indicates the types of synchronization supported.
0004 hex: DC mode 0
- The Delay Time is not supported. It reads as 0000 0000 hex.
- The Sync Error is 1 when there is a synchronization error.

A-1-11 Manufacturer Specific Objects

This section describes objects specific to G5-series Servo Drives with built-in EtherCAT communications. G5-series Servo Drive parameters (Pn□□□) are allocated to objects 3000 to 3999 hex. Index 3□□□ hex corresponds to G5-series Servo Drive parameter Pn□□□. For example, object 3504 hex is the same as parameter Pn504.

For details on servo parameters, refer to *Chapter 9 Details on Servo Parameter Objects*.



Precautions for Correct Use

Pn□□□ uses decimal numbers but object 3 □□□ hex is a hexadecimal number.

| 2002 hex | Sysmac Error All | | | | | | |
|------------------|--|---------------------------|--------|-----------------|---------|--------------|---|
| Sub-index 00 hex | | Number of entries | | | | | |
| Setting range | – | Unit | – | Default setting | 02 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | Sysmac Error Status | | | | | |
| Setting range | – | Unit | – | Default setting | 00 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Possible | |
| Sub-index 02 hex | | Sysmac Error Status Clear | | | | | |
| Setting range | – | Unit | – | Default setting | 00 hex | Attribute | A |
| Size | 1 byte (U8) | | Access | RW | PDO map | Not possible | |

- This object is used to monitor Sysmac error status and clear the errors.
- Sub-index 01 hex: Sysmac Error Status
 - This object notifies the Controller of an error on the G5 Servo Drive.
 - If you are connecting the G5-series Servo Drive with a Machine Automation Controller NJ-series (Model: NJ501-1□00), map this object to the PDO.
- Sub-index 02 hex: Sysmac Error Status Clear
 - This object enables a Sysmac Product controller to reset the error that has occurred in the G5-series Servo Drive.



Additional Information

Sysmac Studio, by default assign the sub-index 01 hex (Sysmac Error Status) automatically, because it is mapped in the 512th transmit PDO Mapping (1BFF hex).

| | | | | | | | |
|-----------------|-------------------------------|------|--------|---------|---------------|--------------|------------|
| 2100 hex | Error History Clear | | | | | | All |
| Range | 0000 0000 to FFFF FFFF hex | Unit | – | Default | 0000 0000 hex | Attribute | A |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- This object clears the contents of Diagnosis history (10F3 hex).
- This function can be executed by writing 6c63 6861 hex using SDO mailbox communications.
- The error history is saved in the EEPROM. If there is a Control Power Supply Undervoltage Error (Error No. 11.0), you cannot make write access to the EEPROM. This means that the diagnosis history cannot be cleared.
- In the following cases, an ABORT code is returned.
 - Writing with CompleteAccess.
 - Writing a value other than 6c63 6861 hex.
 - Writing when there is a Control Power Supply Undervoltage Error (Error No. 11.0).

| | | | | | | | |
|-----------------|------------------------------|------|--------|---------|---------|--------------|------------|
| 2200 hex | Communications Error Setting | | | | | | All |
| Range | 0 to 15 | Unit | Times | Default | 1 | Attribute | C |
| Size | 1 byte (U8) | | Access | RW | PDO map | Not possible | |

- This object sets the number of times communications errors can occur consecutively before being detected as an error.
- It can be set to between 0 and 15. The detection value will be set to one value higher than the set value.



Precautions for Correct Use

The default setting is 1, i.e., an error is detected when two communications errors occur consecutively.

| | | | | | | | |
|-----------------|-----------------------------------|------|--------|---------|---------|--------------|------------|
| 2201 hex | Sync Not Received Timeout Setting | | | | | | All |
| Range | 0 to 600 | Unit | s | Default | 0 | Attribute | C |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |

- Set a value for which Interruptions Error (Error No. 88.2) are detected. If the set value is 0, the detection time will be 120 seconds.

| | | | | | | | |
|-----------------|------------------|------|--------|---------|----------|-----------|------------|
| 4000 hex | Statusword 1 | | | | | | All |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Possible | |

- This object gives the present state of the Servo Drive.

Bit Descriptions

| Bit | Name | Symbol | Code | Description | Support in each mode | | |
|----------|-------------------------|--------|------|--|----------------------|-------|--------|
| | | | | | Position | Speed | Torque |
| 0 | Origin Position | ZPOINT | 0 | Outside origin range | ○ | ○ | ○ |
| | | | 1 | Within origin range | | | |
| 1 | Distribution Completed | DEN | 0 | Distributing | ○ | × | × |
| | | | 1 | Distribution Completed | | | |
| 2 | Zero Speed Detected | ZSP | 0 | Zero speed not detected | ○ | ○ | ○ |
| | | | 1 | Zero speed detected | | | |
| 3 | Torque Limit Applied | TLIMIT | 0 | Torque limit not applied | ○ | ○ | ○ |
| | | | 1 | Torque Limit Applied | | | |
| 4 | Speed Limit | VLIMIT | 0 | Speed limit not detected during torque control | × | × | ○ |
| | | | 1 | Speed limit detected during torque control | | | |
| 5 | Forward Software Limit | PSOT | 0 | Outside limit range | ○ | ○ | ○ |
| | | | 1 | Within limit range | | | |
| 6 | Reverse Software Limit | NSOT | 0 | Outside limit range | ○ | ○ | ○ |
| | | | 1 | Within limit range | | | |
| 7 | Speed Agreement | VCMP | 0 | No speed agreement during speed control | × | ○ | × |
| | | | 1 | Speed agreement during speed control | | | |
| 8 | Positioning Completed 2 | INP2 | 0 | Outside positioning proximity range during positioning control | ○ | × | × |
| | | | 1 | Within positioning proximity range during positioning control | | | |
| 9 | Servo Ready | CMDRDY | 0 | Commands cannot be accepted during processing | ○ | ○ | ○ |
| | | | 1 | Commands can be accepted | | | |
| 10 to 15 | Reserved | – | – | – | – | – | |

- If an unsupported bit is read, the value will be undefined.
- Bit 0: Origin Position (ZPOINT)
This bit is 1 when Position actual value (6064 hex) is within the Origin Range (3803 hex) after homing is completed. In the absolute mode, homing is completed when the control power is turned ON or when the Config operation is completed.

- **Distribution Completed (DEN)**
This bit shows Distribution Completed (DEN) for the position command. DEN is 1 under the following conditions:
 - In csp mode
 - When the position command distribution amount before or after position command filtering is zero during the communications cycle.
 - In hm mode
 - When the position command distribution amount before or after position command filtering is zero during the communications cycle when the NC built into the servo amplifier has completed command distribution up to the target position.
 - **Bit 2: Zero Speed Detected (ZSP)**
This bit shows Zero Speed (ZSPD).
ZSPD is 1 when the absolute velocity actual value is less than Zero Speed Detection (3434 hex).
 - **Bit 3: Torque Limit (TLIM)**
T_LIM is 1 during torque limit. T_LIM is 0 when the servo is OFF. The judgment conditions during torque limit can be changed in the Torque Limit Flag Output Setting (3703 hex).
 - 3703 hex = 0: 1 at torque limit, including torque command value
 - 3703 hex = 1: 1 at torque limit, excluding torque command value
 - **Bit 4: Speed Limit (VLIMIT)**
This bit shows Speed Limiting (VLIMIT). When the Speed Limit Selection (3317 hex) is 0, the speed is limited by the Speed Limit Value Setting (3321 hex). When the Speed Limit Selection (3317 hex) is 1, the speed is limited by the smaller of the Speed Limit Value Setting (3321 hex) and Max profile velocity (607F hex). VLIMIT is 1 when the speed is being limited.
- Note 1** The position error in encoder pulses can be set as the threshold value for the external output signal INP2 output from the Position Setting Unit Selection (3520 hex). However, this signal is always in command units. Therefore, there may be differences in the judgment conditions for INP2 and NEAR, i.e., when an electronic gear is set.
- 2 This bit is forced to 0 when Target velocity ignored (6041 hex, bit 12) = 0 during deceleration processing for the drive prohibition input. Refer to page A-55 for details.
- **Bit 5: Forward Software Limit (PSOT)**
 - **Bit 6: Reverse Software Limit (NSOT)**
PSOT is 1 when the Position actual value is greater than the set value of the Max position limit (607D hex, Sub-index: 02 hex).
NSOT is 1 when the Position actual value is less than the set value of the Min position limit (607D hex, Sub-index: 01 hex).
The value is 0 when the Software Position Limit Function is disabled (individual settings are possible in each direction with 3801 hex) and when homing is not attained.
 - **Bit 7: Speed Agreement (VCMP)**
This bit operates as the Speed Agreement (V_CMP). VCMP is 1 when the absolute value of the difference between the command speed before acceleration limit and the Velocity actual value is less than the Speed Conformity Detection Range (3435 hex).
- Note 1** The position error in encoder pulses can be set as the threshold value for the external output signal INP output from the Position Setting Unit Selection (3520 hex). However, this signal is always in command units. The set values of Positioning Completion Condition Selection (3432 hex) and Positioning Completed Hold Time (3433 hex) do not affect this signal. Therefore, there may be differences in the judgment conditions for INP and Target reached (6041 hex bit 10), i.e., when an electronic gear is set.
- 2 This bit is forced to 0 when Target velocity ignored (6041 hex, bit 12) = 0 during deceleration processing for the drive prohibition input.
- **Bit 8: Positioning Proximity (NEAR) (Only during position control)**
This bit operates as the Positioning Proximity (NEAR). NEAR will be 1 when the absolute value of the position error converted to command units is less than the Position Completion Range 2 (3442 hex) regardless of whether position command distribution is completed.

- Bit 9: Servo Ready (CMDRDY)
This bit indicates if command reception is possible (1) or not possible (0). When Servo Ready is 0, one of the following operations is being processed. It changes to 1 when all processing has been completed.
 - Writing to object using SDO mailbox communications.
 - Executing Config (4100 hex).
 - Resetting Warning/Error.
 - Executing Error History Clear (2100 hex).
 - Executing Backup parameter changed (10F0 hex, Sub: 02 hex).
 - Executing Save all parameters (1010 hex, Sub: 01 hex).
 - Executing Restore all default parameters (1011 hex, Sub: 01 hex).
 - Executing Absolute Encoder Setup (4102 hex).
 - From when a Servo ON command (Enable operation) is accepted until the Servo ON state is reached.
 - From when a Servo OFF command (Disable operation, Shutdown, or Disable Voltage) is accepted until the Servo OFF state is reached.

| | | | | | | | |
|-----------------|------------------|------|--------|---------|----------|-----------|------------|
| 4001 hex | Sub Error Code | | | | | | All |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Possible | |

- This object shows errors that have occurred in the Servo Drive.

| | | | | | | | | | |
|-----------------|-------------------------------------|------|---------------|-----------------|---------|-----------|------------|------------|------------|
| 4020 hex | Reference Position for CSP | | | | | | csp | csv | cst |
| Range | -2,147,483,648 to 2,147,483,647 hex | Unit | Command units | Default setting | 0 | Attribute | – | | |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | | | |

- This object shows the reference position by which the G5-series Servo Drive is switched from Cyclic synchronous velocity mode or Cyclic synchronous torque mode to Cyclic synchronous position mode.
- The controller references this object as the first command position after switching the control mode.
- This objects shows the Following error actual value (60F4 hex) in the Cyclic synchronous position mode.
- If you map this object to the PDO when the communications cycle is set to 250/500 μs or when the electronic gear ratio is not 1:1, a Function Setting Error (Error No. 93.4) will occur.
- When switching to Cyclic synchronous position mode (csp), set the Target position (607A hex) so that the difference between the 607A hex and 4020 hex values equals the operation speed.
- Switch to csp during Constant-speed driving while ensuring that the gain before and after switching is kept at the same value.
Torque fluctuations may occur during switching in the following cases due to a large difference in the reference position value:
 - During acceleration/deceleration
 - During high-speed rotation
 - During transition in the operation of the first-order lag filter based on the Position Command Filter Time Constant (3222 hex)
 - During transition in the operation of the FIR filter based on the Position Command FIR Filter Time Constant (3818 hex)
 - During gain switching
 - When the position gain value is small
 - When the speed integral gain is disabled or retained

Note This object is supported for unit version 2.1 or later.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|---------|---------------|--------------|------------|
| 4100 hex | Config | | | | | | All |
| Range | 0000 0000 to FFFF FFFF hex | Unit | – | Default | 0000 0000 hex | Attribute | A |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- This object enables changing objects with data attribute C.
- This function can be executed by writing 666e 6f63 hex using SDO mailbox communications.
- The Servo will be forced OFF if Configuration is executed in the Servo ON state.
- The Servo Drive moves to a Fault state (Error No. 27.7) after this process is completed.
- In the following cases, an ABORT code is returned.

Writing with CompleteAccess.

Writing a value other than 666e 6f63 hex.

Writing when there is a Control Power Supply Undervoltage Error (Error No. 11.0).

| | | | | | | | |
|-----------------|-------------------------------|------|--------|---------|---------------|--------------|------------------------|
| 4102 hex | Absolute Encoder Setup | | | | | | All except full |
| Range | 0000 0000 to FFFF FFFF hex | Unit | – | Default | 0000 0000 hex | Attribute | A |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- This object clears the multi-rotation counter of the absolute encoder.
- This function can be executed by writing 6a64 6165 hex using SDO mailbox communications.
- The Servo Drive moves to a Fault State (Error No. 27.7) after this process is completed.
- In the following cases, an ABORT code is returned.

Writing with CompleteAccess.

Writing a value other than 6a64 6165 hex.

Writing during semi-closed control when using an absolute encoder as an absolute encoder and the Servo is not OFF.

| | | | | | | | |
|-----------------|--------------------------------|------|--------|---------|---------|-----------|------------|
| 4103 hex | Coordinate System Setting Mode | | | | | | All |
| Range | 0000 to FFFF hex | Unit | – | Default | 0 | Attribute | B |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Possible | |

- Set the mode during coordinate system setting.

| | | | | | | | |
|-----------------|--|------|------------------|---------|---------|-----------|------------|
| 4104 hex | Coordinate System Setting Position | | | | | | All |
| Range | –2,147,483,648 to 2,147,483,647 hex | Unit | Command units | Default | 0 | Attribute | B |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- Set the position information during coordinate system setting.

A-1-12 Servo Drive Profile Object

This section describes the CiA402 drive profile supported by G5-series Servo Drives.

| | | | | | | | |
|-----------------|------------------|------|--------|---------|----------|-----------|------------|
| 603F hex | Error code | | | | | | All |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Possible | |

- This object gives the latest error code or warning code in the Servo Drive.
- The given error is from the manufacturer specific area FF00 to FFFF hex.
- The lower word of FF00 to FFFF hex gives the main number of the error.
- 4001 hex: Sub Error Code (4001 hex) gives the main number and sub number of the error.
- The main number and sub number are hexadecimal numbers but are combinations of 0 to 9.

| Index | Name | Data types | Specifications |
|----------|----------------|------------|---|
| 603F hex | Error code | U16 | 0000 hex: No error FF01 hex: Error main number 1 FF02 hex: Error main number 2 : : FF99 hex: Error main number 99 FFA0 hex: Warning A0 hex : : FFA9 hex: Warning A9 hex FFB0 hex: Warning B0 hex FFB1 hex: Warning B1 hex FFB2 hex: Warning B2 hex Others Reserved |
| 4001 hex | Sub Error Code | U16 | Upper 8 bits F0 to F9 hex: Sub numbers 0 to 9 Lower 8 bits 00 to 99 hex: Main numbers 0 to 99 |

| | | | | | | | |
|-----------------|--|------|--------|---------|----------|-----------|---|
| 6040 hex | Controlword All | | | | | | |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | A |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Possible | |

- This object controls the state machine of the Servo Drive.

Description of Set Values

| Bit | Name | Description |
|----------|-------------------------|--|
| 0 | Switch on | The state is controlled by these bits. Quick stop is not supported. The Quick stop bit is ignored even if set to 0. For details, refer to <i>Command Coding</i> on page A-3. |
| 1 | Enable voltage | |
| 2 | Quick stop | |
| 3 | Enable operation | |
| 4 to 6 | Operation mode specific | These bits are specific to the operation mode. They are not used in Cyclic synchronous position mode. |
| 7 | Fault reset | Errors and warnings are reset when this bit turns ON. |
| 8 | Halt | This bit is specific to the operating mode. *1 |
| 9 | Operation mode specific | They are not used in Cyclic synchronous position mode. |
| 10 | Reserved | |
| 11 | P_CL | These bits switch the torque limit function. They are normally set to 0. For details, refer to Torque Limit Switching. |
| 12 | N_CL | |
| 13 to 15 | Manufacturer specific | These are manufacturer specific bits. Always keep them at 0. |

*1 If this bit is set to 1 during the Homing mode (hm), the Servomotor stops according to the settings of the Halt option code (605D hex). This bit is ignored in other modes of operation.

| | | | | | | | |
|-----------------|---|------|--------|---------|----------|-----------|---|
| 6041 hex | Statusword All | | | | | | |
| Range | 0000 to FFFF hex | Unit | – | Default | 0000 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Possible | |

- This object gives the present state of the Servo Drive.

Bit Descriptions

| Bit | Name | Description |
|-----|-----------------------|--|
| 0 | Ready to switch on | These bits give the state. For details, refer to <i>State Coding</i> on page A-4. |
| 1 | Switched on | |
| 2 | Operation enabled | |
| 3 | Fault | |
| 4 | Voltage enabled *1 | |
| 5 | Quick Stop *2 | |
| 6 | Switch on disabled | |
| 7 | Warning | This bit indicates that warning status exists. Operation continues without changing the status. |
| 8 | Manufacturer specific | These are manufacturer specific bits. This bit is not used by G5-series Servo Drives. |
| 9 | Remote | This bit indicates that the Servo Drive is being controlled by the Controlword. Changes to 1 (remote) after initialization has been completed. When 0 (local) is given, it indicates that the support software has the control right to the Servo Drive. |

| Bit | Name | Description |
|-----------|---|---|
| 10 | Target reached | This bit is 1 when homing is completed during the Homing mode. ^{*3} For details, refer to <i>6-5 Homing Mode</i> . This bit is not used in other modes of operation. |
| 11 | Internal limit active | This bit indicates that the limit function is in effect. This bit becomes 1 when the limit function in the Servo Drive is activated. The limit function has four limits, the torque limit, speed limit, drive prohibition input, and software limit. |
| 12 | Target value ignored or Homing attained | These bits are specific to the operation mode. This bit is 0 when the Servo Drive could not move according to the host command while the Servo is ON or in csp mode, csv mode, or cst mode. This bit will not become 0 if there is an error. When the Target value ignored bit is 0, the target value is ignored and operation will follow the Servo Drive's internal command. Update the target position in the controller while monitoring items such as the Position actual value or other target values for operation when the Target Value Ignored bit changes to 1 and the target position is enabled. It becomes 0 in the following cases. <ul style="list-style-type: none"> • Between when the drive prohibition input (PLS/NLS) is input until when the Servomotor decelerates and stops when the Drive Prohibition Input Selection (3504 hex) is set to 0. • When a warning occurs for a mode of operation. • When a data setting warning (B0 hex) occurs while the mode of operation is being changed and instead of changing the mode of operation, the current mode of operation is retained. • When a drive prohibition direction command is received while in a drive prohibition state. • When there is a change in position command that exceeds the motor's maximum speed. This bit changes to 1 when the homing operation reaches its target while in the Homing mode (hm). |
| 13 | Following error | These bits are specific to the operation mode. The Following error (Error counter overflow) is indicated in Cyclic synchronous position mode. Position Error Counter Overflow is set to 1 when the Position actual value (6064 hex) exceeds the Following error window (6065 hex) that is set based on Position demand value (6062 hex). This bit changes to 1 when the homing operation is not completed successfully while in the Homing mode (hm). |
| 14 and 15 | Manufacturer specific | These are manufacturer specific bits. This bit is not used by G5-series Servo Drives. |

*1 The Voltage enabled bit indicates that the main circuit power supply is ON when it is 1.

*2 Not applicable in Quick stop active state. This bit is 0 in a “Not ready to switch ON” state only. It is always 1 in all other cases.

*3 This bit will also change to 1 when the actual speed becomes less than 30 r/min after bit 8 (Halt) in Controlword (6040 hex) is set to 1 during operation in the Homing mode.

| | | | | | | | |
|-----------------|----------------------|------|--------|---------|---------|--------------|---|
| 605B hex | Shutdown option code | | | | | | All |
| Range | -5 to 0 | Unit | – | Default | -1 | Attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible | |

- This object sets the operation of the G5-series Servo Drive during Shutdown (transition from the operation enable state to the ready to switch state).
"During Shutdown" refers to the duration in which the G5-series Servo Drive decelerates and then stops after main circuit power OFF (Shutdown).

Description of Set Values

| Set value | Decelerating ^{*1} | | After stopping | |
|-----------|--|---------------------|--------------------------|---------------------|
| | Deceleration method | Error | Operation after stopping | Error |
| -5 | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Free | Clear ^{*3} |
| -4 | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| -3 | Dynamic brake operation | Clear ^{*3} | Free | Clear ^{*3} |
| -2 | Free-run | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| -1 | Dynamic brake operation | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| 0 | Free-run | Clear ^{*3} | Free | Clear ^{*3} |

- *1 Decelerating is the time between when the motor is running and when the motor speed reaches 30 r/min or less. Once the motor reaches 30 r/min or less and moves to the after-stop status, subsequent operation is based on the after-stop status regardless of the motor speed.
- *2 "Immediate Stop" means that the Servomotor stops immediately by using controls while the servo is kept ON. The torque command value at this time is restricted by the Immediate Stop Torque (3511 hex).
- *3 When the error is cleared, a process which makes the Position demand value follow the Position actual value comes into effect. To operate in cyclic sync mode (csp) after the servo turns ON, reset the command coordinates in the host controller and then execute the operation. The motor may move suddenly.



Precautions for Correct Use

- Position control is forced into operation during deceleration and after the motor has stopped (main power supply OFF). The internal position command generation process is also forced to stop.
- If an error occurs while the main power supply is OFF, operation will follow the Fault reaction option code (605E hex).
- If the main power supply turns OFF while the Servo is ON and the Undervoltage Error Selection (3508 hex) is set to 1, a Main Power Supply Undervoltage (Error No. 13.1) will occur. Operation will then follow the Fault reaction option code (605E hex). The default value is 1.

| | | | | | | | |
|-----------------|-------------------------------|------|--------|---------|---------|--------------|------------|
| 605C hex | Disable operation option code | | | | | | All |
| Range | -5 to 0 | Unit | - | Default | -1 | Attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible | |

- This object sets the operation of the G5-series Servo Drive during Disable operation (transition from the operation enable state to the switched on state). "During Disable operation" refers to the duration in which the G5-series Servo Drive decelerates and then stops after Servo OFF (Disable operation).

Description of Set Values

| Set value | Decelerating ^{*1} | | After stopping | |
|-----------|--|---------------------|--------------------------|---------------------|
| | Deceleration method | Error | Operation after stopping | Error |
| -5 | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Free | Clear ^{*3} |
| -4 | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| -3 | Dynamic brake operation | Clear ^{*3} | Free | Clear ^{*3} |
| -2 | Free-run | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| -1 | Dynamic brake operation | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| 0 | Free-run | Clear ^{*3} | Free | Clear ^{*3} |

- *1 Decelerating is the time between when the motor is running and when the motor speed reaches 30 r/min or less. Once the motor reaches 30 r/min or less and moves to the after-stop status, subsequent operation is based on the after-stop status regardless of the motor speed.
- *2 "Immediate Stop" means that the Servomotor stops immediately by using controls while the servo is kept ON. The torque command value at this time is restricted by the Immediate Stop Torque (3511 hex).
- *3 When the error is cleared, a process which makes the Position demand value follow the Position actual value comes into effect. To execute interpolation feeding commands after the servo turns ON, reset the command coordinates in the host controller before executing them. The motor may move suddenly.



Precautions for Correct Use

- Position control is forced into operation during deceleration and after the motor has stopped (during servo OFF). The internal position command generation process is also forced to stop.
- If an error occurs while the servo is OFF, operation will follow the Fault reaction option code (605E hex).
- If the main power supply turns OFF while the servo is OFF, the Shutdown option code (605B hex) will be followed.

| | | | | | | | |
|-----------------|------------------|------|--------|---------|---------|--------------|---------------------|
| 605D hex | Halt option code | | | | | | pp hm |
| Range | 1 to 3 | Unit | - | Default | 1 | Attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible | |

- This object sets the stop method when bit 8 (Halt) in Controlword (6040 hex) is set to 1 during the Homing mode (hm).

| Set value | Description |
|-----------|---------------------------------|
| 1 | Profile deceleration (6084 hex) |
| 2 | Not supported |
| 3 | Immediate stop |

| | | | | | | | |
|-----------------|----------------------------|------|--------|---------|---------|--------------|---|
| 605E hex | Fault reaction option code | | | | | | All |
| Range | -7 to 0 | Unit | - | Default | -1 | Attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Not possible | |

- This object sets the behavior when an error occurs.

Description of Set Values

| Set value | Decelerating ^{*1} | | | After stopping | |
|-----------|----------------------------|--|---------------------|--------------------------|---------------------|
| | Deceleration method | | Error | Operation after stopping | Error |
| -7 | Operation A ^{*2} | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Free | Clear ^{*3} |
| | Operation B ^{*2} | Free-run | | | |
| -6 | Operation A ^{*2} | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Free | Clear ^{*3} |
| | Operation B ^{*2} | Dynamic brake operation | | | |
| -5 | Operation A ^{*2} | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| | Operation B ^{*2} | Free-run | | | |
| -4 | Operation A ^{*2} | Immediate Stop ^{*2} Immediate Stop Torque = 3511 hex | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| | Operation B ^{*2} | Dynamic brake operation | | | |
| -3 | Dynamic brake operation | | Clear ^{*3} | Free | Clear ^{*3} |
| -2 | Free-run | | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| -1 | Dynamic brake operation | | Clear ^{*3} | Dynamic brake operation | Clear ^{*3} |
| 0 | Free-run | | Clear ^{*3} | Free | Clear ^{*3} |

- *1 Decelerating is the time between when the motor is running and when the motor speed reaches 30 r/min or less. Once the motor reaches 30 r/min or less and moves to the after-stop status, subsequent operation is based on the after-stop status regardless of the motor speed.
- *2 Operation A and B indicate whether or not to stop immediately when an error occurs. If this value is set to between 4 and 7, the motor is stopped immediately when a specified error occurs as indicated by operation A. If an error occurs that is not subject to this function, an immediate stop is not applied and dynamic braking is applied or the motor is left to run free as indicated by operation B. For details on errors, refer to *Errors* on page 12-9.
- *3 When the error is cleared, a process which makes the Position demand value follow the Position actual value comes into effect. To operate in cyclic sync mode (csp) after the servo turns ON, reset the command coordinates in the host controller and then execute the operation. The motor may move suddenly.



Precautions for Correct Use

Position control is forced into operation during deceleration and after the motor has stopped (during an error or when the servo is OFF). The internal position command generation process is also forced to stop.

| | | | | | | | |
|-----------------|--------------------|------|--------|---------|---------|-----------|------------|
| 6060 hex | Modes of operation | | | | | | All |
| Range | 0 to 10 | Unit | – | Default | 0 | Attribute | A |
| Size | 1 byte (INT8) | | Access | RW | PDO map | Possible | |

- This object sets the operation mode.
- The default value is 0 (Not specified). Set the operation mode from the master after the power supply is turned ON.
- A Command warning (Error No. B1 hex) occurs if the servo is turned ON (Operation enabled = 1) with the default setting of 0 (Not specified).
- Even when the default value (0: Not specified) is set again after changing the mode of operation, the mode of operation does not return to “Not specified.” The previous mode of operation is retained.
- Similarly, when an unsupported mode of operation is set, the previous mode is retained.
- When an unsupported mode of operation is set using SDO mailbox communications, an ABORT code is returned.

Description of Set Values

| Code | Description |
|------|--|
| 0 | Not specified |
| 1 | Profile position mode (pp) ^{*1} |
| 6 | Homing mode (hm) |
| 8 | Cyclic synchronous position mode (csp) |
| 9 | Cyclic synchronous velocity mode (csv) |
| 10 | Cyclic synchronous torque mode (cst) |

*1 Profile position mode (pp) is supported for unit version 2.1 or later.

For details about changing the modes of operation, refer to *A-1-5 Changing the Mode of Operation* on page A-7.

| | | | | | | | |
|-----------------|----------------------------|------|--------|---------|---------|-----------|------------|
| 6061 hex | Modes of operation display | | | | | | All |
| Range | 0 to 10 | Unit | – | Default | 0 | Attribute | – |
| Size | 1 byte (INT8) | | Access | RO | PDO map | Possible | |

- This object gives the present operation mode.
- The value definitions are the same as for the Modes of operation (6060 hex).

| | | | | | | | |
|-----------------|---------------------------------|------|---------------|---------|---------|-----------|--------------------------------|
| 6062 hex | Position demand value | | | | | | csp pp hm |
| Range | –2,147,483,648 to 2,147,483,647 | Unit | Command units | Default | 0 | Attribute | – |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- This object gives the Servo Drive's internal command position.

| | | | | | | | |
|-----------------|---|------|--------|---------|---------|-----------|---|
| 6063 hex | Position actual internal value All | | | | | | |
| Range | -2,147,483,648 to 2,147,483,647 | Unit | Pulses | Default | 0 | Attribute | - |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- This object gives the Servo Drive's present internal position.
- The value is in encoder units or external encoder units.
 - Other than fully-closed control : Encoder units
 - Fully-closed control : External encoder units

| | | | | | | | |
|-----------------|--|------|---------------|---------|---------|-----------|---|
| 6064 hex | Position actual value All | | | | | | |
| Range | -2,147,483,648 to 2,147,483,647 | Unit | Command units | Default | 0 | Attribute | - |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- This object gives the present position.

| | | | | | | | |
|-----------------|---|------|---------------|---------|---------|--------------|---|
| 6065 hex | Following error window csp pp hm | | | | | | |
| Range | 0 to 134,217,728, 4,294,967,295 | Unit | Command units | Default | 100,000 | Attribute | A |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- This object sets the threshold for following errors.
- If it is set to 4,294,967,295 (FFFF FFFF hex), detection of following errors is disabled.
- If it is set to 0, there will always be a following error.
- When it is set to between 134,217,729 and 4,294,967,294, the set value becomes 134,217,728.

| | | | | | | | |
|-----------------|--|------|---------------|---------|---------|--------------|---|
| 6067 hex | Position window csp pp hm | | | | | | |
| Range | 0 to 262,144 | Unit | Command units | Default | 10 | Attribute | A |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- Select the position error threshold at which the positioning completion signal (INP) is output. The default unit is command units, but 3520 hex (Position Setting Unit Selection) can be used to convert to encoder units. If the unit is converted, the unit of 6065 hex (Following error window) will also be converted.
- This setting is also used for the Target reached flag in the EtherCAT communications status. The unit, however, is always command units regardless of the setting of 3520 hex.

| | | | | | | | |
|-----------------|--|------|-----------------|---------|---------|-----------|---|
| 606C hex | Velocity actual value All | | | | | | |
| Range | -2,147,483,647 to 2,147,483,647 | Unit | Command units/s | Default | 0 | Attribute | - |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Possible | |

- This object gives the present speed.

| | | | | | | | |
|-----------------|-----------------|------|--------|---------|---------|-----------|------------|
| 6071 hex | Target torque | | | | | | cst |
| Range | -5,000 to 5,000 | Unit | 0.1% | Default | 0 | Attribute | A |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Possible | |

- This object sets the torque command in the Cyclic synchronous torque mode.

| | | | | | | | |
|-----------------|---------------|------|--------|---------|---------|-----------|------------|
| 6072 hex | Max torque | | | | | | All |
| Range | 0 to 5,000 | Unit | 0.1% | Default | 5,000 | Attribute | A |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Possible | |

- This object sets the maximum torque.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|-----------------|------|--------|---------|---------|-----------|------------|
| 6074 hex | Torque demand | | | | | | All |
| Range | -5,000 to 5,000 | Unit | 0.1% | Default | 0 | Attribute | - |
| Size | 2 bytes (INT16) | | Access | RO | PDO map | Possible | |

- This object gives the Servo Drive's internal torque command value.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|---------------------|------|--------|---------|---------|-----------|------------|
| 6077 hex | Torque actual value | | | | | | All |
| Range | -5,000 to 5,000 | Unit | 0.1% | Default | 0 | Attribute | - |
| Size | 2 bytes (INT16) | | Access | RO | PDO map | Possible | |

- This object gives the feedback torque value. The values are the same as for the internal torque command value.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|---------------------------------|------|---------------|---------|---------|-----------|----------------------|
| 607A hex | Target position | | | | | | csp pp |
| Range | -2,147,483,648 to 2,147,483,647 | Unit | Command units | Default | 0 | Attribute | A |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Possible | |

- This object sets the target position in the Cyclic synchronous position mode.

| | | | | | | | |
|-----------------|---------------------------------|------|---------------|---------|---------|--------------|------------|
| 607C hex | Home offset | | | | | | All |
| Range | -1,073,741,823 to 1,073,741,823 | Unit | Command units | Default | 0 | Attribute | C |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible | |

- This object sets the amount of offset from the origin of the absolute encoder or absolute external encoder to the zero position of the Position actual value (6064 hex).

| | | | | | | | | |
|------------------|------------------------------------|--------------------|------------------|---------|----------|--------------|---|------------|
| 607D hex | Software position limit | | | | | | | All |
| Sub-index 00 hex | | Number of entries | | | | | | |
| Range | – | Unit | – | Default | 02 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 01 hex | | Min position limit | | | | | | |
| Range | –1,073,741,823 to 1,073,741,823 | Unit | Command units | Default | –500,000 | Attribute | A | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible | | |
| Sub-index 02 hex | | Max position limit | | | | | | |
| Range | –1,073,741,823 to 1,073,741,823 | Unit | Command units | Default | 500,000 | Attribute | A | |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Not possible | | |

- This object sets the software limit.
- Ranges for the Position demand value and Position actual value are restricted. New target positions are checked against these ranges.
- The software limit is always relative to the mechanical origin.
- The Min position limit is the limiting value for reverse rotation and the Max position limit is the limiting value for forward rotation.



Precautions for Correct Use

- Make sure that the Max position limit is larger than the Min position limit.
- The software position limit is disabled when an origin return has not been completed.

| | | | | | | | | |
|-----------------|-----------------------|------|--------------------|---------|---------|-----------|---|------------|
| 607F hex | Max profile velocity | | | | | | | cst |
| Range | 0 to 2,147,483,647 | Unit | Command units/s | Default | 0 | Attribute | A | |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Possible | | |

- This object sets the maximum velocity in the Cyclic synchronous torque mode.

| | | | | | | | | |
|--------------|-----------------------|------|--------------------|-----------------|---------|-----------|---|-----------|
| 6081h | Profile Velocity | | | | | | | pp |
| Range | 0 to 2,147,483,647 | Unit | Command units/s | Default setting | 0 | Attribute | A | |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Possible | | |

- This object sets the target velocity for Profile position mode (pp).

Note This object is supported for unit version 2.1 or later.

| | | | | | | | |
|-----------------|---|------|------------------------------|---------|-----------|--------------|---|
| 6083 hex | Profile acceleration [pp] [hm] | | | | | | |
| Range | 1 to 655,350,000 | Unit | Command units/s ² | Default | 1,000,000 | Attribute | B |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- This object sets the acceleration rate in the Cyclic synchronous torque mode (cst).
- The setting resolution is 4,000. For example, if you set 5,000, the resolution will be 4,000.

| | | | | | | | |
|-----------------|---|------|------------------------------|---------|-----------|--------------|---|
| 6084 hex | Profile deceleration [pp] [hm] | | | | | | |
| Range | 1 to 655,350,000 | Unit | Command units/s ² | Default | 1,000,000 | Attribute | B |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- This object sets the deceleration rate in the Cyclic synchronous torque mode (cst).
- The setting resolution is 4000. For example, if you set 5000, the resolution will be 4,000.

| | | | | | | | |
|-----------------|--|------|--------|---------|---------|-----------|---|
| 6086 hex | Motion profile type [csp] [pp] [hm] | | | | | | |
| Range | -1 to 0 | Unit | - | Default | 0 | Attribute | B |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Possible | |

- This object enables and disables the position command FIR filter.
- When this object is set to -1, the value of Position Command FIR Filter Time Constant (3818 hex) is enabled.
- When this object is set to 0, the position command FIR filter is disabled.
- The position command FIR filter can be used in Cyclic synchronous position mode (csp), Profile position mode (pp), and Homing mode (hm).

Note Profile position mode (pp) is supported for unit version 2.1 or later.

- When the communications cycle is set to 250 μs or 500 μs, the position command FIR filter is disabled regardless of this setting.

| | | | | | | | |
|------------------|---|-------------------|--------|---------|---------|--------------|---|
| 6091 hex | Gear ratio All | | | | | | |
| Sub-index 00 hex | | Number of entries | | | | | |
| Range | – | Unit | – | Default | 02 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | Motor revolutions | | | | | |
| Range | 0 to 1,073,741,824 | Unit | – | Default | 1 | Attribute | C |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |
| Sub-index 02 hex | | Shaft revolutions | | | | | |
| Range | 1 to 1,073,741,824 | Unit | – | Default | 1 | Attribute | C |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | |

- These objects set the gear ratio.
- Set the numerator of the electronic gear in the object for sub-index 1 (Motor revolutions). If the set value is 0, the encoder resolution will be set as the numerator.
- Set the denominator of the electronic gear in the object for sub-index 2 (Shaft revolutions).
- Set the gear ratio to between 1/1,000 and 1,000. If the gear ratio is out of range, an Object Setting Error (Error No. 93.0) will occur.
- If the set value of Motor revolutions is 0, the encoder resolution will be set as the numerator, even for fully-closed control.
- If you are mapping the Reference Position for CSP (4020 hex) to the PDO, be sure to set the electronic gear ratio to 1:1. Unless set to 1:1, a Function Setting Error (Error No. 93.4) will occur.
- Refer to 7-6 *Electronic Gear Function* on page 7-21 for details.



Precautions for Correct Use

- The electronic gear function is not supported for unit version 2.0. Use the G-series Servo Drive in the setting of 1:1.

| | | | | | | | |
|-----------------|---|------|------------------------------|---------|---------|--------------|---|
| 6098 hex | Homing method [hm] | | | | | | |
| Range | -128 to 127 | Unit | Command units/s ² | Default | 0 | Attribute | B |
| Size | 1 byte (INT8) | | Access | RW | PDO map | Not possible | |

- This object sets the Homing method in the Homing mode (hm).

Explanation of Set Values

| Set value | Explanation |
|-----------|--|
| 0 | Not specified |
| 8 | Homing by Origin Proximity Input and origin signal (forward operation start) |
| 12 | Homing by Origin Proximity Input and origin signal (reverse operation start) |
| 19 | Homing without origin signal (forward operation start) |
| 20 | Homing without origin signal (reverse operation start) |
| 33 | Homing with origin signal (reverse operation start) |
| 34 | Homing with origin signal (forward operation start) |
| 35 | Present home preset |

- If the homing operation is started by setting a value other than 8, 12, 19, 20, 33, 34, or 35, a Command Error (Error No. 91.1) will occur.
- For details on homing, refer to *A-1-6 Homing Mode Specifications* on page A-15.

| | | | | | | | |
|------------------|---|--------------------------------|-----------------|---------|---------|--------------|---|
| 6099 hex | Homing speeds [hm] | | | | | | |
| Sub-index 00 hex | | Number of entries | | | | | |
| Range | - | Unit | - | Default | 02 hex | Attribute | - |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | Speed during search for switch | | | | | |
| Range | 100 to 3,276,700 | Unit | Command units/s | Default | 5,000 | Attribute | B |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |
| Sub-index 02 hex | | Speed during search for zero | | | | | |
| Range | 100 to 3,276,700 | Unit | Command units/s | Default | 5,000 | Attribute | B |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |

- This object sets the homing speed.
- For Sub-index 01 hex (Speed during search for switch), set the operation speed during the homing operation from the start of the homing operation until the Origin Proximity Input turns ON.
- For Sub-index 02 hex (Speed during search for zero), set the operation speed during the homing operation from when the Origin Proximity Input turns ON until the latch signal is detected after the Origin Proximity Input again turns OFF.

| | | | | | | | |
|-----------------|--|------|---------------|---------|---------|-----------|---|
| 60B0 hex | Position offset [csp] | | | | | | |
| Range | -2,147,483,648 to 2,147,483,647 | Unit | Command units | Default | 0 | Attribute | A |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Possible | |

- This object sets the position command offset.
- In Cyclic synchronous position mode (csp), the offset value is added to the Target position (607A hex) for use as the target position in controlling the position.
- Set the relationship between the Target position (607A hex) and Position offset (60B0 hex) so that the following expression is fulfilled. If the relational expression is not met, the operation may be performed in the direction opposite to the command increment direction.

$$\text{Absolute value of (Current position command additional value - Previous position command additional value)} \leq \text{Maximum motor speed} \leq 2,147,483,647$$

| | | | | | | | |
|-----------------|--|------|-----------------|---------|---------|-----------|---|
| 60B1 hex | Velocity offset [csp] [csv] | | | | | | |
| Range | -2,147,483,648 to 2,147,483,647 | Unit | Command units/s | Default | 0 | Attribute | A |
| Size | 4 bytes (INT32) | | Access | RW | PDO map | Possible | |

- In Cyclic synchronous position mode (csp), the value of this object is added to the Speed Feed-forward Gain (3110 hex) for use as the speed feed-forward input value in controlling the speed.

| | | | | | | | |
|-----------------|--|------|--------|---------|---------|-----------|---|
| 60B2 hex | Torque offset [csp] [csv] [cst] | | | | | | |
| Range | -5,000 to 5,000 | Unit | 0.1% | Default | 0 | Attribute | A |
| Size | 2 bytes (INT16) | | Access | RW | PDO map | Possible | |

- In Cyclic synchronous position mode (csp) or Cyclic synchronous velocity mode (csv), the value of this object is added to the Torque Feed-forward Gain (3112 hex) for use as the torque feed-forward input value in controlling the torque. In Cyclic synchronous torque mode (cst), the value of this object is used as the offset value of the Target torque (6071 hex) to control the torque.

| | | | | | | | |
|-----------------|---------------------------------------|------|--------|---------|---------|-----------|------------|
| 60B8 hex | Touch probe function (Latch function) | | | | | | All |
| Range | – | Unit | – | Default | 0 | Attribute | A |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Possible | |

- This object sets and controls the latch function.
- There are two channels, Latch 1 (bits 1 to 7) and Latch 2 (bits 8 to 15).
- Bits 0 and 8 execute latching when changed from 0 to 1.
- To change the settings, set bit 0 or 8 to 0 and then to 1 again.
- Latching is disabled in the following cases.
 - When communications is in the Init state.
 - When the Statusword (6041 hex) bit 9 (remote) is 0 (local).
- For details on the latch function, refer to *7-11 Touch Probe Function (Latch Function)* on page 7-40.

Bit Descriptions

| Bit | Code | Description |
|----------|------|---|
| 0 | 0 | Latch 1 is disabled. |
| | 1 | Latch 1 is enabled. |
| 1 | 0 | Trigger first event (Latch on the first trigger). |
| | 1 | Continuous (Latch continuously on trigger input). |
| 2 | 0 | Latch on the signal selected in the Touch Probe Trigger Selection (3758 hex). |
| | 1 | Latch on the encoder's phase-Z signal. |
| 3 to 7 | 0 | Reserved (always set to 0). |
| 8 | 0 | Latch 2 is disabled. |
| | 1 | Latch 2 is enabled. |
| 9 | 0 | Trigger first event (Latch on the first trigger). |
| | 1 | Continuous (Latch continuously on trigger input). |
| 10 | 0 | Latch on the signal selected in the Touch Probe Trigger Selection (3758 hex). |
| | 1 | Latch on the encoder's phase-Z signal. |
| 11 to 15 | 0 | Reserved (always set to 0). |

| | | | | | | | |
|-----------------|-----------------------------------|------|--------|---------|---------|-----------|------------|
| 60B9 hex | Touch probe status (Latch status) | | | | | | All |
| Range | – | Unit | – | Default | 0 | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Possible | |

- This object gives the status of the Touch probe function (Latch Function).

Bit Descriptions

| Bit | Code | Description |
|----------|--------|--|
| 0 | 0 | Latch 1 is disabled. |
| | 1 | Latch 1 is enabled. |
| 1 | 0 | No value latched with Latch 1. |
| | 1 | There is a value latched with Latch 1. |
| 2 to 5 | 0 | Reserved (always set to 0). |
| 6 and 7 | 0 to 3 | The number of times latching is performed by Latch 1 in continuous latching.*1 |
| 8 | 0 | Latch 2 is disabled. |
| | 1 | Latch 2 is enabled. |
| 9 | 0 | No value latched with Latch 2. |
| | 1 | There is a value latched with Latch 2. |
| 10 to 13 | 0 | Reserved (always set to 0). |
| 14 to 15 | 0 to 3 | The number of times latching is performed by Latch 2 in continuous latching.*1 |

*1 These bits cyclically indicate the number of times latching is performed between 0 and 3 when continuous latching is set (bits 1 or 9 of 60B8 hex is set to 1). They are cleared when bit 0 or 8 becomes 0.

| | | | | | | | |
|-----------------|---------------------------------|------|---------------|---------|---------|-----------|------------|
| 60BA hex | Touch probe pos1 pos value | | | | | | All |
| Range | –2,147,483,648 to 2,147,483,647 | Unit | Command units | Default | 0 | Attribute | – |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- This object gives the latch position for Latch 1.

| | | | | | | | |
|-----------------|---------------------------------|------|---------------|---------|---------|-----------|------------|
| 60BC hex | Touch probe pos2 pos value | | | | | | All |
| Range | –2,147,483,648 to 2,147,483,647 | Unit | Command units | Default | 0 | Attribute | – |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- This object gives the latch position for Latch 2.

| | | | | | | | |
|-----------------|-----------------------------|------|--------|---------|---------|--------------|------------|
| 60E0 hex | Positive torque limit value | | | | | | All |
| Range | 0 to 5,000 | Unit | 0.1% | Default | 5,000 | Attribute | B |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | |

- This object sets the forward torque limit.
- It is limited by the maximum torque of the connected motor.
- For details refer to *7-7 Torque Limit Switching* on page 7-24.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|-----------------|-----------------------------|------|--------|---------|---------|--------------|------------|
| 60E1 hex | Negative torque limit value | | | | | | All |
| Range | 0 to 5000 | Unit | 0.1% | Default | 5000 | Attribute | B |
| Size | 2 bytes (U16) | | Access | RW | PDO map | Not possible | |

- This object sets the reverse torque limit.
- It is limited by the maximum torque of the connected motor.
- For details refer to *Torque Limit Switching* on page 7-24.
- Set the value in units of 0.1% of the rated voltage (100%).

| | | | | | | | |
|------------------|-------------------------|-----------------------------|--------|---------|---------|--------------|-----------|
| 60E3 hex | Supported homing method | | | | | | hm |
| Sub-index 00 hex | | Number of objects | | | | | |
| Range | – | Unit | – | Default | 07 hex | Attribute | – |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | |
| Sub-index 01 hex | | 1st supported homing method | | | | | |
| Range | – | Unit | – | Default | 08 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |
| Sub-index 02 hex | | 2nd supported homing method | | | | | |
| Range | – | Unit | – | Default | 12 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |
| Sub-index 03 hex | | 3rd supported homing method | | | | | |
| Range | – | Unit | – | Default | 19 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |
| Sub-index 04 hex | | 4th supported homing method | | | | | |
| Range | – | Unit | – | Default | 20 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |
| Sub-index 05 hex | | 5th supported homing method | | | | | |
| Range | – | Unit | – | Default | 33 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |
| Sub-index 06 hex | | 6th supported homing method | | | | | |
| Range | – | Unit | – | Default | 34 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |
| Sub-index 07 hex | | 7th supported homing method | | | | | |
| Range | – | Unit | – | Default | 35 hex | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |

- This object shows the supported Homing methods.

| | | | | | | | | | |
|-----------------|------------------------------|------|---------------|---------|---------|-----------|------------------------------|-----------------------------|-----------------------------|
| 60F4 hex | Following error actual value | | | | | | <input type="checkbox"/> csp | <input type="checkbox"/> pp | <input type="checkbox"/> hm |
| Range | -536,870,912 to 536,870,912 | Unit | Command units | Default | 0 | Attribute | - | | |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | | | |

- This object gives the amount of position error.

| | | | | | | | | | | |
|-----------------|---------------------------------|------|-----------------|---------|---------|-----------|-----------------------------|-----------------------------|------------------------------|------------------------------|
| 60FA hex | Control effort | | | | | | <input type="checkbox"/> pp | <input type="checkbox"/> hm | <input type="checkbox"/> csp | <input type="checkbox"/> csv |
| Range | -1,073,741,823 to 1,073,741,823 | Unit | Command units/s | Default | 0 | Attribute | - | | | |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | | | | |

- This object shows the Velocity Demand Value for the Servo Drive.

| | | | | | | | | |
|-----------------|---------------------------------|------|---------------|---------|---------|-----------|------------------------------|--|
| 60FC hex | Position demand internal value | | | | | | <input type="checkbox"/> All | |
| Range | -1,073,741,823 to 1,073,741,823 | Unit | Encoder units | Default | 0 | Attribute | - | |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | | |

- This object shows the Position demand internal value.

| | | | | | | | | |
|-----------------|-----------------------------|------|--------|---------|---------------|-----------|------------------------------|--|
| 60FD hex | Digital inputs | | | | | | <input type="checkbox"/> All | |
| Range | 0000 0000h to FFFF FFFF hex | Unit | - | Default | 0000 0000 hex | Attribute | - | |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Possible | | |

- The bits in this object give the signal status of functions allocated by servo parameters 3400 to 3407, 3410, and 3411 hex.
- The brake interlock output gives the output status when brake interlock is selected as the general-purpose output.
- EDM output status gives the status of the EDM output.

Bit Descriptions

| Bit | Signal name | Symbol | Code | Description |
|---------|--|--------|------|--|
| 0 | Negative limit switch (Reverse Drive Prohibition Input) | NOT | 0 | OFF |
| | | | 1 | ON |
| 1 | Positive limit switch (Forward Drive Prohibition Input) | POT | 0 | OFF |
| | | | 1 | ON |
| 2 | Home switch (Origin Proximity Input) | DEC | 0 | OFF |
| | | | 1 | ON |
| 3 to 15 | Reserved | - | - | - |
| 16 | Encoder Phase Z Detection | PC | 0 | Phase-Z signal not detected during communication cycle |
| | | | 1 | Phase-Z signal detected during communication cycle |
| 17 | External Latch Input 1 | EXT1 | 0 | OFF |
| | | | 1 | ON |
| 18 | External Latch Input 2 | EXT2 | 0 | OFF |
| | | | 1 | ON |

| Bit | Signal name | Symbol | Code | Description |
|-----|-------------------------------------|--------|------|----------------|
| 19 | External Latch Input 3 | EXT3 | 0 | OFF |
| | | | 1 | ON |
| 20 | Monitor Input 0 | MON0 | 0 | OFF |
| | | | 1 | ON |
| 21 | Monitor Input 1 | MON1 | 0 | OFF |
| | | | 1 | ON |
| 22 | Monitor Input 2 | MON2 | 0 | OFF |
| | | | 1 | ON |
| 23 | Forward External Torque Limit Input | PCL | 0 | OFF |
| | | | 1 | ON |
| 24 | Reverse External Torque Limit Input | NCL | 0 | OFF |
| | | | 1 | ON |
| 25 | Immediate Stop Input | STOP | 0 | OFF |
| | | | 1 | ON |
| 26 | Brake Interlock Output | BKIR | 0 | Brake released |
| | | | 1 | Brake locked |
| 27 | Safety Input 1 | SF1 | 0 | OFF |
| | | | 1 | ON |
| 28 | Safety Input 2 | SF2 | 0 | OFF |
| | | | 1 | ON |
| 29 | EDM Output | EDM | 0 | OFF |
| | | | 1 | ON |

- This object will be 0 if the brake interlock output (BKIR) is not assigned to a general-purpose output.

| | | | | | | | | |
|-----------------|-------------------------------|-------------------|--------|---------|---------------|--------------|---|------------|
| 60FE hex | Digital outputs | | | | | | | All |
| Sub-index 0 | | Number of entries | | | | | | |
| Range | – | Unit | – | Default | 02 hex | Attribute | – | |
| Size | 1 byte (U8) | | Access | RO | PDO map | Not possible | | |
| Sub-index 1 | | Physical outputs | | | | | | |
| Range | 0000 0000 to FFFF FFFF hex | Unit | – | Default | 0000 0000 hex | Attribute | A | |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Possible | | |
| Sub-index 2 | | Bit mask | | | | | | |
| Range | 0000 0000 to FFFF FFFF hex | Unit | – | Default | 0000 0000 hex | Attribute | B | |
| Size | 4 bytes (U32) | | Access | RW | PDO map | Not possible | | |

- The bits in the physical outputs of this object set the outputs of function signals allocated by servo parameters 3400 to 3407, 3410, and 3411 hex.
- The bit mask sets masks for the physical outputs.

Bit Descriptions for Sub-index 01 hex

| Bit | Signal name | Symbol | Code | Description |
|---------|--|--------|------|-----------------|
| 0 | Set brake (Brake Interlock Output) ^{*1} | BKIR | 0 | don't set brake |
| | | | 1 | set brake |
| 1 to 15 | Reserved | – | 0 | – |
| 16 | Remote Output 1 | R-OUT1 | 0 | OFF |
| | | | 1 | ON |
| 17 | Remote Output 2 | R-OUT2 | 0 | OFF |
| | | | 1 | ON |
| 24 | Gain Switching | G-SEL | 0 | Gain 1 |
| | | | 1 | Gain 2 |
| 25 | Reserved | – | 0 | – |
| 26 | Speed Loop P/PI Control | P/PI | 0 | PI control |
| | | | 1 | P control |

- The gain can be switched when realtime autotuning is disabled and gain 2 is enabled.
- Speed loop P/PI control can be switched when realtime autotuning and gain 2 are disabled.
- Set all reserved bits to 0.

*1 This bit cannot be used for NJ501-1□00 and CJ1W-NC□8□.

Bit Descriptions for Sub-index 02 hex

| Bit | Signal name | Symbol | Code | Description |
|---------|--|--------|------|--------------------------|
| 0 | Set brake Mask (Brake Interlock Output Mask) | BKIR | 0 | Set brake disable output |
| | | | 1 | Set brake enable output |
| 1 to 15 | Reserved | – | – | – |
| 16 | Remote Output 1 Mask | R-OUT1 | 0 | R-OUT1 disable output |
| | | | 1 | R-OUT1 enable output |
| 17 | Remote Output 2 Mask | R-OUT2 | 0 | R-OUT2 disable output |
| | | | 1 | R-OUT2 enable output |
| 24 | Gain Switching Mask | G-SEL | 0 | Switch setting disable |
| | | | 1 | Switch setting enable |
| 25 | Reserved | – | – | – |
| 26 | Speed Loop P/PI Control Mask | P/PI | 0 | Switch setting disable |
| | | | 1 | Switch setting enable |

| | | | | | | | |
|-----------------|---------------------------------|------|-----------------|---------|---------|-----------|------------|
| 60FF hex | Target velocity | | | | | | All |
| Range | –2,147,483,647 to 2,147,483,647 | Unit | Command units/s | Default | 0 | Attribute | A |
| Size | 4 bytes (INT32) | | Access | RO | PDO map | Possible | |

- Set the command speed for the Cyclic synchronous velocity.

| | | | | | | | |
|-----------------|---------------|------|--------|---------|---------|--------------|------------|
| 6402 hex | Motor type | | | | | | All |
| Range | – | Unit | – | Default | 3 | Attribute | – |
| Size | 2 bytes (U16) | | Access | RO | PDO map | Not possible | |

- This object indicates the type of motor that is connected.
- It is always 3 (PM synchronous motor) for G5-series Servo Drives.

| | | | | | | | |
|-----------------|---|------|--------|---------|---------------------------|--------------|---|
| 6502 hex | Supported drive modes All | | | | | | |
| Range | – | Unit | – | Default | Refer to the description. | Attribute | – |
| Size | 4 bytes (U32) | | Access | RO | PDO map | Not possible | |

- This object indicates the supported operation modes.

Bit Descriptions

| Bit | Supported mode | Definition |
|----------|--|-------------------------------|
| 0 | pp (Profile position mode) | Refer to the default setting. |
| 1 | vl (Velocity mode) | 0: Not supported |
| 2 | pv (Profile velocity mode) | 0: Not supported |
| 3 | tq (Profile torque mode) | 0: Not supported |
| 4 | Reserved | 0 |
| 5 | hm (Homing mode) | 1: Supported |
| 6 | ip (Interpolated position mode) | 0: Not supported |
| 7 | csp (Cyclic synchronous position mode) | 1: Supported |
| 8 | csv (Cyclic synchronous velocity mode) | 1: Supported |
| 9 | cst (Cyclic synchronous torque mode) | 1: Supported |
| 10 to 31 | Reserved | 0 |

- Default setting
The table below describes the default setting for each unit version.

| Unit version | Default setting | Description |
|--------------|-----------------|--|
| Ver. 2.0 | 000003A0 hex | Bit 0 is "0: Not supported." Profile position mode (pp) cannot be used. |
| Ver. 2.1 | 000003A1 hex | Bit 0 is "1: Supported." Profile position mode (pp) can be used. |

A-2 Object List

- This section describes the profile that is used to control the Servo Drive.
- Some objects are enabled by turning the power supply OFF and then ON again. After changing these objects, turn OFF the power supply, confirm that the power supply indicator has gone OFF, and then turn ON the power supply again.
- See below for the data attributes.

A: Always enabled

B: Prohibited to change during motor rotation or commanding.
If it is changed during motor rotation or commanding, the reflection timing is unknown.

C: Updated after the control power is reset, or after a Config command is executed via EtherCAT communications.

D: Changeable only when the EtherCAT communications state is Pre-Operational (Pre-Op).

R: Updated when the control power supply is reset.
It is not updated for a Config command via EtherCAT communications.

RO: Read only

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|--------------------------------|--|---------------|------|---------------|----------------|---------------|-------------------------|
| 1000 hex | 00 hex | Device Type | 0002 0192 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| 1001 hex | 00 hex | Error Register | 0 | – | – | 1 byte (U8) | RO | Not possible. | – |
| 1008 hex | 00 hex | Manufacturer Device Name | R88D-KN□□□-ECT | – | – | 20 bytes (VS) | RO | Not possible. | – |
| 1009 hex | 00 hex | Manufacturer Hardware Version | – | – | – | 20 bytes (VS) | RO | Not possible. | – |
| 100A hex | 00 hex | Manufacturer Software Version | Contains a number indicating the Servo Drive software version. | – | – | 20 bytes (VS) | RO | Not possible. | – |
| 1010 hex | | Store Parameters | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 01 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Save all parameters | 0000 0001 hex | – | – | 4 bytes (U32) | A | Not possible. | – |
| 1011 hex | | Restore Default Parameters | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 01 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Restore all default parameters | 0000 0001 hex | – | – | 4 bytes (U32) | B | Not possible. | – |
| 1018 hex | | Identity Object | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 04 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Vender ID | 0000 0083 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | Product Code | Refer to the table for object 1018 hex on page A-28. | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 03 hex | Revision Number | | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | Serial Number | | – | – | 4 bytes (U32) | RO | Not possible. | – |

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|------------------------|-----------|---------------------------------|-----------------|---------------|------------------|---------------|----------------|---------------|-------------------------|
| 10F0 hex | | Backup Parameters Mode | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 02 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Backup Parameter Checksum | – | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | Backup Parameter Changed | 0 | – | – | 1 bit (BOOL) | A | Not possible. | – |
| 10F3 hex | | Diagnosis History | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 13 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Maximum Messages | 00 hex | – | 00 to 0E hex | 1 byte (U8) | RO | Not possible. | – |
| | 02 hex | Newest Message | 06 hex | – | 06 to 13 hex | 1 byte (U8) | RO | Not possible. | – |
| | 05 hex | Flags | 0000 hex | – | 0000 to 0001 hex | 2 bytes (U16) | A | Not possible. | – |
| | 06 hex | Diagnosis Message 1 | – | – | – | 16 bytes (VS) | RO | Not possible. | – |
| | 07 hex | Diagnosis Message 2 | – | – | – | 16 bytes (VS) | RO | Not possible. | – |
| | : | : | : | : | : | : | : | : | : |
| | 13 hex | Diagnosis Message 14 | – | – | – | 16 bytes (VS) | RO | Not possible. | – |
| 1600 hex ^{*1} | | 1st receive PDO Mapping | – | – | – | – | – | – | – |
| | 00 hex | Number of objects in this PDO | 03 hex | – | – | 1 byte (U8) | D | Not possible. | – |
| | 01 hex | 1st Output Object to be mapped | 6040 0010 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 02 hex | 2nd Output Object to be mapped | 607A 0020 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 03 hex | 3rd Output Object to be mapped | 60B8 0010 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 04 hex | 4th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 05 hex | 5th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 06 hex | 6th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 07 hex | 7th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 08 hex | 8th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 09 hex | 9th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | D | Not possible. | – |
| | 0A hex | 10th Output Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | | Not possible. | – |

*1 1600 hex is supported for unit version 2.1 or later.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|--------------------------------|--------------------------------|-----------------|---------------|---------------|---------------|----------------|---------------|-------------------------|
| 1701 hex | | 258th receive PDO Mapping | - | - | - | - | - | - | - |
| | 00 hex | Number of objects in this PDO | 04 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 01 hex | 1st Output Object to be mapped | 6040 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 02 hex | 2nd Output Object to be mapped | 607A 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 03 hex | 3rd Output Object to be mapped | 60B8 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 04 hex | 4th Output Object to be mapped | 60FE 0120 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| 1702 hex | | 259th receive PDO Mapping | - | - | - | - | - | - | - |
| | 00 hex | Number of objects in this PDO | 07 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 01 hex | 1st Output Object to be mapped | 6040 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 02 hex | 2nd Output Object to be mapped | 607A 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 03 hex | 3rd Output Object to be mapped | 60FF 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 04 hex | 4th Output Object to be mapped | 6071 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 05 hex | 5th Output Object to be mapped | 6060 0008 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 06 hex | 6th Output Object to be mapped | 60B8 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| 07 hex | 7th Output Object to be mapped | 607F 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - | |
| 1703 hex | | 260th receive PDO Mapping | - | - | - | - | - | - | - |
| | 00 hex | Number of objects in this PDO | 07 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 01 hex | 1st Output Object to be mapped | 6040 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 02 hex | 2nd Output Object to be mapped | 607A 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 03 hex | 3rd Output Object to be mapped | 60FF 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 04 hex | 4th Output Object to be mapped | 6060 0008 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 05 hex | 5th Output Object to be mapped | 60B8 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 06 hex | 6th Output Object to be mapped | 60E0 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| 07 hex | 7th Output Object to be mapped | 60E1 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - | |

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|--------------------------------|--------------------------------|-----------------|---------------|---------------|---------------|----------------|---------------|-------------------------|
| 1704 hex | | 261th receive PDO Mapping | – | – | – | – | – | – | – |
| | 00 hex | Number of objects in this PDO | 09 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | 1st Output Object to be mapped | 6040 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | 2nd Output Object to be mapped | 607A 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 03 hex | 3rd Output Object to be mapped | 60FF 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | 4th Output Object to be mapped | 6071 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 05 hex | 5th Output Object to be mapped | 6060 0008 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | 6th Output Object to be mapped | 60B8 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 07 hex | 7th Output Object to be mapped | 607F 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 08 hex | 8th Output Object to be mapped | 60E0 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 09 hex | 9th Output Object to be mapped | 60E1 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| 1705 hex | | 262th receive PDO Mapping | – | – | – | – | – | – | – |
| | 00 hex | Number of objects in this PDO | 08 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | 1st Output Object to be mapped | 6040 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | 2nd Output Object to be mapped | 607A 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 03 hex | 3rd Output Object to be mapped | 60FF 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | 4th Output Object to be mapped | 6060 0008 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 05 hex | 5th Output Object to be mapped | 60B8 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | 6th Output Object to be mapped | 60E0 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 07 hex | 7th Output Object to be mapped | 60E1 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| 08 hex | 8th Output Object to be mapped | 60B2 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – | |

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------------|-----------|--------------------------------|-----------------|---------------|------|---------------|----------------|---------------|-------------------------|
| 1A00 hex *1 | | 1st transmit PDO Mapping | – | – | – | – | – | – | – |
| | 00 hex | Number of objects in this PDO | 03 hex | – | – | 1 byte (U8) | RW | Not possible. | – |
| | 01 hex | 1st Input Object to be mapped | 6041 0010 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 02 hex | 2nd Input Object to be mapped | 6064 0020 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 03 hex | 3rd Input Object to be mapped | 60B9 0010 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 04 hex | 4th Input Object to be mapped | 60BA 0020 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 05 hex | 5th Input Object to be mapped | 60BC 0020 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 06 hex | 6th Input Object to be mapped | 603F 0010 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 07 hex | 7th Input Object to be mapped | 60FD 0020 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 08 hex | 8th Input Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 09 hex | 9th Input Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| | 0A hex | 10th Input Object to be mapped | 0000 0000 hex | – | – | 4 bytes (U32) | RW | Not possible. | – |
| 1B01 hex | | 258th transmit PDO Mapping | – | – | – | – | – | – | – |
| | 00 hex | Number of objects in this PDO | 09 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | 1st Input Object to be mapped | 603F 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | 2nd Input Object to be mapped | 6041 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 03 hex | 3rd Input Object to be mapped | 6064 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | 4th Input Object to be mapped | 6077 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 05 hex | 5th Input Object to be mapped | 60F4 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | 6th Input Object to be mapped | 60B9 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 07 hex | 7th Input Object to be mapped | 60BA 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 08 hex | 8th Input Object to be mapped | 60BC 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 09 hex | 9th Input Object to be mapped | 60FD 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |

*1 1A00 hex is supported for unit version 2.1 or later.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|--------------------------------|-----------------|---------------|------|---------------|----------------|---------------|-------------------------|
| 1B02 hex | | 259th transmit PDO Mapping | – | – | – | – | – | – | – |
| | 00 hex | Number of objects in this PDO | 09 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | 1st Input Object to be mapped | 603F 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | 2nd Input Object to be mapped | 6041 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 03 hex | 3rd Input Object to be mapped | 6064 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | 4th Input Object to be mapped | 6077 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 05 hex | 5th Input Object to be mapped | 6061 0008 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | 6th Input Object to be mapped | 60B9 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 07 hex | 7th Input Object to be mapped | 60BA 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 08 hex | 8th Input Object to be mapped | 60BC 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | | 260th transmit PDO Mapping | – | – | – | – | – | – | – |
| 1B03 hex | 00 hex | Number of objects in this PDO | 0A hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | 1st Input Object to be mapped | 603F 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 02 hex | 2nd Input Object to be mapped | 6041 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 03 hex | 3rd Input Object to be mapped | 6064 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | 4th Input Object to be mapped | 6077 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 05 hex | 5th Input Object to be mapped | 60F4 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | 6th Input Object to be mapped | 6061 0008 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 07 hex | 7th Input Object to be mapped | 60B9 0010 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 08 hex | 8th Input Object to be mapped | 60BA 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 09 hex | 9th Input Object to be mapped | 60BC 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |
| | 0A hex | 10th Input Object to be mapped | 60FD 0020 hex | – | – | 4 bytes (U32) | RO | Not possible. | – |

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------------|-----------|---|-----------------|------------------|------|---------------|----------------|---------------|-------------------------|
| 1B04 hex | | 261th transmit PDO Mapping | - | - | - | - | - | - | - |
| | 00 hex | Number of objects in this PDO | 0A hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 01 hex | 1st Input Object to be mapped | 603F 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 02 hex | 2nd Input Object to be mapped | 6041 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 03 hex | 3rd Input Object to be mapped | 6064 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 04 hex | 4th Input Object to be mapped | 6077 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 05 hex | 5th Input Object to be mapped | 6061 0008 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 06 hex | 6th Input Object to be mapped | 60F4 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 07 hex | 7th Input Object to be mapped | 60B9 0010 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 08 hex | 8th Input Object to be mapped | 60BA 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 09 hex | 9th Input Object to be mapped | 60FD 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| | 0A hex | 10th Input Object to be mapped | 606C 0020 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| 1BFF hex *1 | | 512th transmit PDO Mapping | - | - | - | - | - | - | - |
| | 00 hex | Number of objects in this PDO | 01 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 01 hex | 1st Input Object to be mapped | 2002 0108 hex | - | - | 4 bytes (U32) | RO | Not possible. | - |
| 1C00 hex | | Sync Manager Communication Type | - | - | - | - | - | - | - |
| | 00 hex | Number of used sync manager channels | 04 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 01 hex | Communication type Synch Manager 0 | 01 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 02 hex | Communication type Synch Manager 1 | 02 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 03 hex | Communication type Synch Manager 2 | 03 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| | 04 hex | Communication type Synch Manager 3 | 04 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| 1C10 hex | | Sync Manager 0 PDO Assignment | - | - | - | - | - | - | - |
| | 00 hex | Number of assigned PDOs | 00 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| 1C11 hex | | Sync Manager 1 PDO Assignment | - | - | - | - | - | - | - |
| | 00 hex | Number of Assigned PDOs | 00 hex | - | - | 1 byte (U8) | RO | Not possible. | - |
| 1C12 hex | | Sync Manager 2 PDO Assignment | - | - | - | - | - | - | - |
| | 00 hex | Number of Assigned RxPDOs | 01 hex | - | - | 1 byte (U8) | D | Not possible. | - |
| | 01 hex | 1st PDO Mapping Object Index of assigned PDO | 1701 hex | 0000 to FFFF hex | - | 2 bytes (U16) | D | Not possible. | - |
| | 02 hex | 2nd PDO Mapping Object Index of assigned PDO *2 | 0000 hex | 0000 to FFFF hex | - | 2 bytes (U16) | D | Not possible. | - |

*1 1BFF hex is supported for unit version 2.1 or later.

*2 The Sync manager 2 PDO assignment (1C12-02 hex) and Sync manager 2 PDO assignment (1C13-02 hex) are supported for unit version 2.1 or later.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|-------------|-----------|---|-----------------|------------------|-------|---------------|----------------|---------------|-------------------------|
| 1C13 hex | | Sync Manager 3 PDO Assignment | – | – | – | – | – | – | – |
| | 00 hex | Number of assigned TxPDOs | 01 hex | – | – | 1 byte (U8) | D | Not possible. | – |
| | 01 hex | 1st PDO Mapping Object Index of assigned PDO | 1B01 hex | 0000 to FFFF hex | – | 2 bytes (U16) | D | Not possible. | – |
| | 02 hex | 2nd PDO Mapping Object Index of assigned PDO *2 | 0000 hex | 0000 to FFFF hex | – | 2 bytes (U16) | D | Not possible. | – |
| 1C32 hex | | Sync Manager 2 synchronization | – | – | – | – | – | – | – |
| | 00 hex | Number of Synchronization Parameters | 20 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Synchronization Type | 0002 hex | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 02 hex | Cycle Time | 0000 0000 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | Synchronization Types supported | 0004 hex | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 05 hex | Minimum Cycle Time | 0000 4268 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | Calc and Copy Time | 0007 A120 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 09 hex | Delay Time | 0000 0000 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 20 hex | Sync Error | 0 | – | – | 1 bit (BOOL) | RO | TxPDO | – |
| 1C33 hex | | Sync Manager 3 synchronization | – | – | – | – | – | – | – |
| | 00 hex | Number of Synchronization Parameters | 20 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Synchronization Type | 0002 hex | – | – | 2 bytes (U16) | – | Not possible. | – |
| | 02 hex | Cycle Time | 0000 0000 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 04 hex | Synchronization Types supported | 0004 hex | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 05 hex | Minimum Cycle Time | 0000 4268 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 06 hex | Calc and Copy Time | 0006 06F8 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 09 hex | Delay Time | 0000 0000 hex | – | ns | 4 bytes (U32) | RO | Not possible. | – |
| | 20 hex | Sync Error | 0 | – | – | 1 bit (BOOL) | RO | TxPDO | – |
| 2002 hex *1 | | Sysmac Error | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 02 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Sysmac Error Status | 00 hex | – | – | 1 byte (U8) | RO | TxPDO | – |
| | 02 hex | Sysmac Error Status Clear | 00 hex | – | – | 1 byte (U8) | A | Not possible. | – |
| 2100 hex | 00 hex | Error History Clear | 0000 0000 hex | 0 to 15 | – | 4 bytes (U32) | A | Not possible. | – |
| 2200 hex | 00 hex | Communications Error Setting | 1 | 00 to 0F hex | Times | 1 byte (U8) | C | Not possible. | Pn776 |

*1 2002 hex is supported for unit version 2.1 or later.

*2 The Sync manager 2 PDO assignment (1C12-02 hex) and Sync manager 2 PDO assignment (1C13-02 hex) are supported for unit version 2.1 or later.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|--|-----------------------|---------------|---------|------------------|----------------|---------------|-------------------------|
| 2201 hex | 00 hex | Sync Not Received Timeout Setting | 0 | 0 to 600 | s | 2 bytes (UINT16) | C | Not possible. | Pn777 |
| 3000 hex | 00 hex | Rotation Direction Switching | 1 | 0 to 1 | – | 2 bytes (INT16) | C | Not possible. | Pn000 |
| 3001 hex | 00 hex | Control Mode Selection | 0 | 0 to 6 | – | 2 bytes (INT16) | R | Not possible. | Pn001 |
| 3002 hex | 00 hex | Realtime Autotuning Mode Selection | 1 | 0 to 6 | – | 2 bytes (INT16) | B | Not possible. | Pn002 |
| 3003 hex | 00 hex | Realtime Autotuning Machine Rigidity Setting | 11/13 ^{*1} | 0 to 31 | – | 2 bytes (INT16) | B | Not possible. | Pn003 |
| 3004 hex | 00 hex | Inertia Ratio | 250 | 0 to 10000 | % | 2 bytes (INT16) | B | Not possible. | Pn004 |
| 3013 hex | 00 hex | External Torque Limit 1 | 5000 | 0 to 5000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn753 |
| 3015 hex | 00 hex | Operation Switch when Using Absolute Encoder | 2 | 0 to 2 | – | 2 bytes (INT16) | C | Not possible. | Pn015 |
| 3016 hex | 00 hex | Regeneration Resistor Selection | 0/3 ^{*2} | 0 to 3 | – | 2 bytes (INT16) | C | Not possible. | Pn016 |
| 3017 hex | 00 hex | External Regeneration Resistor Setting | 0 | 0 to 4 | – | 2 bytes (INT16) | C | Not possible. | Pn017 |
| 3100 hex | 00 hex | Position Loop Gain 1 | 320/480 ^{*3} | 0 to 30000 | 0.1/s | 2 bytes (INT16) | B | Not possible. | Pn100 |
| 3101 hex | 00 hex | Speed Loop Gain 1 | 180/270 ^{*4} | 1 to 32767 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn101 |
| 3102 hex | 00 hex | Speed Loop Integral Time Constant 1 | 210/310 ^{*5} | 1 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn102 |
| 3103 hex | 00 hex | Speed Feedback Filter Time Constant 1 | 0 | 0 to 5 | – | 2 bytes (INT16) | B | Not possible. | Pn103 |
| 3104 hex | 00 hex | Torque Command Filter Time Constant 1 | 84/126 ^{*6} | 0 to 2500 | 0.01 ms | 2 bytes (INT16) | B | Not possible. | Pn104 |
| 3105 hex | 00 hex | Position Loop Gain 2 | 380/570 ^{*7} | 0 to 30000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn105 |
| 3106 hex | 00 hex | Speed Loop Gain 2 | 180/270 ^{*8} | 1 to 32767 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn106 |
| 3107 hex | 00 hex | Speed Loop Integral Time Constant 2 | 10000 | 1 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn107 |
| 3108 hex | 00 hex | Speed Feedback Filter Time Constant 2 | 0 | 0 to 5 | – | 2 bytes (INT16) | B | Not possible. | Pn108 |
| 3109 hex | 00 hex | Torque Command Filter Time Constant 2 | 84/126 ^{*9} | 0 to 2500 | 0.01 ms | 2 bytes (INT16) | B | Not possible. | Pn109 |

- *1 The default setting is 11 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 13 for other Drives.
- *2 The default setting is 0 for a Drive for 100 V and 400 W, for 200 V and 750 W or greater, or for a Drive for 400 V. It is set to 3 for other Drives.
- *3 The default setting is 320 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 480 for other Drives.
- *4 The default setting is 180 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 270 for other Drives.
- *5 The default setting is 310 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 210 for other Drives.
- *6 The default setting is 126 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 84 for other Drives.
- *7 The default setting is 380 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 570 for other Drives.
- *8 The default setting is 180 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 270 for other Drives.
- *9 The default setting is 126 for a Drive for 200 V and 1 kW or greater, or for a Drive for 400 V. It is set to 84 for other Drives.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|---|-----------------|---------------|---------|-----------------|----------------|---------------|-------------------------|
| 3110 hex | 00 hex | Speed Feed-forward Gain | 300 | 0 to 1000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn110 |
| 3111 hex | 00 hex | Speed Feed-forward Command Filter | 50 | 0 to 6400 | 0.01 ms | 2 bytes (INT16) | B | Not possible. | Pn111 |
| 3112 hex | 00 hex | Torque Feed-forward Gain | 0 | 0 to 1000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn112 |
| 3113 hex | 00 hex | Torque Feed-forward Command Filter | 0 | 0 to 6400 | 0.01 ms | 2 bytes (INT16) | B | Not possible. | Pn113 |
| 3114 hex | 00 hex | Gain Switching Input Operating Mode Selection | 1 | 0 to 1 | – | 2 bytes (INT16) | B | Not possible. | Pn114 |
| 3115 hex | 00 hex | Switching Mode in Position Control | 0 | 0 to 10 | – | 2 bytes (INT16) | B | Not possible. | Pn115 |
| 3116 hex | 00 hex | Gain Switching Delay Time in Position Control | 50 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn116 |
| 3117 hex | 00 hex | Gain Switching Level in Position Control | 50 | 0 to 20000 | – | 2 bytes (INT16) | B | Not possible. | Pn117 |
| 3118 hex | 00 hex | Gain Switching Hysteresis in Position Control | 33 | 0 to 20000 | – | 2 bytes (INT16) | B | Not possible. | Pn118 |
| 3119 hex | 00 hex | Position Gain Switching Time | 33 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn119 |
| 3120 hex | 00 hex | Switching Mode in Speed Control | 0 | 0 to 5 | – | 2 bytes (INT16) | B | Not possible. | Pn120 |
| 3121 hex | 00 hex | Gain Switching Delay Time in Speed Control | 0 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn121 |
| 3122 hex | 00 hex | Gain Switching Level in Speed Control | 0 | 0 to 20000 | – | 2 bytes (INT16) | B | Not possible. | Pn122 |
| 3123 hex | 00 hex | Gain Switching Hysteresis in Speed Control | 0 | 0 to 20000 | – | 2 bytes (INT16) | B | Not possible. | Pn123 |
| 3124 hex | 00 hex | Switching Mode in Torque Control | 0 | 0 to 3 | – | 2 bytes (INT16) | B | Not possible. | Pn124 |
| 3125 hex | 00 hex | Gain Switching Delay Time in Torque Control | 0 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn125 |
| 3126 hex | 00 hex | Gain Switching Level in Torque Control | 0 | 0 to 20000 | – | 2 bytes (INT16) | B | Not possible. | Pn126 |
| 3127 hex | 00 hex | Gain Switching Hysteresis in Torque Control | 0 | 0 to 20000 | – | 2 bytes (INT16) | B | Not possible. | Pn127 |
| 3200 hex | 00 hex | Adaptive Filter Selection | 0 | 0 to 4 | – | 2 bytes (INT16) | B | Not possible. | Pn200 |
| 3201 hex | 00 hex | Notch 1 Frequency Setting | 5000 | 50 to 5000 | Hz | 2 bytes (INT16) | B | Not possible. | Pn201 |
| 3202 hex | 00 hex | Notch 1 Width Setting | 2 | 0 to 20 | – | 2 bytes (INT16) | B | Not possible. | Pn202 |
| 3203 hex | 00 hex | Notch 1 Depth Setting | 0 | 0 to 99 | – | 2 bytes (INT16) | B | Not possible. | Pn203 |
| 3204 hex | 00 hex | Notch 2 Frequency Setting | 5000 | 50 to 5000 | Hz | 2 bytes (INT16) | B | Not possible. | Pn204 |
| 3205 hex | 00 hex | Notch 2 Width Setting | 2 | 0 to 20 | – | 2 bytes (INT16) | B | Not possible. | Pn205 |
| 3206 hex | 00 hex | Notch 2 Depth Setting | 0 | 0 to 99 | – | 2 bytes (INT16) | B | Not possible. | Pn206 |
| 3207 hex | 00 hex | Notch 3 Frequency Setting | 5000 | 50 to 5000 | Hz | 2 bytes (INT16) | B | Not possible. | Pn207 |
| 3208 hex | 00 hex | Notch 3 Width Setting | 2 | 0 to 20 | – | 2 bytes (INT16) | B | Not possible. | Pn208 |
| 3209 hex | 00 hex | Notch 3 Depth Setting | 0 | 0 to 99 | – | 2 bytes (INT16) | B | Not possible. | Pn209 |

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|--|-----------------|--------------------|---------------------|-----------------|----------------|---------------|-------------------------|
| 3210 hex | 00 hex | Notch 4 Frequency Setting | 5000 | 50 to 5000 | Hz | 2 bytes (INT16) | B | Not possible. | Pn210 |
| 3211 hex | 00 hex | Notch 4 Width Setting | 2 | 0 to 20 | – | 2 bytes (INT16) | B | Not possible. | Pn211 |
| 3212 hex | 00 hex | Notch 4 Depth Setting | 0 | 0 to 99 | – | 2 bytes (INT16) | B | Not possible. | Pn212 |
| 3213 hex | 00 hex | Damping Filter Selection | 0 | 0 to 3 | – | 2 bytes (INT16) | B | Not possible. | Pn213 |
| 3214 hex | 00 hex | Damping Frequency 1 | 0 | 0 to 2000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn214 |
| 3215 hex | 00 hex | Damping Filter 1 Setting | 0 | 0 to 1000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn215 |
| 3216 hex | 00 hex | Damping Frequency 2 | 0 | 0 to 2000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn216 |
| 3217 hex | 00 hex | Damping Filter 2 Setting | 0 | 0 to 1000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn217 |
| 3218 hex | 00 hex | Damping Frequency 3 | 0 | 0 to 2000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn218 |
| 3219 hex | 00 hex | Damping Filter 3 Setting | 0 | 0 to 1000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn219 |
| 3220 hex | 00 hex | Damping Frequency 4 | 0 | 0 to 2000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn220 |
| 3221 hex | 00 hex | Damping Filter 4 Setting | 0 | 0 to 1000 | 0.1 Hz | 2 bytes (INT16) | B | Not possible. | Pn221 |
| 3222 hex | 00 hex | Position Command Filter Time Constant | 0 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn222 |
| 3312 hex | 00 hex | Soft Start Acceleration Time | 0 | 0 to 10000 | ms/max. motor speed | 2 bytes (INT16) | B | Not possible. | Pn312 |
| 3313 hex | 00 hex | Soft Start Deceleration Time | 0 | 0 to 10000 | ms/max. motor speed | 2 bytes (INT16) | B | Not possible. | Pn313 |
| 3314 hex | 00 hex | S-curve Acceleration/Deceleration Time Setting | 0 | 0 to 1000 | ms | 2 bytes (INT16) | B | Not possible. | Pn314 |
| 3317 hex | 00 hex | Speed Limit Selection | 1 | 0 to 1 | ms | 2 bytes (INT16) | B | Not possible. | Pn317 |
| 3321 hex | 00 hex | Speed Limit Value Setting | 20000 | 0 to 20000 | r/min | 2 bytes (INT16) | B | Not possible. | Pn321 |
| 3323 hex | 00 hex | External Feedback Pulse Type Selection | 0 | 0 to 2 | – | 2 bytes (INT16) | R | Not possible. | Pn323 |
| 3324 hex | 00 hex | External Feedback Pulse Dividing Numerator | 0 | 0 to 1048576 | – | 4 bytes (INT32) | R | Not possible. | Pn324 |
| 3325 hex | 00 hex | External Feedback Pulse Dividing Denominator | 10000 | 1 to 1048576 | – | 4 bytes (INT32) | R | Not possible. | Pn325 |
| 3326 hex | 00 hex | External Feedback Pulse Direction Switching | 0 | 0 to 1 | – | 2 bytes (INT16) | R | Not possible. | Pn326 |
| 3327 hex | 00 hex | External Feedback Pulse Phase-Z Setting | 0 | 0 to 1 | – | 2 bytes (INT16) | R | Not possible. | Pn327 |
| 3328 hex | 00 hex | Hybrid Following Error Counter Overflow Level | 16000 | 1 to 134217728 | Command units | 4 bytes (INT32) | C | Not possible. | Pn328 |
| 3329 hex | 00 hex | Hybrid Following Error Counter Reset | 0 | 0 to 100 | Rotations | 2 bytes (INT16) | C | Not possible. | Pn329 |
| 3400 hex | 00 hex | Input Signal Selection 1 | 0094 9494 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn400 |
| 3401 hex | 00 hex | Input Signal Selection 2 | 0081 8181 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn401 |

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|---|-----------------|-----------------------|---------------|--------------------|----------------|---------------|-------------------------|
| 3402 hex | 00 hex | Input Signal Selection 3 | 0082 8282 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn402 |
| 3403 hex | 00 hex | Input Signal Selection 4 | 0022 2222 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn403 |
| 3404 hex | 00 hex | Input Signal Selection 5 | 002B 2B2B hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn404 |
| 3405 hex | 00 hex | Input Signal Selection 6 | 0021 2121 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn405 |
| 3406 hex | 00 hex | Input Signal Selection 7 | 0020 2020 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn406 |
| 3407 hex | 00 hex | Input Signal Selection 8 | 002E 2E2E hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn407 |
| 3410 hex | 00 hex | Output Signal Selection 1 | 0003 0303 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn410 |
| 3411 hex | 00 hex | Output Signal Selection 2 | 0002 0202 hex | 0 to 00FF FFFF hex | – | 4 bytes (INT32) | C | Not possible. | Pn411 |
| 3416 hex | 00 hex | Analog Monitor 1 Selection | 0 | 0 to 21 | *1 | 2 bytes (INT16) | A | Not possible. | Pn416 |
| 3417 hex | 00 hex | Analog Monitor 1 Scale Setting | 0 | 0 to 214748364 | *2 | 4 bytes (INT32) | A | Not possible. | Pn417 |
| 3418 hex | 00 hex | Analog Monitor 2 Selection | 4 | 0 to 21 | – | 2 bytes (INT16) | A | Not possible. | Pn418 |
| 3419 hex | 00 hex | Analog Monitor 2 Scale Setting | 0 | 0 to 214748364 | *3 | 4 bytes (INT32) | A | Not possible. | Pn419 |
| 3421 hex | 00 hex | Analog Monitor Output Setting | 0 | 0 to 2 | – | 2 bytes (INT16) | A | Not possible. | Pn421 |
| 3432 hex | 00 hex | Positioning Completion Condition Selection | 0 | 0 to 3 | – | 2 bytes (INT16) | A | Not possible. | – |
| 3433 hex | 00 hex | Positioning Completion Hold Time | 0 | 0 to 30000 | ms | 2 bytes (INT16) | A | Not possible. | – |
| 3434 hex | 00 hex | Zero Speed Detection | 50 | 10 to 20000 | r/min | 2 bytes (INT16) | A | Not possible. | Pn434 |
| 3435 hex | 00 hex | Speed Conformity Detection Range | 50 | 10 to 20000 | r/min | 2 bytes (INT16) | A | Not possible. | Pn435 |
| 3436 hex | 00 hex | Rotation Speed for Motor Rotation Detection | 1000 | 10 to 20000 | r/min | 2 bytes (INT16) | A | Not possible. | Pn436 |
| 3437 hex | 00 hex | Brake Timing when Stopped | 0 | 0 to 10000 | ms | 2 bytes (INT16) | B | Not possible. | Pn437 |
| 3438 hex | 00 hex | Brake Timing During Operation | 0 | 0 to 10000 | ms | 2 bytes (INT16) | B | Not possible. | Pn438 |
| 3439 hex | 00 hex | Brake Threshold Speed During Operation | 30 | 30 to 3000 | r/min | 2 bytes (INT16) | B | Not possible. | Pn439 |
| 3440 hex | 00 hex | Warning Output Selection 1 | 0 | 0 to 13 | – | 2 bytes (INT16) | A | Not possible. | Pn440 |
| 3441 hex | 00 hex | Warning Output Selection 2 | 0 | 0 to 13 | – | 2 bytes (INT16) | A | Not possible. | Pn441 |
| 3442 hex | 00 hex | Position Completion Range 2 | 10 | 0 to 262144 | Command units | 4 bytes (INT32) | A | Not possible. | Pn442 |
| 3504 hex | 00 hex | Drive Prohibition Input Selection | 1 | 0 to 2 | – | 2 bytes (INT16) | C | Not possible. | Pn504 |

*1 For units, refer to information on object 3416 hex on page 9-33.

*2 Monitor unit in object 3416 hex/V

*3 Monitor unit in object 3418 hex/V

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|---|-----------------|---------------|--------------|-----------------|----------------|---------------|-------------------------|
| 3505 hex | 00 hex | Stop Selection for Drive Prohibition Input | 0 | 0 to 2 | – | 2 bytes (INT16) | C | Not possible. | Pn505 |
| 3508 hex | 00 hex | Undervoltage Error Selection | 1 | 0 to 1 | – | 2 bytes (INT16) | B | Not possible. | Pn508 |
| 3509 hex | 00 hex | Momentary Hold Time | 70 | 70 to 2000 | ms | 2 bytes (INT16) | C | Not possible. | Pn509 |
| 3511 hex | 00 hex | Immediate Stop Torque | 0 | 0 to 5000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn755 |
| 3512 hex | 00 hex | Overload Detection Level Setting | 0 | 0 to 500 *1 | – | 2 bytes (INT16) | A | Not possible. | Pn512 |
| 3513 hex | 00 hex | Overspeed Detection Level Setting | 0 | 0 to 20000 | r/min | 2 bytes (INT16) | A | Not possible. | Pn513 |
| 3514 hex | 00 hex | Overrun Limit Setting | 10 | 0 to 1000 | 0.1 rotation | 2 bytes (INT16) | A | Not possible. | Pn514 |
| 3515 hex | 00 hex | Control Input Signal Read Setting | 0 | 0 to 3 | – | 2 bytes (INT16) | C | Not possible. | Pn515 |
| 3520 hex | 00 hex | Position Setting Unit Selection | 0 | 0 to 1 | – | 2 bytes (INT16) | C | Not possible. | Pn520 |
| 3521 hex | 00 hex | Torque Limit Selection | 6 | 0 to 7 | – | 2 bytes (INT16) | B | Not possible. | Pn521 |
| 3522 hex | 00 hex | External Torque Limit 2 | 5000 | 0 to 5000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn754 |
| 3525 hex | 00 hex | Forward External Torque Limit | 5000 | 0 to 5000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn730 |
| 3526 hex | 00 hex | Reverse External Torque Limit | 5000 | 0 to 5000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn731 |
| 3602 hex | 00 hex | Excessive Speed Deviation Setting | 0 | 0 to 20000 | r/min | 2 bytes (INT16) | B | Not possible. | – |
| 3605 hex | 00 hex | Gain 3 Effective Time | 0 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn605 |
| 3606 hex | 00 hex | Gain 3 Ratio Setting | 100 | 0 to 10000 | % | 2 bytes (INT16) | B | Not possible. | Pn606 |
| 3607 hex | 00 hex | Torque Command Value Offset | 0 | 50 to 1000 | % | 2 bytes (INT16) | B | Not possible. | Pn607 |
| 3608 hex | 00 hex | Forward Direction Torque Offset | 0 | -100 to 100 | % | 2 bytes (INT16) | B | Not possible. | Pn608 |
| 3609 hex | 00 hex | Reverse Direction Torque Offset | 0 | -100 to 100 | % | 2 bytes (INT16) | B | Not possible. | Pn609 |
| 3610 hex | 00 hex | Function Expansion Setting | 64 | 0 to 30000 | – | 2 bytes (INT16) | B | Not possible. | Pn610 |
| 3611 hex | 00 hex | Electric Current Response Setting | 100 | 50 to 100 | % | 2 bytes (INT16) | B | Not possible. | Pn611 |
| 3614 hex | 00 hex | Error Detection Allowable Time Setting | 200 | 0 to 1000 | ms | 2 bytes (INT16) | B | Not possible. | Pn614 |
| 3615 hex | 00 hex | Overspeed Detection Level Setting at Immediate Stop | 0 | 0 to 20000 | r/min | 2 bytes (INT16) | A | Not possible. | Pn615 |
| 3618 hex | 00 hex | Power Supply ON Initialization Time | 0 | 0 to 100 | 0.1 s | 2 bytes (INT16) | R | Not possible. | Pn618 |
| 3623 hex | 00 hex | Disturbance Torque Compensation Gain | 0 | –100 to 100 | – | 2 bytes (INT16) | B | Not possible. | Pn623 |
| 3624 hex | 00 hex | Disturbance Observer Filter Setting | 53 | 10 to 2500 | 0.01 ms | 2 bytes (INT16) | B | Not possible. | Pn624 |
| 3631 hex | 00 hex | Realtime Autotuning Estimated Speed Selection | 1 | 0 to 3 | – | 2 bytes (INT16) | B | Not possible. | Pn631 |

*1 Regarded as 115% when set to 115 or more.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|------------------------|-----------|--|-----------------|----------------------------|---------------|-----------------|----------------|---------------|-------------------------|
| 3632 hex | 00 hex | Realtime Autotuning Customization Mode Setting | 0 | -32768 to 32767 | - | 2 bytes (INT16) | B | Not possible. | Pn632 |
| 3634 hex | 00 hex | Hybrid Vibration Suppression Gain | 0 | 0 to 30000 | 0.1/s | 2 bytes (INT16) | B | Not possible. | Pn634 |
| 3635 hex | 00 hex | Hybrid Vibration Suppression Filter | 10 | 0 to 6400 | 0.01ms | 2 bytes (INT16) | B | Not possible. | Pn635 |
| 3637 hex | 00 hex | Vibration Detection Threshold | 0 | 0 to 1000 | 0.1% | 2 bytes (INT16) | B | Not possible. | Pn637 |
| 3638 hex | 00 hex | Warning Mask Setting | 4 | -32768 to 32767 | - | 2 bytes (INT16) | C | Not possible. | Pn638 |
| 3700 hex | 00 hex | LED Display Selection | 0 | 0 to 32767 | - | 2 bytes (INT16) | A | Not possible. | Pn700 |
| 3701 hex | 00 hex | Power ON Address Display Duration Setting | 0 | 0 to 1000 | 100ms | 2 bytes (INT16) | R | Not possible. | Pn701 |
| 3703 hex | 00 hex | Torque Limit Flag Output Setting | 1 | 0 to 1 | - | 2 bytes (INT16) | A | Not possible. | Pn703 |
| 3704 hex | 00 hex | Backlash Compensation Selection | 0 | 0 to 2 | - | 2 bytes (INT16) | C | Not possible. | Pn704 |
| 3705 hex | 00 hex | Backlash Compensation Amount | 0 | -32768 to 32767 | Command units | 2 bytes (INT16) | B | Not possible. | Pn705 |
| 3706 hex | 00 hex | Backlash Compensation Time Constant | 0 | 0 to 6400 | 0.01ms | 2 bytes (INT16) | B | Not possible. | Pn706 |
| 3758 hex | 00 hex | Touch Probe Trigger Selection | 0100h | 0000 to FFFF hex | - | 2 bytes (U16) | B | Not possible. | Pn758 |
| 3759 hex | 00 hex | Warning Hold Selection | 0 | 0000 to FFFF hex | - | 2 bytes (U16) | B | Not possible. | Pn759 |
| 3781 hex ^{*1} | 00 hex | Data Setting Warning Detection Setting | 1 | 0 to 15 | - | 2 bytes (INT16) | C | Not possible. | Pn781 |
| 3800 hex | 00 hex | Communications Control | *2 | -32768 to 32767 | - | 2 bytes (INT16) | C | Not possible. | Pn800 |
| 3801 hex | 00 hex | Software Position Limit Function | 3 | 0 to 3 | - | 2 bytes (INT16) | A | Not possible. | Pn801 |
| 3803 hex | 00 hex | Origin Range | 10 | 0 to 250 | Command units | 2 bytes (INT16) | A | Not possible. | Pn803 |
| 3818 hex | 00 hex | Position Command FIR Filter Time Constant | 0 | 0 to 10000 | 0.1 ms | 2 bytes (INT16) | B | Not possible. | Pn818 |
| 3822 hex | 00 hex | Origin Return Mode Settings | 0 | 0 to 1 | - | 2 bytes (INT16) | B | Not possible. | Pn822 |
| 4000 hex | 00 hex | Statusword 1 | 0000 hex | 0000 to FFFF hex | - | 2 bytes (U16) | RO | TxPDO | - |
| 4001 hex | 00 hex | Sub Error Code | 0000 hex | 0000 to FFFF hex | - | 2 bytes (U16) | RO | TxPDO | - |
| 4020 hex ^{*3} | 00 hex | Reference Position for CSP | 0 | -2147483648 to 2147483647 | Command units | 4 bytes (INT32) | RO | TxPDO | - |
| 4100 hex | 00 hex | Config | 0000 0000 hex | 0000 0000 to FFFF FFFF hex | - | 4 bytes (U32) | B | Not possible. | - |
| 4102 hex | 00 hex | Absolute Encoder Setup | 0000 0000 hex | 0000 0000 to FFFF FFFF hex | - | 4 bytes (U32) | B | Not possible. | - |
| 4103 hex | 00 hex | Coordinate System Setting Mode | 0 | 0000 to FFFF hex | - | 2 bytes (U16) | B | RxPDO | - |

*1 3781 hex is supported for unit version 2.1 or later.

*2 Default setting: 0 for unit version 2.0, 16384 for unit version 2.1.

*3 4020 hex is supported for unit version 2.1 or later.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|------------------------------------|-----------------|------------------------------|---|-----------------|----------------|---------------|-------------------------|
| 4104 hex | 00 hex | Coordinate System Setting Position | 0 | -2147483648 to 2147483647 | Command units | 4 bytes (INT32) | B | RxPDO | - |
| 603F hex | 00 hex | Error code | 0000 hex | 0000 to FFFF hex | - | 2 bytes (U16) | RO | TxPDO | - |
| 6040 hex | 00 hex | Controlword | 0000 hex | 0000 to FFFF hex | - | 2 bytes (U16) | A | RxPDO | - |
| 6041 hex | 00 hex | Statusword | 0000 hex | 0000 to FFFF hex | - | 2 bytes (U16) | RO | TxPDO | - |
| 605B hex | 00 hex | Shutdown option code | -1 | -5 to 0 | - | 2 bytes (INT16) | B | Not possible. | Pn735 |
| 605C hex | 00 hex | Disable operation option code | -1 | -5 to 0 | - | 2 bytes (INT16) | B | Not possible. | Pn736 |
| 605D hex | 00 hex | Halt option code | 1 | 1 to 3 | - | 2 bytes (INT16) | B | Not possible. | Pn737 |
| 605E hex | 00 hex | Fault reaction option code | -1 | -7 to 0 | - | 2 bytes (INT16) | B | Not possible. | Pn738 |
| 6060 hex | 00 hex | Modes of operation | 0 | 0 to 10 | - | 1 byte (INT8) | A | RxPDO | - |
| 6061 hex | 00 hex | Modes of operation display | 0 | 0 to 10 | - | 1 byte (INT8) | RO | TxPDO | - |
| 6062 hex | 00 hex | Position demand value | 0 | -2147483648 to 2147483647 | Command units | 4 bytes (INT32) | RO | TxPDO | - |
| 6063 hex | 00 hex | Position actual internal value | 0 | -2147483648 to 2147483647 | Encoder units/ external encoder units ^{*1} | 4 bytes (INT32) | RO | TxPDO | - |
| 6064 hex | 00 hex | Position actual value | 0 | -2147483648 to 2147483647 | Command units | 4 bytes (INT32) | RO | TxPDO | - |
| 6065 hex | 00 hex | Following error window | 100000 | 0 to 134217728 or 4294967295 | Command units | 4 bytes (U32) | A | Not possible. | Pn739 |
| 6067 hex | 00 hex | Position window | 10 | 0 to 262144 | Command units | 4 bytes (U32) | A | Not possible. | Pn740 |
| 606C hex | 00 hex | Velocity actual value | 0 | -2147483647 to 2147483647 | Command units/s | 4 bytes (INT32) | RO | TxPDO | - |
| 6071 hex | 00 hex | Target torque | 0 | -5000 to 5000 | 0.1% | 2 bytes (INT16) | A | RxPDO | - |
| 6072 hex | 00 hex | Max torque | 5000 | 0 to 5000 | 0.1% | 2 bytes (U16) | A | RxPDO | - |
| 6074 hex | 00 hex | Torque demand | 0 | -5000 to 5000 | 0.1% | 2 bytes (INT16) | RO | TxPDO | - |
| 6077 hex | 00 hex | Torque actual value | 0 | -5000 to 5000 | 0.1% | 2 bytes (INT16) | RO | TxPDO | - |
| 607A hex | 00 hex | Target position | 0 | -2147483648 to 2147483647 | Command units | 4 bytes (INT32) | A | RxPDO | - |
| 607C hex | 00 hex | Home offset | 0 | -1073741823 to 1073741823 | Command units | 4 bytes (INT32) | C | Not possible. | Pn742 |

*1 Encoder units are used for semi-closed control and external encoder units are used for fully-closed control.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------------|-----------|--------------------------------|-----------------|---------------------------|------------------------------|-----------------|----------------|---------------|-------------------------|
| 607D hex | | Software position limit | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 2 | 02 hex | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Min position limit | –50000 | –1073741823 to 1073741823 | Command units | 4 bytes (INT32) | A | Not possible. | Pn743 |
| | 02 hex | Max position limit | 50000 | –1073741823 to 1073741823 | Command units | 4 bytes (INT32) | A | Not possible. | Pn744 |
| 607F hex | 00 hex | Max profile velocity | 0 | 0 to 2147483647 | Command units/s | 4 bytes (U32) | A | RxPDO | – |
| 6081 hex *1 | 00 hex | Profile velocity | 0 | 0 to 2147483647 | Command units/s | 4 bytes (U32) | A | RxPDO | – |
| 6083 hex | 00 hex | Profile acceleration | 1000000 | 1 to 655350000 | Command units/s ² | 4 bytes (U32) | B | Not possible. | Pn745 |
| 6084 hex | 00 hex | Profile deceleration | 1000000 | 1 to 655350000 | Command units/s ² | 4 bytes (U32) | B | Not possible. | Pn746 |
| 6086 hex | 00 hex | Motion profile type | 0 | –1 to 0 | – | 2 bytes (INT16) | B | RxPDO | – |
| 6091 hex | | Gear ratio | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 02 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Motor revolutions | 1 | 0 to 1073741824 | – | 4 bytes (U32) | C | Not possible. | Pn748 |
| | 02 hex | Shaft revolutions | 1 | 1 to 1073741824 | – | 4 bytes (U32) | C | Not possible. | Pn749 |
| 6098 hex | 00 hex | Homing method | 0 | –128 to 127 | – | 1 byte (INT8) | B | Not possible. | Pn750 |
| 6099 hex | | Homing speeds | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 02 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Speed during search for switch | 5000 | 100 to 3276700 | Command units/s | 4 bytes (U32) | B | Not possible. | Pn751 |
| | 02 hex | Speed during search for zero | 5000 | 100 to 3276700 | Command units/s | 4 bytes (U32) | B | Not possible. | Pn752 |
| 60B0 hex | 00 hex | Position offset | 0 | –2147483648 to 2147483647 | Command units | 4 bytes (INT32) | A | RxPDO | – |
| 60B1 hex | 00 hex | Velocity offset | 0 | –2147483648 to 2147483647 | Command units/s | 4 bytes (INT32) | A | RxPDO | – |
| 60B2 hex | 00 hex | Torque offset | 0 | –5000 to 5000 | 0.1% | 2 bytes (INT16) | A | RxPDO | – |
| 60B8 hex | 00 hex | Touch probe function | 0 | – | – | 2 bytes (U16) | A | RxPDO | – |
| 60B9 hex | 00 hex | Touch probe status | 0 | – | – | 2 bytes (U16) | RO | TxPDO | – |
| 60BA hex | 00 hex | Touch probe pos1 pos value | 0 | –2147483648 to 2147483647 | Command units | 4 bytes (INT32) | RO | TxPDO | – |
| 60BC hex | 00 hex | Touch probe pos2 pos value | 0 | –2147483648 to 2147483647 | Command units | 4 bytes (INT32) | RO | TxPDO | – |
| 60E0 hex | 00 hex | Positive torque limit value | 5000 | 0 to 5000 | 0.1% | 2 bytes (U16) | B | Not possible. | – |

*1 6081 hex is supported for unit version 2.1 or later.

| Index | Sub-Index | Name | Default setting | Setting range | Unit | Size | Data attribute | PDO map | Corresponding Pn number |
|----------|-----------|--------------------------------|-----------------|----------------------------|-----------------|-----------------|----------------|---------------|-------------------------|
| 60E1 hex | 00 hex | Negative torque limit value | 5000 | 0 to 5000 | 0.1% | 2 bytes (U16) | B | Not possible. | – |
| 60E3 hex | | Supported homing method | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 07 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | 1st supported homing method | 8 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 02 hex | 2st supported homing method | 12 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 03 hex | 3rd supported homing method | 19 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 04 hex | 4th supported homing method | 20 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 05 hex | 5th supported homing method | 33 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 06 hex | 6st supported homing method | 34 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| | 07 hex | 7th supported homing method | 35 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| 60F4 hex | 00 hex | Following error actual value | 0 | –536870912 to 536870912 | Command units | 4 bytes (INT32) | RO | TxPDO | – |
| 60FC hex | 00 hex | Position demand internal value | 0 | –1073741823 to 1073741823 | Encoder units | 4 bytes (INT32) | RO | TxPDO | – |
| 60FD hex | 00 hex | Digital inputs | 0000 0000 hex | 0000 0000 to FFFF FFFF hex | – | 4 bytes (U32) | RO | TxPDO | – |
| 60FA hex | 00 hex | Control effort | 0 | –1073741823 to 1073741823 | Command units/s | 4 bytes (INT32) | RO | TxPDO | – |
| 60FE hex | | Digital outputs | – | – | – | – | – | – | – |
| | 00 hex | Number of entries | 02 hex | – | – | 1 byte (U8) | RO | Not possible. | – |
| | 01 hex | Physical outputs | 0000 0000 hex | 0000 0000 to FFFF FFFF hex | – | 4 bytes (U32) | A | RxPDO | – |
| | 02 hex | Bit mask | 0000 0000 hex | 0000 0000 to FFFF FFFF hex | – | 4 bytes (U32) | B | Not possible. | – |
| 60FF hex | 00 hex | Target velocity | 0 | –2147483647 to 2147483647 | Command units/s | 4 bytes (INT32) | A | RxPDO | – |
| 6402 hex | 00 hex | Motor type | 3 | – | – | 2 bytes (U16) | RO | Not possible. | – |
| 6502 hex | 00 hex | Supported drive modes | *1 | – | – | 4 bytes (U32) | RO | Not possible. | – |

*1 Default setting: 0000 03A0 hex for unit version 2.0, 0000 03A1 hex for unit version 2.1.

A-3 Sysmac Error Status Codes

This section lists and describes the error event codes that you may see in Sysmac Studio. This function is supported for unit version 2.1 or later.

A-3-1 Error Table

The errors that may occur for this Unit are listed below. Event levels are given in the table as follows:

Maj: Major fault level

Prt: Partial fault level

Min: Minor fault level

Obs: Observation

Info: Information

Refer to the *NJ-series Troubleshooting Manual* (Cat. No. W503) for all of the event codes that may occur in an NJ-series Controller.

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|-----------------------------------|--|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 04A80000 hex | Control Power Supply Undervoltage | The voltage between the positive and negative terminals in the control power supply converter dropped below the specified value. | <ul style="list-style-type: none"> Power supply undervoltage. Or, the power supply voltage dropped because there was inrush current when the main power supply was turned ON. A momentary power interruption occurred. The Servo Drive failed. | | | √ | | | page A-108 |
| 04A90000 hex | Overvoltage | The power supply voltage exceeded the allowable input voltage range. | <ul style="list-style-type: none"> The voltage between the positive and negative terminals in the control power supply converter exceeded the specified value. The voltage was suddenly increased by the phase advance capacitor or the uninterruptible power supply (UPS). The Regeneration Resistor wiring is broken. The External Regeneration Resistor is not suitable. The Servo Drive failed. | | | √ | | | page A-109 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---|---|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 04AA0000 hex | Main Circuit Power Supply Undervoltage (Undervoltage between positive and negative terminals) | If the Undervoltage Error Selection (3508 hex) is set to 1, a momentary power interruption occurred between L1 and L3 for longer than the value specified for the Momentary Hold Time. The voltage between the positive and negative terminals in the main power supply converter dropped below the specified value while the Servo was ON. | <ul style="list-style-type: none"> Insufficient power supply capacity The electromagnetic contactor in the main circuit power supply was tripped. A momentary power interruption occurred. A Servo Drive with 3-phase input specifications was operated with a single-phase power supply. The Servo Drive failed. | | | √ | | | page A-110 |
| 04AB0000 hex | Main Circuit Power Supply Undervoltage (AC Cutoff Detected) | If the Undervoltage Error Selection (3508 hex) is set to 1, a momentary power interruption occurred between L1 and L3 for longer than the value specified for the Momentary Hold Time. The voltage between the positive and negative terminals in the main power supply converter dropped below the specified value while the Servo was ON. | <ul style="list-style-type: none"> Insufficient power supply capacity The electromagnetic contactor in the main circuit power supply was tripped. A momentary power interruption occurred. A Servo Drive with 3-phase input specifications was operated with a single-phase power supply. The Servo Drive failed. | | | √ | | | page A-111 |
| 04AC0000 hex | Overcurrent | The current flowing through the converter exceeded the specified value. | <ul style="list-style-type: none"> A short-circuit, line-to-ground fault, contact failure, or insulation failure occurred on the U, V, or W motor line. The Servo Drive failed. The relay for the dynamic brake has been welded due to frequent Servo ON/OFF operations. Motor windings are burned out. The Servomotor is not suitable for the Servo Drive. The command input timing is the same as or earlier than the Servo ON timing. | | | √ | | | page A-112 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|--|--|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 04AD0000 hex | IPM Error | The current flowing through the converter exceeded the specified value. | <ul style="list-style-type: none"> A short-circuit, line-to-ground fault, contact failure, or insulation failure occurred on the U, V, or W motor line. The Servo Drive failed. The relay for the dynamic brake has been welded due to frequent Servo ON/OFF operations. Motor windings are burned out. The Servomotor is not suitable for the Servo Drive. The pulse input timing is the same as or earlier than the Servo ON timing. | | | √ | | | page A-113 |
| 04AE0000 hex | Regeneration Tr Error | The Servo Drive regeneration drive Tr is faulty. | <ul style="list-style-type: none"> The Servo Drive regeneration drive Tr is faulty. | | | √ | | | page A-114 |
| 04AF0000 hex | Encoder Phase-Z Error | A missing serial incremental encoder phase-Z pulse was detected. | <ul style="list-style-type: none"> The encoder is faulty. | | | √ | | | page A-114 |
| 04B00000 hex | Encoder CTS Signal Error | A missing serial incremental encoder CTS signal logic error was detected. | <ul style="list-style-type: none"> The encoder is faulty. | | | √ | | | page A-115 |
| 04B10000 hex | Node Address Setting Error | The node address that was read from the rotary switches was not between 00 and 99. | <ul style="list-style-type: none"> The Servo Drive failed. | | | √ | | | page A-115 |
| 08080000 hex | Encoder Communications Disconnection Error | A disconnection was detected because communications between the encoder and the Servo Drive were stopped more frequently than the specified value. | <ul style="list-style-type: none"> The encoder is not wired correctly. | | | √ | | | page A-116 |
| 08090000 hex | Encoder Communications Error | There is a communications error for the encoder. | <ul style="list-style-type: none"> The power supply voltage of the encoder is low. Noise | | | √ | | | page A-116 |
| 080A0000 hex | Encoder Communications Data Error | There is an error in the communications data of the encoder. | <ul style="list-style-type: none"> The power supply voltage of the encoder is low. Noise | | | √ | | | page A-117 |
| 080B0000 hex | Safety Input Error | At least one of the input photocouplers for safety inputs 1 and 2 turned OFF. | <ul style="list-style-type: none"> The cable is disconnected or broken. | | | √ | | | page A-117 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|--|---|---|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 080C0000 hex | External Encoder Connection Error | A disconnection was detected because communications between the external encoder and the Servo Drive were stopped more frequently than the specified value. | <ul style="list-style-type: none"> The wiring is incorrect. | | | √ | | | page A-118 |
| 080D0000 hex | External Encoder Communications Data Error | There was a communications error in data from the external encoder. | <ul style="list-style-type: none"> There is insufficient external encoder power supply voltage. Noise | | | √ | | | page A-118 |
| 080E0000 hex | External Encoder Status Error 0 | Bit 00 of the external encoder error code (ALMC) was set to 1. | <ul style="list-style-type: none"> Bit 00 of the external scale error code (ALMC) was set to 1. | | | √ | | | page A-119 |
| 080F0000 hex | External Encoder Status Error 1 | Bit 01 of the external encoder error code (ALMC) was set to 1. | <ul style="list-style-type: none"> Bit 01 of the external encoder error code (ALMC) was set to 1. | | | √ | | | page A-119 |
| 08100000 hex | External Encoder Status Error 2 | Bit 02 of the external encoder error code (ALMC) was set to 1. | <ul style="list-style-type: none"> Bit 02 of the external encoder error code (ALMC) was set to 1. | | | √ | | | page A-120 |
| 08110000 hex | External Encoder Status Error 3 | Bit 03 of the external encoder error code (ALMC) was set to 1. | <ul style="list-style-type: none"> Bit 03 of the external encoder error code (ALMC) was set to 1. | | | √ | | | page A-120 |
| 08120000 hex | External Encoder Status Error 4 | Bit 04 of the external encoder error code (ALMC) was set to 1. | <ul style="list-style-type: none"> Bit 04 of the external encoder error code (ALMC) was set to 1. | | | √ | | | page A-121 |
| 08130000 hex | External Encoder Status Error 5 | Bit 05 of the external encoder error code (ALMC) was set to 1. | <ul style="list-style-type: none"> Bit 05 of the external encoder error code (ALMC) was set to 1. | | | √ | | | page A-121 |
| 08140000 hex | Phase-A Connection Error | An error such as broken wiring was detected in the external encoder phase-A connection. | <ul style="list-style-type: none"> An error such as broken wiring was detected in the external encoder phase-A connection. | | | √ | | | page A-122 |
| 08150000 hex | Phase-B Connection Error | An error such as broken wiring was detected in the external encoder phase-B connection. | <ul style="list-style-type: none"> An error such as broken wiring was detected in the external encoder phase-B connection. | | | √ | | | page A-122 |
| 08160000 hex | Phase-Z Connection Error | An error such as broken wiring was detected in the external encoder phase-Z connection. | <ul style="list-style-type: none"> An error such as broken wiring was detected in the external encoder phase-Z connection. | | | √ | | | page A-123 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---|---|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 08170000 hex | Encoder Data Restoration Error | Initialization of internal position data was not processed correctly in Semi-closed Control Mode and Absolute Value Mode. | <ul style="list-style-type: none"> There is insufficient power supply voltage for the encoder. Noise is entering on the encoder line. | | | √ | | | page A-123 |
| 08180000 hex | External Encoder Data Restoration Error | Initialization of internal position data was not processed correctly in Fully-closed Control Mode and Absolute Value Mode. | <ul style="list-style-type: none"> There is insufficient power supply voltage for the external encoder. Noise is entering on the external encoder line. | | | √ | | | page A-124 |
| 14A80000 hex | Object Error | The object area data in non-volatile memory is corrupted. | <ul style="list-style-type: none"> Noise Non-volatile memory failure | | | √ | | | page A-124 |
| 14A90000 hex | Object Error | The object area data in non-volatile memory is corrupted. | <ul style="list-style-type: none"> Noise Non-volatile memory failure | | | √ | | | page A-125 |
| 14AA0000 hex | Object Error | The object area data in non-volatile memory is corrupted. | <ul style="list-style-type: none"> Noise Non-volatile memory failure | | | √ | | | page A-125 |
| 14AB0000 hex | Object Corrupted | The checksum data in non-volatile memory is corrupted. | <ul style="list-style-type: none"> Non-volatile memory failure | | | √ | | | page A-126 |
| 14AC0000 hex | Object Corrupted | The checksum data in non-volatile memory is corrupted. | <ul style="list-style-type: none"> Non-volatile memory failure | | | √ | | | page A-126 |
| 14AD0000 hex | Object Corrupted | The checksum data in non-volatile memory is corrupted. | <ul style="list-style-type: none"> Non-volatile memory failure | | | √ | | | page A-127 |
| 18200000 hex | Absolute Encoder Overspeed Error | The Servomotor rotation speed exceeded the specified value when only the battery power supply was used during a power interruption. | <ul style="list-style-type: none"> There is insufficient power supply voltage for the encoder. The wiring of the CN2 connector is wrong. An external force is rotating the motor when the Servo is OFF. | | | √ | | | page A-127 |
| 18210000 hex | Encoder Initialization Error | An encoder initialization error was detected. | <ul style="list-style-type: none"> Servomotor failed. | | | √ | | | page A-128 |
| 18220000 hex | Absolute Encoder One-rotation Counter Error | The encoder detected a one-rotation counter error. | <ul style="list-style-type: none"> Servomotor failed. | | | √ | | | page A-128 |
| 18230000 hex | Absolute Encoder Multi-rotation Counter Error | The encoder detected a multi-rotation counter error. | <ul style="list-style-type: none"> Servomotor failed. | | | √ | | | page A-129 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|-----------------------|---|---|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 24680000 hex | Motor Non-conformity | The Servo Drive and Servomotor combination is not correct. | <ul style="list-style-type: none"> The Servo Drive and Servomotor combination is not correct. | | | √ | | | page A-129 |
| 24690000 hex | Motor Non-conformity | The Servo Drive and Servomotor combination is not correct. | <ul style="list-style-type: none"> The Servo Drive and Servomotor combination is not correct. | | | √ | | | page A-130 |
| 246A0000 hex | Motor Non-conformity | The Servo Drive and Servomotor combination is not correct. | <ul style="list-style-type: none"> The Servo Drive and Servomotor combination is not correct. | | | √ | | | page A-130 |
| 246B0000 hex | Motor Non-conformity | The Servo Drive and Servomotor combination is not correct. | <ul style="list-style-type: none"> The Servo Drive and Servomotor combination is not correct. | | | √ | | | page A-131 |
| 246C0000 hex | Motor Non-conformity | The Servo Drive and Servomotor combination is not correct. | <ul style="list-style-type: none"> The Servo Drive and Servomotor combination is not correct. | | | √ | | | page A-131 |
| 34E10000 hex | Servo Drive Overheat | The temperature of the Servo Drive radiator or power elements exceeded the specified value. | <ul style="list-style-type: none"> The ambient temperature of the Servo Drive exceeded the specified value. Overload | | | √ | | | page A-132 |
| 34E20000 hex | Overload | When the feedback value for torque command exceeds the overload level specified in the Overload Detection Level Setting (3512 hex), overload protection is performed according to the overload characteristics. | <ul style="list-style-type: none"> Operation was continued for a long time while overloaded. There is incorrect wiring of the motor line or a broken cable. | | | √ | | | page A-133 |
| 34E30000 hex | Regeneration Overload | The regenerative energy exceeds the processing capacity of the Regeneration Resistor. | <ul style="list-style-type: none"> The load inertia is too large. Or, the Servomotor rotation speed is too high to absorb the regenerative energy within the specified deceleration time. This Regeneration Resistor cannot be used for continuous regenerative braking. (The operating limit of the external resistor is limited to a 10% duty.) | | | √ | | | page A-134 |
| 34E40000 hex | ErrorCounter Overflow | Position error pulses exceeded the setting of the Following error window (6065 hex). | <ul style="list-style-type: none"> Motor operation does not follow the command. The value of the Following error window (6065 hex) is small. The encoder wiring is incorrect. | | | √ | | | page A-135 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|----------------------------------|--|---|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 34E50000 hex | Excessive Velocity Error | The difference between the internal position command velocity and the actual velocity (i.e., the velocity error) exceeded the Excessive Velocity Error Setting (3602 hex). | <ul style="list-style-type: none"> Motor operation does not follow the command. The setting of the Excessive Velocity Error Setting (3602 hex) is too small. | | | √ | | | page A-136 |
| 34E60000 hex | Overspeed | The Servomotor rotation speed exceeded the value set on the Overspeed Detection Level Setting (3513 hex). | <ul style="list-style-type: none"> The velocity command value is too large. There is overshooting. The wiring is incorrect. | | | √ | | | page A-136 |
| 383F0000 hex | Excessive Hybrid Following Error | During fully-closed control, the difference between the load position from the external encoder and the Servomotor position from the encoder was larger than the number of pulses set as the Hybrid Following Error Counter Overflow Level (3328 hex). | <ul style="list-style-type: none"> Connections are not correct. The settings are not correct. | | | √ | | | page A-137 |
| 38400000 hex | Overspeed 2 | The Servomotor rotation speed exceeded the value set on Overspeed Detection Level Setting at Immediate Stop (3615 hex). | <ul style="list-style-type: none"> The velocity command value is too large. There is overshooting. The wiring is incorrect. | | | √ | | | page A-138 |
| 38410000 hex | Command Error | The position command variation after the electronic gear exceeded the specified value. | <ul style="list-style-type: none"> The change in position command is too large. The backlash compensation amount is too large. | | | √ | | | page A-138 |
| 38420000 hex | Command Generation Error | During position command processing, an error such as a calculation range error occurred. | <ul style="list-style-type: none"> During position command processing, an error such as a calculation range error occurred. | | | √ | | | page A-139 |
| 38430000 hex | Error Counter Overflow 1 | The absolute encoder (absolute scale) position in pulses divided by the electronic gear ratio exceeded $\pm 2^{31}$ (2,147,483,648). | <ul style="list-style-type: none"> The absolute encoder (absolute scale) position in pulses divided by the electronic gear ratio exceeded $\pm 2^{31}$ (2,147,483,648). | | | √ | | | page A-139 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|--|--|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 38440000 hex | ErrorCounter Overflow 2 | The position following error in pulses exceeded $\pm 2^{29}$ (536,870,912). Or, the position following error in command units exceeded $\pm 2^{30}$ (1,073,741,824). | <ul style="list-style-type: none"> There is insufficient torque. There is insufficient gain. The encoder wiring is incorrect. | | | √ | | | page A-140 |
| 38450000 hex | Interface Input Duplicate Allocation Error 1 | There is a duplicate setting in the input signal (IN1, IN2, IN3, and IN4) function allocations. | <ul style="list-style-type: none"> There is a duplicate setting in the input signal (IN1, IN2, IN3, and IN4) function allocations. | | | √ | | | page A-140 |
| 38460000 hex | Interface Input Duplicate Allocation Error 2 | There is a duplicate setting in the input signal (IN5, IN6, IN7, and IN8) function allocations. | <ul style="list-style-type: none"> There is a duplicate setting in the input signal (IN5, IN6, IN7, and IN8) function allocations. | | | √ | | | page A-141 |
| 38470000 hex | Interface Input Function Number Error 1 | There is an undefined number specification in the input signal (IN1, IN2, IN3, and IN4) function allocations. Or, a logic setting error was detected. | <ul style="list-style-type: none"> There is an undefined number specification in the input signal (IN1, IN2, IN3, and IN4) function allocations. Different logic is set for the same function in the function assignments of the input signals (IN1, IN2, IN3, and IN4). | | | √ | | | page A-142 |
| 38480000 hex | Interface Input Function Number Error 2 | There is an undefined number specification in the input signal (IN5, IN6, IN7, and IN8) function allocations. Or, a logic setting error was detected. | <ul style="list-style-type: none"> There is an undefined number specification in the input signal (IN5, IN6, IN7, and IN8) function allocations. Different logic is set for the same function in the function assignments of the input signals (IN5, IN6, IN7, and IN8). | | | √ | | | page A-143 |
| 38490000 hex | Interface Output Function Number Error 1 | There is an undefined number specification in the output signal (OUTM1) function allocation. | <ul style="list-style-type: none"> There is an undefined number specification in the output signal (OUTM1) function allocation. | | | √ | | | page A-144 |
| 384A0000 hex | Interface Output Function Number Error 2 | There is an undefined number specification in the output signal (OUTM2) function allocation. | <ul style="list-style-type: none"> There is an undefined number specification in the output signal (OUTM2) function allocation. | | | √ | | | page A-144 |
| 384B0000 hex | External Latch Input Allocation Error | There is an error in the latch input function allocation. | <ul style="list-style-type: none"> The latch input was allocated to an input signal other than IN5, IN6, or IN7. A latch input is assigned to an NC signal. The same latch input is not assigned to the same pin in all Control Modes. | | | √ | | | page A-145 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---|--|---|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 384C0000 hex | Overrun Limit Error | The Servomotor exceeded the allowable operating range set in the Overrun Limit Setting (3514 hex) with respect to the position command input range. | <ul style="list-style-type: none"> The gain or inertial ratio is not suitable. The set value of the Overrun Limit Setting (3514 hex) is too small. | | | √ | | | page A-145 |
| 384D0000 hex | Absolute Encoder System Down Error | The voltage of the built-in capacitor dropped below the specified value because the power supply to the encoder or the battery power supply was down. | <ul style="list-style-type: none"> The voltage of the built-in capacitor dropped below the specified value because the power supply to the encoder or the battery power supply was down. | | | √ | | | page A-146 |
| 384E0000 hex | Absolute Encoder Counter Overflow Error | The multi-rotation counter of the encoder exceeded the specified value. | <ul style="list-style-type: none"> The set value for switching operation with the absolute encoder is too large. The traveling distance from home of the machine exceeded 32,767 revolutions. | | | √ | | | page A-147 |
| 384F0000 hex | Object Setting Error 1 | The electronic gear ratio exceeded the allowable range. | <ul style="list-style-type: none"> The electronic gear ratio exceeded the allowable range. | | | √ | | | page A-147 |
| 38500000 hex | Object Setting Error 2 | External encoder ratio exceeded the allowable range. | <ul style="list-style-type: none"> External encoder ratio exceeded the allowable range. | | | √ | | | page A-148 |
| 38510000 hex | External Encoder Connection Error | The set value of the External Feedback Pulse Type Selection (3323 hex) differs from the external encoder type that is connected for serial communications. | <ul style="list-style-type: none"> The set value of the External Feedback Pulse Type Selection (3323 hex) differs from the external encoder type that is connected for serial communications. | | | √ | | | page A-148 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---------------------------------|--|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 38520000 hex | Function Setting Error | The function that was set does not support the communications period. | <ul style="list-style-type: none"> The electronic gear object ratio was not 1:1 when the communications period was set to 250 or 500 μs. Fully-closed Control Mode was selected for a communications period setting of 250 μs. Modes of operation (6060 hex) was set to pp or hm when the communications period was set to 250 or 500 μs. More than 20 bytes were mapped for RxPDO when the communications period was set to 250 μs. More than 12 bytes were mapped for RxPDO in Fully-closed Control Mode. Modes of operation (6060 hex) was set to pp or hm in Fully-closed Control Mode when the communications period was set to 1 ms and the electronic gear parameter ratio was not set to 1:1. No bytes (i.e., no objects) were mapped for RxPDO. More than 10 objects were mapped for RxPDO. More than 11 objects were mapped for TxPDO. CSP Switching Reference Position (4020 hex) was mapped for TxPDO when the communications period was set to 250 or 500 μs or when the electronic gear object ratio was not set to 1:1. | | | √ | | | page A-149 |
| 64E00000 hex | Drive Prohibition Input Error 1 | When the Drive Prohibition Input Selection (3504 hex) was set to 0, both the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT) turned ON. Or, when the Drive Prohibition Input Selection (3504 hex) was set to 2, either the Forward Drive Prohibition Input (POT) or the Reverse Drive Prohibition Input (NOT) turned ON. | <ul style="list-style-type: none"> A problem occurred with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. | | | √ | | | page A-150 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---------------------------------|--|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 64E10000 hex | Drive Prohibition Input Error 2 | An operation command (such as a trial run of FFT) was received from the CX-Drive when the Drive Prohibition Input Selection (3504 hex) was set to 0, EtherCAT communications was interrupted, and either POT or NOT was ON. Or, POT or NOT turned ON while operation was being performed for a CX-Drive operation command. | <ul style="list-style-type: none"> A problem occurred with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. | | | √ | | | page A-150 |
| 64E20000 hex | Immediate Stop Input Error | An Immediate Stop (STOP) signal was input. | <ul style="list-style-type: none"> An Immediate Stop (STOP) signal was input. Incorrect wiring of the immediate stop input (STOP). | | | √ | | | page A-151 |
| 74810000 hex | Command Error | A mistake was made in using a command. | <ul style="list-style-type: none"> When bit 09 (Remote) of the Statusword (6041 hex) was set to 1 (remote), and the Servo Drive was in operation enabled state (Servo ON), a command was received that changes the communications state from Operational to another state (Init, Pre-operational, or Safe-operational state). When bit 09 (Remote) of the Statusword (6041 hex) was set to 0 (local), a command was received during FFT or test run status that changes the ESM state from Operational, Safe-operational, or Pre-operational state to Init state. An unsupported number was set for 6060 hex (Operation Mode). During Fully-closed Control Mode, csv or cst was set for 6060 hex (Operation Mode). The setting of 6060 hex (Operation Mode) was changed at an interval of less than 2 ms. Homing was started when 6098 hex (Homing Method) was set to a value other than 8, 12, 19, 20, 33, 34, or 35. Data setting warnings (B0 hex) occurred continuously for the number of data setting warnings that is set in 3781 hex (Data Setting Warning Detection Count). | | | √ | | | page A-152 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|--------------------------------------|---|---|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 78010000 hex | Operation Command Competition | An attempt was made to establish EtherCAT communications or to turn ON the Servo from the Controller (enable operation) while executing an FFT that operates with the Servo Drive alone or a trial run. | <ul style="list-style-type: none"> EtherCAT communications (change from Init to Pre-operational state) was established or an attempt to turn ON the Servo from the Controller (enable operation) was made while executing an FFT that operates with the Servo Drive trial run. | | | √ | | | page A-153 |
| 78020000 hex | Absolute Encoder Status Error | The rotation of the encoder was higher than the specified value when the power supply was turned ON. | <ul style="list-style-type: none"> The rotation of the encoder was higher than the specified value when the power supply was turned ON. | | | √ | | | page A-153 |
| 84B10000 hex | EtherCAT State Change Error | A communications state change command was received for which the current communications state could not be changed. | <ul style="list-style-type: none"> A communications state change command was received for which the current communications state could not be changed. | | | √ | | | page A-154 |
| 84B20000 hex | EtherCAT Illegal State Change Error | An undefined communications state change command was received. | <ul style="list-style-type: none"> An undefined communications state change command was received. | | | √ | | | page A-154 |
| 84B30000 hex | Communications Synchronization Error | The number of consecutive errors in receiving data during the communication sync time exceeded the value specified for the Communications Control Setting. | <ul style="list-style-type: none"> Power to the host controller was interrupted during PDO communications. An EtherCAT communications cable is disconnected, broken, or incorrectly connected. Noise | | | √ | | | page A-155 |
| 84B40000 hex | Synchronization Error | A synchronization error occurred. | <ul style="list-style-type: none"> Noise Control PCB error | | | √ | | | page A-155 |
| 84B50000 hex | Sync Manager WDT Error | PDO communications were stopped for more than the specified period of time. | <ul style="list-style-type: none"> The EtherCAT communications cable is disconnected or broken. There is an error in the host controller. | | | √ | | | page A-156 |
| 84B60000 hex | ESC Initialization Error | An error occurred in ESC initialization. | <ul style="list-style-type: none"> Control PCB error | | | √ | | | page A-156 |
| 84B70000 hex | Slave Unit Verification Error | An error occurred in Slave Unit verification. | <ul style="list-style-type: none"> Control PCB error | | | √ | | | page A-157 |
| 84B80000 hex | Communications Setting Error | There is an error in the communications settings. | <ul style="list-style-type: none"> An out-of-range value was set from the host controller. A command that changes the communications state to an unsupported state was received. | | | √ | | | page A-157 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---|---|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 84B90000 hex | Synchronization Interruption Error | A synchronization interruption error occurred. | <ul style="list-style-type: none"> Control PCB error | | | √ | | | page A-158 |
| 98010000 hex | Absolute Value Cleared | The multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive. | <ul style="list-style-type: none"> The multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive. | | | √ | | | page A-158 |
| 98020000 hex | Position Data Initialized | A Config operation was performed or the multi-rotation counter was cleared for the absolute encoder during EtherCAT communications. | <ul style="list-style-type: none"> A Config operation was performed or the multi-rotation counter was cleared for the absolute encoder during EtherCAT communications. | | | √ | | | page A-159 |
| 08010000 hex | Battery Warning | The battery voltage is 3.2 V or less. | <ul style="list-style-type: none"> The battery voltage is 3.2 V or lower. | | | | √ | | page A-159 |
| 08020000 hex | Fan Warning | The fan stop state continued for 1 second. | <ul style="list-style-type: none"> There is foreign matter in the fan. The Servo Drive failed. | | | | √ | | page A-160 |
| 08030000 hex | Encoder Communications Warning | Encoder communications errors occurred in series more frequently than the specified value. | <ul style="list-style-type: none"> There is insufficient power supply voltage for the encoder. Noise is entering on the encoder line. | | | | √ | | page A-160 |
| 08040000 hex | Encoder Overheating Warning | The encoder temperature exceeded the specified value. | <ul style="list-style-type: none"> The ambient temperature is too high. Servomotor failed. | | | | √ | | page A-161 |
| 08050000 hex | Life Expectancy Warning | The remaining life of the capacitor or the fan is shorter than the specified value. | <ul style="list-style-type: none"> The life expectancy of the capacitor or the fan is shorter than the specified value. | | | | √ | | page A-161 |
| 08060000 hex | External Encoder Error Warning | The external encoder detected a warning. | <ul style="list-style-type: none"> There is insufficient power supply voltage for the external encoder. Noise is entering on the external encoder connector cable. The external encoder failed. | | | | √ | | page A-162 |
| 08070000 hex | External Encoder Communications Warning | The external encoder had more communications errors than the specified value. | <ul style="list-style-type: none"> There is insufficient power supply voltage for the external encoder. Noise is entering on the external encoder connector cable. | | | | √ | | page A-162 |
| 34E00000 hex | Data Setting Warning | An object setting is out of range. | <ul style="list-style-type: none"> An object setting is out of range. | | | | √ | | page A-163 |
| 383C0000 hex | Overload Warning | The load ratio is 85% or more of the protection level. | <ul style="list-style-type: none"> Overload There is incorrect wiring of the motor line or a broken cable. | | | | √ | | page A-163 |
| 383D0000 hex | Excessive Regeneration Warning | The regeneration load ratio is 85% or more of the level. | <ul style="list-style-type: none"> There is excessive regeneration. This Regeneration Resistor cannot be used for continuous regenerative braking. | | | | √ | | page A-164 |

| Event code | Event name | Meaning | Assumed cause | Level | | | | | Reference |
|--------------|---------------------------------|--|--|-------|-----|-----|-----|------|------------|
| | | | | Maj | Prt | Min | Obs | Info | |
| 383E0000 hex | Vibration Detection Warning | Vibration was detected. | <ul style="list-style-type: none"> The gain or inertial ratio setting is not suitable. | | | | √ | | page A-164 |
| 74800000 hex | Command Warning | A command could not be executed. | <ul style="list-style-type: none"> The absolute multi-rotation counter was cleared when the Servo was not OFF when using an absolute encoder for semi-closed control. A forced brake operation request was sent while the Servo was ON. A Switch ON command was sent when the main power was OFF. (When 3508 hex = 0) An Enable Operation command was sent to request turning ON the Servo when the Servomotor was operating at 30 r/min or higher. A latch operation was started under the following conditions. <ul style="list-style-type: none"> An absolute external encoder was used and phase Z was selected as the trigger for fully-closed control. The absolute multi-rotation data was being cleared or the Config operation was being performed. The Statusword (6041 hex) bit 09 (remote) was 0 (local). An operation command is given in the prohibited direction after the motor made an immediate stop due to a drive prohibition input. | | | | √ | | page A-165 |
| 84B00000 hex | EtherCAT Communications Warning | An EtherCAT communications error occurred one or more times. | <ul style="list-style-type: none"> The EtherCAT communications cable is disconnected or broken. Noise | | | | √ | | page A-166 |

A-3-2 Error Description

This section describes errors.

Controller Error Descriptions

The items that are used to describe individual errors (events) are described in the following copy of an error table.

| | | | | | | |
|--------------------------|---|--|----------------|--|--------------------------------------|--|
| Event name | Gives the name of the error (event). | | | Event code | Gives the code of the error (event). | |
| Meaning | Gives a short description of the error (event). | | | | | |
| Source | Gives the source of the error (event). | | Source details | Gives details on the source of the error. | Detection timing | Tells when the error is detected. |
| Error attributes | Level | Tells the influence on control.*1 | Recovery | Gives the recovery method.*2 | Log category | Tells which log the error is saved in.*3 |
| Effects | User program | Tells what will happen to execution of the user program.*4 | Operation | Provides special information on the operation that results from the error (event). | | |
| Indicators | Gives the status of the built-in EtherNet/IP port and built-in EtherCAT port indicators. Indicator status is given only for errors in the EtherCAT Master Function Module and the EtherNet/IP Function Module. | | | | | |
| System-defined variables | Variable | Data type | | Name | | |
| | Lists the variable names, data types, and meanings for system-defined variables that provide direct error notification, that are directly affected by the error, or that contain settings that cause the error. | | | | | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Lists the possible causes, remedies, and preventive measures for the error (event). | | | | | |
| Attached information | Provides the additional information that is displayed by the Sysmac Studio or an NS-series PT. | | | | | |
| Precautions/Remarks | Provides precautions, restrictions, and supplemental information. | | | | | |

*1 One of the following:

- Major fault: Major fault level
- Partial fault: Partial fault level
- Minor fault: Minor fault level
- Observation
- Information

*2 One of the following:

- Automatic recovery: Normal status is restored automatically when the cause of the error is removed.
- Error reset: Normal status is restored when the error is reset after the cause of the error is removed.
- Cycle the power supply: Normal status is restored when the power supply to the Controller is turned OFF and then back ON after the cause of the error is removed.
- Controller reset: Normal status is restored when the Controller is reset after the cause of the error is removed.
- Depends on cause: The recovery method depends on the cause of the error.

*3 One of the following:

- System: System event log
- Access: Access event log

*4 One of the following:

- Continues: Execution of the user program will continue.
- Stops: Execution of the user program stops.
- Starts: Execution of the user program starts.

Error Descriptions

The following table describes the error codes that are output to *ErrorID* when errors occur in execution of the instructions. The upper four digits of the event codes that are given in the following table are output as the error code to *ErrorID*.

| | | | | | | |
|--------------------------|--|-------------|--|--|--|--------------|
| Event name | Control Power Supply Undervoltage | | Event code | 04A80000 hex | | |
| Meaning | The voltage between the positive and negative terminals in the control power supply converter dropped below the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Power supply undervoltage. Or, the power supply voltage dropped because there was inrush current when the main power supply was turned ON. | | Increase the power supply capacity. | | None | |
| | A momentary power interruption occurred. | | Review the power supply conditions and prevent momentary power interruption. | | Make sure that the power supply conditions prevent momentary power interruption. | |
| | The Servo Drive failed. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “11” is displayed on the Servo Drive front panel and F011 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Overvoltage | | Event code | 04A90000 hex | | |
| Meaning | The power supply voltage exceeded the allowable input voltage range. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The voltage between the positive and negative terminals in the control power supply converter exceeded the specified value. | | Input the correct voltage. | | Input the correct voltage. | |
| | The voltage was suddenly increased by the phase advance capacitor or the uninterruptible power supply (UPS). | | Remove the phase-advancing capacitor or UPS. | | Do not use a phase-advancing capacitor or UPS. | |
| | The Regeneration Resistor wiring is broken. | | Measure the resistance of the external resistor between the B1 and B2 terminals on the Servo Drive. If the resistance is infinite, the wiring is broken. Replace the external resistor. | | None | |
| | The External Regeneration Resistor is not suitable. | | Change the Regeneration Resistor based on the specified regeneration resistance and the calculated power (W). | | Determine the Regeneration Resistor based on the specified regeneration resistance and the calculated power (W). | |
| | The Servo Drive failed. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “12” is displayed on the Servo Drive front panel and F012 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|----------------------------------|
| Event name | Main Circuit Power Supply Undervoltage (Undervoltage between positive and negative terminals) | | Event code | 04AA0000 hex | | |
| Meaning | If the Undervoltage Error Selection (3508 hex) is set to 1, a momentary power interruption occurred between L1 and L3 for longer than the value specified for the Momentary Hold Time. The voltage between the positive and negative terminals in the main power supply converter dropped below the specified value while the Servo was ON. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Insufficient power supply capacity | | Increase the power supply capacity. | | None | |
| | The electromagnetic contactor in the main circuit power supply was tripped. | | Eliminate the cause of the failure of the electromagnetic contactor on the main circuit power supply, and then turn ON the power again. | | Check the wiring of the main circuit power supply. | |
| | A momentary power interruption occurred. | | Review the power supply conditions and prevent momentary power interruption. Alternatively, increase the Momentary Hold Time (3509 hex) setting. | | Make sure that the power supply conditions prevent momentary power interruption. | |
| | A Servo Drive with 3-phase input specifications was operated with a single-phase power supply. | | Make sure that the phases of the power supply are set correctly before you connect them. | | Make sure that the phases of the power supply are set correctly before you connect them. | |
| | The Servo Drive failed. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "13" is displayed on the Servo Drive front panel and F013 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|----------------------------------|
| Event name | Main Circuit Power Supply Undervoltage (AC Cutoff Detected) | | Event code | 04AB0000 hex | | |
| Meaning | If the Undervoltage Error Selection (3508 hex) is set to 1, a momentary power interruption occurred between L1 and L3 for longer than the value specified for the Momentary Hold Time. The voltage between the positive and negative terminals in the main power supply converter dropped below the specified value while the Servo was ON. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Insufficient power supply capacity | | Increase the power supply capacity. | | None | |
| | The electromagnetic contactor in the main circuit power supply was tripped. | | Eliminate the cause of the failure of the electromagnetic contactor on the main circuit power supply, and then turn ON the power again. | | Check the wiring of the main circuit power supply. | |
| | A momentary power interruption occurred. | | Review the power supply conditions and prevent momentary power interruption. Alternatively, increase the Momentary Hold Time (3509 hex) setting. | | Make sure that the power supply conditions prevent momentary power interruption. | |
| | A Servo Drive with 3-phase input specifications was operated with a single-phase power supply. | | Make sure that the phases of the power supply are set correctly before you connect them. | | Make sure that the phases of the power supply are set correctly before you connect them. | |
| | The Servo Drive failed. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "13" is displayed on the Servo Drive front panel and F113 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|---|--------------|
| Event name | Overcurrent | | Event code | 04AC0000 hex | | |
| Meaning | The current flowing through the converter exceeded the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | A short-circuit, line-to-ground fault, contact failure, or insulation failure occurred on the U, V, or W motor line. | | If there is a short-circuit, line-to-ground fault, or contact failure on the U, V, or W motor line, correct the connections. If the insulation resistance between the U, V, or W motor line and the ground line has failed, replace the motor. | | Confirm that the U, V, and W motor lines are connected correctly. | |
| | The Servo Drive failed. | | Disconnect the motor lines and turn ON the Servo. If this error occurs immediately, replace the Servo Drive. | | None | |
| | The relay for the dynamic brake has been welded due to frequent Servo ON/OFF operations. | | Replace the Servo Drive. | | Do not start and stop operation by frequently switching the Servo ON/OFF. | |
| | Motor windings are burned out. | | Check the balance of the resistance between the lines of the Servomotor. If resistance is unbalanced, replace the Servomotor. | | Do not apply excessive load on the motor. | |
| | The Servomotor is not suitable for the Servo Drive. | | Check the model (capacity) of the Servomotor and the Servo Drive on the nameplates. Replace the Servomotor with a Servomotor that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| | The command input timing is the same as or earlier than the Servo ON timing. | | Wait at least 100 ms after the Servo has been turned ON, then input commands. | | Wait at least 100 ms after the Servo has been turned ON, then input commands. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “14” is displayed on the Servo Drive front panel and F014 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|---|--------------|
| Event name | IPM Error | | Event code | 04AD0000 hex | | |
| Meaning | The current flowing through the converter exceeded the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | A short-circuit, line-to-ground fault, contact failure, or insulation failure occurred on the U, V, or W motor line. | | If there is a short-circuit, line-to-ground fault, or contact failure on the U, V, or W motor line, correct the connections. If the insulation resistance between the U, V, or W motor line and the ground line has failed, replace the motor. | | Confirm that the U, V, and W motor lines are connected correctly. | |
| | The Servo Drive failed. | | Disconnect the motor lines and turn ON the Servo. If this error occurs immediately, replace the Servo Drive. | | None | |
| | The relay for the dynamic brake has been welded due to frequent Servo ON/OFF operations. | | Replace the Servo Drive. | | Do not start and stop operation by frequently switching the Servo ON/OFF. | |
| | Motor windings are burned out. | | Check the balance of the resistance between the lines of the Servomotor. If resistance is unbalanced, replace the Servomotor. | | Do not apply excessive load on the motor. | |
| | The Servomotor is not suitable for the Servo Drive. | | Check the model (capacity) of the Servomotor and the Servo Drive on the nameplates. Replace the Servomotor with a Servomotor that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| | The command input timing is the same as or earlier than the Servo ON timing. | | Wait at least 100 ms after the Servo has been turned ON, then input commands. | | Wait at least 100 ms after the Servo has been turned ON, then input commands. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “14” is displayed on the Servo Drive front panel and F114 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--------------------------|--|----------------------|----------------------------------|
| Event name | Regeneration Tr Error | | | Event code | 04AE0000 hex | |
| Meaning | The Servo Drive regeneration drive Tr is faulty. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive regeneration drive Tr is faulty. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “18” is displayed on the Servo Drive front panel and F118 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|-------------------------|--|----------------------|--------------|
| Event name | Encoder Phase-Z Error | | | Event code | 04AF0000 hex | |
| Meaning | A missing serial incremental encoder phase-Z pulse was detected. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The encoder is faulty. | | Replace the Servomotor. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “48” is displayed on the Servo Drive front panel and F048 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|-------------------------|--|----------------------|--------------|
| Event name | Encoder CTS Signal Error | | | Event code | 04B00000 hex | |
| Meaning | A missing serial incremental encoder CTS signal logic error was detected. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power supply) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The encoder is faulty. | | Replace the Servomotor. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "49" is displayed on the Servo Drive front panel and F049 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--------------------------|--|----------------------|--|
| Event name | Node Address Setting Error | | | Event code | 04B10000 hex | |
| Meaning | The node address that was read from the rotary switches was not between 00 and 99. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive failed. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "88" is displayed on the Servo Drive front panel and F088 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|--|--------------|
| Event name | Encoder Communications Disconnection Error | | Event code | 08080000 hex | | |
| Meaning | A disconnection was detected because communications between the encoder and the Servo Drive were stopped more frequently than the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The encoder is not wired correctly. | | Wire the encoder correctly as shown in the wiring diagram. Correct the connector pin connections. | | Wire the encoder correctly as shown in the wiring diagram. Connect the connector pins correctly. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "21" is displayed on the Servo Drive front panel and F021 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|--|--------------|
| Event name | Encoder Communications Error | | Event code | 08090000 hex | | |
| Meaning | There is a communications error for the encoder. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The power supply voltage of the encoder is low. | | Provide the required encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). Be careful especially of voltage drop when the encode cable is long. | | Provide the required encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). Be careful especially of voltage drop when the encode cable is long. | |
| | Noise | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "21" is displayed on the Servo Drive front panel and F121 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|---|--------------|
| Event name | Encoder Communications Data Error | | | Event code | 080A0000 hex | |
| Meaning | There is an error in the communications data of the encoder. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The power supply voltage of the encoder is low. | | Provide the required encoder power supply voltage of 5 VDC $\pm 5\%$ (4.75 to 5.25 V). Be careful especially of voltage drop when the encode cable is long. | | Provide the required encoder power supply voltage of 5 VDC $\pm 5\%$ (4.75 to 5.25 V). Be careful especially of voltage drop when the encode cable is long. | |
| | Noise | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "23" is displayed on the Servo Drive front panel and F023 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | Safety Input Error | | | Event code | 080B0000 hex | |
| Meaning | At least one of the input photocouplers for safety inputs 1 and 2 turned OFF. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The cable is disconnected or broken. | | Reconnect the input wiring for safety inputs 1 and 2. If the cable is broken, replace it. | | Reconnect the input wiring for safety inputs 1 and 2. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "30" is displayed on the Servo Drive front panel and F030 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|---|--------------|
| Event name | External Encoder Connection Error | | Event code | 080C0000 hex | | |
| Meaning | A disconnection was detected because communications between the external encoder and the Servo Drive were stopped more frequently than the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The wiring is incorrect. | | Wire the external encoder correctly as shown in the wiring diagram. Correct the connector pin connections. | | Wire the external encoder correctly as shown in the wiring diagram. Connect the connector pins correctly. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “50” is displayed on the Servo Drive front panel and F050 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Communications Data Error | | Event code | 080D0000 hex | | |
| Meaning | There was a communications error in data from the external encoder. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient external encoder power supply voltage. | | Provide the required external encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). | | Provide the required external encoder power supply voltage 5 VDC ±5% (4.75 to 5.25 V). | |
| | Noise | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “50” is displayed on the Servo Drive front panel and F150 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Status Error 0 | | | Event code | 080E0000 hex | |
| Meaning | Bit 00 of the external encoder error code (ALMC) was set to 1. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Bit 00 of the external scale error code (ALMC) was set to 1. | | Check the external encoder specifications and take suitable corrective actions. | | Take preventative actions according to the external encoder specifications. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "51" is displayed on the Servo Drive front panel and F051 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Status Error 1 | | | Event code | 080F0000 hex | |
| Meaning | Bit 01 of the external encoder error code (ALMC) was set to 1. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Bit 01 of the external encoder error code (ALMC) was set to 1. | | Check the external encoder specifications and take suitable corrective actions. | | Take preventative actions according to the external encoder specifications. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "51" is displayed on the Servo Drive front panel and F151 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Status Error 2 | | Event code | 08100000 hex | | |
| Meaning | Bit 02 of the external encoder error code (ALMC) was set to 1. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Bit 02 of the external encoder error code (ALMC) was set to 1. | | Check the external encoder specifications and take suitable corrective actions. | | Take preventative actions according to the external encoder specifications. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "51" is displayed on the Servo Drive front panel and F251 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Status Error 3 | | Event code | 08110000 hex | | |
| Meaning | Bit 03 of the external encoder error code (ALMC) was set to 1. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Bit 03 of the external encoder error code (ALMC) was set to 1. | | Check the external encoder specifications and take suitable corrective actions. | | Take preventative actions according to the external encoder specifications. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "51" is displayed on the Servo Drive front panel and F351 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Status Error 4 | | | Event code | 08120000 hex | |
| Meaning | Bit 04 of the external encoder error code (ALMC) was set to 1. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Bit 04 of the external encoder error code (ALMC) was set to 1. | | Check the external encoder specifications and take suitable corrective actions. | | Take preventative actions according to the external encoder specifications. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "51" is displayed on the Servo Drive front panel and F451 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | External Encoder Status Error 5 | | | Event code | 08130000 hex | |
| Meaning | Bit 05 of the external encoder error code (ALMC) was set to 1. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Bit 05 of the external encoder error code (ALMC) was set to 1. | | Check the external encoder specifications and take suitable corrective actions. | | Take preventative actions according to the external encoder specifications. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "51" is displayed on the Servo Drive front panel and F551 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | Phase-A Connection Error | | | Event code | 08140000 hex | |
| Meaning | An error such as broken wiring was detected in the external encoder phase-A connection. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An error such as broken wiring was detected in the external encoder phase-A connection. | | Wire phase A of the external encoder correctly as shown in the wiring diagram. If the cable is broken, replace it. | | Wire phase A of the external encoder correctly as shown in the wiring diagram. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "55" is displayed on the Servo Drive front panel and F055 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | Phase-B Connection Error | | | Event code | 08150000 hex | |
| Meaning | An error such as broken wiring was detected in the external encoder phase-B connection. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An error such as broken wiring was detected in the external encoder phase-B connection. | | Wire phase B of the external encoder correctly as shown in the wiring diagram. If the cable is broken, replace it. | | Wire phase B of the external encoder correctly as shown in the wiring diagram. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "55" is displayed on the Servo Drive front panel and F155 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | Phase-Z Connection Error | | | Event code | 08160000 hex | |
| Meaning | An error such as broken wiring was detected in the external encoder phase-Z connection. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An error such as broken wiring was detected in the external encoder phase-Z connection. | | Wire phase Z of the external encoder correctly as shown in the wiring diagram. If the cable is broken, replace it. | | Wire phase Z of the external encoder correctly as shown in the wiring diagram. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “55” is displayed on the Servo Drive front panel and F255 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | Encoder Data Restoration Error | | | Event code | 08170000 hex | |
| Meaning | Initialization of internal position data was not processed correctly in Semi-closed Control Mode and Absolute Value Mode. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient power supply voltage for the encoder. | | Provide the required encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). | | Provide the required encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). | |
| | Noise is entering on the encoder line. | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “92” is displayed on the Servo Drive front panel and F092 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|---|--------------|
| Event name | External Encoder Data Restoration Error | | Event code | 08180000 hex | | |
| Meaning | Initialization of internal position data was not processed correctly in Fully-closed Control Mode and Absolute Value Mode. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient power supply voltage for the external encoder. | | Provide the required external encoder power supply voltage 5 VDC \pm 5% (4.75 to 5.25 V). | | Provide the required external encoder power supply voltage 5 VDC \pm 5% (4.75 to 5.25 V). | |
| | Noise is entering on the external encoder line. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "92" is displayed on the Servo Drive front panel and F192 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--|
| Event name | Object Error | | Event code | 14A80000 hex | | |
| Meaning | The object area data in non-volatile memory is corrupted. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Noise | | Reset all of the objects. Implement noise countermeasures. | | Reset all of the objects. Implement noise countermeasures. | |
| | Non-volatile memory failure | | If the error persists, replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "36" is displayed on the Servo Drive front panel and F036 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--|
| Event name | Object Error | | | Event code | 14A90000 hex | |
| Meaning | The object area data in non-volatile memory is corrupted. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Noise | | Reset all of the objects. Implement noise countermeasures. | | Reset all of the objects. Implement noise countermeasures. | |
| | Non-volatile memory failure | | If the error persists, replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "36" is displayed on the Servo Drive front panel and F136 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--|
| Event name | Object Error | | | Event code | 14AA0000 hex | |
| Meaning | The object area data in non-volatile memory is corrupted. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Noise | | Reset all of the objects. Implement noise countermeasures. | | Reset all of the objects. Implement noise countermeasures. | |
| | Non-volatile memory failure | | If the error persists, replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "36" is displayed on the Servo Drive front panel and F236 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--------------------------|--|----------------------|--|
| Event name | Object Corrupted | | Event code | 14AB0000 hex | | |
| Meaning | The checksum data in non-volatile memory is corrupted. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Non-volatile memory failure | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "37" is displayed on the Servo Drive front panel and F037 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--------------------------|--|----------------------|--|
| Event name | Object Corrupted | | Event code | 14AC0000 hex | | |
| Meaning | The checksum data in non-volatile memory is corrupted. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Non-volatile memory failure | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "37" is displayed on the Servo Drive front panel and F137 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--------------------------|--|----------------------|--|
| Event name | Object Corrupted | | | Event code | 14AD0000 hex | |
| Meaning | The checksum data in non-volatile memory is corrupted. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Non-volatile memory failure | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “37” is displayed on the Servo Drive front panel and F237 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | Absolute Encoder Overspeed Error | | | Event code | 18200000 hex | |
| Meaning | The Servomotor rotation speed exceeded the specified value when only the battery power supply was used during a power interruption. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient power supply voltage for the encoder. | | Provide the required encoder power supply voltage of 5 V \pm 5%. | | Provide the required encoder power supply voltage of 5 V \pm 5%. | |
| | The wiring of the CN2 connector is wrong. | | Correct the wiring of the CN2 connector. | | Connect the wiring of the CN2 connector correctly. | |
| | An external force is rotating the motor when the Servo is OFF. | | Make sure that the motor is not rotated by an external force. | | Make sure that the motor is not rotated by an external force. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “42” is displayed on the Servo Drive front panel and F042 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|-------------------------|--|----------------------|--|
| Event name | Encoder Initialization Error | | Event code | 18210000 hex | | |
| Meaning | An encoder initialization error was detected. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Servomotor failed. | | Replace the Servomotor. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “43” is displayed on the Servo Drive front panel and F043 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|-------------------------|--|----------------------|--------------|
| Event name | Absolute Encoder One-rotation Counter Error | | Event code | 18220000 hex | | |
| Meaning | The encoder detected a one-rotation counter error. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Servomotor failed. | | Replace the Servomotor. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “44” is displayed on the Servo Drive front panel and F044 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|-------------------------|--|----------------------|--------------|
| Event name | Absolute Encoder Multi-rotation Counter Error | | | Event code | 18230000 hex | |
| Meaning | The encoder detected a multi-rotation counter error. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Servomotor failed. | | Replace the Servomotor. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “45” is displayed on the Servo Drive front panel and F045 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Motor Non-conformity | | | Event code | 24680000 hex | |
| Meaning | The Servo Drive and Servomotor combination is not correct. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power supply) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive and Servomotor combination is not correct. | | Replace the Servomotor with one that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “95” is displayed on the Servo Drive front panel and F095 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Motor Non-conformity | | | Event code | 24690000 hex | |
| Meaning | The Servo Drive and Servomotor combination is not correct. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive and Servomotor combination is not correct. | | Replace the Servomotor with one that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "95" is displayed on the Servo Drive front panel and F195 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Motor Non-conformity | | | Event code | 246A0000 hex | |
| Meaning | The Servo Drive and Servomotor combination is not correct. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive and Servomotor combination is not correct. | | Replace the Servomotor with one that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "95" is displayed on the Servo Drive front panel and F295 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Motor Non-conformity | | | Event code | 246B0000 hex | |
| Meaning | The Servo Drive and Servomotor combination is not correct. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive and Servomotor combination is not correct. | | Replace the Servomotor with one that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "95" is displayed on the Servo Drive front panel and F395 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Motor Non-conformity | | | Event code | 246C0000 hex | |
| Meaning | The Servo Drive and Servomotor combination is not correct. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The Servo Drive and Servomotor combination is not correct. | | Replace the Servomotor with one that matches the Servo Drive. | | Use a Servomotor that matches the Servo Drive. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "95" is displayed on the Servo Drive front panel and F495 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|--|--------------|
| Event name | Servo Drive Overheat | | Event code | 34E10000 hex | | |
| Meaning | The temperature of the Servo Drive radiator or power elements exceeded the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The ambient temperature of the Servo Drive exceeded the specified value. | | Improve the ambient temperature and the cooling conditions of the Servo Drive. | | Check the ambient temperature of the Servo Drive and set up the necessary cooling conditions. | |
| | Overload | | Increase the capacities of the Servo Drive and the Servomotor. Or, increase the setting of the acceleration/deceleration time and lighten the load. | | Increase the setting of the acceleration/deceleration time and lighten the load as much as possible. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "15" is displayed on the Servo Drive front panel and F015 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--|---|---|---|--|---|----------------------------------|
| Event name | Overload | | Event code | 34E20000 hex | | |
| Meaning | When the feedback value for torque command exceeds the overload level specified in the Overload Detection Level Setting (3512 hex), overload protection is performed according to the overload characteristics. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Operation was continued for a long time while overloaded. | | Take the following actions according to the situation. <ul style="list-style-type: none"> • Increase the capacities of the Servo Drive and the Servomotor. • Increase the setting of the acceleration/deceleration time and lighten the load. • Adjust the gain or inertial ratio and remove machine distortion. • Measure the voltage at the brake terminal. If the brake is ON, release it. • Correct the system if torque (current) waveforms oscillate or excessively oscillate vertically during analog output or communications. | | Check the items given for corrections in advance and implement countermeasures as required. | |
| There is incorrect wiring of the motor line or a broken cable. | | Connect the Servomotor cable as shown in the wiring diagram. If the cable is broken, replace it. Connect the motor line and encoder line that are used together to the same motor. | | Connect the Servomotor cable as shown in the wiring diagram. Connect the motor line and encoder line that are used together to the same motor. | | |
| Attached information | None | | | | | |
| Precautions/Remarks | "16" is displayed on the Servo Drive front panel and F016 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|---|----------------------------------|
| Event name | Regeneration Overload | | Event code | 34E30000 hex | | |
| Meaning | The regenerative energy exceeds the processing capacity of the Regeneration Resistor. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The load inertia is too large. Or, the Servomotor rotation speed is too high to absorb the regenerative energy within the specified deceleration time. | | <p>Check the operation pattern (velocity monitor). Check the Regeneration Register load rate and the excessive regeneration warning, and perform the following accordingly.</p> <ul style="list-style-type: none"> • Increase the capacity of the Servomotor and Servo Drive. • Increase the deceleration time. • Reduce the Servomotor rotation speed. • Use an External Regeneration Resistor. • Set the Regeneration Resistor Selection (3016 hex) to 2. | | Check the items given for corrections in advance and implement countermeasures as required. | |
| | This Regeneration Resistor cannot be used for continuous regenerative braking. (The operating limit of the external resistor is limited to a 10% duty.) | | Set the Regeneration Resistor Selection (3016 hex) to 2. | | Set the Regeneration Resistor Selection (3016 hex) to 2. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "18" is displayed on the Servo Drive front panel and F018 is given as the AlarmCode (4001 hex) | | | | | |

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|--------------------------|--|-------------|--|--|---|----------------------------------|
| Event name | Error Counter Overflow | | | Event code | 34E40000 hex | |
| Meaning | Position error pulses exceeded the setting of the Following error window (6065 hex). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Motor operation does not follow the command. | | <p>Make sure that the motor rotates according to the position command input, and that the output torque is not saturated on the torque monitor. If there is a problem, perform the following.</p> <ul style="list-style-type: none"> Adjust the gain. Set the torque limit objects (60E0 hex, 60E1 hex, 3013 hex, 3522 hex, 3525 hex, and 3526 hex) to the maximum settings. Increase the acceleration/ deceleration time, lighten the load, and reduce the velocity. | | Adjust the gain and torque limits. Increase the acceleration/ deceleration time, lighten the load, and reduce the velocity as much as possible. | |
| | The value of the Following error window (6065 hex) is small. | | Increase the setting of the Following error window (6065 hex) to an acceptable range. | | Increase the setting of the Following error window (6065 hex) to an acceptable range. | |
| | The encoder wiring is incorrect. | | Wire the encoder correctly as shown in the wiring diagram. | | Wire the encoder correctly as shown in the wiring diagram. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "24" is displayed on the Servo Drive front panel and F024 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|--|----------------------------------|
| Event name | Excessive Velocity Error | | Event code | 34E50000 hex | | |
| Meaning | The difference between the internal position command velocity and the actual velocity (i.e., the velocity error) exceeded the Excessive Velocity Error Setting (3602 hex). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Motor operation does not follow the command. | | Adjust the gain to improve the following ability. Increase the acceleration/deceleration time for the internal position command velocity. | | Adjust the gain to improve the following ability. Increase the acceleration/deceleration time for the internal position command velocity as much as possible. | |
| | The setting of the Excessive Velocity Error Setting (3602 hex) is too small. | | Increase the setting of the Excessive Velocity Error Setting (3602 hex) to an acceptable range. If there is no need to monitor the velocity error, disable detection of Excessive Velocity Error. (3602 hex = 0) | | Increase the setting of the Excessive Velocity Error Setting (3602 hex) to an acceptable range. If there is no need to monitor the velocity error, disable detection of Excessive Velocity Error. (3602 hex = 0) | |
| Attached information | None | | | | | |
| Precautions/Remarks | "24" is displayed on the Servo Drive front panel and F124 is given as the AlarmCode (4001 hex) | | | | | |

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|--------------------------|---|-------------|---|--|---|----------------------------------|
| Event name | Overspeed | | Event code | 34E60000 hex | | |
| Meaning | The Servomotor rotation speed exceeded the value set on the Overspeed Detection Level Setting (3513 hex). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after removing slave error) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The velocity command value is too large. | | Reduce the velocity command value. Adjust the input frequency, dividing ratio, and multiplication ratio of the command pulse. | | Set the velocity command value so that the number of motor rotations does not exceed the overspeed detection level. Check the input frequency, dividing ratio, and multiplication ratio of the command pulse. | |
| | There is overshooting. | | Decrease the gain. | | Do not make the gain too large. | |
| | The wiring is incorrect. | | Wire the encoder correctly as shown in the wiring diagram. | | Wire the encoder correctly as shown in the wiring diagram. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "26" is displayed on the Servo Drive front panel and F026 is given as the AlarmCode (4001 hex) | | | | | |

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|--------------------------|--|-------------|--|--|---|----------------------------------|
| Event name | Excessive Hybrid Following Error | | Event code | 383F0000 hex | | |
| Meaning | During fully-closed control, the difference between the load position from the external encoder and the Servomotor position from the encoder was larger than the number of pulses set as the Hybrid Following Error Counter Overflow Level (3328 hex). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Connections are not correct. | | Correct any mistakes in the connections between the Servomotor and load or between the external encoder and Servo Drive. | | Make sure that the connections between the Servomotor and load or between the external encoder and Servo Drive are correct. | |
| | The settings are not correct. | | If the change in the Servomotor position (encoder feedback value) and the change in the load position (external encoder feedback value) do not have matching signs when the load is moved, correct the settings of the External Feedback Pulse Dividing Numerator and Denominator (3324 hex and 3325 hex), and the External Feedback Pulse Direction Switching (3326 hex). | | Set the External Feedback Pulse Dividing Numerator and Denominator as well as the External Feedback Pulse Direction Switching so that the change in the Servomotor position and change in the load position result in the same sign when the load is moved. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "25" is displayed on the Servo Drive front panel and F025 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|----------------------------------|
| Event name | Overspeed 2 | | Event code | 38400000 hex | | |
| Meaning | The Servomotor rotation speed exceeded the value set on Overspeed Detection Level Setting at Immediate Stop (3615 hex). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The velocity command value is too large. | | Reduce the velocity. Adjust the input frequency, dividing ratio, and multiplication ratio of the command pulse. | | Set the velocity command value in a range that does not exceed the overspeed detection level when the number of motor rotations is stopped immediately. Check the input frequency, dividing ratio, and multiplication ratio of the command pulse. | |
| | There is overshooting. | | Adjust the gain. | | Do not make the gain too large. | |
| | The wiring is incorrect. | | Wire the encoder correctly as shown in the wiring diagram. | | Wire the encoder correctly as shown in the wiring diagram. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "26" is displayed on the Servo Drive front panel and F126 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|--|--------------|
| Event name | Command Error | | Event code | 38410000 hex | | |
| Meaning | The position command variation after the electronic gear exceeded the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The change in position command is too large. | | Reduce the electronic gear ratio. | | Adjust the electronic gear ratio so that the changes in the position command are not too large. | |
| | The backlash compensation amount is too large. | | Reduce the backlash compensation amount. | | Adjust the backlash compensation amount so that the changes in the position command are not too large. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "27" is displayed on the Servo Drive front panel and F427 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|---|--------------|
| Event name | Command Generation Error | | | Event code | 38420000 hex | |
| Meaning | During position command processing, an error such as a calculation range error occurred. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | During position command processing, an error such as a calculation range error occurred. | | Check whether the electronic gear ratio and acceleration/deceleration rate are within the limits and make any necessary corrections. | | Set the electronic gear ratio, acceleration rate, and deceleration rate to meet the restrictions. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “27” is displayed on the Servo Drive front panel and F527 is given as the AlarmCode (4001 hex) | | | | | |

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|--------------------------|--|-------------|--|--|---|----------------------------------|
| Event name | Error Counter Overflow 1 | | | Event code | 38430000 hex | |
| Meaning | The absolute encoder (absolute scale) position in pulses divided by the electronic gear ratio exceeded $\pm 2^{31}$ (2,147,483,648). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The absolute encoder (absolute scale) position in pulses divided by the electronic gear ratio exceeded $\pm 2^{31}$ (2,147,483,648). | | Check the operation range of the absolute external encoder position and correct the electronic gear ratio. | | Check the operation range of the absolute external encoder position and adjust the electronic gear ratio. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “29” is displayed on the Servo Drive front panel and F129 is given as the AlarmCode (4001 hex) | | | | | |

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|----------------------------------|--|--|--|--|------------------------------------|----------------------------------|
| Event name | Error Counter Overflow 2 | | Event code | 38440000 hex | | |
| Meaning | The position following error in pulses exceeded $\pm 2^{29}$ (536,870,912). Or, the position following error in command units exceeded $\pm 2^{30}$ (1,073,741,824). | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient torque. | | Lighten the load if the output torque is saturated on the torque monitor. Set the torque limit objects (60E0 hex, 60E1 hex, 3013 hex, 3522 hex, 3525 hex, and 3526 hex) to the maximum settings. | | Adjust the gain and torque limits. | |
| | There is insufficient gain. | | Increase the gain. | | | |
| The encoder wiring is incorrect. | | Wire the encoder correctly as shown in the wiring diagram. | | Wire the encoder correctly as shown in the wiring diagram. | | |
| Attached information | None | | | | | |
| Precautions/Remarks | "29" is displayed on the Servo Drive front panel and F229 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--|
| Event name | Interface Input Duplicate Allocation Error 1 | | Event code | 38450000 hex | | |
| Meaning | There is a duplicate setting in the input signal (IN1, IN2, IN3, and IN4) function allocations. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is a duplicate setting in the input signal (IN1, IN2, IN3, and IN4) function allocations. | | Allocate the functions to the connector pins so that each function is allocated only once. | | Allocate the functions to the connector pins so that each function is allocated only once. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F033 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|----------------|--|--|--|--------|
| Event name | Interface Input Duplicate Allocation Error 2 | | Event code | 38460000 hex | | |
| Meaning | There is a duplicate setting in the input signal (IN5, IN6, IN7, and IN8) function allocations. | | | | | |
| Source | EtherCAT Master Function Module | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup | |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | --- | | --- | | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is a duplicate setting in the input signal (IN5, IN6, IN7, and IN8) function allocations. | | Allocate the functions to the connector pins so that each function is allocated only once. | | Allocate the functions to the connector pins so that each function is allocated only once. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F133 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--|
| Event name | Interface Input Function Number Error 1 | | Event code | 38470000 hex | | |
| Meaning | There is an undefined number specification in the input signal (IN1, IN2, IN3, and IN4) function allocations. Or, a logic setting error was detected. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is an undefined number specification in the input signal (IN1, IN2, IN3, and IN4) function allocations. | | Allocate the functions to the connector pins using only the numbers that are defined. | | Allocate the functions to the connector pins using only the numbers that are defined. | |
| | Different logic is set for the same function in the function assignments of the input signals (IN1, IN2, IN3, and IN4). | | Correct the settings so that the same logic is used for the same function. | | Use the same logic for the same function. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F233 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--|
| Event name | Interface Input Function Number Error 2 | | Event code | 38480000 hex | | |
| Meaning | There is an undefined number specification in the input signal (IN5, IN6, IN7, and IN8) function allocations. Or, a logic setting error was detected. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | --- | | --- | | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is an undefined number specification in the input signal (IN5, IN6, IN7, and IN8) function allocations. | | Allocate the functions to the connector pins using only the numbers that are defined. | | Allocate the functions to the connector pins using only the numbers that are defined. | |
| | Different logic is set for the same function in the function assignments of the input signals (IN5, IN6, IN7, and IN8). | | Correct the settings so that the same logic is used for the same function. | | Use the same logic for the same function. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F333 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--|
| Event name | Interface Output Function Number Error 1 | | | Event code | 38490000 hex | |
| Meaning | There is an undefined number specification in the output signal (OUTM1) function allocation. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is an undefined number specification in the output signal (OUTM1) function allocation. | | Allocate the functions to the connector pins using only the numbers that are defined. | | Allocate the functions to the connector pins using only the numbers that are defined. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F433 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--|
| Event name | Interface Output Function Number Error 2 | | | Event code | 384A0000 hex | |
| Meaning | There is an undefined number specification in the output signal (OUTM2) function allocation. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is an undefined number specification in the output signal (OUTM2) function allocation. | | Allocate the functions to the connector pins using only the numbers that are defined. | | Allocate the functions to the connector pins using only the numbers that are defined. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F533 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--|
| Event name | External Latch Input Allocation Error | | | Event code | 384B0000 hex | |
| Meaning | There is an error in the latch input function allocation. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave or when transferring EtherCAT Configuration Setup |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The latch input was allocated to an input signal other than IN5, IN6, or IN7. | | Allocate the latch input to input signals IN5, IN6, or IN7. | | Allocate the latch input to input signals IN5, IN6, or IN7. | |
| | A latch input is assigned to an NC signal. | | Assign a latch input to an NO signal. | | Assign a latch input to an NO signal. | |
| | The same latch input is not assigned to the same pin in all Control Modes. | | Assign the same latch input in all Control Modes. | | Assign the same latch input to the same pin in all Control Modes. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "33" is displayed on the Servo Drive front panel and F833 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|----------------------------------|
| Event name | Overrun Limit Error | | | Event code | 384C0000 hex | |
| Meaning | The Servomotor exceeded the allowable operating range set in the Overrun Limit Setting (3514 hex) with respect to the position command input range. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The gain or inertial ratio is not suitable. | | Adjust the gain (the balance between position loop gain and velocity loop gain) and the inertia ratio. | | Adjust the gain or inertial ratio. | |
| | The set value of the Overrun Limit Setting (3514 hex) is too small. | | Increase the set value of the Overrun Limit Setting (3514 hex). Disable the protective function if it is unnecessary. | | Increase the set value of the Overrun Limit Setting (3514 hex). Disable the protective function if it is unnecessary. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "34" is displayed on the Servo Drive front panel and F034 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|----------------------|--------------|
| Event name | Absolute Encoder System Down Error | | Event code | 384D0000 hex | | |
| Meaning | The voltage of the built-in capacitor dropped below the specified value because the power supply to the encoder or the battery power supply was down. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The voltage of the built-in capacitor dropped below the specified value because the power supply to the encoder or the battery power supply was down. | | Reset the power supply to the encoder and to the battery, and then clear the absolute encoder. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "40" is displayed on the Servo Drive front panel and F040 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | Absolute Encoder Counter Overflow Error | | | Event code | 384E0000 hex | |
| Meaning | The multi-rotation counter of the encoder exceeded the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The set value for switching operation with the absolute encoder is too large. | | Correct the Operation Switch when Using Absolute Encoder (3015 hex) to a small value. | | Set the Operation Switch when Using Absolute Encoder (3015 hex) to a small value. | |
| | The traveling distance from home of the machine exceeded 32,767 revolutions. | | Correct the traveling distance from the home of the machine so that there is no more than 32,767 revolutions. | | Correct the traveling distance from the home of the machine is no more than 32,767 revolutions. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “41” is displayed on the Servo Drive front panel and F041 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | Object Setting Error 1 | | | Event code | 384F0000 hex | |
| Meaning | The electronic gear ratio exceeded the allowable range. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The electronic gear ratio exceeded the allowable range. | | Correct the electronic gear ratio to between 1/1,000 and 1,000. | | Set the electronic gear ratio to between 1/1,000 and 1,000. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “93” is displayed on the Servo Drive front panel and F093 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | Object Setting Error 2 | | | Event code | 38500000 hex | |
| Meaning | External encoder ratio exceeded the allowable range. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | External encoder ratio exceeded the allowable range. | | Correct the external encoder ratio to between 1/40 and 160. | | Set the external encoder ratio to between 1/40 and 160. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "93" is displayed on the Servo Drive front panel and F293 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|---|--------------|
| Event name | External Encoder Connection Error | | | Event code | 38510000 hex | |
| Meaning | The set value of the External Feedback Pulse Type Selection (3323 hex) differs from the external encoder type that is connected for serial communications. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The set value of the External Feedback Pulse Type Selection (3323 hex) differs from the external encoder type that is connected for serial communications. | | Set the External Feedback Pulse Type Selection (3323 hex) according to the connected external encoder type. | | Set the External Feedback Pulse Type Selection (3323 hex) according to the connected external encoder type. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "93" is displayed on the Servo Drive front panel and F393 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--|---|-------------|---|--|--|--------------|
| Event name | Function Setting Error | | Event code | 38520000 hex | | |
| Meaning | The function that was set does not support the communications period. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The electronic gear object ratio was not 1:1 when the communications period was set to 250 or 500 μ s. | | Check the following settings for any of the causes and correct any problems. <ul style="list-style-type: none"> • Communications period setting • Electronic gear object • Objects that set the Control Mode • Control Mode • Number of mapped bytes • Number of mapped objects • Mapped objects | | Check the following settings for any of the causes to make sure that problems do not occur. <ul style="list-style-type: none"> • Communications period setting • Electronic gear object • Objects that set the Control Mode • Control Mode • Number of mapped bytes • Number of mapped objects • Mapped objects | |
| | Fully-closed Control Mode was selected for a communications period setting of 250 μ s. | | | | | |
| | Modes of operation (6060 hex) was set to pp or hm when the communications period was set to 250 or 500 μ s. | | | | | |
| | More than 20 bytes were mapped for RxPDO when the communications period was set to 250 μ s. | | | | | |
| | More than 12 bytes were mapped for RxPDO in Fully-closed Control Mode. | | | | | |
| | Modes of operation (6060 hex) was set to pp or hm in Fully-closed Control Mode when the communications period was set to 1 ms and the electronic gear parameter ratio was not set to 1:1. | | | | | |
| | No bytes (i.e., no objects) were mapped for RxPDO. | | | | | |
| | More than 10 objects were mapped for RxPDO. | | | | | |
| More than 11 objects were mapped for TxPDO. | | | | | | |
| CSP Switching Reference Position (4020 hex) was mapped for TxPDO when the communications period was set to 250 or 500 μ s or when the electronic gear object ratio was not set to 1:1. | | | | | | |
| Attached information | None | | | | | |
| Precautions/Remarks | "93" is displayed on the Servo Drive front panel and F493 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|--|--------------|
| Event name | Drive Prohibition Input Error 1 | | | Event code | 64E00000 hex | |
| Meaning | When the Drive Prohibition Input Selection (3504 hex) was set to 0, both the Forward Drive Prohibition Input (POT) and the Reverse Drive Prohibition Input (NOT) turned ON. Or, when the Drive Prohibition Input Selection (3504 hex) was set to 2, either the Forward Drive Prohibition Input (POT) or the Reverse Drive Prohibition Input (NOT) turned ON. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | A problem occurred with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. | | Remove the problem with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. In particular, check to see if the control signal power supply (12 to 24 VDC) turned ON too slowly. | | The goal is to detect the error. (A preventative measure is not required.) | |
| Attached information | None | | | | | |
| Precautions/Remarks | "38" is displayed on the Servo Drive front panel and F038 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|--|--------------|
| Event name | Drive Prohibition Input Error 2 | | | Event code | 64E10000 hex | |
| Meaning | An operation command (such as a trial run of FFT) was received from the CX-Drive when the Drive Prohibition Input Selection (3504 hex) was set to 0, EtherCAT communications was interrupted, and either POT or NOT was ON. Or, POT or NOT turned ON while operation was being performed for a CX-Drive operation command. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | A problem occurred with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. | | Remove the problem with the switches, wires, and power supplies that are connected to the Forward Drive Prohibition input or the Reverse Drive Prohibition input. In particular, check to see if the control signal power supply (12 to 24 VDC) turned ON too slowly. | | The goal is to detect the error. (A preventative measure is not required.) | |
| Attached information | None | | | | | |
| Precautions/Remarks | "38" is displayed on the Servo Drive front panel and F138 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Immediate Stop Input Error | | | Event code | 64E20000 hex | |
| Meaning | An Immediate Stop (STOP) signal was input. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An Immediate Stop (STOP) signal was input. | | Clear the cause of the immediate stop input (STOP). | | The goal is to detect the error. (A preventative measure is not required.) | |
| | Incorrect wiring of the immediate stop input (STOP). | | Correct the wiring of the immediate stop input (STOP) if it is incorrect. | | Make sure that the immediate stop input (STOP) wiring is incorrect. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "87" is displayed on the Servo Drive front panel and F087 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|---|--------------|
| Event name | Command Error | | Event code | 74810000 hex | | |
| Meaning | A mistake was made in using a command. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | Data type | | Name | | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | When bit 09 (Remote) of the Statusword (6041 hex) was set to 1 (remote), and the Servo Drive was in operation enabled state (Servo ON), a command was received that changes the communications state from Operational to another state (Init, Pre-operational, or Safe-operational state). | | Check the command specifications of the host controller and correct the command. | | Check the command specifications of the host controller to use correct command. | |
| | When bit 09 (Remote) of the Statusword (6041 hex) was set to 0 (local), a command was received during FFT or test run status that changes the ESM state from Operational, Safe-operational, or Pre-operational state to Init state. | | | | | |
| | An unsupported number was set for 6060 hex (Operation Mode). | | | | | |
| | During Fully-closed Control Mode, csv or cst was set for 6060 hex (Operation Mode). | | | | | |
| | The setting of 6060 hex (Operation Mode) was changed at an interval of less than 2 ms. | | | | | |
| | Homing was started when 6098 hex (Homing Method) was set to a value other than 8, 12, 19, 20, 33, 34, or 35. | | | | | |
| | Data setting warnings (B0 hex) occurred continuously for the number of data setting warnings that is set in 3781 hex (Data Setting Warning Detection Count). | | | | | |
| | | | | | | |
| Attached information | None | | | | | |
| Precautions/Remarks | "91" is displayed on the Servo Drive front panel and F191 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|------------------------------------|
| Event name | Operation Command Competition | | | Event code | 78010000 hex | |
| Meaning | An attempt was made to establish EtherCAT communications or to turn ON the Servo from the Controller (enable operation) while executing an FFT that operates with the Servo Drive alone or a trial run. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | During independent slave operation |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | EtherCAT communications (change from Init to Pre-operational state) was established or an attempt to turn ON the Servo from the Controller (enable operation) was made while executing an FFT that operates with the Servo Drive trial run. | | Do not establish EtherCAT communications while an FFT or a trial run is being performed. Do not turn ON the Servo (enable operation) while an FFT or a trial run is being performed. | | Do not establish EtherCAT communications while an FFT or a trial run is being performed. Do not turn ON the Servo (enable operation) while an FFT or a trial run is being performed. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "27" is displayed on the Servo Drive front panel and F627 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|--|--|--|
| Event name | Absolute Encoder Status Error | | | Event code | 78020000 hex | |
| Meaning | The rotation of the encoder was higher than the specified value when the power supply was turned ON. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The rotation of the encoder was higher than the specified value when the power supply was turned ON. | | Do not let the Servomotor move when the power supply is turned ON. | | Do not let the Servomotor move when the power supply is turned ON. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "47" is displayed on the Servo Drive front panel and F047 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | EtherCAT State Change Error | | | Event code | 84B10000 hex | |
| Meaning | A communications state change command was received for which the current communications state could not be changed. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | Flashes at 1-s intervals. | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | A communications state change command was received for which the current communications state could not be changed. | | Check the command specifications for communications state transitions in the host controller and correct host controller processing. | | Check the command specifications for communications state transitions in the host controller and program host controller processing. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "83" is displayed on the Servo Drive front panel and F183 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|--|--------------|
| Event name | EtherCAT Illegal State Change Error | | | Event code | 84B20000 hex | |
| Meaning | An undefined communications state change command was received. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | Flashes at 1-s intervals. | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An undefined communications state change command was received. | | Check the command specifications for communications state transitions in the host controller and correct host controller processing. | | Check the command specifications for communications state transitions in the host controller and program host controller processing. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "83" is displayed on the Servo Drive front panel and F283 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | |
|--------------------------|--|----------------|---|--|---|
| Event name | Communications Synchronization Error | | | Event code | 84B30000 hex |
| Meaning | The number of consecutive errors in receiving data during the communication sync time exceeded the value specified for the Communications Control Setting. | | | | |
| Source | EtherCAT Master Function Module | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT |
| | --- | | Flashes at 1-s intervals. | | --- |
| System-defined variables | Variable | Data type | | Name | |
| | None | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention |
| | Power to the host controller was interrupted during PDO communications. | | Reset the error in the host controller. This event reports an error that was detected when power to the host controller was interrupted. It does not indicate that an error currently exists. | | If you turn OFF the power supply to the host controller, also turn OFF the power supply to the Servo Drive. |
| | An EtherCAT communications cable is disconnected, broken, or incorrectly connected. | | Connect the EtherCAT communications cable securely. If the cable is broken, replace it. | | Connect the EtherCAT communications cable securely. |
| | Noise | | Take noise countermeasures if excessive noise is affecting the EtherCAT communications cable. | | Take noise countermeasures if excessive noise is affecting the EtherCAT communications cable. |
| Attached information | None | | | | |
| Precautions/Remarks | "83" is displayed on the Servo Drive front panel and F383 is given as the AlarmCode (4001 hex). | | | | |

| | | | | | |
|--------------------------|---|----------------|---|--|---|
| Event name | Synchronization Error | | | Event code | 84B40000 hex |
| Meaning | A synchronization error occurred. | | | | |
| Source | EtherCAT Master Function Module | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT |
| | --- | | Flashes at 1-s intervals. | | --- |
| System-defined variables | Variable | Data type | | Name | |
| | None | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention |
| | Noise | | Take noise countermeasures if excessive noise is affecting the EtherCAT communications cable. | | Take noise countermeasures if excessive noise is affecting the EtherCAT communications cable. |
| | Control PCB error | | Replace the Servo Drive. | | None |
| Attached information | None | | | | |
| Precautions/Remarks | "83" is displayed on the Servo Drive front panel and F483 is given as the AlarmCode (4001 hex). | | | | |

| | | | | | | |
|--------------------------|---|-------------|--|--|---|--------------|
| Event name | Sync Manager WDT Error | | | Event code | 84B50000 hex | |
| Meaning | PDO communications were stopped for more than the specified period of time. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | Flashes at 1-s intervals. | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The EtherCAT communications cable is disconnected or broken. | | Connect the EtherCAT communications cable securely. | | Connect the EtherCAT communications cable securely. | |
| | There is an error in the host controller. | | Check the operation of the host controller and take appropriate measures if there a problem. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "83" is displayed on the Servo Drive front panel and F583 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|--------------------------|--|----------------------|--|
| Event name | ESC Initialization Error | | | Event code | 84B60000 hex | |
| Meaning | An error occurred in ESC initialization. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Control PCB error | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "88" is displayed on the Servo Drive front panel and F188 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---------------------------|--|----------------------|--|
| Event name | Slave Unit Verification Error | | | Event code | 84B70000 hex | |
| Meaning | An error occurred in Slave Unit verification. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | When establishing communications after turning ON power to the slave |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | Flashes at 1-s intervals. | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Control PCB error | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "88" is displayed on the Servo Drive front panel and F388 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|---|--------------|
| Event name | Communications Setting Error | | | Event code | 84B80000 hex | |
| Meaning | There is an error in the communications settings. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | Flashes at 1-s intervals. | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An out-of-range value was set from the host controller. | | Set EtherCAT communications parameters so that the synchronous cycle (SYNC0 cycle) and other setting are within the specified ranges. | | Set EtherCAT communications parameters so that the synchronous cycle (SYNC0 cycle) and other setting are within the specified ranges. | |
| | A command that changes the communications state to an unsupported state was received. | | Check the command specifications for communications state transitions in the host controller and correct host controller processing. | | Check the command specifications for communications state transitions in the host controller and program host controller processing. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "90" is displayed on the Servo Drive front panel and F090 is given as the AlarmCode (4001 hex). | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---------------------------|--|----------------------|--------------|
| Event name | Synchronization Interruption Error | | | Event code | 84B90000 hex | |
| Meaning | A synchronization interruption error occurred. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | Flashes at 1-s intervals. | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Control PCB error | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "88" is displayed on the Servo Drive front panel and F288 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|--|--|--------------|
| Event name | Absolute Value Cleared | | | Event code | 98010000 hex | |
| Meaning | The multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after cycling slave power) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The multi-rotation counter for the absolute encoder was cleared during USB communications by the CX-Drive. | | This operation is performed for safety and is not an error. | | (A preventative measure is not required because this is a safety measure.) | |
| Attached information | None | | | | | |
| Precautions/Remarks | "27" is displayed on the Servo Drive front panel and F127 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|--|--|--------------|
| Event name | Position Data Initialized | | Event code | 98020000 hex | | |
| Meaning | A Config operation was performed or the multi-rotation counter was cleared for the absolute encoder during EtherCAT communications. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Minor fault | Recovery | Error reset (after resetting slave errors) | Log category | System |
| Effects | User program | Continues. | Operation | Power drive circuit is OFF for relevant slave. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | A Config operation was performed or the multi-rotation counter was cleared for the absolute encoder during EtherCAT communications. | | This operation is performed for safety and is not an error. | | (A preventative measure is not required because this is a safety measure.) | |
| Attached information | None | | | | | |
| Precautions/Remarks | "27" is displayed on the Servo Drive front panel and F727 is given as the AlarmCode (4001 hex) | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|-----------------------------------|--------------|
| Event name | Battery Warning | | Event code | 08010000 hex | | |
| Meaning | The battery voltage is 3.2 V or less. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The battery voltage is 3.2 V or lower. | | Replace the Battery and reset the slave error. | | Periodically replace the Battery. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "A2" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|--|--------------|
| Event name | Fan Warning | | | Event code | 08020000 hex | |
| Meaning | The fan stop state continued for 1 second. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is foreign matter in the fan. | | If there is foreign matter in the fan, remove it. | | Do not use the fan in an area surrounded by excessive foreign matter. Also, do not allow foreign objects to enter. | |
| | The Servo Drive failed. | | If the above cause is not the cause of the problem, replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | “A3” is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|--|--------------|
| Event name | Encoder Communications Warning | | | Event code | 08030000 hex | |
| Meaning | Encoder communications errors occurred in series more frequently than the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient power supply voltage for the encoder. | | Provide the required encoder power supply voltage of 5 VDC $\pm 5\%$ (4.75 to 5.25 V). Be careful especially of voltage drop when the encoder cable is long. | | Provide the required encoder power supply voltage of 5 VDC $\pm 5\%$ (4.75 to 5.25 V). Be careful especially of voltage drop when the encoder cable is long. | |
| | Noise is entering on the encoder line. | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “A4” is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|---|--------------|
| Event name | Encoder Overheating Warning | | | Event code | 08040000 hex | |
| Meaning | The encoder temperature exceeded the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The ambient temperature is too high. | | Remove the cause of encoder overheating. | | Adjust the surrounding environment so that the encoder does not overheat. | |
| | Servomotor failed. | | Replace the Servomotor. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "A5" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--------------------------|---------------|----------------------|--------------|
| Event name | Life Expectancy Warning | | | Event code | 08050000 hex | |
| Meaning | The remaining life of the capacitor or the fan is shorter than the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The life expectancy of the capacitor or the fan is shorter than the specified value. | | Replace the Servo Drive. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "A7" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|---------------|---|--------------|
| Event name | External Encoder Error Warning | | | Event code | 08060000 hex | |
| Meaning | The external encoder detected a warning. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient power supply voltage for the external encoder. | | Provide the required external encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). | | Provide the required external encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). | |
| | Noise is entering on the external encoder connector cable. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | |
| | The external encoder failed. | | If none of the above causes applies, replace the external encoder. | | None | |
| Attached information | None | | | | | |
| Precautions/Remarks | "A8" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|---|-------------|---|---------------|---|--------------|
| Event name | External Encoder Communications Warning | | | Event code | 08070000 hex | |
| Meaning | The external encoder had more communications errors than the specified value. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is insufficient power supply voltage for the external encoder. | | Provide the required external encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). | | Provide the required external encoder power supply voltage of 5 VDC \pm 5% (4.75 to 5.25 V). | |
| | Noise is entering on the external encoder connector cable. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | | If the Servomotor cable and the external encoder cable are bundled together, separate them. Connect the shield to FG. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "A9" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|---|---------------|---|--------------|
| Event name | Data Setting Warning | | | Event code | 34E00000 hex | |
| Meaning | An object setting is out of range. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | An object setting is out of range. | | Correct the object settings so that they are within the specified ranges. | | Set the object settings so that they are within the specified ranges. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "B0" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|--|----------------------------------|
| Event name | Overload Warning | | | Event code | 383C0000 hex | |
| Meaning | The load ratio is 85% or more of the protection level. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | Overload | | <p>Take the following actions according to the situation.</p> <ul style="list-style-type: none"> • Increase the capacities of the Servo Drive and the Servomotor. • Increase the setting of the acceleration/deceleration time and lighten the load. • Adjust the gain or inertial ratio. • Remove machine distortion. • Measure the voltage at the brake terminal. If the brake is ON, release it. • Correct the system if torque (current) waveforms oscillate or excessively oscillate vertically during analog output or communications. | | Check the items given for corrections in advance and implement countermeasures as required. | |
| | There is incorrect wiring of the motor line or a broken cable. | | Connect the Servomotor cable as shown in the wiring diagram. If the cable is broken, replace it. Connect the motor line and encoder line that are used together to the same motor. | | Connect the Servomotor cable as shown in the wiring diagram. Connect the motor line and encoder line that are used together to the same motor. | |
| Attached information | None | | | | | |
| Precautions/Remarks | "A0" is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|--|----------------------------------|
| Event name | Excessive Regeneration Warning | | | Event code | 383D0000 hex | |
| Meaning | The regeneration load ratio is 85% or more of the level. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | There is excessive regeneration. | | <p>Check the operation pattern (velocity monitor). Check the Regeneration Resistor load rate and the excessive regeneration warning, and perform the following accordingly.</p> <ul style="list-style-type: none"> • Increase the capacities of the Servomotor and the Servo Drive. • Increase the deceleration time. • Reduce the Servomotor rotation speed. • Use an External Regeneration Resistor. • Set the Regeneration Resistor Selection (3016 hex) to 2. | | Check the items given for corrections in advance and implement countermeasures as required. Or, set the Regeneration Resistor Selection (3016 hex) to 2. | |
| | This Regeneration Resistor cannot be used for continuous regenerative braking. | | This Regeneration Resistor cannot be used for continuous regenerative braking. | | Do not use the Regeneration Resistor for continuous regenerative braking. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “A1” is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | | |
|--------------------------|--|-------------|--|---------------|---|----------------------------------|
| Event name | Vibration Detection Warning | | | Event code | 383E0000 hex | |
| Meaning | Vibration was detected. | | | | | |
| Source | EtherCAT Master Function Module | | Source details | Slave | Detection timing | While power is supplied to motor |
| Error attributes | Level | Observation | Recovery | --- | Log category | System |
| Effects | User program | Continues. | Operation | Not affected. | | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT | |
| | --- | | --- | | --- | |
| System-defined variables | Variable | | Data type | | Name | |
| | None | | --- | | --- | |
| Cause and correction | Assumed cause | | Remedy | | Prevention | |
| | The gain or inertial ratio setting is not suitable. | | Correct the gain (the balance between position loop gain and velocity loop gain) and the inertial ratio. | | Adjust the gain (the balance between position loop gain and velocity loop gain) and the inertial ratio. | |
| Attached information | None | | | | | |
| Precautions/Remarks | “A6” is displayed on the front panel of the Servo Drive. | | | | | |

| | | | | | |
|--|--|----------------|--|------------------|--|
| Event name | Command Warning | | Event code | 7480000 hex | |
| Meaning | A command could not be executed. | | | | |
| Source | EtherCAT Master Function Module | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category System |
| Effects | User program | Continues. | Operation | Not affected. | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT |
| | --- | | --- | | --- |
| System-defined variables | Variable | | Data type | | Name |
| | None | | --- | | --- |
| Cause and correction | Assumed cause | | Remedy | | Prevention |
| | The absolute multi-rotation counter was cleared when the Servo was not OFF when using an absolute encoder for semi-closed control. | | Make sure that the settings meet the object's operation conditions. Check the drive prohibition input and operation command, and take actions accordingly. | | Make sure that the settings meet the object's operation conditions. Check the drive prohibition input and operation command, and take actions accordingly. |
| | A forced brake operation request was sent while the Servo was ON. | | | | |
| | A Switch ON command was sent when the main power was OFF. (When 3508 hex = 0) | | | | |
| | An Enable Operation command was sent to request turning ON the Servo when the Servomotor was operating at 30 r/min or higher. | | | | |
| | A latch operation was started under the following conditions. <ul style="list-style-type: none"> • An absolute external encoder was used and phase Z was selected as the trigger for fully-closed control. • The absolute multi-rotation data was being cleared or the Config operation was being performed. • The Statusword (6041 hex) bit 09 (remote) was 0 (local). | | | | |
| An operation command is given in the prohibited direction after the motor made an immediate stop due to a drive prohibition input. | | | | | |
| Attached information | None | | | | |
| Precautions/Remarks | "B1" is displayed on the front panel of the Servo Drive. | | | | |

| | | | | | |
|--------------------------|--|----------------|---|------------------|---|
| Event name | EtherCAT Communications Warning | | Event code | 84B00000 hex | |
| Meaning | An EtherCAT communications error occurred one or more times. | | | | |
| Source | EtherCAT Master Function Module | Source details | Slave | Detection timing | Continuously |
| Error attributes | Level | Observation | Recovery | --- | Log category |
| Effects | User program | Continues. | Operation | Not affected. | |
| Indicators | EtherNet/IP NET RUN | | EtherNet/IP NET ERR | | EtherNet/IP LINK/ACT |
| | --- | | --- | | --- |
| System-defined variables | Variable | | Data type | | Name |
| | None | | --- | | --- |
| Cause and correction | Assumed cause | | Remedy | | Prevention |
| | The EtherCAT communications cable is disconnected or broken. | | Connect the EtherCAT communications cable securely. If the cable is broken, replace it. | | Connect the EtherCAT communications cable securely. |
| | Noise | | Take noise countermeasures if excessive noise is affecting the EtherCAT communications cable. | | Take noise countermeasures if excessive noise is affecting the EtherCAT communications cable. |
| Attached information | None | | | | |
| Precautions/Remarks | "B2" is displayed on the front panel of the Servo Drive. | | | | |

A-4 EtherCAT Terminology

Use the following list of EtherCAT terms for reference.

| Term | Abbreviation | Description |
|--|--------------|---|
| object | – | Abstract representation of a particular component within a device, which consists of data, parameters, and methods. |
| object dictionary | OD | Data structure addressed by Index and Subindex that contains description of data type objects, communication objects and application objects. |
| service data object | SDO | CoE asynchronous mailbox communications where all objects in the object dictionary can be read and written. |
| index | – | Address of an object within an application process. |
| subindex | – | Sub-address of an object within the object dictionary. |
| process data | – | Collection of application objects designated to be transferred cyclically or acyclically for the purpose of measurement and control. |
| process data object | PDO | Structure described by mapping parameters containing one or several process data entities. |
| Receive PDO | RxPDO | A process data object received by an EtherCAT slave. |
| Transmit PDO | TxPDO | A process data object sent from an EtherCAT slave. |
| sync manager | SM | Collection of control elements to coordinate access to concurrently used objects. |
| distributed clock | DC | Method to synchronize slaves and maintain a global time base. |
| device profile | – | Collection of device dependent information and functionality providing consistency between similar devices of the same device type. |
| fieldbus memory management unit | FMMU | Single element of the fieldbus memory management unit: one correspondence between a coherent logical address space and a coherent physical memory location. |
| physical device internal interface | PDI | A series of elements to access data link services from the application layer. |
| CAN in Automation | CiA | CiA is the international users' and manufacturers' group that develops and supports higher-layer protocols. |
| CAN application protocol over EtherCAT | CoE | A CAN application protocol service implemented on EtherCAT. |
| EEPROM | EEPROM | Electrically erasable PROM. |
| EtherCAT Technology Group | ETG | The ETG is a global organization in which OEM, End Users and Technology Providers join forces to support and promote the further technology development. |
| EtherCAT slave controller | ESC | A controller for EtherCAT slave communication. |
| EtherCAT state machine | ESM | An EtherCAT communication state machine. |
| EtherCAT slave information | ESI | An XML file that contains setting information for an EtherCAT slave. |
| Slave Information Interface | SII | Slave information stored in the nonvolatile memory of each slave. |
| Power Drive System | PDS | A power drive system consisting of a Servo Drive, an inverter, and other components. |

A-5 Functional Differences among Unit Versions

The following table shows the functional differences among unit versions.

| Item | | Unit version | | |
|---|---------------------------------------|---|--|---|
| | | Ver.1.0 | Ver.2.0 | Ver.2.1 |
| Servo Drive model | | R88D-KN□-ECT-R | R88D-KN□-ECT | |
| Sysmac Device Features | Sysmac Error Status | Not supported | | Supported |
| | Saving the Node Address Setting | Not supported | | Supported |
| | Serial Number Display* ¹ | Not supported | | Supported |
| | ESI Specification (Version 1.0) | Not supported | | Supported |
| | SII Data Check | Not supported | | Supported |
| Fixed PDO mapping | | Not supported | Supported | |
| Variable PDO mapping (1600 hex, 1A00 hex) | | Not supported | | Supported |
| Available operation modes | csp: Cyclic synchronous position mode | Supported | | |
| | csv: Cyclic synchronous velocity mode | Not supported | Supported | |
| | cst: Cyclic synchronous torque mode | Not supported | Supported | |
| | pp: Profile position mode | Not supported | | Supported |
| | hm: Homing mode | Not supported | Supported | |
| FIR filter function | | Not supported | Supported* ² (Available when the communications cycle is 1 ms or above) | |
| Error detection function | Excessive Speed Deviation Error | Not supported | Supported | |
| | Interruptions Error | Not supported | Supported | |
| Electronic gear function | | Supported | Not supported* ³ (only to 1:1) | Supported |
| Fully-closed Control * ⁴ | | Supported | Available when the communications cycle is 500 μs or above in csp and 1 ms or above in hm. | csp: Available when the communications cycle is 500 μs or above at an electronic gear ratio of 1:1 and 1 ms or above at a gear ratio other than 1:1. pp, hm: Available when the communications cycle is 1 ms or above at an electronic gear ratio of 1:1 and 2 ms or above at a gear ratio other than 1:1.* ⁵ |
| Torque limit objects | | PDO mapping to 60E0/60E1 hex is not possible. | PDO mapping to 60E0/60E1 hex is possible.* ⁶ | |
| Positioning Completion Range (6067 hex) | | Disabled | | Enabled |
| Reference Position for CSP (4020 hex) | | Not supported | | Supported |
| Data Setting Warning Detection Setting (3781 hex) | | Not supported | | Supported |
| DC power input | | Not supported | | Supported* ⁷ |
| Reference manual | | I573 | I576 | |

*1 The function to show the serial number controlled by OMRON in 1018h-04 hex.

*2 Setting the communications cycle to 500 μs or less does not enable the FIR filter function, although doing so does not cause any error.

*3 Setting this to an electronic gear ratio other than 1:1 simply causes the G5-series AC Servo Drive to operate at 1:1 without any errors.

*4 If Fully-closed Control is not available, a Function Setting Error (Error No. 93.4) will occur.

*5 This is applicable only when the total size of the objects mapped to RxPDO is 12 bytes or less. For details, refer to A-1-3 *Communications Cycles and Corresponding Modes of Operation*.

*6 There are objects added (3013 hex/3522 hex) to or renamed (3525 hex/3526 hex) from unit version 1.0. For details of these objects, refer to Torque Limit Selection (3521 hex) in Extended Objects of each manual.

*7 Only the following Servo Drive models support DC power input:
 • R88D-KN75H-ECT • R88D-KN150H-ECT



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