Servo System

MINAS A7N Series

Operating Instructions (Overall)

RTEX Rotary Motor

- Thank you for purchasing a Panasonic product.
- Please use it correctly and safely after reading these Operating Instructions (Overall) carefully.
- Read *"1.1.1 Safety Precautions"* before use.
- Keep these Operating Instructions safe.
- This product is for industrial use. It cannot be used for any other (e.g. household) purpose.

Rev.1.1

IMG11
Z0125-3055

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Introduction

Thank you for purchasing the MINAS A7N Servo System. This manual describes the installation and wiring, trial runs, tuning and operations, and maintenance and inspections of the MINAS A7N Series.

— Precautions —

- Unauthorized reproduction or duplication of the contents of the present text, either in whole or in part, is strictly prohibited.
- The contents of the present text (specifications, software versions, etc.) are subject to change without notice.
- Read *"1.1 Precautions"* before using this product.

On Opening the Product Package

On opening the product package, check the following.

Contact the dealer if there is a problem.

- Make sure that the model matches your order.
- Check whether the product has been damaged during transportation.
- Check whether the safety guide is included.
- At the time of shipment, the power input connector and a motor output connector are attached to the driver body. Check whether they are installed correctly.

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1.1 Precautions

1.1.1 Safety Precautions

■ Must be adhered to

This section explains precautions that must be taken to prevent harm to people and damage to property.

■ The following symbols represent the extent of the harm or damage that may occur through improper use.

⚠ **Danger**	This indicates “a significant risk of death or serious injury”.
⚠ **Caution**	This indicates “a risk of injury or property damage”.

■ The matters to be observed are explained using the following symbols.

	Must not be done.
	Must be done.

⚠ DANGER		
	Do not use in wet places, corrosive atmospheres, inflammable gas atmospheres, atmospheres in which gases of low molecular weight such as helium gas are generated, or near combustible materials.	May cause fire.
	Do not place combustible materials near the motor, driver, regenerative resistor, or dynamic brake resistor.	
	Do not use in places subject to strong vibration or impact.	May cause electric shock, injury, and fire.
	Do not use with the cable immersed in oil or water.	May cause electric shock, malfunction, and damage.
	Do not install next to a heating element, such as a heater or large coil resistor.	May cause fire and malfunction.
	Never connect a commercial power supply directly to the motor.	
	Do not perform wiring or operate with wet hands.	May cause electric shock, injury, and fire.
	Never put your hand inside the driver.	May cause burns and electric shock.
	In the case of a motor with axis end keyway, do not touch the keyway with bare hands.	May cause injury.
	Never touch the rotating portion of the motor while it is running.	
	Do not touch the motor, driver heat sink, regenerative resistor, or dynamic brake resistor, since they become very hot.	May cause burns and parts damage.
	Do not drive the motor with external power.	May cause fire.
	Do not damage the cables, subject them to excessive force, place heavy objects on them, or pinch them.	May cause electric shock, malfunction, and damage.
	Install in an area free from excessive dust, water, oil, etc.	Improper installation site conditions may cause electric shock, fire, malfunction or damage.
	Install the motor, driver, and peripheral devices to nonflammable materials such as metal.	Mounting on a flammable material may cause fire.
	Wiring must be carried out by an expert in electrical work.	Wiring by a person with no expertise may cause electrical shock.
	Carry out wiring in accordance with the Operating Instructions.	Incorrect wiring may cause electrical shock, injury, malfunction, or damage.
	After correctly connecting cables, insulate the live parts with insulating material.	Incorrect wiring and short circuits may cause electrical shock, fire, or malfunction.
	Connect to the earth terminals of the motor and driver without fail.	Not grounding may cause electrical shock.
	Install and mount securely to prevent any possible fire or personal injury during an earthquake.	Failure to install properly may cause electric shock, fire, malfunction, or damage.
	Install an emergency stop circuit externally so that operation can be stopped and power turned off immediately in the event of an emergency.	
	Install an overcurrent protection device, residual current device, overheating prevention device, and emergency stop device without fail.	Failure to install and check these may cause electric shock, injury, or fire.
	After an earthquake, always confirm safety.	
	Before moving, wiring, or inspecting the driver, turn off power, wait at least as long as specified on the main unit side panel nameplate, and ensure that there is no risk of electrical shock.	Not turning off the power before these operations may cause electric shock.

⚠ CAUTION

When transporting the product, do not hold it by the cable or motor axis.	May cause injury.
Do not drop or tip over the product during transportation or installation.	May cause injury or malfunction.
Do not stand on or place heavy objects on the product.	May cause electric shock, injury, malfunction, or damage.
Do not place any objects that would block air passage around the motor, driver, and peripheral devices.	May cause burns or fires.
Do not use in direct sunlight.	May cause injury or fire.
Do not block or insert foreign matter into the heat dissipation holes.	May cause electric shock or fire.
There should be no strong impact on the product.	May cause malfunction.
There should be no strong impact on the motor axis.	May cause detectors, etc., to malfunction.
Do not turn the driver main power on and off frequently.	May cause malfunction.
Never run or stop the motor with the electromagnetic contactor installed on the main power supply side.	
Do not make extreme gain adjustments or changes in the driver, or destabilize the driving or operation of the machine.	May cause injury.
Do not use the motor’s built-in brakes to stop a moving load.	May cause injury or malfunction.
Never modify, dismantle, or repair.	May cause fire, electric shock, injury, or malfunction.
Mount in a manner appropriately matched to the base machine mass and product rated output.	Improper attachment or installation may cause injury or malfunction.
Observe the specified mounting method and orientation.	
Only use the eye bolt of the motor for transportation of the motor.	Use for transportation of the machine may cause injury or malfunction.
Set the motor and driver ambient temperature within the temperature and humidity ranges for use.	Improper attachment or installation may cause injury or malfunction.
Create the specified clearance in separating the driver from the control panel inner surface and from other devices when installing.	
Maintain the specified voltage.	Operation at a voltage outside the rated voltage range may cause electric shock, injury, or fire.
Connect a relay that disconnects in the event of an emergency stop in series with the brake control relay.	Not connecting it may cause injury or malfunction.
Install safety devices for built-in brake or gear head idling or locking, or grease leakage from gear head.	Non-installation may cause injury, damage, or pollution.
The servo drive may start up with no warning when power is restored after a blackout, so the machine must be set to ensure the safety of the operator at all times.	May cause injury.
Use the specified combination of motor and driver.	May cause malfunction or fire if not used in the correct combination.
To perform a trial run, secure the motor, and install it in the mechanical system after checking its operation while disconnected from the mechanical system.	Use of the wrong model or incorrect wiring may cause injury.
When an error occurs, clear the error and only restart after eliminating the cause and ensuring safety.	Not eliminating the cause of the error might cause injury.
If the driver malfunctions, shut off the power on the power supply side of the driver.	Continued passage of a large current may lead to fire.
Always disconnect the power when not in use for a long time.	Improper operation may cause injury.
Use a stabilized power supply with double insulation or reinforced insulation for the DC power supply.	May cause electric shock , fire or malfunction.

■ Other precautions

- When disposing of batteries, insulate them with tape and dispose of them in accordance with local regulations.
- When disposing of the Servo driver and motor, they are treated as industrial waste.
- Wrinkling of the label affixed to the motor will not present a problem in use of the motor.

1.1.2 Precautions for Proper Use

- Observe the following precautions when exporting the product or equipment incorporating the product.

  If the end user or end use of this product is related to the military or weaponry, etc., it may be subject to export restrictions as set forth in the Foreign Exchange and Foreign Trade Act or by the regional authority. When exporting, please review and follow the necessary export procedures.
- This product is intended for use with general industrial products. It is not designed or manufactured for use in machines or systems that may cause death on failure. This product is not for use in devices critical to human wellbeing or in specialized environments, such as nuclear power control, aerospace equipment, transportation systems, medical equipment or various safety devices.
- Installation, wiring, operation and maintenance of the equipment should be carried out by qualified and experienced personnel.
- Apply adequate tightening torque to the product mounting screws by taking into consideration the strength of the screws and the characteristics of the material to which the product is installed.
- Install safety equipment when applying this product to systems that could cause serious accidents or damage in the event of product failure.
- Because noise resistance may be affected by wiring conditions (e.g., earthing methods, cable length, signal wire shielding), please confirm the noise resistance of your equipment.
- Ensure that the motor axis is not operated without being electrically grounded, as this may lead to electrolytic corrosion of the motor bearing and increased bearing noise, depending on the machine and the installation environment.
- Some faults may cause the emission of roughly one cigarette's worth of smoke. Please consider these possibilities when using the device in cleanrooms and similar facilities.
- Make sure to follow indications as overloading products can cause loads to collapse.
- Do not use detergents containing benzine, thinner, alcohol, acid, or alkaline, since this may cause discoloration or damage the exterior of the product. When using a neutral detergent, please use a solution diluted to the concentration specified for the neutral detergent you are using.
- Treat as industrial waste on disposal.
- Please ensure that finished equipment complies with standards, laws and regulations, and confirm that the structure, dimensions, lifetime and characteristics of the product are suitable for your installed equipment and components.
- Note that use of this product outside the scope of specifications is not covered under warranty.
- Reverse engineering, decompiling and disassembling of this product is strictly prohibited.

1.1.3 Network Security

As you will use this product connected to a network, your attention is called to the following security risks.

1 Leakage or theft of information through this product

2 Use of this product for fraudulent operation by persons with malicious intent

3 Interference with or stoppage of this product by persons with malicious intent

It is the customer's responsibility to ensure that sufficient network security measures are taken, including the following.

We will not be liable for any damage caused by insufficient network security.

— Precautions —

- This product is to be used in an environment where only a limited number of parties are permitted access to the product.
- This product is not to be installed in locations where the product and its accessories, such as cables, can be easily destroyed.
- This product is to be used on a network that is not connected to the Internet.
- If an external device, such as a computer or tablet, is connected to this product, there are concerns about the effects of computer viruses and unauthorized programs.

  Take appropriate security measures with external devices, such as ensuring that they are checked for computer viruses and that regular cleaning of such viruses is performed before connecting them.
- If this product is turned over to a third party for transfer, disposal, repair, etc., important information may be left recorded in the device.

  Make deletions, etc.. at your own risk, and handle such matters with sufficient care.

1.2 Related Documents

The following are documents related to this product (including this manual). See each document as necessary for safe use of this product.

The documents can be downloaded from the following site.

https://industry.panasonic.com/global/en/

Document name	Abbreviations in this manual	Document No.	Description
Servo System Operating Instructions			
MINAS A7N Series Operating Instructions (Overall) RTEX Rotary Motor	OI_O	IMG11	This manual describes the selection, connection, usage, and error handling of servo drivers and servo motors to ensure correct and safe use of this product.
MINAS A7N Series Operating Instructions (Tuning) RTEX Rotary Motor	OI_A	IMG23	This document describes the adjustment function of the servo driver.
For MINAS Set-up Support Software (PANATERM ver.7) Operating Manual	PT_OM	IMG15	This document describes how to use PANATERM ver. 7, the setup support software for this product.
Servo Driver Standard Specification			
MINAS A7NSeries Standard Specifications Rotary Motor (Standard / Multi-function / Application specialized)	SS	SX-DSV03719	This document describes the hardware specifications of the servo driver.
Servo Driver Technical Reference			
MINAS A7N Series Technical Reference Functional Specification Rotary Motor (Standard / Multi-function / Application specialized)	TR_FS	SX-DSV03758	This document describes how to use the various functions of the servo driver.
MINAS A7N Series Technical Reference Communication Specification Rotary Motor (Standard / Multi-function / Application specialized)	TR_CS	SX-DSV03761	This document describes the interface that connects the servo driver to the host device.
Motion Controller User's Manual			
GM1 Controller User’s Manual (Operation)	GM1_UM	WUME-GM1OP	This document describes how to use the motion controller GM1.

1.3 Product Overview

MINAS A7N Series Servo Systems are advanced network servo systems that support the 100-Mbps full-duplex super high-speed motion network Realtime Express (RTEX), and meet the need for high speed, high precision, and high performance.

The MINAS A7N Series supports ring-connection with an RTEX-supporting host device and commercially available LAN cables (STP of CAT5e or higher), up to a maximum of 32 axes (when communication cycle is 0.5 ms or above). In particular, machines with a lot of axes enable a significant reduction in wiring and system costs. Furthermore, RTEX has a maximum cable length between nodes of 100 m, allowing it to be used in large systems. In addition, since it has superior interaxis synchronization, it can be used for high-precision continuous path (CP) control.

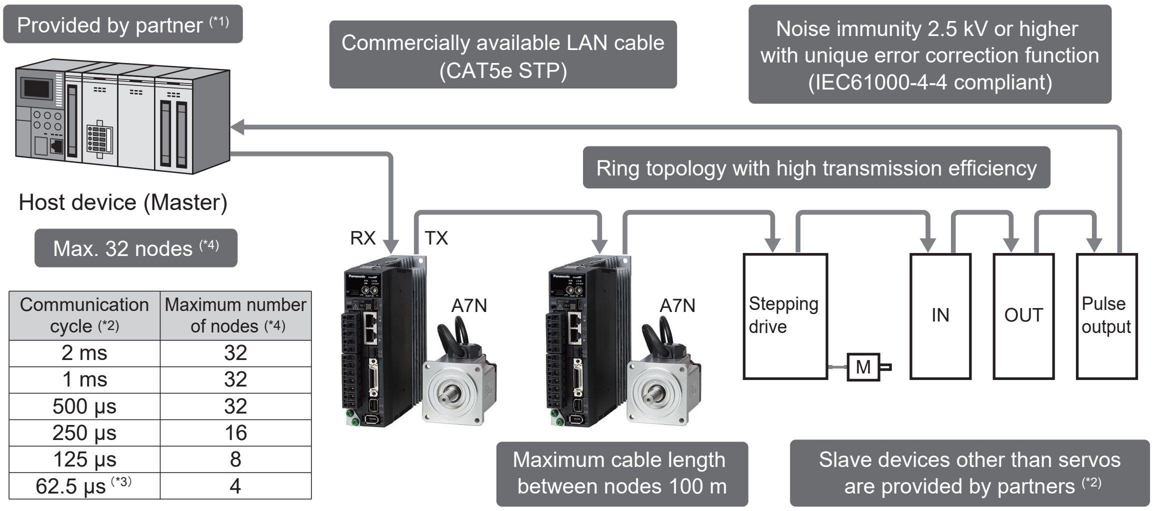
The MINAS A7N Series has a 27-bit encoder resolution (16 times greater than the previous series) to meet needs for faster and more precise positioning as well as greater machine drive than the MINAS A6N Series. It moves smoothly to the targeted position and stops precisely. In addition, the response frequency is 4 kHz, 25% higher than that of the MINAS A6N Series, allowing for more detailed control. Furthermore, by improving heat resistance, the maximum operating ambient temperature has been increased to 60°C, allowing the product to be used in a wider range of applications. This is a significant performance improvement over the MINAS A6N Series.

The TUNE COMPASS automatic tuning function adjusts the servo motor to the desired level through selection of the most suitable method from three options with different degrees of tuning time and precision. In particular, precAIse TUNING, an AI tuning method, can easily perform advanced tuning at the micrometer level, by having AI automatically optimize complex tuning that would require several days even for a skilled engineer, simply by setting conditions. Intelligent servos simplify positioning and greatly reduce the amount of engineering labor.

In addition, the MINAS A7N Series includes application specialized models that enable ultra-high-precision control by directly inputting the displacement sensor output to the servo driver. By selecting a model that matches the customer's equipment, labor can be reduced and high performance can be achieved at the same time.

This manual has been prepared as a guide to help you correctly understand and fully use the functions of the MINAS A7N Series, endowed with all of these superior features.

■ System configuration example



Communication cycle (*2)	Maximum number of nodes (*4)
2 ms	32
1 ms	32
500 µs	32
250 µs	16
125 µs	8
62.5 µs (*3)	4

*1 Please contact the respective partner company for the specifications of products other than servos, such as the host device.

*2 The control mode, communication cycle, and connection of slave devices other than the servo depend on the host device specifications.

*3 The command updating cycle is 125 µs when the communication cycle is 62.5 µs.

*4 Number of slaves nodes

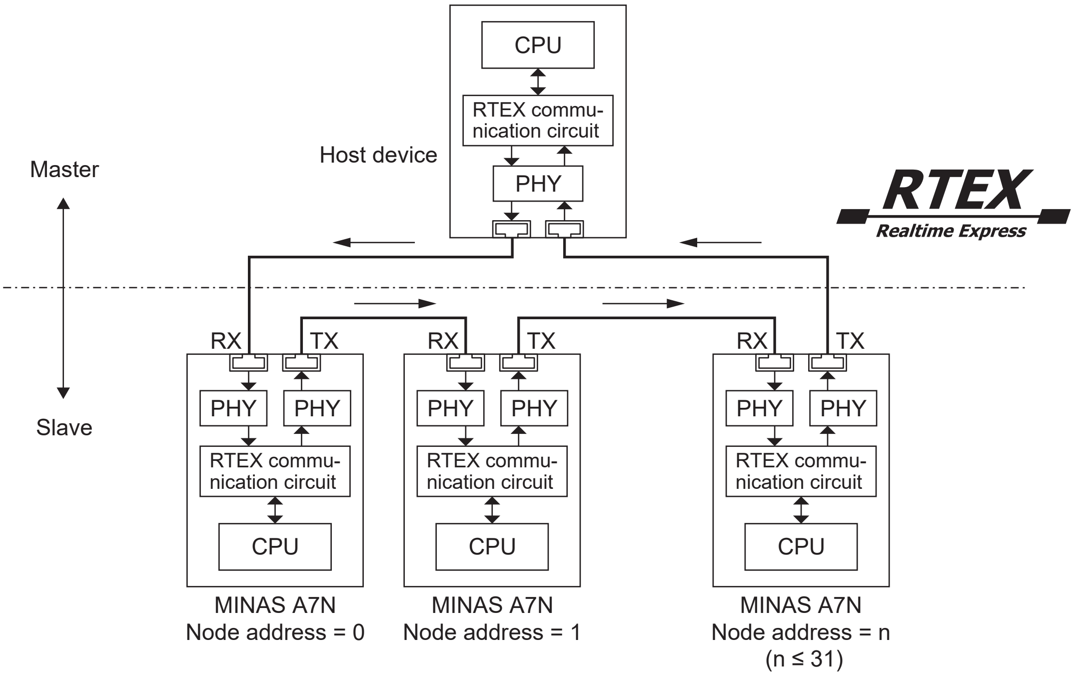
1.4 RTEX Communication

1.4.1 Overview of RTEX Communication

RTEX master-slave 100-Mbps real-time communication system suitable for multi-axis servo control is configured by connecting a master (host device) equipped with a communication IC and slaves (such as this product) in a ring.

1.4.2 System Configuration

The RTEX connection configuration is a network system in which a master (RTEX-supporting host device) is connected to multiple slaves in a ring using LAN cables.



A node address is an ID (MAC-ID) used to identify a slave on the network, and is set using the rotary switch (RSW) on the front panel.

Node addresses need not be set in the slave connection sequence if a master has been created using a Panasonic sample code.

Notes

- As a result of the ring connection system used with this product, the hub required by an ordinary 100 BASE-TX is not used.
- The pulse transformer is built into the RJ45 connector and is not shown.

— Precautions —

- Use shielded twisted pair (STP) cables of category CAT5e or higher specified in the TIA/EIA-568 standards as the communication cables in the above diagram.
- The cable length between nodes should be 100 m or less.
- This product does not support communication other than RTEX. For example, the EtherCAT communication type MINAS A☐B Series cannot be connected.

  However, it can be connected to the RTEX communication type MINAS A☐N Series.

1.5 Software Version

1.5.1 Notes Regarding Software

This product incorporates open source software (OSS), and usage is pursuant to the terms of the license (see *"12.5 License Terms for Open Source Software (OSS)"*). Your company may also have an obligation to use OSS, so please take appropriate measures at your company.

1.5.2 Applicable Software Version

The present manual applies to the following servo driver software versions.

CPU 1 (Software version 1)	Ver.1.05
CPU 2 (Software version 2)	Ver.1.02

1.5.3 Software Version Confirmation Method

The above software versions can be confirmed using the following methods.

- Software version 1, Software version 2
  - RTEX communication command Type_Code 140h (A4N-compatible), 14h (standard)
    (See Technical Reference Communication Specification)
  - Set-up Support Software (PANATERM ver.7)

1.5.4 Functions Not Currently Supported

The functions listed in the table below are not currently supported in this software version.

Please note that although the following functions are described in some parts of the text, they are not supported in this software version.

Function name
Profile position control (PP)
Cyclic velocity control (CV)
Cyclic torque control (CT)
Full-closed control function (rotary scale)
Batteryless absolute encoder
Position comparison output function
Continuous rotating absolute encoder function
Virtual full-closed control function
External scale position information monitor function for semi-closed control
Deterioration diagnosis warning function
Latch mode function with stop function
Retracting operation function
Fall prevention function for when alarm is triggered
Slow stop function
Backlash compensation function

1.5.5 Software Version History

- New software versions are upward compatible with old software versions.

  The parameters used in the old software version can be used as they are in the new software version.

  Parameter factory default values for features added in the new software version are set to values that disable the added features. For this reason, immediately after upgrading, the servo driver will operate in a manner compatible with an older software versions.
- When using the added functions, set parameters in accordance with the explanations of functions in this manual.

Software version		Class	Changed Function Details	Relevant Section	Supported Set-up Support Software (PANATERM ver.7)
CPU1	CPU2				
1.04	1.02	First version	Newly created	—	7.0.0.0 and later
1.05	1.02	Extended Version 1	Monitor Signal Output	*"3.2.8.1"*	7.0.3.0 and later

1.5.6 Functional Differences from Previous Series

- For differences from the MINAS A6N Series, see Technical Reference Functional Specification "1.2.6 Functional Differences from Previous Series" and Technical Reference Communication Specification "1.2.6 Functional Differences from Previous Series" .
- The MINAS A7N Series may not operate in complete compatibility with previous series (the A6N Series, etc.). Be sure to carry out an evaluation before changing from a previous series to the MINAS A7N Series, as parameter re-tuning may be required.

  The initial values for the MINAS A7N Series are listed in *"6.3 List of Parameters"* .

1.6 Trademarks

- MINAS, TUNE COMPASS, PANATERM, Realtime Express and RTEX are registered trademarks or trademarks of Panasonic Holdings Corporation in Japan and other countries.

1.7 Maintenance and Inspection

Routine maintenance and inspection of the driver and motor are essential for proper and safe operation.

1.7.1 Maintenance and Inspection Requests

- Power should be turned on and off by the operators themselves. Do not approach the motor or the machine when it is running during power-up to ensure safety in the event of an unexpected malfunction.
- After the power supply is switched off, the internal circuit is charged at high voltage for a period of time. Turn off the power and allow 15 minutes or longer after the charge lamp display on the front panel has gone off before inspection.
- Disconnect all connections to the driver when a performing a Megger test (insulation resistance measurement) of the driver. Performing a Megger test while it is connected may cause the driver to malfunction.
- Do not use benzine, thinner, alcohol, acidic, or alkaline detergents, since this may cause discoloration or damage the exterior of the product.

1.7.2 Inspection Items and Cycles

- Ordinary, normal usage conditions are indicated below.

  <u>Condition range: Ambient temperature 30°C (annual average), load factor 80% or lower, operating hours 20 hours or less per day</u>
- Perform daily and periodic inspections per the items below.

Classification	Inspec-tion Cycle	Inspection Item
Daily inspec-tion	Daily	● Are the operating temperature and humidity within the guaranteed range? ● Is there dirt, dust, and foreign matter? ● Is there any abnormal vibration or noise? ● Is the power supply voltage normal? ● Is there any unusual odor? ● Is there any lint or other particles adhering to air holes? ● Are the connector cables and the front portion of the driver clean? ● Is the wiring damaged? ● Are there loose connections or any misalignment between the motor and the machine or equipment? ● Is there any foreign matter caught on the load side?
Periodic in-spection	Annual	● Are there loose fasteners? ● Is there any evidence of overheating? ● Is the terminal block damaged? ● Are there loose fasteners on the terminal block?

— Precautions —

- The periodic inspection cycle may change when the usage conditions change from the above.

1.7.3 Part Replacement

Part replacement cycles vary, depending on actual operating conditions. Parts must also be replaced (or repaired) when an error has occurred.

Some equipment may not be supported. Please address requests for parts or repairs to your dealer or motor repair consultation service.

⚠ WARNING

- No disassembly and repair is to be performed except by Panasonic.

Product Name	Classification	Approximate lifetime (hours)
Driver	Smoothing capacitor	Approximately 5 years
	Cooling fan (*1)	Approximately 2 years
	Aluminum electrolytic capacitor on the PCB	Approximately 5 years
	Inrush current preventive relay	Approximately 100,000 times (Lifetime varies depending on usage conditions.)
	Inrush current preventive resistor	Approximately 20,000 times (Lifetime varies depending on usage conditions.)
Motor	Bearing (*2)	3 to 5 years (20,000 to 30,000 hours)
	Oil seal	5000 hours
	Encoder	3 to 5 years (20,000 to 30,000 hours)
	Battery for absolute encoder	See *“2.4.2 Battery for Absolute Encoder”* .

*1 Only some models have internal cooling fans. For details, see *“2.1.2 Model Product Numbers”* .

*2 Bearing replacement requires disassembly of the motor.

When the motor is disassembled and reassembled, the precision of the flange surface perpendicularity to the shaft and shaft end flare cannot be guaranteed. Therefore, replacement and repair will only be performed with the customer's consent.

Notes

- The approximate lifetime is the number of years used for reference. Even before the approximate lifetime has elapsed, parts must be replaced if errors occur.
- If a driver or motor error occurs, replace the defective unit or replace with a new product (for parts other than cooling fan).

1.8 Compliance with International Standards

1.8.1 Conforming Standards

1.8.1.1 List of Conforming Standards

A list of conforming standards is shown below.

Multi-function type
Application specialized type

Standard type

Servo Driver Conforming Standards

Conforming Standard Name		Servo Driver
EU/UK Standards	EMC	EN 55011 (Group1, Class A) EN 61000-6-2 EN 61000-6-4 EN 61800-3 (CategoryC2, Second environment)
	Low Voltage	EN 61800-5-1
	Machinery (Functional Safety)	EN ISO 13849-1:2015 EN 61508 EN IEC 62061 EN 61800-5-2 EN 61326-3-1 IEC 60204-1
UL Standards		UL 61800-5-1 (File No. E164620)
CSA Standards		CSA C22.2 No. 274
Radio Waves Act (South Korea) (KC)		KN 11 KN 61000-4-2, 3, 4, 5, 6, 8, 11

Safety Parameters

Parameters	With SSU diagnostic	With EDM diagnostic	With neither EDM nor SSU diagnostic
Safety integrity level	EN 61508 (SIL3) EN IEC 62061 (maximum SIL 3)	EN 61508 (SIL3) EN IEC 62061 (maximum SIL 3)	EN 61508 (SIL2) EN IEC 62061 (maximum SIL 2)
Performance level	EN ISO 13849-1:2015 Category 3 PL e	EN ISO 13849-1:2015 Category 3 PL e	EN ISO 13849-1:2015 Category 3 PL d
Safety function	EN 61800-5-2 (SIL 3, STO)	EN 61800-5-2 (SIL 3, STO)	EN 61800-5-2 (SIL 2, STO)
Probability of dangerous failure per unit of time	PFH=0.88 $\times 10^{-8}$ [1/h] (% SIL3=8.8 %)	PFH=0.88 $\times 10^{-8}$ [1/h] (% SIL3=8.8 %)	PFH=0.91$\times 10^{-8}$ [1/h] (% SIL2=0.91 %)
Average time to dangerous failure	MTTFd: High (100 years)	MTTFd: High (100 years)	MTTFd: High (100 years)
Average self-diagnosis coverage	DC: Medium 94.6 [%]	DC: Medium 94.6 [%]	DC: Low 68.1 [%]
Mission time	15 years	15 years	15 years
Stop category	IEC 60204-1 (stop category 0)	IEC 60204-1 (stop category 0)	IEC 60204-1 (stop category 0)

For details about diagnostics via SSU and EDM, see *"9.1.4 STO Function Diagnostics"* .

When exporting, follow the statutory provisions of the destination country.

— Precautions —

- The standard type does not support the functional safety standards.
- This product is not subject to China Compulsory Certification (CCC).

AC Servo Motor Conforming Standards

		Standard No.
EU/UK Standards	Low Voltage	EN 60034-1 EN 60034-5
UL Standards		UL 1004-1, UL 1004-6 (File No. E327868)
CSA Standards		CSA 22.2, No. 100
GB Standards (*1)		GB 30253

*1 Models that meet this standard are those with 600 W or more and no brakes.

1.8.1.2 EU Directives and UK Regulations

Panasonic complies with the low voltage regulations of the EU and UK, in order to facilitate compliance of built-in equipment and devices with EU Directive/UK Regulations.

1.8.1.3 Compliance with EU Directives/UK Regulations

1 EN 55011

Warning: Class A equipment is intended for use in an industrial environment. Conductive and radioactive interference can make it difficult to ensure electromagnetic compatibility in other environments.

Note: This product is not intended for use in a residential environment, and protection against radio reception may be inadequate in such an environment.

2 EN 61800-3

This product is not intended for ordinary home use, or for connection to low-voltage public communication circuits. Radio frequency interference may occur when connected to such circuits.

In order to comply with EU EMC Directives and UK EMC Regulations, use a noise filter, a surge absorber, and a ferrite core. Compliance with EU EMC Directives and UK EMC Regulations must be confirmed using final equipment and devices with built-in servo drivers and servo motors.

1.8.1.4 Compliance with UL Standards

1 Installation Environment

Use in an environment with a pollution degree of 2 as stipulated in IEC 60664-1.

Make sure to connect a UL-approved (with LISTED mark) molded-case circuit-breaker (MCCB) and fuse to the main power supply.

Only use copper conductor wires with a temperature rating of 75°C for wiring.

2 Short-Circuit Current Rating (SCCR)

The servo driver of this product is compatible with power supplies with a symmetrical current of 5000 Arms or less at less than the maximum input voltage of the product.

3 Branch Circuit Protection

Implement branch circuit protection in accordance with National Electrical Code (NEC) standards and local standards.

1.8.1.5 Support for SEMI F47 Momentary Power Failure Standard

The SEMI F47 standard includes requirements for voltage drops in semiconductor manufacturing equipment.

The control power supply for the servo driver complies with the SEMI F47 standard. The main circuit power supply complies with the SEMI F47 standard with no load or light loads.

— Precautions —

- The single phase 100 V specification servo driver is excluded.
- Always use the actual equipment for evaluation and review with respect to the SEMI F47 standard.

1.8.1.6 Radio Waves Act (South Korea) (KC)

The servo driver in this product is Class A device (broadcast communication device for business use) under the South Korea Radio Waves Act.

Please be aware of the following precautions before using this product.

A 급 기기 (업무용 방송통신기자재)
이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
(대상기종 : Servo Driver)

[Reference translation]

Class A device (broadcast communication device for business use)

This device is an electromagnetic wave generating device for business use (Class A),

and is intended for non-household use.

Users and distributors should note this fact.

(Applicable model: Servo Driver)

1.8.1.7 Compliance with China RoHS

Hazardous material content information (English, Chinese)

AC Servo Driver

Applicable models and components

	Applicable models	Components						
		Printed circuit board	Heat sink	Plastic case	Screw	Fan	Cable	Accessory plug
A7 series	MADN＊＊＊＊＊＊＊＊	●	●	●	●	—	—	●
	MBDN＊＊＊＊＊＊＊＊	●	●	●	●	—	—	●
	MCDN205＊＊＊＊＊	●	●	●	●	—	●	●
	MCDN245＊＊＊＊＊	●	●	●	●	●	●	●
	MDDN＊＊＊＊＊＊＊＊	●	●	●	●	●	●	●
● : With components — : Without components								

Name and content of hazardous material in a product

Name of component	Hazardous material					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr (VI))	Polybrominated biphenyl (PBB)	Polybrominated diphenyl ether (PBDE)
Printed circuit board	×	○	○	○	○	○
Heat sink	○	○	○	○	○	○
Plastic case	○	○	○	○	○	○
Screw	○	○	○	○	○	○
Fan	×	○	○	○	○	○
Cable	○	○	○	○	○	○
Accessory plug	○	○	○	○	○	○

This table is prepared based on the rules specified in SJ/T11364.

○ : The amount of hazardous materials in materials of all applicable components does not exceed the limit specified in GB/T26572.

× : The amount of hazardous material in the material of at least one of applicable components exceeds the limit specified in GB/T26572.

交流伺服驱动器

对象机型及构成部位

	型号	构成部位						
		印刷电路板完成品	散热器	树脂机箱	螺丝	风扇	配线类	附带连接器
A7 系列	MADN＊＊＊＊＊＊＊＊	●	●	●	●	–	–	●
	MBDN＊＊＊＊＊＊＊＊	●	●	●	●	–	–	●
	MCDN205＊＊＊＊＊	●	●	●	●	–	●	●
	MCDN245＊＊＊＊＊	●	●	●	●	●	●	●
	MDDN＊＊＊＊＊＊＊＊	●	●	●	●	●	●	●
● : 有构成部位　– : 无构成部位								

产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷电路板完成品	×	○	○	○	○	○
散热器	○	○	○	○	○	○
树脂机箱	○	○	○	○	○	○
螺丝	○	○	○	○	○	○
风扇	×	○	○	○	○	○
配线类	○	○	○	○	○	○
附带连接器	○	○	○	○	○	○
本表格依据 SJ/T11364 的规定编制。 ○ : 表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。 × : 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T26572 规定的限量要求。						

AC Servo Motor

Applicable models and components

	Applicable models	Components							
		Frame	Stator Assembly	Rotor Assembly	Bracket	Rotary Encoder	Screw	Resin parts	Metal parts
A7 series	M∗MG∗∗∗∗∗∗∗∗	●	●	●	●	●	●	●	●

● : With components — : Without components

Name and content of hazardous material in a product

Name of component	Hazardous material					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr (VI))	Polybrominated biphenyl (PBB)	Polybrominated diphenyl ether (PBDE)
Frame	×	○	○	○	○	○
Stator Assembly	×	○	○	○	○	○
Rotor Assembly	×	○	○	○	○	○
Bracket	×	○	○	○	○	○
Rotary Encoder	×	○	○	○	○	○
Screw	○	○	○	○	○	○
Resin Parts	○	○	○	○	○	○
Metal Parts	×	○	○	○	○	○

This table is prepared based on the rules specified in SJ/T11364.
○ : The amount of hazardous materials in materials of all applicable components does not exceed the limit specified in GB/T26572.
× : The amount of hazardous material in the material of at least one of applicable components exceeds the limit specified in GB/T26572.

交流伺服电机

对象机型及构成部位

	型号	构成部位							
		架	定子组装	转子组装	托架	编码器	螺丝	树脂零件	金属零件
A7 系列	M＊MG＊＊＊＊＊＊＊＊	●	●	●	●	●	●	●	●
●：有构成部位　–：无构成部位									

产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
架	×	○	○	○	○	○
定子组装	×	○	○	○	○	○
转子组装	×	○	○	○	○	○
托架	×	○	○	○	○	○
编码器	×	○	○	○	○	○
螺丝	○	○	○	○	○	○
树脂零件	○	○	○	○	○	○
金属零件	×	○	○	○	○	○

本表格依据 SJ/T11364 的规定编制。
○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。
×：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T26572 规定的限量要求。

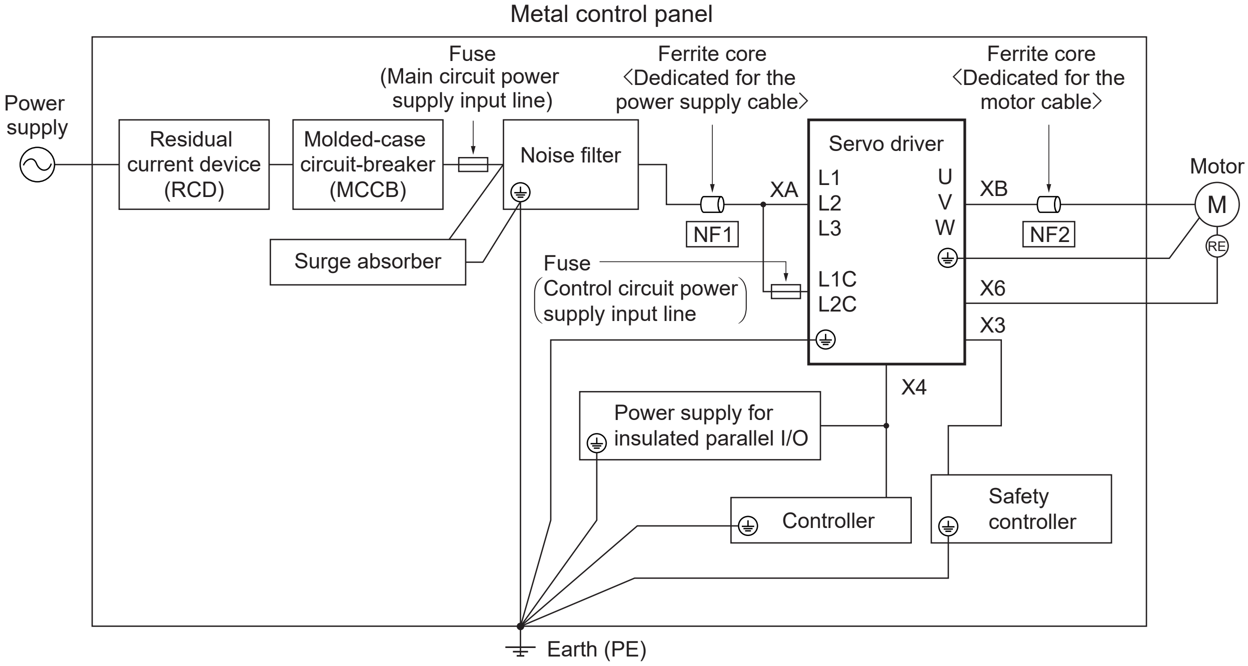
1.8.2 Configuration of Peripheral Devices

1.8.2.1 Installation Environment

- Use in an environment with a pollution degree of 2 as stipulated in IEC 60664-1.
  (Example) Installation in an IP54 metal control panel.
- Make sure to connect an IEC Standard and UL-approved (with LISTED mark) molded-case circuit-breaker (MCCB) and fuse to the main power supply.
- Use a 24 V DC power supply with double insulation or reinforced insulation for the parallel I/O power supply.

Example installation in a metal control panel

100 V/200 V System specifications



The conditions required for compliance with EU EMC Directive/UK EMC Regulations are indicated below.

- Install the servo driver on the metallic casing (control panel).
- Install a noise filter and surge absorber in the power supply line.
- Shielded twisted-pair cables must be used for input/output signal cables and encoder cables. Use tin plated annealed copper wire for the shield.
- Provide a ferrite core, according to the diagram, for each power source cable and motor cable to be connected to the servo driver.
- Cable shields (not shown in the diagram) should be directly grounded to protective earth (PE).

The foregoing are conditions for compliance with EU EMC Directives and UK EMC Regulations, and since installation and wiring conditions are affected by the statuses of connected devices and wiring when incorporated into the equipment used, compatibility with all devices must be confirmed.

Notes

- For details on the structures of the wires, cables, peripheral devices, and control panel in the above diagram, see *"1.8.2.2 List of Peripheral Devices"* to *"1.8.2.14 Overload Protection and Overheating Protection"* from the next section onwards.

— Precautions —

- Use the parts correctly after reading the respective operating instructions for each, and sufficiently reviewing the precautions. Also, ensure that excessive stress is not applied to the parts.

1.8.2.2 List of Peripheral Devices

Peripheral devices used together with the servo driver, as well as device installation methods, methods of use, and installation precautions are indicated below. For an installation example, see *"1.8.2.1 Installation Environment"* .

Servo Driver (*1)	Voltage Specification	Motor rated output	Power Supply Capacity (At rated load)	Molded-case Circuit-Breaker (MCCB) Rated Current	Short protection element (fuse)		Noise filter (*3)	Surge absorber (*3)	Ferrite core (*3)		Electromagnetic Contactor (Rated carrying current/Open thermal current)
					Main circuit power supply input line	Control circuit power supply input line			Power Supply Cable	Motor cable	
MADN061□□	Single phase 100 V	50 W	Approx. 0.4 kVA	15 A	10 A	1 A	DV0P4170	RSPD-250-Q4	—	DV0P1460	20 A
MADN081□□		100 W	Approx. 0.4 kVA						—		
MBDN121□□		200 W	Approx. 0.5 kVA						—		
MCDN201□□		400 W	Approx. 0.9 kVA		20 A		DV0PM20042		—		
MADN065□□	Single phase/3-phase 200 V	50 W	Approx. 0.5 kVA		10 A		DV0P4170 (for single phase) / DV0PM20042 (for 3-phase)	RSPD-250-Q4 (for single phase) / RSPD-250-U4 (for 3-phase)	—		
		100 W							—		
MADN085□□		200 W	Approx. 0.6 kVA						—		
MBDN125□□		400 W	Approx. 1.0 kVA						—		
MCDN205□□		750 W	Approx. 1.9 kVA		20 A		DV0PM20042		—		
MDDN405□□ (*2)		1000 W	Approx. 2.4 kVA		35 A		DV0P4220		—		32 A

*1 The "□" in the model number represents the difference in specification.

*2 When using a single-phase power supply, the driver input RMS current must be derated to 12 Arms or less for UL certification.

*3

	Optional Product Number	Manufacturer Product Number	Manufacturer
Surge absorber	—	RSPD-250-U4	Okaya Electric Industries
	—	RSPD-250-Q4	
Ferrite core	DV0P1460	ZCAT3035-1330	TDK Corporation
Noise filter	DV0P4170	SUP-EK5-ER-6	Okaya Electric Industries
	DV0P4220	3SUP-HU30-ER-6	
	DV0PM20042	3SUP-HU10-ER-6	

Notes

- For models with single-phase/3-phase 200 V specifications, select the peripheral devices according to the power source used.
- For details on servo driver product numbers, see *"How to Read Product Numbers"* and *"2.1.2 Model Product Numbers"* .
- For details on peripheral device specifications, see *"12.4 Optional Parts"* .

— Precautions —

- Select a molded-case circuit-breaker (MCCB) noise filter with a capacity that matches the power supply capacity (considering load conditions).
- Earth terminal

  Use copper conductor wires with a temperature rating of 75°C or higher for wiring.

  Protective earth terminals are M4 for sizes A to D.
- The wire diameter of the earth wire cable should be 2.0 mm^2 (AWG 14) or more for outputs of 50 W to 2.5 kW, 3.5 mm^2 (AWG 12) or more for outputs of 3.0 kW to 5.0 kW, 8.0 mm^2 (AWG 8) or more for 7.5 kW, 22 mm^2 (AWG 4) or more for 15.0 kW, and 38 mm^2 (AWG 2) or more for 22.0 kW.
- For sizes A to D, use the included dedicated connectors.
- The tightening torque of the screws used for connecting the host controller to connector X4 should be 0.2 ± 0.05 N·m.

  The servo driver-side connector may break if you exceed the maximum screw tightening torque.

1.8.2.3 Electric Wires

1.8.2.3.1 Wires and Maximum Cable Length

Name	Symbol	Maximum Cable Length (*1)	Wires Used
Main power supply input	L1, L2, L3	—	See *"1.8.2.3.2 Wire Specifications by Model"* .
Control power supply input	L1C, L2C	—	
Motor output	U, V, W, ⏚	20 m	
Earth cable	⏚	—	
Encoder connection	X6	10 m	Shielded twisted-pair wire 0.18 mm^2 or larger cross-sectional area of core wire
External scale connection (*3)	X5	20 m	
Parallel I/O connection	X4	3 m	
Safety connection (*3)	X3	3 m	0.18 mm^2 or larger cross-sectional area of core wire
RTEX connection	X2	100 m (*2)	TIA/EIA-568 CAT5e STP

*1 The above wiring lengths are the maximum lengths used in Panasonic's evaluation environment, and do not guarantee operation in customers' operating environments.

*2 For details, see *"3.2.3 Wiring to Connector X2 (Host Device Connection)"* .

*3 Compatible with both the multi-function type and application specialized type. For supported functions by driver type, see *"2.1.4.5 Supported Functions (By Driver Type)"* .

1.8.2.3.2 Wire Specifications by Model

Servo Driver	Applicable motors	Voltage Specification	Motor rated output	Power Supply Capacity (At rated load)	Main circuit wire diameter/ Withstand voltage	Control power wire diameter/ Withstand voltage	Motor wire diameter/ Withstand voltage	Brake wire diameter/ Withstand voltage	Earth wire diameter/ Withstand voltage
MADN061☐☐	MHMG5AZU1☐2☐	Single phase 100 V	50 W	Approx. 0.4 kVA	2.0 mm^2/ AWG 14 300 V or more	2.0 mm^2/ AWG 14 300 V or more	0.75 mm^2/ AWG 18 300 V or more	0.75 mm^2/ AWG18 100 V or more	2.0 mm^2/ AWG 14 300 V or more
MADN081☐☐	MHMG011U1☐2☐		100 W	Approx. 0.4 kVA					
MBDN121☐☐	MHMG021U1☐2☐		200 W	Approx. 0.5 kVA					
MCDN201☐☐	MHMG041U1☐2☐		400 W	Approx. 0.9 kVA					
MADN065☐☐	MHMG5AZU1☐2☐	Single phase/ 3-phase 200 V	50 W	Approx. 0.5 kVA					
	MHMG012U1☐2☐		100 W						
MADN085☐☐	MHMG022U1☐2☐		200 W	Approx. 0.6 kVA					
MBDN125☐☐	MHMG042U1☐2☐		400 W	Approx. 1.0 kVA					
MCDN205☐☐	MHMG082U1☐2☐		750 W	Approx. 1.9 kVA					
MDDN405☐☐	MHMG092U1☐2☐		1000 W	Approx. 2.4 kVA			1.25 mm^2/ AWG16 300 V or more		

Notes

- Select the peripheral devices for both single phase and 3-phase 200 V specifications according to the power supply used.

1.8.2.3.3 Wiring Terminal Blocks and Earth Terminals

- Use copper conductor wires with a temperature rating of 75°C or higher for wiring.
- Ensure that the product is wired correctly and securely. Insecure or improper wiring may cause the motor to run out of control or burn.

  Ensure that no conductive material such as wire debris enters into the servo driver during installation and wiring.
- For sizes A to D, use the included dedicated connectors. For wiring methods, see *“3.2.1.3 Wiring the Driver XA, XB Connectors”* and *“3.2.1.4 Motor Connector Specifications”* .
- The tightening torque is indicated below.

  When connecting the ground screw to the host controller with a connector (X4)

Servo Driver Size	Ground Screw		Connector (X4) for Connecting to Host Controller	
	Nominal	Tightening Torque [N·m]	Nominal	Tightening Torque [N·m]
A to D	M4	0.7 to 0.8	M2.6	0.2 ± 0.05

— Precautions —

- Exceeding the maximum tightening torque may cause damage.
- Do not turn on the power with the terminal block screws loose. Turning on the power with screws loose may cause smoke emission or fire.

- Conduct annual periodic inspections of tightening torque to check for looseness and retighten so that the tightening torque is within the specified range as necessary.

1.8.2.3.4 Relationship Between Cable Thickness and Allowable Current

An example of the relationship between cable diameter and allowable current is provided below. Refer to this when selecting cables.

(Example) When used with the conditions of a 3-phase 200 V power supply circuit, 35 A current, and 30°C ambient temperature

1 Select the fundamental allowable current in accordance with the wire material used in the cable (stranded copper wire in the example).

  (Select ◇ in the table of basic current capacity)

2 After selecting the fundamental allowable current, determine the number of wires to be used. A 4-core cable is selected, consisting of 3-phase wire (3 wires) and a ground wire, but the number of wires is 3 because the ground wire is not counted (◎ in the current reduction coefficient table).

3 When the usage conditions have been selected, determine the actual allowable current from the following formula.

  Implemented allowable current

  = fundamental allowable current × current reduction coefficient × current compensation coefficient

  $= 37 \times 0.7 \times 1.414$

  $\cong 36.6$ (A) as the result.

  - The current compensation coefficient can be calculated from the following formula.

    $\sqrt{(\text{Max. allowable temperature} - \text{ambient temperature}) \div 30}$

    Check the specifications for the cable used, since the current compensation coefficient varies, depending on the cable.

  - The current reduction coefficient is provided for cases in which the cable (4-conductor cable in the example), is housed in a plastic sheath, plastic tube, metal sheath, metal tube, or flexible conduit.

4 The current used in the cables is 35 A, which is within the allowable range, and therefore, the cable used, having a nominal cross-sectional area 3.5 mm^2 larger than that of the table of recommended eco-cables, is a 4-core polyethylene-insulated power cable with heat-resistant polyethylene sheath, having a finished outer diameter of 13.5 mm (shielded, 14.5 mm).

Notes

- It is recommended that you take into account a margin for operation temperature, electric current, etc., when selecting cables for cable testing.
- The current reduction coefficient, fundamental allowable current, etc., indicated on this page may change depending on standards revisions, etc. Therefore, be sure to check with the manufacturer of the cable used in testing.

Fundamental allowable current

Stranded conductor wire diameter (Nominal cross-sectional area, mm^2)	Copper wire [A]
≥2 and <3.5	27
≥3.5 and <5.5 ◇	37
≥5.5 and <8	49
≥8 and <14	61
≥14 and <22	88
≥22 and <30	115
≥30 and <38	139
≥38 and <60	162
≥60 and <100	217
≥100 and <150	298
≥150 and <200	395

Current reduction coefficient

Number of cables in the same tube	Current reduction coefficient
3 wires or less ◎	0.70
4 wires	0.63
5 or 6 wires	0.56
≥7 wires and ≤15 wires	0.49
≥16 wires and ≤40 wires	0.43
≥41 wires and ≤60 wires	0.39
≥61 wires	0.34

■ Recommended eco-cables

Cable type: 4-core polyethylene-insulated power cable with heat-resistant polyethylene sheath (standard: "EM" JIS C 3605) Maximum allowable temperature: 90°C									
Conductor			Insulation thickness [mm]	Sheath thickness [mm]	[Reference] Finished outer diameter [mm]	Maximum conductor resistance [20°C] [Ω/km]	Test voltage [V/minute]	Minimum insulation resistance [MΩ·km]	[Reference] Approximate mass [kg/km]
Nominal cross sectional area (mm^2)	Structure or shape (wires/mm^2)	Outer diameter [mm]							
2	7/0.6	1.8	0.8	1.5	12.0	9.42	1500	2500	170
3.5	7/0.8	2.4	0.8	1.5	13.5	5.30	1500	2500	250
5.5	7/1.0	3.0	1.0	1.5	16.0	3.40	1500	2500	360
8	7/1.2	3.6			17.0	2.36		2000	475
14	Circular compressed	4.4			19.0	1.34	2000	1500	730
22		5.5	1.2	1.6	23	0.849			1100
38		7.3		1.8	28	0.491	2500		1800
60		9.3	1.5	2.0	35	0.311			2790
100		12.0	2.0	2.4	44	0.187			4630
150		14.7		2.6	51	0.124	3000	1000	6710
200		17.0	2.5	2.9	60	0.0933		1500	8990

* The finished shielded outer diameter is approximately 1 mm larger.

1.8.2.3.5 Movable Part Cable Wiring

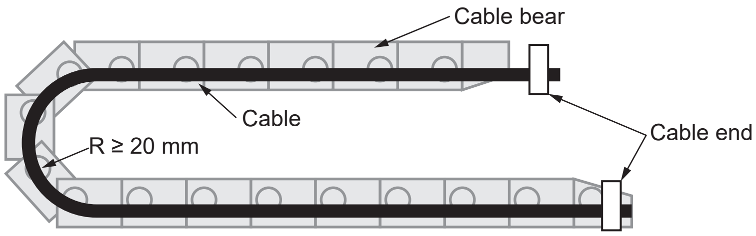
When wiring in a cable bear, please observe the following precautions.

1 Cable bear wiring

The bend radius of the cable must be 10 times or more its finished outer diameter. However, set the minimum radius to R ≥20 mm (for the finished outer diameter, see table *"1.8.2.3.4 Relationship Between Cable Thickness and Allowable Current"* above).

Do not affix or bundle wires in the cable bear. When securing the cable, affix it only at non-movable ends of the cable bear, at which the cable is free from any stress (e.g. tension). (The cable cannot be fixed rigidly.)

Recommended cable bear wiring



Do not keep the cable too long and loose or too short and tense.

Note that in this state the sheath may be cracked by the internal wall of the cable bear, entangled with other cables, etc., causing unexpected accidents.

2 Cable twisting

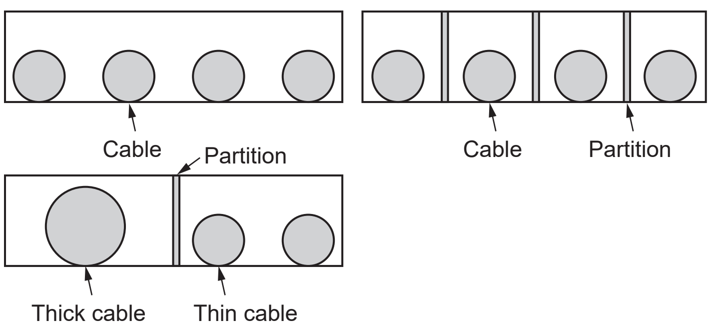
Do not twist the cable. Note that twisted cables may lead to poor contact, lowered performance of the cable from its original state, and declining reliability.

3 Cable bear interior cable space factor

Arrange the cables so as not to overlap horizontally, and select a cable bear of ample width.

Ensure that the cable space factor is 60% or less (30% or less is recommended). Do not run cables of greatly differing outer diameters together in mixed wiring. If cables of greatly differing outer diameters are run together in mixed wiring, thin cables may break under the pressure of thick cables. If mixing cables, provide a partition to separate them inside the cable bear.

Example of wiring inside a cable bear



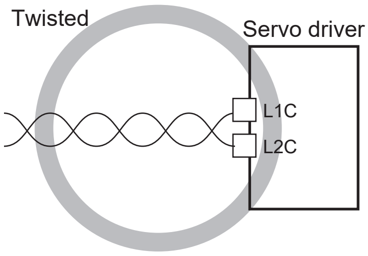
1.8.2.4 Power Supply

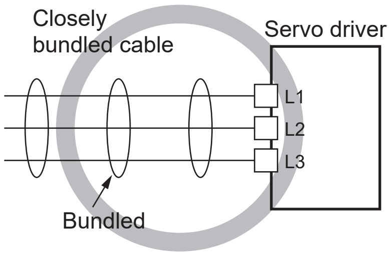
- Use this product in the Overvoltage Category III environment provided for in IEC 60664-1.
- Use a parallel I/O power supply product that is CE marking compliant or an insulated 12-24 V DC power supply that is EN standard (EN 60950) compliant.
- The power supply voltage specifications are as follows.

Voltage	Servo Driver Size	Voltage Specification	Frequency
100 V	A to C	Single phase: 100 to 120 V, -15% to +10%	50/60 Hz
200 V	A to D	Single phase/3-phase: 200 to 240 V, -15% to +10%	50/60 Hz

— Precautions —

- Power cable and signal wires must be isolated from each other in wiring.
- Use a sheathed (jacketed) cable, twisted cable (illustrated on the left below), or closely bundled cable (illustrated on the right below) for the power cable.





1.8.2.5 Molded-Case Circuit-Breaker (MCCB)

- In order to ensure compliance with EU Directives/UK Regulations, make sure to connect a molded-case circuit-breaker (MCCB) between the power supply and noise filter.

  The short-circuit current of the power supply used should be a symmetrical current of 5,000 Arms or less, at or below the maximum input voltage of the product.

  If the short-circuit current of the power supply exceeds this, limit the short-circuit current by using a current-limiting device (such as a current-limiting fuse, current-limiting breaker, transformer).
- The product's short-circuit protection circuit is not intended to protect branch circuits. Select branch circuit protection in accordance with the NEC standard and local standards.
- This product does not have earth fault protection functions. Please install a molded-case circuit-breaker or residual current device that corresponds to the corresponding earthing system.

  Earth fault protection conditions for when using a molded-case circuit-breaker are as shown below. These conditions satisfy the requirements of EN 60364-4-41.

Servo driver	Molded-case circuit-breaker			Voltage to ground [V]	Maximum allowable fault loop impedance (Ω)
	Rating [A]	Recommended model	Manufacturer		
MADN061□□	15	BW50RAGU	Fuji Electric Co., Ltd.	100	0.25
MADN081□□	15	BW50RAGU	Fuji Electric Co., Ltd.	100	0.31
MBDN121□□	15	BW50RAGU	Fuji Electric Co., Ltd.	100	0.31
MCDN201□□	15	BW50RAGU	Fuji Electric Co., Ltd.	100	0.42
MADN065□□	15	BW50RAGU	Fuji Electric Co., Ltd.	115	0.33
MADN085□□	15	BW50RAGU	Fuji Electric Co., Ltd.	115	0.39
MBDN125□□	15	BW50RAGU	Fuji Electric Co., Ltd.	115	0.42

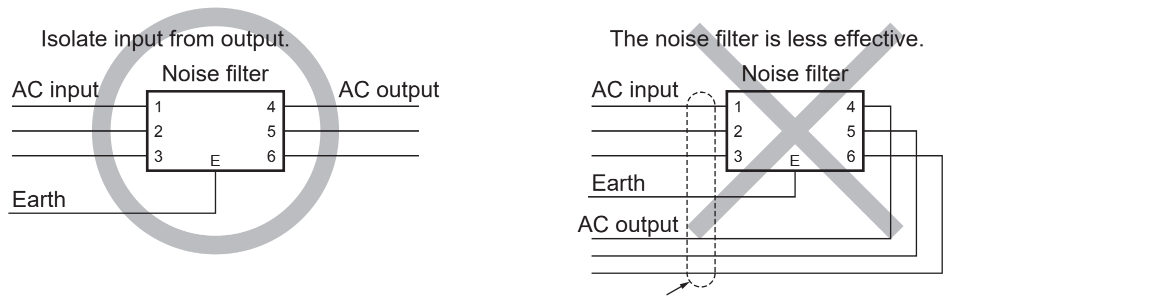
Servo driver	Molded-case circuit-breaker			Voltage to ground [V]	Maximum allowable fault loop impedance (Ω)
	Rating [A]	Recommended model	Manufacturer		
MCDN205□□	15	BW50RAGU	Fuji Electric Co., Ltd.	115	0.50
MDDN405□□	15	BW50RAGU	Fuji Electric Co., Ltd.	115	0.51

Notes

- Select a molded-case circuit-breaker (MCCB) with a capacity that matches the power supply capacity (considering load conditions).

1.8.2.6 Noise Filter

- Select a noise filter with a capacity that matches the power supply capacity (considering load conditions).
- For the detailed specifications of each noise filter, contact the manufacturer.
- Consult with the manufacturer of the noise filter if using multiple servo drivers and installing one noise filter for all power supplies.
- Noise immunity is reduced if the same wiring is used for input and output (Illustrated on the right below.).
- Isolate input from output (Illustrated on the left below.).



Notes

- For details of optional product numbers and specifications, see *“12.4.1 Noise Filter”* .

1.8.2.7 Surge Absorber

- Install the surge absorber on the primary side of the noise filter.
- For details of optional product numbers and specifications, see *“12.4.2 Surge Absorber”* .

— Precautions —

- Always remove the surge absorber before high voltage insulation testing machinery and equipment. Failure to do so may result in damage to the surge absorber.

1.8.2.8 Ferrite Core

- Ensure all cables (motor cables, encoder cables, interface cables, USB cables) have a ferrite core.

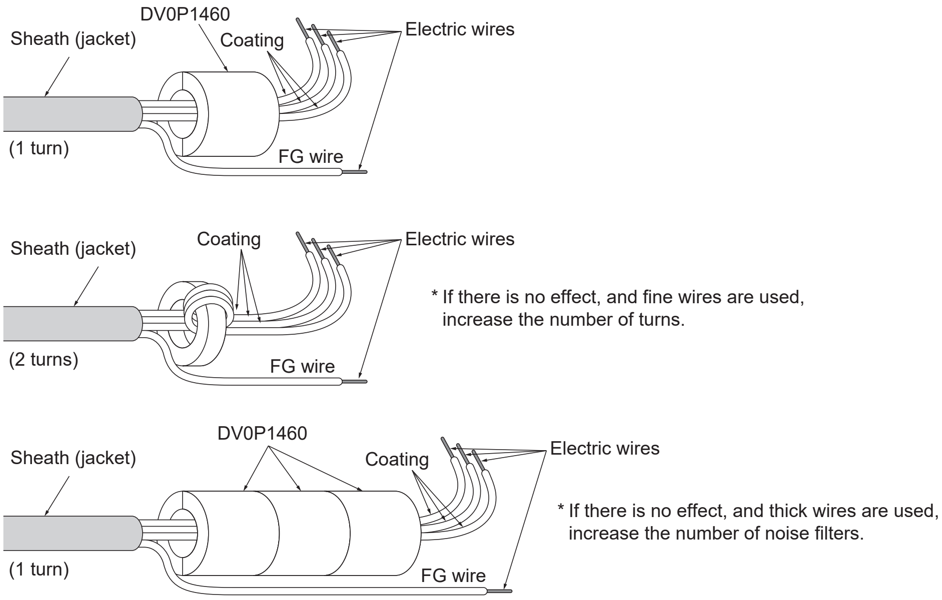
Symbol (*1)	Place of use	Applicable size	Option product number	Manufacturer product number	Manufacturer	Number required
NF1	Power supply cable	(100 V) A, B, C (200 V) A, B, C, D	–	–	–	0
NF2	Motor cable	(100 V) A, B, C (200 V) A, B, C, D	DV0P1460	ZCAT3035-1330	TDK Corporation	1 (*2)

*1 For symbols, see *"1.8.2.1 Installation Environment"* .

*2 For ferrite cores, attach the motor cables (U, V, and W) together into a single unit using 1 turn (once through).

● Attach ferrite cores according to the following procedure.

Signal cables	Wind the ferrite cores for the required number of turns.
Motor cable	When attaching ferrite cores (including those that are power line-dedicated) to Panasonic's optional cables, remove the sheaths (jackets) from the parts attached, and combine the motor cables (U, V, and W) to obtain a noise reducing effect. If there is no effect, take measures such as increasing the number of ferrite cores (including those that are power line-dedicated) (See the figure below.).
Encoder wires	Wind the ferrite cores for the required number of turns.



1.8.2.9 Residual Current Device

- Install a residual current device (RCD) on the primary side of the power supply.
- Use IEC 60947-2/JISC 8201-2-2 Type B (DC sensing type) for the residual current devices.
- This product does not have earth fault protection. Please install a molded-case circuit-breaker or residual current device that corresponds to the corresponding earthing system.

  Earth fault protection conditions for when using residual current devices are as shown below. These conditions satisfy the requirements of EN 60364-4-41.

  Ensure your TT system complies with your local national or regional laws and regulations. The rated sensed current and loop impedance of residual current devices may sometimes be stipulated by law or regulation. Further, Type B residual current devices may be mandatory.

Servo driver	Residual current device				Voltage to ground [V]	Maximum allowable loop impedance [Ω]
	Rating [A]	Rated sensed current [mA]	Recommended model	Manufacturer		
MADN061□□	15	30	EW50RAGU	Fuji Electric Co., Ltd.	100	360
MADN081□□	15	30	EW50RAGU	Fuji Electric Co., Ltd.	100	360
MBDN121□□	15	30	EW50RAGU	Fuji Electric Co., Ltd.	100	360
MCDN201□□	15	30	EW50RAGU	Fuji Electric Co., Ltd.	100	360
MADN065□□	15	100	EW50RAGU	Fuji Electric Co., Ltd.	115	207
MADN085□□	15	100	EW50RAGU	Fuji Electric Co., Ltd.	115	207
MBDN125□□	15	100	EW50RAGU	Fuji Electric Co., Ltd.	115	207
MCDN205□□	15	100	EW50RAGU	Fuji Electric Co., Ltd.	115	207
MDDN405□□	15	100	EW50RAGU	Fuji Electric Co., Ltd.	115	207

1.8.2.10 Earth

- To prevent electric shock, make sure to connect the earth terminal (⏚) of the servo driver to the earth (PE) of the control panel.
- Do not tighten the connection to the protective earth terminal (⏚). Two earth terminals are provided.

1.8.2.11 Control Panel Structure

- If there is a gap at a cable inlet/outlet, the mounting hole of operation panel, a door, etc., radio waves may leak out of or penetrate into the control panel. In order to prevent this, please observe the following in designing or selecting the control panel.
  - The control board should be made of metal and ensure that it is electrically conductive.
  - The control board should not have electrically floating conductive parts.
  - The units mounted inside the case should be connected to the case.

1.8.2.12 Control Input/Output Signal Noise Immunity Enhancement

- When noise is introduced to the control input/output, it causes displacement and input/output signal malfunction.
  - Connectors X1 to X7 are used for the secondary circuit.

    The 24 V DC power supply for brakes requires insulation. Do not connect to the same power supply. Do not connect a ground wire. This may cause erroneous operation of the input/output signal.
  - The control power source should be completely isolated from external operating power sources. Take care not to connect the ground wire of the control power source to that of external power source.
  - Use a shielded cable as the signal cable, and earth both of the shielded ends.

1.8.2.13 Installing Short Protection Elements

- Connect fuses on the main circuit power supply input and control circuit power supply input lines. For details on fuse insertion locations, see below.
  - Sizes A, B: *"3.2.1.1.2 Example Connection for Entire Unit"* , *"3.2.1.1.3 Key Points on Wiring"*
  - Sizes C, D: *"3.2.1.2.2 Example Connection for Entire Unit"* , *"3.2.1.2.3 Key Points on Wiring"*
- Refer to the descriptions in the below table when selecting fuse rated currents. If compliance with UL61800-5-1 is required, use UL Listed fuses.

Servo driver	Main circuit power supply input line fuse				Control circuit power supply input line fuse			
	Rating	Options			Rating	Options		
		UL class	Recommended model	Manufacturer		UL class	Product number	Manufacturer
MADN061□□	10 A	CC	LP-CC-10	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MADN081□□	10 A	CC	LP-CC-10	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MBDN121□□	10 A	CC	LP-CC-10	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MCDN201□□	20 A	CC	LP-CC-20	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MADN065□□	10 A	CC	LP-CC-10	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MADN085□□	10 A	CC	LP-CC-10	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MBDN125□□	10 A	CC	LP-CC-10	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MCDN205□□	20 A	CC	LP-CC-20	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC
MDDN405□□	35 A	J	LPJ-35SP	COOPER BUSSMANN LLC	1 A	CC	LP-CC-1	COOPER BUSSMANN LLC

1.8.2.14 Overload Protection and Overheating Protection

- The servo driver has a built-in servo motor overload protection function. The overload protection function operates on the basis of specified time characteristics at 115% or more of the rated current.
- The servo motor does not have an overheating protection function. If NEC standard compliance is required, implement overheating protection measures for the servo motor.
- The servo driver is equipped with a thermal memory (shutdown) as required by EN 61800-5-1/UL 61800-5-1; however, it does not have thermal memory (power loss) or velocity sensor functions.

Notes

- For overload protection characteristics, see *"2.1.4.2 Overload Protection Time Characteristics (Driver)"* in *"2.1.4.1 Basic Specifications"* and *"2.2.5 Overload Protection Time Characteristics (Motor)"* .

2 Driver and Motor Basic Specifications

2.1 Driver 48
2.1.1 Checking the Model 48
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2.1.2.1 Standard Type 50
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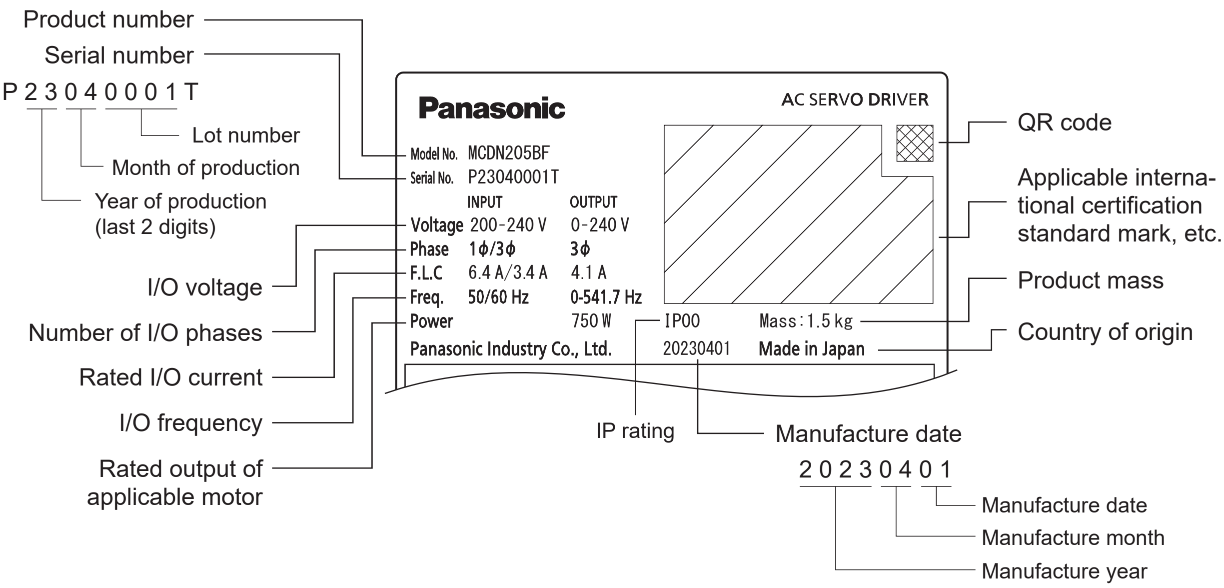
2.1 Driver

2.1.1 Checking the Model

Nameplate Example

The details shown on nameplates are as shown below.



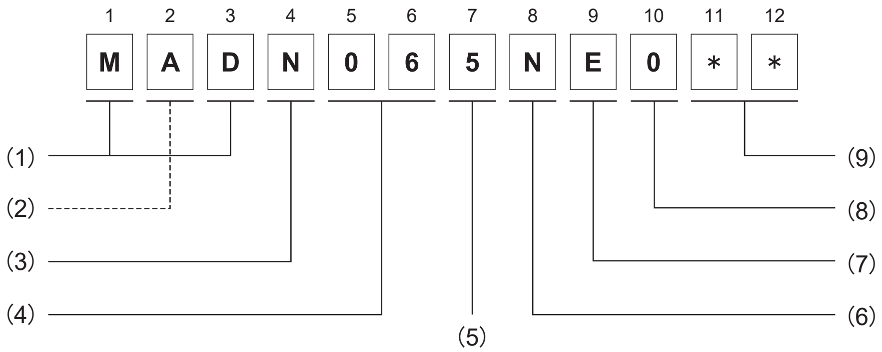
The range of the lot number in serial number is 1 to 33999, but the nameplate has 4 digits in the following format. In the four digits, the alphabet characters "I" (eye) and "O" (o) are not used.

Value of serial number	Notation on the name-plate
1 to 9999	0001 to 9999
10000 to 10999	A000 to A999
11000 to 11999	B000 to B999
…	…
17000 to 17999	H000 to H999
18000 to 18999	J000 to J999
…	…
22000 to 22999	N000 to N999
23000 to 23999	P000 to P999
…	…
33000 to 33999	Z000 to Z999

How to Read Product Numbers

The following explains how to read product numbers.

Sample Description



No.	Item	Symbol	Specifications	Remarks
(1)	Product	M☐D	Servo driver	☐ = size symbol.
(2)	Servo Driver Size	A	Size A	—
		B	Size B	
		C	Size C	
		D	Size D	
(3)	Family	N	A7 family	—
(4)	Instantaneous maximum current (peak value)	06	6 A	—
		08	8 A	
		12	12 A	
		20	20 A	
		40	40 A	
(5)	Power supply and voltage specifications	1	Single phase 100 V	—
		5	Single phase/3-phase 200 V	
(6)	Command interface specification	N	RTEX	—
(7)	Functionality	E	Rotation type Standard type	—
		F	Rotation type Multi-function type Safety STO	
		R	Rotation type Application specialized type Safety STO	
(8)	Special product supported	0	Standard type, multi-function type special product	—
		H	Gantry control supported	
		T	Pressure control supported	
		U	Meandering control, GAP control supported	
(9)	Special specifications	**	—	Alphanumerics

2.1.2 Model Product Numbers

2.1.2.1 Standard Type

Product number	Size symbol	Power supply input	Rated output of applicable motor	Internal fan
MADN061NE	A	Single-phase 100–120 V	Max 50 W	No
MADN081NE			Max 100 W	No
MADN065NE		Single-phase/3-phase 200–240 V	Max 100 W	No
MADN085NE			Max 200 W	No
MBDN121NE	B	Single-phase 100–120 V	Max 200 W	No
MBDN125NE		Single-phase/3-phase 200–240 V	Max 400 W	No
MCDN201NE	C	Single-phase 100–120 V	Max 400 W	No
MCDN205NE		Single-phase/3-phase 200–240 V	Max 750 W	No
MDDN405NE	D	Single-phase/3-phase 200–240 V	Max 1000 W	Yes

* For servo driver and motor combinations, see *“2.3 Driver and Motor Combinations”* . Some motors may not be used even if they match the rated outputs shown in this table.

2.1.2.2 Multi-function Type

Product number	Size symbol	Power supply input	Rated output of applicable motor	Internal fan
MADN061NF	A	Single-phase 100–120 V	Max 50 W	No
MADN081NF			Max 100 W	No
MADN065NF		Single-phase/3-phase 200–240 V	Max 100 W	No
MADN085NF			Max 200 W	No
MBDN121NF	B	Single-phase 100–120 V	Max 200 W	No
MBDN125NF		Single-phase/3-phase 200–240 V	Max 400 W	No
MCDN201NF	C	Single-phase 100–120 V	Max 400 W	No
MCDN205NF		Single-phase/3-phase 200–240 V	Max 750 W	No
MDDN405NF	D	Single-phase/3-phase 200–240 V	Max 1000 W	Yes

* For servo driver and motor combinations, see *“2.3 Driver and Motor Combinations”* . Some motors may not be used even if they match the rated outputs shown in this table.

2.1.2.3 Application specialized Type

Product number	Size symbol	Power supply input	Rated output of applicable motor	Internal fan
MADN065NR☐	A	Single-phase/3-phase 200–240 V	Max 100 W	No
MADN085NR☐			Max 200 W	No
MBDN125NR☐	B	Single-phase/3-phase 200–240 V	Max 400 W	No
MCDN205NR☐	C	Single-phase/3-phase 200–240 V	Max 750 W	No
MDDN405NR☐	D	Single-phase/3-phase 200–240 V	Max 1000 W	Yes

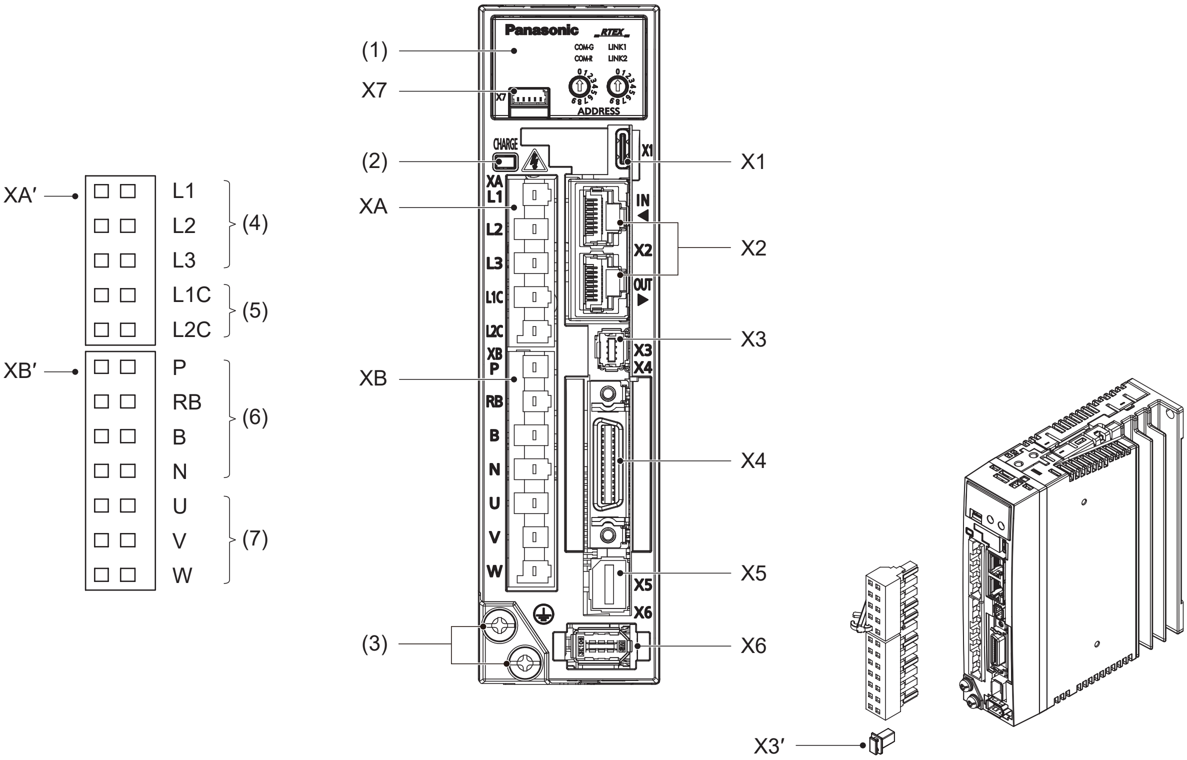
* For servo driver and motor combinations, see *“2.3 Driver and Motor Combinations”* . Some motors may not be used even if they match the rated outputs shown in this table.

2.1.3 Part Names

The names of the driver parts are shown below by driver size.

For each size, the figure is for the multi-function type. The standard type does not have X3 (safety function connectors/safety bypass plug) or X5 (external scale connector).

2.1.3.1 Sizes A, B (100 V/200 V)



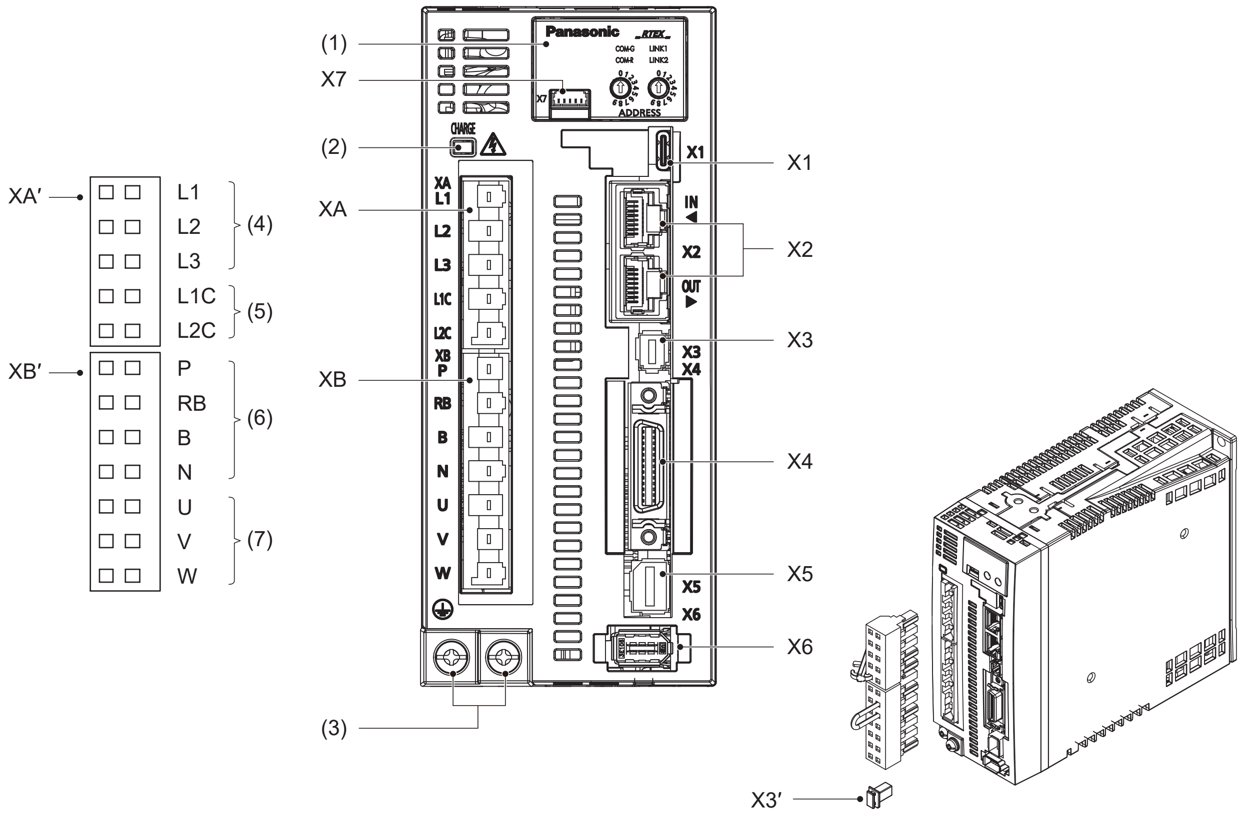
X1	USB connector DX07S016JA3R1500 (JAE) or equivalent	X2	RTEX Connector 2301996-9 (TYCO) or equivalent
X3	Safety function connector 2294417-1 (TYCO) or equivalent	X3’	Safety bypass plug 2371136-3 (TYCO) or equivalent
X4	Parallel I/O connector DF02R026NA2 (JAE) or equivalent	X5	External scale connector MUF-RS10SK-GKX-TB (LF) (JST) or equivalent
X6	Encoder connector 2232261-3 (TYCO) or equivalent	X7	Analog monitor connector 53398-4005 (Molex) or equivalent
XA	Power supply input connector SC05B-JTSKM7.5SK-GSXKR (JST) or equivalent	XA’	Power supply input connector 05JFAT-SAXGSAK-KM7.5 (LA) (JST) or equivalent
XB	Motor output connector SC07B-JTSKM7.5SK-GSXKR (JST) or equivalent	XB’	Motor output connector 07JFAT-SAXGSAK-KM7.5(LA) (JST) or equivalent
(1)	Front panel	(2)	Charge lamp
(3)	Earth connection screw	(4)	Main power input terminal
(5)	Control power input terminal	(6)	Regenerative resistor connection terminal
(7)	Motor output terminal		

* Remove the safety bypass plug when wiring to X3.

Notes

- Connectors XA′ and XB′ are included with sizes A and B.

2.1.3.2 Sizes C, D (100 V/200 V)



X1	USB connector DX07S016JA3R1500 (JAE) or equivalent	X2	RTEX Connector 2301996-9 (TYCO) or equivalent
X3	Safety function connector 2294417-1 (TYCO) or equivalent	X3’	Safety bypass plug 2371136-3 (TYCO) or equivalent
X4	Parallel I/O connector DF02R026NA2 (JAE) or equivalent	X5	External scale connector MUF-RS10SK-GKX-TB (LF) (JST) or equivalent
X6	Encoder connector 2232261-3 (TYCO) or equivalent	X7	Analog monitor connector 53398-4005 (Molex) or equivalent
XA	Power supply input connector SC05B-JTSKM7.5SK-GSXKR (JST) or equivalent	XA’	Power supply input connector 05JFAT-SAXGSAK-KM7.5 (LA) (JST) or equivalent
XB	Motor output connector SC07B-JTSKM7.5SK-GSXKR (JST) or equivalent	XB’	Motor output connector 07JFAT-SAXGSAK-KM7.5 (LA) (JST) or equivalent
(1)	Front panel	(2)	Charge lamp
(3)	Earth connection screw	(4)	Main power input terminal
(5)	Control power input terminal	(6)	Regenerative resistor connection terminal
(7)	Motor output terminal		

* Remove the safety bypass plug when wiring to X3.

Notes

- Connectors XA′ and XB′ are included with sizes C and D.

2.1.4 Specifications

2.1.4.1 Basic Specifications

The specifications of this product are as follows.

Item				Description
Input power supply	100 V	Main circuit power supply	Sizes A to C	Single phase 100 to 120 V, -15 % to +10 %, 50/60 Hz
		Control circuit power supply	Sizes A to C	Single phase 100 to 120 V, -15 % to +10 %, 50/60 Hz
	200 V	Main circuit power supply	Sizes A to D	Single phase/3-phase 200 to 240 V, -15 % to +10 %, 50/60 Hz
		Control circuit power supply	Sizes A to D	Single phase 200 to 240 V, -15 % to +10 %, 50/60 Hz
Ambient operating conditions	Temperature			Operating temperature 0 to 60°C (can be used at 55 to 60°C when derated (*5)) (no freezing) Storage temperature: -20°C to 65°C (Max. temperature guarantee: 80°C, cumulative 72 hours, no condensation (*1))
	Humidity			Operating/storage humidity: 20 to 85% RH or less (no condensation (*1))
	Altitude			2000 m or lower (can be used at 1000 to 2000 m when derated (*5))
	Vibration			5.88 m/s^2 or less, 10 to 60 Hz
	Pollution degree			Pollution degree 2 (IEC60664-1)
	Mounting intervals			10 mm or more (can be used at 1 to 10 mm when derated (*5))
Overvoltage category				III (IEC60364-4-44 and IEC60664-1)
Protective class				I (IEC61140)
IP rating				IP00
Insulation voltage resistance				Withstanding 1,500 V AC between primary and earth for 1 minute
Control method				IGBT PWM method, sinusoidal drive
Encoder feedback				27-bit (134217728 resolution) absolute encoder, 7-wire serial
External scale feedback (*2)				A/B-phase, home signal differential input type Panasonic supported serial communication type (*4)
Control signal	Input			8 general-purpose inputs Select general-purpose input function based on parameters
	Output			3 general-purpose outputs Select general-purpose output function based on parameters
Analog signal	Input			1 input (16 bit A/D input) (*3)
	Output			2 outputs (analog monitor 1, analog monitor 2)
Pulse signal	Output			Switch with following with parameters and output line driver. ● Encoder pulse output (A/B-phase) ● Position comparison output (3 outputs)
Communication function	Realtime Express (RTEX)			Real-time operation command transmission, parameter setting, status monitoring, etc.
	USB			Connect to a computer for parameter setting or status monitoring, etc.

Item		Description
Safety terminal (*2)		Safe Torque Off (STO) 2 inputs (safety input 1, 2) 1 output (EDM output)
Front panel		● Rotary switch ● 7-segment LED for display (2-digit) and 4 network status LEDs ● Analog monitor connector
Regeneration		Sizes A and B: No built-in regenerative resistor (external only) Sizes C and D: Built-in regenerative resistor (external also possible)
Dynamic brake		Built-in
Control mode	Semi-closed control	● Position control: Profile position control (PP) (*6) 、cyclic position control (CP) ● Velocity control: Cyclic velocity control (CV) (*6) ● Torque control: Cyclic torque control (CT) (*6)
	Full-closed control	● Position control: Profile position control (PP) (*6) 、cyclic position control (CP)

*1 Please note that condensation tends to occur when the temperature drops.

*2 Cannot be used with the standard type.

*3 Only application specialized types can be used.

*4 For supported scale manufacturers and product numbers, see the “AC Servo Partner Products” catalog.

*5 See *“Derated Specifications”* .

*6 The function is not yet supported in this software version.

Derated Specifications

- When using servo drivers at an ambient temperature of 55 to 60°C, or at an altitude between 1000 and 2000 meters, use the load factor obtained by multiplying each of the load factors given in the below diagram.

  When derated, change Pr5.110 “Driver derating factor” from the initial value. For details on how to set parameters and check the load factor of the servo driver, see *“8.22 Driver Derating Function”* .

  For servo driver overload protection time characteristics, see *“2.1.4.2 Overload Protection Time Characteristics (Driver)”* .

  An example of Pr5.110 “Driver derating factor” configuration is shown below.

  - (Example 1) When used at an ambient temperature of 60°C and an altitude of 1000 m

    The figure shows that the load factor at an ambient temperature of 60°C is 85% and at an altitude of 1000 m the load factor is 100%. Multiplying each load factor yields 85% × 100% = 85%.

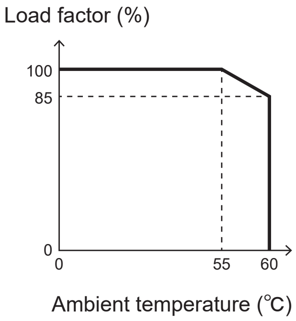
    For Pr5.110 “Driver derating factor” , set to "85".

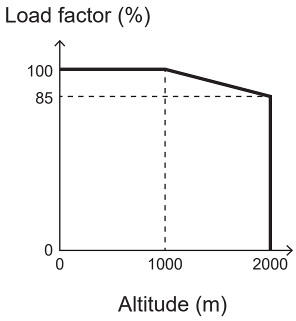
  - (Example 2) When used at an ambient temperature of 60°C and an altitude of 2000 m or less

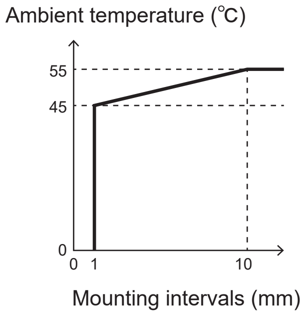
    The figure shows that the load factor at an ambient temperature of 60°C is 85% and at an altitude of 2000 m the load factor is 85%. Multiplying each load factor yields 85% × 85% = 72% (Round down to nearest decimal point).

    For Pr5.110 “Driver derating factor” , set to "72".

- If using servo drivers mounted at intervals of 1 to 10 mm, be sure to keep the below ambient temperatures in mind.


Load factor (%)
100
85
0
0
55
60
Ambient temperature (℃)


Load factor (%)
100
85
0
0
1000
2000
Altitude (m)


Ambient temperature (℃)
55
45
0
0
1
10
Mounting intervals (mm)

2.1.4.2 Overload Protection Time Characteristics (Driver)

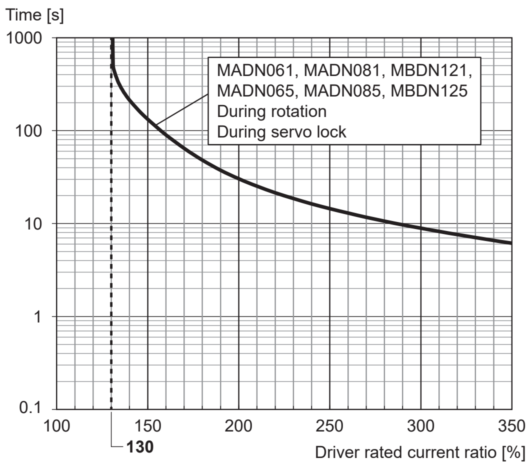
The driver overload warning function is activated when the overload protection time characteristic (driver) is reached.

Servo driver and servo motor overload warnings and protection functions (driver overload warning, motor overload warning, and motor overload protection) give priority to the lower between the overload protection time characteristic (driver) and overload protection time characteristic (motor). For details on overload protection time characteristics (motor), see *"2.2.5 Overload Protection Time Characteristics (Motor)"* .

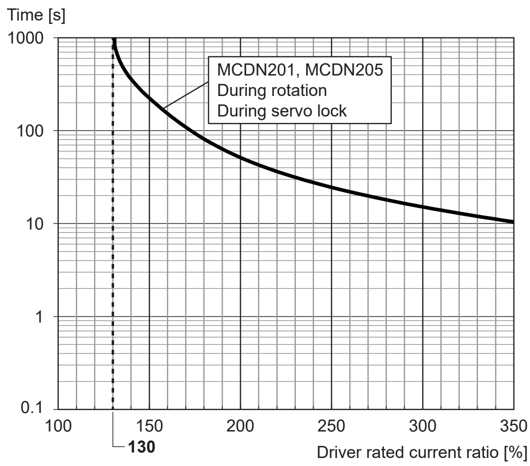
The figure below shows the overload protection time characteristics (driver) when Pr5.110 "Driver derating factor" is set to "100". See *"Derated Specifications"* in *"2.1.4.1 Basic Specifications"* and set Pr5.110 "Driver derating factor" according to the ambient operating conditions. Since the overload protection time characteristic of the servo driver changes depending on the set value of Pr5.110 "Driver derating factor" , tune the operating conditions so that the overload protection time characteristic (driver) is not reached.

See *"8.22 Driver Derating Function"* for more information on the driver derating function.

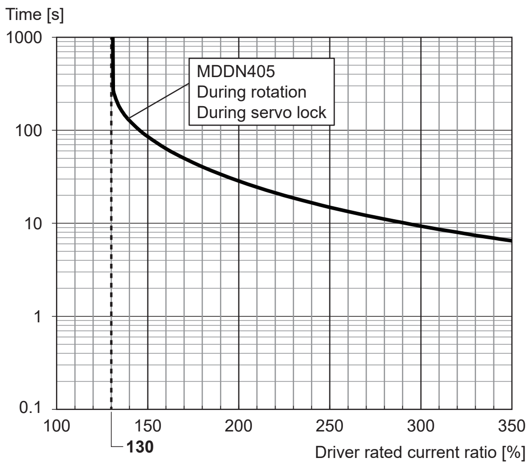
Common to MADN and MBDN



MCDN201, MCDN205



MDDN405



2.1.4.3 Supported Control Modes

The table below shows the control modes supported by the product and an overview of the control modes.

The functions listed in gray in the table below are not supported in this software version.

—: None

Class	Control mode		Abbreviation	Description
—	NOP	NOP	NOP	A mode for sending temporary invalid data immediately after the network is established.
Semi-closed control	Profile position control mode	Profile Position Mode	PP	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver.
	Cyclic position control mode	Cyclic Position Mode	CP	A position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.
	Cyclic velocity control mode	Cyclic Velocity Mode	CV	A velocity control mode in which the host device generates a speed command, and operates by updating (sending) the command speed in a communication cycle.
	Cyclic torque control mode	Cyclic Torque Mode	CT	A torque control mode in which the host device generates a torque command, and operates by updating (sending) the command torque in a communication cycle.
Full-closed control	Profile position control mode	Profile Position Mode	PP	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver.
	Cyclic position control mode	Cyclic Position Mode	CP	A position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.

2.1.4.4 Supported Functions (Function List and Overview)

The table below shows the functions supported by the product and an overview of those function.

The functions listed in gray in the table below are not supported in this software version.

Class	Function name	Function overview	Reference
Input/ output	Positioning complete output (INP and INP2)	When in positioning complete state, this function outputs external output signal positioning complete output (INP) or positioning complete output 2 (INP2).	*"7.3.4"*
	Speed arrival output	A function that outputs a speed arrival output (AT-SPEED) signal, an external output signal, when the motor speed exceeds the set velocity.	*"7.4.4"*
	Velocity coincidence output	If the speed command and motor speed match, this function outputs a velocity coincidence output (V-COIN), which is an external output signal.	*"7.4.5"*
Basic	Rotational direction setting	A function that sets motor rotational direction for the position command, speed command, and torque command.	*"7.2.1"*
	Command input processing	A function that sets the control mode according to the RTEX communication command.	*"7.2.2"*
	Electronic gear function	This is a function that uses a value obtained by multiplying the position and speed control commands input from the host device by the electronic gear ratio set by the object as the position and speed commands for the position and speed control unit.	*"7.2.3"*
	Motor working range setup function	This function triggers an alarm and decelerates the motor to a stop if the motor position exceeds the set the movable motor range with respect to the position command input range.	*"7.2.4"*
	Two-degree-of-freedom control (position)	This is an extension function for each control mode that improves responsiveness by allowing command response and servo stiffness to be set independently.	*"7.2.5"*
	Two-degree-of-freedom control (speed)		
	Two-degree-of-freedom control (full-closed)		
	Regenerative resistor settings	A function that switches the regenerative resistance overload protection function setup.	*"7.2.6"*
	Absolute settings	A function that sets the method of use of the absolute encoder.	*"7.2.7"*
	Velocity limit function	A function that controls the velocity so that it does not exceed the velocity limit value set during torque control as a protection.	*"7.5.2"*
	External scale selection function	A function that selects the external scale type to be used and sets the reversal of external scale feedback counter.	*"7.2.8"*
	External scale dividing ratio settings	A function that sets the dividing ratio of encoder resolution and number of scale pulses per rotation.	*"7.6.4"*
	Hybrid Deviation Excess Setup	This function detects the difference between motor (encoder) position and load (external scale) position, and generates hybrid deviation excess error protection when the difference exceeds the allowable value.	*"7.6.5"*
	Network settings	A function that sets the communication cycle and command updating cycle for RTEX communication.	*"4.1.4"*
	Batteryless absolute encoder		
Adjustment	For details on adjustment functions, see Operating Instructions (Tuning).		
Application	Torque limit switching function	A function that changes the torque limit values according to the operation direction or torque limit switching command (TL_SW) of RTEX communication.	*"8.1"*
	Torque saturation protection function	This function triggers an alarm when torque saturation condition lasts for a set amount of time.	*"8.2"*

Class	Function name	Function overview	Reference
Application	Position comparison output function	A general-purpose output or position comparison output terminal outputs a pulse signal when the actual position passes the position set for the parameter.	*"8.3"*
	Single-turn absolute function	This function uses the absolute encoder as an absolute system only for single-turn absolute position.	*"8.4"*
	Continuous rotating absolute encoder function	This function sets any upper-limit value for absolute encoder multi-turn data.	*"8.5"*
	Pulse regeneration function	This function outputs the amount of movement of the actual position with the A/B-phase pulse.	*"8.6"*
	Displacement control function	This function directly inputs the output signal of the displacement sensor to the servo driver to achieve a fixed clearance for workpieces of varying height, completely within the driver.	*"8.7.1"*
	Virtual full-closed control function	This function enables continuous axis operation by virtually estimating the external scale position from the encoder position information.	*"8.8"*
	External scale position information monitor function for semi-closed control	A function that monitors external scale position information under semi-closed control using RTEX communication.	*"8.9"*
	Deterioration diagnosis warning function	This is a function to check the changes in motor and connected equipment characteristics to output deterioration diagnosis warning.	*"8.10"*
	Latch mode function with stop function	A function for stopping at the latched position with the input/output timing of the latch trigger signal with stop function, without initialization of position information.	*"8.11"*
	Retracting operation function	This function sets retracting operation initiation and operation contents when the main power supply is OFF or the retracting operation signal is input.	*"8.12"*
	Deceleration to stop function	This function sets the motor deceleration stop method in the event of main power interruption or alarm.	*"8.13"*
	Deceleration to stop function for during over-travel inhibit input (POT, NOT)	This function sets the mid-deceleration and post-stop operations after over-travel inhibit input (POT, NOT) is input.	*"8.14"*
	Deceleration to Stop Function for Servo Off	This function sets the mid-deceleration stopping method and post-stop operations when the servo is off.	*"8.15"*
	Deceleration to stop function for when main power supply is off	This function sets the stopping method during deceleration and post-stop operations after the main power supply is turned OFF.	*"8.16"*
	Deceleration to stop function for when alarm is triggered	This function sets the mid-deceleration stopping method and post-stop operations when an alarm is triggered.	*"8.17"*
	Emergency stop function for when alarm is triggered	This function sets the stopping operations when an emergency stop alarm is triggered.	*"8.18"*
	Fall prevention function for when alarm is triggered	This function prevents falls when an alarm triggers by setting the alarm deceleration to stop function to emergency stop.	*"8.19"*
	Fall prevention function for servo-on	This function eliminates the delay in torque command rise at the servo-on command input timing and prevents the equipment from falling.	*"8.20"*
	Slow stop function	This function stops the motor smoothly with servo-on when the main power is turned off or an alarm occurs with the emergency stop setting.	*"8.21"*
	Driver derating function	Derating is applied to the servo driver's overload protection time characteristic according to the derating factor set by the parameter.	*"8.22"*
Safety	Safety function	This function turns off the motor output torque by forcibly turning off the driving signal of the power transistor inside the servo driver from the safety input signal by means of an electric circuit (hardware), thereby cutting off the motor current.	*"9.1"*
Protection	Protection functions	These functions ensure safety by stopping the motor when errors are detected in the equipment.	*"10.2"*

Class	Function name	Function overview	Reference
Protecti on	Warning functions	These functions generate a warning before a protection function is triggered to check in advance for a condition, such as an overload.	*“10.3”*
	Timestamp function	This function adds the time when the alarm occurred to the alarm supplementary information and adds the measurement time to the waveform data measured by the waveform measurement function with Set-up Support Software (PANATERM ver.7) .	*“10.4”*

2.1.4.5 Supported Functions (By Driver Type)

The table below shows the functions supported by this product by driver type.

The functions listed in gray in the table below are not supported in this software version.

○: Supported ×: Not supported

Class	Function	Driver Type		
		A7NE Standard type	A7NF Multi-function type	A7NR Application specialized type
Control mode	Semi-closed control			
	Profile position control (PP)	×	×	×
	Cyclic position control (CP)	○	○	○
	Cyclic velocity control (CV)	×	×	×
	Cyclic torque control (CT)	×	×	×
	Full-closed control			
	Profile position control (PP)	×	×	×
	Cyclic position control (CP)	×	○	○
	Full-closed control (rotary scale)	×	×	×
Input/ output	Analog input	×	×	○
	Analog output (analog monitor 1, analog monitor 2)	○	○	○
	External scale division/multiplication settings	○	○	○
	Positioning complete output (INP/INP2)	○	○	○
	Speed arrival output	○	○	○
	Velocity coincidence output	○	○	○
Basic	Rotational direction setting	○	○	○
	Command input processing	○	○	○
	Electronic gear function	○	○	○
	Motor working range setup function	○	○	○
	Two-degree-of-freedom control (position)	○	○	○
	Two-degree-of-freedom control (speed)	○	○	○
	Two-degree-of-freedom control (full-closed)	×	○	○
	Regenerative resistor settings	○	○	○
	Absolute settings	○	○	○
	Velocity limit function	○	○	○
	External scale selection function	×	○	○
	External scale dividing ratio settings	×	○	○
	Hybrid Deviation Excess Setup	×	○	○
	Network settings	○	○	○
	Batteryless absolute encoder	×	×	×
Adjustment	For details on adjustment functions, see Operating Instructions (Tuning).			
Application	Torque limit switching function	○	○	○
	Torque saturation protection function	○	○	○
	Position comparison output function	×	×	×
	Single-turn absolute function	○	○	○

Class	Function	Driver Type		
		A7NE Standard type	A7NF Multi-function type	A7NR Application specialized type
Application	Continuous rotating absolute encoder function	×	×	×
	Pulse regeneration function	○	○	○
	Displacement control function	×	×	○
	Virtual full-closed control function	×	×	×
	External scale position information monitor function for semi-closed control	×	×	×
	Deterioration diagnosis warning function	×	×	×
	Latch mode function with stop function	×	×	×
	Retracting operation function	×	×	×
	Deceleration to stop function	○	○	○
	Deceleration to stop function for during overtravel inhibit input (POT, NOT)	○	○	○
	Deceleration to Stop Function for Servo Off	○	○	○
	Deceleration to stop function for when main power supply is off	○	○	○
	Deceleration to stop function for when alarm is triggered	○	○	○
	Emergency stop function for when alarm is triggered	○	○	○
	Fall prevention function for when alarm is triggered	×	×	×
	Fall prevention function for servo-on	○	○	○
	Slow stop function	×	×	×
	Driver derating function	○	○	○
Safety	Safety function	×	○	○
Protection	Protection functions	○	○	○
	Warning functions	○	○	○
	Timestamp function	○	○	○

2.1.4.6 Supported Functions (By Control Mode)

The table below shows the functions supported by this product by control mode.

The functions listed in gray in the table below are not supported in this software version.

○: Supported ×: Not supported

Class	Function	Description			
		Position control	Velocity control	Torque control	Full-closed control
Input/ output	Control input	Positive direction drive inhibit, negative direction drive inhibit, latch signal, near home position, etc.	Positive direction drive inhibit, negative direction drive inhibit, latch signal, etc.	Positive direction drive inhibit, negative direction drive inhibit, latch signal, etc.	Positive direction drive inhibit, negative direction drive inhibit, latch signal, near home position, etc.
	Control output	Positioning completion, etc.	Velocity arrival, etc.	Velocity arrival, etc.	Positioning completion, etc.
	Command input (RTEX command type)	Position command	Speed command	Torque command	Position command
	Smoothing filter	○	×	×	○
	Analog input	○	×	×	○
	Analog output (analog monitor 1, analog monitor 2)	○	○	○	○
	External scale division/multiplication settings	×	×	×	○
	Positioning complete output (INP/INP2)	○	×	×	○
	Speed arrival output	×	○	○	×
	Velocity coincidence output	×	○	○	×
Basic	Rotational direction setting	○	○	○	○
	Command input processing	○	○	○	○
	Electronic gear function	○	○	○	○
	Motor working range setup function	○	×	×	○
	Two-degree-of-freedom control mode (position)	○	×	×	×
	Two-degree-of-freedom control mode (speed)	×	○	×	×
	Two-degree-of-freedom control mode (full-closed)	×	×	×	○
	Regenerative resistor settings	○	○	○	○
	Absolute settings	○	○	○	×
	Velocity limit function	×	×	×	×
	External scale selection function	○	○	○	○

Class	Function	Description			
		Position control	Velocity control	Torque control	Full-closed control
Basic	External scale dividing ratio settings	×	×	×	○
	Hybrid Deviation Excess Setup	×	×	×	○
	Network settings	○	○	○	○
	Batteryless absolute encoder	×	×	×	×
Adjustment	For details on adjustment functions, see Operating Instructions (Tuning).				
Application	Torque limit switching function	○	○	○	○
	Torque saturation protection function	○	○	×	○
	Position comparison output function	×	×	×	×
	Single-turn absolute function	○	○	○	×
	Continuous rotating absolute encoder function	×	×	×	×
	Pulse regeneration function	○	○	○	○
	Displacement control function	○	×	×	○
	Virtual full-closed control function	×	×	×	×
	External scale position information monitor function for semi-closed control	×	×	×	×
	Deterioration diagnosis warning function	×	×	×	×
	Latch mode function with stop function	×	×	×	×
	Retracting operation function	×	×	×	×
	Deceleration to stop function	○	○	○	○
	Deceleration to stop function for during over-travel inhibit input (POT, NOT)	○	○	○	○
	Deceleration to Stop Function for Servo Off	○	○	○	○
	Deceleration to stop function for when main power supply is off	○	○	○	○
	Deceleration to stop function for when alarm is triggered	○	○	○	○

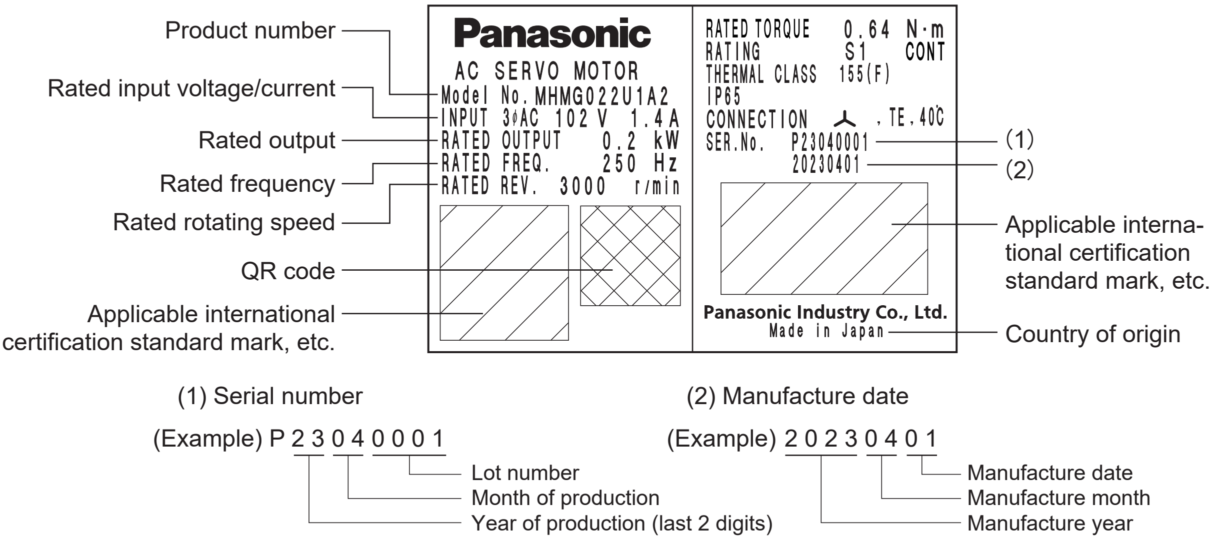
Class	Function	Description			
		Position control	Velocity control	Torque control	Full-closed control
Application	Emergency stop function for when alarm is triggered	○	○	○	○
	Fall prevention function for when alarm is triggered	×	×	×	×
	Fall prevention function for servo-on	○	○	×	○
	Slow stop function	×	×	×	×
	Driver derating function	○	○	○	○
Safety	Safety function	○	○	○	○
Protection	Protection functions	○	○	○	○
	Warning functions	○	○	○	○
	Timestamp function	○	○	○	○

2.2 Motor

2.2.1 Checking the Model

Nameplate Example

The details shown on nameplates are as shown below.



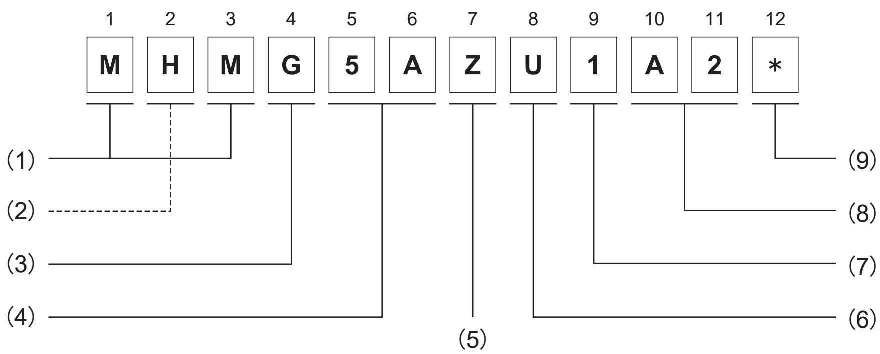
The range of the lot number in serial number is 1 to 33999, but the nameplate has 4 digits in the following format. In the four digits, the alphabet characters "I" (eye) and "O" (o) are not used.

Value of serial number	Notation on the name-plate
1 to 9999	0001 to 9999
10000 to 10999	A000 to A999
11000 to 11999	B000 to B999
…	…
17000 to 17999	H000 to H999
18000 to 18999	J000 to J999
…	…
22000 to 22999	N000 to N999
23000 to 23999	P000 to P999
…	…
33000 to 33999	Z000 to Z999

How to Read Product Numbers

Product numbers, symbols, and their meanings are as shown below.

Sample description



No.	Item	Symbol	Specifications	Remarks
(1)	Product	M☐M	Motor	☐ = type symbol/mark
(2)	Type	H	High inertia	—
(3)	Family	G	A7 Family	—
(4)	Motor rated output	5 A	50 W	—
		01	100 W	
		02	200 W	
		04	400 W	
		08	750 W	
		09	1000 W	
(5)	Voltage specification	1	100 V	—
		2	200 V	
		Z	100/200 V common (50 W only)	
(6)	Rotary encoder specifica-tions	U	Absolute	Pulse no.: 27 bits Resolution: 134217728 Lead wire: 7-cores
(7)	Design order	1	Standard	—
(8)	Motor structure	(*1)	(*1)	(*1) See “Motor Structure”.
(9)	Special specifications	*	—	Alphanumerics

*1 Motor structure

Motor structure symbols, and their meanings are as shown below.

●: Supported Blank: Not supported

Symbol	Shaft specification			Holding brake		Oil seal		Motor I/F
	Straight	D-cut	With key and tap	No	Yes	No	Yes	Lead wire
A2	●			●		●		●
B2	●				●	●		●
C2	●			●			●	●
D2	●				●		●	●
N2		●		●		●		●
P2		●			●	●		●
Q2		●		●			●	●

Symbol	Shaft specification			Holding brake		Oil seal		Motor I/F
	Straight	D-cut	With key and tap	No	Yes	No	Yes	Lead wire
R2		●			●		●	●
S2			●	●		●		●
T2			●		●	●		●
U2			●	●			●	●
V2			●		●		●	●

2.2.2 Model Product Numbers

Applicable Models	Motor Rating	Other Specifications
MHMG5AZU1□2	50 W, 100 V/200 V shared	Shaft specification: Straight/D-cut/With key and tap Oil seal: Without/With Holding brake: Without/With
MHMG011U1□2	100 W, 100 V	
MHMG012U1□2	100 W, 200 V	
MHMG021U1□2	200 W, 100 V	
MHMG022U1□2	200 W, 200 V	
MHMG041U1□2	400 W, 100 V	
MHMG042U1□2	400 W, 200 V	
MHMG082U1□2	750 W, 200 V	
MHMG092U1□2	1000 W, 200 V	

* See *"How to Read Product Numbers"* *"Motor structure"* in *"2.2.1 Checking the Model"* for what the □ symbols in the applicable model names represent.

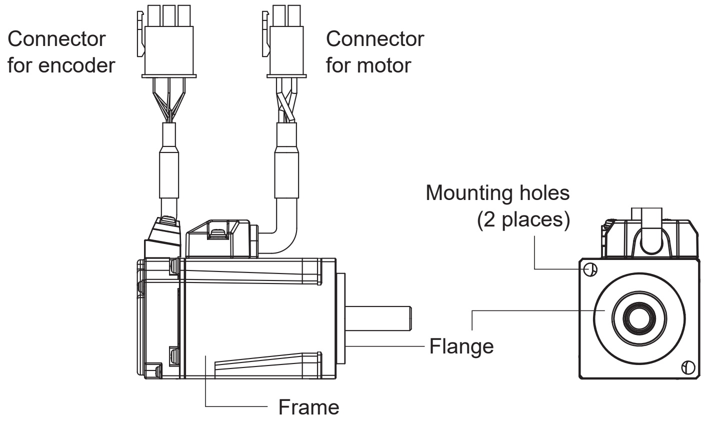
2.2.3 Part Names

The names and descriptions of the motor parts by model are as shown below.

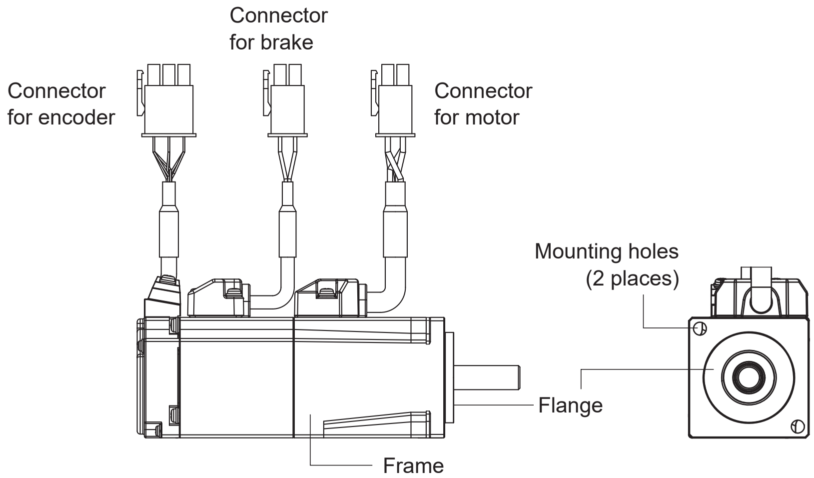
For details by motor model, see *"12.2.2 Motor (Absolute Encoder Specification)"* .

■ MHMG 50 W and 100 W (□40)

[Without brake]

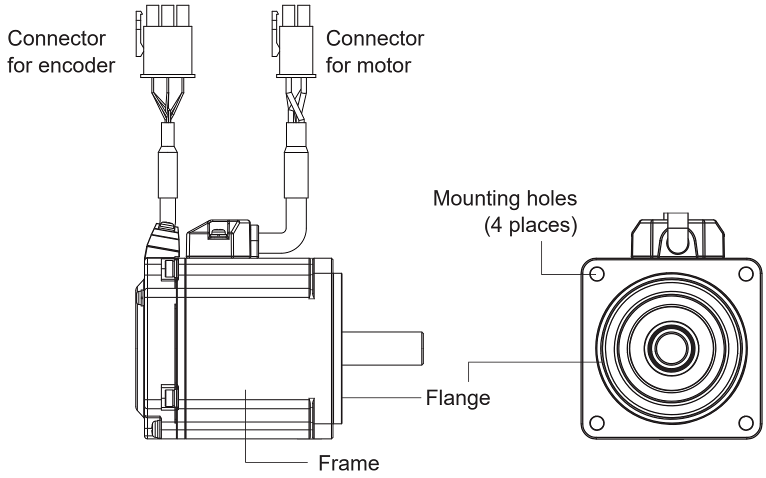


[With brake]

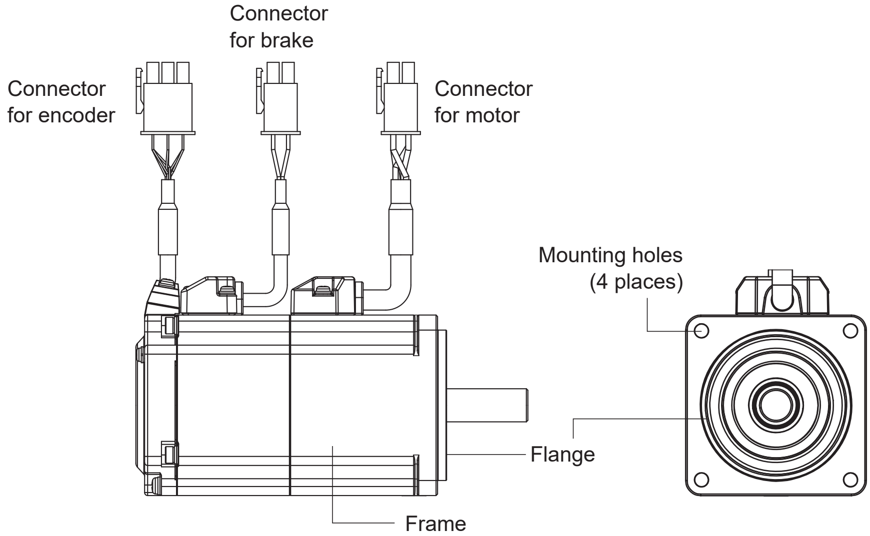


■ MHMG 200 W, 400 W (□60)

[Without brake]

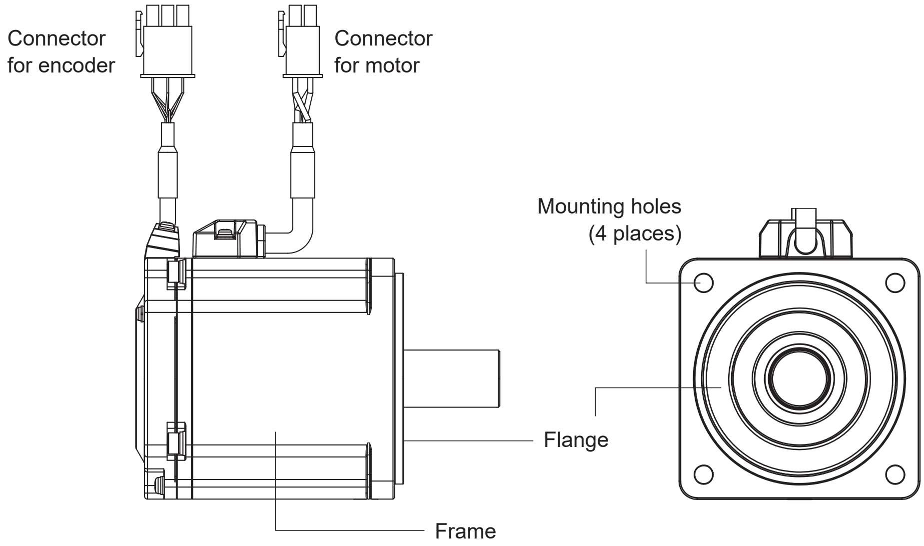


[With brake]

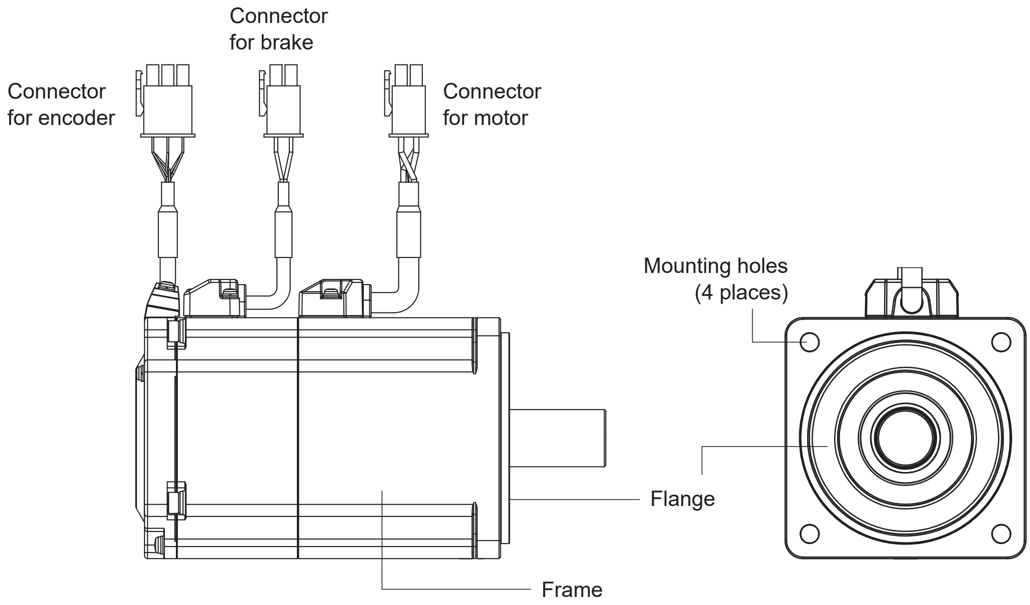


■ MHMG 750 W and 1000 W (□80)

[Without brake]



[With brake]



2.2.4 Specifications

Motor specifications are shown by motor.

The □△ symbols in the AC servo motor model names indicate differences in motor structure.

— Precautions —

- The motor characteristics (S-T characteristic) may vary depending on whether oil seals or brakes are used.

  Motor characteristics are subject to change, so be sure to check the motor characteristics of your motor when designing your system.
- The motor characteristics are shown after adjustment for combination with our servo driver (Representative values at 20°C).
- Rated torque values represent continuous allowable torque tolerance under our measurement conditions.
- If a faster response is desired, use a lower load moment of inertia ratio.

2.2.4.1 MHMG5AZU1□△ (50 W 100 V/200 V shared)

■ Specifications

Motor product number	Unit	MHMG5AZU1□△	
Brake		No	Yes
Oil seal		Without/With	
Rated output	W	50	
Compatible driver		MADN061□□	
		MADN065□□	
Driver power supply and voltage specifications	VAC	100/200	
Rated torque	N·m	0.16	
Instantaneous maximum torque	N·m	0.56	
Rated current	A(rms)	(1.1)	
Instantaneous maximum current	A(0-p)	(5.5)	
Rated rotational velocity	r/min	3000	
Maximum rotational velocity	r/min	7150	
Rotor inertial moment	$\times10^{-4}$kg·m^2	0.0366	0.0401

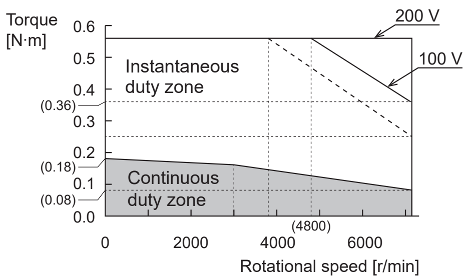
— Precautions —

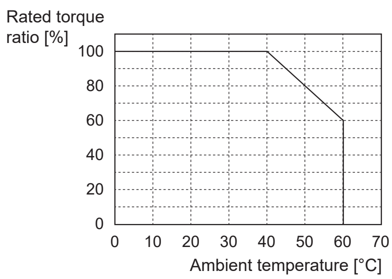
- Use in a location where the temperature at the center of the motor frame is below 75°C (When the ambient temperature is 40°C at an altitude of 1000 m or less).

■ S-T characteristics (representative values)

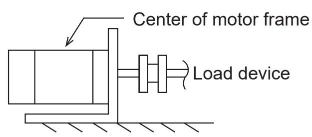
Servo driver power supply voltage: For 100 V/200 V AC (dotted line indicates 10% drop in power supply voltage 100 V)

- Without oil seal

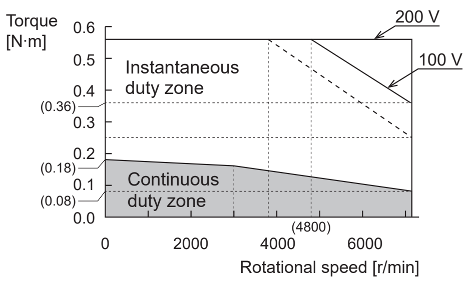


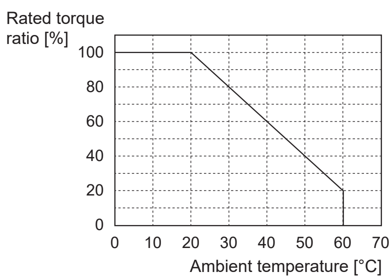


Measurement conditions
Flange size: 200 × 200 × t6
Material: Aluminum

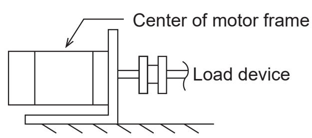


- With oil seal





Measurement conditions
Flange size: 200 × 200 × t6
Material: Aluminum



2.2.4.2 MHMG011U1□△ (100 W 100 V), MHMG012U1□△ (100 W 200 V)

■ **Specifications**

Motor product number	Unit	MHMG011U1□△		MHMG012U1□△	
Brake		No	Yes	No	Yes
Oil seal		Without/With		Without/With	
Rated output	W	100		100	
Compatible driver		MADN081□□		MADN065□□	
Driver power supply and voltage specifications	VAC	100		200	
Rated torque	N·m	0.32		0.32	
Instantaneous maximum torque	N·m	1.11		1.11	
Rated current	A(rms)	(1.6)		(1.1)	
Instantaneous maximum current	A(0-p)	(8.0)		(5.5)	
Rated rotational velocity	r/min	3000		3000	
Maximum rotational velocity	r/min	7150		7150	
Rotor inertia	$\times 10^{-4}$kg·m^2	0.0648	0.0674	0.0648	0.0674

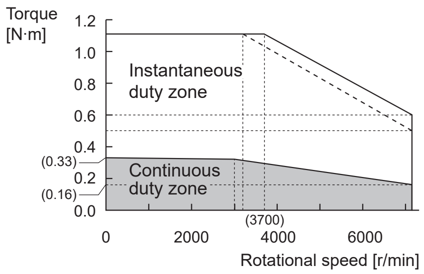
— Precautions —

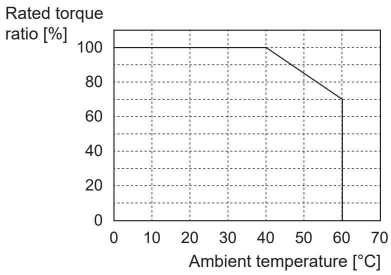
- Use in a location where the temperature at the center of the motor frame is below 85°C (When the ambient temperature is 40°C at an altitude of 1000 m or less).

■ **S-T characteristics (representative values)**

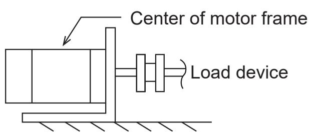
Servo driver power supply voltage: For 100 V AC (dotted line indicates 10% drop in power supply voltage)

- MHMG011U1□ △ Without oil seal

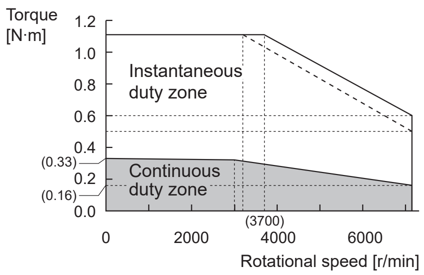


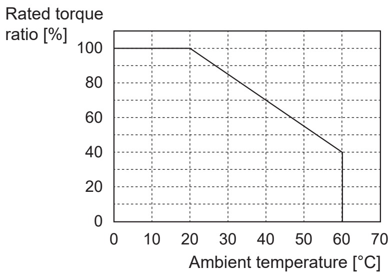


Measurement conditions
Flange size: 200 × 200 × t6
Material: Aluminum

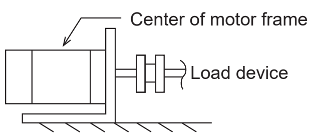


- MHMG011U1□△ With oil seal



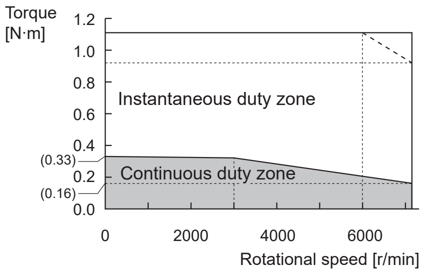


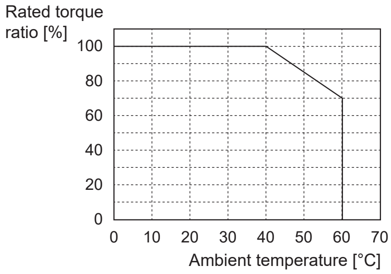
Measurement conditions
Flange size: 200 × 200 × t6
Material: Aluminum



Servo driver power supply voltage: For 200 V AC (dotted line indicates 10% drop in power supply voltage)

- MHMG012U1□ △ Without oil seal

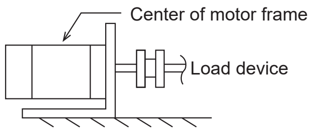




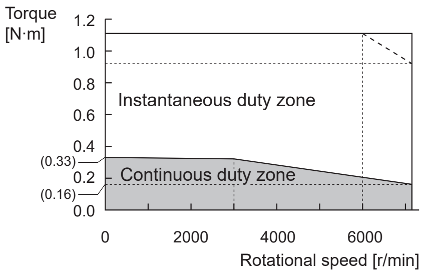
Measurement conditions

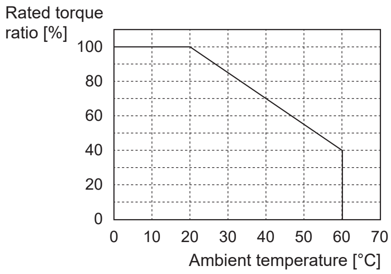
Flange size: 200 × 200 × t6

Material: Aluminum



- MHMG012U1□△ With oil seal

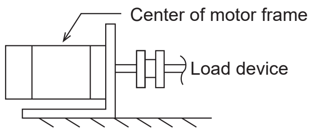




Measurement conditions

Flange size: 200 × 200 × t6

Material: Aluminum



2.2.4.3 MHMG021U1□△ (200 W 100 V), MHMG022U1□△ (200 W 200 V)

■ Specifications

Motor product number	Unit	MHMG021U1□△		MHMG022U1□△	
Brake		No	Yes	No	Yes
Oil seal		Without/With		Without/With	
Rated output	W	200		200	
Compatible driver		MBDN121□□		MADN085□□	
Driver power supply and voltage specifications	VAC	100		200	
Rated torque	N·m	0.64		0.64	
Instantaneous maximum torque	N·m	2.23		2.23	
Rated current	A(rms)	(2.2)		(1.4)	
Instantaneous maximum current	A(0-p)	(11)		(6.9)	
Rated rotational velocity	r/min	3000		3000	
Maximum rotational veloci-ty	r/min	6700		7150	
Rotor inertial moment	$\times 10^{-4}$kg·m^2	0.254	0.271	0.254	0.271

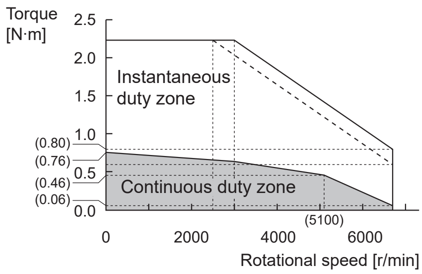
— Precautions —

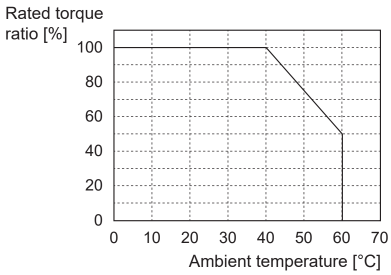
- Use in a location where the temperature at the center of the motor frame is below 75°C (When the ambient temperature is 40°C at an altitude of 1000 m or less).

■ S-T characteristics (representative values)

Servo driver power supply voltage: For 100 V AC (dotted line indicates 10% drop in power supply voltage)

- MHMG021U1□ △ Without oil seal

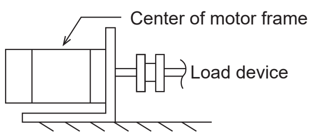




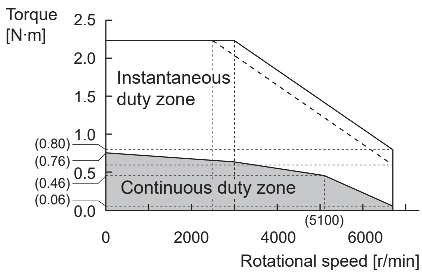
Measurement conditions

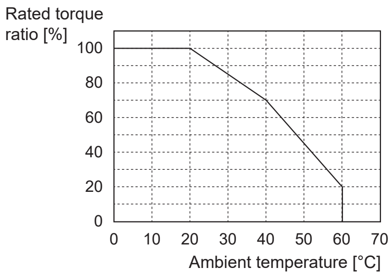
Flange size: 130 × 120 × t12

Material: Aluminum



- MHMG021U1□△ With oil seal

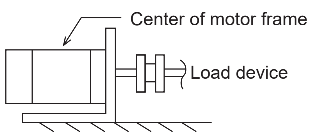




Measurement conditions

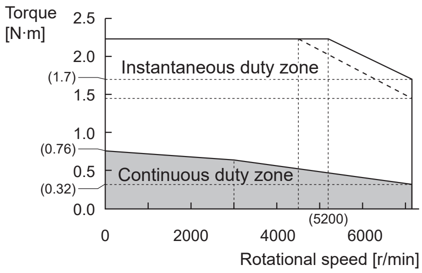
Flange size: 130 × 120 × t12

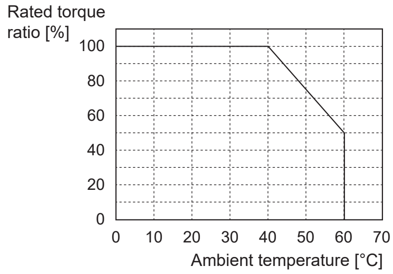
Material: Aluminum



Servo driver power supply voltage: For 200 V AC (dotted line indicates 10% drop in power supply voltage)

- MHMG022U1□ △ Without oil seal

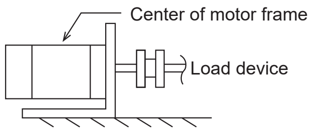




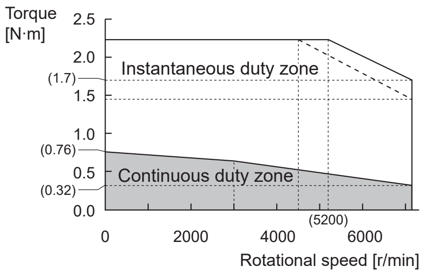
Measurement conditions

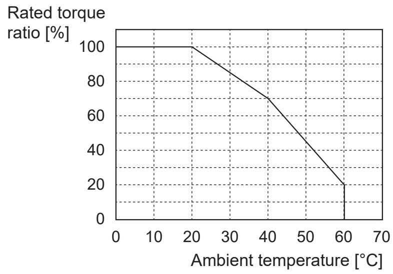
Flange size: 130 × 120 × t12

Material: Aluminum



- MHMG022U1□△ With oil seal

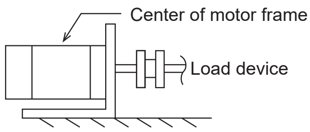




Measurement conditions

Flange size: 130 × 120 × t12

Material: Aluminum



2.2.4.4 MHMG041U1□△ (400 W 100 V), MHMG042U1□△ (400 W 200 V)

■ Specifications

Motor product number	Unit	MHMG041U1□△		MHMG042U1□△	
Brake		No	Yes	No	Yes
Oil seal		Without/With		Without/With	
Rated output	W	400		400	
Compatible driver		MCDN201□□		MBDN125□□	
Driver power supply and voltage specifications	VAC	100		200	
Rated torque	N·m	1.27		1.27	
Instantaneous maximum torque	N·m	4.46		4.46	
Rated current	A(rms)	(4.1)		(2.2)	
Instantaneous maximum current	A(0-p)	(20)		(11)	
Rated rotational velocity	r/min	3000		3000	
Maximum rotational velocity	r/min	6700		6700	
Rotor inertial moment	$\times 10^{-4}$kg·m^2	0.462	0.479	0.462	0.479

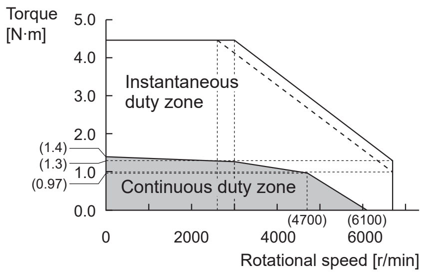
— Precautions —

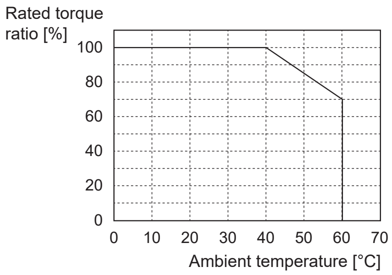
- Use in a location where the temperature at the center of the motor frame is below 85°C (When the ambient temperature is 40°C at an altitude of 1000 m or less).

■ S-T characteristics (representative values)

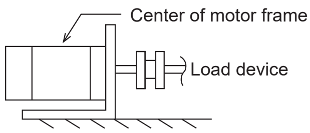
Servo driver power supply voltage: For 100 V AC (dotted line indicates 10% drop in power supply voltage)

- MHMG041U1□ △ Without oil seal

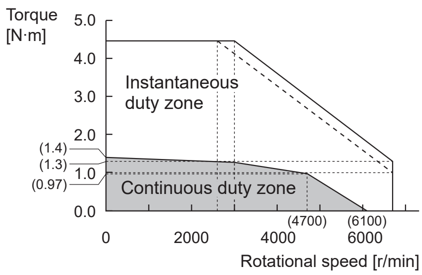


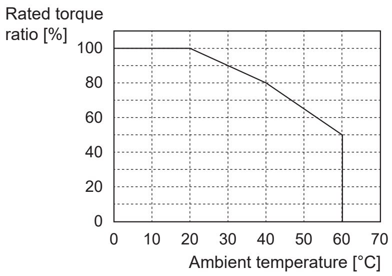


Measurement conditions
Flange size: 130 × 120 × t12
Material: Aluminum

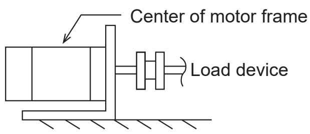


- MHMG041U1□△ With oil seal



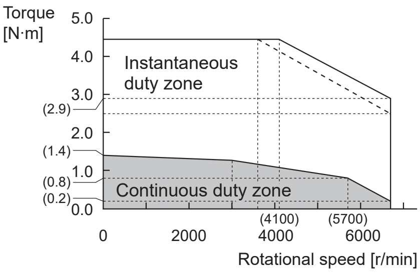


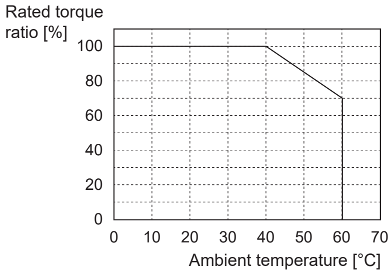
Measurement conditions
Flange size: 130 × 120 × t12
Material: Aluminum



Servo driver power supply voltage: For 200 V AC (dotted line indicates 10% drop in power supply voltage)

● MHMG042U1□ △ Without oil seal

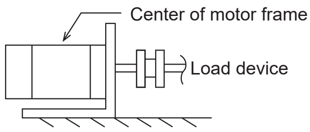




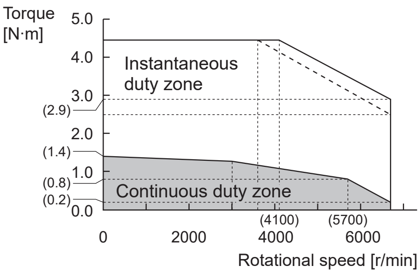
Measurement conditions

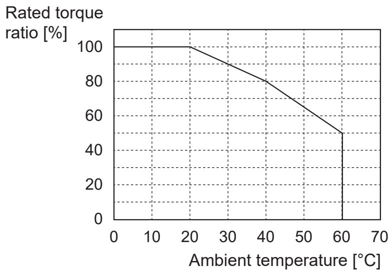
Flange size: 130 × 120 × t12

Material: Aluminum



● MHMG042U1□△ With oil seal

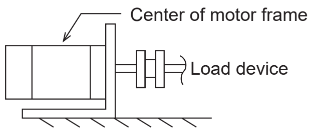




Measurement conditions

Flange size: 130 × 120 × t12

Material: Aluminum



2.2.4.5 MHMG082U1□△ (750 W 200 V), MHMG092U1□△ (1000 W 200 V)

■ Specifications

Motor product number	Unit	MHMG082U1□△		MHMG092U1□△	
Brake		No	Yes	No	Yes
Oil seal		Without/With		Without/With	
Rated output	W	750		1000	
Compatible driver		MCDN205□□		MDDN405□□	
Driver power supply and voltage specifications	VAC	200		200	
Rated torque	N·m	2.39		3.18	
Instantaneous maximum torque	N·m	8.36		11.1	
Rated current	A(rms)	(3.8)		(5.7)	
Instantaneous maximum current	A(0-p)	(20)		(30)	
Rated rotational velocity	r/min	3000		3000	
Maximum rotational velocity	r/min	6000		6700	
Rotor inertial moment	$\times 10^{-4} kg \cdot m^2$	1.30	1.38	1.72	1.80

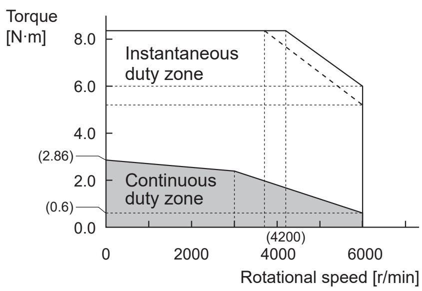
— Precautions —

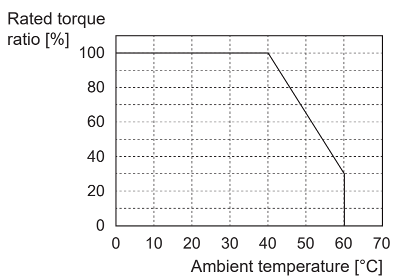
- Use in a location where the temperature at the center of the motor frame is below 75°C (750 W) or 85°C (1000 W) (When the ambient temperature is 40°C at an altitude of 1000 m or less).

■ S-T characteristics (representative values)

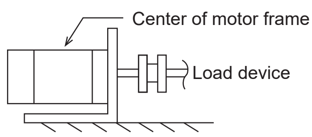
Servo driver power supply voltage: For 200 V AC (dotted line indicates 10% drop in power supply voltage)

- MHMG082U1□ △ Without oil seal

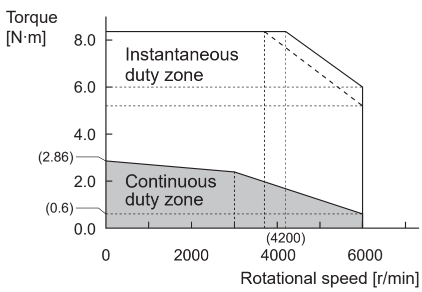


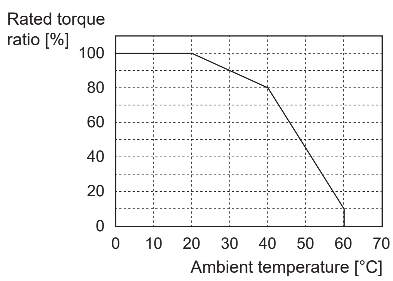


Measurement conditions
Flange size: 170 × 160 × t12
Material: Aluminum

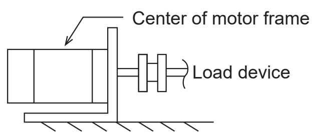


- MHMG082U1□△ With oil seal

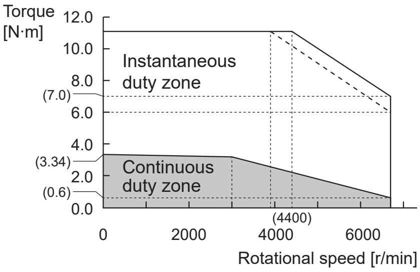


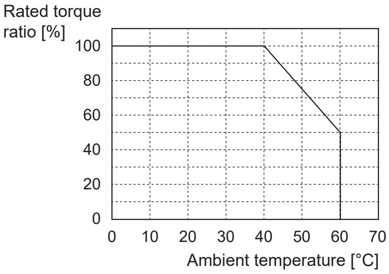


Measurement conditions
Flange size: 170 × 160 × t12
Material: Aluminum



● MHMG092U1□ △ Without oil seal

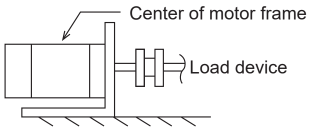




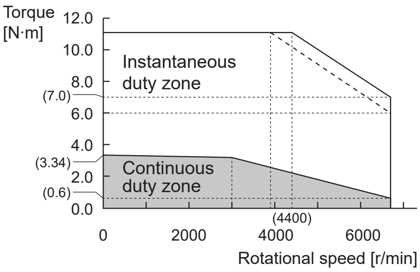
<u>Measurement conditions</u>

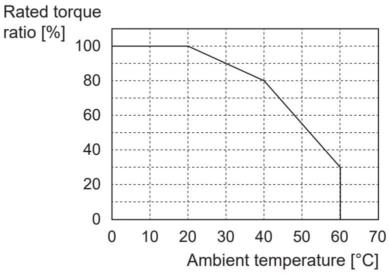
Flange size: 170 × 160 × t12

Material: Aluminum



● MHMG092U1□△ With oil seal

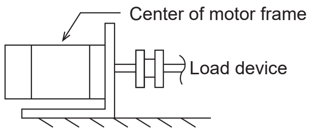




<u>Measurement conditions</u>

Flange size: 170 × 160 × t12

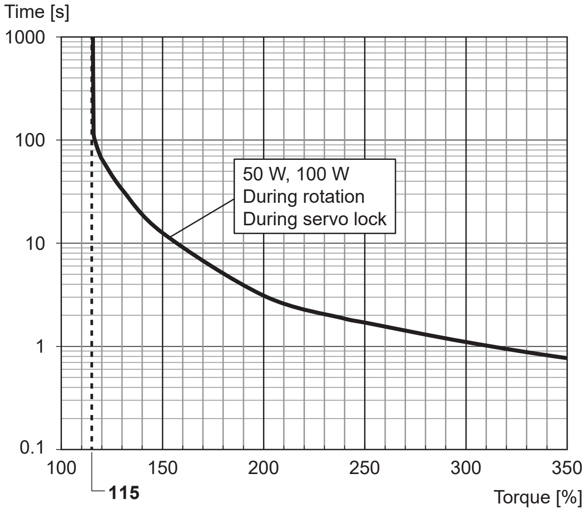
Material: Aluminum



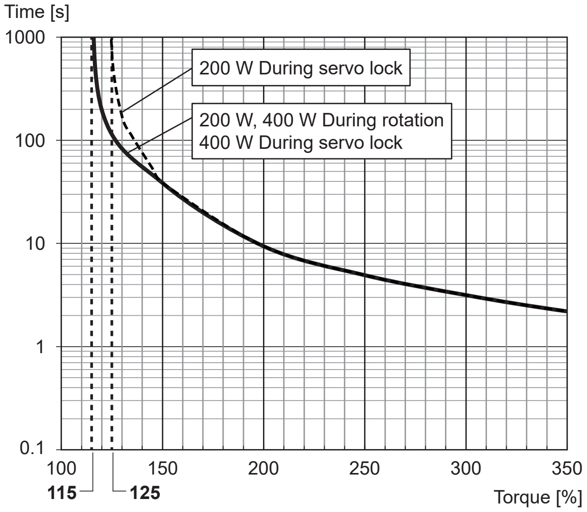
2.2.5 Overload Protection Time Characteristics (Motor)

Overload protection time characteristics (motor) are shown below.

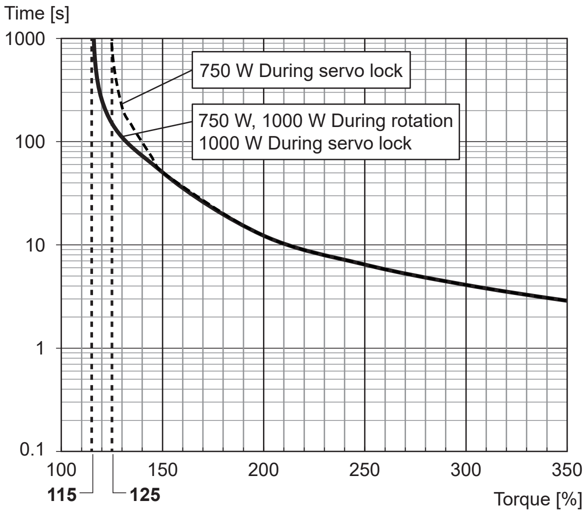
MHMG5AZU1□△, MHMG011U1□△, MHMG012U1□△



MHMG021U1□△, MHMG022U1□△, MHMG041U1□△, MHMG042U1□△



MHMG082U1□△, MHMG092U1□△



— Precautions —

- The above time characteristics use our standard servo drivers.

  Ensure that the effective torque is within the continuous duty zone of the S-T characteristics of each motor.

  For "S-T characteristics", see *“2.2.4 Specifications”* .
- When used in combination with a servo driver other than our standard servo driver, ensure that the overload setting for the servo driver is below the time characteristics stated above.

  Please contact us for the time characteristics of specific models.

2.3 Driver and Motor Combinations

Driver and motor combinations are shown in the table below.

Check the applicable motor series name, rated output, voltage specification and encoder specifications and use the correct combination.

— Precautions —

- Do not use in other combinations than those listed in the table below.

Motor					Driver	
Power supply	Type	Rated rotating speed	Product number (*1)	Rated output	Type product number (*1)	Size
Single phase 100 V	MHMG High inertia	3000 r/min	MHMG5AZU1□2□	50 W	MADN061□□	A
			MHMG011U1□2□	100 W	MADN081□□	
			MHMG021U1□2□	200 W	MBDN121□□	B
			MHMG041U1□2□	400 W	MCDN201□□	C
Single phase/3-phase 200 V			MHMG5AZU1□2□	50 W	MADN065□□	A
			MHMG012U1□2□	100 W		
			MHMG022U1□2□	200 W	MADN085□□	
			MHMG042U1□2□	400 W	MBDN125□□	B
			MHMG082U1□2□	750 W	MCDN205□□	C
			MHMG092U1□2□	1000 W	MDDN405□□	D

*1 The "□" in the model number represents the difference in specification.

2.4 Absolute Encoder (Battery Backup)

2.4.1 Overview

The absolute encoder is an encoder that can back up motor position information when the power supply is off.

A system using an absolute encoder is called an "absolute system". The absolute system eliminates the need for homing operations when the power is on and can be useful for robots and other applications.

For details on how to use absolute encoders, see *"7.2.7 Absolute Encoder"* .

There are two types of absolute encoder as described below.

- Absolute encoder (battery backup)
- Batteryless absolute encoder

The absolute encoder (battery backup) requires the connection of an absolute encoder battery to back up multi-turn data.

"2.4" section mainly describes this absolute encoder (battery backup).

2.4.2 Battery for Absolute Encoder

When using the optional battery unit provided by our company, install, replace, and set up (initialize) batteries in an absolute system using an absolute encoder (battery backup) according to the following procedure.

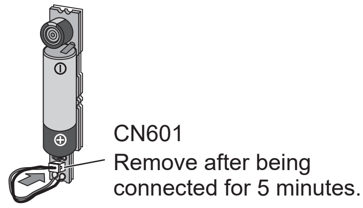
For details of battery product numbers and specifications, see *"12.4.9 Battery for Absolute Encoder"* .

2.4.2.1 How to Install Batteries (How to Install to Encoder Junction Cable)

Follow the procedure below to install batteries.

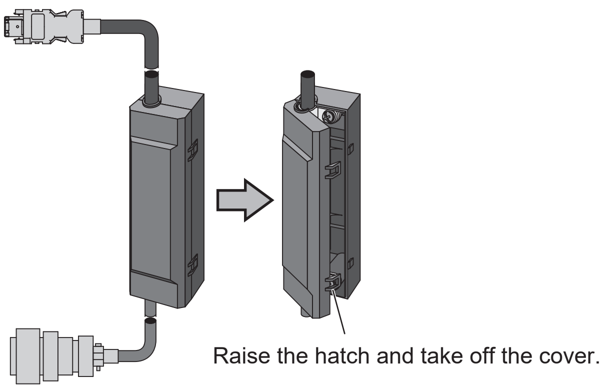
<< Procedure >>

1. Perform a refresh of the new battery.

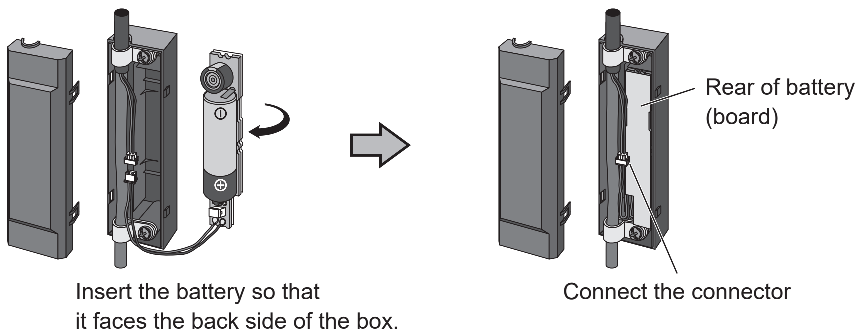


Connect the connector with battery lead wire to CN601 and leave for 5 minutes.
After five minutes, remove the connector from CN601.

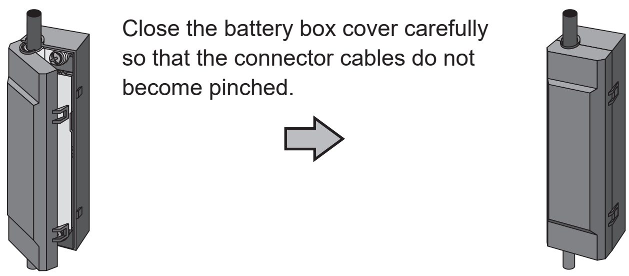
2. Remove the battery box cover.



3. Install the battery to the battery box.



4. Close the cover of the battery box.



— Precautions —

- Using batteries incorrectly may result in product corrosion due to battery leakage and in damage to the battery. When using batteries, be sure to observe the following.
  1. The positive and negative poles of the battery must be correctly oriented and the CN601 connector with lead wires must be correctly connected.
  2. Because leaving batteries that have been used for long periods of time or that are no longer usable inside the device may cause problems such as leaks, make sure to replace them promptly. (Replacement is recommended roughly every two years). The electrolyte in the battery is highly corrosive and can corrode peripheral parts. It is also conductive and can cause issues such as short circuits. Therefore, make sure to replace the battery periodically.
  3. Do not attempt to disassemble the battery or place it in a fire. Do not attempt to disassemble the battery as it is very dangerous if contents are splashed into your eyes. It may also explode if put into a fire or heated.
  4. Do not short-circuit the battery. Do not remove the battery tube. If metal or other such materials come into contact with the positive or negative pole terminals of the battery, a large current flows all at once, which would not only weaken the battery, but also generate severe heat and possibly cause the battery to explode.
  5. Do not attempt to charge it. This battery cannot be charged.

- Disposal of batteries after replacement is regulated by municipalities in some cases. Please dispose of batteries according to local regulations.
- Applications for shipment as a hazardous material may be required for air shipments (both passenger and cargo aircraft). Consult with the shipping company when requesting air shipments.

2.4.2.2 First Installation of the Battery

After installing and connecting the absolute encoder battery to the motor, set up the absolute encoder. For details, see *"2.4.3 Setup (Initialization) of Absolute Encoder"* .

We recommend turning the control power supply ON/OFF (battery refresh operation) after installing the battery for the absolute encoder. For details on refreshing the battery, see *"2.4.2.3 Battery Refresh (Method Using Set-up Support Software (PANATERM ver.7))"* .

Lithium batteries have a transient minimum voltage (voltage delay phenomenon), which causes a temporary voltage drop when the battery begins to discharge current. A battery error might occur due to this phenomenon if you fail to refresh the battery.

We recommend that the battery be refreshed about once a day after the battery unit is installed.

We also recommend that you refresh the battery even if you have prepared it yourself. Please consult with the battery manufacturer regarding the method of doing so.

A voltage drop in the battery may be primarily caused by battery life. Battery life may be shortened depending on ambient conditions.

2.4.2.3 Battery Refresh (Method Using Set-up Support Software (PANATERM ver.7))

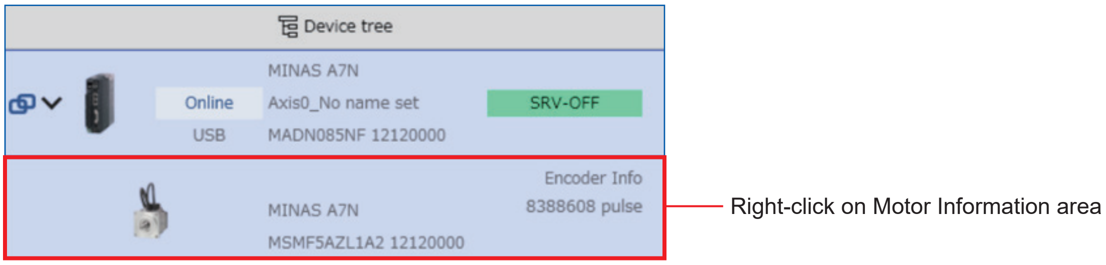
If the battery (battery for absolute encoder) is not discharged continuously, a battery alarm may be triggered. Perform the battery refresh process (forced discharge) to prevent this from happening.

The battery refresh process is required in cases such as the following:

- When replacing with a new battery
- When operating after a period of inactivity

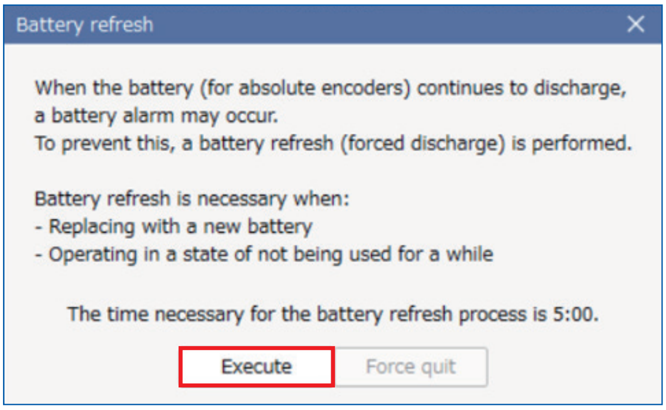
<< Procedure >>

1. Right-click on the motor information area of the device tree and select “Battery Refresh” from the context menu.



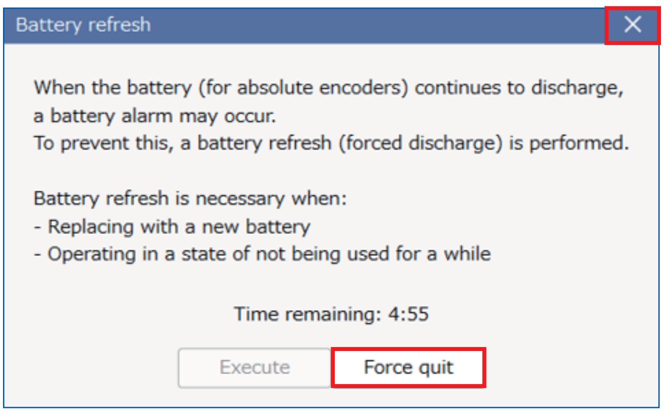
The Battery Refresh dialog box appears.

2. Click the "[Execute]" button.



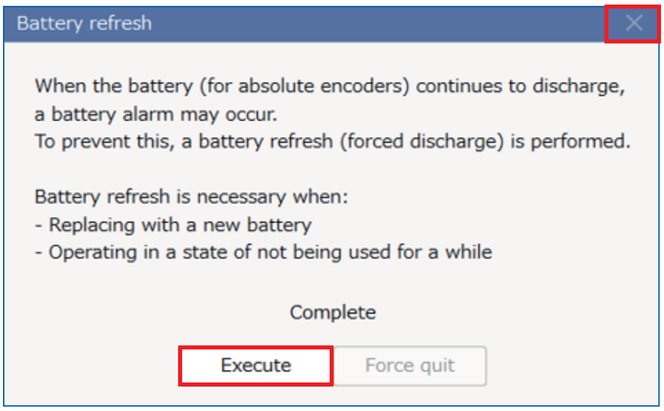
The remaining time for the battery refresh process will start counting down.

3. The battery refresh process starts.

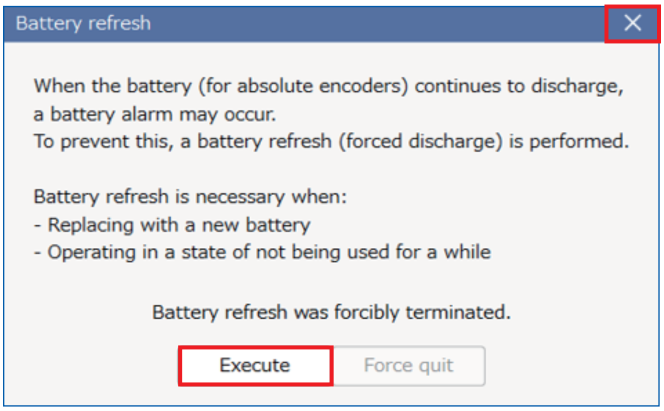


For clicking the [Force Quit] button during the battery refresh process, see“Step 5”. For clicking the [×] button, see“Step 6”.

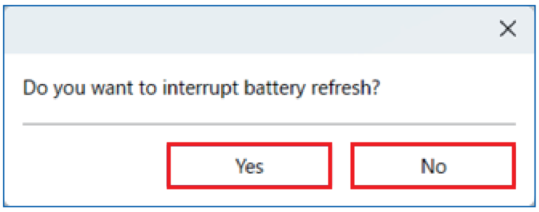
4. The following screen will appear once the battery refresh process is complete.
Click the [Execute] button to refresh the battery again, or click the [×] button to exit.



5. Clicking the [Force Quit] button during the battery refresh process forcefully terminates the battery refresh process. Click the [Execute] button to refresh the battery again, or click the [×] button to exit.



6. Clicking the [×] button during battery refresh displays a dialog box.
Clicking the [Yes] button will cancel the battery refresh process and return you to main screen operations.
Clicking the [No] button will return you to main screen operations while the battery refresh process continues.



— Precautions —

- The battery refresh process is not available for batteryless or incremental encoders.
- The battery refresh process cannot be used in full-closed control mode.
- Be aware that a battery alarm may be triggered. during the battery refresh process.

2.4.2.4 Replacement of the Battery

It is necessary to replace the absolute encoder battery if a battery warning occurs.

Replace the battery with the driver control power ON. Data stored in the encoder might be lost if you replace the battery while the control power of the driver is OFF.

After replacing the absolute encoder battery, clear the battery warning. Click the warning clear button on the Set-up Support Software (PANATERM ver.7) monitor display window to clear alarms, or do so via RTEX communication.

— Precautions —

- If you clear the absolute encoder rather than the alarm, all error and multi-turn data will be cleared together with the warning.

2.4.2.5 Battery Life

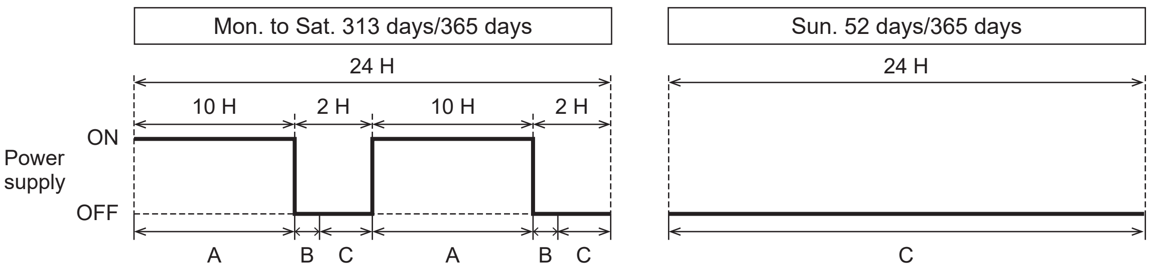
The following example shows the life calculation of the absolute encoder battery used, assuming robot operation.

Calculated with a battery capacity of 2000 mAh. Note that the following value is not a guaranteed value, but only represents a calculated value.

— Precautions —

- The values below were calculated with only the current consumption factored in. The calculations do not factor in electrolyte leakage and other forms of battery deterioration. Lifetime may be shortened depending on ambient condition.

1 Example of operation of 2 cycles/day



A: Battery current consumption in normal mode (0 μA)
B: Battery current consumption in power failure timer mode (90 μA)
C: Battery current consumption in power failure mode (30 μA)

Consumption capacity per year =
(10H×A + 0.0014H×B + 2H×C)×2×313 days + 24H×C×52 days
= 75.1 mAh
Battery life = 2000 mAh/75.1 mAh/year = 26.6 years

2 Example of operation of 1 cycle/day

The following shows an example of battery life calculations when two cycles in "1" above is set to rest.

Consumption capacity per year =
(10H×A + 0.0014H×B + 14 H×C)×313 days + 24H×C×52 days
= 168.9 mAh
Battery life = 2000 mAh/168.9 mAh/year = 11.8 (11.841) years

2.4.2.6 When Making Your Own Cable for Absolute Encoders (Battery Backup)

When you make your own cable for the absolute encoder (battery backup), connect the optional absolute encoder battery as per the wiring figure. The customer must also provide their own connectors for connecting absolute encoder batteries.

— Precautions —

- Install and fix batteries securely. If the installation and fixing of the battery is not appropriate, it may cause wire malfunction or damage to the battery.

  For details on handling the battery, see the operating manual of the battery.

■ Where to install batteries

1 Indoors, where the products are not subjected to rain or direct sunlight

2 Where the products are not subjected to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chloride gas, sulfuric gas, acid, alkaline and salt and so on, as well as places where they are not subjected inflammable gas, grinding fluid, oil mist, iron powder, chips, etc.

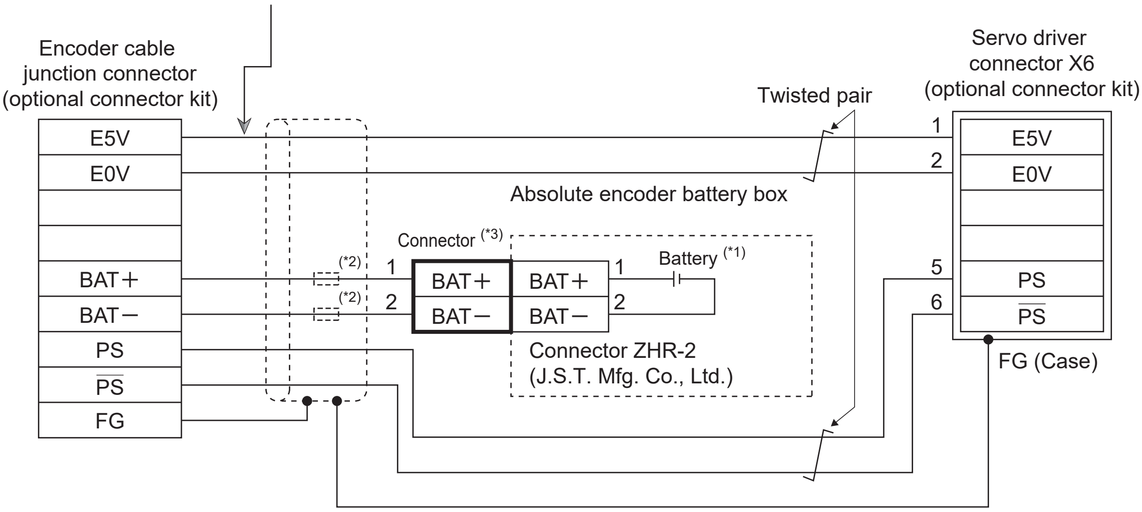
3 Somewhere well-ventilated and humid and dust-free

4 Somewhere free from vibrations

■ Wiring diagram

Pin numbers of optional connector

		E5V	E0V	BAT+	BAT-	PS	PS	FG
Small motor	Lead wire type	7	8	1	2	4	5	3



*1 Battery for absolute encoder

*2 Join the encoder side connector and battery side connector with solder, as the applicable electric wire diameters are different.

*3 Connectors for connecting absolute encoder batteries

Name	Product number	Manufacturer
Connector	ZMR-2	J.S.T. Mfg. Co., Ltd.
Connector pin	SMM-003T-P0.5	J.S.T. Mfg. Co., Ltd.
Recommended manual clamping jig	YRS-800	J.S.T. Mfg. Co., Ltd.

See *"12.4.9 Battery for Absolute Encoder"* for information on optional parts such as absolute encoder batteries, connectors for connecting absolute encoder batteries, and boxes for absolute encoder batteries.

2.4.3 Setup (Initialization) of Absolute Encoder

Absolute multi-turn data is retained by the absolute encoder battery. When operating the machine for the first time after installing an absolute encoder battery, you must clear the absolution encoder data (multi-turn data) to 0 at the origin by clearing the encoder at the home position. This clearing operation is called "multi-turn data clear".

Multi-turn data is cleared with Set-up Support Software (PANATERM ver.7) or RTEX communication. After performing the multi-turn data clearing operation, turn off the control power supply once, and then turn it back on.

For the method and procedure for clearing the multi-turn data using RTEX communication, check the host device specifications.

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3.1 Installation

This section contains information required for the installation of drivers and motors.

Install drivers and motors properly to avoid malfunctions or accidents.

3.1.1 Driver Installation

3.1.1.1 Installation Location

Please observe the following items when selecting a location to install the driver.

- The product is not waterproof. Install the driver in a control panel enclosed in noncombustible materials and placed indoors where the product is not subjected to rain or direct sunlight. The control board should be made of metal and ensure that it is electrically conductive.
- Install the driver in a location where it will not be exposed to grinding fluid, oil mist, iron powder, or chips.
- Install the driver in a well-ventilated location with low humidity and little dust or debris.
- Install in a vibration-free location.
- Avoid installing the driver near corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chloric gas, sulfuric gas, acid, alkali, and salt, as well as near atmospheres of inflammable gas, atmospheres where helium gas or other gases with small molecular weight are generated, or near combustible materials.

3.1.1.2 Environmental Conditions

Please observe the following items when selecting an environment in which to use the driver.

Item	Condition
Operating temperature	0°C to 60°C (it must not freeze) (Can be used between 55°C and 60°C when derated (*3))
Operating humidity	20% to 85% RH (free from condensation (*2))
Storage temperature (*1)	-20°C to 65°C (Max. temperature guarantee: 80°C for total of 72 hours, free from condensation (*2))
Storage humidity	20% to 85% RH (free from condensation (*2))
Vibration	5.88 m/s^2 (0.6 G) or less, 10 to 60 Hz
Altitude	2000 m or less (can be used at 1000 to 2000 m when derated (*3))

*1 Extreme temperatures are allowable only for short periods such as during transportation.

*2 Please note that condensation is more likely to occur when the temperature drops and humidity rises.

*3 For details on derating, see *“2.1.4.1 Basic Specifications”* .

3.1.1.3 How to Install

Please observe the following items when installing the driver.

- This is a vertically mounted product. Please install vertically.
- Sizes A to D drivers are base-mounted drivers (rear-mounted).
- To change the mounting surface of Sizes A to D drivers, use the optional mounting bracket. During installation, use the mounting screws provided with the product and the following tightening torque.
  - 1.0 to 1.35 N·m

  For optional mounting brackets, see *"12.4.10 Mounting Bracket"* .
- Apply adequate tightening torque to the product mounting screws by taking into consideration the strength of the screws and the characteristics of the material to which the product is installed.

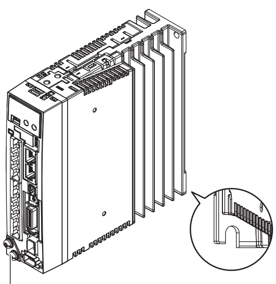
  (Example) Fastening to steel with steel screws

  Sizes A to D: M5 2.7 to 3.3 N·m

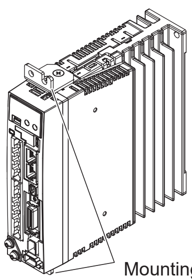
  Sizes A to D: M5 2.7 to 3.3 N·m installation is shown below.

Sizes A to D

Base mount (Standard)
[Rear mount]



Front mount
[Use mounting bracket]



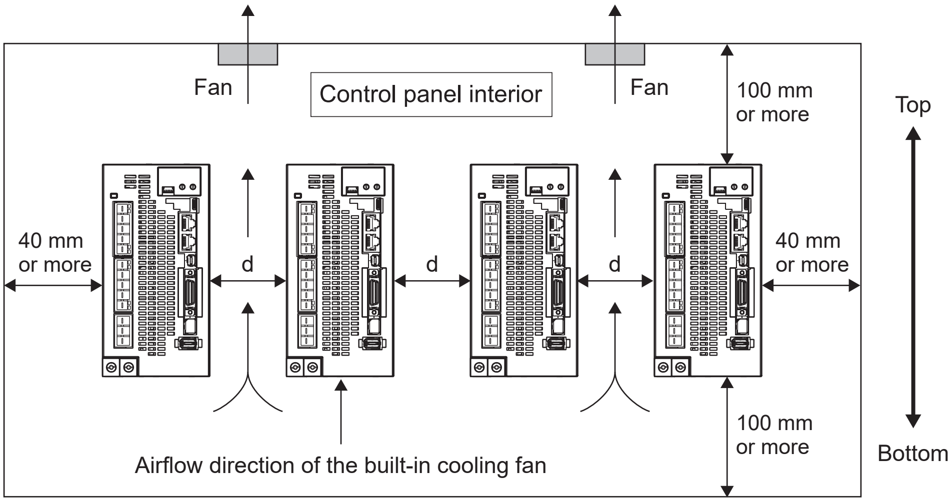
— Precautions —

- In order to prevent noise, it is recommended that conductive plating is used at the location where the driver is to be mounted. If the driver mounting points are painted, removing the paint before installation may help to prevent noise. When making your own mounting brackets, use conductive plating.

3.1.1.4 Mounting Orientation and Intervals

Please observe the following heat protection measures for the driver.

- Ensure sufficient surrounding space for effective cooling. For installation intervals, see the below diagram.
- Install a fan to achieve a uniform temperature within the control panel.
- Size D is equipped with a cooling fan on the bottom of the servo driver.
- Observe *"3.1.1.2 Environmental Conditions"* for the control panel internal environmental conditions.
- Check that the ambient temperature within 50 mm of the servo driver does not exceed the operating temperature range.
- If it is not possible to measure the temperature from a distance of 50 mm, instead measure at the midpoint of the gap between the obstacle preventing measurement and the servo driver.



d
10 mm or more

Notes

- Can be used derated when mounting interval d is 1 to 10 mm. For details on derating, see *"2.1.4.1 Basic Specifications"* .

— Precautions —

- Owing to the possibility, however unlikely, that your finished equipment will operate abnormally due to a malfunction of our product (such as due to signal disconnections, signal open phases, or operation performed outside the settings as a result of external noise or static electricity being applied), put in place fail-safes and ensure adequate safety within the operational range of your site.
- When using stranded electric wires, use insulated ferrule terminals or insulated round terminals. If stranded wires are used as-is, it can result in unexpected accidents or injuries such as electric shock and short circuits.
- Be sure to install a molded-case circuit-breaker to the power supply. Make sure to ground the earth terminals and earth wires. In order to prevent electric shock and malfunctions, Class D grounding or higher (grounding resistance of 100 Ω or less) is recommended. If not properly grounded, not only might the driver not deliver sufficient performance, but safety hazards such as malfunctions due to electrification or disturbances may arise.
- Binding and inserting wires into a metal duct will cause the temperature to increase, resulting in reduced allowable current values for the cables, possibly leading to burning. Consider the current reduction coefficient before deciding on how to wire the product.
- Ensure that the product is wired correctly and securely. Insecure or improper wiring may cause the motor to go out of control or burn. Ensure that no conductive material such as wire debris enters into the driver during installation and wiring.
- Be sure to tighten terminal block and ground screws properly using the torques specified in *"1.8.2.3.3 Wiring Terminal Blocks and Earth Terminals"* .
- Do not approach the motor or a machine being driven by the motor when the power is on to ensure safety in the event of an unexpected malfunction.
- Do not start or stop the device by turning the servo-on signal on or off. Doing so may damage the built-in dynamic brake circuit in the driver.
- Take care to ensure that the ambient temperature of the driver is within the operating range. The driver emits heat while the motor is in operation. Using the driver in a sealed control box may cause abnormal heating of the control box.
- Malfunctions of the motor or the driver it is combined with may result in burns to the motor and the emission of smoke and dust in an amount equivalent to roughly one cigarette. Please consider these possibilities when using the device in cleanrooms and similar facilities.

- The capacity of the capacitors of the power supply rectifier circuit will drop over time. To avoid a secondary problem due to malfunction, replacement is recommended approximately every five years. Replacement must be carried out by Panasonic or an authorized dealer.
- If the dynamic brake is applied when the device is operating at high speed, allow a stop time of approximately 10 minutes. Restarting the motor earlier may cause a broken wire in the dynamic brake making the brake inoperable.

3.1.2 Motor Installation

3.1.2.1 Installation Location

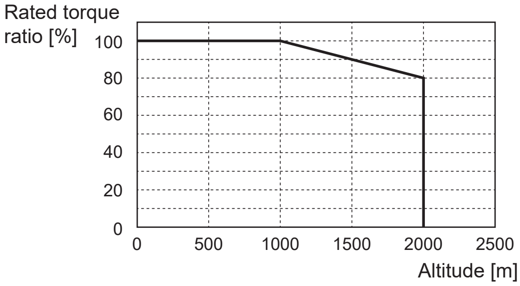
Whether the installation location is good or bad greatly affects the life expectancy of the motor, so be sure to select a location that meets the following conditions.

- Install the motor indoors, where it is not subjected to rain or direct sunlight.
- Install the driver in a location where it will not be exposed to grinding fluid, oil mist, iron powder, or chips.
- Install the motor in a well-ventilated location with minimal infiltration of moisture, oil, or water, and away from furnaces or other heat sources.
- Install in a location with easy access for inspection and cleaning.
- Install in a vibration-free location.
- Avoid using the motor in enclosed spaces, and install it in a well-ventilated space. The motor may overheat in enclosed spaces, shortening the motor's life.
- Avoid installing the driver near corrosive atmospheres or atmospheres of inflammable gas such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chloric gas, sulfuric gas, acid, alkali, and salt, atmospheres where helium gas or other gases with small molecular weight are generated, or near combustible materials.

3.1.2.2 Environmental Conditions

Please observe the following items when selecting an environment in which to use the motor.

Item		Condition
Operating temperature (*1)		Allowable ambient temperature (Except for motor temperature rise) During operation : 0 °C to 60 °C (free from condensation (*4)) However, in the following cases, be sure to perform the derating indicated in *"2.2.4 Specifications"* specifications and Speed-Torque characteristics. ● Motors without oil seals, when the temperature exceeds 40 °C ● Motors with oil seals, when the temperature exceeds 20 °C
Operating humidity		20% to 85% RH (free from condensation (*4))
Storage temperature (*2)		-20°C to 65°C (Max. temperature guarantee: 80°C for total of 72 hours, free from condensation (*4))
Storage humidity		20% to 85% RH (free from condensation (*4))
Vibration resistance	Motor only	49 m/s^2 or less during rotation in X, Y, and Z directions (Frame median: 20–3000 Hz, amplitude: 1.5 mm or less) 24.5 m/s^2 or less when stopped
Impact resistance	Motor only	98 m/s^2 or less in X, Y, Z directions 3 times each (with flange surface as reference)
IP rating (*3)	Motor only (Lead wire type)	IP65 (Except for shaft through sections and connector sections)

Item	Condition
Altitude	2000 m or less However, be sure to perform the derating shown below when using at altitudes in excess of 1000 meters. 

*1 The operating temperature is the temperature 5 cm away from the motor.

*2 Extreme temperatures are allowable only for short periods such as during transportation.

*3 These motors conform to the test conditions specified in the EN 60529 and EN 60034-5 standards. Not applicable for applications that require waterproof performance over extended periods of time, such as constant washing in water.

*4 Please note that condensation is more likely to occur when the temperature drops and humidity rises.

3.1.2.3 How to Install

You can mount the motor either horizontally or vertically as long as you observe the following.

- Horizontal mounting

  Mount the motor with the cable outlet facing downward as a countermeasure against water and oil.

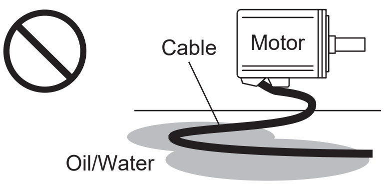
- Vertical mounting

  Use a motor with an oil seal when mounting a motor with a gear reducer to the axis upward to prevent the reducer oil from entering the interior of the motor.

3.1.2.4 Oil/Water Protection

Please observe the following items to protect the motor from oil and water.

- Do not use with the cable immersed in oil or water.



- Install the motor with the cable outlet facing downward.
- Do not use in an environment where the motor is constantly exposed to oil or water.
- When combining with a gear reducer, use a motor with an oil seal to prevent oil from entering the motor through the axis.

3.1.2.5 Stress to Cables

Please observe the following items to avoid stressing the cables.

- Avoid applying stress to the cable outlet and connecting portion by bending or its own weight.
- Especially in applications where the motor itself moves, fix the relay cable into the cable bear so that the stress by bending can be minimized.
- Make the cable bending radius as large as possible. (When using our optional cable, minimum R20 mm)

3.1.2.6 Permissible Load of Motor Output Axis

The mechanical system must be designed so that the applied radial load and/or thrust load to the motor axis at installation and at normal operation can meet the allowable value specified for each model.

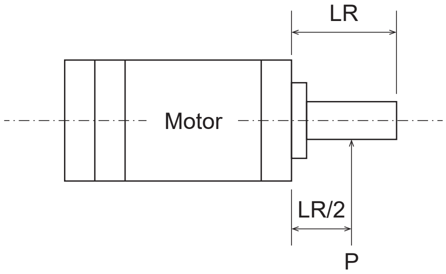
Pay extra attention when using rigid coupling, as excessive bending loads may cause the axis to break and reduce bearing life.

In order to keep the radial load caused by slight misalignment below the allowable value, use flexible coupling with the highest possible stiffness designed exclusively for the motor.

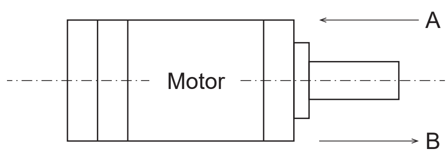
For the permissible load at output axis for each motor series, see the table below.

For measurement (LR) details, see the dimension diagram (*“12.2 Dimensions”*).

Radial load (P) position



Thrust load direction

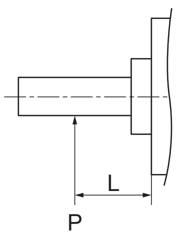


Unit: [N]

Motor series	Motor output	During assembly			During operation	
		Radial load	Thrust load		Radial load	Thrust load
			A-direction	B-direction		
MHMG	50 W	147	88	117	68	58
	100 W					
	200 W	392	147	196	245	98
	400 W					
	750 W	686	294	392	392	147
	1000 W					

Notes

- When the load position is changed, calculate the allowable radial load P (N) using the relational expressions shown in the table below. When doing so, use load position distance L (mm) from the mounting flange surface and set the load to a value less than or equal to the calculated result.



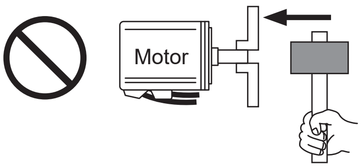
Applicable models	Motor output	Relational expressions for load-to-load position
MHMG	50 W	$P=\dfrac{2658}{L+26.3}$
	100 W	$P=\dfrac{3499}{L+38.5}$

Applicable models	Motor output	Relational expressions for load-to-load position
MHMG	200 W	$P=\frac{13402}{L+39.7}$
	400 W	$P=\frac{17432}{L+56.2}$
	750 W	$P=\frac{29949}{L+58.9}$
	1000 W	$P=\frac{34339}{L+70.1}$

3.1.2.7 Other Precautions

Please observe the following items when installing the motor.

- Do not apply direct impact to the axis with a hammer or similar tool while attaching or detaching a coupling to or from the motor axis (Doing so may damage the encoder mounted on the other side of the axis).



- Perform full alignment (Incomplete alignment may cause vibration and damage the bearing.).
- Ensure that the motor axis is not operated without being electrically grounded, as this may lead to the electrolytic corrosion of the motor bearing and increased bearing noise, depending on the machine and the installation environment. Confirmation and verification by the customer is required.

3.2 Connections

3.2.1 Wiring to the Main Circuit

The following will be described in each section.

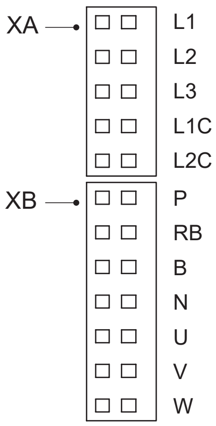
- Connector specifications: Terminal names, symbols, and descriptions of Connectors XA and XB. There are specific wiring procedures for each product type that must be followed when wiring.
- Example of complete connections: Typical example connection that covers the entire unit.
- Key points on wiring: Key points on wiring and connections.
- Wiring diagram: Detailed wiring example of the main circuit section. In this manual, all driver connector pinout diagrams are from an external view of the driver.

3.2.1.1 Sizes A, B (100 V/200 V)

3.2.1.1.1 Connector Specifications

Connect main power supply and control power to XA. Connect motor and regenerative resistor to XB.

Pinout diagram



Name			Symbol	Connector pin no.	Description
Connector	XA	Main power supply input terminal	L1	1	100 V system: Input single-phase 100 to 120 V +10%/-15% 50/60 Hz. 200 V system: Input single-phase/three-phase 200 to 240 V +10%/-15% 50/60 Hz. For single phase, connect to terminals L1 and L3.
			L2	2	
			L3	3	
		Control power supply input terminal	L1C	4	100 V system: Input single-phase 100 to 120 V +10%/-15% 50/60 Hz. 200 V system: Input single-phase 200 to 240 V +10%/-15% 50/60 Hz.
			L2C	5	
	XB	Regenerative resistor connection terminal	P	1	When adding an external regenerative resistor, connect the external regenerative resistor (prepared by customer) between P and B. Then, set Pr0.16. to 1 or 2. Do not connect anything to the RB terminal. Do not connect anything to the N terminal.
			RB	2	
			B	3	
			N	4	
		Motor connection terminal	U	5	Connect each phase of the motor coil. U: U-phase V: V-phase W: W-phase
			V	6	
			W	7	
Earth terminal			⏚		Terminal for grounding. There are two terminals. One should be connected to the earth, and the other should be connected to the motor earth wire.

* Tighten earth screws with a torque of M4: 0.7 to 0.8 N·m.

Wiring Procedure

1 Connect the power supply and motor to Connector XA and Connector XB.

2 Connect the wired connector to the driver.

Insert the connector securely until it is locked.

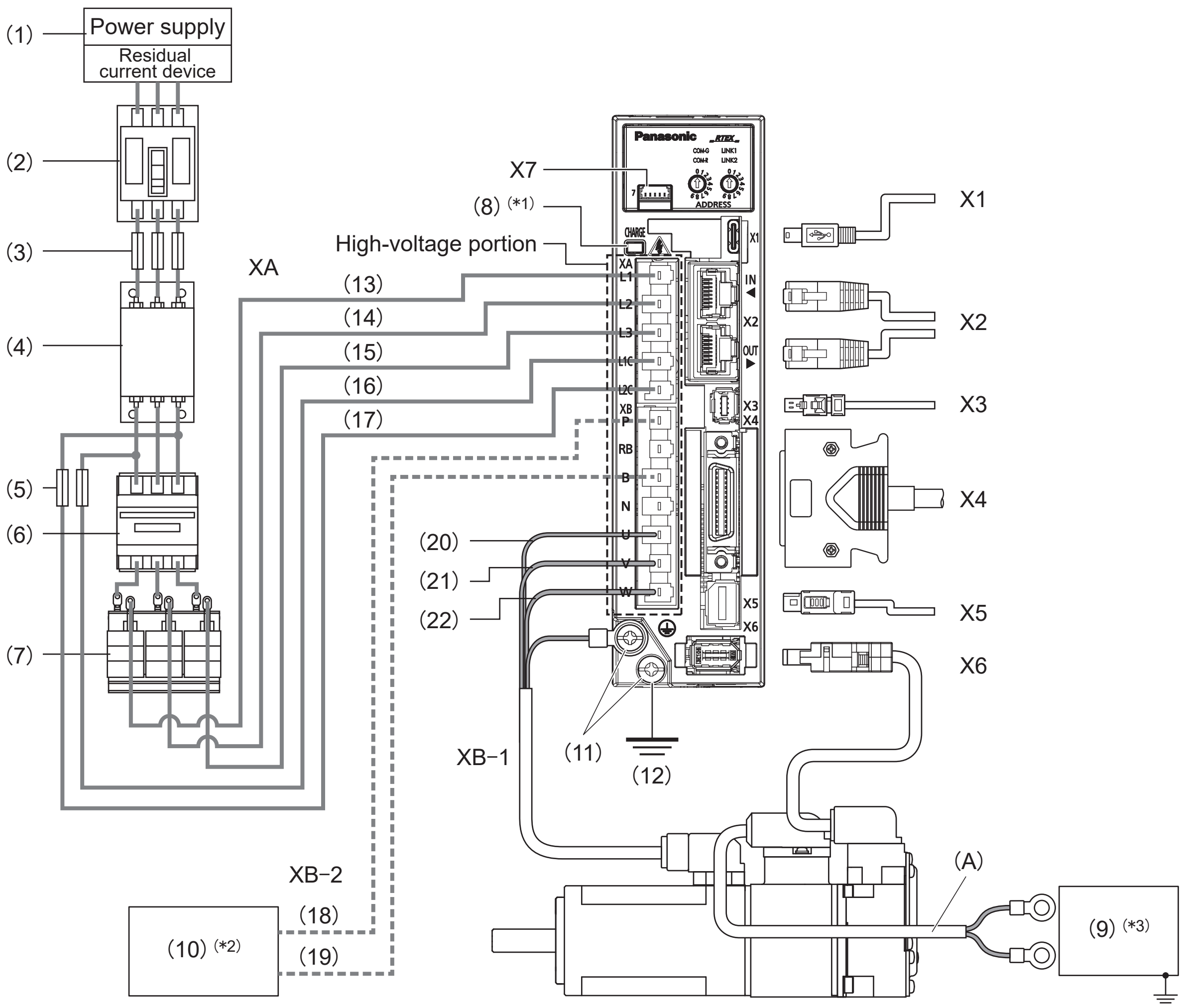
— Precautions —

- Wiring should be performed by a qualified electrician.
- In order to prevent electric shocks, do not connect to a power source until the wiring is complete.
- The power connectors (XA and XB) conduct high voltages and carry a risk of electric shock.

Notes

- When carrying out wiring work, check *"3.2.1.3 Wiring the Driver XA, XB Connectors"* for the wiring method of the XA and XB power connectors and *"3.2.1.4 Motor Connector Specifications"* for the specifications of the motor connector.

3.2.1.1.2 Example Connection for Entire Unit



*1 **Do not move, wire, or inspect the unit when the light is lit. There is a danger of electric shock.**

*2
- **Regenerative resistor connection terminal (18) and regenerative resistor connection terminal (19) must be wired in when connecting to a regenerative resistor (sold separately).**
- **Be sure to install external protection such as a thermal fuse when using an external regenerative resistor.**

- **Each regenerative resistor (sold separately) has a built-in thermal fuse and thermal protector. An activated thermal fuse cannot be restored.**
- **Install the regenerative resistor on nonflammable materials such as metal.**

*3 **X1 to X7 are secondary circuits and must be insulated from the 24 V DC brake power supply (9). Do not connect to the same power supply.**

Parts and Wiring, etc.

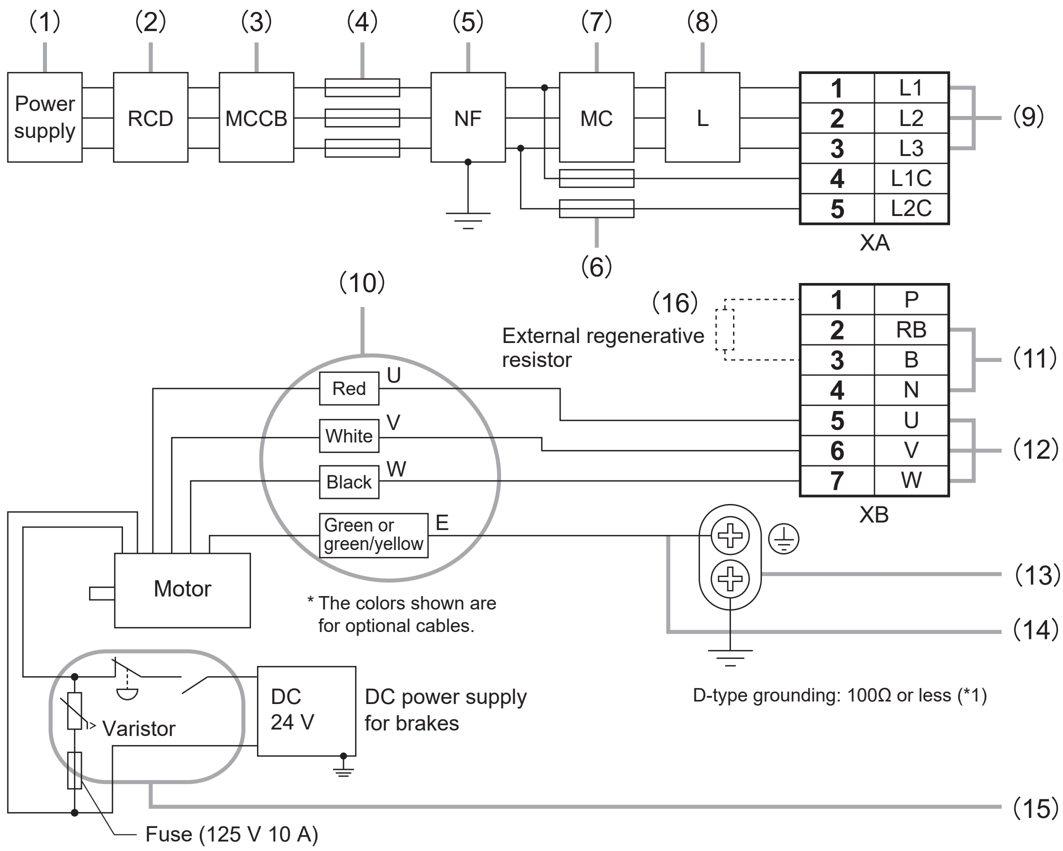
(1)	Power supply and residual current device (RCD)	(12)	D-type ground (earth)
(2)	Molded-Case Circuit-Breaker (MCCB)	(13)	Main power supply input L1 (1-pin)
(3)	Main circuit power supply input line fuse	(14)	Main power supply input L2 (2-pin)
(4)	Noise filter (NF)	(15)	Main power supply input L3 (3-pin)
(5)	Control circuit power supply input line fuse	(16)	Control power input L1C (4-pin)
(6)	Electromagnetic contactor (MC)	(17)	Control power input L2C (5-pin)
(7)	Reactor (L)	(18)	Wiring P to the regenerative resistor (1-pin)
(8)	Charge lamp (red LED)	(19)	Wiring B to the regenerative resistor (3-pin)
(9)	DC power supply for brakes 24 V DC	(20)	U-phase (5-pin, red) (*1)
(10)	Regenerative resistor (sold separately)	(21)	V-phase (6-pin, white) (*1)
(11)	Earth terminal	(22)	W-phase (7-pin, black) (*1)

*1 Colors in ( ) are for optional cables.

Connection points for connectors

X1	Connection to computer	X6	Connection to encoder
X2	Connection with host device (RTEX communication)	X7	Connection to external monitor
X3	Connection to safety controller	XA	Connection to input power
X4	Parallel I/O connection	XB	1 Connection to motor driving phase and earth 2 External regenerative resistor connection
X5	Connection to external scale	(A)	Connection to DC brake power supply

3.2.1.1.3 Key Points on Wiring



*1 For suitable power cables, see *"1.8.2.3 Electric Wires"* .

1 Check the nameplate of the driver for power specifications.

2 Install a residual current device. Use a residual current device with high-frequency countermeasures "for inverters".

3 Install a molded-case circuit-breaker (MCCB).

4 Connect fuses on the main circuit power supply input. See *"1.8.2.13 Installing Short Protection Elements"* when selecting fuse rated currents.

5 Install a noise filter. When using a single phase power supply, always connect to terminals L1 and L3.

6 Connect fuses on the control circuit power supply input line. See *"1.8.2.13 Installing Short Protection Elements"* when selecting fuse rated currents.

7 Install the coil surge absorber recommended by the manufacturer to the coil of the electromagnetic contactor.
Do not start or stop the motor with the electromagnetic contactor.

8 Install an AC reactor.

9 Connect L1 and L1C, and L3 and L2C for single phase use (100 V and 200 V), and do not use L2.

10 Match the colors of the motor lead wires to those of the corresponding motor output terminals (U, V, W).

11 Do not connect anything to "N" and "RB".

12 Avoid shorting and earth faults. Do not connect to the main power supply.

13 Ground. To prevent electric shock, be sure to connect the earth terminal (⏚) of the driver and the earth (earth plate) of the control panel. Do not make multiple connections to one earth terminal (⏚). Two earth terminals are provided.

14 Do not connect earth wires to insertion slots for other wires and do not allow them touch.

15 The holding brake has no polarity. Construct a duplex brake control circuit so that the brake can also be activated by an external emergency stop signal.

For holding brake power supply capacity and use, see *"3.3.1 Internal Brake"* .

Install a varistor. Connect a 10 A fuse in series with the varistor.

16 If connecting an external regenerative resistor, the wiring shown with dotted lines is required.

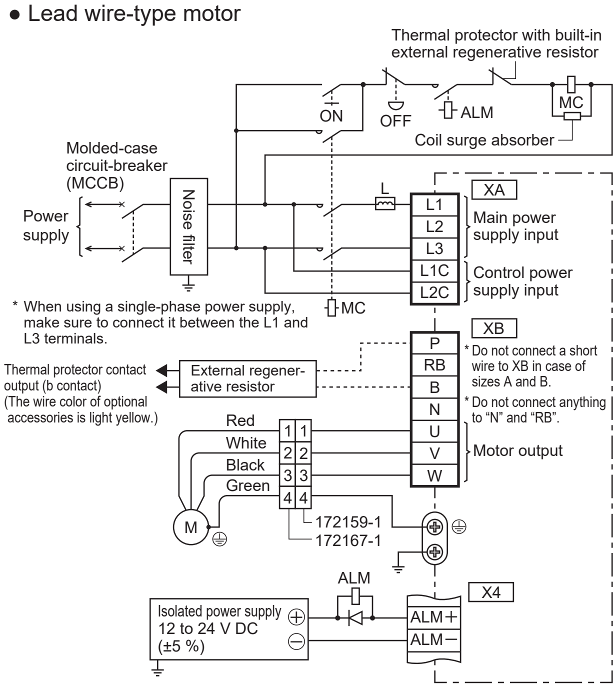
3.2.1.1.4 Wiring Diagram

— Precautions —

- Configure the circuit so that the main power supply will shut off when an alarm occurs.

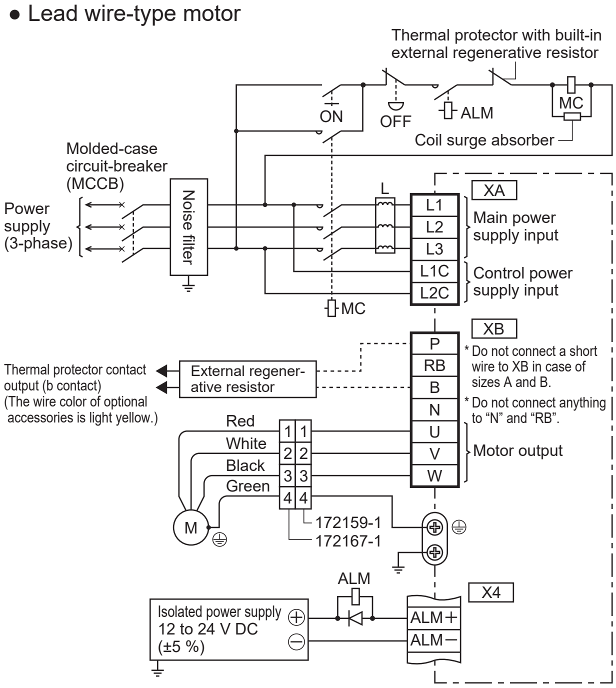
Single phase 100 V or 200 V

- Lead wire-type motor



3-phase 200 V

- Lead wire-type motor



Notes

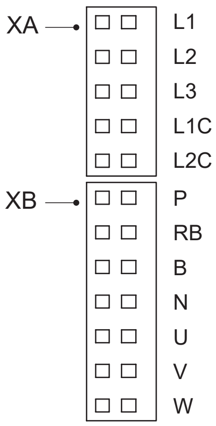
- Sizes A and B are not equipped with regenerative resistors (External only).
  External regenerative resistors can be connected to both sizes A and B.
  If connecting, apply the wiring shown with dotted lines.

3.2.1.2 Sizes C, D (100 V/200 V)

3.2.1.2.1 Connector Specifications

Connect main power supply and control power to XA. Connect motor and regenerative resistor to XB.

Pinout diagram



Name			Symbol	Connector pin no.	Description
Connector	XA	Main power supply input terminal	L1	1	100 V system: Input single-phase 100 to 120 V +10%/-15% 50/60 Hz. 200 V system: Input single-phase/three-phase 200 to 240 V +10%/-15% 50/60 Hz. For single phase, connect to terminals L1 and L3.
			L2	2	
			L3	3	
		Control power supply input terminal	L1C	4	100 V system: Input single-phase 100 to 120 V +10%/-15% 50/60 Hz. 200 V system: Input single-phase 200 to 240 V +10%/-15% 50/60 Hz.
			L2C	5	
	XB	Regenerative resistor connection terminal	P	1	Normally, short the circuit between RB and B. When adding an external regenerative resistor, disconnect the short wire between RB and B, connect the external regenerative resistor between P and B, and set Pr0.16 to 1 or 2. Do not connect anything to the N terminal.
			RB	2	
			B	3	
			N	4	
		Motor connection terminal	U	5	Connect each phase of the motor coil. U: U-phase V: V-phase W: W-phase
			V	6	
			W	7	
Earth terminal			⏚		Terminal for grounding. There are two terminals. One should be connected to the earth, and the other should be connected to the motor earth wire.

* Tighten earth screws with a torque of M4: 0.7 to 0.8 N·m.

Wiring Procedure

1 Connect the power supply and motor to Connector XA and Connector XB.

2 Connect the wired connector to the driver.

Insert the connector securely until it is locked.

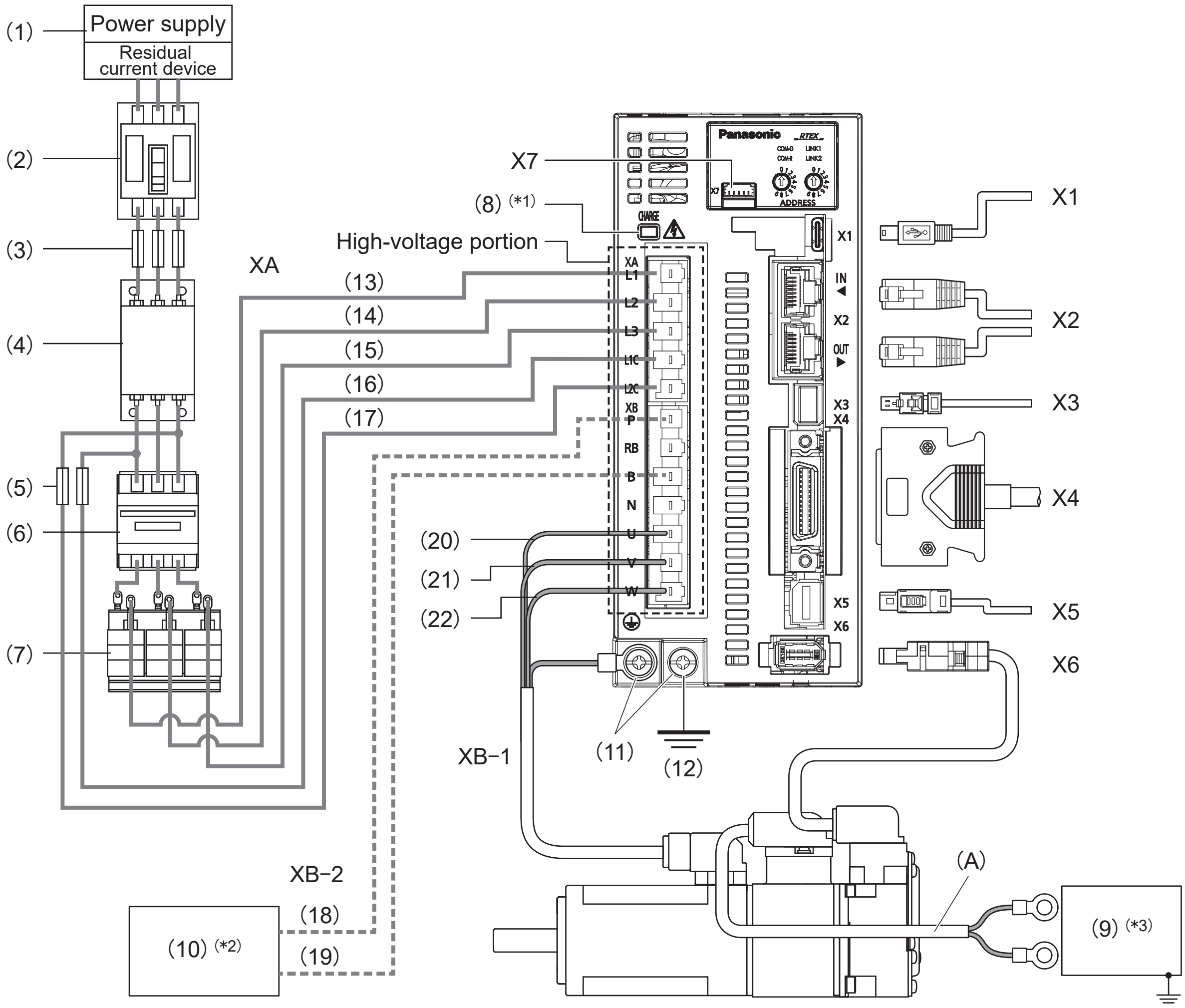
— Precautions —

- Wiring should be performed by a qualified electrician.
- In order to prevent electric shocks, do not connect to a power source until the wiring is complete.
- The power connectors (XA and XB) conduct high voltages and carry a risk of electric shock.

Notes

- When carrying out wiring work, check *"3.2.1.3 Wiring the Driver XA, XB Connectors"* for the wiring method of the XA and XB power connectors and *"3.2.1.4 Motor Connector Specifications"* for the specifications of the motor connector.

3.2.1.2.2 Example Connection for Entire Unit



*1 **Do not move, wire, or inspect the unit when the light is lit. There is a danger of electric shock.**

*2
- **Regenerative resistor connection terminal (18) and regenerative resistor connection terminal (19) must be wired in when connecting to a regenerative resistor (sold separately).**
- **Be sure to install external protection such as a thermal fuse when using an external regenerative resistor.**

- **Each regenerative resistor (sold separately) has a built-in thermal fuse and thermal protector. An activated thermal fuse cannot be restored.**
- **Install the regenerative resistor on nonflammable materials such as metal.**

*3 **X1 to X7 are secondary circuits and must be insulated from the 24 V DC brake power supply (9). Do not connect to the same power supply.**

Parts and Wiring, etc.

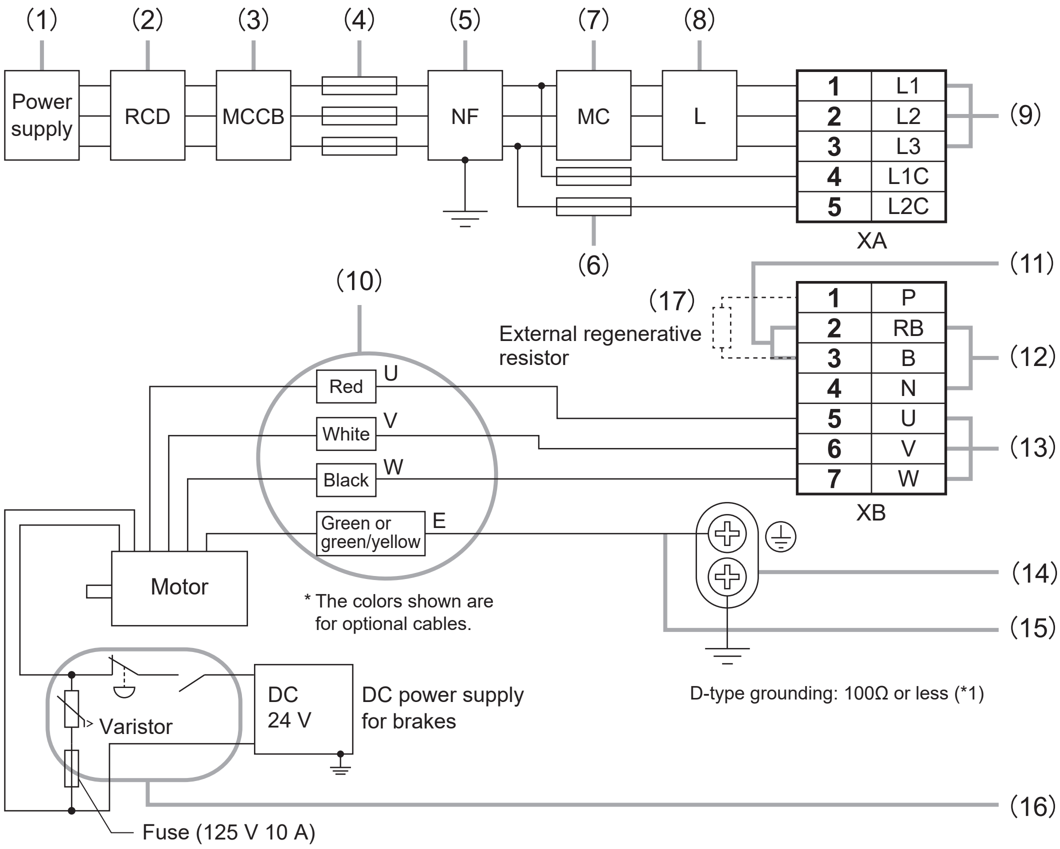
(1)	Power supply and residual current device (RCD)	(12)	D-type ground (earth)
(2)	Molded-Case Circuit-Breaker (MCCB)	(13)	Main power supply input L1 (1-pin)
(3)	Main circuit power supply input line fuse	(14)	Main power supply input L2 (2-pin)
(4)	Noise filter (NF)	(15)	Main power supply input L3 (3-pin)
(5)	Control circuit power supply input line fuse	(16)	Control power input L1C (4-pin)
(6)	Electromagnetic contactor (MC)	(17)	Control power input L2C (5-pin)
(7)	Reactor (L)	(18)	Wiring P to the regenerative resistor (1-pin)
(8)	Charge lamp (red LED)	(19)	Wiring B to the regenerative resistor (3-pin)
(9)	DC power supply for brakes 24 V DC	(20)	U-phase (5-pin, red) (*1)
(10)	Regenerative resistor (sold separately)	(21)	V-phase (6-pin, white) (*1)
(11)	Earth terminal	(22)	W-phase (7-pin, black) (*1)

*1 Colors in ( ) are for optional cables.

Connection points for connectors

X1	Connection to computer	X6	Connection to encoder
X2	Connection with host device (RTEX communication)	X7	Connection to external monitor
X3	Connection to safety controller	XA	Connection to input power
X4	Parallel I/O connection	XB	1 Connection to motor driving phase and earth 2 External regenerative resistor connection
X5	Connection to external scale	(A)	Connection to DC brake power supply

3.2.1.2.3 Key Points on Wiring



*1 For suitable power cables, see *"1.8.2.3 Electric Wires"* .

1 Check the nameplate of the driver for power specifications.

2 Install a residual current device. Use a residual current device with high-frequency countermeasures "for inverters".

3 Install a molded-case circuit-breaker (MCCB).

4 Connect fuses on the main circuit power supply input. See *"1.8.2.13 Installing Short Protection Elements"* when selecting fuse rated currents.

5 Install a noise filter. When using a single phase power supply, always connect to terminals L1 and L3.

6 Connect fuses on the control circuit power supply input line. See *"1.8.2.13 Installing Short Protection Elements"* when selecting fuse rated currents.

7 Install the coil surge absorber recommended by the manufacturer to the coil of the electromagnetic contactor.

Do not start or stop the motor with the electromagnetic contactor.

8 Install an AC reactor.

9 Connect L1 and L1C, and L3 and L2C for single phase use (100 V and 200 V), and do not use L2.

10 Match the colors of the motor lead wires to those of the corresponding motor output terminals (U, V, W).

11 Normally, do not remove the short wire between RB and B. Remove only when using an external regenerative resistor.

12 Do not connect anything to "N" and "RB".

13 Avoid shorting and earth faults. Do not connect to the main power supply.

14 Ground. To prevent electric shock, be sure to connect the earth terminal (⏚) of the driver and the earth (earth plate) of the control panel. Do not make multiple connections to one earth terminal (⏚). Two earth terminals are provided.

15 Do not connect earth wires to insertion slots for other wires and do not allow them touch.

16 Construct a duplex brake control circuit so that the brake can also be activated by an external emergency stop signal. The holding brake has no polarity.

For holding brake power supply capacity and use, see *"3.3.1 Internal Brake"* .

Install a varistor. Connect a 10 A fuse in series with the varistor.

17 If connecting an external regenerative resistor, the wiring shown with dotted lines is required.

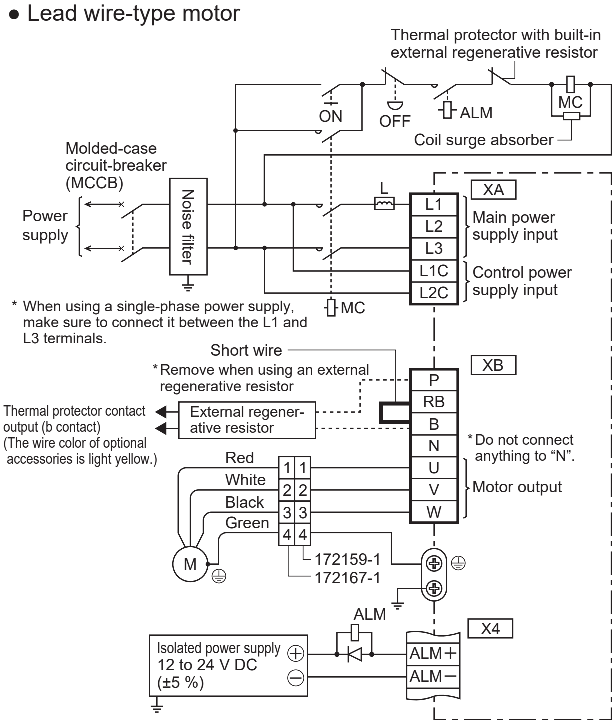
3.2.1.2.4 Wiring Figure

— Precautions —

- Configure the circuit so that the main power supply will shut off when an alarm occurs.

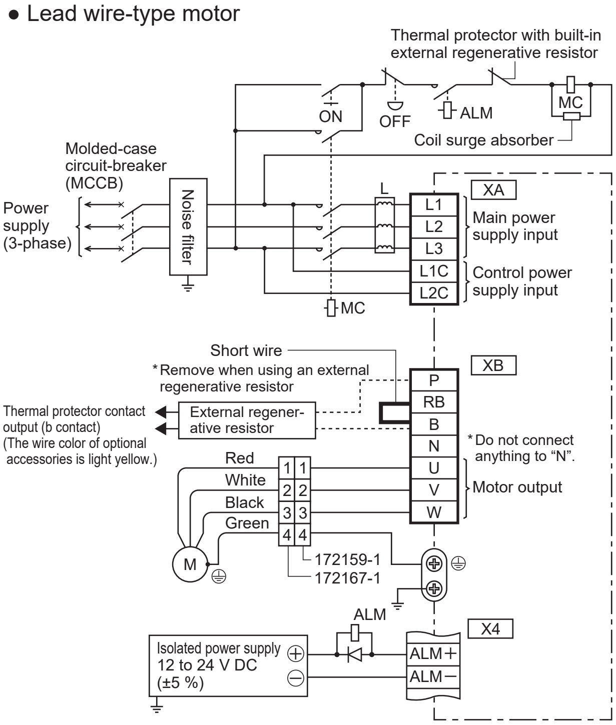
Single phase 100 V or 200 V

- Lead wire-type motor



3-phase 200 V

- Lead wire-type motor



Notes

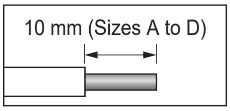
- The regenerative resistor is built into sizes C and D.
  Sizes C and D can also connect with an external regenerative resistor.
  If connecting, apply the wiring shown with dotted lines.

3.2.1.3 Wiring the Driver XA, XB Connectors

Follow the procedures below to wire the power supply and motor to connectors XA and XB.

<< Procedure >>

1. Strip the wires for use.



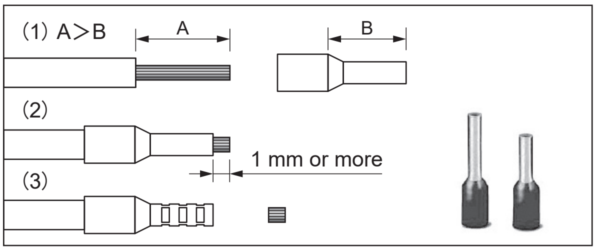
— Precautions —

- Be careful not to damage or cut the core wire when stripping the wire.

For single wires, refer to the dimensions in the figure above.

For stranded wires, be sure to use terminals. Examples given for reference below.

(Example) AI Series terminals with insulating sleeves made by Phoenix Contact



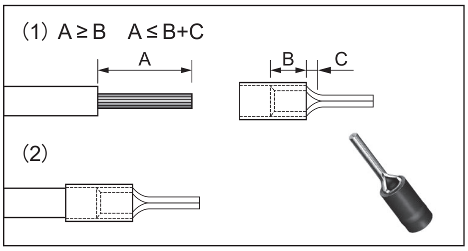
1 Peel off the sheath so that the conductor portion of the wire protrudes from the tip of the terminal (It should protrude 1 mm or more from the terminal.).

2 Insert the wire into the terminal and crimp it with an appropriate crimping tool.

Part No. of the crimping tool: CRIMPFOX U-D66 (1204436) made by Phoenix Contact

3 After crimping, cut off the wire conductor portion protruding from the terminal (The allowable protruding length after cutting should be 0 to 0.5 mm.).

(Example) VTUB Series vinyl-insulated terminal made by J.S.T. Mfg. Co., Ltd.



1 Peel off the sheath of the wire conductor portion to the length equal to that of the sheath on the terminal.

2 Insert the wire into the terminal and crimp it with an appropriate crimping tool.

Part No. of the crimping tool: YNT-1614 made by J.S.T. Mfg. Co., Ltd.

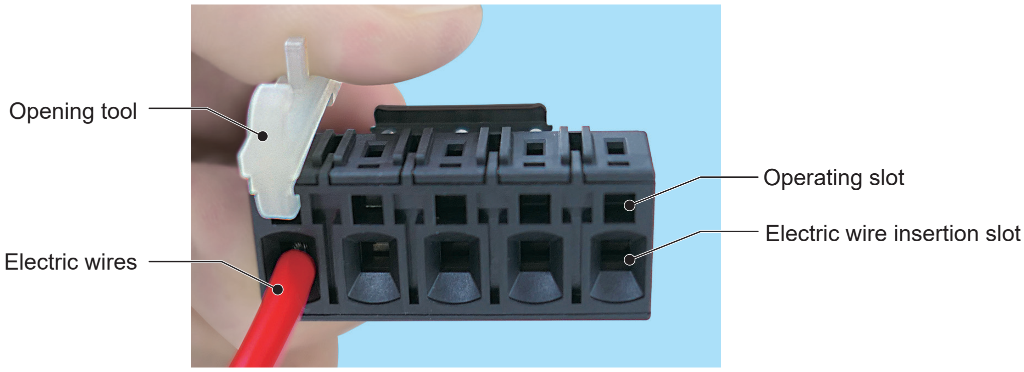
- When peeling off the sheath of the wire, take care not to damage other portions.
- If the conductors of the wire stick out from the insulation cover or protrude excessively from the tip of the terminal, accidents such as electric shocks or fires caused by short circuits may result. When crimping the terminal, carefully check the status of the terminal and wire.

The specifications for adaptive wires for connectors and recommended terminals are shown below.

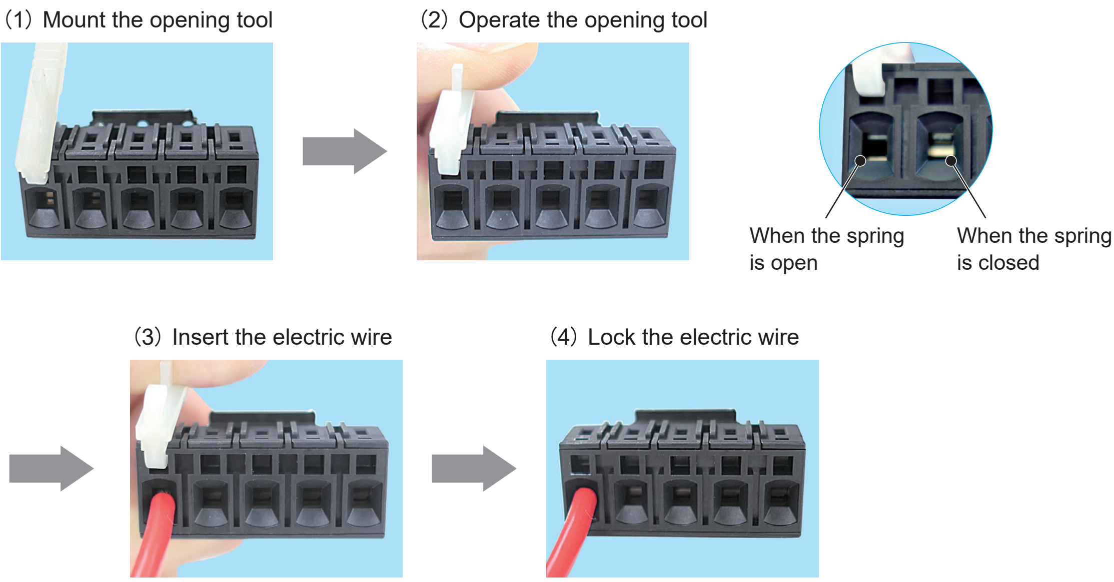
		Sizes A to C (100 V/200 V)	Size D (200 V)
Compatible wires	Conductor size	AWG18 to 14	
	Sheath outline	Φ2.1 to 3.8 mm	
Recommended terminals	Conductor size	AWG18	
	Terminal model number	AI0.75-8GY (Phoenix Contact)	

2. Insert the wire into the connector.

Connector external appearance



Insertion procedure



1 Insert the opening tool through the operating slot and attach it to the connector.

2 Push the opening tool down to open the spring.

*The wire can be removed by pressing down on the spring in the same manner as the insertion operation.

3 While holding the opening tool down, insert the wire straight into the wire insertion hole.

*Make sure that the entire strand section that has been peeled is inserted into the spring opening.

4 Release the opening tool and lock the wire. Gently pull on the wires to make sure they are securely connected. Make sure that the wire coating is not pinched by the spring. Remove the opening tool once the wiring has been completed.

— Precautions —

- Remove the connector from the driver before making the connection.

- Insert only one wire into each wire insertion hole of the connector.
- Keep the opening tool for the next time you may need to use it.
- Since the strip length of the wire depends on the type of wire, decide the optimum strip length according to the processing condition.

3.2.1.4 Motor Connector Specifications

The encoding connector, brake connector, and motor connector specifications are indicated below.

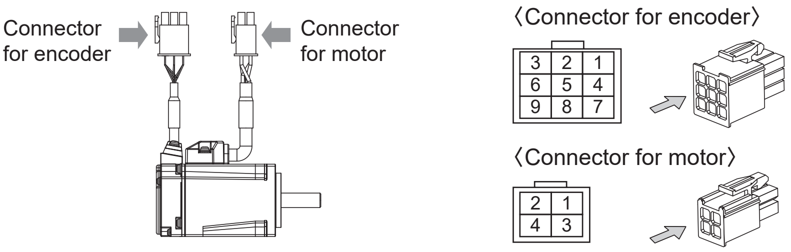
— Precautions —

- Do not connect anything to NC.

■ <MHMG> lead wire type motor

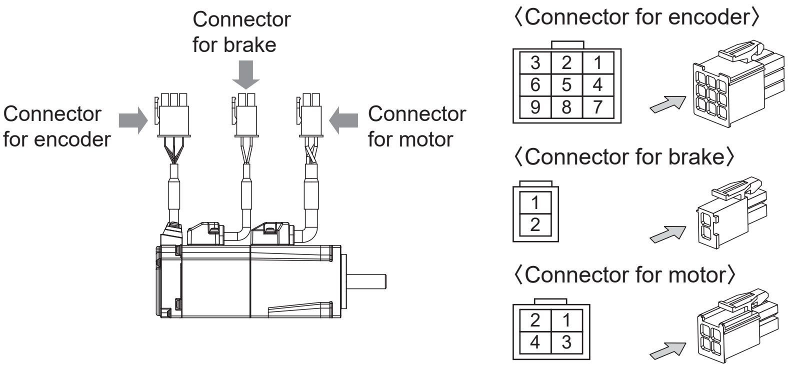
Connector: Made by Tyco Electronics Japan G.K. (the figure below shows a connector on the motor side)

MHMG 50 W and 100 W (□40)



Plug: 172169-1 (made by TE)
Pin: 770835-1 (made by TE)

Plug: 172167-1 (made by TE)
Pin: 170360-1 (made by TE)



Plug: 172169-1 (made by TE)
Pin: 770835-1 (made by TE)

Plug: 172165-1 (made by TE)
Pin: 170360-1 (made by TE)

Plug: 172167-1 (made by TE)
Pin: 170360-1 (made by TE)

Connector for encoder

Pin No.	Purpose
1	BAT+
2	BAT-
3	FG (shield)
4	PS
5	$\overline{PS}$
6	NC
7	E5V
8	E0V
9	NC

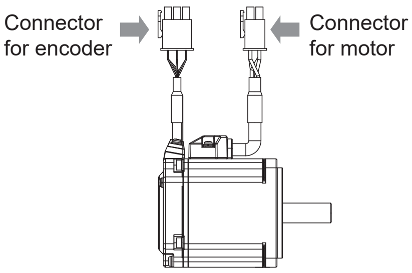
Connector for brake

Pin No.	Purpose
1	Brake
2	Brake

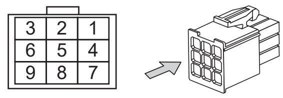
Connector for motor

Pin No.	Purpose
1	U-phase
2	V-phase
3	W-phase
4	Earth

MHMG 200 W and 400 W (□60)

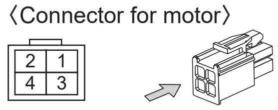


〈Connector for encoder〉

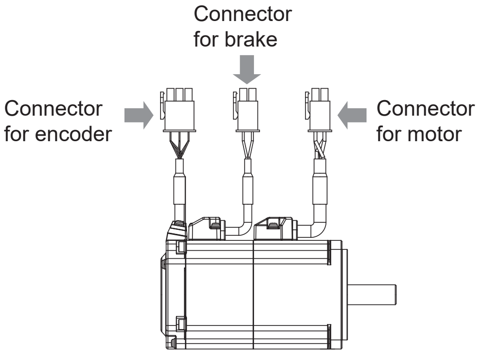


Plug: 172169-1 (made by TE)
Pin: 770835-1 (made by TE)

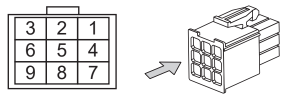
〈Connector for motor〉



Plug: 172167-1 (made by TE)
Pin: 170360-1 (made by TE)

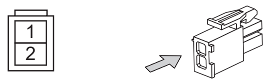


〈Connector for encoder〉



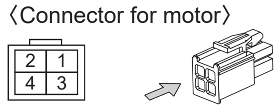
Plug: 172169-1 (made by TE)
Pin: 770835-1 (made by TE)

〈Connector for brake〉



Plug: 172165-1 (made by TE)
Pin: 170360-1 (made by TE)

〈Connector for motor〉



Plug: 172167-1 (made by TE)
Pin: 170360-1 (made by TE)

Connector for encoder

Pin No.	Purpose
1	BAT+
2	BAT-
3	FG (shield)
4	PS
5	$\overline{\text{PS}}$
6	NC
7	E5V
8	E0V
9	NC

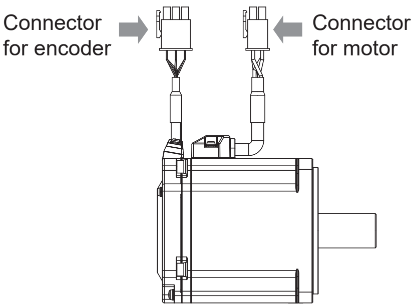
Connector for brake

Pin No.	Purpose
1	Brake
2	Brake

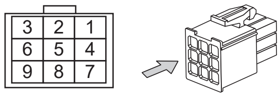
Connector for motor

Pin No.	Purpose
1	U-phase
2	V-phase
3	W-phase
4	Earth

MHMG 750 W and 1 kW (□80)

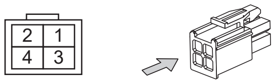


〈Connector for encoder〉

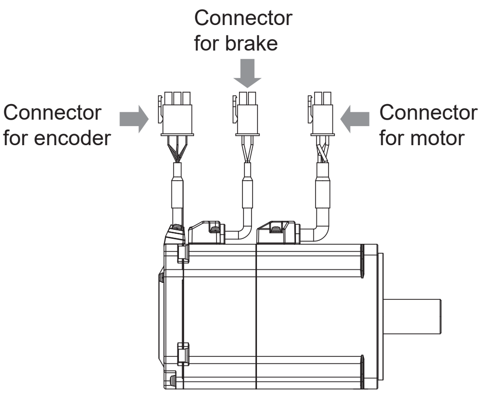


Plug: 172169-1 (made by TE)
Pin: 770835-1 (made by TE)

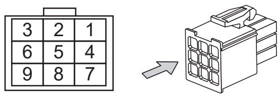
〈Connector for motor〉



Plug: 172167-1 (made by TE)
Pin: 170360-1 (made by TE)

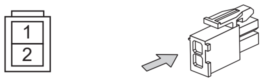


〈Connector for encoder〉



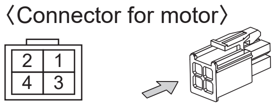
Plug: 172169-1 (made by TE)
Pin: 770835-1 (made by TE)

〈Connector for brake〉



Plug: 172165-1 (made by TE)
Pin: 170360-1 (made by TE)

〈Connector for motor〉



Plug: 172167-1 (made by TE)
Pin: 170360-1 (made by TE)

Connector for encoder

Pin No.	Purpose
1	BAT+
2	BAT-
3	FG (shield)
4	PS
5	$\overline{\text{PS}}$
6	NC
7	E5V
8	E0V
9	NC

Connector for brake

Pin No.	Purpose
1	Brake
2	Brake

Connector for motor

Pin No.	Purpose
1	U-phase
2	V-phase
3	W-phase
4	Earth

3.2.2 Wiring to Connector X1 (Connecting to Computer)

Connecting to a PC or host device via USB allows for parameter setting/changing, control status monitoring, error status/history reference, parameter saving/loading, and other operations.

The driver uses USB Type-C connectors. Use a commercially available USB Type-C cable.

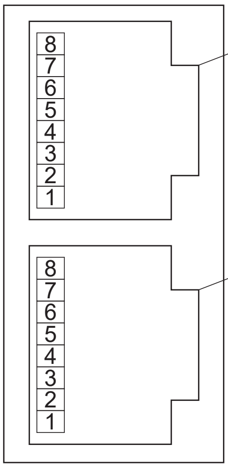
3.2.3 Wiring to Connector X2 (Host Device Connection)

3.2.3.1 Connector Specifications

Connect an RTEX communication cable to connector X2 in order to connect to the host device.

This connector is an RJ45 connector used with RTEX and consists of an input X2 IN Connector and an output X2 OUT Connector.

Pinout Diagram



Specifications for each connector shown below.

[X2 IN] connector

Name	Symbol	Connector pin no.	Description
NC	—	1	Connect to pin 1 on TX connector of transmitting-side node.
NC	—	2	Connect to pin 2 on TX connector of transmitting-side node.
Network input +	RX+	3	Connect to pin 3 on TX connector of transmitting-side node.
NC	—	4	Connect to pin 4 on TX connector of transmitting-side node.
NC	—	5	Connect to pin 5 on TX connector of transmitting-side node.
Network input -	RX-	6	Connect to pin 6 on TX connector of transmitting-side node.
NC	—	7	Connect to pin 7 on TX connector of transmitting-side node.
NC	—	8	Connect to pin 8 on TX connector of transmitting-side node.
Frame ground	FG	Shell	Connect to the cable shield.

[X2 OUT] connector

Name	Symbol	Connector pin no.	Description
NC	—	1	Connect to pin 1 on RX connector of receiving-side node.
NC	—	2	Connect to pin 2 on RX connector of receiving-side node.
Network output +	TX+	3	Connect to pin 3 on RX connector of receiving-side node.
NC	—	4	Connect to pin 4 on RX connector of receiving-side node.
NC	—	5	Connect to pin 5 on RX connector of receiving-side node.
Network output -	TX-	6	Connect to pin 6 on RX connector of receiving-side node.
NC	—	7	Connect to pin 7 on RX connector of receiving-side node.
NC	—	8	Connect to pin 8 on RX connector of receiving-side node.

Name	Symbol	Connector pin no.	Description
Frame ground	FG	Shell	Connect to the cable shield.

Be sure to use industrial 2P4C or 4P8C shielded twisted pair (STP) Ethernet cables compatible with TIA/EIA-568 CAT5e or higher.

3.2.3.2 Key Points on Wiring

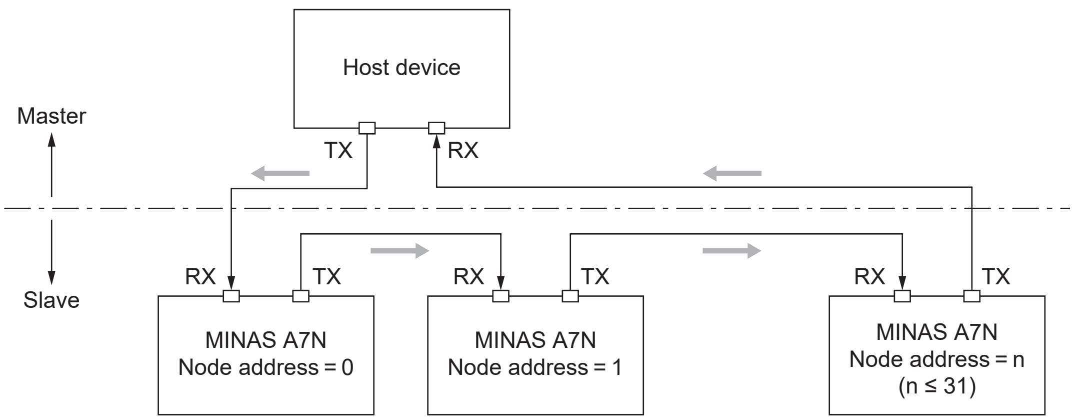
- Be sure to use shielded twisted pair cables (STP) compatible with CAT5e or higher.
- If both ends of the shield are not grounded, EMC characteristics will degrade.
  When attaching the connector plug to each end of the cables, ensure that the shielded wire of the cable is connected to the metal shell of the plug.
- For lead wire colors and matching connector terminals, follow TIA/EIA-568B (see *"3.2.3.3 Wiring Example"*).
  Pins 1-2 and 3-6 are signal wires. Make sure to also wire connectors for the three unused 4-5 and 7-8 pin pairs.
- When using two-pair wires in place of four-pair wires, connect the two-pair wires to pins 1-2 and 3-6 on the connectors, and leave 4-5 and 7-8 unconnected.
- Communication cable length should meet both of the below conditions for use.
  1 **Length of each node: max. 100 m**
  2 **Total length of cables between all nodes in the communication loop: Max. 200 m**
  Both the above conditions should be met for use.
  Please contact Panasonic if the condition "2" is to be exceeded.
  Cable specifications such as bending characteristics, temperature ranges, and covering materials will vary by manufacturer.
  Select a cable that meets the usage conditions at your company.
  Also select a movable cable that meets the usage conditions at your company.

<Communication cable for evaluations at Panasonic>

Manufacturer: SANWA SUPPLY INC.

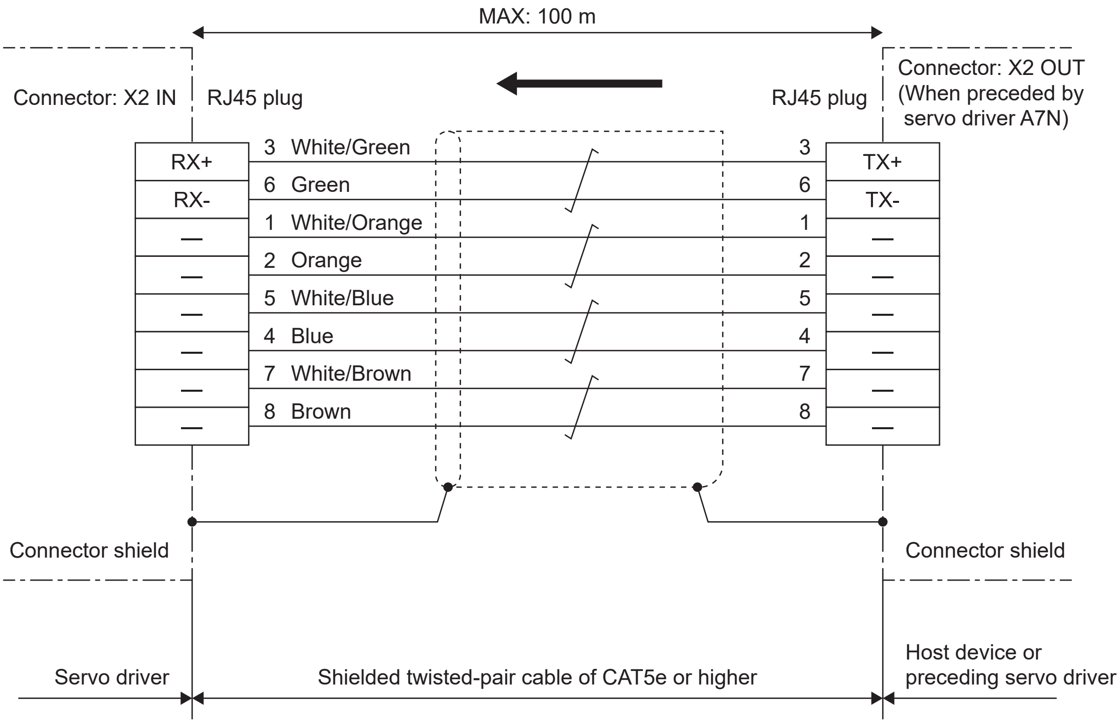
Product number: KB-STP-*LBN CAT5e, STP

System Configuration Diagram

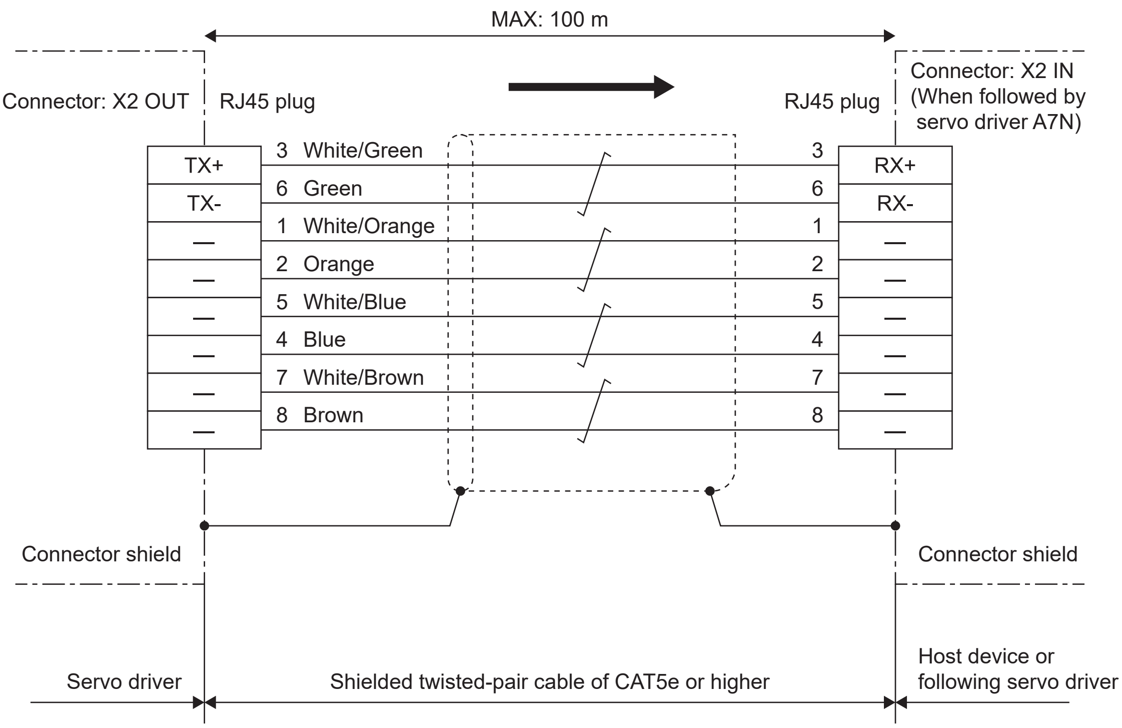


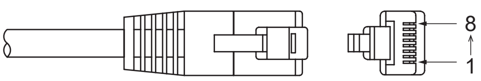
3.2.3.3 Wiring Example

Wiring for X2 IN



Wiring for X2 OUT





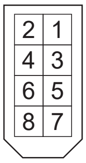
RJ45 plug pin

3.2.4 Wiring to Connector X3 (Connecting to the Safety Function Connector)

3.2.4.1 Connector Specifications

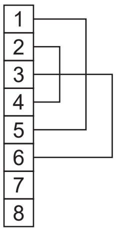
- This is a connector that is compatible with Functional Safety (Safety) specifications, and supports both the multi-function type and application specialized type.
- A safety bypass plug is connected as standard, and set to not use the safety function. If not using the safety function, do not remove the safety bypass plug.
- When using the safety function, remove the safety bypass plug and connect to the host device. For details on the safety functions, see *"9 Safety Function"* .

Pinout diagram



Safety bypass plug supplied with driver (internal wiring)

Pin No.



This is the wiring for when no safety circuit is constructed.

Do not connect in this way when using safety functions.

Name	Symbol	Con-nector pin no.	Description
—	—	1	This terminal is for the safety bypass, so do not connect anything other than the safety bypass plug.
	—	2	
Safety input 1	SF1-	3	• Input 1 for operating the STO function. This input interrupts the power transistor upper arm driving signal. • Make sure that it is connected so that the input circuit photocoupler turns OFF when the STO function is activated.
	SF1+	4	
Safety input 2	SF2-	5	• Input 2 for operating the STO function. This input interrupts the power transistor lower arm driving signal. • Make sure that it is connected so that the input circuit photocoupler turns OFF when the STO function is activated.
	SF2+	6	
EDM output	EDM-	7	This is a monitoring output for monitoring safety function failures. Do not use this monitor output when using the SSU function.
	EDM+	8	
Frame ground	FG	Shell	Connected to the earth terminal inside the servo driver.

For information on safety connectors, see *"12.4.8.6 Connector Kit for Safety"* .

In order to achieve the safety levels SIL3 and PL e, EDM output or SSU function is needed for STO function diagnosis (maximum diagnosis interval is 3 months).

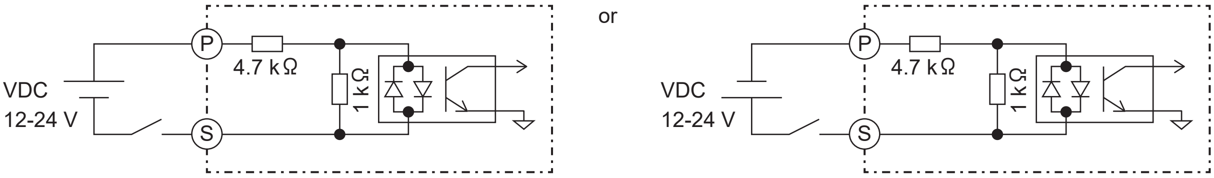
Safety levels are SIL2 and PL d when no STO function diagnosis with EDM output or the SSU function is performed.

For details on diagnostics via the STO function, see *"9.1.4 STO Function Diagnostics"* .

— Precautions —

- The unit will stop immediately if the connection cable to the host device or the safety bypass plug is unplugged during operation.

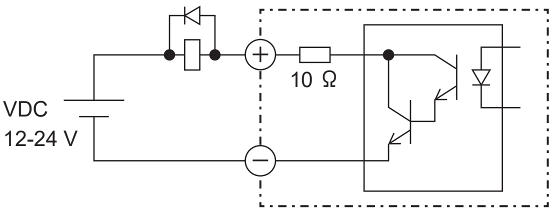
Safety input signal interface



P: 4 and 6-pin

S: 3 and 5-pin

EDM output signal interface



+: 8-pin

-: 7-pin

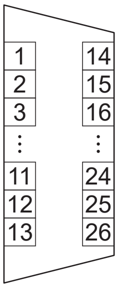
- Note the polarity of the control signal power supply (VDC). The servo driver will be damaged if connected in reversed polarity to that shown in the diagram.
- When the relay is directly driven, install a diode in parallel with the relay and in the direction as shown in the figure.

3.2.5 Wiring to Connector X4 (Connecting to I/O)

3.2.5.1 Connector Specifications

This is a connector for external input/output (I/O) to which interface cables (26-strand) are connected.

Pinout diagram



* (View from the cable side)

Connector (Plug): DF02P026F22A1 (Japan Aviation Electronics Industry, Ltd. or equivalent)

Name	Symbol	Connector pin no.	Description
General-purpose output 1	SO1+	1	Assign the desired function using parameters and output the signal for that function. For example, the external brake release signal outputs the alarm.
	SO1-	2	
General-purpose output 3	SO3+	3	
	SO3-	4	
General-purpose input 1	SI1	5	• SI-COM: Shared terminal for general-purpose inputs 1 to 8. Connect to either terminal of the external DC power supply. • SI1 to 8: When the desired function is assigned using parameters, they operate as signal input terminals for that function. For example, general-purpose motor input, or positive direction over-travel inhibit input.
General-purpose input common	SI-COM	6	
General-purpose input 2	SI2	7	
General-purpose input 3	SI3	8	
General-purpose input 4	SI4	9	
General-purpose input 5	SI5	10	
General-purpose input 6	SI6	11	
General-purpose input 7	SI7	12	
General-purpose input 8	SI8	13	
Absolute encoder battery input	BTP-I	14	Connect the battery for the absolute encoder.
	BTN-I	15	
Signal ground	GND	16	Signal ground.
A-phase output/position comparison output 1	OA+/OCMP1+	17	The following outputs are available using parameter settings. • OA ± and OB ±: Differential output of divided feedback scale signals (A/B-phase). • OCMP1 to 3 ± : Can be used as position comparison output.
	OA-/OCMP1-	18	
B-phase output/position comparison output 2	OB-/OCMP2-	19	
	OB+/OCMP2+	20	
Position comparison output 3	OCMP3+	21	
	OCMP3-	22	
Analog input (NC)	AI (NC)	23	Analog input with 16-bit resolution. (*1)
Signal ground (NC)	GND (NC)	24	Signal ground. (*1)
General-purpose output 2	SO2+	25	Assign the desired function using parameters and output the signal for that function.

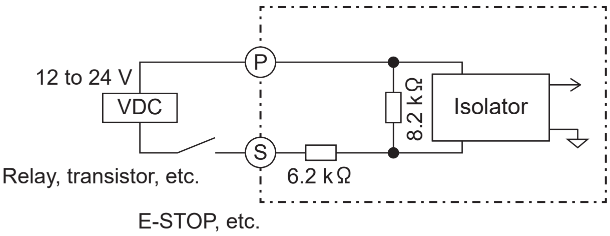
Name	Symbol	Connector pin no.	Description
General-purpose output 2	SO2-	26	Assign the desired function using parameters and output the signal for that function.
Frame ground	FG	Shell	Connected to the earth terminal inside the servo driver.

*1 Analog input and signal ground are supported only by the application specialized type. Do not connect to standard type or multi-function type.

3.2.5.1.1 Input Signal

Name	Symbol	Connector pin no.	Description
General-purpose input common	SI-COM	6	● Connect to either the + or - terminal of the external DC power supply (12 to 24 V). ● Use a power supply with voltage in the range of 12 V ±5% to 24 V ±5%. ● This must be isolated from the primary power supply. Do not connect it to the same power supply. Primary power supply: power supply for motor brake
General-purpose input 1	SI1	5	● Functions are allocated using parameters. For details, see the “Technical Reference - Functional Specification”.
General-purpose input 2	SI2	7	
General-purpose input 3	SI3	8	
General-purpose input 4	SI4	9	
General-purpose input 5	SI5	10	
General-purpose input 6	SI6	11	
General-purpose input 7	SI7	12	
General-purpose input 8	SI8	13	

Signal interface



P: 6-pin

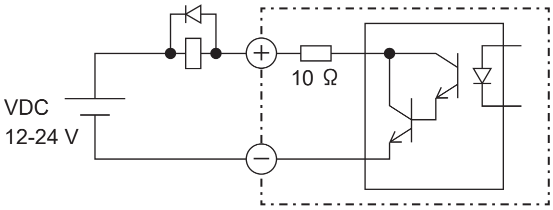
S: 5-, 7-, 8-, 9-, 10-, 11-, 12-, or 13-pin

- The polarity of the control signal power supply (VDC) is random (+ or - polarity).

3.2.5.1.2 Output Signal

Name	Symbol	Connector pin no.	Description
General-purpose output 1	SO1+ SO1-	1 2	● Any function can be assigned by using parameters. ● The logic of the output pins cannot be changed. ● For details on assigning parameters, see *"When Changing and Using the Output Signal Assignment"* . ● For factory standard parameters, see *"Default Assignment"* .
General-purpose output 2	SO2+ SO2-	25 26	
General-purpose output 3	SO3+ SO3-	3 4	

Signal interface



+: 1-, 3-, and 25-pin

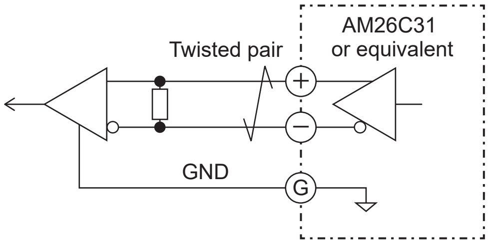
-: 2-, 4-, and 26-pin

- Note the polarity of the control signal power supply (VDC). The servo driver will be damaged if connected in reversed polarity to that shown in the diagram.
- When the relay is directly driven, install a diode in parallel with the relay and in the direction as shown in the figure.

3.2.5.1.3 Encoder Output Signal/Position Comparison Output Signal

<table>
<tr><th>Name</th><th>Symbol</th><th>Connec-
tor pin no.</th><th>Description</th></tr>
<tr><td rowspan="2">A-phase output /
Position comparison output 1</td><td>OA+ /
OCMP1+</td><td>17</td><td rowspan="6">● Differential output of divided feedback scale signal (A/B phase) (AM26C31 or equivalent).
● The division ratio can be set by the parameters.
● The ground of the line driver for the output circuit is connected to the signal ground (GND) and is not insulated.
● The maximum output frequency is 4 Mpulse/s (after being multiplied by 4).
● Pr4.47 “Pulse output selection” can be set to 1 and used as position comparison output.
● This differential signal should be received by a line receiver (AM26C32 or equivalent), and a terminating resistor (approx. 330 Ω) should be connected between the line receiver inputs.
● Use shielded twisted-pair cables for wiring, and connect the shielded wires to the connector shell.</td></tr>
<tr><td>OA- /
OCMP1-</td><td>18</td></tr>
<tr><td rowspan="2">B-phase output /
Position comparison output 2</td><td>OB+ /
OCMP2+</td><td>20</td></tr>
<tr><td>OB- /
OCMP2-</td><td>19</td></tr>
<tr><td rowspan="2">Position comparison output 3</td><td>OCMP3+</td><td>21</td></tr>
<tr><td>OCMP3-</td><td>22</td></tr>
<tr><td>Signal ground</td><td>GND</td><td>16</td><td>● Signal ground.
● Always connect the line receiver ground to this terminal.</td></tr>
</table>

Signal interface



+: (X4) 17-, 20-, and 21-pin

-: (X4) 18-, 19-, and 22-pin

G: (X4) 16-pin

● Install a terminating resistor (approx. 330 Ω) between line receiver inputs.

3.2.5.1.4 Encoder Backup Battery Input

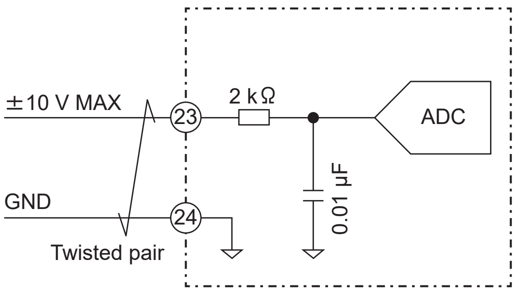
Name	Symbol	Connector pin no.	Description
Battery input for absolute encoder	BTP-I	14	● Connect the battery for the absolute encoder. For details, see *"3.2.7.2 Key Points on Wiring"* . BTP-I: Positive+ BTN-I: Negative- ● Connect the power for multi-turn data storage to the absolute encoder through BTP-O (3-pin) and BTN-O (4-pin) of encoder connector X6. ● Connect the absolute encoder battery using any of the below methods. 1 Connect to motor side directly 2 Connect to encoder cable 3 Connect to this connector
	BTN-I	15	

3.2.5.1.5 Analog Input Signal

Analog input and signal ground are supported only by the application specialized type. Do not connect to standard type or multi-function type.

Name	Symbol	Connector pin no.	Description
Analog input	AIN	23	● Analog input with 16-bit resolution. ● The maximum allowable input voltage is ±10 V. ● Accuracy of analog input values is not guaranteed. ● Assign functions using parameters. For details, see the "Technical Reference - Functional Specification".
Signal ground	GND	24	● Signal ground.

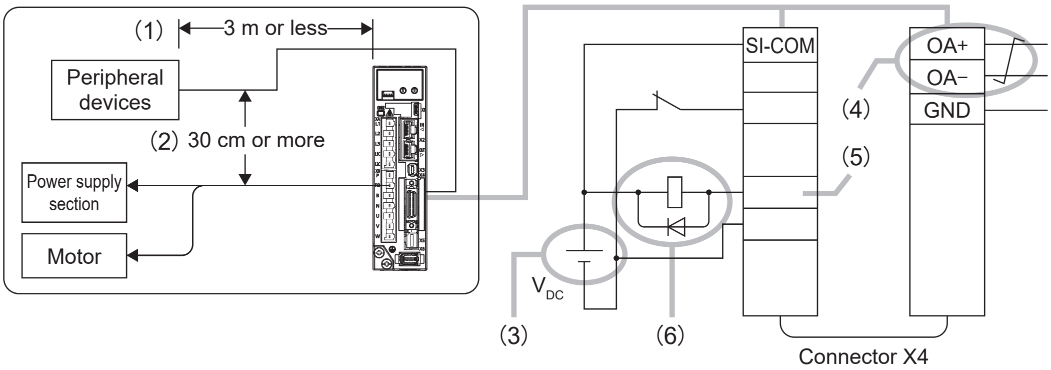
Signal interface



3.2.5.1.6 Other

Name	Symbol	Connector pin no.	Description
Frame ground	FG	Shell	● Connected to the earth terminal inside the servo driver.

3.2.5.2 Key Points on Wiring



1 Peripheral devices such as sensors should be placed within 3 m.

2 Keep a distance of at least 30 cm between the wiring and the main circuit (connectors XA and XB). Do not pass the wires through the same duct or bundle them together.

3 The control signal power supply (VDC) that connects to SI-COM should be prepared by the customer.

Voltage: 12 to 24 V DC

For the actual wiring, see *"3.2.5.4.1 General-purpose Input Common"* .

Insulation from 24 V DC brake DC power supply is required. Do not connect to the same power supply (See *"1.8.2.12 Control Input/Output Signal Noise Immunity Enhancement"*).

4 Use shielded twisted pairs of wires for wiring the differential signal output.

5 Do not apply more than 24 V to the control signal output terminals. For the actual wiring, see *"3.2.5.5.1 Control Output Signal"* . In addition, the output current should be less than or equal to the below values.

Rated current: 40 mA

6 When the relay is directly driven by the control output signals, install a diode in parallel with the relay and in the direction as shown in the figure. Failure to install a diode or installing it in the opposite direction may damage the driver.

Notes

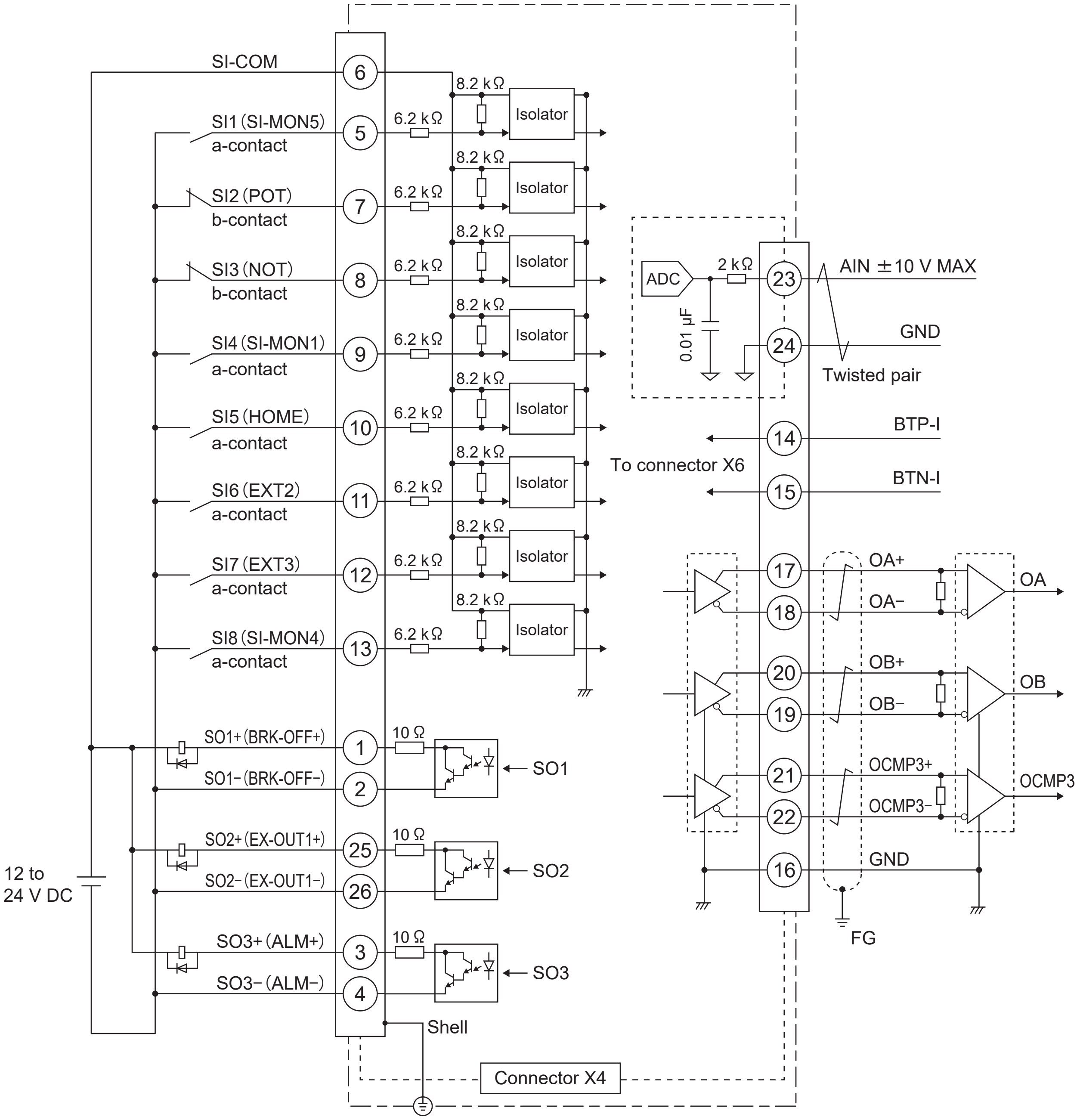
- The connector shell is connected to the earth terminal inside the driver.
- For details of connectors, see *"12.4.8.1 Connector Kit for Interface"* .

— Precautions —

- The tightening torque of the screws used for connecting the I/O controller to connector X4 should be 0.2 ±0.05 N·m.

  The driver-side connector may break if you exceed the maximum tightening torque.

3.2.5.3 Wiring Example



Notes

- The functions of the pins below can be changed depending on the parameters (see *"3.2.5.4.2 Control Input Signal"* - *"Changing and Using the Input Signal Assignment"* and *"3.2.5.5.1 Control Output Signal"* - *"When Changing and Using the Output Signal Assignment"*).

  Input: 5, 7, 8, 9, 10, 11, 12, 13

  Output: 1, 2, 3, 4, 25, 26

  The functions of the pins in the above figure are the initial values.

3.2.5.4 Input Signal and Pin No.

How to read the table (applies to both *"3.2.5.4 Input Signal and Pin No."* and *"3.2.5.5 Output Signals and Pin No."*)

Pin No.	The pin assignment number of the signal in question
Symbol	The symbol of the input signal or output signal The RTEX communication symbol is shown in parentheses ( ) Note that detection conditions for external output signals and RTEX communication signals are not the same.
Signal name	Signal name
Related mode	Related modes symbol P (position control/full-closed control mode), S (velocity control mode), T (torque control mode)
Communications monitor	Monitoring of RTEX communication responses ○: Allocation is performed for the RTEX response (status flag), and monitoring is possible —: Allocation is not performed for the RTEX response (status flag), and monitoring is not possible △: Regardless of the set values for Pr4.40 and Pr4.41, the RTEX response (status flag) "Warning" will turn ON when an alarm is issued. Causes of alarms can be checked with the RTEX alarm command.

* Check the operating instructions for the host device for a detailed description and how to handle the input/output signal.

3.2.5.4.1 General-purpose Input Common

Pin No.	Symbol	Signal name	Related mode			Communications monitor
6	SI-COM	General-purpose input common	—	—	—	—

Connect to either the + or - terminal of the external DC power supply (12 to 24 V).

Use a power supply with voltage in the range of 12 V ±5% to 24 V ±5%.

3.2.5.4.2 Control Input Signal

Any function can be assigned to control input signals SI1 to SI8.

The logic can also be changed.

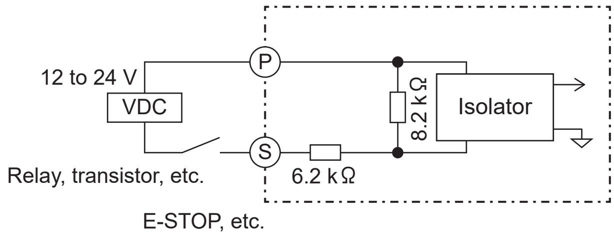
- For details on assigning parameters, see *"Changing and Using the Input Signal Assignment"* . For factory standard parameters, see *"Default Assignment"* .

■ **Control Input Circuit**

Pin No.	Symbol	Signal name
5	SI1	General-purpose input 1
7	SI2	General-purpose input 2
8	SI3	General-purpose input 3
9	SI4	General-purpose input 4
10	SI5	General-purpose input 5
11	SI6	General-purpose input 6
12	SI7	General-purpose input 7
13	SI8	General-purpose input 8

The input signal connects to contacts on switches and relays, or open collector output transistors.

When using contact input, use switches and relays for micro current to avoid contact failure.



■ Functions That Can Be Allocated to Control Inputs

Symbol	Signal name	Related mode			Communications monitor
E-STOP	Forced alarm input	P	S	T	O
• Generates Err 87.0.0 "Forced alarm input error".					

Symbol	Signal name	Related mode			Communications monitor
POT	Positive direction over-travel inhibit input	P	S	T	O
• A positive direction over-travel inhibit input. • The operation when this input is turned ON is set in Pr5.04 “Over-travel inhibit input setup” . In general, configure Pr5.04=1 (disabled), as over-travel inhibit input is controlled by host devices. Be sure to check the host device specifications. • When using the driver to control, set Pr5.04 “Over-travel inhibit input setup” to anything other than 1, and make the connections so that this input is ON when the moving portion of the machine exceeds the range of movement in a positive direction. • When using the home reference trigger in the homing operation, set Pr5.04 to 1 and disable over-travel inhibit input. This input signal can be assigned to SI5, SI6, or SI7. • The signal width should be at least 1 ms when closed and 2 ms when open. Note that these values are not guaranteed values.					

Symbol	Signal name	Related mode			Communications monitor
NOT	Negative direction over-travel inhibit input	P	S	T	O
• Negative direction over-travel inhibit input. • The operation when this input is turned ON is set with Pr5.04 “Over-travel inhibit input setup” . In general, configure Pr5.04=1 (disabled), as over-travel inhibit input is controlled by host devices. Be sure to check the host device specifications. • When using the driver to control, set Pr5.04 “Over-travel inhibit input setup” to anything other than 1, and make the connections so that this input is ON when the moving portion of the machine exceeds the range of movement in a negative direction. • When using the home reference trigger in the homing operation, set Pr5.04 to 1 and disable over-travel inhibit input. This input signal can be assigned to SI5, SI6, or SI7 • The signal width should be at least 1 ms when closed and 2 ms when open. Note that these values are not guaranteed values.					

Symbol	Signal name	Related mode			Communications monitor
HOME	Near home input	P	S	T	O
• When using the near home sensor during the homing operation, input the sensor signal. • If used as a home position reference trigger in the homing operation, this input signal can be assigned to SI5, SI6, or SI7. • The signal width should be at least 1 ms when closed and 2 ms when open. Note that these values are not guaranteed values.					

Symbol	Signal name	Related mode			Communications monitor
STOP	Retracting operation stop input	P	S	T	O
• If a STOP signal is input during retracting operations, the operation stops and Err85.2.0 “Retracting operation error” or Err87.3.0 “Retracting operation error” is triggered.					

Symbol	Signal name	Related mode			Communications monitor
RET	Retracting operation input	P	S	T	○
• The retracting operation is performed when the conditions set in Pr6.85 “Retracting operation condition setting” are met.					

Symbol	Signal name	Related mode			Communications monitor
EXT1	External latch input 1	P	S	T	○
EXT2	External latch input 2	P	S	T	○
EXT3	External latch input 3	P	S	T	○
• An external signal input is used as a trigger signal in position latch, latch mode with stop function and homing operation. • The signal width should be at least 1 ms when closed and 2 ms when open. Note that these values are not guaranteed values. • With a logical rising edge setup with a-contact and logical falling edge setup with b-contact, latch is performed at the timing of change from open (OFF) to closed (ON). • EXT1, EXT2, and EXT3 can be assigned to SI5, SI6, or SI7.					

When using positive direction over-travel inhibit input (POT), negative direction over-travel inhibit input (NOT), and near home input (HOME) with the edge method, and when using external latch inputs 1 to 3 (EXT 1 to 3), these inputs can only be assigned to SI5, SI6 and SI7 respectively.

For details of assigning methods and conditions, see *“Changing and Using the Input Signal Assignment”* .

Check the operating instructions for the host device for actual position latch via signal input and homing operations using these signals.

Symbol	Signal name	Related mode			Communications monitor
SI-MON1	General-purpose monitor input 1	P	S	T	○
SI-MON2	General-purpose monitor input 2	P	S	T	○
SI-MON3	General-purpose monitor input 3	P	S	T	○
SI-MON4	General-purpose monitor input 4	P	S	T	○
SI-MON5	General-purpose monitor input 5	P	S	T	○
• Used as the general-purpose monitor input. • Turning this input signal ON/OFF has no impact on operation, and can only be monitored via RTEX communication responses. • SI-MON1 and EXT1, SI-MON2 and EXT2, SI-MON3 and EXT 3, SI-MON 4 and EX-SON and SI-MON5 and E-STOP cannot be assigned overlapping. Err33.0.0 “Input overlapping assignment error 1 protection” and Err33.1.0 “Input overlapping assignment error 2 protection” are generated when parameters overlap.					

Symbol	Signal name	Related mode			Communications monitor
EX-SON	External servo-on input	P	S	T	○
• Use as an external servo-on input. • If both the RTEX communication or Set-up Support Software (PANATERM ver.7) servo-on commands for the host device and this input are ON, the servo-on command to the servo control process will be ON.					

Symbol	Signal name	Related mode			Communications monitor
DB-SEL	Dynamic brake (DB) switching input	P	S	T	○

- Switches the dynamic brake (DB) ON/OFF after stop (when the main power is off).
  Switching is only possible when main power supply off is detected.

— Precautions —

- When using the dynamic brake switching input (DB-SEL), Pr6.36 “Dynamic brake operation input setup” must be set to 1, and the dynamic brake (DB) switching input must be set for input selection in all control modes after. When only one or two control modes are set, either Err33.2.0 “Input function number error 1 protection” or Err33.3.0 “Input function number error 2 protection” will occur.

■ Default Assignment

Pin Name	Pin No.	Supported parameters	Factory default values (*1) (): decimal	Factory default setup state					
				Position control/full-closed control		Velocity control		Torque control	
				Signal name	Logic (*2)	Signal name	Logic (*2)	Signal name	Logic (*2)
SI1	5	Pr4.00	00323232h (3289650)	SI-MON5	a-contact	SI-MON5	a-contact	SI-MON5	a-contact
SI2 (*3)	7	Pr4.01	00818181h (8487297)	POT	b-contact	POT	b-contact	POT	b-contact
SI3 (*3)	8	Pr4.02	00828282h (8553090)	NOT	b-contact	NOT	b-contact	NOT	b-contact
SI4	9	Pr4.03	002E2E2Eh (3026478)	SI-MON1	a-contact	SI-MON1	a-contact	SI-MON1	a-contact
SI5	10	Pr4.04	00222222h (2236962)	HOME	a-contact	HOME	a-contact	HOME	a-contact
SI6	11	Pr4.05	00212121h (2171169)	EXT2	a-contact	EXT2	a-contact	EXT2	a-contact
SI7	12	Pr4.06	002B2B2Bh (2829099)	EXT3	a-contact	EXT3	a-contact	EXT3	a-contact
SI8	13	Pr4.07	00313131h (3223857)	SI-MON4	a-contact	SI-MON4	a-contact	SI-MON4	a-contact

*1 Factory default values are arranged in the following order, with two hexadecimal digits for each.
00/Torque Control/Velocity Control/Position Control or Full-closed Control (8 hexadecimal digits)
You can also refer to Pr4.00 “SI1 input selection” below or Pr4.10 “SO1 output selection” for specific examples.

*2 “a-contact” and “b-contact” refer to the following states.
a-contact (Normally open: function OFF with no input):
Current in the input circuit is stopped and the isolator is turned OFF, disabling the function (OFF state)
Current flows through the input circuit and the isolator is turned ON, enabling the function (ON state)
b-contact (Normally closed: function ON with no input):
Current in the input circuit is stopped and the isolator is turned OFF, enabling the function (ON state)
Current flows through the input circuit and the isolator is turned ON, disabling the function (OFF state)

*3 POT (SI2) and NOT (SI3) are assigned to the b-contact by default. Therefore, if neither a POT nor NOT signal is input, over-travel inhibit input protection is activated and the motor does not rotate.
Implement one of the following measures.
1 Input POT and NOT signals.
2 Change POT and NOT assignments.

- Change the b-contact setting to a-contact. Or, Cancel POT and NOT assignment.

■ Changing and Using the Input Signal Assignment

Change the following parameters to change the input signal assignment

—: N/A

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	00	C	SI1 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI1 input. This parameter is set using the hexadecimal display standard. After displaying in hexadecimal format, set for each control mode as shown below. 00yyyyxxh: Position control/full-closed control 00yyxxyyh: Velocity control 00xxyyyyh: Torque control Enter the function No. into the “xx” portion. For details on function numbers, see *“Function No. Table”* below. Logic can also be set using the function number. (Setting example) To disable this pin, set it to the a-contact of SI-MON1 in position control/full-closed control, to the b-contact of SI-MON2 in velocity control, and to 0000AF2Eh in torque control. Position: 2Eh, Speed: AFh, Torque: 00h
4	01	C	SI2 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI2 input. The setup method is the same as for Pr4.00.
4	02	C	SI3 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI3 input. The setup method is the same as for Pr4.00.
4	03	C	SI4 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI4 input. The setup method is the same as for Pr4.00.
4	04	C	SI5 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI5 input. The setup method is the same as for Pr4.00. This pin has a latch compensation function.
4	05	C	SI6 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI6 input. The setup method is the same as for Pr4.00. This pin has a latch compensation function.
4	06	C	SI7 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI7 input. The setup method is the same as for Pr4.00. This pin has a latch compensation function.
4	07	C	SI8 input selection	0 to 00FFFFFFh	—	Sets the assignment function for the SI8 input. The setup method is the same as for Pr4.00.

*1 For attributes, see *“6.3 List of Parameters”* .

Function No. Table

—: N/A

Signal name	Symbol	Setup value	
		a-contact	b-contact
Invalid	—	00h	Cannot be set

Signal name	Symbol	Setup value	
		a-contact	b-contact
Positive direction over-travel inhibit input	POT	01h	81h
Negative direction over-travel inhibit input	NOT	02h	82h
External servo-on input	EX-SON	03h	83h
Forced alarm input	E-STOP	14h	94h
Dynamic brake (DB) switching input	DB-SEL	16h	Cannot be set
External latch input 1	EXT1	20h	A0h
External latch input 2	EXT2	21h	A1h
Near home input	HOME	22h	A2h
Retracting operation stop input	STOP	23h	A3h
Retracting operation input	RET	27h	A7h
External latch input 3	EXT3	2Bh	ABh
General-purpose monitor input 1	SI-MON1	2Eh	AEh
General-purpose monitor input 2	SI-MON2	2Fh	AFh
General-purpose monitor input 3	SI-MON3	30h	B0h
General-purpose monitor input 4	SI-MON4	31h	B1h
General-purpose monitor input 5	SI-MON5	32h	B2h

■ Control Input Signal Read Cycle

The control input signal read cycle is set using the following parameters.

—: N/A

(*1)

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	15	C	Control input signal reading setup	0 to 3	—	Selects the signal reading cycle for control input. 0: 250 μs 1: 500 μs 2: 1 ms 3: 2 ms Excludes POT, NOT, and HOME as home reference triggers, as well as external latch input 1 (EXT1), external latch input 2 (EXT2) and external latch input 3 (EXT3).

*1 For attributes, see *“6.3 List of Parameters”* .

■ Precautions

1 Input signal assignment

- Do not use setup values other than those listed in the table.
- The same signal cannot be assigned to more than one pin. If the same signal is set so that it will be assigned to multiple pins, Err33.0.0 “Input overlapping assignment error 1 protection” and Err33.1.0 “Input overlapping assignment error 2 protection” will be triggered.
- Control input pins set to disabled have no effect on operation. It also has no effect on the RTEX communication responses.

- Signals used in multiple control modes must be assigned to the same pins and their logics must be matched. If not assigned to the same pin, Err33.0.0 “Input overlapping assignment error 1 protection” or Err33.1.0 “Input overlapping assignment error 2 protection” will occur. If the logic does not match, Err33.2.0 “Input function number error 1 protection” or Err33.3.0 “Input function number error 2 protection” will occur.
- When SI-MON1 and EXT1, SI-MON2 and EXT2 and RET, SI-MON3 and EXT3 and STOP, SI-MON4 and EX-SON, and SI-MON5 and E-STOP have the RTEX status respectively, they have the same bit arrangement and duplicate settings are therefore not possible. Err33.0.0 “Input overlapping assignment error 1 protection” and Err33.1.0 “Input overlapping assignment error 2 protection” are generated when parameters overlap.
- Control mode is forcibly switched inside this product according to its operation status, regardless of commands from the host device. Because this operation also affects input signal assignments, it is generally recommended to assign the same function to each terminal in all modes.

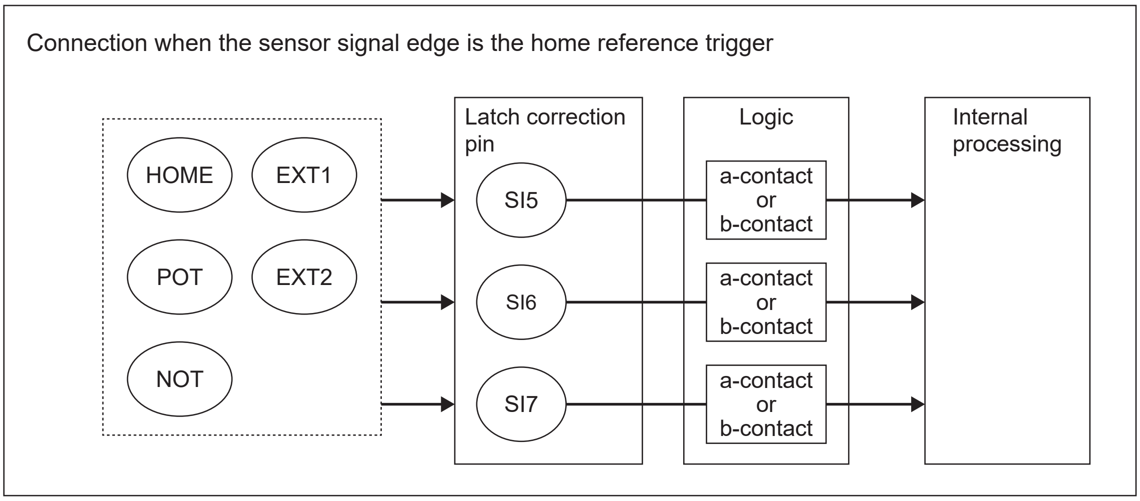
  The conditions for forcibly switching control modes are shown below.

Operation status if this product	Control mode after forced switching
When using Set-up Support Software (PANATERM ver.7) to perform frequency characteristics analysis	● During position loop characteristics analysis: Position control ● During velocity closed-loop characteristics analysis: Velocity control ● During torque speed (automatic) analysis: Position control ● During torque speed (vertical) analysis: Velocity control ● During torque speed (normal) analysis: Torque control
During trial run via Set-up Support Software (PANATERM ver.7)	● Position control
Operations with descriptions of “forcible position control” using various deceleration to stop functions (*“8.14”* to *“8.17”*)	● Position control
During retracting operations	● Position control

- When using the dynamic brake switching input (DB-SEL), settings are required for all control modes after setting Pr6.36 “Dynamic brake operation input setup” = 1. When only one or two control modes are set, either Err33.2.0 “Input function number error 1 protection” or Err33.3.0 “Input function number error 2 protection” will occur. For details, see *“8.17 Deceleration to Stop Function for When Alarm Is Triggered”* .
- When using the forced alarm input (E-STOP), a retracting operation input (RET), or an external servo-on input (EX-SON), settings must be complete for all control modes. When only one or two control modes are set, either Err33.2.0 “Input function number error 1 protection” or Err33.3.0 “Input function number error 2 protection” will occur. For details, see *“8.17 Deceleration to Stop Function for When Alarm Is Triggered”* .

2 Latch correction pins (SI5/SI6/SI7)

- When using POT/NOT as the home reference trigger in the homing operation, set Pr5.04 “Over-travel inhibit input setup” to 1 and disable over-travel inhibit input. If Pr5.04 “Over-travel inhibit input setup” is not set to 1, Err38.2.0 “Over-travel inhibit input protection 3” will occur.
- When using the latch correction pins (SI5/SI6/SI7), the same settings are required for all control modes. When only one or two control modes are set, Err33.8.0 “Latch input assignment error protection” will occur.



3 Safety Precautions

The over-travel inhibit input (POT, NOT) and the forced alarm input (E-STOP) should normally be set to b-contact, which stops when disconnected.

If setting to a-contact, be sure to confirm that there are no safety issues.

3.2.5.4.3 Encoder Backup Power Supply Input

Pin No.	Symbol	Signal name	Related mode			Communications monitor
14	BTP-I	Battery input for absolute encoder	–	–	–	–
15	BTN-I					

Connect the battery for the absolute encoder.
(BTP-I: Positive+ BTN-I: Negative-)
For absolute encoder batteries, see *"12.4.9 Battery for Absolute Encoder"* .
Connect the power for multi-turn data storage to the absolute encoder through BTP-O (pin 3) and BTN-O (pin 4) of encoder connector X6.
Either directly connect the encoder connection cable to the battery, or connect this terminal to the battery.
For connection methods other than connecting the battery to this connector, see *"3.2.7.3 Wiring Example"* .

3.2.5.4.4 Analog Input Signal

Pin No.	Symbol	Signal name	Related mode			Communications monitor
23	AIN	Analog input	P	–	–	–
24	GND	Signal ground	–	–	–	–

Analog input with 16-bit resolution.
The maximum allowable input voltage is ±10 V.
Accuracy of analog input values is not guaranteed.
Compatible with only the application specialized type.
Do not connect anything to standard types or multi-function types.

3.2.5.5 Output Signals and Pin No.

3.2.5.5.1 Control Output Signal

Any function can be assigned to control output signals SO1 to SO3.

The logic of the output pins cannot be changed.

For details on assigning parameters, see *"When Changing and Using the Output Signal Assignment"* . For factory standard parameters, see *"Default Assignment"* .

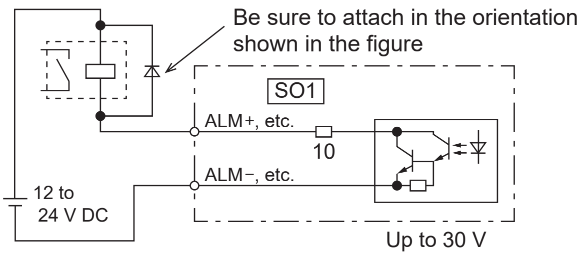
■ Control Output Circuit

Pin No.	Symbol	Signal name
1	SO1+	General-purpose output 1
2	SO1-	
25	SO2+	General-purpose output 2
26	SO2-	
3	SO3+	General-purpose output 3
4	SO3-	

The output circuit is composed of open collector Darlington connection transistor outputs.

Because the output transistors use Darlington connections, the voltage V_{ce} (sat) is approx. 1 V between the collector and emitter when the transistor is ON. Note that normal TTL ICs cannot satisfy VIL and cannot be directly connected.

The current to be passed through each output must not exceed a rated current of 40 mA.



■ Functions That Can Be Allocated to Control Outputs

Symbol	Signal name	Related mode			Communications monitor
ALM (Alarm)	Servo alarm output	P	S	T	O
• This output signal shows the alarm generation status. The output transistor turns ON during normal circumstances, and OFF when an alarm is triggered.					

Symbol	Signal name	Related mode			Communications monitor
S-RDY (Servo_Ready)	Servo-ready output	P	S	T	O
• This output signal shows that the motor is ready to be energized. The output transistor will turn ON when all of the below conditions are satisfied. - Control/main power supply is established - Not in an alarm state - RTEX communication established - RTEX communication and servo synchronization complete					

Symbol	Signal name	Related mode			Communications monitor
BRK-OFF	External brake release signal	P	S	T	×

- Outputs the timing signal which activates the electromagnetic brake of the motor.
  The output transistor will turn ON when the electromagnetic brake releases.
- When switching control mode during operation, the signal must be assigned to all control modes.

Symbol	Signal name	Related mode			Communications monitor
INP (In_Position)	Positioning complete	P	–	–	○

- Outputs the positioning complete signal.
  Turns the output transistor ON when positioning is complete.
  For details, see *“7.3.4 Positioning Complete Output (INP/INP2) Function”* .

Symbol	Signal name	Related mode			Communications monitor
AT-SPEED	Speed arrival output	P	S	T	×

- Outputs the speed arrival signal.
  Turns ON the output transistor when the speed has been reached.
  For details, see *“7.4.4 Speed Arrival Output (AT-SPEED)”* .

Symbol	Signal name	Related mode			Communications monitor
TLC (Torque_Limited)	Torque limit signal output	–	S	T	○

- Outputs the torque limit signal.
  The output transistor turns ON with the torque limit

Symbol	Signal name	Related mode			Communications monitor
ZSP	Zero-speed detection signal	P	S	T	×

- Outputs the zero-speed detection signal.
  Turns ON the output transistor upon detection of zero-speed.

Symbol	Signal name	Related mode			Communications monitor
V-COIN	Velocity coincidence output	–	S	T	×

- Outputs the velocity coincidence signal.
  Turns ON the output transistor upon coincidence of velocity.
  For details, see *“7.4.5 Velocity Coincidence Output (V-COIN)”* .

Symbol	Signal name	Related mode			Communications monitor
INP2	Positioning complete 2	P	–	–	×

- Outputs the positioning complete signal 2.
  Turns the output transistor ON when positioning is complete 2.
  For details, see *“7.3.4 Positioning Complete Output (INP/INP2) Function”* .

Symbol	Signal name	Related mode			Communications monitor
WARN1 (Warning)	Warning output 1	P	S	T	△

- Outputs the warning output signal set in Pr4.40 “Selection of alarm output 1” .
  Turns ON the output transistor when the selected warning is triggered.

Symbol	Signal name	Related mode			Communications monitor
WARN2 (Warning)	Warning output 2	P	S	T	△

- Outputs the warning output signal set in Pr4.41 "Selection of alarm output 2" .
  Turns ON the output transistor when the selected warning is triggered.

Symbol	Signal name	Related mode			Communications monitor
P-CMD	Position command ON/OFF signal	P	–	–	×

- Outputs the position command ON/OFF signal.
  Turns ON the output transistor when the position command (pre-filter) is something other than 0 (with position command).

Symbol	Signal name	Related mode			Communications monitor
V-LIMIT	Output during velocity limit	–	–	T	×

- Outputs the velocity limit signal during torque control.
  Turns ON the output transistor when velocity is limited.

Symbol	Signal name	Related mode			Communications monitor
ALM-ATB	Alarm clear attribute output	P	S	T	×

- The signal is output if an alarm has occurred and if it can be cleared.
  Turns ON the output transistor when the relevant alarm is triggered.

Symbol	Signal name	Related mode			Communications monitor
V-CMD	Speed command ON/OFF output	–	S	–	×

- Outputs the speed command ON/OFF signal during velocity control.
  Turns ON the output transistor when the speed command (before filter) is 30 r/min or higher (with speed command).

Symbol	Signal name	Related mode			Communications monitor
EX-OUT1	RTEX Operation output 1	P	S	T	×

- Signal output will be according to the RTEX communication control bit (EX-OUT1) value.
  0: Output transistor is OFF
  1: Output transistor is ON
  The output transistor turns OFF if RTEX communication is not established.

Notes

- The following shows the output transistor state for RTEX operation output 1/2 when RTEX is established, after resetting when RTEX communication is not established, and when RTEX is shut down after establishment. Operation through RTEX communication control bit is not allowed except when RTEX is established. Configure the system to avoid safety issues.

Symbol	Signal name	Related mode			Communications monitor
EX-OUT2	RTEX Operation output 2	P	S	T	×

- Signal output will be according to the RTEX communication control bit (EX-OUT2) value.
  0: Output transistor is OFF
  1: Output transistor is ON
  The output transistor turns OFF if RTEX communication is not established.

Notes

- The following shows the output transistor state for RTEX operation output 1/2 when RTEX is established, after resetting when RTEX communication is not established, and when RTEX is shut down after establishment. Operation through RTEX communication control bit is not allowed except when RTEX is established. Configure the system to avoid safety issues.

Signal name	Symbol	Pr7.24 “RTEX function expansion setup 3”	RTEX control bits	Output transistor state		
				Communication established	When reset	When communication is interrupted
RTEXOperation output 1	EX-OUT1	bit 0 = 0 (Retained)	EX-OUT1 = 0	OFF	OFF	Retained
			EX-OUT1 = 1	ON		
		bit 0 = 1 (Initialized)	EX-OUT1 = 0	OFF	OFF	OFF
			EX-OUT1 = 1	ON		
RTEXOperation output 2	EX-OUT2	bit 0 = 0 (Retained)	EX-OUT2 = 0	OFF	OFF	Retained
			EX-OUT2 = 1	ON		
		bit 0 = 1 (Initialized)	EX-OUT2 = 0	OFF	OFF	OFF
			EX-OUT2 = 1	ON		

Symbol	Signal name	Related mode			Communications monitor
SRV-ST (Servo_Active)	Servo-on status output	P	S	T	○

- Turns ON the output transistor during servo-on.
- Pr7.24 “RTEX function expansion setup 3” bit 4 = 1 (Turns on in command receivable state after servo-on) is not supported.

Symbol	Signal name	Related mode			Communications monitor
CMP-OUT	Position comparison output	P	S	T	×

- The output transistor is turned ON or OFF when the actual position passes the position set by the parameter.

Symbol	Signal name	Related mode			Communications monitor
V-DIAG	Deterioration diagnosis velocity output	P	S	T	×

- Output transistor turns ON when the motor speed is within the range of Pr5.75 “Deterioration diagnosis velocity setting” - Pr4.35 “Speed coincidence range” .
- There is a hysteresis of 10 r/min in the coincidence determination of deterioration diagnosis velocity.

■ Default Assignment

Input signal	Corresponding parameters	Factory default values (*1) (): decimal	Factory default setup state		
			Position control/full-closed control	Velocity control	Torque control
			Signal name	Signal name	Signal name
SO1 output	Pr4.10	00030303h (197379)	BRK-OFF	BRK-OFF	BRK-OFF
SO2 output	Pr4.11	00101010h (1052688)	EX-OUT1	EX-OUT1	EX-OUT1
SO3 output	Pr4.12	00010101h (65793)	ALM	ALM	ALM

*1 Factory default values are arranged in the following order, with two hexadecimal digits for each.

00/Torque Control/Velocity Control/Position Control or Full-closed Control (8 hexadecimal digits)

You can also refer to Pr4.00 “SI1 input selection” below or Pr4.10 “SO1 output selection” for specific examples.

■ When Changing and Using the Output Signal Assignment

Change the following parameters to change the output signal assignment

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	10	C	SO1 output selection	0 to 00FFFFFFh	—	Sets the assignment function for the SO1 output. This parameter is set using the hexadecimal display standard. After displaying in hexadecimal format, set for each control mode as shown below. 00yyyyxxh: Position control/full-closed control 00yyxxyyh: Velocity control 00xxyyyyh: Torque control Enter the function No. into the “xx” portion. For details on function numbers, see *“Function No. Table”* below.
4	11	C	SO2 output selection	0 to 00FFFFFFh	—	Sets the assignment function for the SO2 output. The setup method is the same as for Pr4.10.
4	12	C	SO3 output selection	0 to 00FFFFFFh	—	Sets the assignment function for the SO3 output. The setup method is the same as for Pr4.10.

*1 For attributes, see *“6.3 List of Parameters”* .

■ Output Signal Related Parameters

—: N/A

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	34	A	Zero-speed	10 to 20000	r/min	Sets the detection threshold value for zero speed (ZSP).

*1 For attributes, see *“6.3 List of Parameters”* .

Function No. Table

—: N/A

Signal name	Symbol		Setup value
	External output	RTEX status	
Invalid	—	—	00h
Alarm Output	ALM	Alarm	01h
Servo-ready output	S-RDY	Servo_Ready	02h
External brake release signal	BRK-OFF	—	03h
Positioning complete	INP	In_Position	04h
Speed arrival output	AT-SPEED	—	05h
Torque limit signal output	TLC	Torque_Limited	06h
Zero-speed detection signal	ZSP	—	07h
Velocity coincidence output	V-COIN	In_Position	08h
Warning output 1	WARN1	Warning (*1)	09h
Warning output 2	WARN2	Warning (*1)	0Ah
Position command ON/OFF signal	P-CMD	—	0Bh
Positioning complete 2	INP2	—	0Ch
Output during velocity limit	V-LIMIT	—	0Dh
Alarm attribute output	ALM-ATB	—	0Eh
Speed command ON/OFF output	V-CMD	—	0Fh
RTEXOperation output 1	EX-OUT1	—	10h
RTEXOperation output 2	EX-OUT2	—	11h
Servo-on status output	SRV-ST	Servo_Active	12h
Position comparison output	CMP-OUT	—	14h
Deterioration diagnosis velocity output	V-DIAG	—	15h

*1 The warning flag of the RTEX status is set to 1 when a warning is triggered regardless of the settings of Pr4.40 “Selection of alarm output 1” -Pr4.41 “Selection of alarm output 2” .

■ Precautions

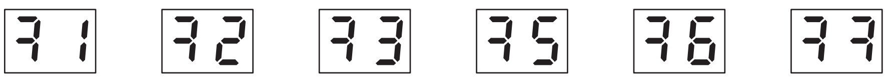
1 The same output signal function can be assigned to more than one pin.

2 The output transistor will always be OFF for output pins set to disabled, but this will not affect RTEX communication response.

3 Do not use setup values other than those listed in the table.

4 External brake release signal (BRK-OFF) and position comparison output (CMP-OUT) must be set for all control modes when used. When only one or two control modes are set, either Err33.4.0 “Output function number error 1 protection” or Err33.5.0 “Output function number error 2 protection” will occur.

5 Between when the servo driver control power is turned on and initialization is completed, the output transistor will turn OFF if the control power is off, mid-reset, or the front display is any of the following. Design the system to ensure that this does not pose a problem.



6 Control mode is forcibly switched inside this product according to its operation status, regardless of commands from the host device. Because this operation also affects output signal processing, it is generally recommended to assign the same function to each terminal in all modes.

The conditions for forcibly switching control modes are shown below.

Operation status if this product	Control mode after forced switching
When using Set-up Support Software (PANATERM ver.7) to perform frequency characteristics analysis	● During position loop characteristics analysis: Position control ● During velocity closed-loop characteristics analysis: Velocity control ● During torque speed (automatic) analysis: Position control ● During torque speed (vertical) analysis: Velocity control ● During torque speed (normal) analysis: Torque control
During trial run via Set-up Support Software (PANATERM ver.7)	● Position control
Operations with descriptions of "forcible position control" using various deceleration to stop functions (*"8.14"* to *"8.17"*)	● Position control
During retracting operations	● Position control

7 The uppermost bit (80h) is used as a reserved bit, so it is outside the judgment target of Err33.4.0 "Output function number error 1 protection" or Err33.5.0 "Output function number error 2 protection" . Therefore, even if the uppermost bit is set to 1, no error occurs.

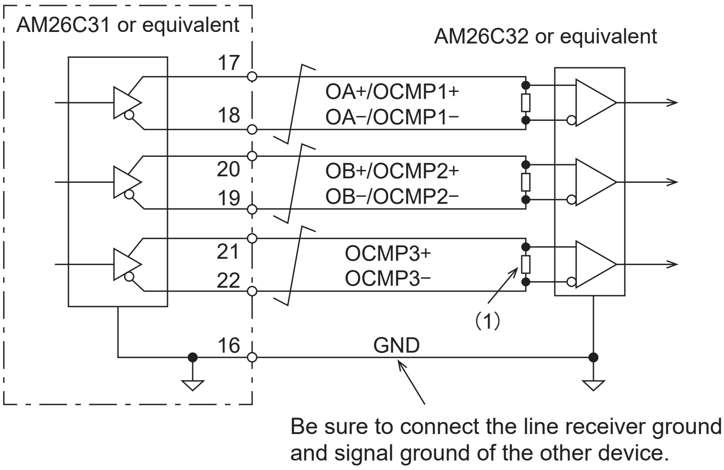
A signal corresponding to a setup value excluding the uppermost bit is assigned. For example, if the setup value is 81h, the signal is assigned as 01h (alarm output).

3.2.5.5.2 Encoder Output Signal/Position Comparison Output Signal

■ **Output signal circuit**

Differential output of the frequency-divided encoder signal or external scale outputs (A-/B-phase) through each line driver (RS422 or equivalent).

The host device should receive these with a line receiver. When using a line receiver for receipt, be sure to install a terminating resistor (approx. 330 Ω, see (1) in the figure below) between line receiver inputs.



Pin No.	Symbol	Signal name	Related mode			Communications monitor
17	OA+/OCMP1+	A-phase output/position comparison output 1	P	S	T	–
18	OA-/OCMP1-					
20	OB+/OCMP2+	B-phase output/position comparison output 2	P	S	T	–
19	OB-/OCMP2-					
21	OCMP3+	Position comparison output 3	P	S	T	–
22	OCMP3-					

- The frequency-divided encoder signal processed is output by a differential line driver signal equivalent to RS422.
- The ground of the line driver for the output circuit is connected to the signal ground (GND) and is not insulated.
- The maximum output pulse frequency is 4 Mpulse/s (after being multiplied by 4).
- Pr4.47 “Pulse output selection” can be set to 1 and used as position comparison output.

Pin No.	Symbol	Signal name	Related mode			Communications monitor
16	GND	Signal ground	–	–	–	–

- Signal ground.
- Connect this terminal to the ground of the line receiver of the other device.

3.2.5.6 Other

Pin No.	Symbol	Signal name	Related mode			Communications monitor
Shell	FG	Frame ground	–	–	–	–

- Connected to the protective earth terminal inside the servo driver.

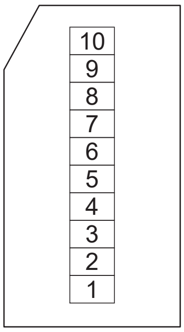
3.2.6 Wiring to Connector X5 (Connecting to External Scale)

3.2.6.1 Connector Specifications

Used to connect to an external scale.

This connector is compatible with both the multi-function type and application specialized type.

Pinout diagram



* Connector (Plug): MUF-PK10K-X (made by J.S.T. Mfg. Co., Ltd.) or equivalent

Name	Symbol	Connector pin no.	Description
External scale power supply output	EX5V	1	Provides power to external scales (for serial signals and ABZ-phase signals). (*1) (*2)
	EX0V	2	Connect with the signal ground using the external scale power supply output ground.
External scale signal input/output (Serial signal)	EXPS	3	Serial signal Sending and receiving
	/EXPS	4	
External scale signal input/output (ABZ-phase signal)	EXA	5	A-/B-/Z-phase pulse signals are received in parallel Supported speed: approx. 4 Mpulse/s (after being multiplied by 4) (*3)
	/EXA	6	
	EXB	7	
	/EXB	8	
	EXZ	9	
	/EXZ	10	
Frame ground	FG	Shell	Connected to the earth terminal inside the servo driver.

*1 EX5V power supply output for external scale is 5 V ±5 %, 300 mA MAX.

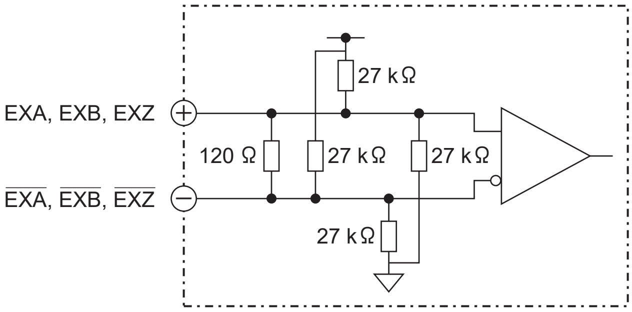
A customer-supplied power supply is necessary if using an external scale with a consumption current higher than this.

Also, some external scales may take time to initialize when powering on. In such a case, it can be handled by adjusting the power-up wait time, which is a function of the servo driver.

*2 If the external scale is powered by an external power supply, the EX5V pin should be open to prevent external voltage from being supplied to this pin.

*3 Note that if the duty ratio of the input signal waveform from the external scale is not 50%, it may not be read correctly.

Signal interface



+: 5-, 7-, and 9-pin

-: 6-, 8-, and 10-pin

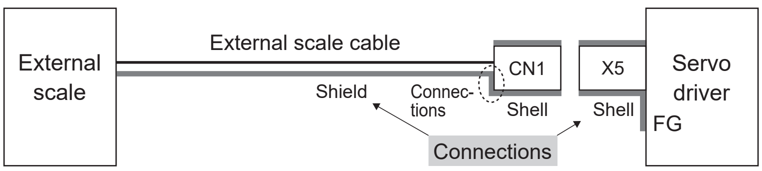
— Precautions —

- This product supports two types of external scales for serial signals: incremental type and absolute type. Please visit the Panasonic website to check if the external scale of the manufacturer you are using is compatible.
- We recommend a scale ratio of1/40 ≦ External scale ratio ≦ 20480 for external scales.
  Increasing the external scale ratio may increase operating noise.

3.2.6.2 Key Points on Wiring

- Wire the signals from the external scale to the X5 connector of the external scale.
- The core wire used to connect to the external scale cable should be a stranded wire of 0.18 mm^2 or more. Use a shielded twisted-pair wire.
- Keep cable lengths within 20 m. If using a long cable lengths, double wiring (with the wires connected in parallel) is recommended for the cable connecting to the external scale in order to slightly reduce the impact of voltage drops on the 5 V power supply.
- Make sure to connect the jacket of the external scale side cable shield to the shell (FG) of the driver connector X5.
  Note that the relay cable shield and the shell (FG) of connector X5 are connected via connecting the shell of the external scale-side cable connector plug CN1 and the external scale-side cable shield.

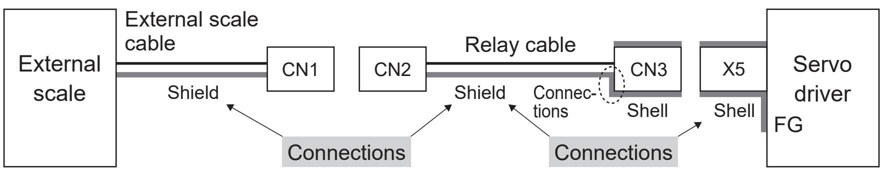
When there is no relay cable



* The connector X5 shell is connected to the servo driver FG.

- Connect the relay cable shield to the external scale-side cable shield when using a relay cable for the external scale connection. Also make sure to connect the relay cable shield to the shell (FG) of the connector X5 on the driver-side too.
  Note that the relay cable shield and the shell (FG) of connector X5 are connected via connecting the shell of the relay cable connector plug CN3 and the relay cable shield.

When there is a relay cable

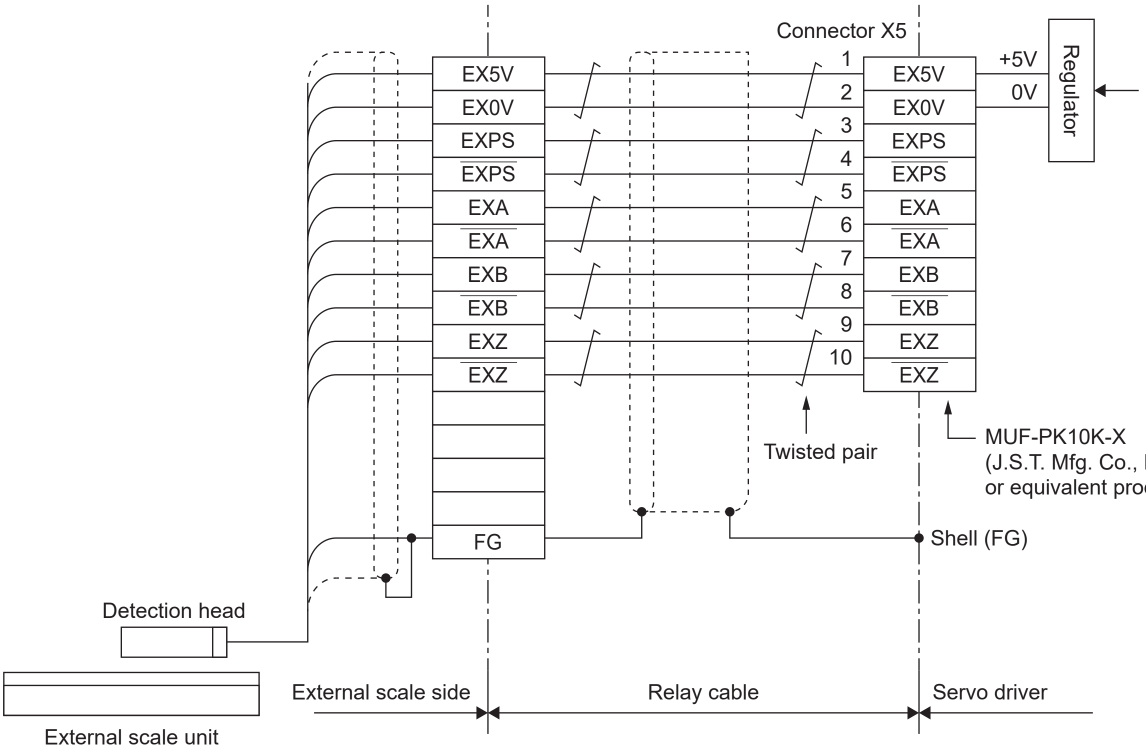


* The connector X5 shell is connected to the servo driver FG.

- Keep as much distance from the main circuit (L1, L2, L3, L1C, L2C, U, V, W ⏚) wiring as possible (at least 30 cm). Do not pass the wires through the same duct or bundle them together.
- Do not connect anything to the vacant pins of the X5 connector.
- If the external scale is powered by an external power supply, the EX5V pin should be open to prevent external voltage from being supplied to this pin. Connect the external power supply of 0 V (GND) to EX0V (connector X5: 2-pin) of the driver to eliminate potential difference.

3.2.6.3 Wiring Example

The wiring diagram of the X5 connector is shown below.

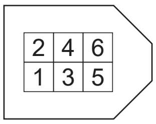


3.2.7 Wiring to Connector X6 (Connecting to Encoder)

3.2.7.1 Connector Specifications

Connect the encoder relay cable to the X6 connector.

Pinout diagram

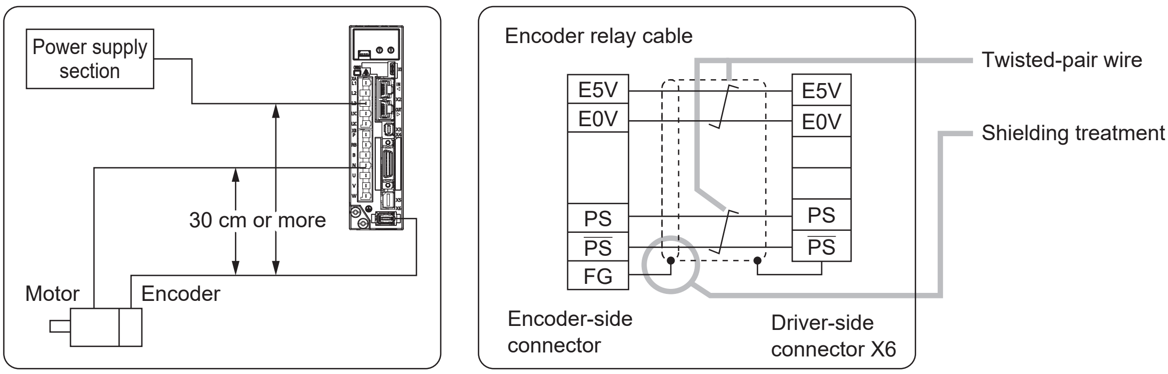


Name	Symbol	Connector pin no.	Description
Encoder power supply output	E5V	1	Encoder power supply.
	E0V	2	Connect with the signal ground using the encoder power supply output ground.
Absolute encoder battery output (*1)	BTP-O	3	Use the battery output (positive+) to connect the connector X4 absolute encoder battery output BTP-I.
	BTN-O	4	Use the battery output (negative-) to connect the connector X4 absolute encoder battery output BTN-I.
Encoder signal input/output	PS	5	Serial signal Sending and receiving
	$\overline{PS}$	6	
Frame ground	FG	Shell	Connected to the earth terminal inside the servo driver.

*1 When directly connecting the battery to the encoder connection cable, do not connect this terminal to anything.

For details on the optional encoder relay cable and connector, see *"12.4 Optional Parts"* .

3.2.7.2 Key Points on Wiring



- Maintain at least a 30 cm distance from the main circuit wiring (L1, L2, L3, L1C, L2C, U, V, W,⏚). Do not pass the wires through the same duct or bundle them together.

Check the description below if making your own encoder relay cable.

- Refer to the wiring diagram in the figure above for details on the wiring.
- Select cables and wires to ensure that the DC input voltage of the connector on the encoder side is within 5 V ±5 %.

  Reference:

  Use stranded, highly bend-resistant, shielded twisted pair wire with a cross-section area of min. 0.18 mm^2 (24 AWG) if the cable length is max. 10 m. Optional accessories are listed in *"12.4.4 Relay Cable for Encoder"* .
- Use twisted-pair wire for the corresponding signal/cable wiring.

- Shield relay cables in the following manner.
  - Driver-side shield jacket
    Connect to connector X6 shell
  - Motor-side shield jacket
    Connect to FG terminal
- Do not connect anything to the empty terminals of each connector.

3.2.7.3 Wiring Example

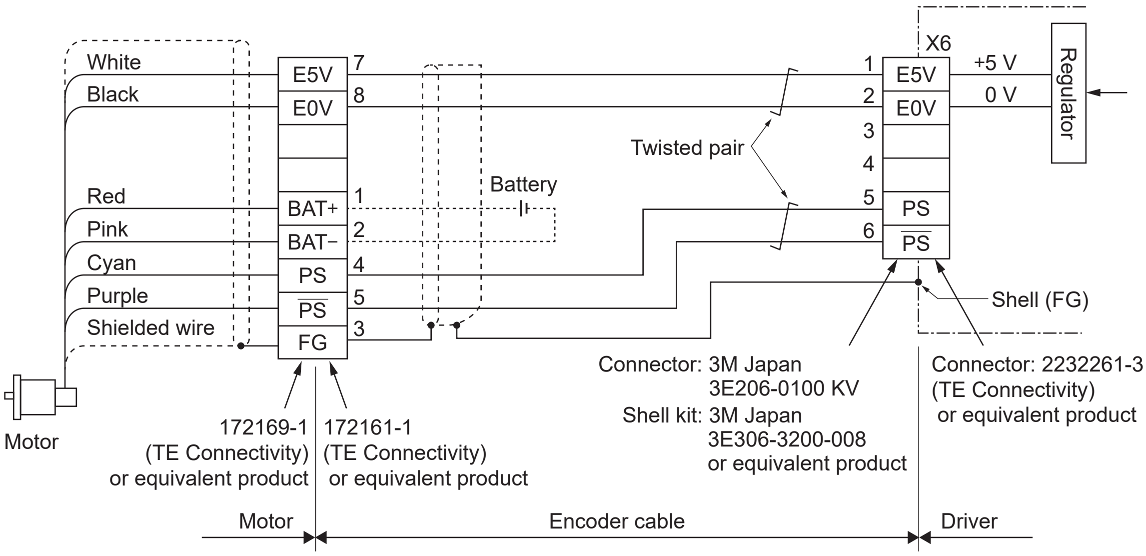
Suitable wiring is required according to the encoder of the motor used.

3.2.7.3.1 When Using Multi-turn Data From an Absolute Encoder

When constructing an absolute system.

Lead wire-type motor (for multi-turn data)

MHMG 50 W and 1000 W (□80)



■ Connecting the absolute encoder battery

1 Connecting on the motor side using optional accessories (recommended)

- Connect between encoder connectors BAT+ (1-pin) and BAT- (2-pin) on the motor side as shown in *"Lead wire-type motor (for multi-turn data)"* . In practice, a relay cable or other means is used between the battery and the BAT+ and BAT- terminals.
- For the actual connection method, see *"2.4.2 Battery for Absolute Encoder"* .

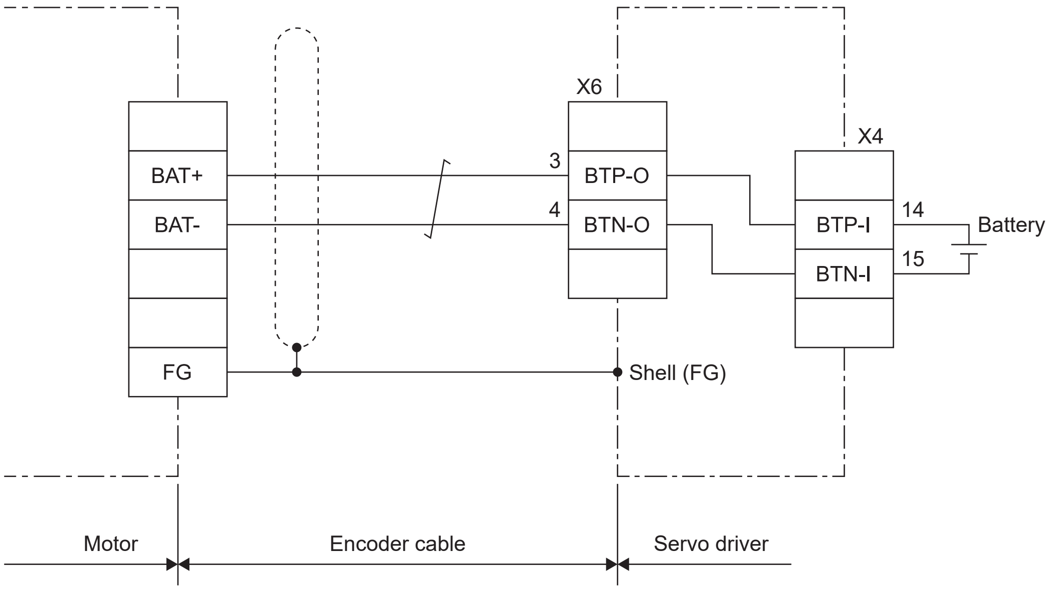
2 Directly connect to motor side

- Connect a battery directly between encoder connectors BAT+ (1-pin) and BAT- (2-pin) on the motor side as shown in *"Lead wire-type motor (for multi-turn data)"* .
- Batteries and cables must be purchased by the customer. The recommended battery is the Toshiba Lifestyle ER6V 3.6 V. Consult the battery manufacturer for information on the configuration of the battery's peripheral circuit and how to refresh the battery.

3 Connecting on the driver side

- Connect the battery between BTP-I (14-pin) and BTN-I (15-pin) of the X4 connector and to BAT+ (1-pin) and BAT- (2-pin) of the motor via BTP-O (3-pin) and BTN-O (4-pin) of the X6 connector as shown in *"When connecting a battery to X4"* .
- Batteries and cables must be purchased by the customer. The recommended battery is the Toshiba Lifestyle ER6V 3.6 V. Consult the battery manufacturer for information on the configuration of the battery's peripheral circuit and how to refresh the battery.

When connecting a battery to X4



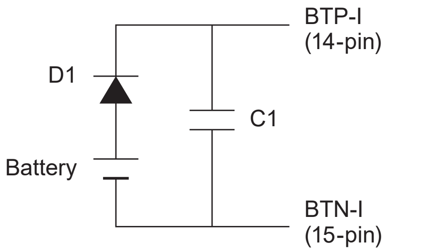
— Precautions —

- When directly connecting the battery to the motor-side encoder connector (connecting "1"), do not connect anything to connector X6 3-pin and 4-pin.
- For battery boxes and battery connection cables, use the optional relay cable or prepare a cable yourself.

Notes

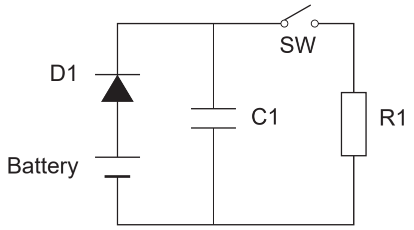
- The following is the configuration used for optional accessories. The following information is only provided for reference when implementing connections 2 and 3. Please consult the battery manufacturer for the final configuration.
  - Connect a diode to prevent charging and an electric double layer capacitor to reduce voltage drop against the battery, as shown in *"Protection Circuit"* . Note that with lithium batteries, the voltage may drop temporarily (voltage delay phenomenon) when the battery begins to discharge current. Connect an electric double layer capacitor to reduce this voltage drop. Also, use diodes of a type with low leakage current.
  - As shown in *"Battery Refresh Circuit"* , connect a resistor when refreshing the battery.
  - Do not connect anything to BTP-O (3-pin) or BTN-O (4-pin) of the X6 connector.

Protection Circuit



C1 (electric double layer capacitor) : 0.1 μF
D1: Diode (low leakage current)

Battery Refresh Circuit



C1 (electric double layer capacitor) : 0.1 μF
D1: Diode (low leakage current)
R1: 220 Ω
SW: Switch (closed during refresh)

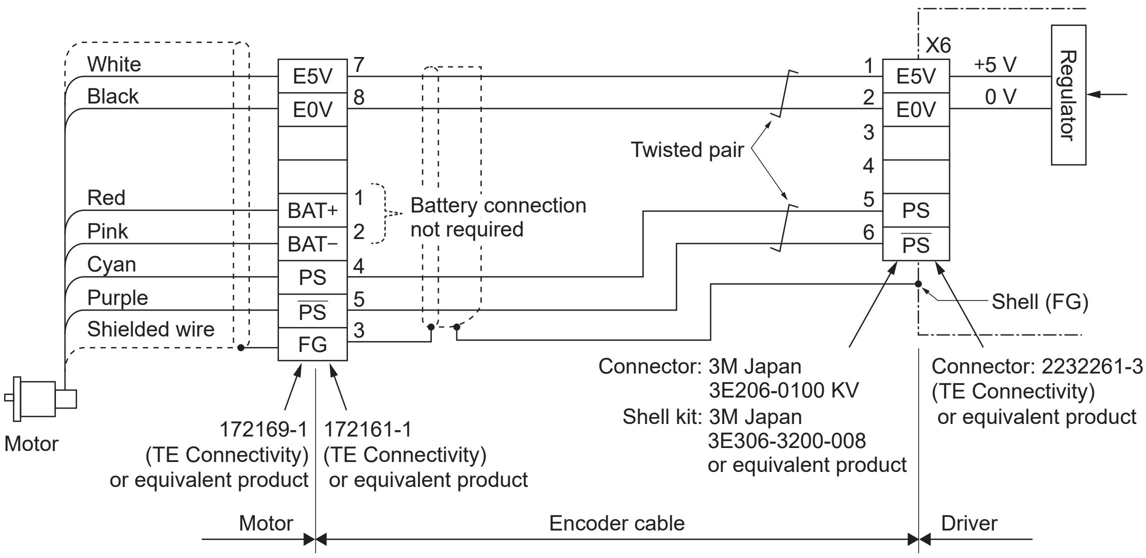
3.2.7.3.2 When Not Using Multi-turn Data From an Absolute Encoder

When using as an incremental encoder or single-turn absolute encoder.

3.2.7.3.2.1 Lead wire-type motor (without multi-turn data)

When using as an incremental encoder or single-turn absolute encoder.

MHMG 50 W and 1000 W (□80)



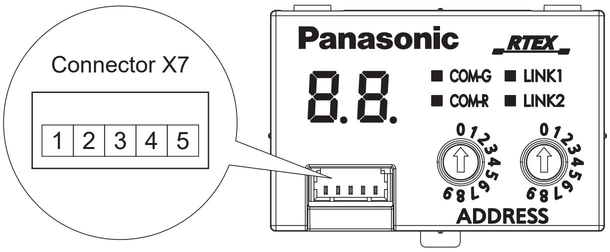
3.2.8 Wiring to Connector X7 (Connecting to External Monitor)

3.2.8.1 Connector Specifications

The connector X7 of the front panel is for monitor output.

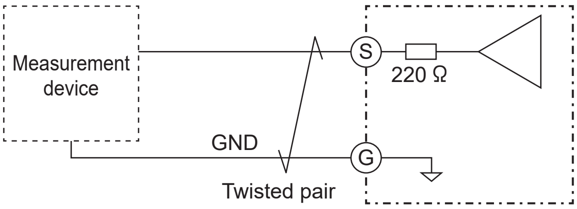
The monitor output has two systems of analog output signals for monitoring.

Output signals can be switched by parameter settings.



Name	Symbol	Connector pin no.	Description
Analog monitor output 1	AM1	1	Outputs analog signals for the monitor. Parameter settings alter the meaning of output signals.
Analog monitor output 2	AM2	2	
Signal ground	GND	3	Connected to the signal ground.
NC	—	4	Do not connect.
NC	—	5	Do not connect.

Signal Interface



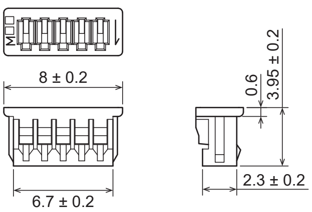
S: 1- and 2-pin

G: 3-pin

- Output signal amplitude is ±10 V.

Cable-side Connector Specifications

Cable-side connectors		Manufacturer
Parts	Product number	
Connector	51021-0500	Molex Japan LLC
Connector pin	50058-8020	Molex Japan LLC



- When switching analog monitor output signal types

Change the following parameters to change the analog monitor output signal types.

■ Operational conditions

Item	Operational conditions
Control mode	● All operation statuses
Other	● Extended version 1 or later software version

■ Setup value

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	16	A	Type of analog monitor 1	0 to 35	—	Selects the type of monitor for analog monitor 1. For details on output specifications, see *"Operational conditions"* "Analog monitor types".
4	17	A	Analog monitor 1 output gain	0 to 214748364	[Pr4.16 monitor unit] /V	Sets the analog monitor 1 output gain. When Pr4.16 = 0 "Motor speed," 1 V is output when the setup value for the motor speed [r/min] = Pr4.17.
4	18	A	Type of analog monitor 2	0 to 35	—	Selects the type of monitor for analog monitor 2. For details on output specifications, see *"Operational conditions"* "Analog monitor types".
4	19	A	Analog monitor 2 output gain	0 to 214748364	[Pr4.18 monitor unit] /V	Sets the analog monitor 2 output gain. When Pr4.18 = 4 "Torque command", 1 V is output when the setup value for the torque command [%] = Pr4.19.
4	21	A	Analog monitor output setup	0 to 2	—	Selects the analog monitor output format 0: Signed data output -10 V to 10 V 1: Absolute data output 0 V to 10 V 2: Data output with offset 0 V to 10 V (5 V center) For details on output specifications, see *"Operational conditions"* "Analog monitor types".

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

Analog Monitor Types

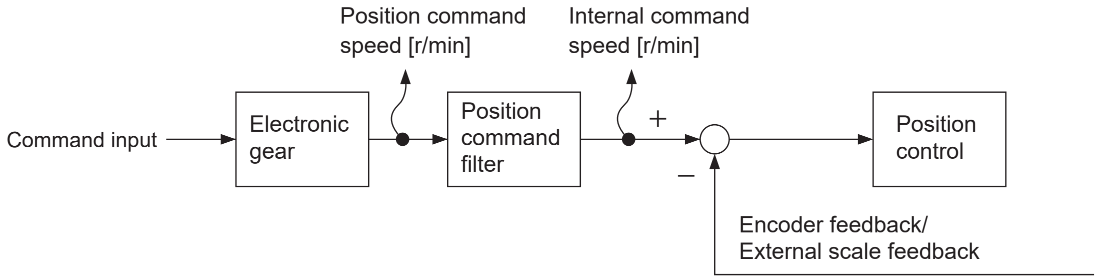
The table below shows the monitor types that are set with Pr4.16 "Type of analog monitor 1" and Pr4.18 "Type of analog monitor 2" . Set the conversion gain corresponding to the unit for each type with Pr4.17 "Analog monitor 1 output gain" and Pr4.19 "Analog monitor 2 output gain" . When gain setting = 0, the gain listed on the right side of the table below is automatically applied.

Pr4.16/Pr4.18	Monitor Type	Unit	Output gain [1/V] when Pr4.17/ Pr4.19 = 0
0	Motor speed	r/min	500
1	Position command speed (*2)	r/min	500
2	Internal position command speed (*2)	r/min	500
3	Velocity control command	r/min	500
4	Torque command	%	33
5	Command position deviation (*3)	pulse (command unit)	3000

Pr4.16/Pr4.18	Monitor Type	Unit	Output gain [1/V] when Pr4.17/ Pr4.19 = 0
6	Encoder position deviation (*3)	pulse (encoder unit)	3000
7	Full-closed deviation (*3)	pulse (external scale unit)	3000
8	Hybrid deviation	pulse (command unit)	3000
9	Voltage across PN	V	80
10	Regenerative load factor	%	33
11	Motor load factor	%	33
12	Positive direction torque limit	%	33
13	Negative direction torque limit	%	33
14	Velocity limit value	r/min	500
15	Inertia ratio	%	500
16	Reserved	—	—
17	Reserved	—	—
18	Reserved	—	—
19	Encoder temperature	°C	10
20	Driver temperature	°C	10
21	Encoder single-turn data (*1)	pulse (encoder unit)	110000
22	Reserved	—	—
23	Movement command status (*4)	—	—
24	Gain selection status (*4)	—	—
25	Positioning complete status	0: Positioning incomplete 1: Positioning complete	(*6)
26	Alarm triggered state	0: Alarm not triggered 1: Alarm triggered	(*6)
27	Motor power consumption	W	100
28	Motor power consumption (*5)	Wh	100
29	Reserved	—	—
30	Reserved	—	—
31	Reserved	—	—
32	Reserved	—	—
33	Reserved	—	—
34	Reserved	—	—
35	Driver derating monitor	%	33

*1 The positive and negative directions of the monitor data basically follow Pr0.00 “Rotational direction setup” .
However, encoder single-turn data is always positive in the CCW direction.

*2 The position command speed is the pre-position command filter (smoothing, FIR filter) corresponding to the command input, and the internal command speed is post-filter.



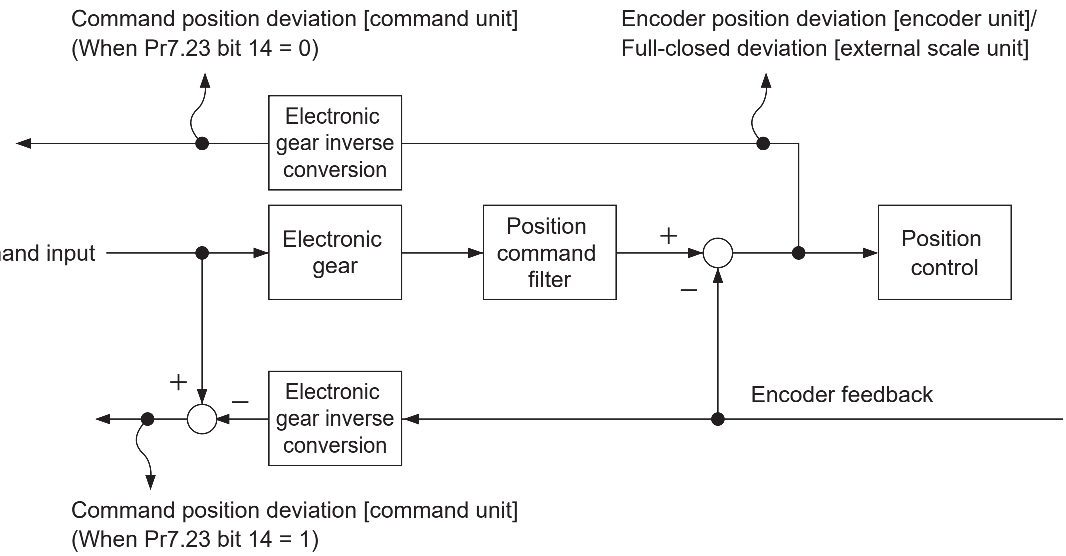
*3 The RTEX communication type allows you to set the calculation method (reference) for command position deviation.

Switching takes place as follows depending on the settings for Pr7.23 “RTEX function expansion setup 2” :bit 14 “Command position deviation output switching.”

Pr7.23 bit 14 = 0: Deviation relative to post-position command filter command input

Pr7.23 bit 14 = 1: Deviation relative to pre-position command filter command input

Details are shown in the figure below.



*4 For monitor types No. 23 and 24, digital signals are monitored using analog monitors, so the outputs are as shown in the table below regardless of Pr4.17 “Analog monitor 1 output gain” and Pr4.19 “Analog monitor 2 output gain” settings.

Pr4.16 “Type of analog monitor 1” Pr4.18 “Type of analog monitor 2”	Monitor Type		Output Voltage	
			0 V	+5 V
23	Movement command status	Profile position control (PP)	During profile operation	When profile operation has stopped
		Cyclic position control (CP)	Command updating cycle period Movement command ≠ 0	Command updating cycle period Movement command = 0
		Cyclic velocity control (CV)	Speed command ≠ 0	Speed command = 0
		Cyclic torque control (CT)	Torque command ≠ 0	Torque command = 0
24	Gain selection status		2nd gain (incl. 3rd gain)	1st gain

*5 Outputs the motor power consumption per 30 minutes. The value is updated after 30 minutes.

e.g. When the motor operates for 30 minutes at 10 W motor power consumption

10 W × 0.5 h = 5 Wh

*6 The output gain is 0 V for unit 0 and 5 V for unit 1 regardless of Pr4.17 “Analog monitor 1 output gain” and Pr4.19 “Analog monitor 2 output gain” settings.

Analog Monitor Output Setup

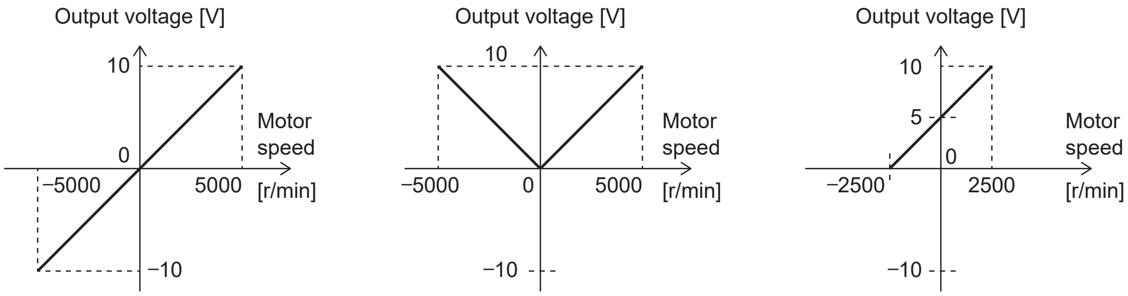
The following figure shows the output specifications when Pr4.21 “Analog monitor output setup” = 0, 1, and 2, respectively.

The figure below shows a case where the monitor type is motor speed and the conversion gain is 500 (1 V = 500 r/min).

Pr4.21=0 signed data output (Output range: -10 to 10 V)

Pr4.21=1 absolute value data output (Output range: 0 to 10 V)

Pr4.21=2 offset data output (Output range: 0 to 10 V)



3.3 Brake System

3.3.1 Internal Brake

3.3.1.1 Overview

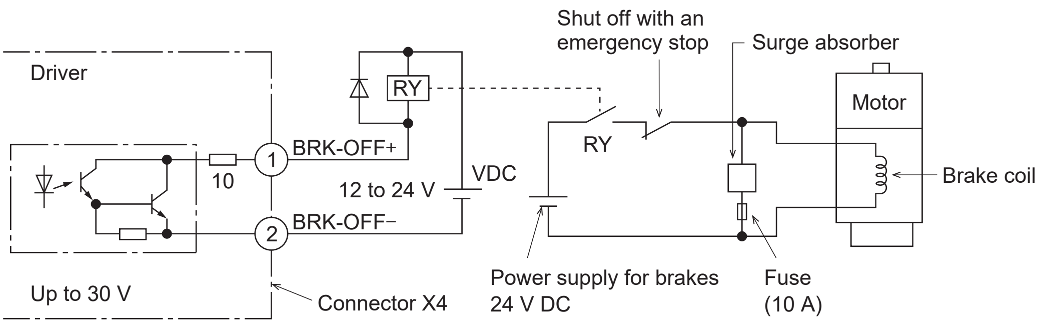
In applications where the motor drives the vertical axis, the brake built into the motor is used to hold and prevent the work (moving load) from falling due to gravity when the power to the driver is shut off and the motor is stopped.

— Precautions —

- The brake built into the motor is for "holding" purposes only, that is, to keep something stopped. Do not use it to "brake" or stop moving loads.

3.3.1.2 Example Connection

The figure below shows an example connection where the holding brake is controlled using the external brake release output signal (BRK-OFF) of the driver.



— Precautions —

- The brake coil has no polarity.
- The power supply for the brake is to be provided by the customer. Do not share the power supply (VDC) between the brake and the control signals.
- Install a surge absorber as shown in the figure above to suppress the surge voltage generated by the on and off action of the relay (RY). If using a diode, the time from holding brake release to brake engagement is sometimes slower than would be the case when using a surge absorber.
- Refer to *"12.4.13 Surge Absorber for Motor Brake"* for information on brake surge absorbers.
- Reactance of the cable varies depending on the cable length and may generate surge voltage. Select a surge absorber that can suppress the coil voltage of the relay and the voltage between the terminals of the holding brake.
- The current to be passed through the SO terminals must not exceed a rated current of 40 mA, a maximum current of 50 mA or an inrush current of 90 mA.

Notes

- The external brake release output is assigned to SO1 (X4: 1, 2 pin) as the default setting.

3.3.1.3 Output Timing of BRK-OFF Signal

- See the *"7.1" "Operation"* timing chart for the holding brake release timing at power-on, the holding brake timing at servo-off while the motor is in operation, or when an alarm is triggered.

- With the parameter (Pr4.38 “Mechanical brake action at running setup”), when at servo-off or if an alarm is triggered while the motor is in motion, you can set up a time between when the motor enters a free-run state from an excited state to when the BRK-OFF signal turns off (holding brake engaged). For details, see *“6 Parameters”* .

3.3.1.4 Specifications

Item	Unit	Applicable Models		
		MHMG5A MHMG01	MHMG02 MHMG04	MHMG08 MHMG09
Static friction torque (*1)	N·m	0.38 or more	1.6 or more	3.8 or more
Armature pull in time (*2)	ms	Less than 35	Less than 50	Less than 70
Armature release time (*2) (*3)	ms	Less than 20		
Releasing voltage (*1)	DC, V	1 or more		
Excitation voltage	DC, V	24 ± 2.4		
Excitation current (with 24 V DC) (*2)	DC, A	0.30	0.36	0.42
Allowable braking energy	J	39.2	105	185
All allowable braking energy	J	4.9×10^3	44.1×10^3	80.0×10^3
Permissible angle acceleration	rad/s^2	30000		

*1 Values at the time of shipping inspection by Panasonic.

*2 Representative values at 20 °C.

*3 DC cuts off when using a varistor (TND14V271K made by Nippon Chemi-con).

* This brake is a non-excitation brake.
* Armature pull in time and armature release times are the brake actuation delay times. Please check the actual state before actual use.
* The backlash for this brake should not exceed 2° at the time of shipping.
* The brake power supply is to be provided by the user (No polarity specified).
* The allowable braking energy stated above represents the amount of braking that can be performed in compliance with brake specifications.

  (braking energy capable of performing a suction motion in consideration of braking temperature increases)
* The allowable braking energy may vary depending on wear during idling (when brakes are powered).
* The motor's life span is 10 million accelerations and decelerations at the permissible angle acceleration stated above (The number of accelerations and decelerations before brake backlash starts increasing rapidly).
* When using a varistor, it is recommended to connect protective parts, such as fuses, in series.

3.3.2 Dynamic Brake (DB)

3.3.2.1 Overview

Sizes A to D drivers come equipped with built-in dynamic brakes for emergency stopping.

The dynamic brake can be activated in the below scenarios.

1. When the main power supply is off
2. At servo-off
3. When protection function is activated
4. When over-travel inhibit input (NOT, POT) of connector X4 is activated

Under conditions "1" through "4" above, dynamic brake operation or free running can be selected using parameters during deceleration or after stopping.

The dynamic brake in sizes A to D drivers remains activated when the control power is off.

— Precautions —

- Dynamic brakes are for emergency stopping.

  Do not start or stop the device by turning the servo-on signal (SRV-ON) on or off. Doing so may damage the dynamic brake circuit built into the driver.

  When driven externally, the motor becomes a generator. A short-circuit current flows during dynamic brake operation regardless of whether the power supply is supplied with current. Continued external driving may cause the driver and motor to smoke or catch fire.
- Dynamic brakes are rated for a short time and should only be used for emergency stopping. If the dynamic brake is applied from the rated rotational velocity and below the recommended load inertia ratio, allow a stop time of at least 10 minutes.

3.3.2.2 Dynamic Brake Driving Conditions

The conditions for operating the dynamic brake can be configured by setting specific parameters.

Check the conditions chart below and apply settings that fit your usage environment.

3.3.2.2.1 When the Main Power Supply is Off

The driving conditions of the dynamic brake from deceleration to stop due to the main power supply turning off can be set using the values in Pr5.07 “Sequence upon main power off” .

Check the chart below for driving conditions.

Driving conditions settings from deceleration to stop due to main power supply off (Pr5.07)

Sequence upon main power off (Pr5.07) Set value of Pr5.07	Over-travel conditions Mid-deceleration	Post-stop When Pr6.36 = 0	Post-stop When Pr6.36 = 1	Deviation counter details
0	D B	D B	Operates via external signal	Clear
1	Free run	D B	Operates via external signal	Clear
2	D B	Free run	Operates via external signal	Clear
3	Free run	Free run	Operates via external signal	Clear
4	D B	D B	Operates via external signal	Clear
5	Free run	D B	Operates via external signal	Clear
6	D B	Free run	Operates via external signal	Clear
7	Free run	Free run	Operates via external signal	Clear
8	Emergency stop	D B	Operates via external signal	Clear
9	Emergency stop	Free run	Operates via external signal	Clear

Notes

- If the Pr5.07 “Sequence upon main power off” setup value is 8 or 9, the torque limit value at emergency stop will be that of the setup values given in Pr5.11 “Torque setup for emergency stop” .

3.3.2.2.2 At Servo-Off

The driving conditions of the dynamic brake from deceleration to stop due to servo-off can be set using the values in Pr5.06 “Sequence at servo-off” .

Check the conditions chart below for the driving conditions.

Driving conditions settings from deceleration to stop due to servo off (Pr5.06)

Sequence at servo-off (Pr5.06) Set value of Pr5.06	Over-travel conditions: Mid-deceleration	Over-travel conditions: Post-stop	Deviation counter details
0	D B	D B	Clear
1	Free run	D B	Clear
2	D B	Free run	Clear
3	Free run	Free run	Clear
4	D B	D B	Clear
5	Free run	D B	Clear
6	D B	Free run	Clear
7	Free run	Free run	Clear
8	Emergency stop	D B	Clear
9	Emergency stop	Free run	Clear

Notes

- If the Pr5.06 “Sequence at servo-off” setup value is 8 or 9, the torque limit value at emergency stop will be that of the setup values given in Pr5.11 “Torque setup for emergency stop” .

3.3.2.2.3 When Protection Function is Activated

The driving conditions of the dynamic brake from deceleration to stop due to activation of protection functions can be set using the values in Pr5.10 “Sequence at alarm” .

Check the conditions chart below for the driving conditions.

Driving conditions settings from deceleration to stop due to activation of protection function (Pr5.10)

Sequence at alarm (Pr5.10) Set value of Pr5.10	Over-travel conditions: Mid-deceleration	Over-travel conditions: Post-stop	Deviation counter details
0	D B	D B	Clear
1	Free run	D B	Clear
2	D B	Free run	Clear
3	Free run	Free run	Clear
4	Operation A: Emergency stop Operation B: DB	D B	Clear
5	Operation A: Emergency stop Operation B: Free run	D B	Clear
6	Operation A: Emergency stop Operation B: DB	Free run	Clear
7	Operation A: Emergency stop Operation B: Free run	Free run	Clear

Notes

- If the Pr5.10 “Sequence at alarm” setup value is between 4 and 7, operation A will be executed if the protection function supports emergency stopping, and operation B will be executed if the protection function does not support emergency stopping.

  The deviation counter that runs when the protection function is in operation will be cleared when the alarm is cleared.

— Precautions —

- Maintain the main circuit power supply throughout the deceleration to stop.

3.3.2.2.4 When Over-travel Inhibit Input (NOT, POT) is Activated

The driving conditions of the dynamic brake from deceleration to stop due to over-travel inhibit input (NOT, POT) can be set using the values in Pr5.05 “Sequence at over-travel inhibit” when Pr5.04 “Over-travel inhibit input setup” is 0.

Check the conditions chart below for the driving conditions.

Driving conditions settings from deceleration to stop due to activation of over-travel inhibit input (NOT, POT) (Pr5.05)

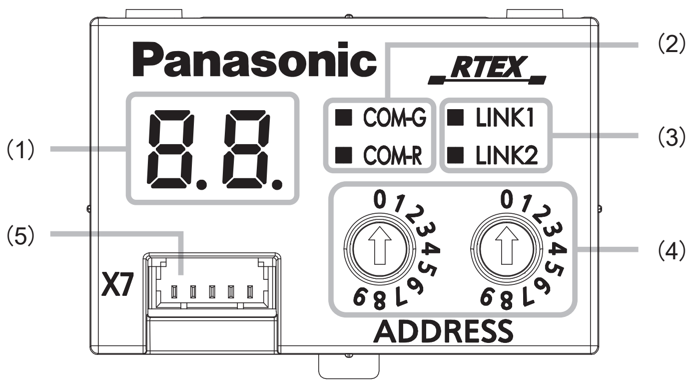
Sequence at over-travel inhibit (Pr5.05)	Over-travel conditions			
	Mid-deceleration		Post-stop	
Set value of Pr5.05	Stopping method	Deviation counter details	Post-stop operation	Deviation counter details
0	D B	Clear	Torque command in the direction of over-travel inhibition = 0	Retained
1	Free run	Clear	Torque command in the direction of over-travel inhibition = 0	Retained
2	Emergency stop	Clear	Torque limit and torque command are as usual	Retained

Notes

- If the Pr5.05 “Sequence at over-travel inhibit” setup value is 2, the torque limit value during deceleration will be Pr5.11 “Torque setup for emergency stop” .

3.4 Front Panel

3.4.1 Operation and Display of the Front Panel



<table>
<tr><th>No. in image</th><th colspan="2">Name</th></tr>
<tr><td>(1)</td><td colspan="2">7-segment LED for display (2-digit)</td></tr>
<tr><td>(2)</td><td>COM-G LED (green)
COM-R LED (red)</td><td rowspan="2">Network status LED</td></tr>
<tr><td>(3)</td><td>LINK1, LINK2 LED (green)</td></tr>
<tr><td>(4)</td><td colspan="2">Rotary switch for setting node addresses (2-digit)
Setting range: 0 to 31</td></tr>
<tr><td>(5)</td><td colspan="2">Analog monitor connector (X7)</td></tr>
</table>

3.4.2 Node Address

- Configure node address (MAC-ID) in decimals.

  Upper row: Left-side rotary switch (MSD)

  Lower row: Right-side rotary switch (LSD)

  (Example) If MAC-ID=13

  Set MSD=1, LSD=3
- To set the rotary switches, use a flathead screwdriver with the following specifications.

  Blade tip width: 2.6 mm or less

  Blade tip thickness: 0.6 mm or less
- Turn the rotary switch until you feel a click.
- Node addresses (MAC-ID) set with the rotary switches will be loaded only once when the control power is turned on.

  Changes made after power-on are not reflected in the control. Note that the setup values will be applied with the next power-on.

  To avoid unnecessary trouble, do not change the values of the rotary switch after the power supply is turned on.
- Settings for node addresses (MAC-IDs) range from 0 to 31.

  If the setup value exceeds 31, Err82.0.0 "RTEX node address setting error protection" is triggered.

3.4.3 7-segment LED

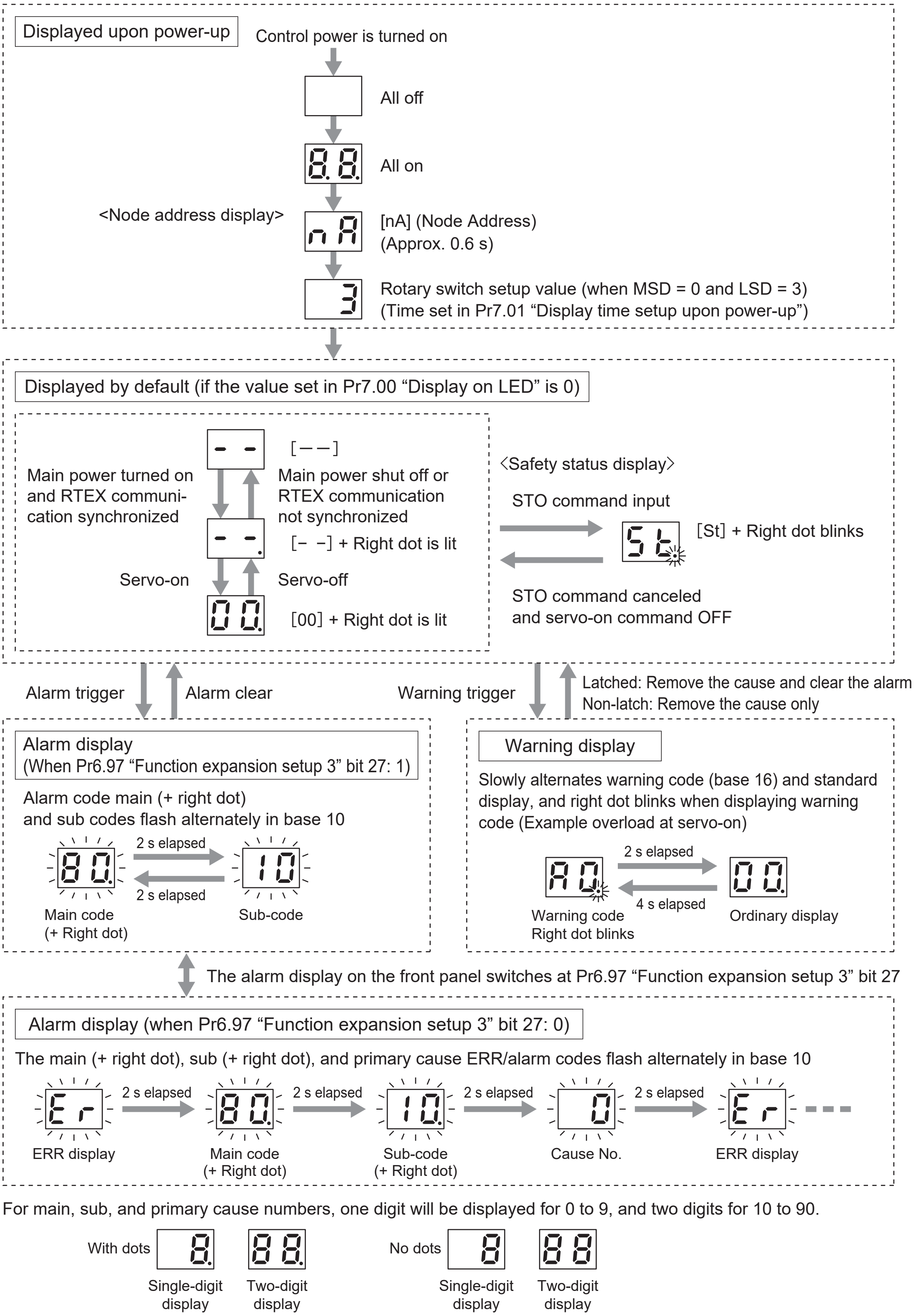
The 7-segment LED in the front panel displays the node address values set in the rotary switch when the control power is turned on. After that, it will display the values set up in Pr7.00 “Display on LED” .

An alarm number is displayed when an alarm is triggered. The display method is switched by the Pr6.97 “Function expansion setup 3” :bit 27 setting.

A warning number is displayed when a warning is triggered.

The diagram below shows the transition in states after the control power supply is turned on.

7-segment LED Display



When a warning number is displayed, refer to *“10.3.2 List of Warning Functions”* to check the warning number and descriptions.

3.4.4 Network Status List

Network LEDs include COM LEDs and LINK LEDs.

COM LED and LINK LED display specifications are shown below.

The network status LEDs are located on the front panel. See *"3.4.1 Operation and Display of the Front Panel"* for a detailed description of the front panel.

COM-G LED, COM-R LED Display Specifications

Display status		Description
COM-G	COM-R	
Off	Off	Initialization
Blinking green	Off	During configuration
Green light	Off	Network established
Off	Blinking red	Network-related, clearable alarm triggered
Off	Red light	Network-related, non-clearable alarm triggered

LINK1 LED, LINK2 LED Display Specifications

Display status		Description
LINK1	LINK2	
Off	Off	Cable not connected (Sender node power supply not connected or cable disconnected)
Green light	Off	Connected normally (Sender node TX and local node RX have a normal electrical connection)

- The COM-R LED will change to blinking or solidly lit in red according to the above if a RTEX communication-related alarm is triggered that overlaps with an alarm not related to RTEX communication (ex. Err16.0.09). However, note that the alarm not related to RTEX communication which was triggered first will continue to be displayed on the 7-segment LED in such cases.
- The conditions for illumination of the COM-G LED can be changed by configuring Pr7.23 "RTEX function expansion setup 2" :bit 4. Normally, use bit 4 = 1.

4 Communication Specifications

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4.1 Network Outline

4.1.1 Supported Control Modes

This product supports five control modes.

However, the functions listed in gray in the table below are not currently supported in this software version.

Position control modes (PP and CP), velocity control modes (CV), and torque control modes (CT) are used with semi-closed control. Semi-closed control executes control by feeding motor encoder data back to the servo driver.

In addition to semi-closed control, position control modes are also used with full-closed control. Full-closed control uses an external scale to directly detect the position of the machine to be controlled, provide feedback, and perform position control. Please see *"7.6 Full-closed Control"* for a detailed description of full-closed control mode.

Use Pr0.01 "Control mode setup" to choose between semi-closed and full-closed control.

Control modes (PP, CP, CV, and CT) are set with cyclic commands. For the details of cyclic commands, see Technical Reference Communication Specification.

—: None

Class	Control mode		Abbreviation	Description
—	NOP	NOP	NOP	A mode for sending temporary invalid data immediately after the network is established.
Semi-closed control	Profile position control mode	Profile Position Mode	PP	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver.
	Cyclic position control mode	Cyclic Position Mode	CP	A position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.
	Cyclic velocity control mode	Cyclic Velocity Mode	CV	A velocity control mode in which the host device generates a speed command, and operates by updating (sending) the command speed in a communication cycle.
	Cyclic torque control mode	Cyclic Torque Mode	CT	A torque control mode in which the host device generates a torque command, and operates by updating (sending) the command torque in a communication cycle.
Full-closed control	Profile position control mode	Profile Position Mode	PP	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver.
	Cyclic position control mode	Cyclic Position Mode	CP	A position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.

Notes

- Check the host device operating instructions since the control modes that can actually be used depend on the host device specifications.

4.1.2 Control Modes: Overview

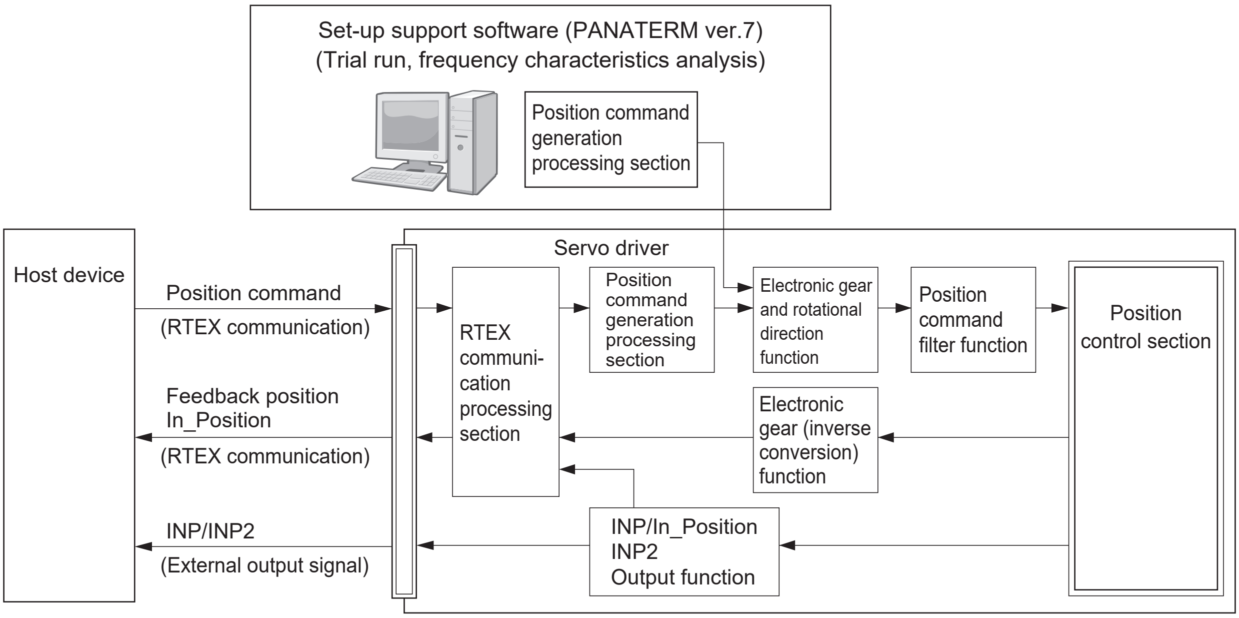
4.1.2.1 Position Control Modes

Position control is performed on the basis of the RTEX communication command position commands input from the host device.

Position control modes include the following modes, with modes specified by RTEX communication commands.

- Profile Position Control (PP): A control mode in which the host device designates the target position, target speed, and acceleration/deceleration, and generates position commands inside the servo driver.
- Cyclic Position Control (CP): A control mode in which the host device updates the command position in the command updating cycle.

Please see *"7.3 Position Control"* , *"7.6 Full-closed Control"* , Technical Reference Communication Specification and for a detailed description of position control modes.

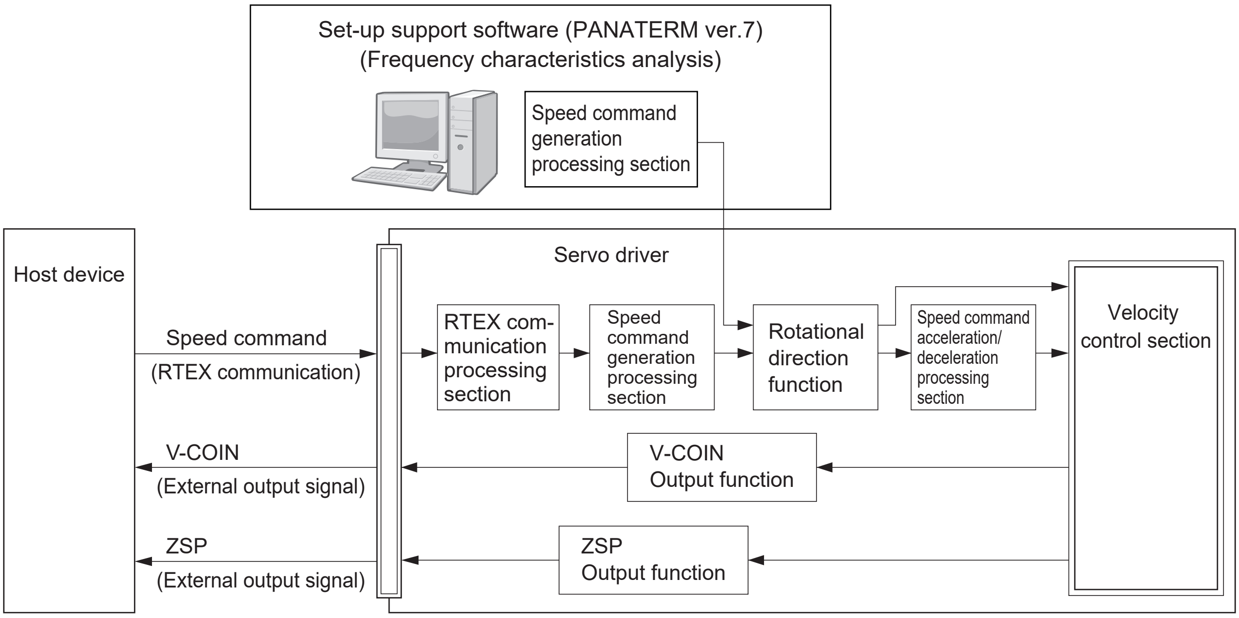


4.1.2.2 Velocity Control Modes

Velocity control is performed on the basis of the RTEX communication command velocity commands input from the host device.

Velocity control modes include the cyclic velocity control (CV) mode that updates the command speed in the communication cycle, specified by RTEX communication command.

Please see *"7.4 Velocity Control"* and Technical Reference Communication Specification for a detailed description of velocity control modes.



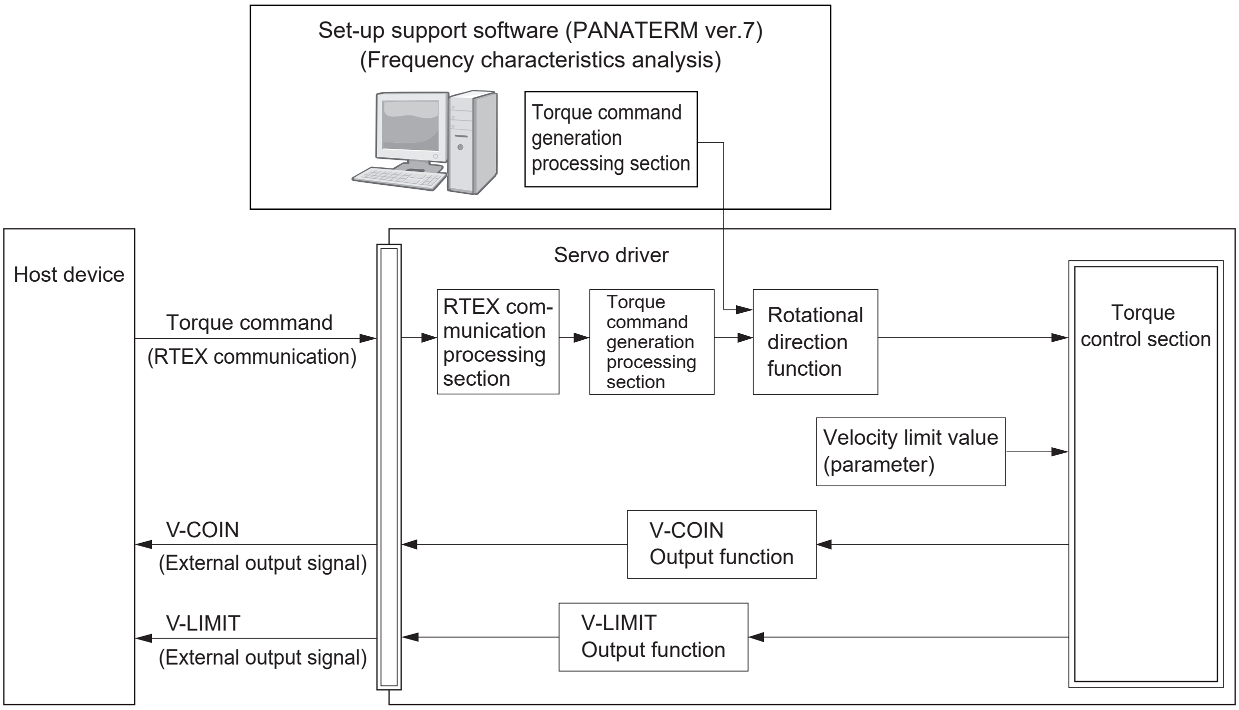
4.1.2.3 Torque Control Modes

Torque control is performed on the basis of the RTEX communication command torque commands input from the host device.

In addition to the torque command, a velocity limit value is required for torque control. The servo driver not only controls torque, but controls it so that the velocity does not exceed the velocity limit.

Torque control mode contains the cyclic torque control (CT) mode that updates the command torque at the communication cycle, specified by RTEX communication commands.

Please see *"7.5 Torque Control"* and Technical Reference Communication Specification for a detailed description of torque control modes.



4.1.3 Basic Network Specifications

Item	Specifications
Topology	Ring
Physical layer	100BASE-TX (IEEE 802.3)
Baud rate	100 Mbps
Network status LED	4 pcs. (COM-G, COM-R, LINK1, LINK2)
Node address (MAC-ID) setting	Rotary switch, 2-digit (front panel) Setting range: 0 to 31 (factory default value: 0)
Communication cycle (Physical data transmission cycle)	62.5 μs, 125 μs, 250 μs, 500 μs, 1 ms, 2 ms
Command updating cycle	62.5 μs, 125 μs, 250 μs, 500 μs, 1 ms, 2 ms, 4 ms
Control mode	● Semi-closed control (S) • Position control: Profile position control (PP), cyclic position control (CP) • Velocity control: Cyclic velocity control (CV) • Torque control: Cyclic torque control (CT) ● Full-closed control (F) • Position control: Profile position control (PP), cyclic position control (CP) The above semi-closed control and full-closed control are switched by parameters. The above PP/CP/CV/CT are switched using RTEX communication commands
Connection cable	STP (shielded twisted pair) cables compatible with CAT 5e of TIA/EIA-568 or higher Straight cable type
Cable length	1 Between nodes: Maximum 100 m 2 Total length: Maximum 200 m Both the above conditions should be met for use. Please contact Panasonic if the condition "2" above is to be exceeded.
Number of slaves (axes) connected	When the communication cycle = 62.5 μs: Max. 4 When the communication cycle = 125 μs: Max. 8 When the communication cycle = 250 μs: Max. 16 When the communication cycle = 500 μs, 1.0 ms, 2.0 ms: Max. 32 ● This is the number of axes when all connected axes are in 16-byte mode. ● When in 32-byte mode, the number of axes connected is one half that of axes connected in 16-byte mode because twice as many transmitted/received data blocks are used as in the 16-byte mode. ● It also depends on the computing capacity of the host device. ● When using in the same communication system as the MINAS-A☐N series driver, set all servo drivers to the same communication cycle.
Data size	● 16-byte mode: Command, 16 bytes; Response, 16 bytes ● 32-byte mode: Command, 32 bytes; Response, 32 bytes
Communication error detection	CRC-CCITT

Communication Cycle, Command Updating Cycle

■ Communication cycle

The communication cycle is the cycle during which RTEX frames for commands and responses are transmitted.

Generally, servo driver command and response processing is performed in the same cycle as the communication cycle.

For command and response processing cycles, see *"Command updating cycle"* .

■ Command updating cycle

The command updating cycle is a cycle during which the host device updates commands.

Servo driver-side processing is performed as follows depending on the communication cycle.

CP (*1)	Command position commands and responses are processed in the command updating cycle that has been set. The servo driver calculates changes in command position during the command updating cycle and generates a movement command. Commands and responses other than command positions are processed in the same cycle as the communication cycle. The command updating cycle on the servo driver side must be matched to the command updating cycle on the host device side, for normal operation.
PP, CV, CT (*1)	Commands and responses are processed in the same cycle as the communication cycle, regardless of the command updating cycle.

*1 For information on control modes, see *“2.1.4.3 Supported Control Modes”* .

4.1.4 Supported Mode Table

Each servo driver mode setting (control mode or data size, full-closed control, semi-closed control) corresponds to the communication cycle and command updating cycle.

Check the table below to configure settings appropriate for the mode setting, communication cycle, and specific updating cycle to be used.

Data size: 16-byte mode

◎: Semi-closed and full-closed supported ○: Only semi-closed supported ×: Not supported

Communication cycle [ms]	Maximum number of axes [axes]	Command updating cycle [ms]																											
		0.0625				0.125				0.250				0.5				1.0				2.0				4.0			
		PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT
0.0625	4	×	◎	×	×	×	◎	×	×																				
0.125	8					×	◎	×	×	×	◎	×	×																
0.250	16									×	◎	×	×	×	◎	×	×												
0.5	32													◎	◎	×	×	◎	◎	×	×								
1.0	32																	◎	◎	×	×	◎	◎	×	×				
2.0	32																					◎	◎	×	×	◎	◎	×	×

* The maximum number of axes depends on the communication cycle. For details, see *"4.1.3 Basic Network Specifications"* .

Data size: 32-byte mode

◎: Semi-closed and full-closed supported ○: Only semi-closed supported ×: Not supported

Communication cycle [ms]	Maximum number of axes [axes]	Command updating cycle [ms]																											
		0.0625				0.125				0.250				0.5				1.0				2.0				4.0			
		PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT	PP	CP	CV	CT
0.0625	2	×	×	×	×	×	×	×	×																				
0.125	4					×	×	×	×	×	×	×	×																
0.250	8									×	×	×	×	×	×	×	×												
0.5	16													◎	◎	×	×	◎	◎	×	×								
1.0	16																	◎	◎	×	×	◎	◎	×	×				
2.0	16																					◎	◎	×	×	◎	◎	×	×

* The maximum number of axes depends on the communication cycle. For details, see *"4.1.3 Basic Network Specifications"* .

A mode setting example is provided below.

(Example) Communication cycle 500 μs (0.5 ms), command updating cycle 1 ms, semi-closed control, 16-byte mode, interaxis semi-synchronous mode

Pr0.01 “Control mode setup” = 0 (Semi-closed control)

Pr7.20 “RTEX communication cycle setup” = 3 (Communication cycle: 500 μs)

Pr7.21 “RTEX command updating cycle ratio setup” = 2 (Command update cycle: 1 ms = 500 μs × 2)

Pr7.22 “RTEX function expansion setup 1” = 0 (16-byte mode, interaxis semi-synchronous mode)

Notes

- If Pr7.20 “RTEX communication cycle setup” is not -1, it is not necessary to set Pr7.91 “RTEX communication cycle expansion setup” .

— Precautions —

- Full-closed control supports position control (CP and PP), and switching to velocity control or torque control (CV or CT) is not enabled.
- Err93.5.0 “Parameter setup error protection 4” will be triggered if the combination condition of Pr7.20 “RTEX communication cycle setup” , Pr7.91 “RTEX communication cycle expansion setup” , and Pr7.21 “RTEX command updating cycle ratio setup” is not currently supported.

  For information on Pr7.20 “RTEX communication cycle setup” , Pr7.21 “RTEX command updating cycle ratio setup” , Pr7.22 “RTEX function expansion setup 1” , and Pr7.91 “RTEX communication cycle expansion setup” , see *“4.1.5 Related Parameters”* .
- Set the host device communication cycle precision to within ± 0.05%.
- Always set the same communication cycle and command updating cycle as that of the host device.
- Always set the same RTEX function expansion (Pr7.22 “RTEX function expansion setup 1”) as that of the host device. Operation is not guaranteed if the host device and RTEX function expansion setups are not the same.

  For information on Pr7.20 “RTEX communication cycle setup” , Pr7.21 “RTEX command updating cycle ratio setup” , Pr7.22 “RTEX function expansion setup 1” , and Pr7.91 “RTEX communication cycle expansion setup” , see *“4.1.5 Related Parameters”* .
- Full-closed control cannot be used with the standard type.
- The external scale position information monitoring function cannot be used with the standard type during semi-closed control.

4.1.5 Related Parameters

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
0	01	R	Control mode set-up	0 to 6	—	Sets the control mode of this product. 0: Semi-closed control Switchable between position (PP/CP), velocity (CV), and torque (CT) control 6: Full-closed control Position (PP/CP) control only Other than the above: Manufacturer use (setting is prohibited)
7	20	R	RTEX communication cycle setup	-1 to 12	—	The communication cycle for RTEX communication is set. -1: Enables setting by Pr7.91 3: 500 μs 6: 1 ms Other than the above: Manufacturer use (setting is prohibited)
7	21	R	RTEX command updating cycle ratio setup	1 to 2	—	The ratio of the communication cycle to the command updating cycle is set for RTEX communication. Setup values = command updating cycle, communication cycle 1: 1× 2: 2×
7	22	R	RTEX function expansion setup 1	-32768 to 32767	—	● bit 0 Sets the data size for RTEX communication. 0: 16-byte mode 1: 32-byte mode ● bit 1 Sets the synchronous mode between multiple axes for which TMG_CNT is used. If TMG_CNT is not used, set to 0. 0: Interaxis semi-synchronous mode (partially asynchronous) 1: Interaxis full-synchronous mode (completely synchronous) (For details, see *"4.2.4.1.3 Command_Code, TMG_CNT and Interaxis Synchronous Mode (Command byte 1)"* .) ● bit 4 External scale position information monitoring function setting for semi-closed control 0: Disabled 1: Enabled **Notes** ● External scale position information can be monitored during full-closed control, regardless of the setting of this bit.

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	91	R	RTEX communication cycle expansion setup	0 to 2000000	ns	Sets the communication cycle for RTEX when Pr7.20 “RTEX communication cycle setup” = -1. The only possible settings are 62500, 125000, 250000, 500000, 1000000, or 2000000. If set to a different value, Err93.5.☐ “Parameter setup error protection 4” is triggered.

■ RTEX Communication Settings Using Set-up Support Software (PANATERM ver.7)

- RTEX communication-related parameters can be easily set using the “RTEX communication setup function” of Set-up Support Software (PANATERM ver.7) .
- Actual cycle measurement results for RTEX communication data sent from the host device can be monitored on the communication status monitor screen of the “RTEX communication setup function”. Fluctuations in the communication data cycle of the host device can be checked by monitoring measurement results. Use for analysis when communication is established or when communication-related errors occur.

  The values that can be monitored are the actual cycle measurement results received by the driver from the RTEX communication data sent from the host device. Because these measurement results include the internal clock errors of the driver, treat them as reference values for confirming the communication cycle.

4.2 RTEX Communication Protocol

4.2.1 Data Transfer Timing

This section describes the timing of data transmission (command reception and response transmission).

The timing of data transmission becomes indefinite when communication and servo synchronization are not established.

The timing diagrams in this section show a state of established synchronization. Whether or not synchronization has been established can be confirmed using the monitor command logical output signal (expansion).

The echo back of Update_Counter (Update_Counter_Echo) is generated during the data exchange process on the servo driver side. Therefore, unless a communication error occurs, the echo back is returned immediately.

The echo back of a command code (Command_Code_Echo) is generated by command and response processing, and is therefore not an immediate response. Note as regards the correspondence between the Update_Counter and command codes that the data sent may be inconsistent with the data received.

Note that the command code echo back response timing for the response when the command mode is switched with communication cycles of 62.5 μs and 125 μs will not match the response timing for internal data dependent on control mode (for example, position deviation). For details, see *"Transmission Timing Diagram"* below.

Please observe the following, in order to reliably transmit the intended commands.

- Check the value of the command error bit (CMD_Error or Sub_CMD_Err) to confirm that the command is being accepted normally.
  0: The command has been normally received.
  1: The command has not been normally received (There is a problem with e.g. a command code or argument.).
- Retain the command code value until an echo back (echo data such as Command_Code_Echo, Type_Code_Echo, and Index_Echo) is returned.
- Use the echo back to confirm that the intended command has been transmitted.
  If operations are performed without confirming the echo back, unintended actions may be taken.

If the communication cycle is 250 μs or less, set the Update_Counter to the same value for all axes, and update the data in the command updating cycle.

Set operation commands (position, speed and torque commands) after 100 ms or more have elapsed since the servo-ON command. For the timing chart, see "Operational Details" of Technical Reference Functional Specification "4.1 Startup Operation" .

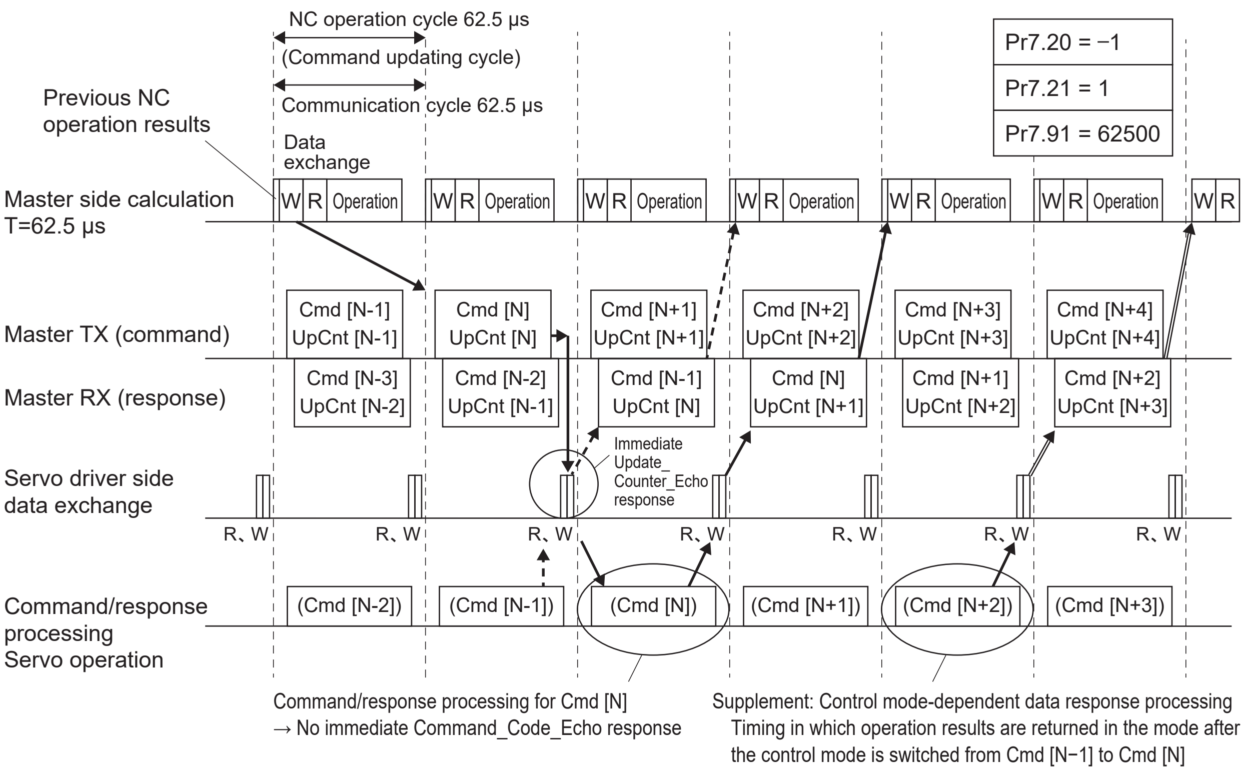
Transmission Timing Diagram

The communication cycle and the command updating cycle can be set so as to be 1:1 or 1:2.

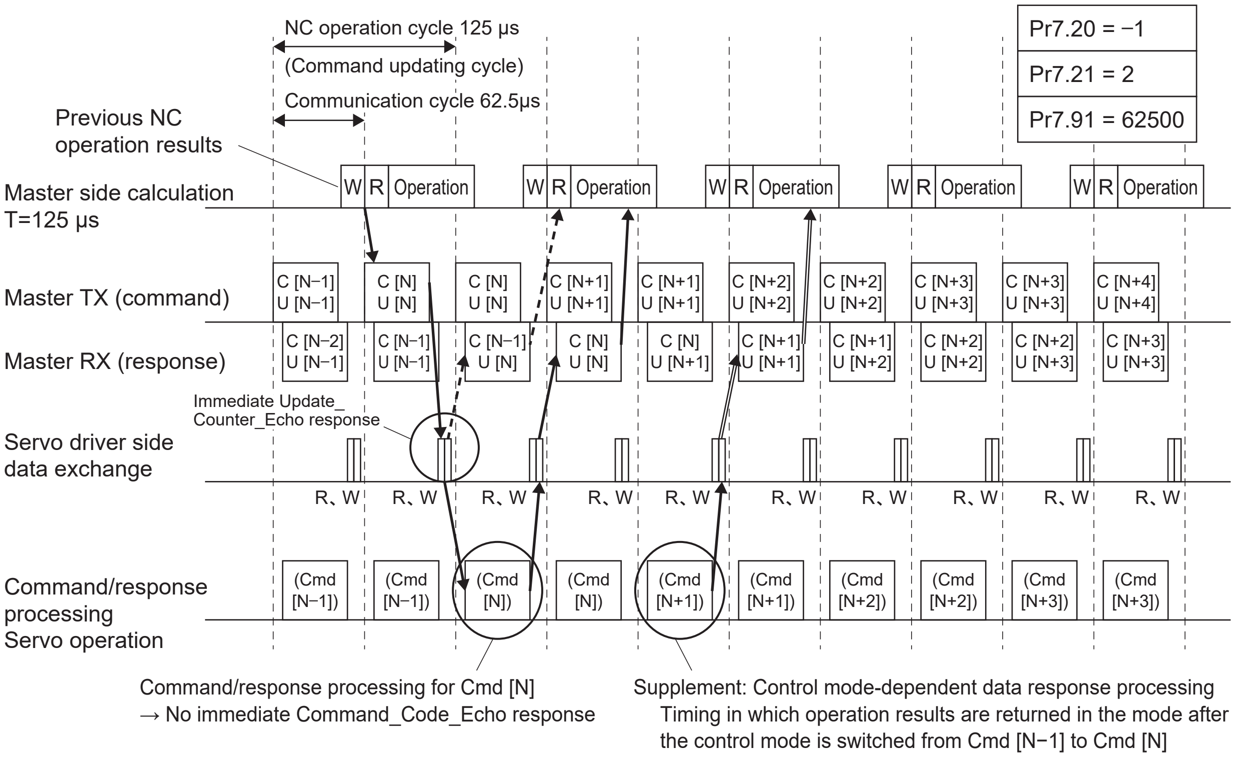
Setting the communication cycle and the command updating cycle to 1:2 enhances noise-proofing.

An example of a timing chart for transmission timing is shown below.

1 **Transmission timing with a communication cycle of 62.5 μs and a command updating cycle of 62.5 μs (communication cycle and command updating cycle at 1:1)**



2 **Transmission timing with a communication cycle of 62.5 μs and a command updating cycle of 125 μs (communication cycle and command updating cycle at 1:2)**



4.2.2 Cyclic Commands and Non-cyclic Commands

4.2.2.1 Cyclic Command List

Cyclic commands are commands for switching between control modes. Operation updating by switching control modes is performed using command updating cycles.

With this product, full-closed control is only supported for position control.

Therefore, if a CV (velocity control) or CT (torque control) signal is received when in full-closed control, a command error is triggered.

See *"4.1.4 Supported Mode Table"* for the correspondence of other control modes to communication cycles and command updating cycles.

Control mode		Abbreviation	Command code	Description
NOP	No Operation	NOP	0□h	A mode for sending temporary invalid data immediately after the network is established. Never use it under any other circumstances. When this command is received, control continues on the basis of the previous commands, without any new control.
Profile position control mode	Profile Position Mode	PP	1□h	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver. Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on.
Cyclic position control mode	Cyclic Position Mode	CP	2□h	A position control mode in which the host device generates a position command, updates (sends) a command position in a command updating cycle, and the servo driver operates. Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on.
Cyclic velocity control mode	Cyclic Velocity Mode	CV	3□h	A velocity control mode in which the host device generates a speed command, updates (sends) the command speed in a communication cycle, and the servo driver operates. Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on.
Cyclic torque control mode	Cyclic Torque Mode	CT	4□h	A torque control mode in which the host device generates a torque command, updates (sends) the command torque in a communication cycle, and the servo driver operates. Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on.

4.2.2.2 Non-cyclic Command List

Non-cyclic commands are event-driven commands such as parameter settings.

For details on transmission protocols, see *"4.2.3.2 Non-cyclic Command Areas"* .

The functions listed in gray in the table below are not supported in this software version.

○: Supported, △: Partly supported, ×: Not supported

Non-cyclic command code	Name	Description	Subcommand supported	Cyclic command (☐ part on the left) support				
				NOP (0h)	PP (1h)	CP (2h)	CV (3h)	CT (4h)
☐0h	Normal	Used for normal operations. This command is also the standard command for non-cyclic commands. For details, see Technical Reference Communication Specification.	○	○	×	○	×	×
☐1h	Reset	Use in the following cases: ● To force reset this product by software reset ● To enable the attribute C parameter without resetting this product ● To reset the reference time for time-stamping For details, see Technical Reference Communication Specification.	×	○	×	○	×	×
☐2h	System ID	Used for reading out the system ID of this product. Information specified by Type_Code and index is returned in ASCII code. For details, see Technical Reference Communication Specification.	○	○	×	○	×	×
☐4h	Homing	Used for performing homing operations, position information latch, etc. For details, see Technical Reference Communication Specification.	×	×	×	○	×	×
☐5h	Alarm	Used for reading out an alarm code, for clearing an alarm that is presently being generated, etc. For details, see Technical Reference Communication Specification.	×	×	×	○	×	×
☐6h	Parameters	Used to read and write parameters, for writing to EEPROM, etc. For details, see Technical Reference Communication Specification.	×	×	×	○	×	×
☐7h	Profile	Used when starting up in profile position control (PP) mode. For details, see Technical Reference Communication Specification .	×	×	×	×	×	×
☐Ah	Monitor	Used for monitoring position deviation, load factor, etc. For details, see Technical Reference Communication Specification.	○	×	×	○	×	×

—: N/A

Non-cyclic command code	Name	Description
—	Command error	If this product does not receive a command because of an error in its content, a response of 1 is returned for byte 1:bit 7. For details, see Technical Reference Communication Specification .

Non-cyclic command code	Name	Description
(FFh) Response only	Communication error	This response is returned when the product has detected a communication error (CRC error). When a communication error (CRC error) occurs, this product controls based on the last normally received command (With CP, the command position is controlled using an estimated command position.). For details, see Technical Reference Communication Specification.

4.2.3 Cyclic and Non-Cyclic Command Areas

RTEX communication has a 16-byte mode and a 32-byte mode, depending on the difference in the data size used.

More response data can be received in the 32-byte mode than in the 16-byte mode, but the maximum number of axes that can be used is half that of the 16-byte mode.

Moreover, since the 32-byte mode does not support communication cycles or command updating cycles of less than 250 µs, ensure than 16-byte mode is used when high-speed communication is desired.

4.2.3.1 Cyclic Command Areas

The following data block areas are used as cyclic transmission areas.

- Cyclic transmission area for real-time data transmission (command positions, feedforward data, etc.)
  - Command data block

    Bytes 2 to 7 (Control_Bits, Command_Data1) are used, while bytes 24 to 31 (Sub_Command_Data2, Sub_Command_Data3) are used in 32-byte mode.
  - Response data block

    Bytes 2 to 7 (Status_Flags, Response_Data1) are used, while bytes 24 to 31 (Sub_Response_Data2, Sub_Response_Data3) are used in 32-byte mode.
- Transmission areas capable of use as a cyclic transmission area by means of parameter setup
  - Command data block

    Bytes 12 to 15 (Command_Data3) are used. For details, see Technical Reference Communication Specification.
  - Response data block

    Bytes 8 to 15 (Response_Data2, Response_Data3) are used, while bytes 20 to 23 (Sub_Response_Data1) are used in 32-byte mode. For details, see *"4.2.4.2.5 Response_Data (Response Bytes 4 to 15)"* .

As soon as this product receives a command, it immediately reflects it in its control behavior and returns the latest response value.

Main command: Shared by 16-byte mode and 32-byte mode

<table>
<tr><th rowspan="2"></th><th rowspan="2">byte</th><th colspan="8">Command</th><th rowspan="2">byte</th><th colspan="8">Response</th></tr>
<tr><th>bit 7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th>bit 7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td rowspan="8">Cyclic</td><td>0</td><td>C (0)</td><td colspan="2">Update_ Counter</td><td colspan="5">MAC-ID</td><td>0</td><td>R (1)</td><td colspan="2">Update_ Counter_Echo</td><td colspan="5">Actual MAC-ID</td></tr>
<tr><td>1</td><td>TMG_ CNT</td><td colspan="7">Command_Code</td><td>1</td><td>CMD_ Error</td><td colspan="7">Command_Code_Echo</td></tr>
<tr><td>2</td><td colspan="8" rowspan="2">Control_Bits</td><td>2</td><td colspan="8" rowspan="2">Status_Flags</td></tr>
<tr><td>3</td><td>3</td></tr>
<tr><td>4</td><td colspan="8" rowspan="4">Command_Data1</td><td>4</td><td colspan="8" rowspan="4">Response_Data1</td></tr>
<tr><td>5</td><td>5</td></tr>
<tr><td>6</td><td>6</td></tr>
<tr><td>7</td><td>7</td></tr>
<tr><td rowspan="7">Non-cyclic</td><td>8</td><td colspan="8" rowspan="4">Command_Data2</td><td>8</td><td colspan="8" rowspan="4">Response_Data2</td></tr>
<tr><td>9</td><td>9</td></tr>
<tr><td>10</td><td>10</td></tr>
<tr><td>11</td><td>11</td></tr>
<tr><td>12</td><td colspan="8" rowspan="3">Command_Data3</td><td>12</td><td colspan="8" rowspan="3">Response_Data3</td></tr>
<tr><td>13</td><td>13</td></tr>
<tr><td>14</td><td>14</td></tr>
</table>

	byte	Command								byte	Response							
		bit 7	6	5	4	3	2	1	0		bit 7	6	5	4	3	2	1	0
Non-cyclic	15	Command_Data3								15	Response_Data3							

Subcommand: 32-byte mode only

	byte	Command								byte	Response							
		bit 7	6	5	4	3	2	1	0		bit 7	6	5	4	3	2	1	0
Non-cyclic	16	Sub_ Chk	0	0	0	Sub_Command_Code				16	Sub_ CMD_ Err	Sub_ ERR	Sub_ WNG	Sub_ Busy	Sub_Command_ Code_Echo			
	17	Sub_Type_Code								17	Sub_Type_Code_Echo							
	18	Sub_Index								18	Sub_Index_Echo							
	19									19								
	20	Sub_Command_Data1								20	Sub_Response_Data1							
	21									21								
	22									22								
	23									23								
Cyclic	24	Sub_Command_Data2								24	Sub_Response_Data2							
	25									25								
	26									26								
	27									27								
	28	Sub_Command_Data3								28	Sub_Response_Data3							
	29									29								
	30									30								
	31									31								

4.2.3.2 Non-cyclic Command Areas

Bytes 8 to 15 of the command and response data blocks, as well as bytes 17 to 23 in 32-byte mode, can be used as non-cyclic transmission areas, for event-driven data transmission, such as parameter settings (Some areas can also be used as cyclic transmission areas.). For details, see . *"4.2.3.1 Cyclic Command Areas"* .

Main command: Shared by 16-byte mode and 32-byte mode

	byte	Command								byte	Response							
		bit 7	6	5	4	3	2	1	0		bit 7	6	5	4	3	2	1	0
Cyclic	0	C (0)	Update_ Counter		MAC-ID					0	R (1)	Update_ Counter_Echo		Actual MAC-ID				
	1	TMG_ CNT	Command_Code							1	CMD_ Error	Command_Code_Echo						
	2	Control_Bits								2	Status_Flags							
	3									3								
	4	Command_Data1								4	Response_Data1							
	5									5								
	6									6								
	7									7								

	byte	Command								byte	Response							
		bit 7	6	5	4	3	2	1	0		bit 7	6	5	4	3	2	1	0
Non-cyclic	8	Command_Data2								8	Response_Data2							
	9									9								
	10									10								
	11									11								
	12	Command_Data3								12	Response_Data3							
	13									13								
	14									14								
	15									15								

Subcommand: 32-byte mode only

	byte	Command								byte	Response							
		bit 7	6	5	4	3	2	1	0		bit 7	6	5	4	3	2	1	0
Non-cyclic	16	Sub_Chk	0	0	0	Sub_Command_Code				16	Sub_CMD_Err	Sub_ERR	Sub_WNG	Sub_Busy	Sub_Command_Code_Echo			
	17	Sub_Type_Code								17	Sub_Type_Code_Echo							
	18	Sub_Index								18	Sub_Index_Echo							
	19									19								
	20	Sub_Command_Data1								20	Sub_Response_Data1							
	21									21								
	22									22								
	23									23								
Cyclic	24	Sub_Command_Data2								24	Sub_Response_Data2							
	25									25								
	26									26								
	27									27								
	28	Sub_Command_Data3								28	Sub_Response_Data3							
	29									29								
	30									30								
	31									31								

Non-cyclic Status Flag

When there is a command other than a normal command (□0h), bits 7 to 4 of byte 9 indicate the non-cyclic command status.

bit	Name	Description
4	Busy	During command processing, 1 is returned.
5	Reserved	Always returns 0.
6	WNG	When a process has been executed, but some problem has occurred, 1 is returned. (If written with added restrictions when setting parameters, etc.)
7	ERR	1 is returned when an error occurs in processing after a command is received.

In 32-byte mode, bits 6 to 4 of byte 16 of the response indicate the subcommand status.

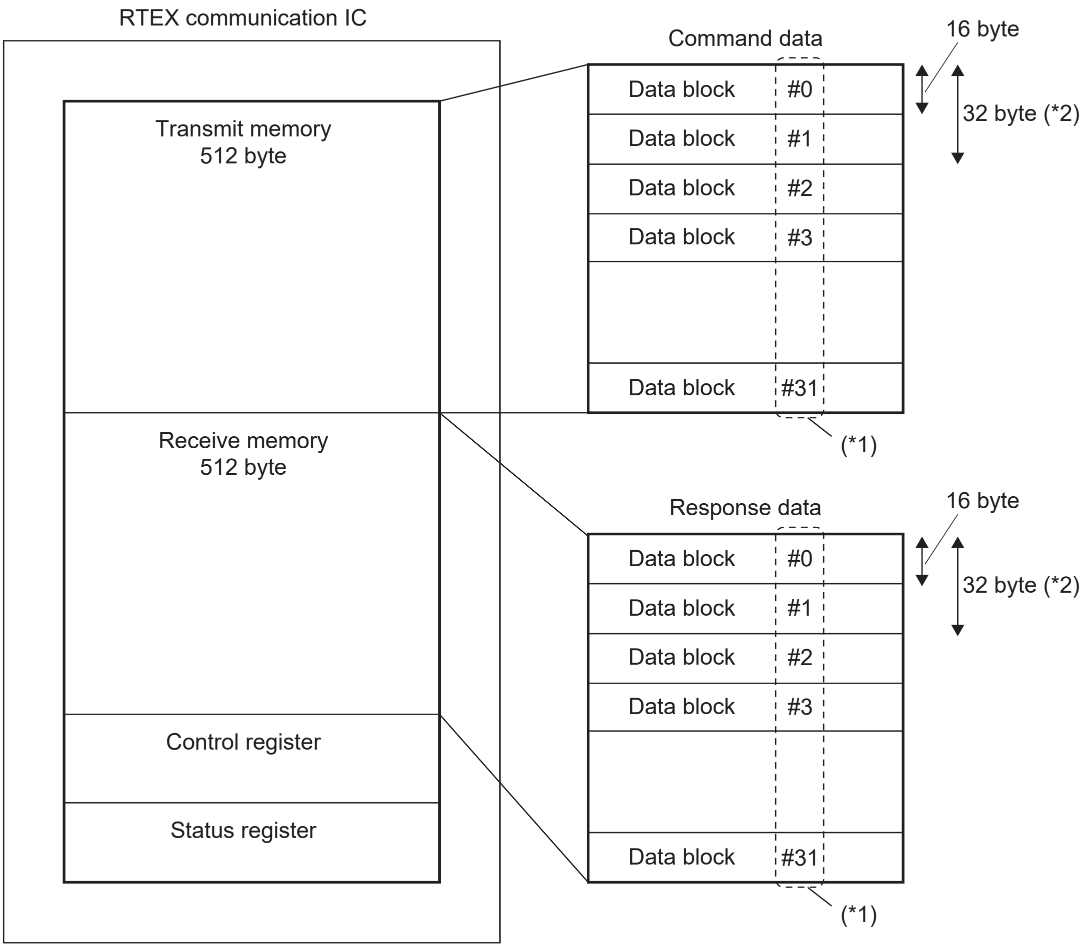
bit	Name	Description
4	Sub_Busy	During command processing, 1 is returned.
5	Sub_WNG	When a process has been executed, but some problem has occurred, 1 is returned.
6	Sub_ERR	1 is returned when an error occurs in processing after a command is received.

4.2.4 RTEX Communication Data Block

Transmit memory, receive memory, a control register, and a status register are assigned inside the RTEX communication IC internal memory mounted in this product.

In addition, one or two data blocks each are assigned to transmit memory and receive memory (16 or 32 bytes per slave axis).

Memory Allocation Inside the RTEX Communication IC



*1 Data block numbers “#0” to “#31” in the diagram indicate the slave connection order.
Note that this is not the node address (MAC-ID).

*2 Slaves with 32-byte mode settings use two consecutive 16-byte data blocks.
For this reason, half the number of connected slaves (axes) as in 16-byte mode are used.
Whereas 32 axes can be connected in 16-byte mode, 16 axes can be connected in 32-byte mode.

4.2.4.1 Command Data Block Configuration (same for 16-byte and 32-byte modes)

4.2.4.1.1 Block Configuration

Commands are sent from the master (host device) to slaves (servo drivers).

The configuration from byte 4 to byte 15 is specified by the Command_Code in byte 1.

A little endian (lower byte first) arrangement is used for multiple bytes of data. Set unused bits to 0.

Among commands in byte 2 to byte 15, only byte 2, bit 7 (Servo On) and torque feedforward commands sent using byte 12 to byte 15 are received during the retracting operation. Please see Technical Reference Communication Specification for a detailed description of TFF.

<table>
<tr><th>byte</th><th>bit 7</th><th>bit 6</th><th>bit 5</th><th>bit 4</th><th>bit 3</th><th>bit 2</th><th>bit 1</th><th>bit 0</th></tr>
<tr><td>0</td><td>C/R (0)</td><td colspan="2">Update_Counter</td><td colspan="5">MAC-ID (0 to 31)</td></tr>
<tr><td>1</td><td>TMG_CNT</td><td colspan="7">Command_Code</td></tr>
<tr><td>2</td><td>Servo_On</td><td>V_Full/
Sen-
sor_FB_Ctrl</td><td>0</td><td>Gain_SW</td><td>TL_SW</td><td>Homing_Ctrl</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>Hard_Stop</td><td>Smooth_Stop</td><td>Pause</td><td>0</td><td>SL_SW</td><td>0</td><td>EX-OUT2</td><td>EX-OUT1</td></tr>
<tr><td>4</td><td colspan="7" rowspan="4">Command_Data1</td><td>L</td></tr>
<tr><td>5</td><td>ML</td></tr>
<tr><td>6</td><td>MH</td></tr>
<tr><td>7</td><td>H</td></tr>
<tr><td>8</td><td colspan="7" rowspan="4">Command_Data2</td><td>L</td></tr>
<tr><td>9</td><td>ML</td></tr>
<tr><td>10</td><td>MH</td></tr>
<tr><td>11</td><td>H</td></tr>
<tr><td>12</td><td colspan="7" rowspan="4">Command_Data3</td><td>L</td></tr>
<tr><td>13</td><td>ML</td></tr>
<tr><td>14</td><td>MH</td></tr>
<tr><td>15</td><td>H</td></tr>
</table>

4.2.4.1.2 Command Header and Update_Counter (command byte 0)

C/R, Update_Counter, and MAC-ID are assigned to byte 0 (command header).

Name	Description
C/R	● Commands are distinguished from responses. ● Commands are set to 0. ● Any value other than 0 will cause Err86.0.0 “RTEX cyclic data error protection 1” to occur.
Update_Counter	● Sets the count-up value for the command updating cycle. ● Used to detect the command update timing on the servo driver side. ● The servo driver echoes back the Update_Counter data in the response, enabling use as a watchdog timer to check that the servo driver is operating normally.
MAC-ID	● Sets the servo driver node address. ● Err86.0.0 “RTEX cyclic data error protection 1” is triggered if a node address different from the rotary switch setup value is set.

■ **Update_Counter Setting**

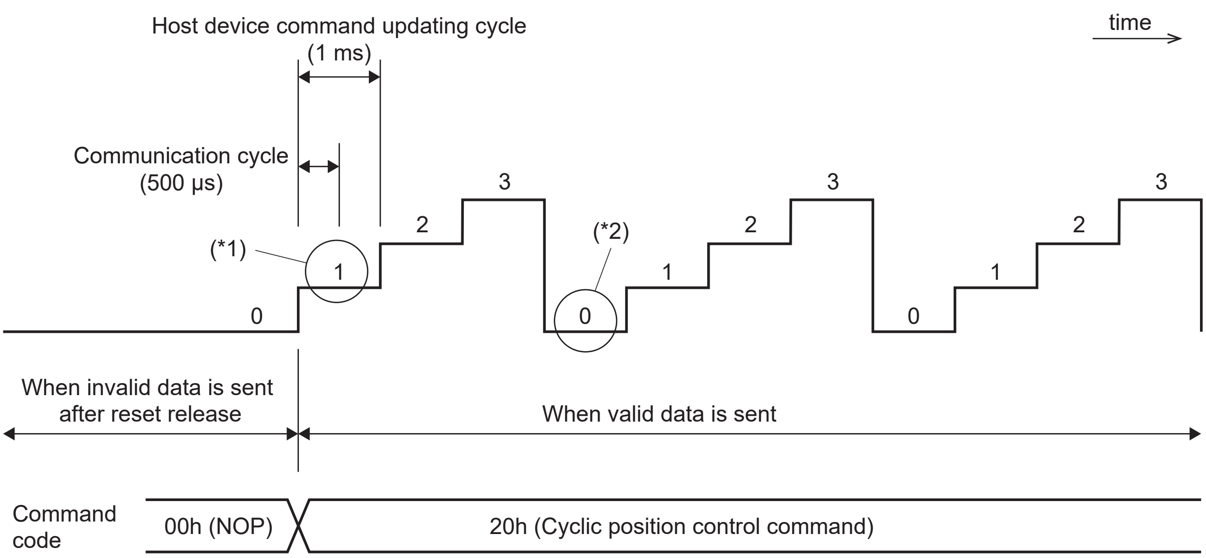
Have the Update_Counter count up at the data update timing of the host device and in the command updating cycle. If count-up is not performed at the data update timing of the host device and in the command updating cycle, servo driver operation commands may be obtained in error.

If the communication cycle is 250 μs or less, set the Update_Counter to the same value for all axes and update in the command updating cycle.

The Update_Counter is used to transmit the command update timing to the servo driver, regardless of whether or not there is an update.

For this reason, count-up is required even if there are no changes in the command data block content.

Update_Counter Setting Example (with command updating cycle of 1 ms)



*1 Set the counter value to 1 when sending the first valid data.

*2 If the counter overflows, count up again after the counter is reset to 0.

4.2.4.1.3 Command_Code, TMG_CNT and Interaxis Synchronous Mode (Command byte 1)

TMG_CNT and Command_Code are assigned to byte 1.

Name	Description
Command_Code	● The command code is set. ● Command codes are broadly classified into the following two types. • Cyclic command code Command codes for real-time data transmission such as command positions • Non-cyclic command code Command codes for event-driven data transmission such as parameter settings ● "Cyclic command codes" are assigned to bits 6 to 4 of command byte 1. This command specifies the data in bytes 4 to 7 (Command_Data 1). ● "Non-cyclic command codes" are assigned to bits 3 to 0 of command byte 1. This command code specifies data in bytes 8 to 15 (Command_Data 2, Command_Data 3). ● If a cyclic command that is not currently supported, Err86.1.0 "RTEX cyclic data error protection 2" is triggered. (For details, see *"Byte 1 Details"* below.)
TMG_CNT	● Used in interaxis full-synchronous mode. (For details, see *"TMG_CNT setting and interaxis synchronous mode"* below.)

■ Byte 1 Details

byte	bit 7 (*1)	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
1	TMG_CNT, CMD_Error	Cyclic command code (*2) (Data from bytes 4 to 7 are specified)			Non-cyclic command code (*3) (Data from bytes 8 to 15 are specified)			

*1 TMG_CNT, CMD_Error

bit 7	Purpose	
	Commands: TMG_CNT	Responses: CMD_Error
0	See *"TMG_CNT setting and interaxis synchronous mode"*	Command normal
1		Command error

*2 Cyclic command

bits 6 to 4	Purpose
0	NOP
1	Profile position control mode (PP)
2	Cyclic position control mode (CP)
3	Cyclic velocity control mode (CV)
4	Cyclic torque control mode (CT)
5 to 7	Reserved

*3 Non-cyclic command

bits 3 to 0	Purpose
0	Normal command
1	Reset command
2	System ID command
3	Reserved
4	Homing command
5	Alarm command
6	Parameter command
7	Profile command
8 to 9	Reserved

bits 3 to 0	Purpose
10	Monitor command
11 to 15	Reserved

Only transmit NOP for the cyclic command code (bits 6 to 4) during invalid data transmission after reset release. After sending invalid data, send the control mode (PP, CP, CV, CT) to be used instead of NOP.

For the details of each command, see Technical Reference Communication Specification.

■ TMG_CNT setting and interaxis synchronous mode

Pr7.22 “RTEX function expansion setup 1” settings for TMG_CNT are used to switch between interaxis full-synchronous mode and interaxis semi-synchronous mode.

When Pr7.22 “RTEX function expansion setup 1” :bit 1 = 1, all of the servo driver internal control cycles are synchronized with the TMG_CNT timing.

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	22	R	RTEX function expansion setup 1	-32768 to 32767	—	● bit 0 Sets the data size for RTEX communication. 0: 16-byte mode 1: 32-byte mode ● bit 1 Sets the synchronous mode between multiple axes for which TMG_CNT is used. If TMG_CNT is not used, set to 0. 0: Interaxis semi-synchronous mode (partially asynchronous) 1: Interaxis full-synchronous mode (completely synchronous) ● bit 4 External scale position information monitoring function setting for semi-closed control 0: Disabled 1: Enabled **Notes** ● External scale position information can be monitored during full-closed control, regardless of the setting of this bit.

- Semi-synchronous mode between axes (Pr7.22 “RTEX function expansion setup 1” :bit 1 = 0)

  This mode is used for synchronizing the reception timing of operation commands such as position commands between multiple axes without using TMG_CNT.

  Some functions other than operation commands (sequence at servo-off and sequence at alarm) are not synchronized between axes.

- Full-synchronous mode between axes (Pr7.22 “RTEX function expansion setup 1” :bit 1 = 1)

  This is a mode that is used when all internal operation process activation timings are synchronized between multiple axes. All of the servo driver interior control cycles, including functions other than operational commands (such as sequence at servo-off), are synchronized with the TMG_CNT timing.

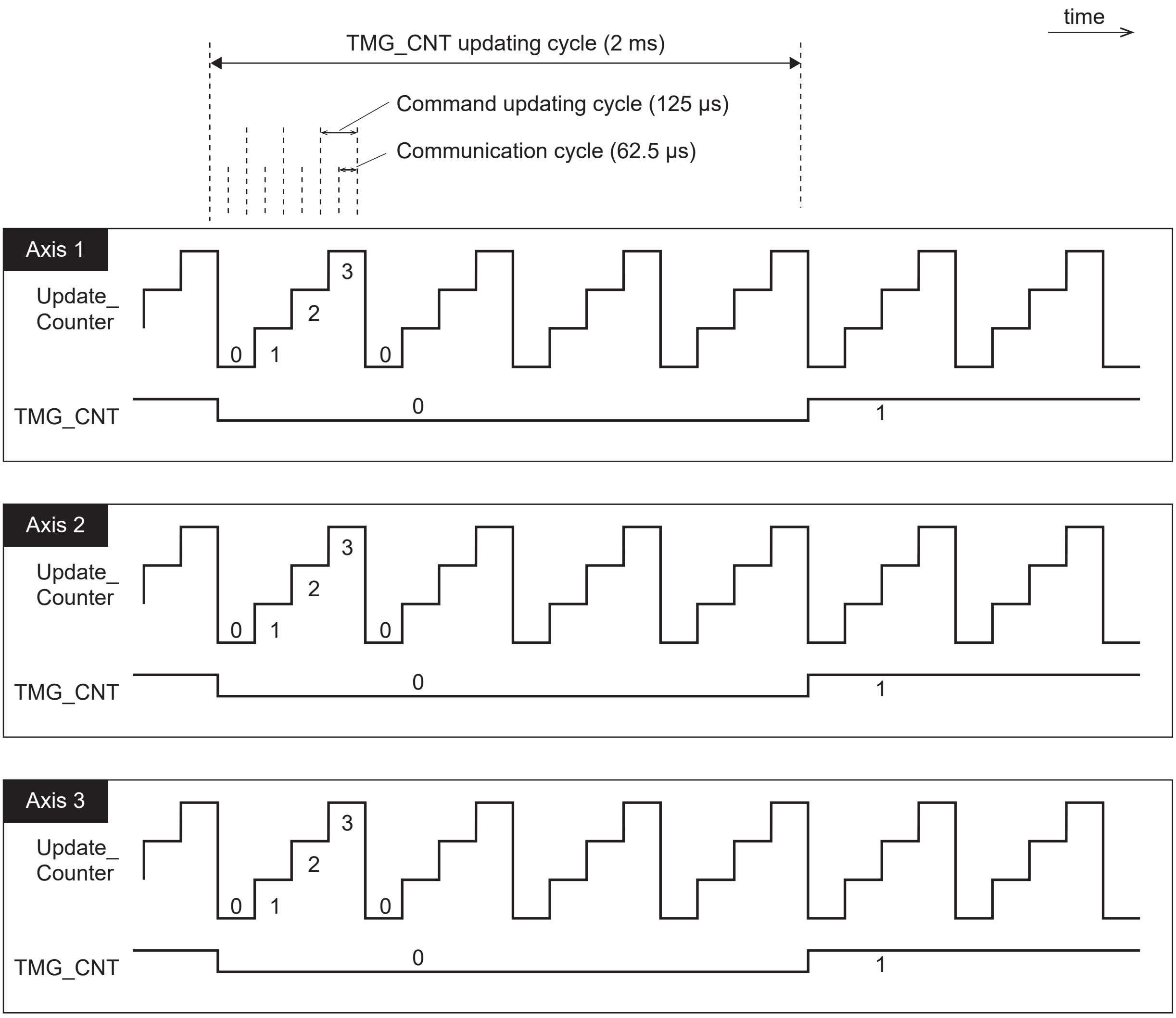
  Set TMG_CNT to the same value for all axes, and update in a 2-ms cycle.

  If TMG_CNT is not normally updated, communication is not normally established (the COM-G LED does not light up green), or synchronization is lost between axes.

Note that the time until communication establishment is completed (when the COM-G LED lights up green) varies among axes.

Note that even after synchronization is completed, interaxis synchronization is not established if a communication error occurs when operations start (especially when starting PP control mode).

3-axis synchronization example (with a communication cycle of 62.5 μs and a command updating cycle of 125 μs)



4.2.4.1.4 Control Bits (command bytes 2 and 3)

Bytes 2 and 3 are allocated to the below control bits.

Name	Description
Servo_On	● The servo-on/off command is set. 0: Servo-off 1: Servo-on ● When external servo-on input (EX-SON) is assigned to the interface connector (X4), a servo-on command is issued under an AND condition (logical AND), along with the external servo-on input. For details, see *"4.2.4.1.4.1 Servo-on/off Command (Servo_On)"* . ● Retain the servo-on command during the retracting operation (RET_Status = 1). If it is not retained, Err85.2.0 "Retracting operation error" and Err87.3.☐ "Retracting operation error" are triggered.
V_Full/Sensor_FB_Ctrl	● Set V_Full when Pr0.22 "Sensor feedback control mode setup" = 0. Set Sensor_FB_Ctrl when Pr0.22 "Sensor feedback control mode setup" = 1. ● For V_Full, a command to switch to virtual full-closed control mode is set. 0: Full-closed control mode 1: Virtual full-closed control mode ● For Sensor_FB_Ctrl, enable or disable displacement control using the sensor feedback function. 0: Displacement control disabled 1: Displacement control enabled For details, see *"8.7.1 Displacement Control Function"* .
Gain_SW	● A gain switching command is set. 0: First gain selection 1: Second gain selection ● This signal is enabled when real-time auto tuning is disabled, second gain is enabled, and gain switching by RTEX communication is enabled. For details, see *"4.2.4.1.4.2 Gain Switching Command (Gain_SW)"* .
TL_SW	● A torque limit switching command is set. ● This signal is enabled when the Pr5.21 "Selection of torque limit" value is 3 or 4. For details, see *"4.2.4.1.4.3 Torque Limit Switching Command (TL_SW)"* .
Homing_Ctrl	● Sets a homing operation control command. ● When this bit is 1, the home trigger signal (Z-phase, etc.) is detected. ● This signal is disabled by commands other than homing commands. For details, see *"5.5.1 Overview of Homing"* .
Hard_Stop	● When in profile position control (PP) mode, internal command generation processing is brought to an emergency stop, and profile operations are ended. ● Do not use this other than in profile position control (PP) mode. For details, see Technical Reference Communication Specification .
Smooth_Stop	● When in profile position control (PP) mode, profile operations are decelerated to stop at the set deceleration rate, and ended. ● Do not use this other than in profile position control (PP) mode. For details, see Technical Reference Communication Specification .
Pause	● When in profile position control (PP) mode, profile operations are decelerated to stop at the set deceleration rate, and remain at temporary stop. ● Do not use this other than in profile position control (PP) mode. For details, see Technical Reference Communication Specification .
SL_SW	● The velocity limit switching command for torque control is set. ● This signal is enabled when Pr3.17 "Selection of speed limit" is 1. For details, see *"4.2.4.1.4.4 Velocity Limit Switching Command (SL_SW)"* .

Name	Description
EX-OUT2 EX-OUT1	● An external output signal RTEX operational output (EX-OUT1 and EX-OUT2) operation is performed. ● This signal is enabled when RTEX operational output (EX-OUT1 and EX-OUT2) is assigned to an interface connector (X4). ● This signal will not affect servo control. For details, see *“4.2.4.1.4.5 Output Signal Control Command (EX-OUT1 and EX-OUT2)”* .

4.2.4.1.4.1 Servo-on/off Command (Servo_On)

Servo-on/off command (servo_on) is used when a motor is turned on (servo-on) and when the power is turned off (servo-off). When external servo-on input (EX-SON) is assigned to the interface connector (X4), a servo-on command is issued under an AND condition (logical AND), along with the external servo-on input.

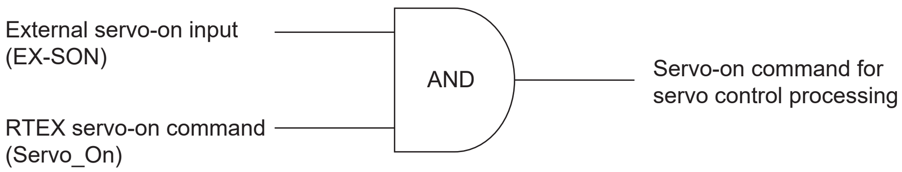
When executing the “trial run function,” “frequency characteristics analysis function (FFT function),” “Z-phase search function,” or “One Minute TUNING function” with Set-up Support Software (PANATERM ver.7) , the servo-on command is forcibly input by Set-up Support Software (PANATERM ver.7) .

■ In RTEX communication: When external servo-on input (EX-SON) is assigned

When external servo-on input (EX-SON) is assigned, the servo-on command for servo control processing is ON if both this bit and the external servo-on input (EX-SON) are in servo-on status.

Only this bit is enabled when external servo-on input (EX-SON) is not assigned.

Although terminal functions can be freely assigned to terminals in each of the control modes, they should basically be assigned to the same terminal in all control modes. Note that if different terminal functions are assigned to the same terminal, the enabled and disabled states of the terminal functions are switched when switching between control modes.



Servo-on is not enabled when an alarm is issued, when the main power supply is off (i.e., not in servo ready status), or when the motor is rotating (at 30 r/min or faster).

Check bit 6 of byte 2 (Servo_Ready) of the response to see whether or not the status is “servo ready”.

The servo driver internal command position follows the actual position of the motor during servo-off (during position deviation clearing) so that position deviation is 0. Accordingly, reset the coordinate system of the host device in servo-off status, and send the servo-on command after setting the actual position value to the command position when implementing cyclic position control (CP) after servo-on transitioning (For details, see Technical Reference Communication Specification .).

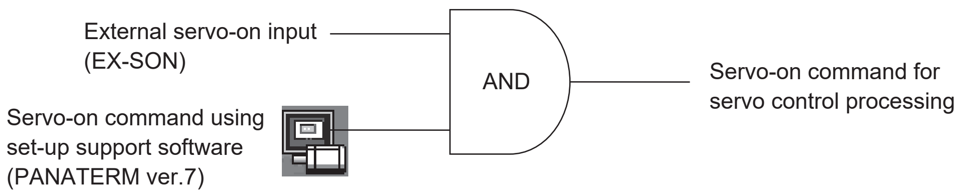
Profile processing is canceled when at servo-off during a profile position control operation (In_Progress = 1). During servo-off, servo internal processing is under position control, even if cyclic command is CV or CT.

■ Using Set-up Support Software (PANATERM ver.7) : When external servo-on input (EX-SON) is assigned

When executing the “trial run function”, “frequency characteristics analysis function (FFT function)”, “Z-phase search function”, or “One Minute TUNING function” with Set-up Support Software (PANATERM ver.7) , rather than a servo-on command using this bit, the servo-on command is forcibly input by Set-up Support Software (PANATERM ver.7) .

Even in this case, external servo-on input (EX-SON) is enabled if external servo-on input (EX-SON) is assigned.

Only the servo-ON command by Set-up Support Software (PANATERM ver.7) is enabled when external servo-on input (EX-SON) is not assigned.



The monitor value in the servo-on input status on Set-up Support Software (PANATERM ver.7) shows "Servo-on command for servo control processing."

When the "trial run function", "frequency characteristics analysis function (FFT function)", "Z-phase search function", "One Minute TUNING function", or "Config" is executed, RTEX communication must be turned off in advance, or Pr7.99 "RTEX function expansion setup 6" :bit 0 must be set to 1.

Operations such as the "trial run function" are enabled when the RTEX servo-on command is at servo-off, even in RTEX communication-established status, by setting Pr7.99 "RTEX function expansion setup 6" bits 0 to 1.

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	99	B	RTEX function expansion setup 6	-32768 to 32767	—	bit 0: Enable/disable FFT execution while RTEX communication is established 0: Disabled 1: Enabled

When in servo-on status under Set-up Support Software (PANATERM ver.7) command, the Servo-Active of the RTEX response returns 0 (servo-off). For details on Servo-Active, see *"4.2.4.2.3 Status Flag (Response Byte 2)"* .

The "trial run function", "frequency characteristics analysis function (FFT function)", "Z-phase search function", and "One Minute TUNING function" involve motor operation. Always ensure the safety of the surrounding area when the power is to be suddenly turned off, etc.

4.2.4.1.4.2 Gain Switching Command (Gain_SW)

Gain_SW is used for gain switching or speed loop P and PI control switching. Set whether Gain_SW is used for gain switching or for speed loop P or PI control switching with Pr1.14 "2nd gain setup" .

Related Parameters

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
1	14	B	2nd gain setup	0 to 1	—	Set when performing optimum tuning using the gain switching function. ● 0: Fixes 1st gain, and switches the speed loop operation between PI operation and P operation using the RTEX communication control bit Gain_SW. Gain_SW = 0: PI operation Gain_SW = 1: P operation ● 1: Enables gain switching between 1st gain (Pr1.00 to Pr1.04) and 2nd gain (Pr1.05 to Pr1.09).

■ If Using Gain_SW for Gain Switching

When all the conditions in the table below are met, Gain_SW is used for gain switching.

Set parameter		Setup value	Description
Pr0.02	Real-time auto-gain tuning setup	0	Real-time auto tuning disabled
Pr1.14	2nd gain setup	1	First and second gain switching enabled P and PI control switching disabled
Pr1.15 (*1)	Mode of position control switching	2	Gain switching by RTEX communication (Gain_SW)
Pr1.20 (*1)	Mode of velocity control switching	2	Gain switching by RTEX communication (Gain_SW)
Pr1.24 (*1)	Mode of torque control switching	2	Gain switching by RTEX communication (Gain_SW)

*1 Enable gain switching with RTEX communication (Gain_SW) in the control mode during operation.

The settings for Gain_SW when Pr1.14 “2nd gain setup” = 1 (enabled) are as below.

0: First gain selection

1: Second gain selection

■ If using Gain_SW for speed loop and P and PI control switching

When all the conditions in the table below are met, Gain_SW is used for speed loop and P and PI control switching.

Set parameter		Setup value	Description
Pr0.02	Real-time auto-gain tuning setup	0	Real-time auto tuning disabled
Pr1.14	2nd gain setup	0	First and second gain switching disabled P and PI control switching enabled

The settings for Gain_SW when Pr1.14 “2nd gain setup” = 0 (disabled) are as below.

0: PI control (speed loop integral valid)

1: P control (speed loop integral cleared)

4.2.4.1.4.3 Torque Limit Switching Command (TL_SW)

Use TL_SW for torque limit switching when the setup value of Pr5.21 “Selection of torque limit” is 3 or 4.

However, the switching function is disabled during torque control, and Pr0.13 “1st torque limit” is fixed.

<table>
<tr><th>Class</th><th>No.</th><th>Attribute</th><th>Parameter name</th><th>Setting range</th><th>Unit</th><th>Function</th></tr>
<tr><td>5</td><td>21</td><td>B</td><td>Selection of torque limit</td><td>0 to 4</td><td>—</td><td>Sets the torque limit selection method.
If set to 0, 1 is set internally.
<table>
<tr><td rowspan="2">Setup value</td><td colspan="2">TL_SW = 0</td><td colspan="2">TL_SW = 1</td></tr>
<tr><td>Negative direction</td><td>Positive direction</td><td>Negative direction</td><td>Positive direction</td></tr>
<tr><td>1</td><td colspan="4">Pr0.13</td></tr>
<tr><td>2</td><td>Pr5.22</td><td>Pr0.13</td><td>Pr5.22</td><td>Pr0.13</td></tr>
<tr><td>3</td><td colspan="2">Pr0.13</td><td colspan="2">Pr5.22</td></tr>
<tr><td>4</td><td>Pr5.22</td><td>Pr0.13</td><td>Pr5.26</td><td>Pr5.25</td></tr>
</table>
Pr0.13 “1st torque limit”
Pr5.22 “2nd torque limit”
Pr5.25 “Positive direction torque limit”
Pr5.26 “Negative direction torque limit”</td></tr>
</table>

4.2.4.1.4.4 Velocity Limit Switching Command (SL_SW)

Use SL_SW for velocity limit value switching during torque control when the setup value of Pr3.17 “Selection of speed limit” is 1.

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
3	17	B	Selection of speed limit	0 to 1	—	Sets the velocity limit value selection method during torque control. ● Setup value 0 SL_SW = 0: Pr3.21 SL_SW = 1: Pr3.21 ● Setup value 1 SL_SW = 0: Pr3.21 SL_SW = 1: Pr3.22
3	21	B	Velocity limit value 1	0 to 20000	r/min	Sets the velocity limit value during torque control. During torque control, the speed set by the velocity limit value cannot be exceeded. Furthermore, the internal value is limited by Pr5.13 “Overspeed level setup” , Pr6.15 “2nd overspeed level setting” , and the smallest velocity set for the internal value of overspeed protection level.
3	22	B	Velocity limit value 2	0 to 20000	r/min	Sets the velocity limit value when Pr3.17 “Selection of speed limit” is set to 1, and SL_SW is 1. Furthermore, the internal value is limited by Pr5.13 “Overspeed level setup” , Pr6.15 “2nd overspeed level setting” , and the smallest velocity set for the internal value of overspeed protection level.

4.2.4.1.4.5 Output Signal Control Command (EX-OUT1 and EX-OUT2)

The output signal operation can be performed when RTEX operation output 1 or RTEX operation output 2 is assigned to external output signal SO1 or SO2 of the interface connector (X4).

EX-OUT1 and EX-OUT2 output statuses are set by Pr7.24 “RTEX function expansion setup 3” .

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	24	C	RTEX function expansion setup 3	-32768 to 32767	—	● bit 0: EX-OUT1 output status setting at the time of communication interrupted after RTEX communication is established 0: Retained 1: Initialized (output when EX-OUT1 = 0) ● bit 1: EX-OUT2 output status setting at the time of communication interrupted after RTEX communication is established 0: Retained 1: Initialized (output when EX-OUT2 = 0)

When RTEX communication is established, when RTEX communication is not established after reset, and when RTEX is turned off after communication is established, the RTEX operation output 1 and output 2 output transistor statuses are as shown below.

Signal name	Symbol	Pr7.24 “RTEX function expansion setup 3”	RTEX control bits	Output transistor state		
				Communication established	When reset	When communication is interrupted
RTEXOperation output 1	EX-OUT1	bit 0 = 0 (Retained)	EX-OUT1 = 0	OFF	OFF	Retained
			EX-OUT1 = 1	ON		
		bit 0 = 1 (Initialized)	EX-OUT1 = 0	OFF	OFF	OFF
			EX-OUT1 = 1	ON		
RTEXOperation output 2	EX-OUT2	bit 1 = 0 (Retained)	EX-OUT2 = 0	OFF	OFF	Retained
			EX-OUT2 = 1	ON		
		bit 1 = 1 (Initialized)	EX-OUT2 = 0	OFF	OFF	OFF
			EX-OUT2 = 1	ON		

When RTEX communication is not established after reset, and when RTEX is turned off after communication is established, implement settings such that there are no system safety problems, keeping in mind that control by control bits from RTEX communication is disabled.

4.2.4.1.4.6 Virtual full-closed control mode switching command (V_Full)/Sensor feedback function setting (Sensor_FB_Ctrl)

Pr0.22 “Sensor feedback control mode setup” Select the function to be assigned to byte 2:bit 6 of the command data with the set value for Pr0.22 “Sensor feedback control mode setup”.

Pr0.22 “Sensor feedback control mode setup” When Pr0.22 “Sensor feedback control mode setup” = 0, the V_Full function is assigned, allowing switching between full-closed control mode and virtual full-closed control mode.

Pr0.22 “Sensor feedback control mode setup” When Pr0.22 “Sensor feedback control mode setup” = 1, the Sensor_FB_Ctrl function is assigned, allowing displacement control enabling/disabling switching by the sensor feedback function.

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
0	22	R	Sensor feedback control mode setup	0 to 1	—	Selects the sensor feedback control mode for this product. 0: Sensor feedback disabled 1: Sensor feedback enabled (position feedback)

4.2.4.1.5 Command_Data (Command Bytes 4 to 15)

Command_Data is assigned to bytes 4 to 15.

Name	Description
Command_Data1	• The command data specified by the cyclic command code is set. • For the details of each command, see Technical Reference Communication Specification.
Command_Data2	• The command data specified by the non-cyclic command code is set. • For the details of each command, see Technical Reference Communication Specification.
Command_Data3	• The command data specified by the non-cyclic command code is set. • For the details of each command, see Technical Reference Communication Specification.

4.2.4.2 Response Data Block Configuration (same for 16-byte and 32-byte modes)

4.2.4.2.1 Response Header (Response Byte 0)

C/R, Update_Counter_Echo, and Actual_MAC-ID are assigned to byte 0.

Name	Description
C/R	• Commands are distinguished from responses. • Returns 1 in a response.
Update_Counter_Echo	• The echo back value for the Update_Counter value is returned. • This is used for confirming whether or not receive processing is performed on the servo driver side.
Actual_MAC-ID	• The node address of the servo driver is returned. • Rather than an echo back, the actual servo driver setup value (the rotary switch setup value for power ON) is returned.

4.2.4.2.2 Command_Code_Echo (Response Byte 1)

CMD_Error and Command_Code_Echo are assigned to byte 1.

Name	Description
CMD_Error	• When a command error occurs, 1 is returned. The value is 1 if an error has occurred at the command receiving stage (before process execution).
Command_Code_Echo	• A command code echo back value is returned.

4.2.4.2.3 Status Flag (Response Byte 2)

Byte 2 is assigned to a status flag.

Name	Description
Servo_Active	● In servo-on status (with the motor turned on), 1 is returned. ● In servo-off status while decelerating through use of the dynamic brake, etc. ● When Pr7.24 “RTEX function expansion setup 3” :bit 4 = 1, the Servo_Active flag forcibly returns servo-off (turned off) status until shifting to command receivable status after servo-on. (*1) ● When in servo-on status as a result of a Set-up Support Software (PANATERM ver.7) command, 0 is returned.
Servo_Ready	● When in servo ready status (with transition to servo-on enabled), 1 is returned. ● When the conditions “main power supply established”, “alarm not generated”, and “synchronization of servo with communication established” have all been satisfied, 1 is set. For details, see *“4.2.4.2.3.1 Servo Ready Status (Servo_Ready)”* .
Alarm	● When an alarm is issued, 1 is returned.
Warning	● When a warning is issued, 1 is returned. ● Whether or not to latch the warning status is set using Pr6.27 “Warning latch state setup” . For details, see *“10.3 Warning Functions”* .
Torque_Limited	● Due to the torque limit, 1 is returned. ● When the internal command torque is restricted by parameters etc., 1 is returned. ● Output conditions for torque control can be set using Pr7.03 “Output setup during torque limit” . For details, see Technical Reference Functional Specification “5.1 Torque Limit Switching Function” .
Homing_Complete	● When homing is completed, 1 is returned (except in latch mode and latch mode with stop function), and after completion (and homing confirmation), 1 is retained. ● Regardless of whether in absolute mode (i.e., when an absolute encoder in an absolute sense, or when using an external scale in full-closed control mode in an absolute sense), the value is temporarily cleared to 0 when the homing command is received. ● After clearing to 0 upon performance of homing, the value continues at 0 when homing is canceled. ● If the power is reset due to homing failure while in absolute mode, the value starts at 1. ● The initial value is 1 in absolute mode, since home is defined on the basis of control power turn-on timing, and conversely is 0 in incremental mode. ● Position information is initialized, as after control power turn-on, even when executing a reset command (□1h), and the bit concerned is also initialized. ● When execution of “trial run function”, “frequency characteristics analysis function (FFT function)”, “absolute encoder multi-turn data clear”, “Z-phase search function”, “One Minute TUNING function” and “Config” by Set-up Support Software (PANATERM ver.7) is completed in incremental mode, as well as during homing command execution in absolute mode, position information is initialized similarly to after the control power is turned on, and the bit concerned is also initialized. ● In incremental mode, 0 is set after the retracting operation.

<table>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>In_Progress, AC_OFF, Pr7.112</td><td>
● When In_Progress is set and in profile position control (PP) mode, 1 is returned during internal command position generation.
Upon completion of internal command position generation (completion of transfer), 0 is returned.
● When AC_OFF is set, a main power off warning is issued, and 1 is returned.
● When Pr7.23 “RTEX function expansion setup 2” :bit 15 = 1 (as per Pr7.112 “Selection of RTEX communication status flag” setting) and when RET_Status is set by Pr7.112 “Selection of RTEX communication status flag” , 1 is returned during retracting operations and during assessment of Err85.2.0/Err87.3.☐ “Retracting operation error”
Retain Servo_On = 1 during the retracting operation. If it is not retained, Err85.2.0 “Retracting operation error” and Err87.3.☐ “Retracting operation error” are triggered.
For details on the read-out signal selection method, see “4.2.4.2.3.2 Internal position command generation status (In_Progress) and Main power off warning status (AC_OFF)” .
● When all of the statuses below are met, 1 is returned during virtual full-closed control mode.
• Pr7.23 “RTEX function expansion setup 2” :bit 15 = 1 (as per Pr7.112 “Selection of RTEX communication status flag” setting)
• Pr0.22 “Sensor feedback control mode setup” = 0
• V_Full_Status/Sensor_FB_Status set with Pr7.112 “Selection of RTEX communication status flag”
● When all of the statuses below are met, 1 is returned when displacement control is enabled with the sensor feedback function.
• Pr7.23 “RTEX function expansion setup 2” :bit 15 = 1 (as per Pr7.112 “Selection of RTEX communication status flag” setting)
• Pr0.22 “Sensor feedback control mode setup” = 1
• V_Full_Status/Sensor_FB_Status set with Pr7.112 “Selection of RTEX communication status flag”
● When Pr7.23 “RTEX function expansion setup 2” :bit 15 = 1 (as per Pr7.112 “Selection of RTEX communication status flag” setting) and when CMP_OUT_Status in set by Pr7.112 “Selection of RTEX communication status flag” , 1 is returned when the position comparison output function is enabled.
</td></tr>
<tr><td>In_Position</td><td>
● As shown below, there are different flag functions in each control mode.
<table>
<tr><th>Function</th><th>Control mode</th><th>Description</th></tr>
<tr><td>Positioning complete</td><td>Position control (CP and PP)</td><td>
● When positioning is completed, 1 is returned.
● Output conditions are set by Pr4.31 “Positioning complete (In-position) range” , Pr4.32 “Positioning complete (In-position) output setup” , and Pr4.33 “INP hold time” .
For details, see “7.3.4 Positioning Complete Output (INP/INP2) Function” .
● When operating in virtual full-closed control mode, and in virtual full-closed control mode with the external scale displacement assessment function enabled (Pr6.98 “Function expansion setup 4” :bit 9 = 1), 1 is returned if the external scale position variation exceeds the setup value of Pr3.32 “Threshold value of external scale position variation in virtual full-closed control mode” .
For details, see “8.8 Virtual Full-closed Control Mode Function” .
</td></tr>
<tr><td rowspan="2">Velocity matching</td><td>Velocity control (CV)</td><td>
● When the actual motor speed matches the command speed, 1 is returned.
● As with velocity matching output (V-COIN), which is an external output signal, the output conditions are set using Pr4.35 “Speed coincidence range” .
For details, see “7.4.5 Velocity Coincidence Output (V-COIN)” .
</td></tr>
<tr><td>Torque control (CT)</td><td>
● When the actual motor velocity matches the velocity limit, 1 is returned.
● Output conditions are set by Pr4.35 “Speed coincidence range” .
For details, see “7.4.5 Velocity Coincidence Output (V-COIN)” .
</td></tr>
</table>
</td></tr>
</table>

*1 The Pr7.24 “RTEX function expansion setup 3” :bit 4 “Servo_Active ON timing switching” settings are shown in the table below.

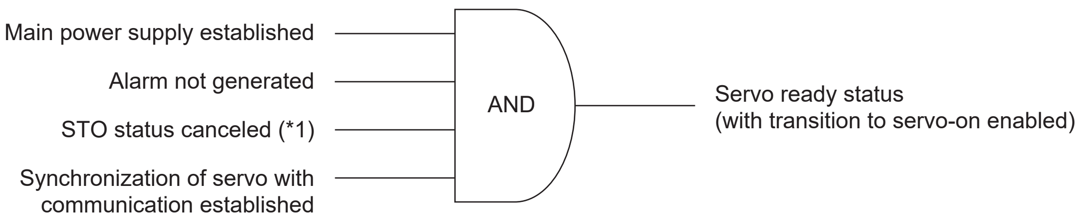
—: N/A

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	24	C	RTEX function expansion setup 3	-32768 to 32767	—	bit 4: Servo_Active ON timing switching 0: Conventional compatibility 1: Turns on when the servo is turned on and ready to accept commands

4.2.4.2.3.1 Servo Ready Status (Servo_Ready)

When in servo ready status (with transition to servo-on enabled), 1 is returned.

The servo ready status is established when all the following conditions have been satisfied: “main power supply established”, “alarm not generated”, “synchronization of servo with communication established” and “STO status canceled.”



*1 The STO function is not supported with the standard type.

Servo ready status will not be established in the following cases.

- When the ratio of the communication cycle to the command updating cycle is other than 1:1 in interaxis semi-synchronous mode (Pr7.22 “RTEX function expansion setup 1” :bit 1 = 0)
- TMG_CNT is not counted up normally in interaxis full-synchronous mode (Pr7.22 “RTEX function expansion setup 1” :bit 1 = 1)

As exceptional processing, servo ready status values are indeterminate during reset command attribute C parameter validation mode processing.

4.2.4.2.3.2 Internal position command generation status (In_Progress) and Main power off warning status (AC_OFF)

In_Progress and AC_OFF are set by Pr7.23 “RTEX function expansion setup 2” :bit 8.

Setting to Pr7.23 “RTEX function expansion setup 2” :bit 8 = 1 (AC_OFF) allows the signal to be assigned to bit 1 of the status flag.

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 8: RTEX status selection of In_Progress/AC_OFF 0: In_Progress 1: AC_OFF *Linked to the bit 15 setting. bit 15: In_Progress/AC_OFF/Pr7.112 value RTEX status selection expansion 0: As per Pr7.23: bit 8 setting (In_Progress or AC_OFF). 1: As per Pr7.112 setting
7	112	B	Selection of RTEX communication status flag	0 to 2	—	Selects the signal returned by the RTEX response status flag (byte 2:bit 1) when Pr7.23:bit 15 = 1. ● 0: Returns RET_Status (status when running retracting operation). ● 1: Returns V_Full_Status/Sensor_FB_Status (virtual full-closed control mode status/sensor feedback function status). ● 2: Returns CMP_OUT_Status (Position comparison output function enabled). 0: Disabled 1: Enabled

4.2.4.2.4 Input Signal Status Flag (Response Byte 3)

Byte 3 is a status area for the external input signal from the interface connector (X4).

With this product, external input signals are input to eight connection terminals, and terminal functions and logic can be assigned to these terminals individually. For details, see Technical Reference Functional Specification “3.1.2 Input Signal Assignment” .

If no terminal function assignment is made, the value of the corresponding bit in this status is 0.

The terminal functions can be freely assigned to terminals in each of the control modes; however, they should basically be assigned to the same terminal in all control modes. Note that if different terminal functions are assigned to the same terminal, the enabled and disabled states of the terminal functions are switched when switching between control modes.

For the following response data, it is not possible for parameters to overlap because the same bit arrangement is used for each.

Err33.0.0 “Input overlapping assignment error 1 protection” or Err33.1.0 “Input overlapping assignment error 2 protection” are generated when parameters overlap.

- SI-MON1, EXT1
- SI-MON2, EXT2, RET
- SI-MON3, EXT3, STOP
- SI-MON4, EX-SON
- SI-MON5, E-STOP

In this status, a logical status (1 on the function active side) is returned instead of a physical status (input transistor ON or OFF status). However, logical status settings for over-travel inhibit input (POT and NOT) are enabled.

EXT1, EXT2, and EXT3 indicate the input signal status, not the latch completion status.

For over-travel inhibit inputs (POT, NOT), the following settings can be configured for status response conditions, status bit arrangement, and status logic with Pr7.23 “RTEX function expansion setup 2” when the function is disabled (Pr5.04 = 1).

Since CCWL and CWL, as they were in the MINAS A4N series, have changed to POT and NOT in the MINAS A7N series, these parameters and Pr0.00 “Rotational direction setup” must be set appropriately for the sake of compatibility with the MINAS A4N series. For details, see *“7.2.1 Rotational Direction Setting”* .

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 2: RTEX status response condition setting with POT and NOT functions disabled RTEX status response condition setup with over-travel inhibit input (POT, NOT) input operation setting disabled (Pr5.04 = 1). 0: Enabled in RTEX status (responds) 1: Also disabled in RTEX status (does not respond) bit 3: POT and NOT RTEX status bit arrangement settings 0: POT is bit 1, NOT is bit 0 1: NOT is bit 1, POT is bit 0 bit 6: POT and NOT RTEX status logical settings 0: No inversion (1 when active) 1: Inversion (0 when active) bit 9: Command error return switching for commands received in the direction of over-travel inhibit input after over-travel inhibit deceleration to stop Select whether command errors are returned when a command is received in the direction of over-travel inhibit input after deceleration to stop due to over-travel inhibit input. 0: No command error response 1: Command error response

A noise filtering process which delays detection is performed when an input signal is introduced inside the servo driver.

The combined total of this detection delay and transmission delays due to communication amounts to a total delay of a few milliseconds.

If this delay time is problematic, adopt a configuration in which the sensor signal is directly connected to the host device.

4.2.4.2.5 Response_Data (Response Bytes 4 to 15)

Response_Data is assigned to bytes 4 to 15.

Name	Description
Response_Data1	● Monitor data specified by Pr7.29 “RTEX monitor select 1” is returned. For Pr7.29 “RTEX monitor select 1” , specify the motor data by setting the standard Type_Code (8 bit size) of the monitor command in the lower 8 bits and the Index (8 bit size) in the upper 8 bits. For details on the standard Type_Code, see Technical Reference Communication Specification . Exceptionally, if Pr7.29 “RTEX monitor select 1” = 0, it becomes MINAS A4N compatible and returns the actual position (Type_Code = 07h). ● Arrangement is little endian (lower byte first).

Name	Description
Response_Data2	● The response data specified by the non-cyclic command code is returned. ● Monitor data specified using Pr7.30 “RTEX monitor select 2” is returned when the non-cyclic command code is 0h (a normal command). For Pr7.30 “RTEX monitor select 2” , specify the motor data by setting the standard Type_Code (8 bit size) of the monitor command in the lower 8 bits and the Index (8 bit size) in the upper 8 bits. For details on the standard Type_Code, see Technical Reference Communication Specification . Exceptionally, if Pr7.30 “RTEX monitor select 2” = 0, it becomes MINAS A4N compatible and returns the actual velocity (Type_Code = 05h). ● Arrangement is little endian (lower byte first).
Response_Data3	● The response data specified by the non-cyclic command code is returned. ● Monitor data specified using Pr7.31 “RTEX monitor select 3” is returned when the non-cyclic command code is 0h (a normal command). For Pr7.31 “RTEX monitor select 3” , specify the motor data by setting the standard Type_Code (8 bit size) of the monitor command in the lower 8 bits and the Index (8 bit size) in the upper 8 bits. For details on the standard Type_Code, see Technical Reference Communication Specification . Exceptionally, if Pr7.31 “RTEX monitor select 3” = 0, it becomes MINAS A4N compatible and returns the torque (Type_Code = 06h). ● Arrangement is little endian (lower byte first).

Related Parameters

—: N/A

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	29	A	RTEX monitor select 1	0 to 32767	—	Selects the type of monitor for Response_Data1. Set the Type Code (8 bits) of the RTEX monitor command in the lower 8 bits and the Index (8 bits) of the RTEX monitor command in the upper 8 bits. When the setup value is 0, the actual position (APOS) is monitored.
7	30	A	RTEX monitor select 2	0 to 32767	—	Selects the type of monitor for Response_Data2 when the non-cyclic command = 0h. Set the Type Code (8 bits) of the RTEX monitor command in the lower 8 bits and the Index (8 bits) of the RTEX monitor command in the upper 8 bits. When the setup value is 0, the actual velocity (ASPD) is returned.
7	31	A	RTEX monitor select 3	0 to 32767	—	Selects the type of monitor for Response_Data3 when the non-cyclic command = 0h. Set the Type Code (8 bits) of the RTEX monitor command in the lower 8 bits and the Index (8 bits) of the RTEX monitor command in the upper 8 bits. When the setup value is 0, the torque (TRQ) is returned.

4.2.4.3 Subcommand Command Data Block Configuration (32-byte mode only)

4.2.4.3.1 Subcommand Code and Subcommand Arguments (Command Bytes 16 to 31)

The following is an outline of subcommands assigned to each byte.

Name	Description
Sub_Chk	● This is used to determine whether the frame is a subcommand frame. ● Always set to 1. ● When this bit is 0 in 32-byte mode, Err86.0.0 “RTEX cyclic data error protection 1” is triggered.
Sub_Command_Code	● A subcommand code is set. This has basically the same function as a non-cyclic command. Command names and command codes of the supported non-cyclic commands (subcommands) are as follows. Normal command: 0h System ID command: 2h Monitor command: Ah
Sub_Type_Code	● Sets command data specified using a subcommand code.
Sub_Index	● Sets command data specified using a subcommand code.
Sub_Command_Data1	● Sets command data specified using a subcommand code.
Sub_Command_Data2	● Data selected using Pr7.36 “RTEX command setup 2” (i.e., feedforward data) is set. For details, see Operating Instructions (Tuning).
Sub_Command_Data3	● Data selected using Pr7.37 “RTEX command setup 3” (i.e., feedforward data) is set. For details, see Operating Instructions (Tuning).

For the details of each subcommand, see Technical Reference Communication Specification .

4.2.4.4 Subcommand Response Data Block Configuration (32-byte Mode Only)

4.2.4.4.1 Subcommand Code Echo and Response Data (Command Bytes 16 to 31)

The following is an outline of subcommands assigned to each byte.

Name	Description
Sub_CMD_Err	● When there is a subcommand error, 1 is returned. If an error has occurred at the subcommand receiving stage (before process execution), 1 is returned.
Sub_ERR	● Indicates the subcommand status. This is 1 when an error occurs during processing after a command is received.
Sub_WNG	● Indicates the subcommand status. This is 1 when a process has been executed, but some problem has occurred.
Sub_Busy	● Indicates the subcommand status. During command processing, 1 is returned.
Sub_Command_Code_Echo	● A Sub_Command_Code echo back value is returned.
Sub_Type_Code_Echo	● A Sub_Type_Code echo back value is returned.
Sub_Index_Echo	● A Sub_Index echo back value is returned.
Sub_Response_Data1	● The response data specified by the subcommand code is returned. ● Monitor data specified using Pr7.32 “RTEX monitor select 4” is returned when the subcommand is 0h (a normal command). For Pr7.32 “RTEX monitor select 4” , specify the motor data by setting the standard Type_Code (8 bit size) of the monitor command in the lower 8 bits and the Index (8 bit size) in the upper 8 bits. For details on the standard Type_Code, see Technical Reference Communication Specification . When Pr7.32 “RTEX monitor select 4” = 0, 0 is returned. ● Arrangement is little endian (lower byte first).

Name	Description
Sub_Response_Data2	● Monitor data specified by Pr7.33 “RTEX monitor select 5” is returned. For Pr7.33 “RTEX monitor select 5” , specify the motor data by setting the standard Type_Code (8 bit size) of the monitor command in the lower 8 bits and the Index (8 bit size) in the upper 8 bits. For details on the standard Type_Code, see Technical Reference Communication Specification . When Pr7.33 “RTEX monitor select 5” = 0, 0 is returned. ● Arrangement is little endian (lower byte first).
Sub_Response_Data3	● Monitor data specified by Pr7.34 “RTEX monitor select 6” is returned. For Pr7.34 “RTEX monitor select 6” , specify the motor data by setting the standard Type_Code (8 bit size) of the monitor command in the lower 8 bits and the Index (8 bit size) in the upper 8 bits. For details on the standard Type_Code, see Technical Reference Communication Specification . When Pr7.34 “RTEX monitor select 6” = 0, 0 is returned. ● Arrangement is little endian (lower byte first).

Related Parameters

—: N/A

Class	No.	Attribute	Parameter name	Setting range	Unit	Function
7	32	A	RTEX monitor select 4	0 to 32767	—	Selects the type of monitor for Sub_Response_Data1 when in 32-byte mode or when the subcommand = 0h. Set the Type Code (8 bits) of the RTEX monitor command in the lower 8 bits and the Index (8 bits) of the RTEX monitor command in the upper 8 bits. When the setup value is 0, 0 is returned.
7	33	A	RTEX monitor select 5	0 to 32767	—	Selects the type of monitor for Sub_Response_Data2 when in 32-byte mode. Set the Type Code (8 bits) of the RTEX monitor command in the lower 8 bits and the Index (8 bits) of the RTEX monitor command in the upper 8 bits. When the setup value is 0, 0 is returned.
7	34	A	RTEX monitor select 6	0 to 32767	—	Selects the type of monitor for Sub_Response_Data3 when in 32-byte mode. Set the Type Code (8 bits) of the RTEX monitor command in the lower 8 bits and the Index (8 bits) of the RTEX monitor command in the upper 8 bits. When the setup value is 0, 0 is returned.

5 Trial Run

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5.1 Trial Run Flow

First check the operation of the servo driver in a trial run.

The procedure of the trial run is as follows.

5.1.1 Preparation

1 Installation

Install the servo driver and motor properly.

2 Wiring

Wire the servo driver, motor and host device.

— Precautions —

- Because the trial run is performed without load, do not connect the motor to the mechanical system.

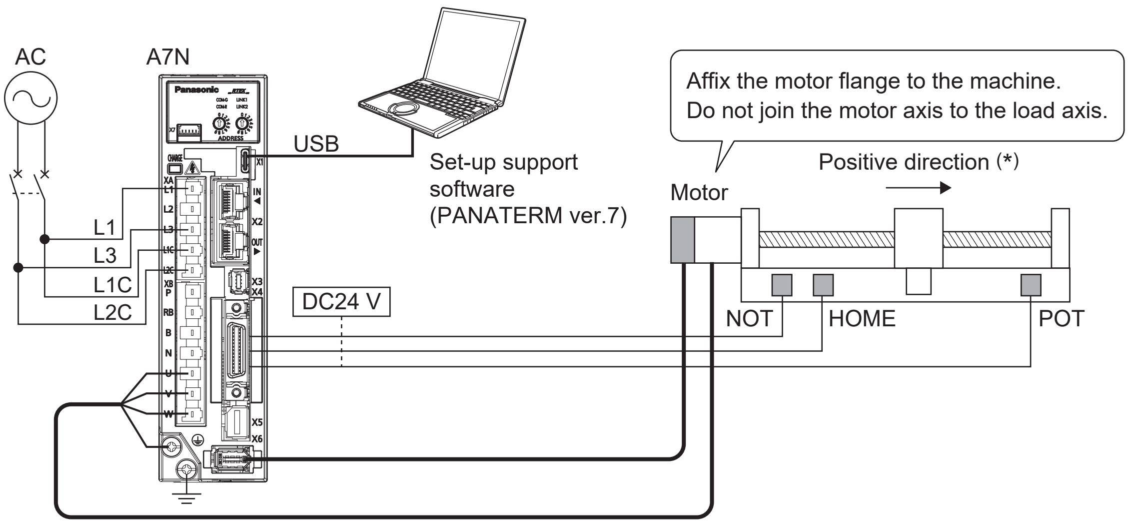
3 Confirmation before trial run

Check *"5.2 Confirmation Before Trial Run"* before conducting the trial run.

5.1.2 Trial Run

1 Trial run using the motor unit

Check the operation of the motor unit using the trial run function of Set-up Support Software (PANATERM ver.7) on the PC connected to the servo driver. Check the operation of the servo driver and motor before operating using RTEXcommunication from the host device. For detailed steps, check *"5.3 Trial Run Using the Motor Unit"* .



* Whether CCW or CW is the positive direction is set by Pr0.00

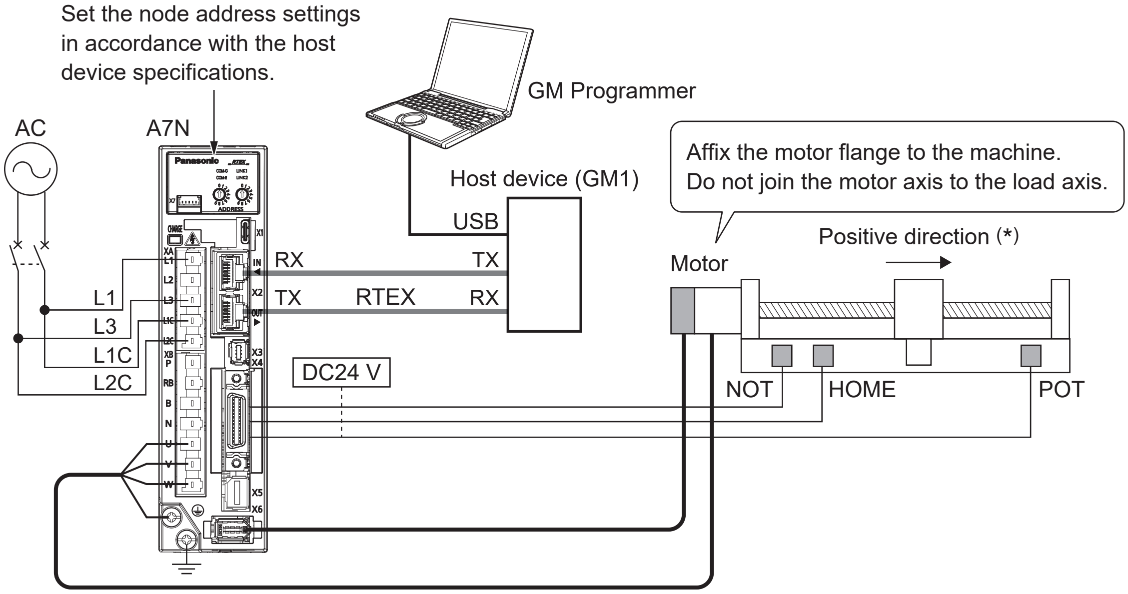
2 Trial run via RTEX communication

Connect the host device to the servo driver and perform an operation check via RTEX communication from the host device side.

After checking operation with a trial run using the motor unit, confirm operation via RTEX communication.

In the method described here, the trial run is carried out using a Panasonic motion controller GM1 as the host device and the application GM Programmer on the PC to control the host device GM1.

Check *"5.4 Trial Run via RTEX Communication"* .



* Whether CCW or CW is the positive direction is set by Pr0.00

5.2 Confirmation Before Trial Run

To run a trial run safely and properly, check the installation status and wiring as follows before running the trial.

1 Installation

Confirm proper installation of the servo driver and motor to prevent accidents and damage to the servo driver and motor, referring to *"3.1 Installation"* .

2 Wiring

Referring to *"3.2 Connections"* , check the following items regarding the wiring of the servo driver, motor, and host device.

- Is the power supply connected to the power supply input terminal?
- Is the earth wire connected to the earth terminal?
- Do the motor connection terminal and the motor phase match?
- Have the power supply input terminal and motor connection terminal not shorted?
- Is the motor earth connected to the servo driver earth terminal?
- Are the terminal parts loose?
- Is excessive force being exerted on the wires or cables, or are they being pulled?
- Does the voltage applied to the I/O connector X4 not exceed 24 V DC?
- Is a device such as a host device connected to the pins of I/O connector X4 and is a signal input to the POT (SI2) and NOT (SI3) terminals?

  If not input, see as there are other methods besides signal input.
- Has the short wire been removed when using an external regenerative resistor?

3 Power supply

Referring to *"2.1.4 Specifications"* , check that the input power supply voltage is within the specified range in line with the specifications.

4 Servo driver

Check to make sure that the screws in the fastening section of the terminal block are not loose.

5 Motor

- Check that the motor mount and axis coupling are not loose.

— Precautions —

- The description in this document assumes that the trial run is carried out in a no-load environment with the motor not connected to the mechanical system.
- If the motor is connected to the mechanical system, check that incorporated equipment is operating properly.

5.3 Trial Run Using the Motor Unit

Operation can be confirmed using the motor unit without connecting the host device to the servo driver.

Operation of a trial run using Set-up Support Software (PANATERM ver.7) on the PC is described here.

Although JOG operation, STEP operation, and Z-phase search can be performed with trial run, this section describes JOG operation. See Set-up Support Software (PANATERM ver.7) Operating Manual for STEP and Z-phase search operation.

- In JOG operation, the motor can be rotated in the positive (+ direction) or negative (- direction) direction at the touch of a button.
- In STEP operation, the amount of movement and operation pattern can be set, and the motor can be operated according to the setting.
- Z-phase search allows the motor to rotate to the position where the Z-phase output turns on.

When connecting the host device, ensure that the host device power is off.

Implement the trial run without connecting the RTEX communication cable.

5.3.1 Items to Check Before Running the Trial

Ensure that the following items are checked before conducting the trial run.

- The main circuit power supply is ON.
- An alarm is not occurring.
- The status is at servo-off.
- Be ready to shut off power immediately in case of hazards such as unexpected operation of the motor.

5.3.2 Operational Tools

The following tools are required for carrying out a trial run using the motor unit.

Operation tool	Function name	Reference
Set-up Support Software (PANATERM ver.7)	Trial run	*"5.3.3 Operation Procedure"*

In preparation, please read the Set-up Support Software (PANATERM ver.7) Operating Manual carefully for usage notes and setup instructions when using the Set-up Support Software (PANATERM ver.7) .

The following operation procedure assumes normal connection of the Set-up Support Software (PANATERM ver.7) with the servo driver.

5.3.3 Operation Procedure

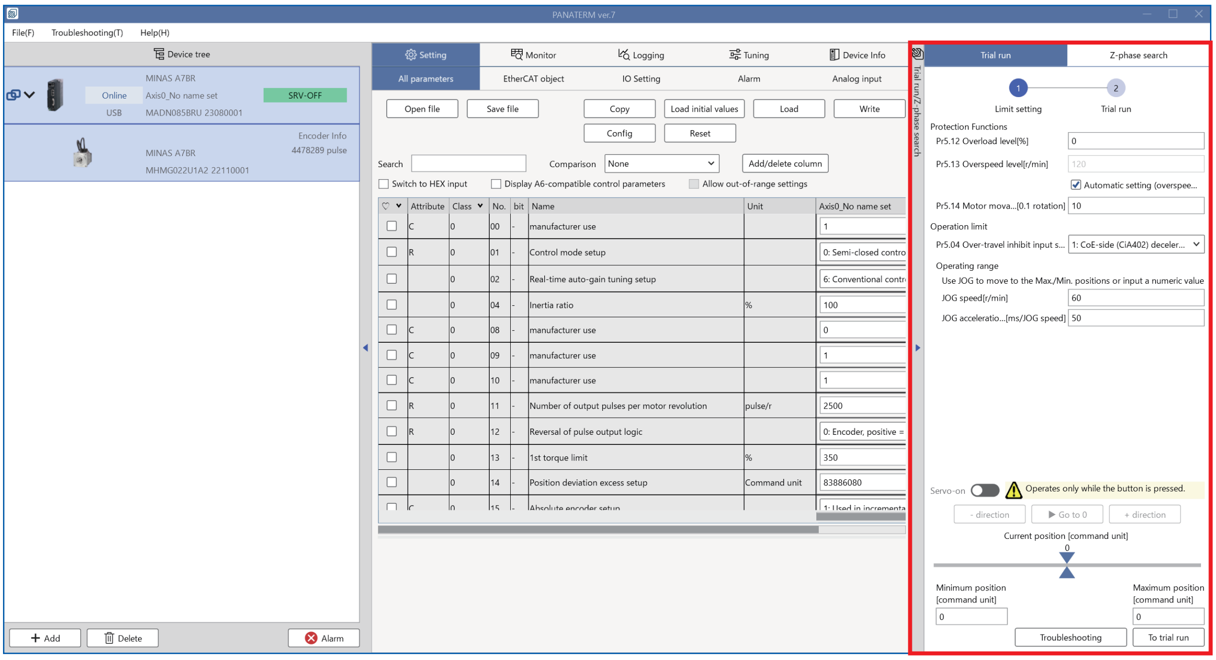
The procedure of the trial run (JOG operation) using the Set-up Support Software (PANATERM ver.7) is as follows.

<< Procedure >>

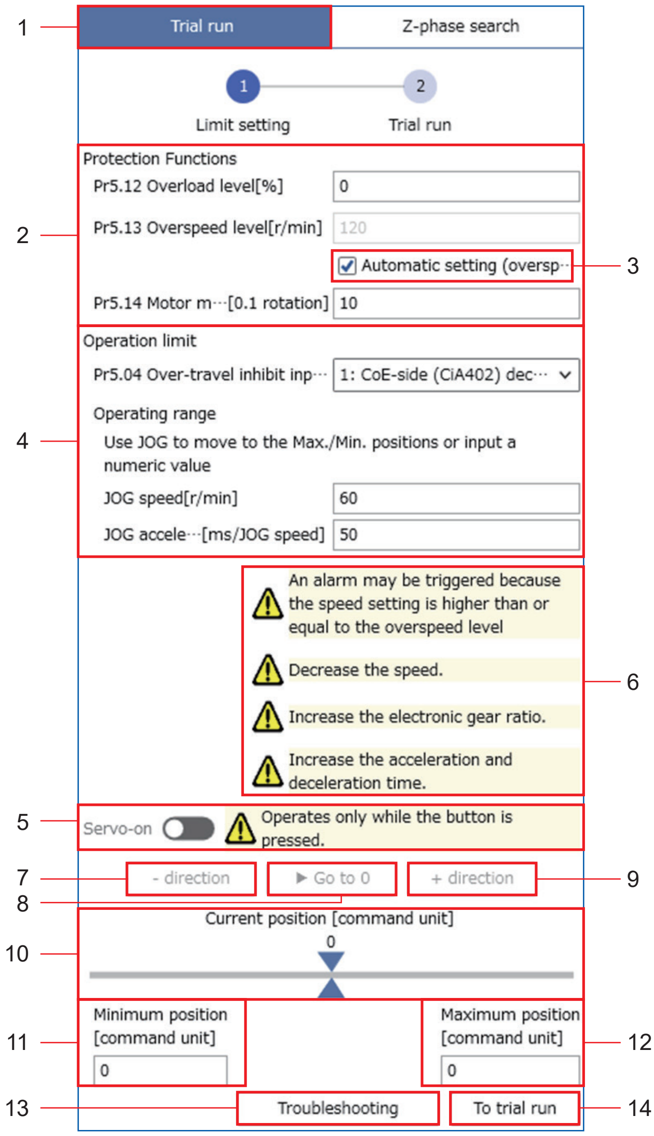
1. Activating the trial run function

Double-click the Set-up Support Software (PANATERM ver.7) icon on the desktop of the PC where you installed Set-up Support Software (PANATERM ver.7) .

The “Trial Run” screen appears on the right side of the main screen of the launched Set-up Support Software (PANATERM ver.7) .



"Trial Run (Limit Setting)" Screen Details



"Trial Run (Limit Setting)" Screen Button Operation Specifications

	Name	Description	Reference item
1	Trial Run tab	Displays the train run function. Limit setting is displayed first.	—
2	Protection functions	Sets parameters related to protection functions.	OI_A
3	Auto tuning (Overspeed)	When checked, the overspeed level changes to twice the JOG speed.	—
4	Operation limit	Sets parameters related to operation limits. When the over-travel inhibit input setting is changed, it is written to the driver.	OI_A
5	Servo-on	Toggle the driver between servo-on/servo-off. Servo-off can also be perform by pressing the ESC key. If Set-up Support Software (PANATERM ver.7) is inactive while operating another application such as Excel, servo-off cannot be performed by pressing the ESC key.	—
6	Command saturation/ acceleration warning display	This message appears when the driver command value exceeds the operating limit or the speed setting is above the overspeed level.	PT_OM

	Name	Description	Reference item
7	Negative direction	The motor rotates while the button is pressed (direction of rotation depends on Pr0.00 “Rotational direction setup” or Obj.607Eh:00h “Polarity”). Enabled only during servo-on.	—
8	To position 0	Performs step operation to the current position “0”. Enabled only during servo-on and when the motor is not in the 0 position. The current position of the motor is the command unit position set to 0 at servo-on.	—
9	Positive direction	The motor rotates while the button is pressed (direction of rotation depends on Pr0.00 “Rotational direction setup” or Obj.607Eh:00h “Polarity”). Enabled only during servo-on.	—
10	Current position/Minimum position/Maximum position slider	Indicates the current position of the motor and the minimum and maximum positions of the motor operating range. Set the minimum and maximum positions by moving the “minimum position” and “maximum position” sliders [] left and right. The current position of the motor is the command unit position set to 0 at servo-on.	—
11	Minimum position	Input a numerical value to set the minimum position of the motor operating range.	—
12	Maximum position	Input a numerical value to set the maximum position of the motor operating range.	—
13	Troubleshooting	Displays Troubleshooting.	PT_OM
14	To Trial Run	Displays the screen for executing the trial run.	—

2. Related parameter settings

Sets "Protection functions" and "Operation limits".

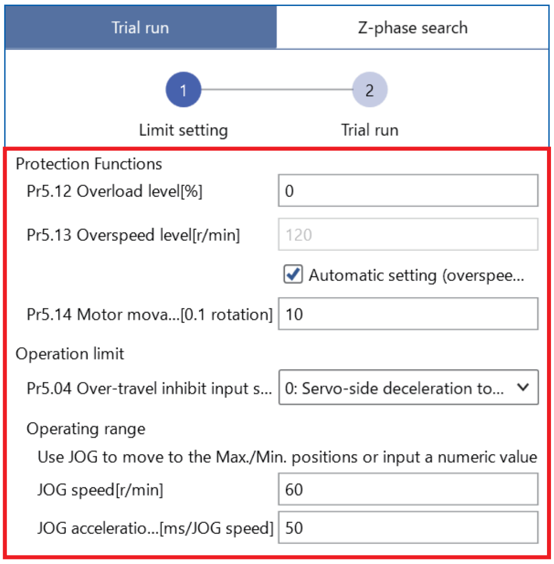
For related parameters, see *"6.3 List of Parameters"* .

Notes

- The default values for "Protection Function" and "Operation Limit" are the values set in the Set-up Support Software (PANATERM ver.7) .

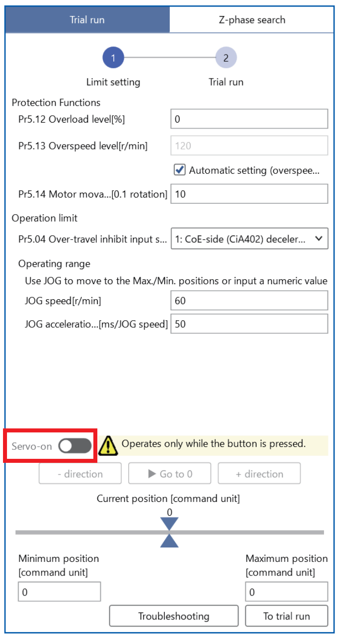
  The setup value for "Protection Function" is written to the servo driver just before the operation starts after the set value is changed.

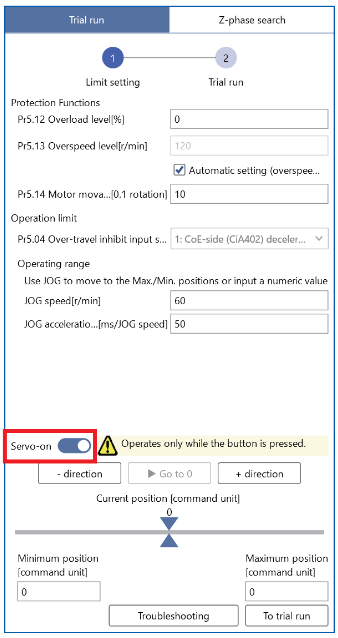
  The "Operation Limit" is written to the servo driver just before the operation starts after the set value is changed.



3. Servo-on

Click "Servo-On" in the limit setting screen for "Trial Run" and put the driver in the servo-on state.





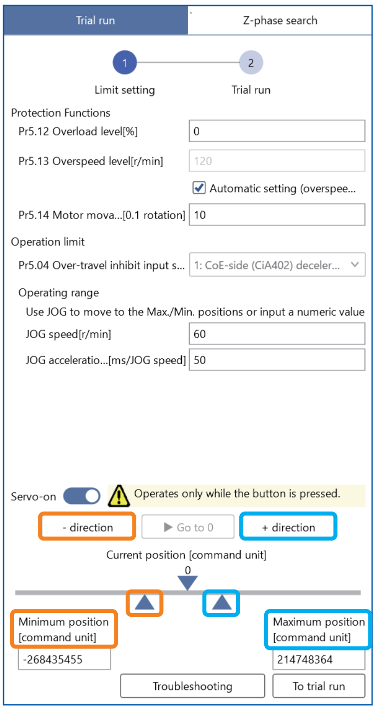
If a warning or error appears after servo-on, eliminate the cause. Then clear the alarm. Then, perform "Step 2" again.

4. Motor operating range setup

While checking the operation of the actual device, set the "Minimum position" and "Maximum position" of the motor operating range by moving the motor with the [- direction] and [+ direction] buttons.

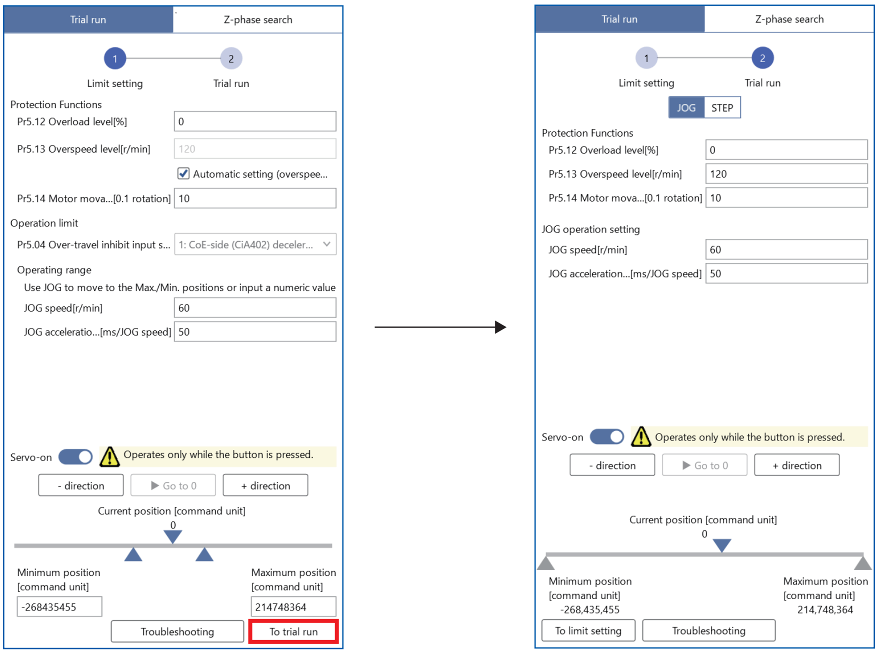
Notes

- The "Current position [command unit] 0" of the motor is the command unit position set to 0 at servo-on.



5. Applying the trial run parameters to the servo driver

Click [To Trial Run]. The operating range settings are applied to the servo driver and the screen switches.



— Precautions —

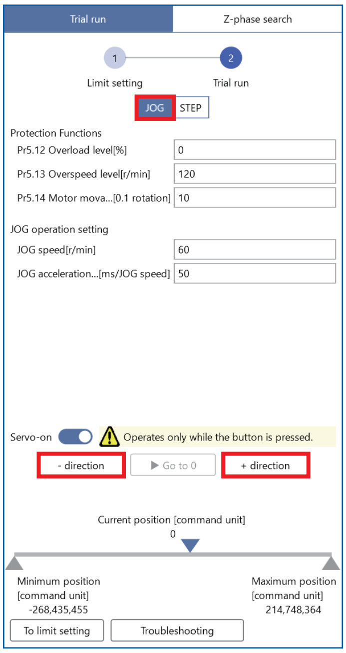
- If the [To trial run] button is clicked without changing the maximum and minimum positions, an operation that exceeds the actual scale is possible because the operating range is not limited. Be sure to set the maximum and minimum positions to avoid the risk of accidents.

6. Trial run (JOG operation)

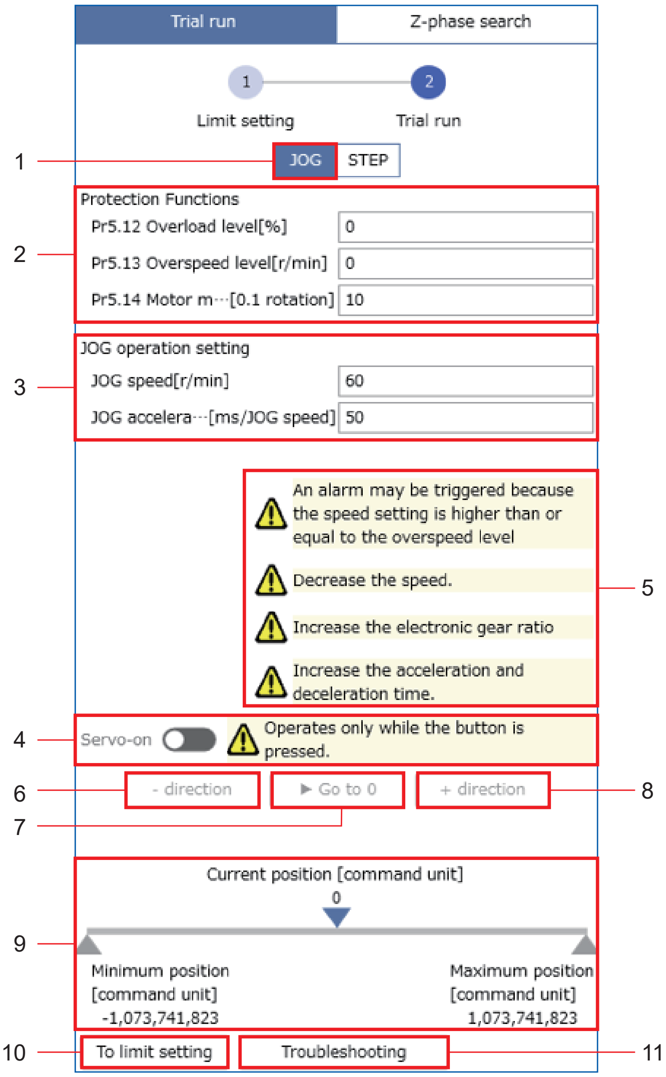
Click the [JOG] button on the “Trial Run” screen to enable the JOG operation state.

Click the [–] and [+] direction buttons to confirm that the motor rotates. The motor continues to rotate as long as the [–] and [+] direction buttons are held down.

If a warning or error appears during the trial run, eliminate the cause. Then clear the alarm. Then start over from “Step 2”.



“Trail Run” Screen Details



“Trial Run” Screen Button Operation Specifications

	Name	Description	Reference item
1	JOG	Switches to JOG operation.	—
2	Protection functions	Sets parameters related to protection functions. Each time a setting is changed, it is written to the driver.	OI_A
3	JOG operation setting	Sets the speed and acceleration and deceleration time for JOG operation.	—
4	Servo-on	Toggle the driver between servo-on/servo-off. Servo-off can also be perform by pressing the ESC key. If Set-up Support Software (PANATERM ver.7) is inactive while operating another application such as Excel, servo-off cannot be performed by pressing the ESC key.	—
5	Command saturation/ acceleration warning display	This message appears when the driver command value exceeds the operating limit or the speed setting is above the overspeed level.	PT_OM
6	Negative direction	The motor rotates while the button is pressed (direction of rotation depends on Pr0.00 “Rotational direction setup” or Obj.607Eh:00h “Polarity”). Enabled only during servo-on.	—

	Name	Description	Reference item
7	To position 0	Performs step operation to the current position “0”. Enabled only during servo-on and when the motor is not in the 0 position. The current position of the motor is the command unit position set to 0 at servo-on.	–
8	Positive direction	The motor rotates while the button is pressed (direction of rotation depends on Pr0.00 “Rotational direction setup” or Obj.607Eh:00h “Polarity”). Enabled only during servo-on.	–
9	Current position/Minimum position/Maximum position slider	Indicates the current position of the motor and the minimum and maximum positions of the motor operating range.	–
10	To limit setting	Displays the limit setting screen for the trial run.	–
11	Troubleshooting	Displays Troubleshooting.	PT_OM

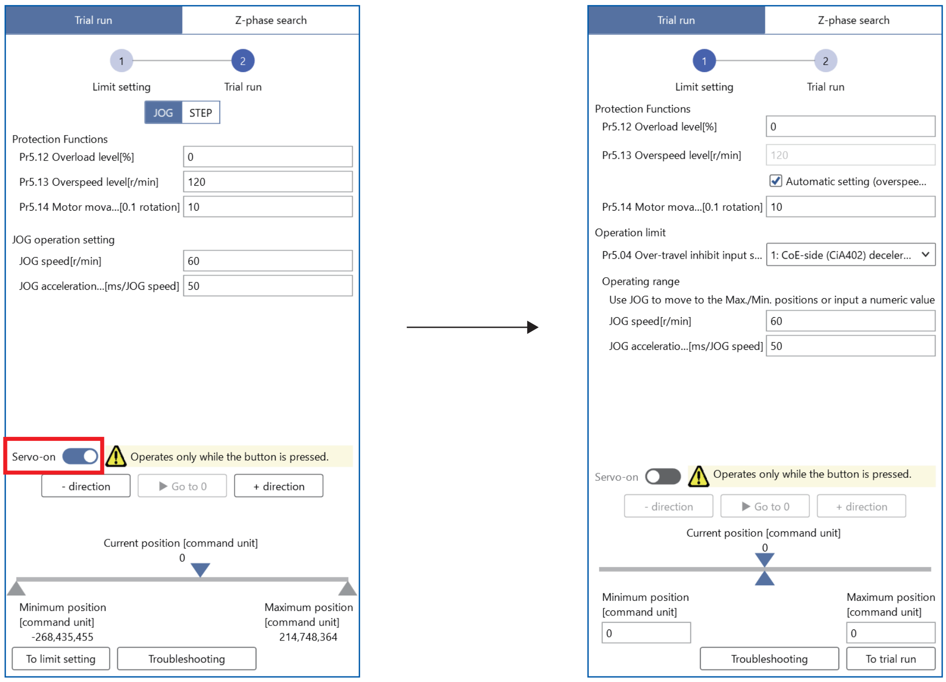
7. Finishing the trial run function

Ends the trial run or resets the operating range for the trial run.

- Ending the trial run

  Click the [Servo-on] button.

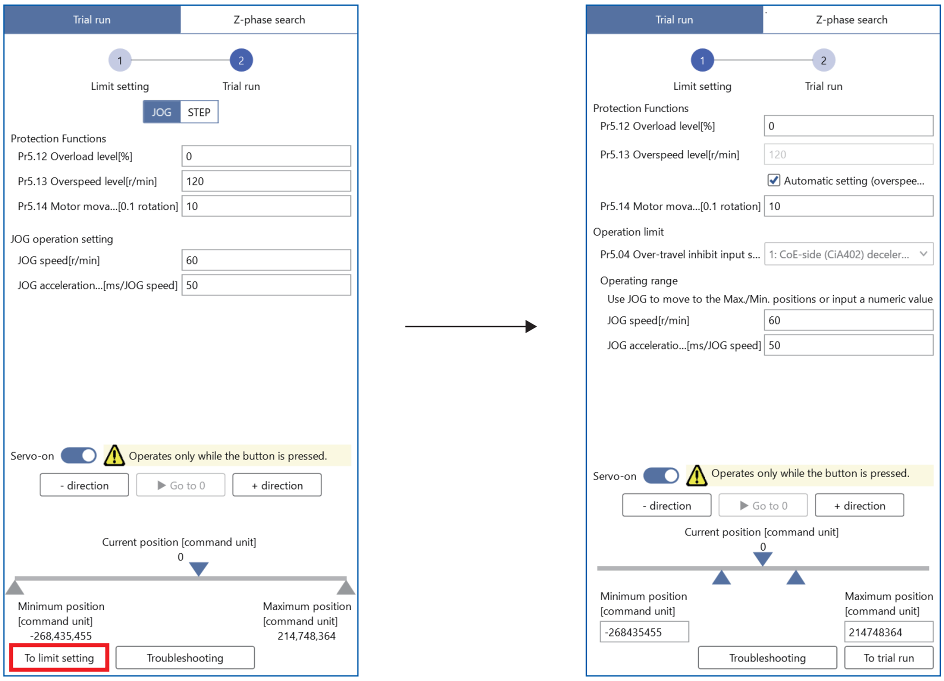
  This switches to a servo-off state, initializes the operating range, and transitions to the “Limit Setting” screen.



- Changing the operating range of the motor

  Click the [To Limit Setting] button.

  This transitions to the “Limit Setting” screen while retaining the operating range. Then start over from “Step 4”.



The trial run with the motor unit using the Set-up Support Software (PANATERM ver.7) is now complete.

5.4 Trial Run via RTEX Communication

A motor operation check via RTEX communication from the host device side can be performed by connecting the host device to the servo driver.

Operation is described here using the Panasonic motion controller GM1 as the host device.

5.4.1 Items to Check Before Running the Trial

Ensure that the following items are checked before conducting the trial run.

- The main circuit power supply is ON.
- An alarm is not occurring.
- The status is at servo-off.
- Be ready to shut off power immediately in case of hazards such as unexpected operation of the motor.

5.4.2 Operational Tools

The following tools are required for trial run via RTEX communication from the host device.

Operation tool	Function name	Reference
GM Programmer	Trial run	*“5.4.3 Operation Procedure”*
PANATERM Lite for GM	Servo driver communication settings	GM1 Controller RTEX User’s Manual (Setup)

In preparation, carefully read the GM1 controller Operating Instructions, “GM1 Controller RTEX User’s Manual (Setup),” for precautions regarding use and setup of the host device GM1 Controller, GM Programmer, and PANATERM Lite for GM.

Servo driver initial settings are required to control the servo driver using the GM1 Controller. The initial settings can be configured easily using PANATERM Lite for GM.

After configuring the initial settings, the driver must be connected to the GM1 Controller in online setting mode to conduct the trial run using the GM Programmer.

The following operation procedure assumes normal connection of the GM1 Controller with the servo driver.

5.4.3 Operation Procedure

The operation procedure for a trial run using the GM Programmer is as follows.

A program does not need to be created for the trial run.

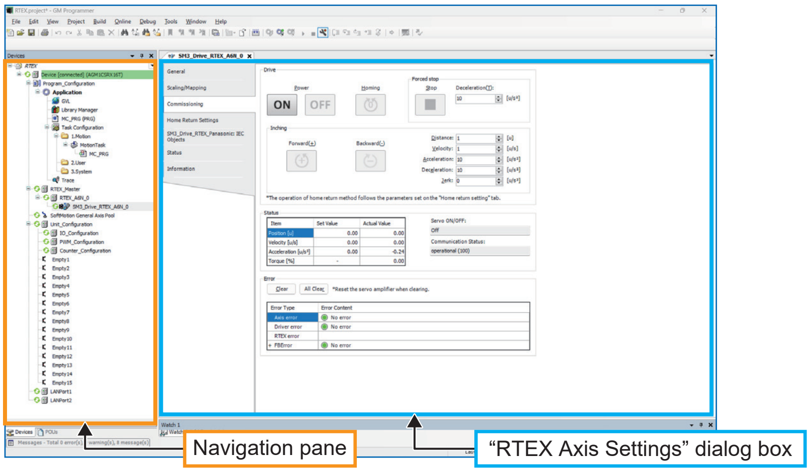
<< Procedure >>

1. Activating the trial run function

Click the [Start] button on the PC where GM Programmer is installed, and select **Panasonic Corporation**>**GM Programmer**.

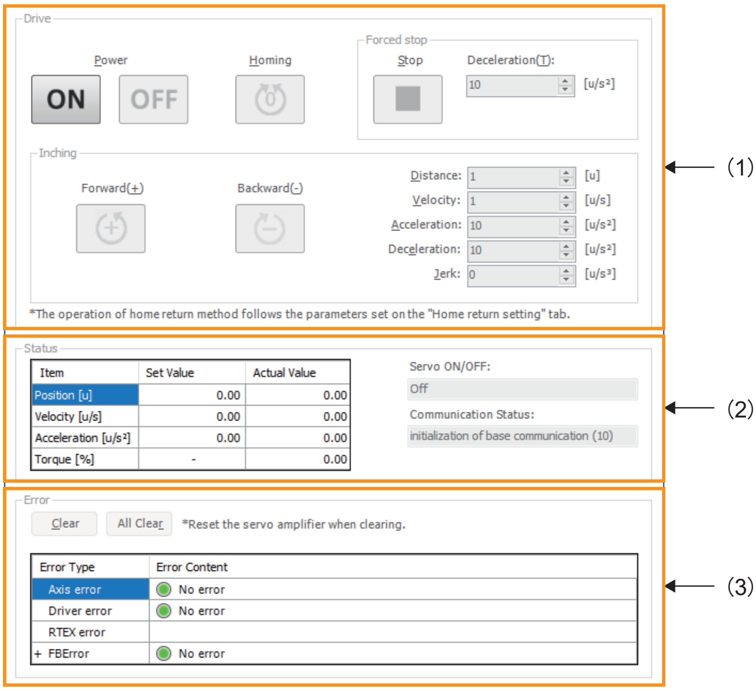
Select **Project**>**Online Setting Mode** on the menu bar.

Double-click on the servo driver object in the GM Programmer navigation window. This displays the “RTEX Axis Settings” dialog box.



Click on the “Trial run” tab in the “RTEX axis settings” dialog box. This displays the “Trial run” screen.

The “Trial Run” screen is composed of three areas.

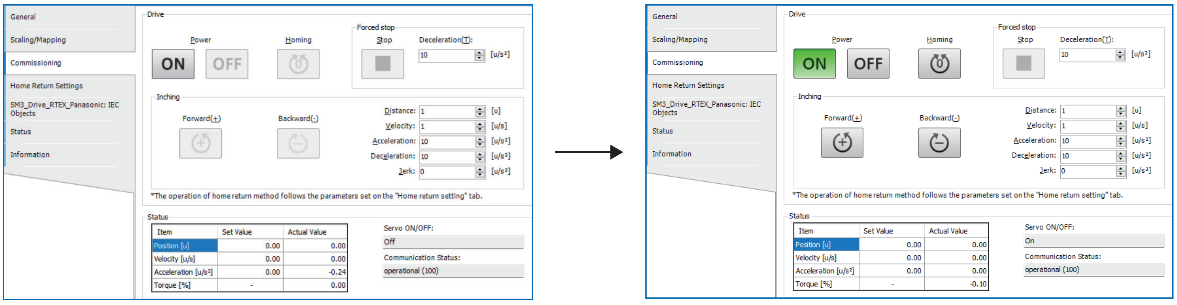


No.	Area	Description
(1)	Operation	Sets the parameters for the trial run. Executes the trial run.

No.	Area	Description
(2)	Status	Displays the servo driver execution state during trial run execution.
(3)	Error	Displays the errors that occurred during trial run execution. Executes error clearance.

2. Servo-on

Click the power supply control icon in the operation area to turn to servo-on.

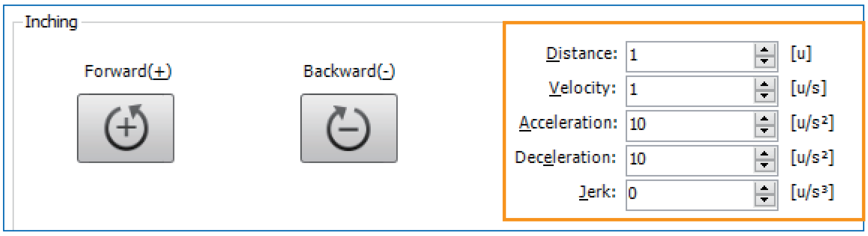


After operating servo-on, refer to the 7-segment LED display on the front panel of the servo driver and check that RTEX communication synchronization is established and at servo-on. For the 7-segment LED display specifications, see *“3.4.3 7-segment LED”* .

If an error appears within the error area after servo-on, eliminate the cause and clear any alarms. Then, perform “Step 2” again.

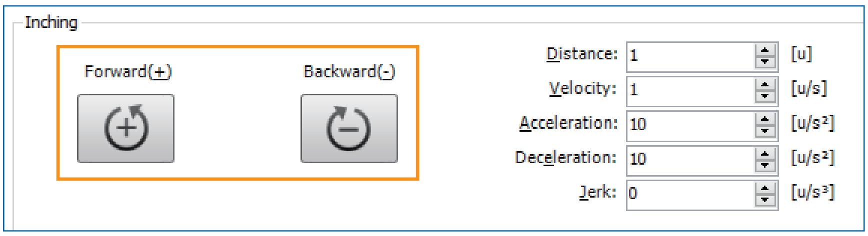
3. Related parameter settings

Input the setting parameters for during inching operation in related parameters in the inching area inside the operation area on the “Trial run” screen.



4. Trial run (inching)

Click the [Forward (+)] and [Backward (-)] direction buttons in the inching area inside the operation area to confirm that the motor rotates. Click on 1 to perform inching (1 step positioning operation) according to the parameters set in “Step 3”.



5. Finishing the trial run function

Cancel Online Config Mode. The trial run function finishes.

To cancel Online Config Mode, select **Project>Online Config Mode** on the menu bar.

The trial run (inching) via RTEX communication using the host device GM1 is now complete.

5.5 RTEX Homing Operation

5.5.1 Overview of Homing

When using this product in incremental mode for motor control during position control, a homing operation must be performed after powering on, after a software reset, and before any positioning operation performed after executing the attribute C parameter enable mode, etc.

Although no homing operation is required when used in absolute mode, performing a homing operation enables the driver to automatically set the value of Pr7.13 “Absolute home position offset” and save it in the EEPROM.

With this product, the homing operations in the following table are possible in incremental mode and absolute mode.

Name	Description
Cyclic homing	The host device controls the homing sequence in cyclic position control (CP) mode
Profile homing	This product controls the homing operation sequence in profile position control (PP) mode

For details on profile homing, see Technical Reference Communication Specification .

— Precautions —

- The homing operation (excluding clearing of absolute encoder multi-turn data) cannot be used in velocity control (CV) and torque control (CT) modes.

  Once you switch to the Cyclic Position Control (CP) mode or the Profile Position Control (PP) mode for the homing operation, you must then return to the original control mode.
- When using the homing command during semi-closed control and absolute mode, the actual position value calculated from the multi-turn data and single-turn data should not exceed a width of 32 bits.

  When power is restored on at a position beyond this range, Err29.1.0 “Counter overflow protection 1” may be triggered. If this occurs, execute clearing of absolute encoder multi-turn data. During full-closed control and absolute mode, Err29.1.0 “Counter overflow protection 1” is triggered if the actual position calculated from the external scale value exceeds a width of 32 bits.
- Executing cyclic homing without over-travel inhibit input (POT, NOT) as the homing reference trigger enables Pr5.04 “Over-travel inhibit input setup” , and operations during over-travel inhibit input (POT, NOT) take place following parameter setup values.

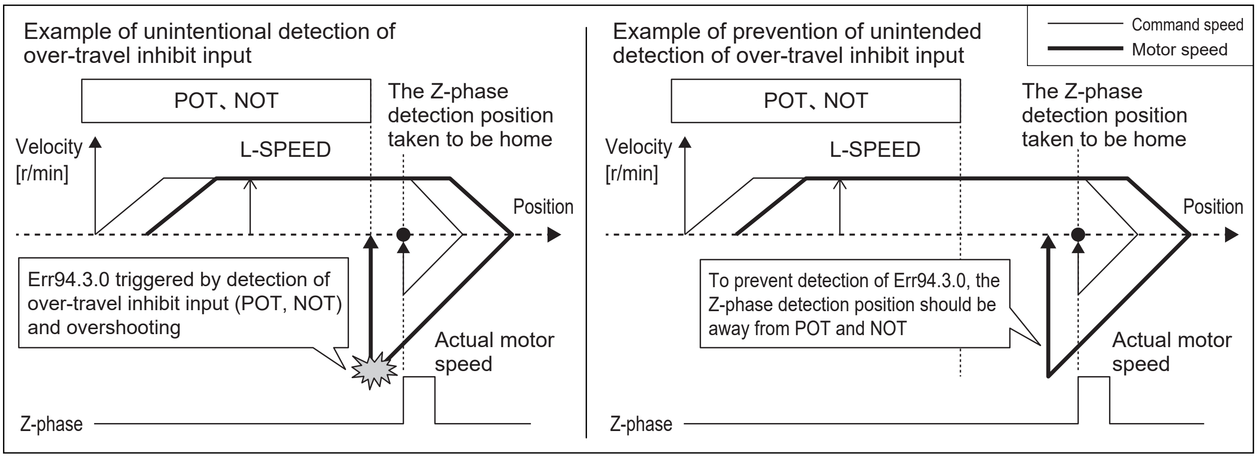
5.5.2 Protection Function Setup in Homing Using Z-phase

By setting to Pr7.41 “RTEX function expansion setup 5” :bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 1 (enabled), the over-travel inhibit input (POT, NOT) will be detected while returning to the Z-phase detection position, which is treated as the home in homing using the Z-phase.

If over-travel inhibit input is detected during the return operation, Err94.3.0 “Homing error protection 2” can be triggered to enable the protection function used to stop the motor by shutting off current to it.

— Precautions —

- If set to Pr7.41 “RTEX function expansion setup 5” : bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 1 and the Z-phase in proximity to over-travel inhibit input (POT or NOT) is taken to be home, Err94.3.0 “Homing error protection 2” may be unintentionally triggered through detection of over-travel inhibit input when the return operation to the Z-phase detection position has overshot. In order to prevent unintentional detection of over-travel inhibit inputs, the position at which over-travel inhibit is input must be separated from the Z-phase, which is treated as the position for completing homing. Prevent the return operation from occurring in the proximity of over-travel inhibit input (POT/NOT).



If not set to Pr7.41 “RTEX function expansion setup 5” :bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 1, detection of over-travel inhibit input (POT/ NOT) is disabled during return to the Z-phase detection position when homing by use of the Z-phase.

Related Parameters

- Pr5.04 “Over-travel inhibit input setup” and Pr5.05 “Sequence at over-travel inhibit” settings are temporarily disabled during profile homing operations, and so it is recommended to set to Pr7.41 “RTEX function expansion setup 5” :bit 7 = 1.

  When using the profile homing function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input. Simply setting to Pr5.04 “Over-travel inhibit input setup” = 1 does not disable the function. For details on the profile homing function, see Technical Reference Communication Specification .

—: N/A

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	04	C	Over-travel inhibit input setup	0 to 2	—	Sets the operation for the over-travel inhibit inputs (POT, NOT). Set according to the host device specification. Normally set to 1 (disabled) in order for the host device to control the operation. 0: POT -> Positive direction over-travel inhibit, NOT -> Negative direction over-travel inhibit. Stops as per Pr5.05 “Sequence at over-travel inhibit” when POT is input when operating in a positive direction. Operation is similar when NOT is input when operating in a negative direction. Regardless of operating status, torque in the over-travel inhibit direction is 0. 1: POT and NOT are disabled, but operation is unaffected. 2: Inputting either POT or NOT triggers Err38.0.0 “Over-travel inhibit input protection 1” .
7	41	R	RTEX function expansion setup 5	-32768 to 32767	—	bits 6 to 0: Not used Please fix to 0. bit 7: Over-travel inhibit input detection setting during Z-phase homing return operation 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

Related protection functions

Alarm number			Name	Cause	Handling
Main	Sub	Primary cause			
94	3	0	Homing error protection 2	• Either positive direction over-travel inhibit input (POT) or negative direction over-travel inhibit input (NOT) was turned ON during the return operation to the Z-phase position detected during homing using Z-phase while set to Pr7.41 “RTEX function expansion setup 5” :bit 7 = 1. • An error occurred in EEPROM writing of Pr7.13 “Absolute home position offset” during a homing operation in absolute mode.	• Increase the distance between the Z-phase and the positive direction over-travel inhibit input (POT)/negative direction over-travel inhibit input (NOT). • After ensuring safety, set Pr7.41:bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 0 (disabled). • Clear the alarm, then re-run the homing operation. If the alarm still occurs after performing the homing operation again, there may be a malfunction. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

5.5.3 Cyclic Homing

Homing in cyclic position control mode is dependent on host device specifications. Execute homing according to the specifications of the controller used.

The homing operation is performed using the homing command. For details of homing commands, see Technical Reference Communication Specification.

For details on homing sequences, see Technical Reference Communication Specification, , and .

The following shows an example of cyclic homing operation.

Example	Home reference	Method
1	Combining the sensor signal (HOME) and encoder Z-phase	Check the sensor signal level and control the velocity to operate the Homing_Ctrl bit
2	Sensor signal (EXT1)	
3	Encoder Z-phase	Operate Homing_Ctrl bit
4	Mechanical stopper	Set the torque limit low beforehand and when the Torque_Limited bit returns 1 continuously, set the actual position

— Precautions —

- When executing a homing operation with over-travel inhibit input (POT, NOT) as the home reference, ensure that Pr5.04 “Over-travel inhibit input setup” is set to 1 and that over-travel inhibit input is disabled. Err38.2.0 “Over-travel inhibit input protection 3” will be triggered if enabled.

  Even when the over-travel inhibit input is disabled, the signal can be loaded inside the servo driver and used as a home reference signal.
- When executing home offset, use command position set rather than actual position set. Using actual position set may lead to position deviation.

5.5.3.1 Homing Command Type_Code Table

The homing command Type_Code tables for each control mode are shown below.

- *“5.5.3.1.1 PP Type_Code Table”*
- *“5.5.3.1.2 CP Type_Code Table”*
- *“5.5.3.1.3 CV Type_Code Table”*
- *“5.5.3.1.4 CT Type_Code Table”*

The Type_Code tables show conditions for executing initialization so that the position information (actual position, internal command position) for each Type_Code is zero.

(Example) When the Type_Code = 18h, operation under the following conditions is possible

- During semi-closed position control (CP) and for SER_INC or during full-closed position control (CP) and for SER_INC or ABZ_INC
- Servo-on state
- Homing_Ctrl bit is 1
- At EXT1 signal logical rising edge (0 to 1) timing

Notes

- In terms of internal processing, position correction processing between arithmetic processing (sampling) cycles is also executed.

SER_INC, ABZ_INC, SER_ABS, INC, and ABS shown in the Type_Code tables indicate the following.

—: Unused

Table terminology	Semi-closed	Full-closed
SER_INC	—	Serial communication type: Incremental external scale
ABZ_INC	—	AB Z-phase output type: Incremental external scale
SER_ABS	Absolute encoder	Serial communication type: Absolute external scale
INC	Use in incremental mode	—
ABS	Use in absolute mode	—

5.5.3.1.1 PP Type_Code Table

○: Supported, △: Partly supported, ×: Not currently supported

Type_Code (*1) (*6)	[Name] Types of homing (Reference trigger)	Description								
		Position information Initialization Yes/No	Pr0.01 "Control mode setup"					Servo-on state		Homing_Ctrl Used Yes/No
			Profile position control (PP)							
			0: Semi-closed		6: Full-closed					
			SER_ABS		SER_INC	ABZ_INC	SER_ABS	ON	OFF	
			INC	ABS						
11h	Z-phase	[Yes] Initialization mode	×	×	×	×	×	○	×	Used
12h	HOME ↑ (*2)		×	×	×	×	×	○	×	
13h	HOME ↓ (*3)									
14h	POT ↑ (*2)									
15h	POT ↓ (*3)									
16h	NOT ↑ (*2)									
17h	NOT ↓ (*3)									
18h	EXT1 ↑ (*2)									
19h	EXT1 ↓ (*3)									
1Ah	EXT2 ↑ (*2)									
1Bh	EXT2 ↓ (*3)									
1Ch	EXT3 ↑ (*2)									
1Dh	EXT3 ↓ (*3)									
21h	Actual position set		○	○	○	○	○	○	○	Not used
22h	Command position set									
31h	Absolute encoder multi-turn clear (*5)		×	○	×	×	×	×	○	
50h	Position latch status monitor	[No] Latch mode	○	○	○	○	△ (*4)	○	○	Not used
51h	Position latch 1 activate									
52h	Position latch 2 activate									
53h	Position latch 1, 2 activate									
54h	Position latch 1 cancel									
58h	Position latch 2 cancel									
5Ch	Position latch 1, 2 cancel									
F1h	Position latch with stop function 1 activate	[No] Latch mode with stop function	×	×	×	×	×	○	×	Not used

*1 When there is a Type_Code error, a command error (0031h) is triggered.

*2 "↑" indicates the external input signal logical rising edge (when it switches from OFF to ON after internal processing).

*3 "↓" indicates the external input signal logical falling edge (when it switches from ON to OFF after internal processing).

*4 Because the serial communication type absolute external scale does not have a Z-phase, a Z-phase cannot be set for the latch trigger signal. When a Z-phase is set to the latch trigger signal, a command error (005Ah) is triggered.

*5 When the single-turn absolute function is enabled and absolute encoder multi-turn data clear is executed, a command error (0051h) is triggered.

*6 External scale position information when the external scale position information monitor function is enabled during semi-closed control is not initialized even for homing.

5.5.3.1.2 CP Type_Code Table

○: Supported, △: Partly supported, ×: Not currently supported

Type_Code (*1) (*6)	[Name] Types of homing (Reference trigger)	Description								
		Position information Initialization Yes/No	Pr0.01 "Control mode setup"					Servo-on state		Homing_Ctrl Used Yes/No
			Cyclic position control (CP)							
			0: Semi-closed		6: Full-closed					
			SER_ABS		SER_INC	ABZ_INC	SER_ABS	ON	OFF	
			INC	ABS						
11h	Z-phase	[Yes] Initialization mode	○	○	○	○	×	○	×	Used
12h	HOME ↑ (*2)		○	○	○	○	○	○	×	
13h	HOME ↓ (*3)									
14h	POT ↑ (*2)									
15h	POT ↓ (*3)									
16h	NOT ↑ (*2)									
17h	NOT ↓ (*3)									
18h	EXT1 ↑ (*2)									
19h	EXT1 ↓ (*3)									
1Ah	EXT2 ↑ (*2)									
1Bh	EXT2 ↓ (*3)									
1Ch	EXT3 ↑ (*2)									
1Dh	EXT3 ↓ (*3)									
21h	Actual position set		○	○	○	○	○	○	○	Not used
22h	Command position set									
31h	Absolute encoder multi-turn clear (*5)		×	○	×	×	×	×	○	
50h	Position latch status monitor	[No] Latch mode	○	○	○	○	△ (*4)	○	○	Not used
51h	Position latch 1 activate									
52h	Position latch 2 activate									
53h	Position latch 1, 2 activate									
54h	Position latch 1 cancel									
58h	Position latch 2 cancel									
5Ch	Position latch 1, 2 cancel									
F1h	Position latch with stop function 1 activate	[No] With stop function Latch mode	○	○	○	○	○	○	×	Not used

*1 When there is a Type_Code error, a command error (0031h) is triggered.

*2 “↑” indicates the external input signal logical rising edge (when it switches from OFF to ON after internal processing).

*3 “↓” indicates the external input signal logical falling edge (when it switches from ON to OFF after internal processing).

*4 Because the serial communication type absolute external scale does not have a Z-phase a Z-phase cannot be set for the latch trigger signal. When a Z-phase is set to the latch trigger signal, a command error (005Ah) is triggered.

*5 When the single-turn absolute function is enabled and absolute encoder multi-turn data clear is executed, a command error (0051h) is triggered.

*6 External scale position information when the external scale position information monitor function is enabled during semi-closed control is not initialized even for homing.

5.5.3.1.3 CV Type_Code Table

○: Supported, △: Partly supported, ×: Not currently supported

Type_Code (*1) (*5)	[Name] Types of homing (Reference trigger)	Description: Position information Initialization Yes/No	Pr0.01 "Control mode setup" Cyclic velocity control (CV) 0: Semi-closed SER_ABS INC	ABS	Servo-on state ON	OFF	Homing_Ctrl Used Yes/No
11h	Z-phase	[Yes] Initialization mode	×	×	○	×	Used
12h	HOME ↑ (*2)		×	×	○	×	
13h	HOME ↓ (*3)						
14h	POT ↑ (*2)						
15h	POT ↓ (*3)						
16h	NOT ↑ (*2)						
17h	NOT ↓						
18h	EXT1 ↑ (*2)						
19h	EXT1 ↓ (*3)						
1Ah	EXT2 ↑ (*2)						
1Bh	EXT2 ↓ (*3)						
1Ch	EXT3 ↑ (*2)						
1Dh	EXT3 ↓ (*3)						
21h	Actual position set		×	×	○	○	Not used
22h	Command position set						
31h	Absolute encoder multi-turn clear (*4)		×	○	×	○	
50h	Position latch status monitor	[No] Latch mode	○	○	○	○	Not used
51h	Position latch 1 activate						
52h	Position latch 2 activate						
53h	Position latch 1, 2 activate						
54h	Position latch 1 cancel						
58h	Position latch 2 cancel						
5Ch	Position latch 1, 2 cancel						
F1h	Position latch with stop function 1 activate	[No] Latch mode with stop function	×	×	○	×	Not used

*1 When there is a Type_Code error, a command error (0031h) is triggered.

*2 "↑" indicates the external input signal logical rising edge (when it switches from OFF to ON after internal processing).

*3 "↓" indicates the external input signal logical falling edge (when it switches from ON to OFF after internal processing).

*4 When the single-turn absolute function is enabled and absolute encoder multi-turn data clear is executed, a command error (0051h) is triggered.

*5 External scale position information when the external scale position information monitor function is enabled during semi-closed control is not initialized even for homing.

5.5.3.1.4 CT Type_Code Table

○: Supported, △: Partly supported, ×: Not currently supported

Type_Code (*1) (*5)	[Name] Types of homing (Reference trigger)	Description					
		Position information Initialization Yes/No	Pr0.01 "Control mode set-up"		Servo-on state		Homing_Ctrl Used Yes/No
			Cyclic torque control (CT)				
			0: Semi-closed				
			SER_ABS		ON	OFF	
			INC	ABS			
11h	Z-phase	[Yes] Initialization mode	×	×	○	×	Used
12h	HOME ↑ (*2)		×	×	○	×	
13h	HOME ↓ (*3)						
14h	POT ↑ (*2)						
15h	POT ↓ (*3)						
16h	NOT ↑ (*2)						
17h	NOT ↓						
18h	EXT1 ↑ (*2)						
19h	EXT1 ↓ (*3)						
1Ah	EXT2 ↑ (*2)						
1Bh	EXT2 ↓ (*3)						
1Ch	EXT3 ↑ (*2)						
1Dh	EXT3 ↓ (*3)						
21h	Actual position set		×	×	○	○	Not used
22h	Command position set						
31h	Absolute encoder multi-turn clear (*4)		×	○	×	○	
50h	Position latch status monitor	[No] Latch mode	○	○	○	○	Not used
51h	Position latch 1 activate						
52h	Position latch 2 activate						
53h	Position latch 1, 2 activate						
54h	Position latch 1 cancel						
58h	Position latch 2 cancel						
5Ch	Position latch 1, 2 cancel						
F1h	Position latch with stop function 1 activate	[No] Latch mode with stop function	×	×	○	×	Not used

*1 When there is a Type_Code error, a command error (0031h) is triggered.

*2 "↑" indicates the external input signal logical rising edge (when it switches from OFF to ON after internal processing).

*3 "↓" indicates the external input signal logical falling edge (when it switches from ON to OFF after internal processing).

*4 When the single-turn absolute function is enabled and absolute encoder multi-turn data clear is executed, a command error (0051h) is triggered.

*5 External scale position information when the external scale position information monitor function is enabled during semi-closed control is not initialized even for homing.

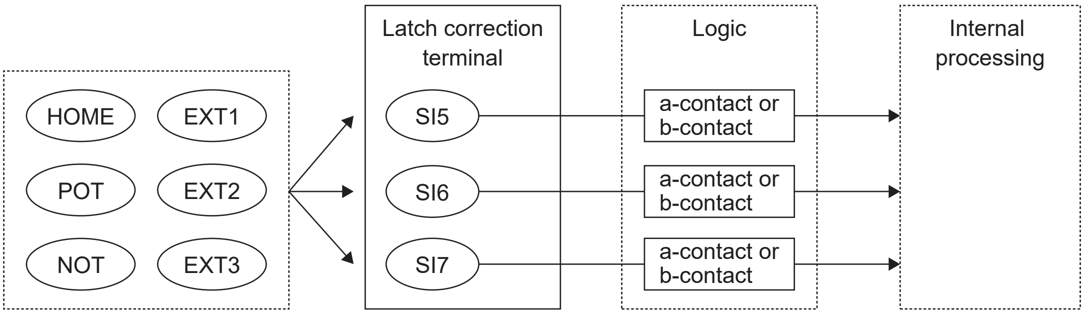
5.5.3.2 Homing-related External Input Terminals

Assign external input signals related to homing (HOME, POT, NOT, EXT1, EXT2, EXT3) to input terminals under the conditions below.

- EXT1, EXT2, and EXT3 can be assigned to SI5, SI6, or SI7.

■ When the sensor signal edge is home

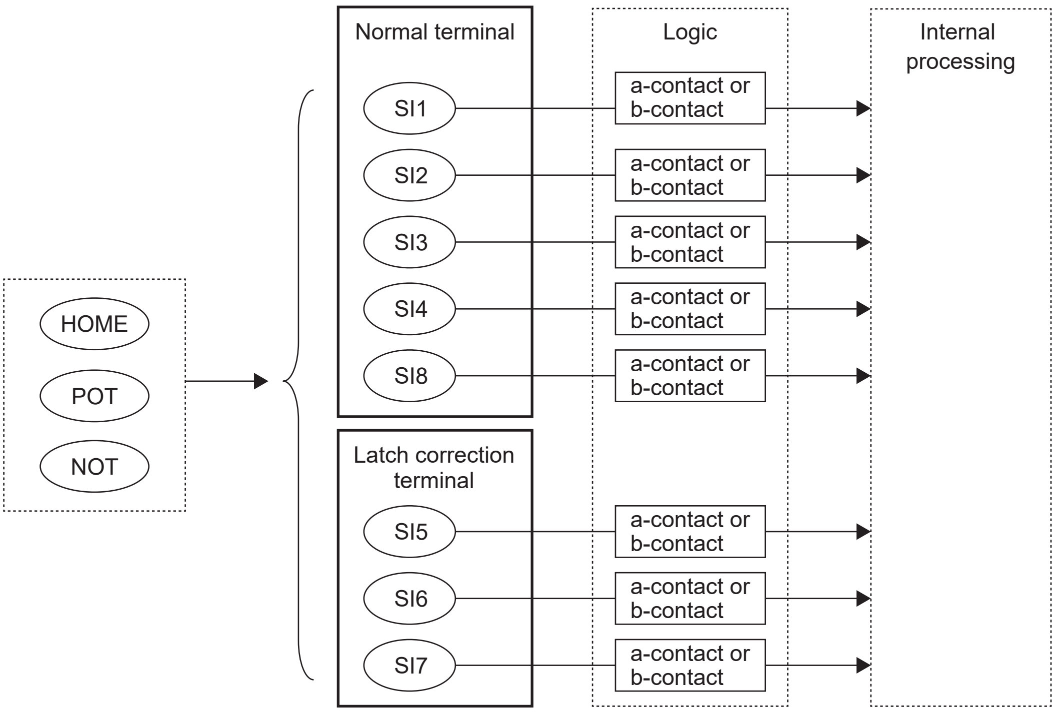
- When HOME, POT, NOT are home reference triggers, HOME, POT, and NOT can be assigned to SI5, SI6, or SI7.
- When assigning EXT1, EXT2, EXT3, HOME, POT or NOT to a latch correction terminal (SI5, SI6, SI7), the same signal must be assigned for all control modes.



■ When the sensor signal edge is not home

- When HOME, POT, NOT are not home reference triggers, they can be assigned to normal terminals (SI1, SI2, SI3, SI4, SI8) that are not latch correction terminals (SI5, SI6 and SI7).

Connection when the sensor signal edge is not home



— Precautions —

- In the event of the below, Err33.8.0 “Latch input assignment error protection” is triggered.
  - EXT1, EXT2, and EXT3 are assigned to terminals other than SI5, SI6, or SI7

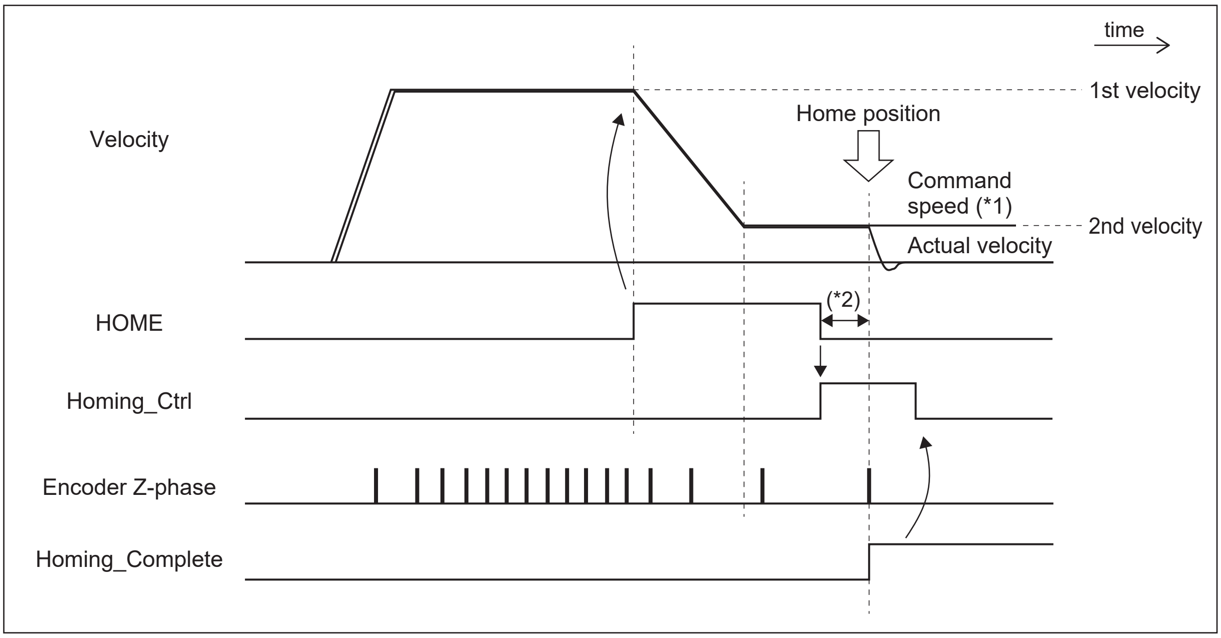
- When assigning EXT1, EXT2, EXT3, HOME, POT or NOT to a latch correction terminal (SI5, SI6, SI7), the same signals are not assigned for all control modes

● Regardless of whether HOME, POT, or NOT is assigned, an abnormal Type_Code triggers a command error (0031h). Command error (0058h) is returned if there is no HOME, POT, or NOT assignment when a Type_Code that uses HOME, POT, or NOT is specified.

5.5.3.3 Cyclic Homing Operation Example_1

As an example of a cyclic homing operation, detailed below is the homing procedure for a homing operation that combines a sensor signal (HOME) and encoder Z-phase with the first encoder Z-phase after passing through the HOME sensor detection area set as home.

1 After the Type_Code is set to the encoder Z-phase (011h) and the Homing_Ctrl bit is set to 0, the normal command (20h) changes to the homing command (24h).
   Retain the homing command until homing is complete.
2 Operation is at the command position, which is based on the position from when the power supply is turned ON (1st velocity in the image below).
3 When a rising edge is detected for the HOME sensor (confirmed by response HOME bit), the command speed drops (2nd velocity in the image below).
4 When a falling edge is detected for the HOME sensor, the Homing_Ctrl bit is set to 1.
5 When an encoder Z-phase is detected by this product, 1 is returned to the Homing_Complete bit, the command position is ignored, and the servo lock is activated at the home position (position at which single-turn data is 0). However, be aware that when feedforward is input, this value remains enabled. If the feedforward value being enabled is a problem, set the feedforward value to 0 during homing.
6 After checking that 1 is returned for Homing_Complete bit, set Homing_Ctrl bit to 0 and then set the command position to 0 (home position).
7 Next, change the command code back to the normal code (20h).
   When the command code reverts back to the normal code, positioning is executed based on a new reference. Ensure that the operation in "6" above is executed before changing the command code back to the normal code.



*1 The command speed is the command position differential value (value calculated inside this product).

*2 If the HOME signal falling edge position and encoder Z-phase are different, this is likely to lead to a single turn position delay.

If possible, mount the motor so that the positional relationship is 180° apart at the rotor mechanical angle (Even with full-closed control, Z-phase is not captured in the same way and this may lead to position misalignment.).

The encoder and external scale Z-phase can be checked using the following methods.

- Semi-closed control

Method (1): Set Pr7.00 “Display on LED” to 1, and when the 7-segment LED displays the mechanical angle, the position value displayed is 0

Method (2): When the mechanical angle is read by the monitor command, the read position value is 0

- Full-closed control
  - Serial communication type when using an incremental external scale

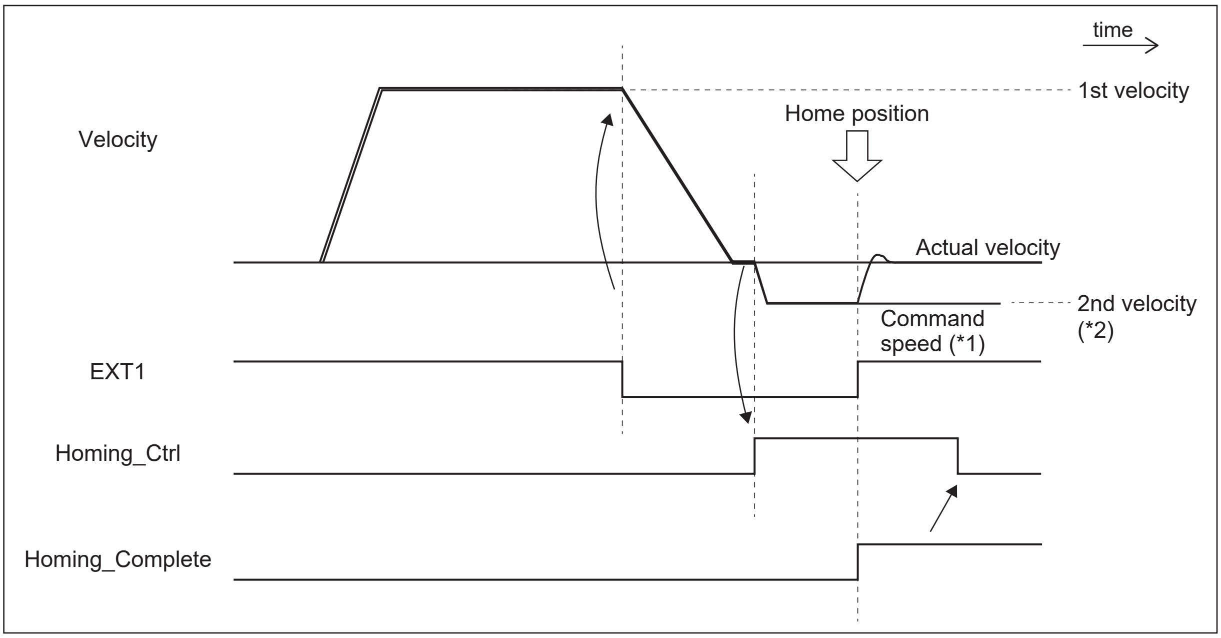
    Method: Set Pr7.00 “Display on LED” to 7, and when the 7-segment LED displays the Z-phase counter, the position value displayed changes
  - AB Z-phase output type when using an incremental external scale

    Method: Check the Z-phase original signal, the position is one where the signal changes

5.5.3.4 Cyclic Homing Operation Example_2

As an example of a cyclic homing operation, detailed below is the homing procedure for when the home is set as the EXT1 sensor logical rising edge.

1 After the Type_Code is set to the EXT1 sensor logical rising edge (018h) and the Homing_Ctrl bit is set to 0, the normal command (20h) changes to the homing command (24h).
  Retain the homing command until homing is complete. Operation is at the command position, which is based on the position when the power supply is turned ON (1st velocity).
2 When a logical falling edge is detected for the EXT1 sensor (confirmed by the response EXT1 bit), the operation stops and the Homing_Ctrl bit is set to 1. After this, the operation is inverted (2nd velocity).
3 When a logical rising edge of the EXT1 sensor is detected by this product, 1 is returned for the Homing_Complete bit, the command position is ignored, and the servo lock is activated at the home position. However, be aware that when feedforward is input, this value remains enabled. If the feedforward value being enabled is a problem, set the feedforward value to 0 during homing.
4 After checking that 1 is returned for Homing_Complete bit, set Homing_Ctrl bit to 0 and then set the command position to 0 (home position).
5 Next, change the command code back to the normal code (20h).
  When the command code reverts back to the normal code, positioning is executed based on a new reference. Ensure that the operation in "4" above is executed before changing the command code back to the normal code.



*1 The command speed is the command position differential value (value calculated inside this product).

*2 Set the 2nd velocity as low as possible.

Inside this product, noise filtering filter processing is executed when the sensor signal is taken in and this leads to detection delay. Correction processing is executed to remove this delay, but please note that if the 2nd velocity is set high, the home position detection accuracy drops.

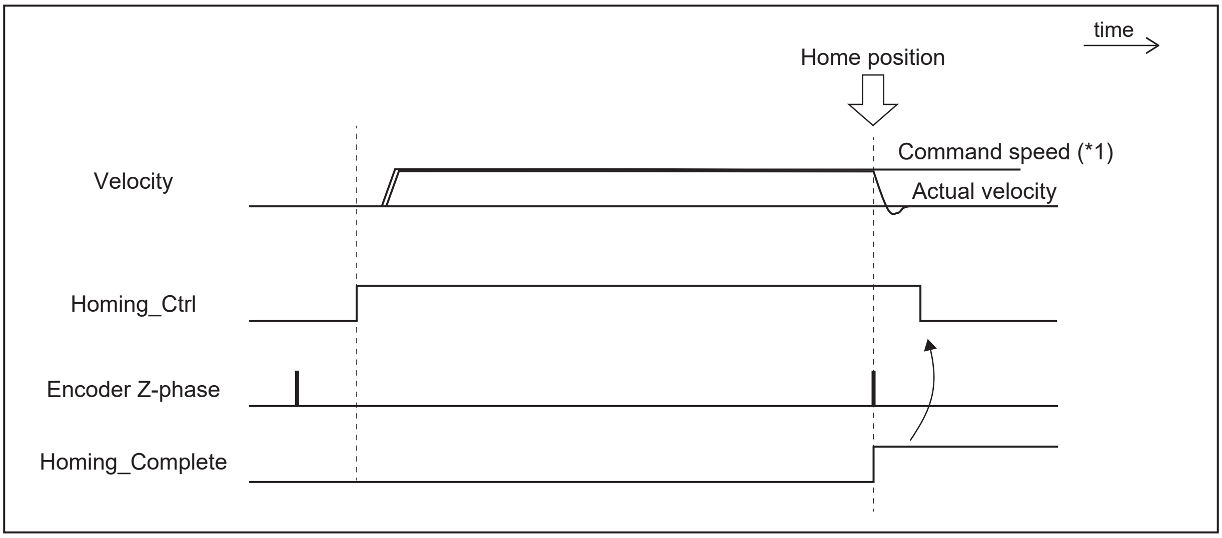
In application cases when you require high accuracy, please use the method that uses encoder Z-phase as shown in *"5.5.3.3 Cyclic Homing Operation Example_1"* .

Also, when the trigger position is detected at high speed, particularly when the electronic gear ratio is extremely small (for example, 1/1000), the detection position is wraparound during inverse conversion to the command unit and sometimes an accurate latch position cannot be detected. Set so that the latch trigger signal is detected at as low a speed as possible.

5.5.3.5 Cyclic Homing Operation Example_3

As an example of a cyclic homing operation, detailed below is the homing procedure for when the encoder Z-phase is set as the home.

1 After the Type_Code is set to the encoder Z-phase (011h) and the Homing_Ctrl bit is set to 1, the normal command (20h) changes to the homing command (24h).
  Retain the homing command until homing is complete.
2 Operation is at the command position, which is based on the position when the power supply is turned ON.
3 When an encoder Z-phase is detected by this product, 1 is returned to the Homing_Complete bit, the command position is ignored, and the servo lock is activated at the home position (Z-phase). However, be aware that when feedforward is input, this value remains enabled. If the feedforward value being enabled is a problem, set the feedforward value to 0 during homing.
4 After checking that 1 is returned for Homing_Complete bit, set Homing_Ctrl bit to 0 and then set the command position to 0 (home position).
5 Next, change the command code back to the normal code (20h).
  When the command code reverts back to the normal code, positioning is executed based on a new reference. Ensure that the operation in "4" above is executed before changing the command code back to the normal code.

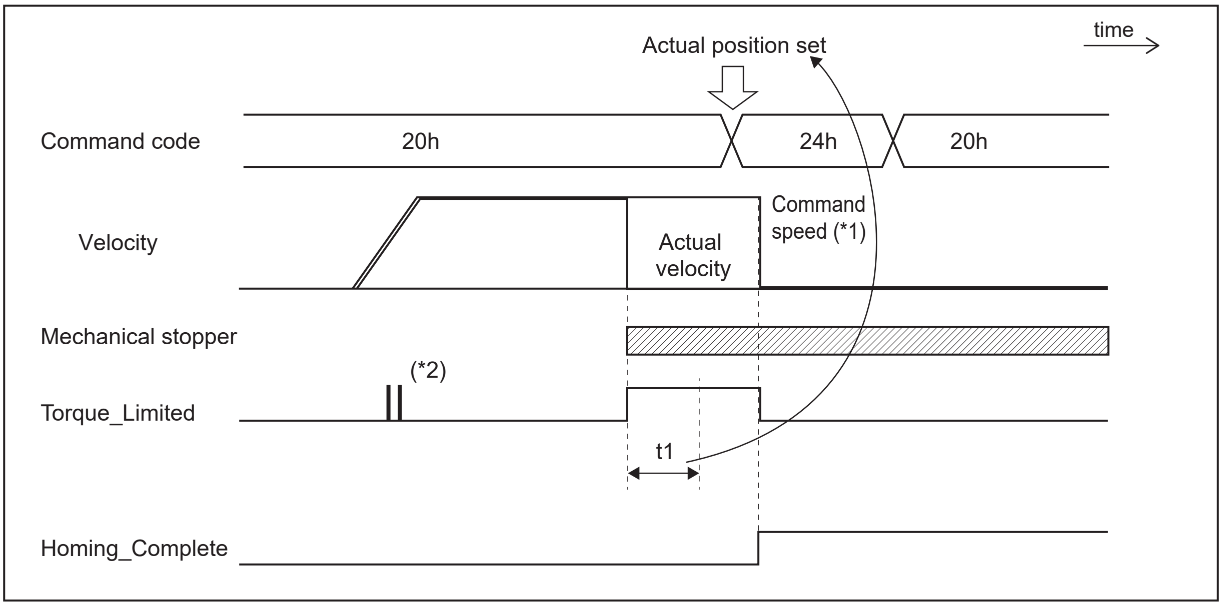


*1 The command speed is the command position differential value (value calculated inside this product).

5.5.3.6 Cyclic Homing Operation Example_4

As an example of a cyclic homing operation, detailed below is the homing procedure for when using a mechanical stopper.

1. The parameter command (26h) or command TL_SW bit is used to lower the torque limit value.
   For details on torque limit value settings, see *"4.2.4.1.4.3 Torque Limit Switching Command (TL_SW)"* .
2. Operation is at the command position, which is based on the position when the power supply is turned ON. For safety, set the command speed low.
3. When the slider contacts the mechanical stopper, the actual velocity is 0 and torque limit state (1 is returned for the Torque_Limited bit) is reached.
4. After confirming that the torque limit state continued for a fixed period (t1) the normal command (20h) changes to the homing command (24h). At this point, set the Type_Code to actual position set (021h) and the setting position (byte 12 to 15) to 0 (or the desired value). Also, do not change the command position.
5. After actual position set inside this product is complete, 1 is returned to the Homing_Complete bit, the command position is ignored, and the servo lock is activated at the setting position. However, be aware that when feedforward is input, this value remains enabled. If the feedforward value being enabled is a problem, set the feedforward value to 0 during homing.
6. After checking that 1 is returned for the Homing_Complete bit, change the command position to the actual position value set.
7. Next, change the command code back to the normal code (20h).
   When the command code reverts back to the normal code, positioning is executed based on a new reference. Ensure that the operation in "6" above is executed before changing the command code back to the normal code.
8. Change the torque limit value back to the original value.



*1 The command speed is the command position differential value (value calculated inside this product).

*2 Because the torque limit is falling, 1 may be returned for the Torque_Limited bit, even if the slider does not contact the stopper. Adjust t1 so this does not lead to false detection.
Please note that if t1 is too big, Err24.0.0 "Position deviation excess protection" may be triggered.

5.5.4 Profile Homing

For homing in profile position control mode, use the following parameters.

Related Parameters

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
8	01	B	Profile linear acceleration constant	1 to 429496	10000 Command unit/s^2	Sets the acceleration for retracting operations. Check that the set value is valid before initializing operation.
8	04	B	Profile linear deceleration constant	1 to 429496	10000 Command unit/s^2	Sets the deceleration for retracting operations. Check that the set value is valid before initializing operation.
8	12	B	Profile homing mode setting	0 to 1		Sets the latch trigger signal detection direction for the profile homing operation.
8	13	B	Profile homing speed 1	0 to 2147483647		Sets the velocity during high-speed operation for the profile homing operation.
8	14	B	Profile homing speed 2	0 to 2147483647	Command unit/s or r/min	Sets the velocity during low-speed operation for the profile homing operation.
7	25	C	RTEX velocity unit setup	0 to 1	—	Sets the unit of velocity data used in RTEX communication. Sets the units for both command data such as command speed and for response data such as actual velocity.

*1 For attributes, see *"6.3 List of Parameters"* .

For the specific method for activating profile homing, refer to the specifications for the host device.

For details of homing commands, see Technical Reference Communication Specification.

For details on parameters used for profile homing, see Technical Reference Communication Specification.

5.5.4.1 Homing Method

There are the following types of homing methods according to the reference trigger.

- *"5.5.4.2.1 Profile Homing 1 (HOME + Z-phase) [Type_Code: 31h]"*
- *"5.5.4.2.2 Profile Homing 2 (HOME) [Type_Code: 32h]"*
- *"5.5.4.2.3 Profile Homing 3 (Z-phase) [Type_Code: 33h]"*
- *"5.5.4.2.4 Profile Homing 4 (POT + HOME, NOT+ HOME) [Type_Code: 34h]"*
- *"5.5.4.2.5 Profile Homing 6 (POT + Z-phase, NOT+ Z-phase) [Type_Code: 36h]"*

5.5.4.2 Operation Example

The following are examples of profile homing operations.

For images of mounted sensors used in homing (HOME, POT, NOT), refer to the connection images in *"5.1 Trial Run Flow"* .

5.5.4.2.1 Profile Homing 1 (HOME + Z-phase) [Type_Code: 31h]

Profile homing 1 (HOME + Z-phase) uses the Z-phase with the HOME sensor as the trigger signal.

The home position is set as the position of the first Z-phase after the HOME sensor detects the rising edge in the homing direction.

After stopping in the home position and when in incremental mode, position information is initialized so that this position becomes zero.

When in absolute mode and after Homing_complete = 1 is returned, the Pr7.13 “Absolute home position offset” value is automatically set by the driver so that the position at which the trigger signal is detected is zero, which is then saved to EEPROM.

The direction of homing can be set in either a positive direction or a negative direction with Pr8.12 “Profile homing mode setting” .

If writing to EEPROM is not completed properly when in absolute mode, the error Err94.3.0 “Homing error protection 2” is triggered.

■ **Timing Chart**

When Pr8.12 “Profile homing mode setting” = 0 (Homing direction = Trigger signal detection in positive direction)

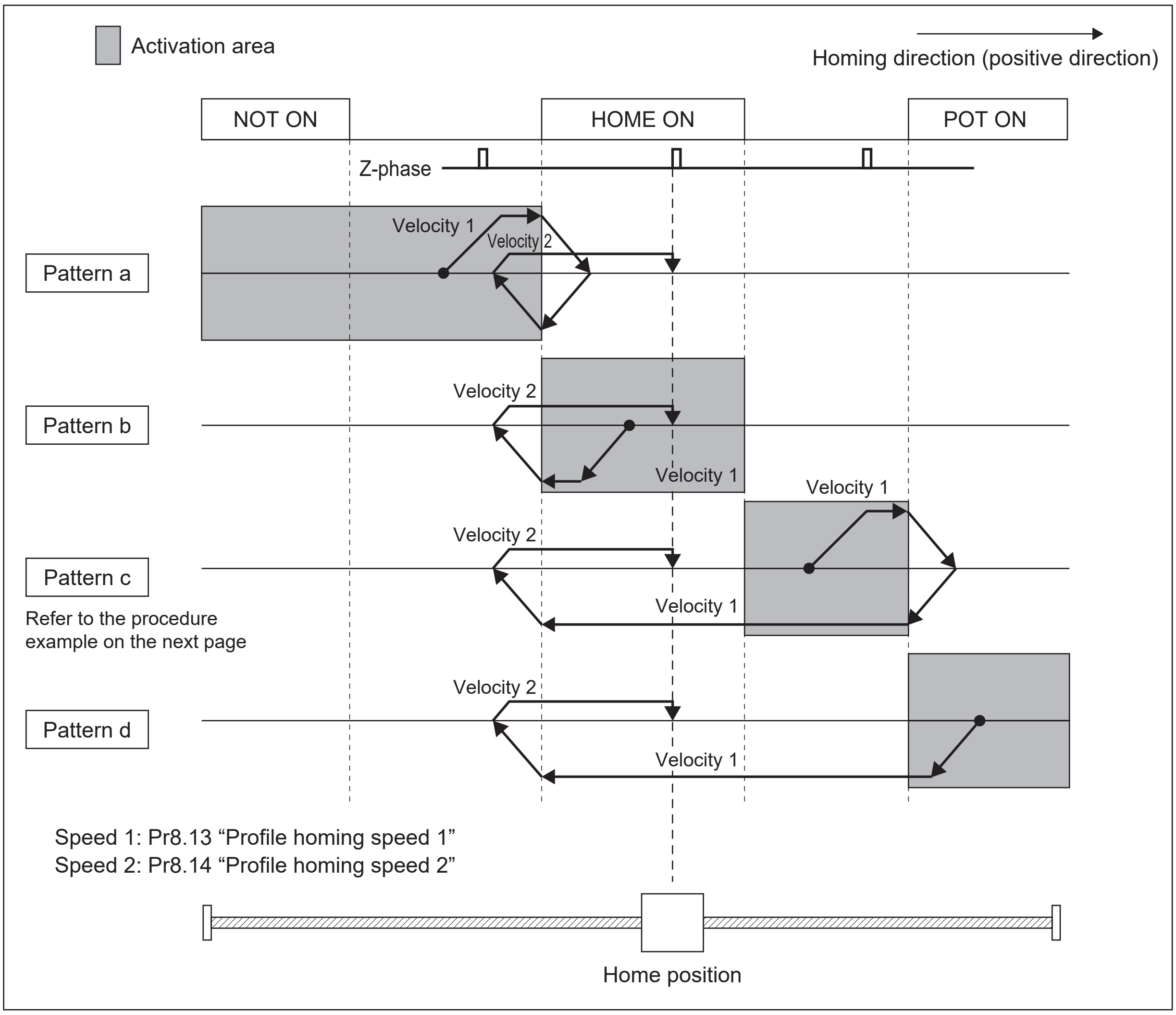
Shown below is a timing chart for when profile homing 1 is activated as a position from patterns a to d.

a. Activates homing in a position on the negative side of the HOME sensor

b. Activates homing within the HOME sensor

c. Activates homing in a position on the positive side of the HOME sensor

d. Activates homing within the POT sensor



■ Procedure for executing profile homing 1

(Example) A sequence operation for when Pr8.12 “Profile homing mode setting” = 0 (trigger signal detection in a positive direction) and when homing is activated from a position on the positive side of the HOME sensor

1 The host device sets the command code to a normal PP command (10h).

Profile operation for this product is not activated at this stage.

2 In the normal command (10h) state, set the Type_Code to 31h (profile homing 1) on the host device.

Set the target position and target speed to 0 since they are not used.

Set Latch_Sel1 to 0 and for Monitor_Sel set data to be returned to Monitor_Data.

Profile operation for this product is not activated at this stage.

3 Acceleration/deceleration and homing-related parameters must be set before activating the profile operation of this product. Therefore, set the acceleration/deceleration and homing-related parameters before performing the following procedure “4”. Set acceleration/deceleration using Pr8.01 “Profile linear acceleration constant” and Pr8.04 “Profile linear deceleration constant” . Set homing related parameters using Pr8.12 “Profile homing mode setting” , Pr8.13 “Profile homing speed 1” , and Pr8.14 “Profile homing speed 2” .

4 On the host device, change the command code from normal command (10h) to profile command (17h).

Profile operations on this product are activated at the time at which the command code changes from 10h to 17h and accelerates (starts operation) to Pr8.13 “Profile homing speed 1” using Pr8.01 “Profile linear acceleration constant” . At the point that profile operations for this product activate, Homing_Complete returns 0.

5 Confirm that the command code echo on the host device is 17h, the Type_Code echo is 31h, the status In-Progress is 1 and that a command error has not been generated. Then, confirm that the homing operation of this product has started.

If a command error has been generated, take appropriate action in accordance with the error code.

6 If this product detects POT before HOME sensor detection during the homing operation, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

7 After the homing operation of this product has stopped, the homing operation starts at a speed of Pr8.13 “Profile homing speed 1” in the direction opposite to the homing direction.

8 If the OFF edge is detected after the HOME sensor is detected as ON during the homing operation of this product, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

9 After the homing operation of this product has stopped, the homing operation accelerates to Pr8.14 “Profile homing speed 2” in the homing direction, re-enters the HOME sensor, and stops the homing operation of this product at the position where the first Z-phase was detected (positioning).

10 The position information is initialized so that the detected Z-phase position is zero in the homing operation. Also, when in absolute mode, this product automatically sets to the Pr7.13 “Absolute home position offset” value so that the detected Z-phase position is zero in the homing operation, which is then saved to EEPROM.

Profile homing operation for this product finishes when Homing_Complete = 1 is returned.

— Precautions —

- If the Z-phase is close to the point at which the HOME sensor changes, the first Z-phase may not be detected as home due to a delay in HOME sensor reading.

  Set the Z-phase as far as possible from the point at which the HOME sensor changes.
- Install each sensor (HOME, POT, NOT) so that no other sensors pass before the product detects the respective sensors and decelerates the homing operation to a stop.
- During profile homing 1 (HOME + Z-phase), the Pr5.04 “Over-travel inhibit input setup” and Pr5.05 “Sequence at over-travel inhibit” settings are temporarily disabled. When POT/NOT are detected, the profile homing operation of the product is decelerated to a stop and a reverse operation is performed automatically.

  When using this function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input.

  If an over-travel inhibit input (POT, NOT) is assigned to a general-purpose input, the over-travel inhibit input cannot be disabled using the Pr5.04 “Over-travel inhibit input setup” = 1 setting.
- If an error is detected during homing operation, such as the over-travel inhibit input on the reverse side is detected as ON and home cannot be detected during reverse operation by over-travel inhibit input, or when both sides of the over-travel inhibit input are in an ON state, Err94.2.0 “Homing Error Protection is generated and homing processing is canceled.
- It is also possible to execute other non-cyclic commands (excluding homing commands) during homing operation (until Homing_Complete =1 is returned).Profile operation of this product will continue, even when other non-cyclic commands have been executed.

  However, do not change the operation mode of the profile command (Type_Code is changed during PP operation, or Latch_Sel1 is switched during PP operation with Type_Code=12h or 13h). Err91.1.0 “RTEX Command error protection” and command error (0104h) are triggered if the operation mode is changed.

5.5.4.2.2 Profile Homing 2 (HOME) [Type_Code: 32h]

Profile homing 2 (HOME) uses the HOME sensor as the trigger signal.

The homing position is set as the position the HOME sensor detects the rising edge in the homing direction.

After stopping in the home position and when in incremental mode, position information is initialized so that this position becomes zero.

When in absolute mode and after Homing_complete = 1 is returned, the Pr7.13 “Absolute home position offset” value is automatically set by the driver so that the position at which the trigger signal is detected is zero, which is then saved to EEPROM.

Only homing in a positive direction is supported Note that homing in a negative direction is not supported.

Set Pr8.12 “Profile homing mode setting” to 0.

If set to Pr8.12 “Profile homing mode setting” = 1 the homing direction will be in the positive direction.

When POT and NOT are detected in the same direction as the homing direction, Err94.2.0 “Homing Error Protection” is generated and the homing process is canceled.

If writing to EEPROM is not completed properly when in absolute mode, the error Err94.3.0 “Homing error protection 2” is triggered.

■ Timing Chart

When Pr8.12 “Profile homing mode setting” = 0 (Homing direction = Trigger signal detection in positive direction)

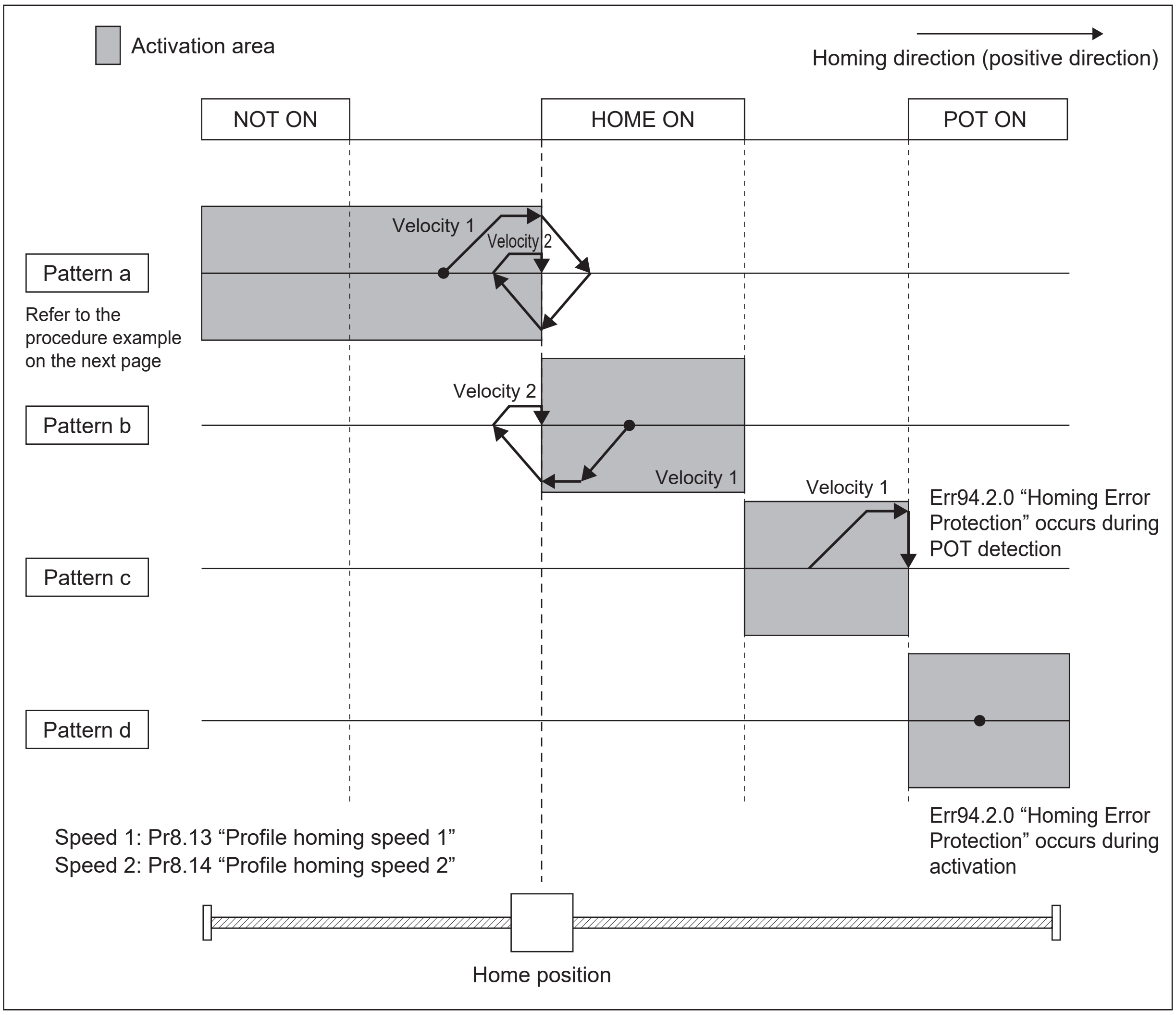
Shown below is a timing chart for when profile homing 2 is activated as a position from patterns a to d.

a. Activates homing in a position on the negative side of the HOME sensor

b. Activates homing within the HOME sensor

c. Activates homing in a position on the positive side of the HOME sensor

d. Activates homing within the POT sensor



■ Procedure for executing profile homing 2

(Example) A sequence operation for when Pr8.12 “Profile homing mode setting” = 0 (trigger signal detection in a positive direction) and homing is activated from a position on the negative side of the HOME sensor

1 The host device sets the command code to a normal PP command (10h).

Profile operation for this product is not activated at this stage.

2 In the normal command (10h) state, set the Type_Code to 32h (profile homing 2) on the host device.

Set the target position and target speed to 0 since they are not used.

Set Latch_Sel1 to 0 and for Monitor_Sel set data to be returned to Monitor_Data.

Profile operation for this product is not activated at this stage.

3 Acceleration/deceleration and homing-related parameters must be set before activating the profile operation of this product. Therefore, set the acceleration/deceleration and homing-related parameters before performing the following procedure “4”. Set acceleration/deceleration using Pr8.01 “Profile linear acceleration constant” and Pr8.04 “Profile linear deceleration constant” . Set homing related parameters using Pr8.12 “Profile homing mode setting” , Pr8.13 “Profile homing speed 1” , and Pr8.14 “Profile homing speed 2” .

4 On the host device, change the command code from normal command (10h) to profile command (17h).

Profile operations on this product are activated at the time at which the command code changes from 10h to 17h and accelerates (starts operation) to Pr8.13 “Profile homing speed 1” using Pr8.01 “Profile linear acceleration constant” . At the point that profile operations for this product activate, Homing_Complete returns 0.

5 Confirm that the command code echo on the host device is 17h, the Type_Code echo is 32h, the status In-Progress is 1 and that a command error has not been generated. Then, confirm that the homing operation of this product has started.

If a command error has been generated, take appropriate action in accordance with the error code.

6 If this product detects that the HOME sensor is ON during the homing operation, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

7 After the homing operation of this product has stopped, the homing operation starts at a speed of Pr8.13 “Profile homing speed 1” in the direction opposite to the homing direction.

8 If the OFF edge is detected after the HOME sensor is detected as ON during the homing operation of this product, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

9 After the homing operation of this product has stopped, the homing operation accelerates to Pr8.14 “Profile homing speed 2” in the homing direction, and stops the homing operation at the position where the HOME sensor was detected as ON (rising edge) again (positioning).

10 The position information is initialized so that the detected HOME sensor rising edge position is zero in the homing operation. When in absolute mode, this product automatically sets to the Pr7.13 “Absolute home position offset” value so that the detected HOME sensor rising edge position is zero in the homing operation, which is then saved to EEPROM.

Profile homing operation for this product finishes when Homing_Complete = 1 is returned.

— Precautions —

- Set the Pr8.14 “Profile homing speed 2” value as low as possible.

  The higher the velocity, the more likely there are to be errors due to reading delays.
- Install each sensor (HOME, POT, NOT) so that no other sensors pass before the product detects the respective sensors and decelerates the homing operation to a stop.
- When POT and NOT are detected in the same direction as the homing direction during Profile Homing 2 (HOME), Err94.2.0 “Homing Error Protection” is generated and homing processing is canceled.

  When using this function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input.

  If an over-travel inhibit input (POT, NOT) is assigned to a general-purpose input, the over-travel inhibit input cannot be disabled using the Pr5.04 “Over-travel inhibit input setup” = 1 setting.
- It is also possible to execute other non-cyclic commands (excluding homing commands) during homing operation (until Homing_Complete =1 is returned).Profile operation of this product will continue, even when other non-cyclic commands have been executed.

  However, do not change the operation mode of the profile command (Type_Code is changed during PP operation, or Latch_Sel1 is switched during PP operation with Type_Code=12h or 13h). Err91.1.0 “RTEX Command error protection” and command error (0104h) are triggered if the operation mode is changed.

5.5.4.2.3 Profile Homing 3 (Z-phase) [Type_Code: 33h]

Profile homing 3 (Z-phase) uses the Z-phase as the trigger signal.

The home position is set as the position of the first Z-phase in the homing direction.

After stopping in the home position and when in incremental mode, position information is initialized so that this position becomes zero.

When in absolute mode and after Homing_complete = 1 is returned, the Pr7.13 “Absolute home position offset” value is automatically set by the driver so that the position at which the trigger signal is detected is zero, which is then saved to EEPROM.

The direction of homing can be set in either a positive direction or a negative direction with Pr8.12 “Profile homing mode setting” .

When POT and NOT are detected in the same direction as the homing direction, Err94.2.0 “Homing Error Protection” is generated and the homing process is canceled.

If writing to EEPROM is not completed properly when in absolute mode, the error Err94.3.0 “Homing error protection 2” is triggered.

■ **Timing Chart**

When Pr8.12 “Profile homing mode setting” = 0 (Homing direction = Trigger signal detection in positive direction)

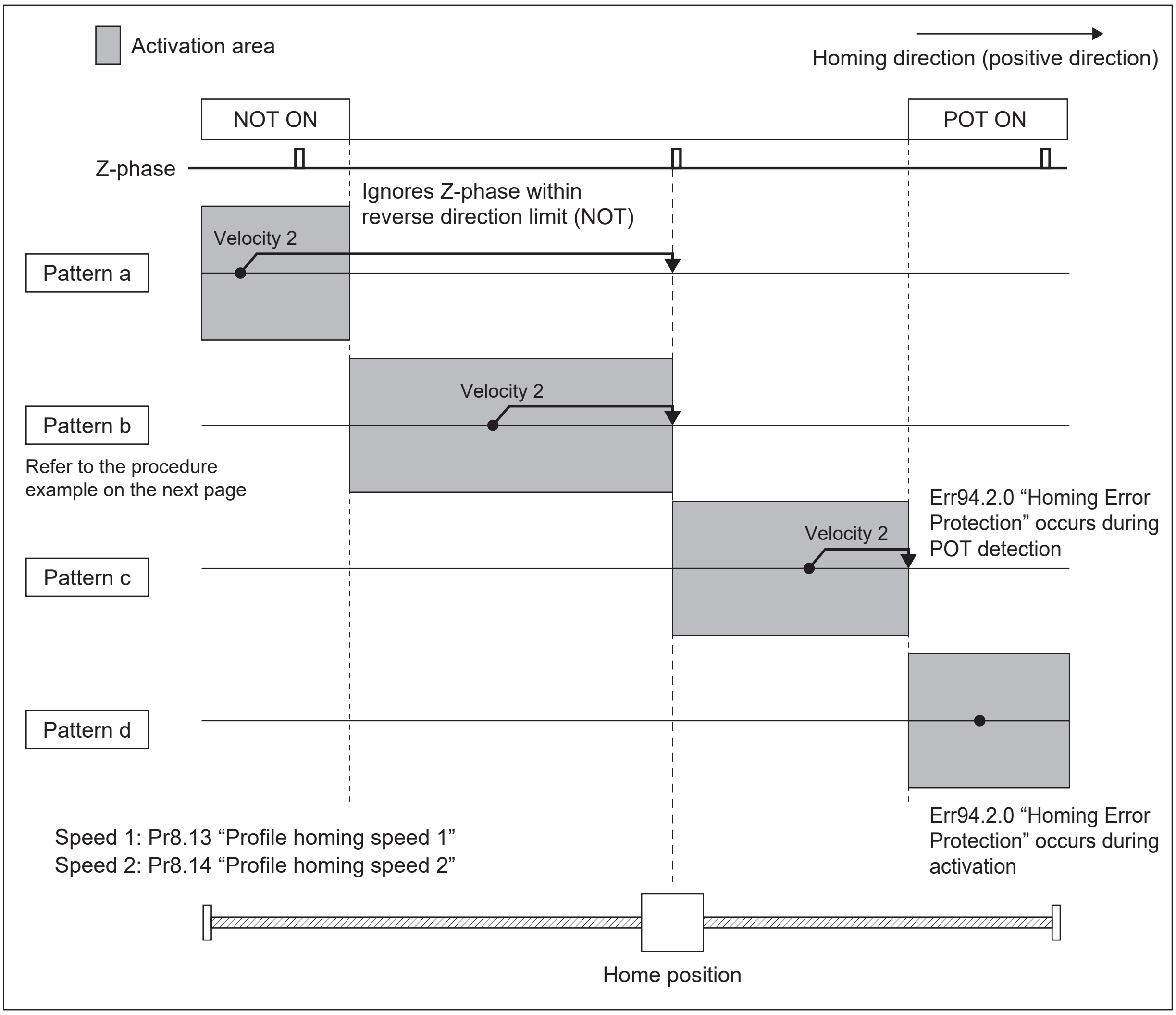
Shown below is a timing chart for when profile homing 3 is activated as a position from patterns a to d.

a. Activates homing within the NOT sensor

b. Activates homing in a position on the negative side of the Z-phase

c. Activates homing in a position on the positive side of the Z-phase

d. Activates homing within the POT sensor



■ Procedure for executing profile homing 3

(Example) A sequence operation for when Pr8.12 "Profile homing mode setting" = 0 (trigger signal detection in a positive direction) and homing is activated from a position on the negative side of the Z-phase

1 The host device sets the command code to a normal PP command (10h).

Profile operation for this product is not activated at this stage.

2 In the normal command (10h) state, set the Type_Code to 33h (profile homing 3) on the host device.

Set the target position and target speed to 0 since they are not used.

Set Latch_Sel1 to 0 and for Monitor_Sel set data to be returned to Monitor_Data.

Profile operation for this product is not activated at this stage.

3 Acceleration/deceleration and homing-related parameters must be set before activating the profile operation of this product. Therefore, set the acceleration/deceleration and homing-related parameters before performing the following procedure "4". Set acceleration/deceleration using Pr8.01 "Profile linear acceleration constant" and Pr8.04 "Profile linear deceleration constant" . Set homing related parameters using Pr8.12 "Profile homing mode setting" , Pr8.13 "Profile homing speed 1" , and Pr8.14 "Profile homing speed 2" .

4 On the host device, change the command code from normal command (10h) to profile command (17h).

Profile operations on this product are activated at the time at which the command code changes from 10h to 17h and accelerates (starts operation) to Pr8.14 "Profile homing speed 2" using Pr8.01 "Profile linear acceleration constant" . At the point that profile operations for this product activate, Homing_Complete returns 0.

5 Confirm that the command code echo on the host device is 17h, the Type_Code echo is 33h, the status In-Progress is 1 and that a command error has not been generated. Then, confirm that the homing operation of this product has started.

If a command error has been generated, take appropriate action in accordance with the error code.

6 The homing operation stops at a position when the first Z-phase is detected (positioning).

7 The position information is initialized so that the detected Z-phase position is zero in the homing operation. When in absolute mode, this product automatically sets to the Pr7.13 “Absolute home position offset” value so that the detected Z-phase position is zero in the homing operation, which is then saved to EEPROM.

Profile homing operation for this product finishes when Homing_Complete = 1 is returned.

— Precautions —

- When over-travel inhibit input is detected in the same direction as the homing direction, Err94.2.0 “Homing Error Protection” is generated.

  This will disable reverse operation in the opposite direction.
- When over-travel inhibit input is detected in the opposite direction to the homing direction, Z-phase is not detected or is ignored.
- When POT and NOT are detected in the same direction as the homing direction during Profile Homing 3 (Z-phase), Err94.2.0 “Homing Error Protection” is generated and homing processing is canceled. When using this function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input.

  If an over-travel inhibit input (POT, NOT) is assigned to a general-purpose input, the over-travel inhibit input cannot be disabled using the Pr5.04 “Over-travel inhibit input setup” = 1 setting.
- It is also possible to execute other non-cyclic commands (excluding homing commands) during homing operation (until Homing_Complete =1 is returned).Profile operation of this product will continue, even when other non-cyclic commands have been executed.

  However, do not change the operation mode of the profile command (Type_Code is changed during PP operation, or Latch_Sel1 is switched during PP operation with Type_Code=12h or 13h). Err91.1.0 “RTEX Command error protection” and command error (0104h) are triggered if the operation mode is changed.
- If the Z-phase width is smaller than the amount of deceleration movement, this may lead to an error with detection of the Z-phase.

  Adjust the amount of deceleration movement using Pr8.04 “Profile linear deceleration constant” and set a margin so that the amount is significantly larger than the Z-phase width.
- When there are multiple Z-phases, it may not be possible to detect the desired Z-phase with this homing method.

  Therefore, set only one Z-phase or use a homing method combined with a HOME sensor (Type_Code = 31h).

5.5.4.2.4 Profile Homing 4 (POT + HOME, NOT+ HOME) [Type_Code: 34h]

Profile homing 4 (POT + HOME, NOT + HOME) uses the HOME sensor as the trigger signal.

The home position is set as the position the HOME sensor detects the rising edge in the homing direction.

After stopping in the home position and when in incremental mode, position information is initialized so that this position becomes zero.

When in absolute mode and after Homing_complete = 1 is returned, the Pr7.13 “Absolute home position offset” value is automatically set so that the position at which the trigger signal is detected is zero, which is then saved to EEPROM.

Only homing in a positive direction is supported Note that homing in a negative direction is not supported.

Set Pr8.12 “Profile homing mode setting” to 0.

If set to Pr8.12 “Profile homing mode setting” = 1 the homing direction will be in the positive direction.

When POT and NOT are detected in the same direction as the homing direction, reverse operation starts automatically after deceleration to stop and homing processing continues.

If writing to EEPROM is not completed properly, the error Err94.3.0 “Homing error protection 2” is generated.

■ **Timing Chart**

When Pr8.12 “Profile homing mode setting” = 0 (Homing direction = Trigger signal detection in positive direction)

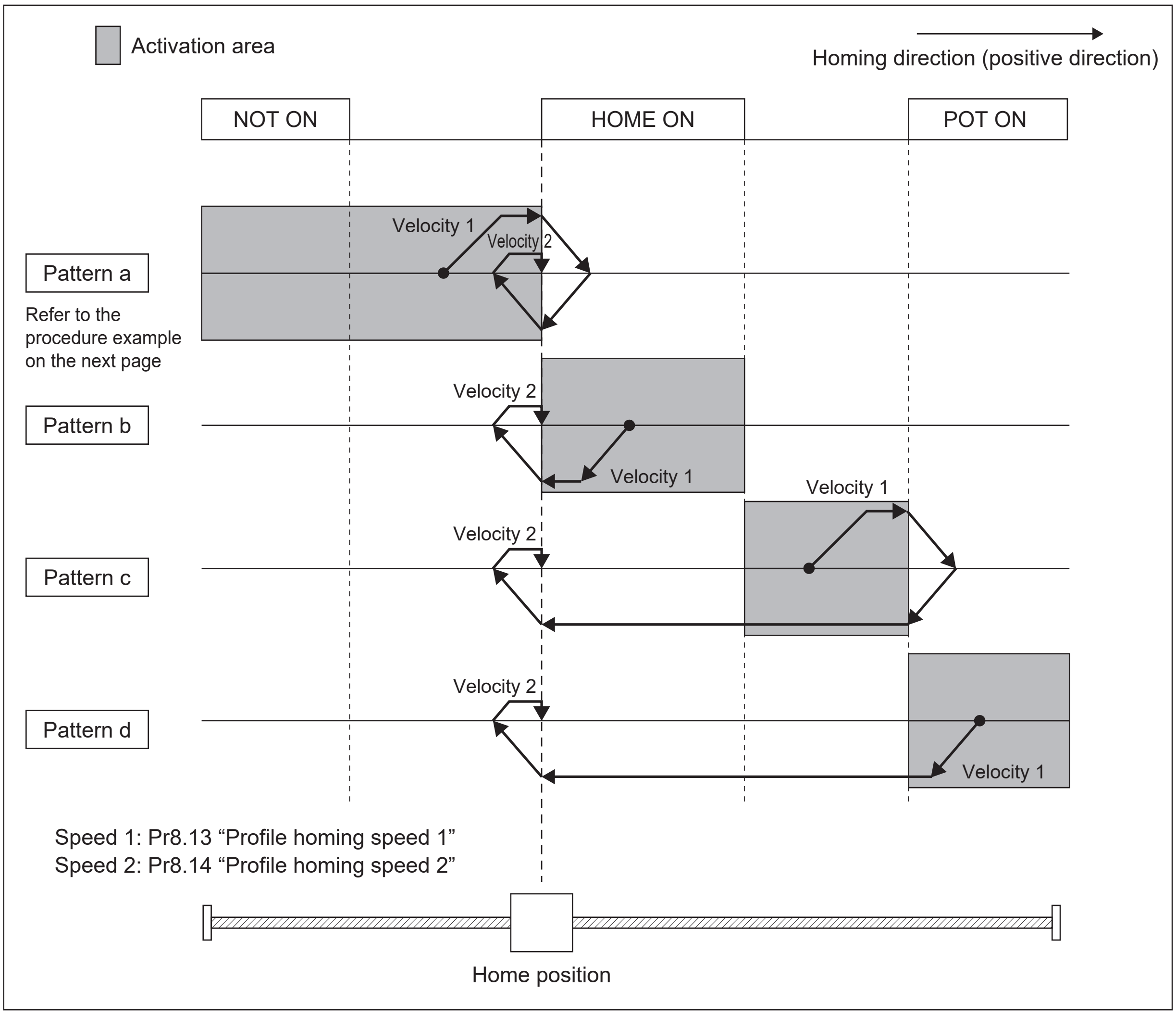
Shown below is a timing chart for when profile homing 4 is activated as a position from patterns a to d.

a. Activates homing in a position on the negative side of the HOME sensor

b. Activates homing within the HOME sensor

c. Activates homing in a position on the positive side of the HOME sensor

d. Activates homing within the POT sensor



■ Procedure for executing profile homing 4

(Example) A sequence operation for when Pr8.12 “Profile homing mode setting” = 0 (trigger signal detection in a positive direction) and homing is activated from a position on the negative side of the HOME sensor

1 The host device sets the command code to a normal PP command (10h).

Profile operation for this product is not activated at this stage.

Set acceleration/deceleration (Pr8.01 “Profile linear acceleration constant” , Pr8.04 “Profile linear deceleration constant”) and homing-related (Pr8.12 “Profile homing mode setting” ,Pr8.13 “Profile homing speed 1” , Pr8.14 “Profile homing speed 2”) parameters before activating operation.

2 In the normal command (10h) state, set the Type_Code to 34h (profile homing 4) on the host device.

Set the target position and target speed to 0 since they are not used.

Set Latch_Sel1 to 0 and for Monitor_Sel set data to be returned to Monitor_Data.

Profile operation for this product is not activated at this stage.

3 Acceleration/deceleration and homing-related parameters must be set before activating the profile operation of this product. Therefore, set the acceleration/deceleration and homing-related parameters before performing the following procedure “4”. Set acceleration/deceleration using Pr8.01 “Profile linear acceleration constant” and Pr8.04 “Profile linear deceleration constant” . Set homing related parameters using Pr8.12 “Profile homing mode setting” , Pr8.13 “Profile homing speed 1” , and Pr8.14 “Profile homing speed 2” .

4 On the host device, change the command code from normal command (10h) to profile command (17h).

Profile operations on this product are activated at the time at which the command code changes from 10h to 17h and accelerates (starts operation) to Pr8.13 “Profile homing speed 1” using Pr8.01 “Profile linear acceleration constant” . At the point that profile operations for this product activate, Homing_Complete returns 0.

5 Confirm that the command code echo on the host device is 17h, the Type_Code echo is 34h, the status In-Progress is 1 and that a command error has not been generated. Then, confirm that the homing operation of this product has started.

If a command error has been generated, take appropriate action in accordance with the error code.

6 If this product detects that the HOME sensor is ON during the homing operation, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

7 After the homing operation of this product has stopped, the homing operation starts at a speed of Pr8.13 “Profile homing speed 1” in the direction opposite to the homing direction.

8 If the OFF edge is detected after the HOME sensor is detected as ON during the homing operation of this product, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

9 After the homing operation of this product has stopped, the homing operation accelerates to Pr8.14 “Profile homing speed 2” in the homing direction, and stops (positions) the homing operation at the position where the HOME sensor was detected as ON (rising edge) again.

10 The position information is initialized so that the detected HOME sensor rising edge position is zero in the homing operation. When in absolute mode, this product automatically sets to the Pr7.13 “Absolute home position offset” value so that the detected HOME sensor rising edge position is zero in the homing operation, which is then saved to EEPROM.

Profile homing operation for this product finishes when Homing_Complete = 1 is returned.

— Precautions —

- Set the Pr8.14 “Profile homing speed 2” value as low as possible.

  The higher the velocity, the more likely there are to be errors due to reading delays.
- Install each sensor (HOME, POT, NOT) so that no other sensors pass before the product detects the respective sensors and decelerates the homing operation to a stop.
- During profile homing 4 (POT + HOME, NOT + HOME), the Pr5.04 “Over-travel inhibit input setup” and Pr5.05 “Sequence at over-travel inhibit” settings are temporarily disabled. When POT/NOT are detected, the profile homing operation of the product is decelerated to a stop and a reverse operation is performed automatically.

  When using this function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input.

  If an over-travel inhibit input (POT, NOT) is assigned to a general-purpose input, the over-travel inhibit input cannot be disabled using the Pr5.04 “Over-travel inhibit input setup” = 1 setting.
- If an error is detected during homing operation, such as the over-travel inhibit input on the reverse side is detected as ON and home cannot be detected during reverse operation by over-travel inhibit, or when both sides of the over-travel inhibit input are in an ON state, Err94.2.0 “Homing Error Protection” is generated and homing processing is canceled.
- It is also possible to execute other non-cyclic commands (excluding homing commands) during homing operation (until Homing_Complete =1 is returned).Profile operation of this product will continue, even when other non-cyclic commands have been executed.

  However, do not change the operation mode of the profile command (Type_Code is changed during PP operation, or Latch_Sel1 is switched during PP operation with Type_Code=12h or 13h). Err91.1.0 “RTEX Command error protection” and command error (0104h) are triggered if the operation mode is changed.

5.5.4.2.5 Profile Homing 6 (POT + Z-phase, NOT+ Z-phase) [Type_Code: 36h]

Profile homing 6 (POT + Z-phase, NPT + Z-phase) uses the Z-phase as the trigger signal.

After execution of reverse operation by limit sensor detection in the homing direction, the first Z-phase position where the limit sensor is no longer detected shall become home.

After stopping in the home position and when in incremental mode, position information is initialized so that this position becomes zero.

When in absolute mode and after Homing_complete = 1 is returned, the Pr7.13 “Absolute home position offset” value is automatically set by the driver so that the position at which the trigger signal is detected is zero, which is then saved to EEPROM.

The direction of homing can be set in either a positive direction or a negative direction with Pr8.12 “Profile homing mode setting” .

If writing to EEPROM is not completed properly, the error Err94.3.0 “Homing error protection 2” is generated.

■ **Timing Chart**

When Pr8.12 “Profile homing mode setting” = 0 (Homing direction = Trigger signal detection in positive direction)

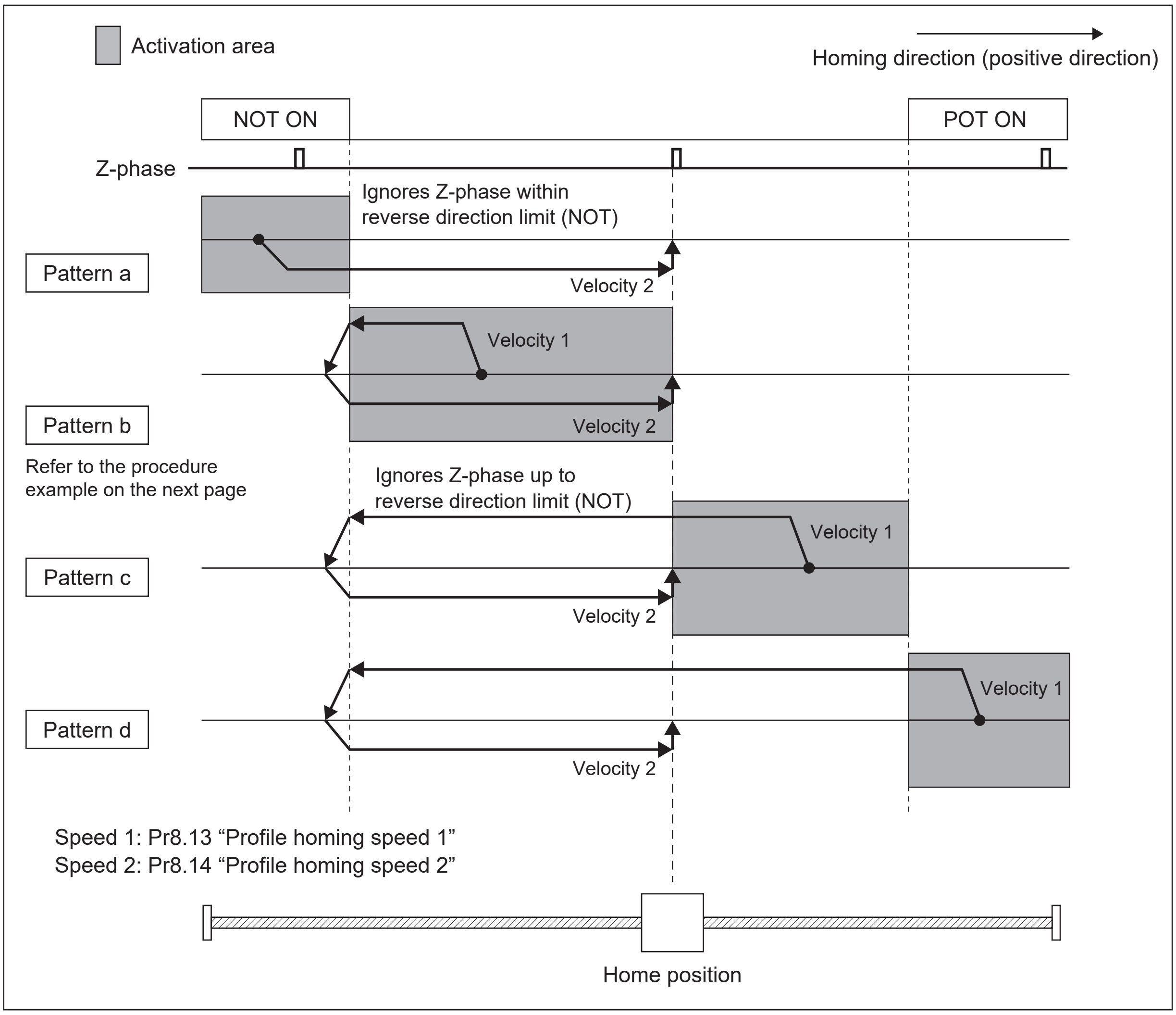
Shown below is a timing chart for when profile homing 6 is activated as a position from patterns a to d.

a. Activates homing within the NOT sensor

b. Activates homing in a position on the negative side of the Z-phase

c. Activates homing in a position on the positive side of the Z-phase

d. Activates homing within the POT sensor



■ **Procedure for executing profile homing 6**

(Example) A sequence operation for when Pr8.12 “Profile homing mode setting” = 0 (trigger signal detection in a positive direction) and homing is activated from a position on the negative side of the Z-phase

1 The host device sets the command code to a normal PP command (10h).

Profile operation for this product is not activated at this stage.

2 In the normal command (10h) state, set the Type_Code to 36h (profile homing 6) on the host device.

Set the target position and target speed to 0 since they are not used.

Set Latch_Sel1 to 0 and for Monitor_Sel set data to be returned to Monitor_Data.

Profile operation for this product is not activated at this stage.

3 Acceleration/deceleration and homing-related parameters must be set before activating the profile operation of this product. Therefore, set the acceleration/deceleration and homing-related parameters before performing the following procedure “4”. Set acceleration/deceleration using Pr8.01 “Profile linear acceleration constant” and Pr8.04 “Profile linear deceleration constant” . Set homing related parameters using Pr8.12 “Profile homing mode setting” , Pr8.13 “Profile homing speed 1” , and Pr8.14 “Profile homing speed 2” .

4 On the host device, change the command code from normal command (10h) to profile command (17h).

Profile operations are activated in the reverse direction to the homing direction at the time at which the command code changes from 10h to 17h and accelerates (starts operation) to Pr8.13 “Profile homing speed 1” using Pr8.01 “Profile linear acceleration constant” . At the point that profile operations for this product activate, Homing_Complete returns 0.

5 Confirm that the command code echo on the host device is 17h, the Type_Code echo is 36h, the status In-Progress is 1 and that a command error has not been generated. Then, confirm that the homing operation of this product has started.

If a command error has been generated, take appropriate action in accordance with the error code.

6 If this product detects that the NOT sensor is ON during the homing operation, the homing operation will decelerate to a stop at a deceleration rate of Pr8.04 “Profile linear deceleration constant” .

7 After the homing operation of this product has stopped, the homing operation starts at a speed of Pr8.14 “Profile homing speed 2” in the homing direction.

8 The homing operation stops at a position when the first Z-phase is detected (positioning).

9 The position information is initialized so that the detected Z-phase position is zero in the homing operation. When in absolute mode, this product automatically sets to the Pr7.13 “Absolute home position offset” value so that the detected Z-phase position is zero in the homing operation, which is then saved to EEPROM.

Profile homing operation for this product finishes when Homing_Complete = 1 is returned.

— Precautions —

- During profile homing 6 (POT + Z-phase, NOT + Z-phase), the Pr5.04 “Over-travel inhibit input setup” and Pr5.05 “Sequence at over-travel inhibit” settings are temporarily disabled. When POT/NOT are detected, the profile homing operation of the product is decelerated to a stop and a reverse operation is performed automatically.
- If an error is detected during homing operation, such as the over-travel inhibit input on the reverse side is detected as ON and home cannot be detected during reverse operation by over-travel inhibit, or when both sides of the over-travel inhibit input are in an ON state, Err94.2.0 “Homing Error Protection” is generated and homing processing is canceled.
- It is also possible to execute other non-cyclic commands (excluding homing commands) during homing operation (until Homing_Complete =1 is returned).Profile operation of this product will continue, even when other non-cyclic commands have been executed.

  However, do not change the operation mode of the profile command (Type_Code is changed during PP operation, or Latch_Sel1 is switched during PP operation with Type_Code=12h or 13h). Err91.1.0 “RTEX Command error protection” and command error (0104h) are triggered if the operation mode is changed.
- If the Z-phase width is smaller than the amount of deceleration movement, this may lead to an error with detection of the Z-phase.

  Adjust the amount of deceleration movement using Pr8.04 “Profile linear deceleration constant” and set a margin so that the amount is significantly larger than the Z-phase width.
- When there are multiple Z-phases, it may not be possible to detect the desired Z-phase with this homing method.

  Therefore, set only one Z-phase or use a homing method combined with a HOME sensor (Type_Code = 31h).

6 Parameters

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6.1 Outline of Parameters

The operational characteristics and functions of the servo driver are set using various parameters.

This section describes the function and purpose of each parameter.

Obtain a thorough understanding of the function and purpose of each parameter so that you can make adjustments to the servo driver to achieve the optimum condition to meet your operating requirements.

Some parameters cannot be used with the standard type or multi-function type.

6.2 Setup Procedure for Parameters

Parameters can be referred to and set using the following two methods.

1 RTEX Communication

Parameters can be referenced/set from the host device using RTEX communication.

For host device operating instructions, refer to the operating manual for the host device used.

2 Combination of Set-up Support Software (PANATERM ver.7) and PC

By connecting to a PC, the parameters can be set from Set-up Support Software (PANATERM ver.7) installed on the PC.

For information on how to connect this product to a PC and the operations of Set-up Support Software (PANATERM ver.7) , see *“12.1 Set-up Support Software (PANATERM ver.7)”* .

For parameters, see *“6.3 List of Parameters”* .

6.3 List of Parameters

Information on the parameters used for this product, such as parameter numbers, names, setting ranges and initial values, are shown in a list for each parameter class (whole number).

For this product, parameters are classified into the 11 classes below.

Parameter No.		Class name	Description	Reference
Class	No. (*1)			
0	00 to 28	Basic setting	Parameters relating to basic settings	*"6.3.2 Class 0: Basic Settings"*
1	00 to 115	Gain adjustment	Parameters relating to gain adjustment	*"6.3.3 Class 1: Gain Adjustment"*
2	00 to 80	Vibration suppression	Parameters relating to vibration suppression	*"6.3.4 Class 2: Vibration Suppression"*
3	04 to 42	Velocity, torque control	Parameters relating to velocity and torque control	*"6.3.5 Class 3: Velocity/Torque Control/ Full-closed Control"*
4	00 to 67	I/O monitor setting	Parameters relating to the interface monitor	*"6.3.6 Class 4: I/O Monitor Settings"*
5	03 to 112	Enhancing setting	Parameters relating to enhancing setting	*"6.3.7 Class 5: Enhancing Settings"*
6	02 to 127	Special setting	Parameters relating to special setting	*"6.3.8 Class 6: Special Settings"*
7	00 to 127	Special setting 2		*"6.3.9 Class 7: Special Settings 2"*
8	00 to 19	Special setting 3		*"6.3.10 Class 8: Special Settings 3"*
11	00 to 26	Manufacturer use	Parameters for manufacturer use	*"6.3.11 Class 11: Manufacturer Use"*

*1 No. is a 2- or 3-digit number.

6.3.1 Sample Description

The following is an example of entries for a List of Parameters.

Class 0: Basic Settings

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter names (*3)	Setting range	Factory default values	Unit	At-trib-ute (*4)	Related control modes (*5)				Refer-ences (*6)
Class (*1)	No. (*2)						P	S	T	F	
**	**	********	—	********	—	—	×	×	×	×	—
**	**	********	********	********	—	B	○	○	○	○	********

*1 Shows the classification of the parameter (large number). Shows the X section of PrX.YY.

*2 Shows the parameter No. (small number). Shows the Y section of PrX.YY.

*3 Shows the parameter name. Do not change the setup value from the factory default value for the “Manufacturer use” parameter.

*4 For parameter attributes, see *“Parameter Attributes”* .

*5 Shows the relationships between parameters and control modes. Shows whether a parameter is enabled or disabled for each control mode.

Control modes are indicated using the symbols below.

Symbol	Control mode
P	Position control
S	Velocity control
T	Torque control
F	Full-closed control

*6 Parameter references. The references provide details on parameters and describe their related functions.

For details on abbreviations used for document names, see *“1.2 Related Documents”* .

■ Parameter Attributes

There are attributes for the parameters.

The attribute indicates the timing under which the parameter change description is enabled.

Symbol	When the changed parameter details are enabled
A	Always enabled
B	Always enabled Changes are prohibited while the motor is running and during command transfer. If parameters are changed while the motor is running and during position command transfer, the time it takes for the changes to be reflected will be uncertain, which may transiently lead to unstable operation.
C	Enabled after executing the RTEX communication reset command attribute C parameter enabling mode or by the same operation as attribute R below
R	Enabled by turning the control power back on after EEPROM writing or after executing the RTEX communication reset command software reset mode
RO	In read-only, changes cannot be made using the normal procedure for changing parameters

For the details on the RTEX communication reset command, see Technical Reference Communication Specification - .

For details on bit allocation of parameter attributes that can be read by parameter attribute reading, see Technical Reference Communication Specification - .

— Precautions —

- If, after changing a parameter, the power is turned off or the reset command software reset mode is executed, the changed value is lost.
  To save the changed value, ensure that it is written to EEPROM.
  Use the parameter command or Set-up Support Software (PANATERM ver.7) to write values to EEPROM.
  Refer to the operating instructions for the host device or the operating instructions for the Set-up Support Software (PANATERM ver.7) .

■ Attribute C Parameter Enabling Mode

This is executed using the RTEX communication reset command from the host device. Refer to the operating instructions for the host device for the reset command for the host device.

Use this mode to enable the attribute C parameter change value when communication with the host device is established without turning the servo driver control power on again or performing a software reset.

It is not necessary to write the parameter to EEPROM before executing this mode. (It is not an issue if it is written to EEPROM).

Execute the reset command in a servo-off state and maintain servo-off state during reset command processing. If this command is received in servo-on state, this leads to command error (0045h). Also, if servo-on is executed (Servo_On = 1) while this command is processed, Err27.7.0 “Position information initialization error protection” is generated.

After the command is executed, position information is initialized, including actual position and position deviation, and is the same as when reset. Also, homing is not completed (excluding when in absolute mode) and latch is not completed. After the command is completed successfully, execute homing again.

The status during command execution and the output signals are as follows.

Status/output signal	Before execution	While executing	After execution
Position information	Current position information	Initialization	Information on current position with reference to the position at which command was executed (*1)
Homing state	Current state	Indeterminate	● Not complete in incremental mode ● Complete in absolute mode
Latch state	Current state	Indeterminate	Not complete
Busy (non-cyclic status)	0	1	0
Other status	Current state	Indeterminate	Current state
Output signal	Current state	Indeterminate	Current state

*1 Position information after command execution (initialization)

- Incremental mode
  All position information = 0
- Absolute mode
  All position information = Value of absolute encoder (scale)/ electronic gear ratio + Pr7.13 “Absolute home position offset”

— Precautions —

- While executing the command, do not run operations from Set-up Support Software (PANATERM ver.7) .

6.3.2 Class 0: Basic Settings

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
0	00	Rotational direction setup	0 to 1	1	—	C	○	○	○	○	*“7.2.1”*
0	01	Control mode setup	0 to 6	0	—	R	○	○	○	○	*“4.1.4”* *“8.8”*
0	02	Real-time auto-gain tuning setup	0 to 7	1	—	B	○	○	○	○	OI_A
0	03	Real-time auto-tuning machine stiffness setup	0 to 31	Sizes A, B: 13 Sizes C, D: 11 (13) (*3)	—	B	○	○	○	○	
0	04	Inertia ratio	0 to 100000	250	%	B	○	○	○	○	OI_A
0	08	Number of command pulses per one motor revolution	0 to 134217728	8388608	pulse	C	○	○	○	○	*“7.2.3”* TR_CS “”
0	09	Numerator of electronic gear	0 to 2^{30}	1	—	C	○	○	○	○	
0	10	Denominator of electronic gear	1 to 2^{30}	1	—	C	○	○	○	○	
0	11	Number of output pulses per motor revolution	1 to 33554432	2500	pulse	R	○	○	○	○	*“8.6”*
0	12	Reversal of pulse output logic	0 to 3	0	—	R	○	○	○	○	
0	13	1st torque limit	0 to 500	500 (*2)	%	B	○	○	○	○	*“8.1”*
0	14	Position deviation excess setup	0 to 2^{30}	83886080	Command unit	A	○	×	×	○	*“7.2.9”* *“Err24.0.0”*
0	15	Absolute encoder setup	0 to 4	1	—	C	○	○	○	×	*“7.2.7”* *“8.4”* *“8.5”* TR_CS “”
0	16	External regenerative resistor setup	0 to 3	Sizes A, B: 3 Sizes C, D: 0	—	C	○	○	○	○	*“7.2.6”*
0	17	Selection of load factor for external regenerative resistor	0 to 4	0	—	C	○	○	○	○	
0	18	Manufacturer use	—	0	—	—	—	—	—	—	—
0	22	Sensor feedback control mode setup (*1)	0 to 1	0	—	R	○	×	×	×	*“8.7.1”* *“4.2.4.1.4.6”* TR_CS “”
0	27	Selection of machine stiffness at real-time auto-gain tuning 2	0 to 44	Sizes A, B: 16 Sizes C, D: 12 (16) (*3)	—	B	○	○	○	○	OI_A
0	28	Selection of feed forward stiffness at real-time auto-gain tuning	0 to 44	Sizes A, B: 16 Sizes C, D: 12 (16) (*3)	—	B	○	○	○	○	

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

*2 Factory default values vary depending on the servo driver and motor combination.

For details, see *“8.1 Torque Limit Switching Function”* .

*3 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

6.3.3 Class 1: Gain Adjustment

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
1	00	1st gain of position loop	0 to 30000	Sizes A, B : 480 Sizes C, D: 320 (480) (*1)	0.1 s^{-1}	B	○	×	×	○	OI_A
1	01	1st velocity loop gain	1 to 32767	Sizes A, B: 270 Sizes C, D: 180 (270) (*1)	0.1 Hz	B	○	○	○	○	
1	02	1st velocity loop integration time constant	1 to 10000	Sizes A, B: 210 Sizes C, D: 310 (210) (*1)	0.1 ms	B	○	○	○	○	
1	03	1st filter of velocity detection	0 to 5	0	—	B	○	○	○	○	
1	04	1st torque filter time constant	0 to 2500	Sizes A, B: 84 Sizes C, D: 126 (84) (*1)	0.01 ms	B	○	○	○	○	OI_A
1	05	2nd gain of position loop	0 to 30000	Sizes A, B: 480 Sizes C, D: 320 (480) (*1)	0.1 s^{-1}	B	○	×	×	○	OI_A
1	06	2nd velocity loop gain	1 to 32767	Sizes A, B: 270 Sizes C, D: 180 (270) (*1)	0.1 Hz	B	○	○	○	○	
1	07	2nd velocity loop integration time constant	1 to 10000	Sizes A, B: 210 Sizes C, D: 310 (210) (*1)	0.1 ms	B	○	○	○	○	
1	08	2nd filter of velocity detection	0 to 5	0	—	B	○	○	○	○	
1	09	2nd torque filter time constant	0 to 2500	Sizes A, B: 84 Sizes C, D: 126 (84) (*1)	0.01 ms	B	○	○	○	○	OI_A
1	10	Velocity feed forward gain	0 to 4000	1000	0.1 %	B	○	×	×	○	OI_A
1	11	Velocity feed forward filter	0 to 6400	0	0.01 ms	B	○	×	×	○	
1	12	Torque feed forward gain	0 to 2000	1000	0.1 %	B	○	○	○	○	
1	13	Torque feed forward filter	0 to 6400	0	0.01 ms	B	○	○	○	○	
1	14	2nd gain setup	0 to 1	1	—	B	○	○	○	○	*“4.2.4.1.4.2”* OI_A
1	15	Mode of position control switching	0 to 10	0	—	B	○	×	×	○	OI_A
1	16	Delay time of position control switching	0 to 10000	10	0.1 ms	B	○	×	×	○	
1	17	Level of position control switching	0 to 20000	0	—	B	○	×	×	○	OI_A
1	18	Hysteresis at position control switching	0 to 20000	0	—	B	○	×	×	○	
1	19	Position gain switching time	0 to 10000	10	0.1 ms	B	○	×	×	○	
1	20	Mode of velocity control switching	0 to 5	0	—	B	×	○	×	×	
1	21	Delay time of velocity control switching	0 to 10000	0	0.1 ms	B	×	○	×	×	
1	22	Level of velocity control switching	0 to 20000	0	—	B	×	○	×	×	
1	23	Hysteresis at velocity control switching	0 to 20000	0	—	B	×	○	×	×	
1	24	Mode of torque control switching	0 to 3	0	—	B	×	×	○	×	
1	25	Delay time of torque control switching	0 to 10000	0	0.1 ms	B	×	×	○	×	
1	26	Level of torque control switching	0 to 20000	0	—	B	×	×	○	×	
1	27	Hysteresis at torque control switching	0 to 20000	0	—	B	×	×	○	×	

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
1	28	Manufacturer use	–	0	–	–	–	–	–	–	–
⋮											
1	78	Manufacturer use	–	0	–	–	–	–	–	–	
1	106	1st position loop gain change ratio	0 to 300	100	%	B	○	×	×	○	OI_A
1	107	1st velocity integration change ratio	0 to 300	100	%	B	○	○	○	○	
1	108	1st torque filter change ratio	0 to 300	100	%	B	○	○	○	○	
1	109	2nd position loop gain change ratio	0 to 300	100	%	B	○	×	×	○	
1	110	2nd velocity loop gain change ratio	0 to 300	100	%	B	○	○	○	○	
1	111	2nd velocity integration change ratio	0 to 300	100	%	B	○	○	○	○	
1	112	2nd torque filter change ratio	0 to 300	100	%	B	○	○	○	○	
1	113	Load fluctuation compensation filter change ratio	0 to 300	100	%	B	○	○	○	○	
1	114	Smoothing filter change ratio	0 to 300	100	%	B	○	○	○	○	
1	115	Tuning filter change ratio	0 to 300	100	%	B	○	○	○	○	

*1 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

6.3.4 Class 2: Vibration Suppression

○: Enabled ×: Disabled —: N/A

Parameter No. Class	No.	Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode P	S	T	F	Reference
2	00	Adaptive filter mode setup	0 to 6	0	—	B	○	○	×	○	OI_A
2	01	1st notch frequency	10 to 5000	5000	Hz	B	○	○	○	○	OI_A
2	02	1st notch width selection	0 to 20	2	—	B	○	○	○	○	
2	03	1st notch depth selection	0 to 99	0	—	B	○	○	○	○	
2	04	2nd notch frequency	10 to 5000	5000	Hz	B	○	○	○	○	
2	05	2nd notch width selection	0 to 20	2	—	B	○	○	○	○	
2	06	2nd notch depth selection	0 to 99	0	—	B	○	○	○	○	
2	07	3rd notch frequency	10 to 5000	5000	Hz	B	○	○	○	○	OI_A
2	08	3rd notch width selection	0 to 20	2	—	B	○	○	○	○	
2	09	3rd notch depth selection	0 to 99	0	—	B	○	○	○	○	
2	10	4th notch frequency	10 to 5000	5000	Hz	B	○	○	○	○	
2	11	4th notch width selection	0 to 20	2	—	B	○	○	○	○	
2	12	4th notch depth selection	0 to 99	0	—	B	○	○	○	○	
2	13	Selection of damping filter switching	0 to 7	0	—	B	○	×	×	○	OI_A
2	14	1st damping frequency	0 to 3000	0	0.1 Hz	B	○	×	×	○	OI_A
2	15	1st damping filter setup	0 to 1500	0	0.1 Hz	B	○	×	×	○	
2	16	2nd damping frequency	0 to 3000	0	0.1 Hz	B	○	×	×	○	
2	17	2nd damping filter setup	0 to 1500	0	0.1 Hz	B	○	×	×	○	
2	18	3rd damping frequency	0 to 3000	0	0.1 Hz	B	○	×	×	○	
2	19	3rd damping filter setup	0 to 1500	0	0.1 Hz	B	○	×	×	○	
2	20	4th damping frequency	0 to 3000	0	0.1 Hz	B	○	×	×	○	
2	21	4th damping filter setup	0 to 1500	0	0.1 Hz	B	○	×	×	○	
2	22	Positional command smoothing filter	0 to 10000	Sizes A, B: 92 Sizes C, D: 139 (92) (*1)	0.1 ms	B	○	○	×	○	"7.3.2" "7.3.3" "7.4.2" "7.6.2" "7.6.3" OI_A
2	23	Positional command FIR filter	0 to 10000	10	0.1 ms	B	○	×	×	○	OI_A
2	24	5th notch frequency	10 to 5000	5000	Hz	B	○	○	○	○	OI_A
2	25	5th notch width selection	0 to 20	2	—	B	○	○	○	○	
2	26	5th notch depth selection	0 to 99	0	—	B	○	○	○	○	
2	27	1st damping width setting	0 to 1000	0	—	B	○	×	×	○	OI_A
2	28	2nd damping width setting	0 to 1000	0	—	B	○	×	×	○	
2	29	3rd damping width setting	0 to 1000	0	—	B	○	×	×	○	
2	30	4th damping width setting	0 to 1000	0	—	B	○	×	×	○	
2	31	Manufacturer use	—	0	—	—	—	—	—	—	—
		⋮									
2	37	Manufacturer use	—	0	—	—	—	—	—	—	
2	38	Filter function switching	-32768 to 32767	3	—	B	○	○	○	○	—
		• bit 0: Custom notch filter									"7.3.2" "7.4.2" "7.6.2"
		• bit 1: Tuning filter 2									"7.3.2" "7.4.2" "7.6.2" OI_A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
2	39	Custom notch compensation coefficient	0 to 1000	0	0.01	B	○	○	○	○	“7.3.2” “7.4.2” “7.6.2” OI_A
2	40	Custom notch compensation frequency 1	0 to 10000	0	0.1 Hz	B	○	○	○	○	
2	41	Custom notch compensation frequency 2	0 to 10000	0	0.1 Hz	B	○	○	○	○	
2	42	Custom notch frequency	10 to 5000	5000	Hz	B	○	○	○	○	
2	43	Custom notch width	0 to 20	2	–	B	○	○	○	○	
2	44	Custom notch depth	0 to 99	0	–	B	○	○	○	○	
2	45	Function expansion setup 10	-2147483648 to 2147483647	61	–	B	○	○	○	○	–
		● bit 1 to 0: Two-degree-of-freedom control function setting									“7.2.5” OI_A
		● bit 2: Friction torque compensation parameter selection									OI_A
		● bit 3: Load fluctuation suppression function automatic calculation									OI_A
		● bit 5 to 4: Stiffness setting resolution, individual FB/FF setting switching									OI_A
2	46	Tuning filter 2	0 to 20000	Size A: 110 Size B: 120 Sizes C, D: 170 (120) (*1)	0.01 ms	B	○	×	×	○	“7.3.2” “7.4.2” “7.6.2”
2	50	Detection start vibration count	0 to 100	3	–	B	○	×	×	×	OI_A
2	51	Detected vibration amplitude	0 to 134217728	0	Command unit	B	○	×	×	×	
2	52	Torque command additional value 2	-1000 to 1000	0	0.1 %	B	○	○	×	○	OI_A
2	53	Positive direction torque compensation value 2	-1000 to 1000	0	0.1 %	B	○	×	×	○	
2	54	Negative direction torque compensation value 2	-1000 to 1000	0	0.1 %	B	○	×	×	○	
2	61	Target settling time	0 to 32767	0	ms	A	○	○	○	○	OI_A
2	62	Settling time count condition	0 to 1	0	–	A	○	○	○	○	
2	63	Allowable overshoot amount	0 to 500	100	%	A	○	○	○	○	
2	64	Tuning amount of movement	0 to 2147483647	0	Command unit	A	○	○	○	○	
2	65	Tuning max speed	0 to 20000	0	r/min	A	○	○	○	○	
2	66	Tuning acceleration and deceleration time	0 to 5000	0	ms	A	○	○	○	○	
2	67	Tuning wait time	0 to 10000	2000	ms	A	○	○	○	○	
2	68	Tuning operating range upper limit	0 to 1073741823	8388608	Command unit	A	○	○	○	○	
2	69	Tuning operating range lower limit	-1073741824 to 0	-8388608	Command unit	A	○	○	○	○	
2	70	Tuning overspeed level setting	0 to 20000	0	r/min	A	○	○	○	○	
2	71	Tuning torque limit	0 to 500	0	%	A	○	○	○	○	
2	72	Tuning start RTAT machine stiffness setting	0 to 44	8	–	A	○	○	○	○	
2	73	Tuning stability margin	0 to 100	80	%	A	○	○	○	○	
2	74	Tuning auto tuning application selection	-32768 to 32767	0	–	A	○	○	○	○	OI_A
2	75	Tuning step selection	-32768 to 32767	3	–	A	○	○	○	○	–
		● bit 0: Advance operation									OI_A
		● bit 1: Homing operation									

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
2	76	Tuning target function selection	-32768 to 32767	1009	–	A	○	○	○	○	–
		● bit 0: Inertia ratio									OI_A
		● bit 1: Unbalanced load compensation (default disabled)									
		● bit 2: Dynamic friction compensation (default disabled)									
		● bit 3: Viscous friction compensation (default disabled)									
		● bit 4: RTAT machine stiffness setting (position and speed gains, speed integration time constant, torque filter)									
		● bit 5: RTAT feedforward control section stiffness setting (smoothing filter time constant)									
		● bit 6: Notch filter									
		● bit 7: 1st damping filter									
		● bit 8: 2nd damping filter									
		● bit 9: Load fluctuation control function									
2	77	Tuning start position	-1073741824 to 1073741823	0	Command unit	A	○	○	○	○	OI_A
2	78	Tuning vibration automatic suppression effective level	0 to 100	15	%	A	○	○	○	○	
2	79	Tuning JOG test run command speed	0 to 500	60	r/min	A	○	○	○	○	
2	80	Tuning JOG test run acceleration and deceleration time	0 to 5000	50	ms	A	○	○	○	○	

*1 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

6.3.5 Class 3: Velocity/Torque Control/Full-closed Control

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
3	04	Manufacturer use	—	0	—	—	—	—	—	—	—
⋮											
3	07	Manufacturer use	—	0	—	—	—	—	—	—	
3	12	Acceleration time setup	0 to 10000	0	ms/(1000 r/min)	B	×	○	×	×	OI_A
3	13	Deceleration time setup	0 to 10000	0	ms/(1000 r/min)	B	×	○	×	×	
3	14	Sigmoid acceleration / deceleration time setup	0 to 1000	0	ms	B	×	○	×	×	
3	17	Selection of speed limit	0 to 1	0	—	B	×	×	○	×	“7.5.2”
3	21	Velocity limit value 1	0 to 20000	0	r/min	B	×	×	○	×	
3	22	Velocity limit value 2	0 to 20000	0	r/min	B	×	×	○	×	
3	23	External scale selection	0 to 2	0	—	R	○	○	○	○	“7.2.8” “8.8” “8.9”
3	24	Numerator of external scale division	0 to 2^{27}	0	—	R	×	×	×	○	“7.6.4”
3	25	Denominator of external scale division	1 to 2^{27}	10000	—	R	×	×	×	○	
3	26	Reversal of direction of external scale	0 to 3	0	—	R	○	○	○	○	“7.2.8” “8.9”
3	27	External scale Z phase disconnection detection disable	0 to 1	0	—	R	○	○	○	○	“8.9”
3	28	Hybrid deviation excess setup	1 to 2^{27}	16000	Command unit	C	×	×	×	○	“7.6.5”
3	29	Hybrid deviation clear setup	0 to 100	0	Rotation	C	×	×	×	○	
3	33	Analog input gain (*1)	0 to 30000	0	Command unit/mV	B	○	×	×	○	“8.7.1”
3	34	Analog input polarity (*1)	0 to 1	0	—	B	○	×	×	○	
3	35	Analog input integration time constant (*1)	0 to 100000	0	0.01 ms	B	○	×	×	○	
3	36	Analog input integration limit (*1)	0 to 2147483647	0	Command unit	B	○	×	×	○	
3	42	Sensor feedback control function extended setup (*1)	-32768 to 32767	0	—	B	○	×	×	×	—
		● bit 0: Displacement control function position command latch switching									“8.7.1” TR_CS “”

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

6.3.6 Class 4: I/O Monitor Settings

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
4	00	SI1 input selection	0 to 00FFFFFFh	3289650	—	C	○	○	○	○	*“3.2.5.4.2”*
4	01	SI2 input selection	0 to 00FFFFFFh	8487297	—	C	○	○	○	○	
4	02	SI3 input selection	0 to 00FFFFFFh	8553090	—	C	○	○	○	○	
4	03	SI4 input selection	0 to 00FFFFFFh	3026478	—	C	○	○	○	○	
4	04	SI5 input selection	0 to 00FFFFFFh	2236962	—	C	○	○	○	○	
4	05	SI6 input selection	0 to 00FFFFFFh	2171169	—	C	○	○	○	○	
4	06	SI7 input selection	0 to 00FFFFFFh	2829099	—	C	○	○	○	○	
4	07	SI8 input selection	0 to 00FFFFFFh	3223857	—	C	○	○	○	○	
4	10	SO1 output selection	0 to 00FFFFFFh	197379	—	C	○	○	○	○	*“3.2.5.5.1”*
4	11	SO2 output selection	0 to 00FFFFFFh	1052688	—	C	○	○	○	○	
4	12	SO3 output selection	0 to 00FFFFFFh	65793	—	C	○	○	○	○	
4	16	Type of analog monitor 1	0 to 35	0	—	A	○	○	○	○	*“3.2.8”*
4	17	Analog monitor 1 output gain	0 to 214748364	0	—	A	○	○	○	○	
4	18	Type of analog monitor 2	0 to 35	0	—	A	○	○	○	○	
4	19	Analog monitor 2 output gain	0 to 214748364	0	—	A	○	○	○	○	
4	21	Analog monitor output setup	0 to 2	0	—	A	○	○	○	○	
4	22	Analog input (AIN) offset setting (*1)	-26666 to 26666	0	0.375 mV	B	○	○	○	○	*“8.7.1”* TR_CS “”
4	23	Analog input (AIN) filter setting (*1)	0 to 6400	0	0.01 ms	B	○	○	○	○	
4	24	Analog input (AIN) excessive setting (*1)	0 to 100	0	0.1 V	B	○	○	○	○	
4	31	Positioning complete (In-position) range	0 to 2097152	8400	Command unit	A	○	×	×	○	*“7.3.4”* OI_A
4	32	Positioning complete (In-position) output setup	0 to 10	0	—	A	○	×	×	○	*“7.3.4”*
4	33	INP hold time	0 to 30000	0	ms	A	○	×	×	○	
4	34	Zero-speed	10 to 20000	50	r/min	A	○	○	○	○	*“3.2.5.5.1”*
4	35	Speed coincidence range	10 to 20000	50	r/min	A	×	○	○	×	*“7.4.5”*
4	36	At-speed (Speed arrival)	10 to 20000	1000	r/min	A	×	○	○	×	*“7.4.4”*
4	37	Mechanical brake action at stalling setup	0 to 10000	0	ms	B	○	○	○	○	*“8.15”*
4	38	Mechanical brake action at running setup	0 to 32000	0	ms	B	○	○	○	○	*“8.15”* *“8.17”* *“8.18”* *“8.21”*
4	39	Brake release speed setup	30 to 3000	30	r/min	B	○	○	○	○	*“8.15”* *“8.17”* *“8.18”*
4	40	Selection of alarm output 1	0 to 32767	0	—	A	○	○	○	○	*“10.3”*
4	41	Selection of alarm output 2	0 to 32767	0	—	A	○	○	○	○	
4	42	Positioning complete (In-position) range 2	0 to 2097152	8400	Command unit	A	○	×	×	○	*“7.3.4”*
4	44	Position comparison output pulse width setting	0 to 32767	0	0.1 ms	R	○	○	○	○	*“8.3”*
4	45	Position comparison output polarity selection	0 to 7	0	—	R	○	○	○	○	—
		● bit 0: Polarity for SO1 (general-purpose output) or OCMP1 (encoder/position comparison output terminal)									*“8.3”*
		● bit 1: Polarity for SO2 (general-purpose output) or OCMP2 (encoder/position comparison output terminal)									
		● bit 2: Polarity for SO3 (general-purpose output) or OCMP3 (encoder/position comparison output terminal)									

Parameter No. Class	No.	Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode P	S	T	F	Reference
4	47	Pulse output selection	0 to 1	0	—	R	○	○	○	○	*"8.3"* *"8.6"*
4	48	Position comparison value 1	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	*"8.3"*
4	49	Position comparison value 2	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	50	Position comparison value 3	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	51	Position comparison value 4	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	52	Position comparison value 5	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	53	Position comparison value 6	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	54	Position comparison value 7	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	55	Position comparison value 8	-2147483648 to 2147483647	0	Command unit	A	○	○	○	○	
4	56	Position comparison output delay compensation amount	-32768 to 32767	0	0.1 μs	B	○	○	○	○	
4	57	Position comparison output assignment setting	-2147483648 to 2147483647	0	—	R	○	○	○	○	—
		● bit 3 to 0: Position comparison 1									*"8.3"*
		● bit 7 to 4: Position comparison 2									
		● bit 11 to 8: Position comparison 3									
		● bit 15 to 12: Position comparison 4									
		● bit 19 to 16: Position comparison 5									
		● bit 23 to 20: Position comparison 6									
		● bit 27 to 24: Position comparison 7									
		● bit 31 to 28: Position comparison 8									
4	63	Manufacturer use	—	5242884	—	—	—	—	—	—	—
4	64	Manufacturer use	—	64	—	—	—	—	—	—	—
4	65	Analog input internal offset setting	-32768 to 32767	0	mV	A	○	○	○	○	*"8.7.1"* TR_CS ""
4	66	Analog input deviation limit setting	0 to 65535	0	mV	A	○	○	○	○	
4	67	Analog input voltage dead zone setting	0 to 65535	0	mV	B	○	○	○	○	

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

6.3.7 Class 5: Enhancing Settings

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
5	03	Denominator of pulse output division	0 to 134217728	0	—	R	○	○	○	○	"8.6"
5	04	Over-travel inhibit input setup	0 to 2	1	—	C	○	○	○	○	"8.14" "5.5.2"
5	05	Sequence at over-travel inhibit	0 to 2	0	—	C	○	○	○	○	"8.14" "8.21"
5	06	Sequence at servo-off	0 to 9	0	—	B	○	○	○	○	"8.15" "8.21"
5	07	Sequence upon main power off	0 to 9	0	—	B	○	○	○	○	"8.16" "8.21"
5	08	L/V trip selection upon main power off	0 to 3	1	—	B	○	○	○	○	—
		• bit 0: Operation selection with main power supply OFF • bit 1: Main power off warning condition detection time									"8.12" "8.16"
5	09	Detection time of main power off	20 to 2000	70	ms	C	○	○	○	○	"8.12" "8.16"
5	10	Sequence at alarm	0 to 7	0	—	B	○	○	○	○	"8.17" "8.18" "8.19" "8.21"
5	11	Torque setup for emergency stop	0 to 500	0	%	B	○	○	○	○	"8.1" "8.14" "8.15" "8.16" "8.18"
5	12	Motor overload level setup	0 to 500	0	%	A	○	○	○	○	"10.3"
5	13	Over-speed level setup	0 to 20000	0	r/min	B	○	○	○	○	"8.18"
5	14	Motor working range setup	0 to 1000	10	0.1 rotation	A	○	×	×	○	"7.2.4"
5	15	Control input signal reading setup	0 to 3	0	—	C	○	○	○	○	"3.2.5.4.2"
5	20	Position setup unit select	0 to 1	0	—	C	○	×	×	○	"7.3.4" "7.2.9"
5	21	Selection of torque limit	0 to 4	1	—	B	○	○	×	○	"8.1" "4.2.4.1.4.3"
5	22	2nd torque limit	0 to 500	500 (*1)	%	B	○	○	×	○	"8.1"
5	23	Torque limit switching setup 1	0 to 4000	0	ms/100 %	B	○	○	×	○	
5	24	Torque limit switching setup 2	0 to 4000	0	ms/100 %	B	○	○	×	○	
5	25	Positive direction torque limit	0 to 500	500 (*1)	%	B	○	○	×	○	
5	26	Negative direction torque limit	0 to 500	500 (*1)	%	B	○	○	×	○	
5	29	Manufacturer use	—	2	—	—	—	—	—	—	—
5	31	USB axis address	0 to 127	1	—	C	○	○	○	○	PT_OM
5	33	Pulse regenerative output limit setup	0 to 1	0	—	C	○	○	○	○	"8.6"
5	34	Manufacturer use	—	4	—	—	—	—	—	—	—
5	36	Manufacturer use	—	0	—	—	—	—	—	—	—
5	45	Quadrant glitch positive-direction compensation value	-1000 to 1000	0	0.1 %	B	○	×	×	○	OI_A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
5	46	Quadrant glitch negative-direction compensation value	-1000 to 1000	0	0.1 %	B	○	×	×	○	OI_A
5	47	Quadrant glitch compensation delay time	0 to 1000	0	ms	B	○	×	×	○	
5	48	Quadrant glitch compensation filter setting L	0 to 6400	0	0.01 ms	B	○	×	×	○	
5	49	Quadrant glitch compensation filter setting H	0 to 10000	0	0.1 ms	B	○	×	×	○	
5	50	Manufacturer use	–	0	–	–	–	–	–	–	–
⋮											
5	55	Manufacturer use	–	0	–	–	–	–	–	–	
5	56	Slow stop deceleration time setting	0 to 10000	0	ms/(1000 r/min)	B	○	○	○	×	*“8.21”*
5	57	Slow stop S-shape acceleration and deceleration setting	0 to 1000	0	ms	B	○	○	○	×	
5	66	Deterioration diagnosis convergence judgment time	0 to 10000	0	0.1 s	A	○	○	○	○	*“8.10”*
5	67	Deterioration diagnosis inertia ratio upper limit	0 to 10000	0	%	A	○	○	○	○	
5	68	Deterioration diagnosis inertia ratio lower limit	0 to 10000	0	%	A	○	○	○	○	
5	69	Deterioration diagnosis unbalanced load upper limit	-1000 to 1000	0	0.1 %	A	○	○	○	○	
5	70	Deterioration diagnosis unbalanced load lower limit	-1000 to 1000	0	0.1 %	A	○	○	○	○	
5	71	Deterioration diagnosis dynamic friction upper limit	-1000 to 1000	0	0.1 %	A	○	○	○	○	
5	72	Deterioration diagnosis dynamic friction lower limit	-1000 to 1000	0	0.1 %	A	○	○	○	○	
5	73	Deterioration diagnosis viscous friction upper limit	0 to 10000	0	0.1%/(10000 r/min)	A	○	○	○	○	
5	74	Deterioration diagnosis viscous friction lower limit	0 to 10000	0	0.1%/(10000 r/min)	A	○	○	○	○	
5	75	Deterioration diagnosis velocity setting	-20000 to 20000	0	r/min	A	○	○	○	○	
5	76	Deterioration diagnosis torque average time	0 to 10000	0	ms	A	○	○	○	○	
5	77	Deterioration diagnosis torque upper limit	-1000 to 1000	0	0.1 %	A	○	○	○	○	
5	78	Deterioration diagnosis torque lower limit	-1000 to 1000	0	0.1 %	A	○	○	○	○	
5	95	Manufacturer use	–	0	0	–	–	–	–	–	–
5	110	Driver derating factor	0 to 100	100	%	A	○	○	○	○	*“8.22”*
5	112	Manufacturer use	–	0	–	–	–	–	–	–	–

*1 Factory default values vary depending on the servo driver and motor combination.

For details, see *“8.1 Torque Limit Switching Function”* .

6.3.8 Class 6: Special Settings

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
6	02	Speed deviation excess setup	0 to 20000	0	r/min	A	○	×	×	×	*"Err24.1.0"*
6	03	Manufacturer use	—	0	—	—	—	—	—	—	—
6	05	Position 3rd gain valid time	0 to 10000	0	0.1 ms	B	○	×	×	○	OI_A
6	06	Position 3rd gain scale factor	50 to 1000	100	%	B	○	×	×	○	
6	07	Torque command additional value	-100 to 100	0	%	B	○	○	×	○	OI_A
6	08	Positive direction torque compensation value	-100 to 100	0	%	B	○	×	×	○	
6	09	Negative direction torque compensation value	-100 to 100	0	%	B	○	×	×	○	
6	10	Function expansion setup	-32768 to 32767	16	—	B	○	○	○	○	—
		• bit 1: Load fluctuation control function									OI_A
		• bit 2: Load fluctuation stabilization setting									
		• bit 4: Current response improvement									OI_A
		• bit 10: Fall prevention function during an alarm									*"8.19"* *"8.21"*
		• bit 11: Encoder overheat error protection detection									*"Err15.1.0"*
		• bit 14: Load fluctuation suppression function automatic tuning									OI_A
		• bit 15: Slow stop function									*"8.21"*
6	11	Current loop gain response setup	10 to 300	100	%	B	○	○	○	○	OI_A
6	14	Emergency stop time at alarm	0 to 1000	200	ms	B	○	○	○	○	*"8.18"* *"8.21"*
6	15	2nd overspeed level setting	0 to 20000	0	r/min	B	○	○	○	○	*"8.18"*
6	18	Power-up wait time	0 to 100	0	0.1 s	R	○	○	○	○	*"7.1"*
6	19	Manufacturer use	—	0	—	—	—	—	—	—	—
⋮											
6	21	Manufacturer use	—	0	—	—	—	—	—	—	
6	22	AB phase external scale pulse outputting method selection	0 to 1	0	—	R	×	×	×	○	*"8.6"*
6	23	Load change compensation gain	-100 to 100	0	%	B	○	○	×	○	OI_A
6	24	Load change compensation filter	10 to 2500	53	0.01 ms	B	○	○	×	○	
6	26	Manufacturer use	—	0	—	—	—	—	—	—	—
6	27	Warning latch state setup	0 to 3	0	—	C	○	○	○	○	—
		• bit 0: Expanded warnings									*"10.3"*
		• bit 1: General warnings									
6	30	Manufacturer use	—	0	—	—	—	—	—	—	—
6	31	Real time auto tuning estimation speed	0 to 3	1	—	B	○	○	○	○	OI_A

Parameter No. Class	No.	Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode P	S	T	F	Reference
6	32	Real time auto tuning custom setup	-32768 to 32767	0	–	B	○	○	○	○	–
		● bit 1 to 0: Load characteristics estimation									OI_A
		● bit 3 to 2: Inertia Ratio Update									
		● bit 6 to 4: Torque compensation									
		● bit 7: Stiffness Setup									
		● bit 8: Fixed Parameter Setup									
		● bit 10 to 9: Gain Switching Setup									
		● bit 11: Torque compensation setting switching									
		● bit 15 to 12: Individual torque compensation settings									
6	34	Hybrid vibration suppression gain	0 to 30000	0	0.1 s^{-1}	B	×	×	×	○	OI_A
6	35	Hybrid vibration suppression filter	0 to 32000	10	0.01 ms	B	×	×	×	○	
6	36	Dynamic brake operation input setup	0 to 1	0	–	R	○	○	○	○	"8.16"
6	37	Oscillation detecting level	0 to 1000	0	0.1 %	B	○	○	○	○	"10.3"
6	38	Warning mask setup	-32768 to 32767	4	–	C	○	○	○	○	
6	39	Warning mask setup 2	-32768 to 32767	0	–	C	○	○	○	○	
6	41	1st damping depth	0 to 1000	0	–	B	○	×	×	○	OI_A
6	42	2-stage torque filter time constant	0 to 2500	0	0.01 ms	B	○	○	○	○	OI_A
6	43	2-stage torque filter attenuation term	0 to 1000	0	–	B	○	○	○	○	
6	47	Function expansion setup 2	-32768 to 32767	1	–	R	○	○	○	○	–
		● bit 0: Two-degree-of-freedom control mode									"7.2.5" OI_A
		● bit 2: Encoder communication error/warning judgment setup									"10.3"
		● bit 3: Two-degree-of-freedom control real-time auto tuning selection									"7.2.5" OI_A
		● bit 14: Quadrant glitch compensation function									OI_A
6	48	Tuning filter	0 to 2000	Size A: 11 Size B: 12 Sizes C, D: 17 (12) (*1)	0.1 ms	B	○	○	×	○	"7.3.2" "7.4.2" "7.6.2"
6	49	Command response/tuning filter attenuation term	0 to 99	15	–	B	○	×	×	○	"7.3.2" "7.4.2" "7.6.2" OI_A
6	50	Viscous friction compensating gain	0 to 10000	0	0.1 %/ (10000 r/min)	B	○	○	×	○	"7.3.2" "7.6.2"
6	51	Wait time for emergency stop	0 to 10000	0	ms	B	○	○	○	○	"8.19"
6	52	Manufacturer use	–	0	–	–	–	–	–	–	–
⋮											
6	54	Manufacturer use	–	0	–	–	–	–	–	–	
6	57	Torque saturation error protection detection time	0 to 5000	0	ms	B	○	○	×	○	"8.2"
6	58	Manufacturer use	–	0	–	–	–	–	–	–	–
6	59	Manufacturer use	–	0	–	–	–	–	–	–	–
6	60	2nd damping depth	0 to 1000	0	–	B	○	×	×	○	OI_A
6	61	1st resonance frequency	0 to 3000	0	0.1 Hz	B	○	×	×	×	OI_A
6	62	1st resonance attenuation ratio	0 to 1000	0	–	B	○	×	×	×	

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
6	63	1st anti-resonance frequency	0 to 3000	0	0.1 Hz	B	○	×	×	×	OI_A
6	64	1st anti-resonance attenuation ratio	0 to 1000	0	–	B	○	×	×	×	
6	65	1st response frequency	0 to 3000	0	0.1 Hz	B	○	×	×	×	
6	66	2nd resonance frequency	0 to 3000	0	0.1 Hz	B	○	×	×	×	
6	67	2nd resonance attenuation ratio	0 to 1000	0	–	B	○	×	×	×	
6	68	2nd anti-resonance frequency	0 to 3000	0	0.1 Hz	B	○	×	×	×	
6	69	2nd anti-resonance attenuation ratio	0 to 1000	0	–	B	○	×	×	×	
6	70	2nd response frequency	0 to 3000	0	0.1 Hz	B	○	×	×	×	
6	71	3rd damping depth	0 to 1000	0	–	B	○	×	×	○	OI_A
6	72	4th damping depth	0 to 1000	0	–	B	○	×	×	○	
6	73	Load estimation filter	0 to 2500	0	0.01 ms	B	○	○	×	○	OI_A
6	74	Torque compensation frequency 1	0 to 5000	0	0.1 Hz	B	○	○	×	○	
6	75	Torque compensation frequency 2	0 to 5000	0	0.1 Hz	B	○	○	×	○	
6	76	Load estimation count	0 to 8	0	–	B	○	○	×	○	
6	85	Retracting operation condition setting	-32768 to 32767	0	–	C	○	○	○	○	–
		● bits 0 to 3: Retracting operation initialization conditions (I/O)									*"8.12"*
		● bits 7 to 4: Retracting operation initialization conditions (communication)									
		● bits 9 to 8: Judgment condition for stopping retracting operation									
6	86	Retracting operation alarm setting	-32768 to 32767	0	–	C	○	○	○	○	–
		● bit 0: Err85.0.0 "Retracting operation completion (I/O)" /Err87.1.0 "Retracting operation completion (I/O)"									*"8.12"*
		● bit 1: Err85.1.0 "Retracting operation completion (communication)" /Err87.2.0 "Retracting operation completion (communication)"									
		● bit 2: Err85.2.0 "Retracting operation error" /Err87.3.☐ "Retracting operation error"									
		● bit 15: Retracting operation-related alarm switching									
6	87	Manufacturer use	–	0	–	–	–	–	–	–	–
6	88	Absolute encoder multi-turn data upper-limit value	0 to 65534	0	–	C	○	○	○	○	*"8.5"* TR_CS ""
6	95	Motor overload warning detection level	0 to 114	0	%	A	○	○	○	○	*"10.3"*
6	96	Motor overload warning release level	0 to 114	0	%	A	○	○	○	○	
6	97	Function expansion setup 3	-2147483648 to 2147483647	1024	–	B	○	○	○	○	–
		● bit 0: Quadrant glitch compensation HPF clear									OI_A
		● bit 1: Deterioration Diagnosis Warning Function									*"8.10"*
		● bit 2: Motor movable range error protection expansion									*"7.2.4"*
		● bit 6: Manufacturer use									–
		● bit 10: Position comparison output function selection									*"8.3"*
		● bit 27: Alarm display switch setting									TR_FS "3.3.1"
6	98	Function expansion setup 4	-2147483648 to 2147483647	0	–	R	○	○	○	○	–
		● bit 3: Effective bit expansion for multi-turn data									TR_CS ""
		● bit 9: Virtual full-closed control mode function									*"8.8"*
6	104	Open-phase monitoring setup	0 to 3	0	–	B	○	○	○	○	*"Err13.2.0"* *"10.3"*

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
6	106	Manufacturer use	–	0	–	–	–	–	–	–	–
6	121	Current feed forward response setup	0 to 300	100	%	B	○	○	○	○	OI_A
6	125	Manufacturer use	–	0	–	–	–	–	–	–	–
6	126	Warning 2 mask setup	-2147483648 to 2147483647	0	–	C	○	○	○	○	*"10.3"*
6	127	Warning 3 mask setup	-2147483648 to 2147483647	0	–	C	○	○	○	○	

*1 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

6.3.9 Class 7: Special Settings 2

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
7	00	Display on LED	0 to 32767	0	—	A	○	○	○	○	“3.4.3”
7	01	Address display time setup upon power-up	-1 to 1000	0	100 ms	R	○	○	○	○	
7	03	Output setup during torque limit	0 to 1	0	—	A	×	×	○	×	“8.2”
7	04	Manufacturer use	—	0	—	—	—	—	—	—	—
⋮											
7	08	Manufacturer use	—	0	—	—	—	—	—	—	
7	09	Correction time of latch delay 1	-2000 to 2000	360	25 ns	B	○	○	○	○	TR_CS “”
7	10	Software limit function	0 to 3	0	—	A	○	×	×	○	TR_CS “”
7	11	Positive side software limit value	-1073741823 to 1073741823	500000	Command unit	A	○	×	×	○	
7	12	Negative side software limit value	-1073741823 to 1073741823	-500000	Command unit	A	○	×	×	○	
7	13	Absolute home position offset	-2147483648 to 2147483647	0	Command unit	C	○	○	○	○	“8.4” “8.5” TR_CS “”
7	14	Main power off warning detection time	0 to 2000	0	ms	C	○	○	○	○	“10.3”
7	15	Positioning proximity range	0 to 1073741823	10	Command unit	A	○	×	×	○	TR_CS “”
7	16	Torque saturation error protection frequency	0 to 30000	0	Incidences	B	○	○	×	○	“8.2”
7	20	RTEX communication cycle setup	-1 to 12	3	—	R	○	○	○	○	“4.1.4” TR_CS “”
7	21	RTEX command updating cycle ratio setup	1 to 2	2	—	R	○	○	○	○	
7	22	RTEX function expansion setup 1	-32768 to 32767	0	—	R	○	○	○	○	—
		• bit 0: RTEX communication data size									“4.1.4”
		• bit 1: Interaxis full-synchronous mode using RTEX communication TMG_CNT									TR_CS “” “”
		• bit 4: External scale position information monitoring function setting for semi-closed control									“4.1.4” “8.9” TR_CS “” “”
		• bit 5: Command position change saturation function selection									TR_CS “”
		• bit 6: Homing return velocity limit enabled									TR_CS “”

Parameter No. Class	Parameter No. No.	Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode P	S	T	F	Reference
7	23	RTEX function expansion setup 2	-32768 to 32767	18	–	B	○	○	○	○	–
		● bit 0: Parameter writing via RTEX communication permitted									TR_CS “”
		● bit 1: Alarm No. sub-number setting									TR_CS “”
		● bit 2: RTEX status response condition setting with POT and NOT functions disabled									“8.14” TR_CS “”
		● bit 3: POT and NOT RTEX status bit arrangement settings									“8.14” TR_CS “”
		● bit 4: COM-LED compatibility (COM-LED is the phase status)									“3.4.4”
		● bit 5: Non-cyclic Command Startup Mode Settings									TR_CS “”
		● bit 6: POT and NOT RTEX status logical settings									“8.14” TR_CS “”
		● bit 7: RTEX status bit arrangement settings for PSL and NSL									TR_CS “”
		● bit 8: RTEX status selection of In_Progress/AC_OFF									“8.3” “8.8” “8.12” TR_CS “”
		● bit 9: Command error return switching for commands received in the direction of over-travel inhibit input after over-travel inhibit deceleration to stop									“8.8” “8.14” TR_CS “”
		● bit 14: Position deviation [command unit] output setup									“7.3.4” “7.3.2” “7.3.3” “7.6.2” “7.6.3”
		● bit 15: In_Progress/AC_OFF/Pr7.112 value									“8.3” “8.8” “8.12” TR_CS “”
7	24	RTEX function expansion setup 3	-32768 to 32767	0	–	C	○	○	○	○	–
		● bit 0: EX-OUT1 output status setting at the time of communication interrupted after RTEX communication is established									TR_CS “”
		● bit 1: EX-OUT2 output status setting at the time of communication interrupted after RTEX communication is established									
		● bit 3: RTEX communication In_Position judgment condition setting									“7.3.4”
		● bit 4: Servo_Active ON timing switching									TR_CS “”
		● bit 5: Latch position detection delay compensation function switching									TR_CS “”
		● bit 7: Internal value status selection of TFF from RTEX communication (fall prevention when servo-on)									“8.20” TR_CS “”
7	25	RTEX velocity unit setup	0 to 1	0	–	C	○	○	○	○	“8.12”
7	26	RTEX continuous communication error warning setup	0 to 32767	0	Incidences	A	○	○	○	○	“10.3”
7	27	RTEX accumulated communication error warning setup	0 to 32767	0	Incidences	A	○	○	○	○	

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
7	28	RTEX_Update_Counter error warning setup	0 to 32767	0	Incidences	A	○	○	○	○	*“10.3”*
7	29	RTEX monitor select 1	0 to 32767	0	–	A	○	○	○	○	TR_CS “”
7	30	RTEX monitor select 2	0 to 32767	0	–	A	○	○	○	○	TR_CS “” “”
7	31	RTEX monitor select 3	0 to 32767	0	–	A	○	○	○	○	
7	32	RTEX monitor select 4	0 to 32767	0	–	A	○	○	○	○	TR_CS “” “”
7	33	RTEX monitor select 5	0 to 32767	0	–	A	○	○	○	○	TR_CS “”
7	34	RTEX monitor select 6	0 to 32767	0	–	A	○	○	○	○	
7	35	RTEX command setup 1	0 to 2	0	–	C	○	○	○	○	*“8.20”* TR_CS “”
7	36	RTEX command setup 2	0 to 2	0	–	C	○	○	○	○	
7	37	RTEX command setup 3	0 to 2	0	–	C	○	○	○	○	
7	38	RTEX_Update_Counter error protection setup	0 to 32767	0	Incidences	A	○	○	○	○	*“10.3”*
7	39	Manufacturer use	–	0	–	–	–	–	–	–	–
7	41	RTEX function expansion setup 5	-32768 to 32767	0	–	R	○	○	○	○	–
		● bit 7: Over-travel inhibit input detection setting during Z-phase homing return operation									TR_CS “”
7	44	Manufacturer use	–	16908546	–	–	–	–	–	–	–
7	78	Latch trigger signal reading setting with stop function	0 to 3	0	–	C	○	×	×	○	*“8.11”*
7	80	Manufacturer use	–	0	–	–	–	–	–	–	–
7	87	Manufacturer use	–	0	–	–	–	–	–	–	–
⋮											
7	89	Manufacturer use	–	0	–	–	–	–	–	–	
7	91	RTEX communication cycle expansion setup	0 to 2000000	500000	ns	R	○	○	○	○	*“4.1.4”* TR_CS “”
7	92	Correction time of latch delay 2	-2000 to 2000	0	25 ns	B	○	○	○	○	TR_CS “”
7	93	Homing return speed limit value	0 to 20000	0	r/min	C	○	○	○	○	TR_CS “”
7	95	RTEX continuous communication error protection 1 detection count	0 to 17	4	Incidences	R	○	○	○	○	TR_CS “” *“Err83.0.0”*
7	96	RTEX continuous communication error protection 2 detection count	0 to 17	12	Incidences	R	○	○	○	○	TR_CS “” *“Err83.1.0”*
7	97	RTEX communication timeout error protection detection count	0 to 17	4	Incidences	R	○	○	○	○	*“Err84.0.0”*
7	98	RTEX cyclic data error protection 1/2 detection count	0 to 17	4	Incidences	R	○	○	○	○	*“Err86.0.0, Err86.1.0”*

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
7	99	RTEX function expansion setup 6	-32768 to 32767	0	–	B	○	○	○	○	–
		● bit 0: Enable/disable FFT execution while RTEX communication is established									"10.3" TR_CS ""
		● bit 3: Command pulse accumulated value [command unit] output setting									"7.3.2" "7.3.3" "7.6.2" "7.6.3" "8.8"
		● bit 7: Monitor command regenerative load factor unit switching									TR_CS ""
7	100	Manufacturer use	–	0	–	–	–	–	–	–	–
		⋮									
7	104	Manufacturer use	–	0	–	–	–	–	–	–	
7	108	RTEX communication synchronization setup	0 to 7	7	–	R	○	○	○	○	"Err96.4.0"
7	109	Manufacturer use	–	1	–	–	–	–	–	–	–
7	110	RTEX function expansion setup 7	-2147483648 to 2147483647	0	–	B	×	×	×	○	–
		● bit 4: Profile position control mode startup condition expansion									TR_CS ""
		● bit 16: External scale position variation enabled during virtual full-closed control mode									"8.8"
7	111	Trigger signal allocation setting of latch mode with stop function	0 to 64	0	–	C	○	×	×	○	"8.11" TR_CS ""
7	112	Selection of RTEX communication status flag	0 to 2	0	–	B	○	○	○	○	"8.3" "8.8" "8.12"
7	127	Manufacturer use	–	0	–	–	–	–	–	–	–

6.3.10 Class 8: Special Settings 3

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
8	00	Manufacturer use	—	0	—	—	—	—	—	—	—
8	01	Profile linear acceleration constant	1 to 429496	100	10,000 command units/s^2	B	○	○	○	○	“8.12” TR_CS “”
8	02	Manufacturer use	—	0	—	—	—	—	—	—	—
8	03	Manufacturer use	—	0	—	—	—	—	—	—	—
8	04	Profile linear deceleration constant	1 to 429496	100	10,000 command units/s^2	B	○	○	○	○	“8.12” TR_CS “”
8	05	Manufacturer use	—	0	—	—	—	—	—	—	—
8	10	Amount of travel after profile position latch detection	-1073741823 to 1073741823	0	Command unit	B	○	×	×	○	TR_CS “”
8	12	Profile homing mode setting	0 to 1	0	—	B	○	×	×	○	
8	13	Profile homing speed 1	0 to 2147483647	50	Command unit/s or r/min	B	○	×	×	○	
8	14	Profile homing speed 2	0 to 2147483647	5	Command unit/s or r/min	B	○	×	×	○	
8	15	Manufacturer use	—	0	—	—	—	—	—	—	—
8	17	Relative movement of retracting operation	-2147483647 to 2147483647	0	Command unit	B	○	○	○	○	“8.12”
8	18	Retracting operation speed	0 to 2147483647	0	Command unit/s or r/min	B	○	○	○	○	
8	19	Manufacturer use	—	0	—	—	—	—	—	—	—

6.3.11 Class 11: Manufacturer Use

○: Enabled ×: Disabled —: N/A

Parameter No.		Parameter name	Setting range	Factory default values	Unit	Attribute	Related control mode				Reference
Class	No.						P	S	T	F	
11	00	Manufacturer use	—	1	—	—	—	—	—	—	—
11	01	Manufacturer use	—	503578880	—	—	—	—	—	—	—
11	02	Manufacturer use	—	658185	—	—	—	—	—	—	—
11	03	Manufacturer use	—	-1	—	—	—	—	—	—	—
11	04	Manufacturer use	—	-1	—	—	—	—	—	—	—
11	05	Manufacturer use	—	-1	—	—	—	—	—	—	—
11	06	Manufacturer use	—	-1	—	—	—	—	—	—	—
11	07	Manufacturer use	—	16	—	—	—	—	—	—	—
11	08	Manufacturer use	—	6	—	—	—	—	—	—	—
11	09	Manufacturer use	—	1	—	—	—	—	—	—	—
11	10	Manufacturer use	—	129	—	—	—	—	—	—	—
11	11	Manufacturer use	—	0	—	—	—	—	—	—	—
11	12	Manufacturer use	—	0	—	—	—	—	—	—	—
11	13	Manufacturer use	—	0	—	—	—	—	—	—	—
11	14	Manufacturer use	—	0	—	—	—	—	—	—	—
11	15	Manufacturer use	—	0	—	—	—	—	—	—	—
11	16	Manufacturer use	—	255	—	—	—	—	—	—	—
11	17	Manufacturer use	—	0	—	—	—	—	—	—	—
11	18	Manufacturer use	—	0	—	—	—	—	—	—	—
11	19	Manufacturer use	—	0	—	—	—	—	—	—	—
11	20	Manufacturer use	—	0	—	—	—	—	—	—	—
11	21	Manufacturer use	—	0	—	—	—	—	—	—	—
11	22	Manufacturer use	—	15	—	—	—	—	—	—	—
11	23	Manufacturer use	—	0	—	—	—	—	—	—	—
11	24	Manufacturer use	—	0	—	—	—	—	—	—	—
11	25	Manufacturer use	—	0	—	—	—	—	—	—	—
11	26	Manufacturer use	—	0	—	—	—	—	—	—	—

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7.1 Startup Operation

This section describes control signal input timing from after control power supply is turned on until a command is input.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Power supply is off

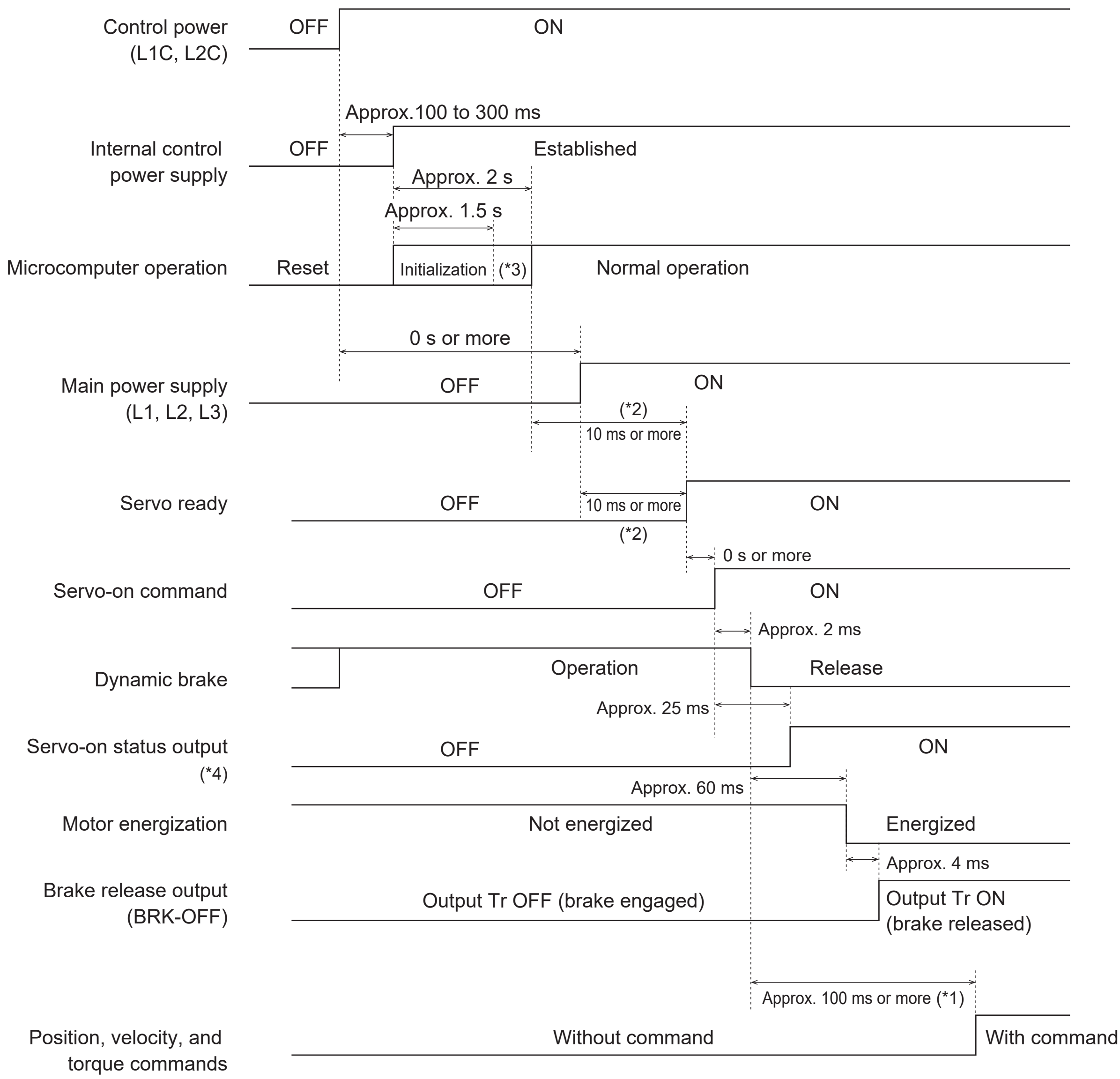
■ Setup value

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	18	R	Power-up wait time	0 to 100	0.1 s	Sets the initialization time after power-on to a standard time of approx. 1.5 s + α (set value × 0.1 s). For example, with a set value of 10, 1.5 s + (10 × 0.1 s) = approx. 2.5 s.

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

Input servo-on commands, position, velocity, and torque commands according to the times shown in the following chart.



*1 This period is not ready to receive position, speed, or torque command input. Command input should be made after this period is completed.

*2 Servo ready turns on when all of the following conditions are met: the microcomputer is initialized, main power supply is established, no alarms have been triggered, RTEX communication and the servo are synchronized (phase matched), and RTEX communication has been established.

*3 Once internal control power supply is established, the protection function starts running approx. 1.5 s after microcomputer initialization begins. Configure so that all input/output signals connected to the servo driver (especially those that can trigger the protection function, such as positive direction/negative direction over-travel inhibit input, external scale input) are confirmed before the protection function begins operating. The time between the start of microcontroller initialization and the start of protection function operation can be increased at Pr6.18 “Power-up wait time” .

*4 Note that the servo-on status output is a signal indicating that a servo-on command has been received and is not an output indicating that a command input is possible.

■ Precautions

Before turning on the power, check the wiring, the power supply voltage, and confirm that the motor is connected correctly.

7.2 Control Mode Common Functions

7.2.1 Rotational Direction Setting

A function that sets motor rotational direction relative to the command direction.

■ Operational Conditions

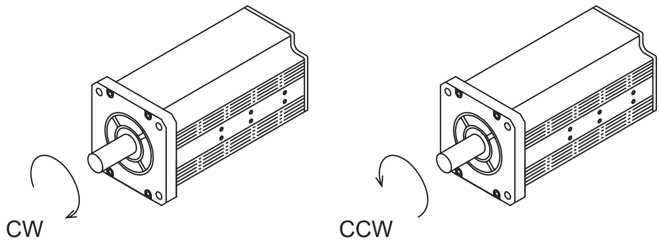
Item	Operational Conditions
Control mode	● All control modes

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	00	C	Rotational direction setup	0 to 1	—	Sets the relationship between the command direction and motor rotational direction.

The motor rotational direction, when viewed from the load side axis end, is defined as CW when clockwise and CCW when counterclockwise.



The relationships between the command direction, motor rotation method, positive direction over-travel inhibit input, negative direction over-travel inhibit input are as follows.

Pr0.00	Command direction	Motor rotational direction	Positive direction over-travel inhibit input	Negative direction over-travel inhibit input
0	Positive Direction	CW direction	Enabled	—
	Negative direction	CCW direction	—	Enabled
1	Positive Direction	CCW direction	Enabled	—
	Negative direction	CW direction	—	Enabled

Changing this parameter may require changing Pr7.23 “RTEX function expansion setup 2” :bit 3 “POT and NOT RTEX status bit arrangement settings” .

Be sure to check the host device specifications.

Parts expressed as positive direction or negative direction described in this manual refer to the directions set here.

*1 For attributes, see “6.3 List of Parameters” .

7.2.2 Command Input Processing

This process sets the control mode by inputting RTEX communication commands.

In position control and full-closed control, the commands perform position command input, in velocity control, speed command input, and in torque control, torque command input.

For the details of each communication command, see below.

- Technical Reference Communication Specification
- Technical Reference Communication Specification
- Technical Reference Communication Specification
- Technical Reference Communication Specification

Control mode is forcibly switched inside this product according to its operation status, regardless of commands from the host device. Because this operation also affects input signal assignments, it is generally recommended to assign the same function to each terminal in all modes.

The conditions for forcibly switching control modes are shown below.

Operation status if this product	Control mode after forced switching
When using Set-up Support Software (PANATERM ver.7) to perform frequency characteristics analysis	● During position loop characteristics analysis: Position control ● During velocity closed-loop characteristics analysis: Velocity control ● During torque speed (automatic) analysis: Position control ● During torque speed (vertical) analysis: Velocity control ● During torque speed (normal) analysis: Torque control
During trial run via Set-up Support Software (PANATERM ver.7)	● Position control
Operations with descriptions of “forcible position control” using various deceleration to stop functions (*“8.14”* to *“8.17”*)	● Position control
During retracting operations	● Position control

7.2.3 Electronic Gear Function

The electronic gear is a function that sets a value obtained by multiplying a position and speed command input from a host device by an electronic gear ratio set in an object as a position and speed command to a position and velocity controller.

This function can be used to set motor rotation and movement amounts arbitrarily on a per-command-unit basis.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes

■ Setup value

—: None

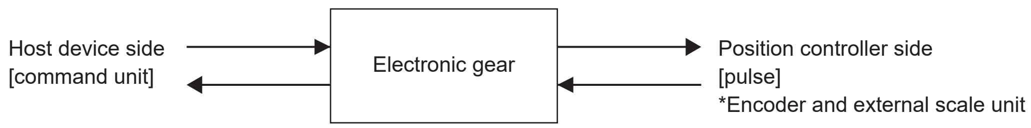
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	08	C	Number of command pulses per one motor revolution	0～134217728	pulse	Sets a command pulse count equivalent to one motor rotation. When this setup value is 0, Pr0.09 “Numerator of electronic gear” and Pr0.10 “Denominator of electronic gear” are enabled. This setting is disabled during full-closed control.
0	09	C	Numerator of electronic gear	0 to 1073741824	—	Sets numerators for electronic gear ratios. Set numerators so that electronic gear ratios are in the range of 1/1000 to 128000×. Err93.0.0 “Parameter setup error protection 1” occurs when electronic gear ratio is set outside this range. When this setup value is 0, the encoder resolution is set as the numerator. When this setup value is 0, the electronic gear ratio becomes 1/1 during full-closed control.
0	10	C	Denominator of electronic gear	1 to 1073741824	—	Sets denominators for electronic gear ratios. Set denominators so that electronic gear ratios are in the range of 1/1000 to 128000×. Err93.0.0 “Parameter setup error protection 1” occurs when electronic gear ratio is set outside this range.

*1 For attributes, see “6.3 List of Parameters” .

■ How to use

● Command units

Command units are position command units input to the electronic gear from the host device side.



● Electronic gear unit details

Relationships between Pr0.08, Pr0.09, and Pr0.10 during position control

Pr0.08	Pr0.09	Pr0.10	Electronic gear process
1 to 134217728	— (No impact)	— (No impact)	Position command input → $\frac{\text{Encoder resolution}}{\text{[Pr0.08 set value]}}$ → Position command * The process in the figure above is performed based on the Pr0.08 setup value regardless of Pr0.09 and Pr0.10 settings.
0	0	1 to 1073741824	Position command input → $\frac{\text{Encoder resolution}}{\text{[Pr0.10 set value]}}$ → Position command * When Pr0.08 and Pr0.09 are both 0, the process in the figure above is performed based on the Pr0.10 setup value.
	1 to 1073741824	1 to 1073741824	Position command input → $\frac{\text{[Pr0.09 set value]}}{\text{[Pr0.10 set value]}}$ → Position command * When Pr0.08 is 0 but Pr0.09 is not 0, the process in the figure above is performed based on the Pr0.09 and Pr0.10 setup values.

Relationships between Pr0.08, Pr0.09, and Pr0.10 during full-closed control

Pr0.08	Pr0.09	Pr0.10	Electronic gear process
— (No impact)	0	— (No impact)	Position command input → $\frac{1}{1}$ → Position command * When Pr0.09 is 0, the process in the figure above is performed with 1 as both numerator and denominator.
	1 to 1073741824	1 to 1073741824	Position command input → $\frac{\text{[Pr0.09 set value]}}{\text{[Pr0.10 set value]}}$ → Position command * When Pr0.09 is not 0, the process in the figure above is performed based on the Pr0.09 and Pr0.10 setup values.

■ Precautions

The encoder resolution of the A7N Series has been increased to 27 bits from the previous series. When using this series with a small electronic gear ratio, such as the default setting of 1× electronic gear ratio, the following points should be noted.

- The 32-bit position information [command unit], such as command position and actual position, wraps around in at most 32 motor revolutions. Since the home information is lost at that point, if this electronic gear ratio causes a problem, consider performing position control on the host device side or increasing the electronic gear ratio.
- Since, for example, 32 bits will overflow at approximately 960 r/min when the electronic gear ratio is 1×, when 32-bit speed information such as command speed or actual speed is used in [command unit/s] units, consider using a speed range where this does not occur or increasing the electronic gear ratio.

7.2.4 Motor Working Range Setup Function

This function triggers an alarm and decelerates the motor to a stop if the motor position exceeds the motor operation working range with respect to the position command input range.

The motor operation working range is calculated inside the product according to the following formula.

- Positive direction motor operation working range = positive direction position command input range + Pr5.14 “Motor working range setup”
- Negative direction allowable motor operation working range = negative direction position command input range - Pr5.14 “Motor working range setup”

If the actual motor position for judgment exceeds this range, Err34.0.0 “Motor movable range setup error protection” is triggered.

Note that this function does not protect against erroneous position commands.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control and full-closed control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor rotates normally.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	14	A	Motor working range setup	0 to 1000	0.1 rotation	Sets the motor operation working range for the position command input range. If this setup value is exceeded, Err34.0.0 “Motor movable range setup error protection” is triggered. The protection function is disabled when this setup value is 0. Also, the protection function is disabled even if detection of *“Operation”* “Err34.0.0 “Motor movable range setup error protection” ” is disabled.
6	97	B	Function expansion setup 3	-2147483648 to 2147483647	—	Set the functions in bit units. bit 2: Motor movable range error protection expansion 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

* In virtual full-closed control mode, the motor working range is determined using information obtained through virtual estimation of external scale position based on encoder position information.

■ Operation

- Motor operation working range

  The motor operation working range is the movement amount range set by Pr5.14 “Motor working range setup” on both sides of the motor position. Inputting the position command expands the range by exactly the position command amount.

Err34.0.0 “Motor movable range setup error protection” occurs when the actual motor position for judgment enters the error occurrence range (area shaded with light slanted lines in the operation example in the figure below) due to oscillation, etc.

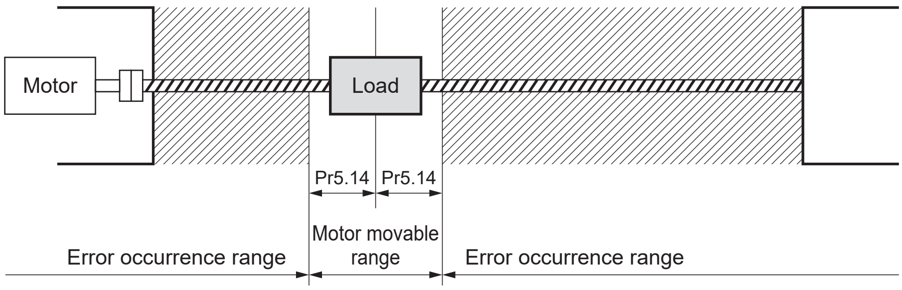
When the motor working range setup protection activates, the motor decelerates and stops according to Pr5.10 “Sequence at alarm” .

Since, depending on the load, loads may hit and damage the machine end during this deceleration, set the Pr5.14 “Motor working range setup” setting range so that it allows for the deceleration operation.

Operation examples are shown below.

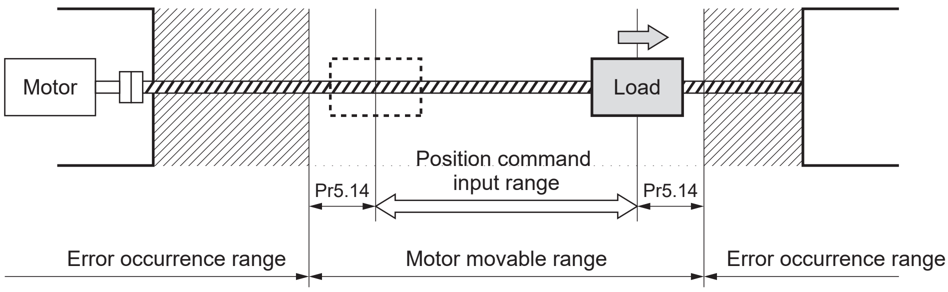
- **When position command is not input (servo-on state)**

  As no position command is entered, the motor operation working range serves as the range of movement set in Pr5.14 “Motor working range setup” on both sides of the load position.



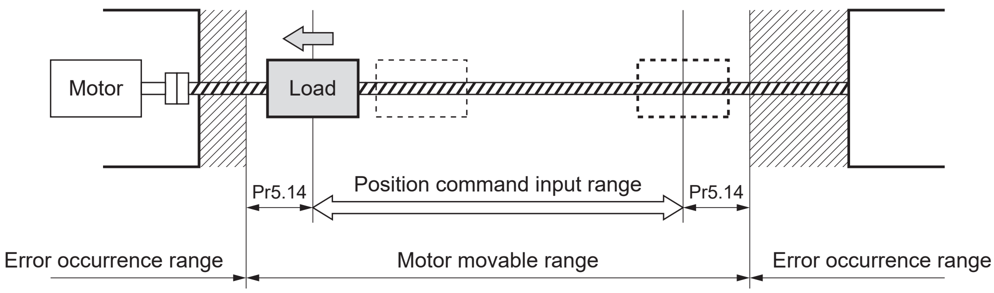
- **During right side operation (servo-on state)**

  When a position command is input to the right, the motor operation working range expands by exactly the position command amount and becomes the number of rotations range set in Pr5.14 “Motor working range setup” on both sides of the position command input range.



- **During left side operation (servo-on state)**

  When a position command is input to the left, the position command input range expands further.



- When the Err34.0.0 “Motor movable range setup error protection” detection process is disabled
  - When any of the following values ([encoder pulse] or [external scale pulse] units) managed internally in this product exceed the range of -2^{63} to $2^{63}-1$, detection of Err34.0.0 “Motor movable range setup error protection” is disabled.

- Position command input range
- Actual motor position for judgment
- Motor movable range

To enable the Err34.0.0 “Motor movable range setup error protection” detection process, set Pr6.97 “Function expansion setup 3” :bit 2 “Motor movable range error protection expansion” to 1 (enable).

• If any of the following conditions are met, the position command input range and actual motor position for judgment managed inside this product are cleared, and the Err34.0.0 “Motor movable range setup error protection” detection process is disabled.
  - When control power is turned on
  - Servo-off state
  - Velocity control state or torque control state
  - Performing frequency characteristics analysis with Set-up Support Software (PANATERM ver.7)
  - While position deviation is being cleared (at servo-off, or when position deviation is cleared during deceleration to stop because the alarm sounds, etc.)
  - At the start of a trial run or Z-phase search operation using Set-up Support Software (PANATERM ver.7)
  - At position information initialization

    During absolute clear by Set-up Support Software (PANATERM ver.7) , etc.
  - Pr5.14 “Motor working range setup” = 0
  - When position deviation is cleared during deceleration to stop due to over-travel inhibit input
  - During homing
  - If Pr5.14 “Motor working range setup” satisfies the formula below during full-closed control (When the value obtained by converting Pr5.14 to the [External scale pulse] unit exceeds 2^{63}-1)

    Pr5.14 > ((2^{63} -1) × Pr3.24 × 10)/(Encoder resolution × Pr3.25)

• To enable the Err34.0.0 “Motor movable range setup error protection” detection process, set Pr6.97 “Function expansion setup 3” :bit 2 “Motor movable range error protection expansion” to 1 (enable).

■ Precautions

When changing the control mode (including for the purpose of only velocity control or torque control), do not use this function. Instead, use the software limit function or over-travel inhibit input.

7.2.5 Two-degree-of-freedom Control Mode

The two-degree-of-freedom control mode is an expansion function for each control mode that improves responsiveness by setting command response and servo stiffness independently.

There are two types of two-degree-of-freedom control modes as shown below.

- Standard type: Control mode suitable for positioning control
- Synchronization type: Control mode used when controlling multiple loci such as with multijoint robots, etc.

Type to be used varies with control mode. See *"Setup value"* .

■ Operational conditions

- Conditions for enabling two-degree-of-freedom control

Item	Operational conditions
Control mode	● Position control, velocity control, and full-closed control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor rotates normally.

The types of two-degree-of-freedom control real-time auto tuning used with each mode are described in the table below.

○: Can be used ×: Cannot be used

Real-time auto tuning type	Position control	Velocity control	Full-closed control
Standard type	○	○	○
Synchronization type	○	×	×

If a type that cannot be used is set, Err91.1.0 "RTEX Command error protection" is triggered.

Although two-degree-of-freedom control mode is not supported during torque control, when the settings are Pr6.47 "Function expansion setup 2" :bit 0 "two-degree-of-freedom control mode" = 1 (enabled), Err91.1.0 "RTEX Command error protection" will not be triggered.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
2	45	B	Function expansion setup 10	-32768 to 32767	—	Sets whether to permit or prohibit various functions. bit 1 to 0: Two-degree-of-freedom control function setting 00b: Two-degree-of-freedom control (MINAS A6 Series specification) 01b: Two-degree-of-freedom control (MINAS A7 Series specification) 10b: Manufacturer use 11b: Manufacturer use

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Set the functions in bit units. bit 0: Two-degree-of-freedom control mode 0: Disabled 1: Enabled bit 3: Two-degree-of-freedom control real-time auto tuning selection 0: Standard type 1: Synchronization type **Notes** ● bit 3 can only be used when bit 0 is 1.

*1 For attributes, see *"6.3 List of Parameters"* .

The parameters that can be set when two-degree-of-freedom control mode is enabled in each mode are as follows.

For details on setting values, see *"7.3 Position Control"* , *"7.4 Velocity Control"* , and *"7.6 Full-closed Control"* .

○: Setting enabled ×: Setting disabled

Class	No.	Parameter name	Position control	Velocity control	Full-closed control
2	22	Positional command smoothing filter	○	○	○
2	38	Filter function switching	○	○	○
2	39	Custom notch compensation coefficient	○	○	○
2	40	Custom notch compensation frequency 1	○	○	○
2	41	Custom notch compensation frequency 2	○	○	○
2	42	Custom notch frequency	○	○	○
2	43	Custom notch width	○	○	○
2	44	Custom notch depth	○	○	○
2	46	Tuning filter 2	○	○	○
6	48	Tuning filter	○	○	○
6	49	Command response/tuning filter attenuation term	○	×	○
6	50	Viscous friction compensating gain	○	×	○

■ How to use

- When two-degree-of-freedom control mode is enabled

  Set Pr6.47 "Function expansion setup 2" :bit 0 to 1, and then, after writing it to EEPROM, enable two-degree-of-freedom control mode by resetting the control power supply.

  Next, use the real-time auto tuning function (two-degree-of-freedom control mode standard type or two-degree-of-freedom control mode synchronization type) to adjust the basic gain settings and load fluctuation compensation.

  If further improvement is required, manually make fine adjustments to the parameters shown in the *"Setup value"* while checking the response.

- When the two-degree-of-freedom control mode is disabled

  Set Pr6.47 "Function expansion setup 2" :bit 0 to 0, and then, after writing it to EEPROM, disable two-degree-of-freedom control by resetting the control power supply.

  Next, using the real-time auto tuning function, set basic gain and adjust load fluctuation compensation.

7.2.6 Regenerative Resistor Settings

A function to setup the regenerative resistor overload protection function.

For details on the regenerative resistor specifications, see *"12.4.12 External Regenerative Resistor"* .

■ Operational conditions

Item	Operational conditions
Control mode	● All control modes

■ Setup value

—: N/A

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	16	C	External regenerative resistor setup	0 to 3	—	Sets this parameter according to whether the regenerative resistor built into this product is to be used as-is, or the built-in resistor is to be disconnected and an external regenerative resistor is to be provided. 0: Use the built-in resistor, and perform regenerative overload protection. 1: Use an external resistor, and perform regenerative overload protection. 2: Use an external resistor, but do not perform regenerative overload protection. 3: Use without a regenerative resistor (Regenerative overload protection not performed).
0	17	C	Selection of load factor for external regenerative resistor	0 to 4	—	Sets the method for computing regenerative resistance load factor an external regenerative resistor is selected (Pr0.16 = 1 or 2). 0: Regenerative load factor is 100% when duty factor of external regenerative resistor is 10%. 1 to 4: Manufacturer use (setting is prohibited)

*1 For attributes, see *"6.3 List of Parameters"* .

7.2.7 Absolute Encoder

The absolute encoder is an encoder that can back up motor position information when the power supply is off.

With an absolute encoder, it is possible to create an absolute system that does not require a homing operation after the power supply is turned on by setting Pr0.15 “Absolute encoder setup” to something other than “1” (default setting).

With full-closed control, an external scale can be used to create an absolute system that does not require a homing operation after the power supply is turned on.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, velocity control, torque control

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	15	C	Absolute encoder setup	0 to 4	—	Sets the method of use of the absolute encoder. During full-closed control, the absolute encoder is treated as an incremental system (setting = 1) by the internal control. 0: Use as an absolute system (absolute mode). 1: Use as an incremental system (incremental mode) (Detection of the following protection functions is disabled.). Err40.0.0 “Absolute system down error protection” Err41.0.0 “Absolute counter over error protection” Err42.0.0 “Absolute overspeed error protection” Err45.0.0 “Multi-turn counter error protection” 2: Use as an absolute system (absolute mode). Ignore multi-turn counter overs. 3: Use as an absolute system (absolute mode). Do not use multi-turn counter (Single-turn absolute encoder mode. For details, see *“8.4 Single-turn Absolute Function”* .). 4: Use as an absolute system (absolute mode). Multi-turn counter upper-limit value can be set arbitrarily. Ignore multi-turn counter overs (Continuous rotating absolute encoder mode. For details, see *“8.5 Continuous Rotating Absolute Encoder Function”* .).

*1 For attributes, see *“6.3 List of Parameters”* .

■ How to use

● Regarding the necessity of connecting the battery to the absolute encoder

The following two types of data are read from the absolute encoder (27 bit/r).

- Single-turn data that indicates position within one motor rotation
- Multi-turn data counted once per single turn

Both data are combined into absolute data, which provides information on the current position of the motor.

Both types of data have polarities that increase with CCW rotation.

The following two types of absolute encoders exist, which differ depending on the method in which multi-turn data is backed up.

- Absolute encoder (battery backup)
  A type that requires a battery connection to back up multi-turn data
- Batteryless absolute encoder
  A type that does not require a battery connection to back up multi-turn data

The table below shows the relationships between the absolute encoder types and Pr0.15 “Absolute encoder setup” .

Absolute encoder type	Pr0.15 “Absolute encoder setup”	
	0, 2, 4	1, 3
Battery backup	Battery required	Battery not required
Batteryless	Battery not required	

For details on how to install batteries connected to the absolute encoder (battery backup), see *“2.4.2 Battery for Absolute Encoder”* .

● Absolute encoder clearing operation

When operating the machine for the first time, multi-turn data must be cleared to 0 by clearing the absolute encoder at the home position. This clearing operation is called "multi-turn data clear".

Multi-turn data is cleared with Set-up Support Software (PANATERM ver.7) or RTEX communication.

When clearing multi-turn data, turn off the control power supply once, and then turn it back on.

For the method of clearing the absolute encoder, see Set-up Support Software (PANATERM ver.7) Operating Manual or Technical Reference Communication Specification.

● Battery refresh operation of the absolute encoder (battery backup)

If the absolute encoder battery (lithium-thionyl chloride battery) continues to be in a non-discharged state, including during long-term storage, a battery alarm, due to a temporary drop in voltage, may occur at the next discharge.

To avoid triggering a battery alarm, perform a battery refresh with Set-up Support Software (PANATERM ver.7) . For details on refreshing the battery, see *“2.4.2.3 Battery Refresh (Method Using Set-up Support Software (PANATERM ver.7))”* .

— Precautions —

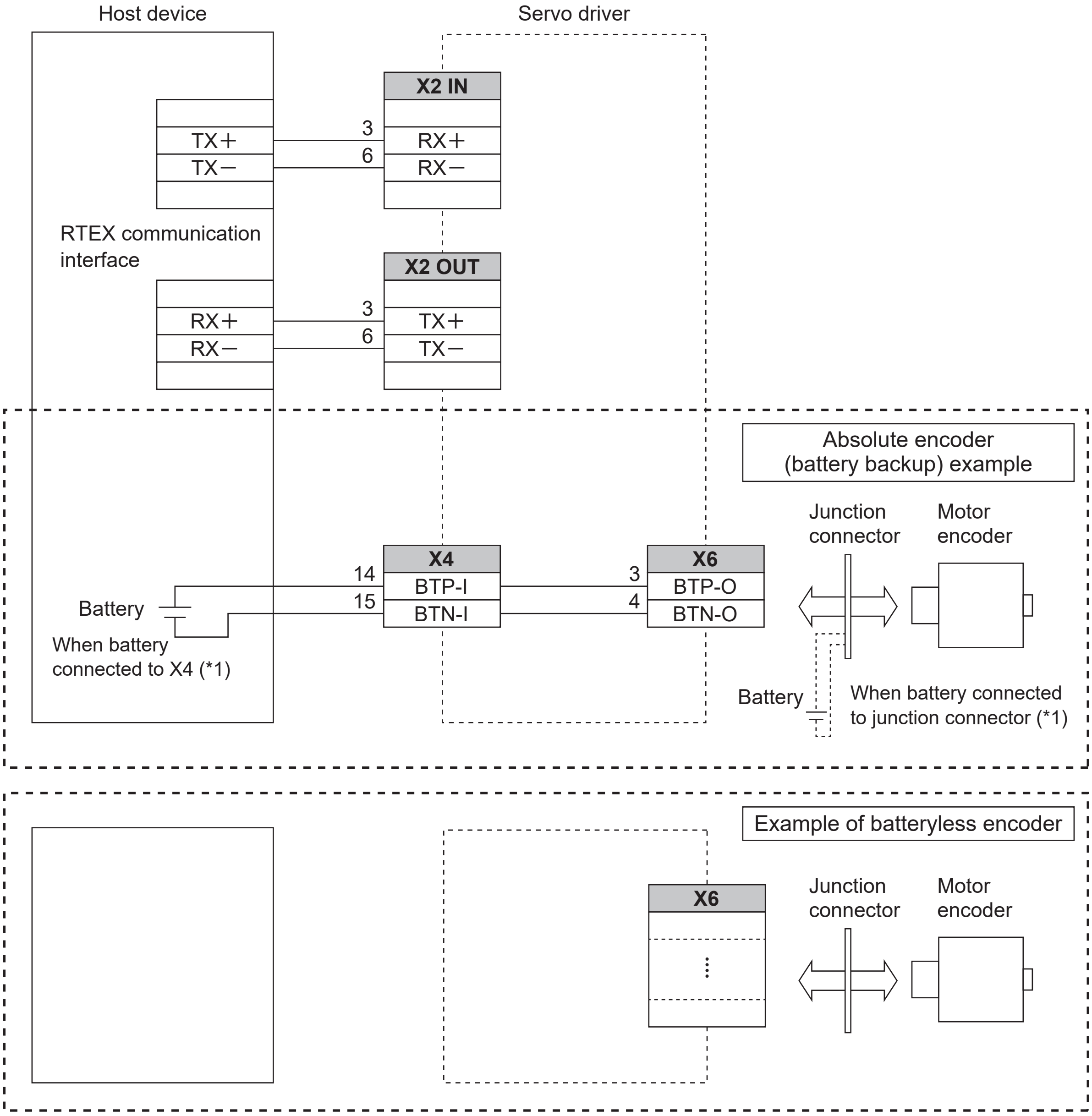
- Executing a battery refresh may result in a battery warning.
  If a battery warning is generated, clear the battery warning.
- Do not perform a battery refresh with batteryless absolute encoders.

■ Control Block Diagram

- Absolute system configuration with absolute encoder

  Absolute data is transmitted to the host device as the current position in the RTEX communication response (servo driver -> host device).

Example of when the servo driver is connected to one axis



*1 When connecting the battery, connect it to either connector X4 or the junction connector between connector X6 and the encoder. Under no circumstances should both be connected at the same time.

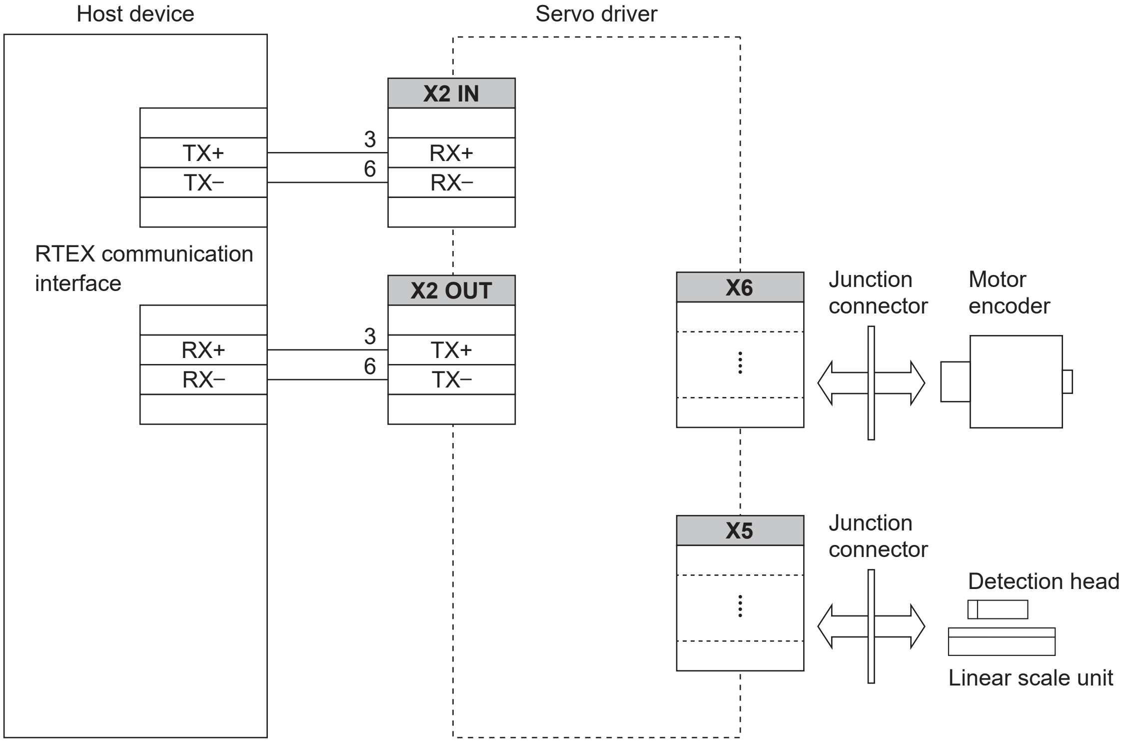
— Precautions —

- When replacing the battery, be sure to turn on the control power supply. If the control power supply is not applied, retained absolute data will be lost.

- Absolute system configuration with external scale (full-closed control)

  Absolute data is transmitted to the host device as the current position in the RTEX communication response (servo driver -> host device).

Example of when the servo driver is connected to one axis (when using external scale)



7.2.8 External Scale Selection Function

This function selects the type of external scale to be used and sets the direction reversal of the external scale feedback counter.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes
Other	● Driver type must be one other than standard type.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
3	23	R	External scale selection	0 to 2	—	Select the type of external scale.

0: A/B-phase output type
1: Serial communication type (incremental)
2: Serial communication type (absolute)

- Please ensure the settings correspond to the type of external scale used. The table below shows the relationship between the external scale and the setting values.

<table>
<tr><th rowspan="2">External scale type used</th><th colspan="3">Setup value of Pr3.23</th></tr>
<tr><th>0</th><th>1</th><th>2</th></tr>
<tr><td>A/B-phase output type</td><td>Enabled</td><td>Err50.0.0 “External scale wiring error protection” is triggered</td><td>Err50.0.0 “External scale wiring error protection” is triggered</td></tr>
<tr><td>Serial communication type (incremental)</td><td rowspan="2">Err55.0.0 “A-phase connection error protection” , Err55.1.0 “B-phase connection error protection” , Err55.2.0 “Z-phase connection error protection” are triggered</td><td>Enabled</td><td>Err93.3.2 “External scale connection error protection” is triggered</td></tr>
<tr><td>Serial communication type (absolute)</td><td>Err93.3.1 “External scale connection error protection” is triggered</td><td>Enabled</td></tr>
</table>

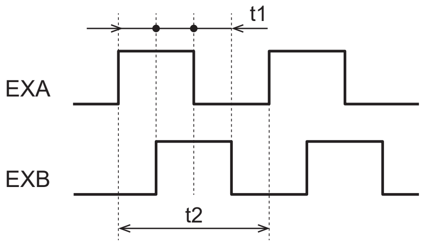
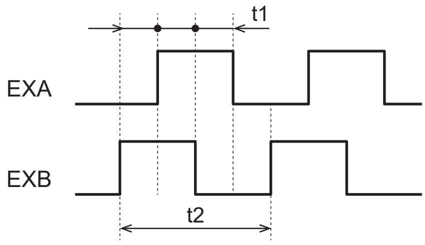
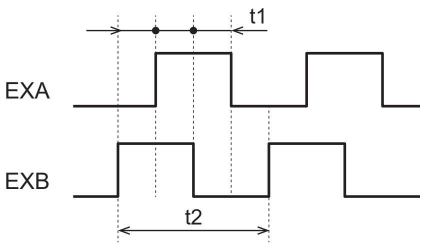
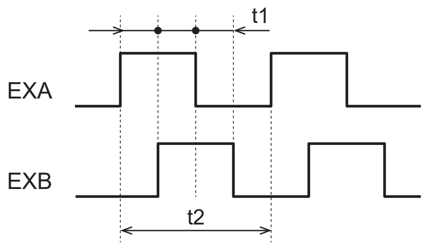
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
3	26	R	Reversal of direction of external scale	0 to 3	—	Set the reversal of external scale feedback counter. 0: Not reversed 1: Reversed 2: Manufacturer use (setting is prohibited) 3: Manufacturer use (setting is prohibited)

*1 For attributes, see *“6.3 List of Parameters”* .

Pr3.23 external scale type details

Pr3.23	External scale type	Supported speeds (*3)
0	A/B-phase output type (*1) (*2) (*4)	Up to 4 Mpulse/s (after being multiplied by 4)
1	Serial communication type (incremental) (*2) (*4)	Up to 4 Gpulse/s
2	Serial communication type (absolute) (*2) (*4)	Up to 4 Gpulse/s

*1 The following table shows internal process counting direction of this product for A/B-phase output type external scales.

Pr3.26 “Reversal of direction of external scale”	Count-down direction	Count-up direction
0: Not reversed	 EXB is 90° behind EXA t1 > 0.25 μs t2 > 1.0 μs	 EXB is 90° ahead of EXA t1 > 0.25 μs t2 > 1.0 μs
1: Reversed	 EXB is 90° ahead of EXA t1 > 0.25 μs t2 > 1.0 μs	 EXB is 90° behind EXA t1 > 0.25 μs t2 > 1.0 μs

*2 Connect the external scale so that when the motor axis turns CCW, the scale counting direction counts up, and when the motor axis turns CW it counts down. If this connection arrangement is impossible due to installation conditions, etc., the scale counting direction can be reversed with Pr3.26 “Reversal of direction of external scale” .

Notes

- The following procedure can be used to confirm installation direction.

  1 Check the following items with Set-up Support Software (PANATERM ver.7) .

  1-1 Count direction for external scale feedback pulse sum

  1-2 Count direction for encoder feedback pulse sum

  2 Compare the counting direction in “1-1” and “1-2”.

  If they match, connection is correct.

  If they do not match, they did not connect correctly. Set to the opposite value (0 -> 1 or 1 -> 0) of Pr3.26 “Reversal of direction of external scale” .

*3 Supported speeds refer to the external scale feedback speeds [pulse/s] that can be processed by this product.

See the external scale specifications for the working ranges that can be supported by the scales.

The speed of the external scale is limited to 4 m/s when an external scale with 1 nm resolution is used in serial communication type.

However, caution is required because, even with full-closed control, overspeed protection occurs when motor axis rotational speed exceeds maximum velocity.

*4 Please contact us for information on compatible external scales.

7.2.9 Pre-gain Adjustment Protection Function Setup

When running the motor, it can be used with greater peace of mind by making the following settings appropriately according to device usage conditions.

- Over-travel inhibit input setup

  Inputting the limit sensor signal to this product can help prevent collisions with the mechanical end. Use positive direction over-travel inhibit input (POT) and negative direction over-travel inhibit input (NOT), which are both external input signals. The following over-travel inhibit input-related parameters must also be set.

  Pr5.04 “Over-travel inhibit input setup”

  Pr5.05 “Sequence at over-travel inhibit”

  Since limit input is normally controlled by the host device, set over-travel inhibit input to disabled in this product. Be sure to check the host device specifications.

  For details, see *“8.14 Deceleration to Stop Function for Over-Travel Inhibit Inputs (POT, NOT)”* .

- Torque limit setup

  Limiting motor maximum torque can minimize damage caused by disturbances such as machine jamming and collisions. When setting a uniform limit using Pr0.13 “1st torque limit” , set Pr5.21 “Selection of torque limit” to 0 or 1 before setting the value.

  However, caution is required because, if torque is limited to below the actual required torque, overspeed protection caused by overshoot and position deviation excess protection may occur due to delayed command response.

  Torque limit conditions can be detected externally by allocating the external output signal torque limitation output (TLC) to the output signal.

  For details, see *“8.1 Torque Limit Switching Function”* .

- Overspeed protection setup

  Generates Err26.0.0 “Overspeed protection” when motor speed is abnormally high.

  The factory default setting is set to the overspeed level in the applicable motor.

  If your application requires speeds below the motor maximum speed, set Pr5.13 “Over-speed level setup” using the formula below.

Pr5.13 “Over-speed level setup” = Vmax × (1.2 to 1.5) Vmax: Motor maximum speed [r/min] under operating conditions Range in ( ) is the margin to prevent frequent activation of overspeed protection.

  When running the motor at a low speed during the initial adjustment stage, set up the overspeed protection by multiplying the adjusting speed by a certain margin to protect the motor against potential oscillation.

  For details, see *“7.5.2 Velocity Limit Function”* and *“8.18 Emergency Stop Function For When Alarm is Triggered”* .

- Motor working range setup

  Err34.0.0 “Motor movable range setup error protection” is generated when the actual motor position for judgment exceeds the motor operation working range during position control or full-closed control.

  The motor operation range is calculated inside the product according to the following formula.

  - Positive direction motor operation working range = positive direction position command input range + Pr5.14 “Motor working range setup”
  - Negative direction allowable motor operation working range = negative direction position command input range - Pr5.14 “Motor working range setup”

  For details, see *“7.2.4 Motor Working Range Setup Function”* .

- Hybrid deviation excess protection setup

  When performing initial operation with full-closed control, abnormal operation may occur due to reverse connection of the external scale or incorrect setting of the external scale dividing ratio.

To indicate this type of defect, Err25.0.0 "Hybrid deviation excess protection" is triggered when the deviation of the motor position (encoder unit) and load position (external scale unit) exceed Pr3.28 "Hybrid deviation excess setup" .

For details, see *"7.6.5 Hybrid Deviation Excess Setup"* .

- Position deviation excess protection setup

  During position control or full-closed control, this detects potential excessive differences between the positional command and motor position, and issues Err24.0.0 "Position deviation excess protection" .

  Excessive position deviation level can be set at Pr0.14 "Position deviation excess setup" . Detection locations can be selected from the command position deviation [pulse (command unit)] and encoder position deviation [pulse (encoder unit)] using Pr5.20 "Position setup unit select" . For detection locations, see the table below.

Related	
"7.3.2 Position Control (Two-degree-of-freedom Control Mode Enabled)"	*"Control Block Diagram: Position Control (Two-degree-of-freedom Control Mode Enabled) "*
"7.3.3 Position Control (Two-degree-of-freedom Control Mode is Disabled)"	*"Control Block Diagram: Position Control (Two-degree-of-freedom Control Mode Disabled)"*
"7.6.2 Full-closed Control (Two-degree-of-freedom Control Mode Enabled)"	*"Control Block Diagram: Full-closed Control (Two-degree-of-freedom Control Mode Enabled) "*
"7.6.3 Full-closed Control (Two-degree-of-freedom Control Mode Disabled)"	*"Control Block Diagram: Full-closed Control (Two-degree-of-freedom Control Mode Disabled)"*

Related parameters

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	14	A	Position deviation excess setup	0 to 2^{30}	Command unit	Sets the position deviation excess setup range. Err24.0.0 "Position deviation excess protection" detection is disabled when the setup value is 0. Units follow Pr5.20 "Position setup unit select" . The factory default value is equivalent to 10 motor revolutions at 23 bits. If the command pulse per single-turn is changed, this setup value will also be affected. Configure settings appropriately according to the safety features of the equipment.
5	20	C	Position setup unit select	0 to 1	—	Selects setup units for positioning complete (In-position) range and position deviation excess. 0: Command unit 1: Encoder unit (external scale unit) **— Precautions —** ● The positioning complete detection threshold value of the RTEX communication status is always in command units regardless of this setup value.

*1 For attributes, see *"6.3 List of Parameters"* .

Pr0.14 "Position deviation excess setup" setting

Because the position deviation during normal operation depends on the operating speed and gain setting, set the value shown in the following formula in Pr0.14 "Position deviation excess setup" based on your operating conditions.

- When two-degree-of-freedom control is enabled (Pr6.47 bit 0 = 1)
  - Pr5.20 "Position setup unit select" = 0 (detected by command position deviation)

Position deviation [command unit] output setting uses position command deviation (after filter) (Pr7.23 bit 14 = 0)

Pr0.14 “Position deviation excess setup” = Pmax × (1.2 to 2.0) Range in ( ) is the margin to prevent frequent activation of position deviation excess protection. Since the position deviation in this case cannot be obtained by the calculation formula, estimate the maximum value Pmax of the command position deviation required for use from the actual machine operation waveform, and set the value including a margin.

- Position deviation [command unit] output setting uses position command deviation (before filter) (Pr7.23 bit 14 = 1)

Pr0.14 “Position deviation excess setup” = (P1 + P2 + P3 + P4) × (1.2 to 2.0) Range in ( ) is the margin to prevent frequent activation of position deviation excess protection.

Position command smoothing (secondary) accumulated pulse count: P1 = Vc × (Pr2.22 setting value/10000) × 2

Positional command FIR filter accumulated pulse count: P2 = Vc × (Pr2.23 setting value/10000)/2

Tuning filter accumulated pulse count: P3 = Vc × (Pr6.48 setting value/10000)

Damping filter accumulated pulse count: P4 = Vc/(π × damping frequency [Hz])

- Vc: Position command pulse maximum frequency [pulse (command unit)/s]
- Only calculate damping frequency when the setting value is enabled at a value that is 1/10 the setting value of Pr2.14 “1st damping frequency” , Pr2.16 “2nd damping frequency” , Pr2.18 “3rd damping frequency” , and Pr2.20 “4th damping frequency” . When multiple damping controls are enabled, calculate P4 for each damping filter, and apply the total value to P4.

- When Pr5.20 “Position setup unit select” = 1 (detected by encoder position deviation and full-closed position deviation)

Pr0.14 “Position deviation excess setup” = Pmax × (1.2 to 2.0) Range in ( ) is the margin to prevent frequent activation of position deviation excess protection. Since the position deviation in this case cannot be obtained by the calculation formula, estimate the maximum value Pmax of the encoder position deviation or full-closed position deviation required for use from the actual machine operation waveform, and set the value including a margin.

- Measure with the smallest value when switching position loop gain Kp.
- When Pr5.20 “Position setup unit select” = 1, command filter and damping control settings have no effect.

● When two-degree-of-freedom control is disabled (Pr6.47 bit 0 = 0)

- Pr5.20 “Position setup unit select” = 0 (detected by command position deviation)

Position deviation [command unit] output setting uses position command deviation (after filter) (Pr7.23 bit 14 = 0)

Pr0.14 “Position deviation excess setup” = P1 × (1.2 to 2.0) Range in ( ) is the margin to prevent frequent activation of position deviation excess protection.

Command position deviation: P1 = Vc/Kp × ((100-(Pr1.10 setting value/10))/100)

- Vc: Position command pulse maximum frequency [pulse (command unit)/s]
- Kp: Position loop gain [1 s^{-1}] (when switching, calculate with the smallest value)

Position deviation [command unit] output setting uses position command deviation (before filter) (Pr7.23 bit 14 = 1)

Pr0.14 “Position deviation excess setup” = (P1 + P2 + P3 + P4) × (1.2 to 2.0) Range in ( ) is the margin to prevent frequent activation of position deviation excess protection.

Command position deviation: P1 = Vc/Kp × ((100-(Pr1.10 setting value/10))/100)

Position command smoothing (primary) accumulated pulse count: P2 = Vc × (Pr2.22 setting value/10000)

Positional command FIR filter accumulated pulse count: P3 = Vc × (Pr2.23 setting value/10000)/2

Damping filter accumulated pulse count: P4 = Vc/(π × damping frequency [Hz])

- Vc: Position command pulse maximum frequency [pulse (command unit)/s]
- Kp: Position loop gain [1 s^{-1}] (when switching, calculate with the smallest value)
- Only calculate damping frequency when the setting value is enabled at a value that is 1/10 the setting value of Pr2.14 “1st damping frequency” , Pr2.16 “2nd damping frequency” , Pr2.18 “3rd damping frequency” , and Pr2.20 “4th damping frequency” . When multiple damping controls are enabled, calculate P4 for each damping filter, and apply the total value to P4.

• When Pr5.20 “Position setup unit select” = 1 (detected by encoder position deviation and full-closed position deviation)

Pr0.14 “Position deviation excess setup” = P1 × (1.2 to 2.0) Range in ( ) is the margin to prevent frequent activation of position deviation excess protection.

Encoder position deviation and full-closed position deviation: P1 = Ve/Kp × ((100-(Pr1.10 setting value/10))/100)

- Ve: Maximum operating frequency [pulse/s] in encoder units or full-closed units
- Kp: Position loop gain [1 s^{-1}] (when switching, calculate with the smallest value)
- When Pr5.20 “Position setup unit select” = 1, command filter and damping control settings have no effect.
- Note that when switching from velocity control to position control, processing to correct position deviation is used, so the above calculated value and error may increase. To cope with these problems, increase the margin.

— Precautions —

● If Pr0.14 “Position deviation excess setup” = 1073741824 or higher and Pr5.20 “Position setup unit select” = 1 in full-closed control, Err29.2.☐ “Counter overflow protection 2” will trigger without triggering Err24.0.0 “Position deviation excess protection” .

7.3 Position Control

7.3.1 Position Control Overview

The following types of position control mode are available:

- Profile position control (PP):

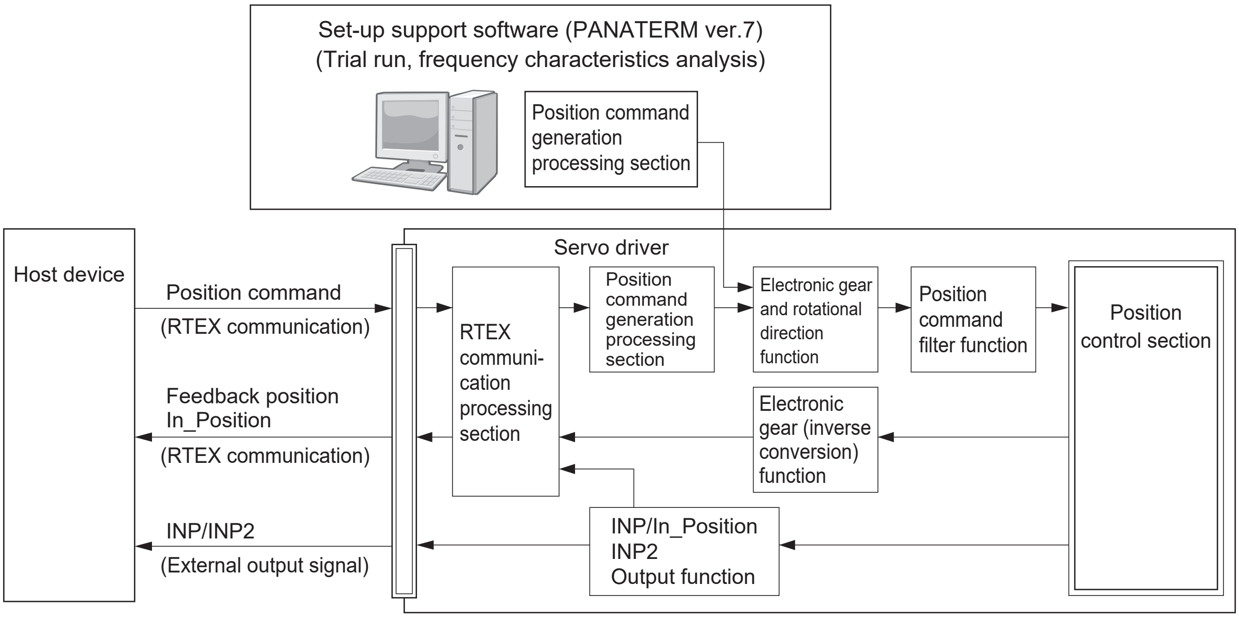
  This is a position control mode in which the host device designates the target position, target speed, and acceleration/deceleration, and operates by generating position commands inside the servo driver.

- Cyclic position control (CP):

  This is a position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.

For details on position control, see Technical Reference Communication Specification, .

A position control system overview is shown below.



— Precautions —

- To prevent sudden motor movement, see Operating Instructions (Tuning).
- The positioning complete state can be checked using positioning complete output (INP) or positioning complete output 2 (INP2), which are external output signals.

  For details, see *"7.3.4 Positioning Complete Output (INP/INP2) Function"* .
- Control mode is forcibly switched inside this product according to its operation status, regardless of commands from the host device. Because this operation also affects input signal assignments, it is generally recommended to assign the same function to each terminal in all modes.

  The conditions for forcibly switching control modes are shown below.

Operation status if this product	Control mode after forced switching
When using Set-up Support Software (PANATERM ver.7) to perform frequency characteristics analysis	● During position loop characteristics analysis: Position control ● During velocity closed-loop characteristics analysis: Velocity control ● During torque speed (automatic) analysis: Position control ● During torque speed (vertical) analysis: Velocity control ● During torque speed (normal) analysis: Torque control
During trial run via Set-up Support Software (PANATERM ver.7)	● Position control
Operations with descriptions of "forcible position control" using various deceleration to stop functions (*"8.14"* to *"8.17"*)	● Position control
During retracting operations	● Position control

7.3.2 Position Control (Two-degree-of-freedom Control Mode Enabled)

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control (semi-closed control)
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Enables and disables two-degree-of-freedom control mode and sets standard or synchronization type. For details, see *“7.2.5 Two-degree-of-freedom Control Mode”* .
2	22	B	Positional command smoothing filter	0 to 10000	0.1 ms	Sets the time constant of the “command response filter” when two-degree-of-freedom control mode is enabled. ● Maximum value is limited to 2000 (= 200.0 ms). **Notes** ● The parameter value itself is not limited, but the value applied in this product is limited. ● Decrease this parameter to speed up the command response, and increase it to slow down the command response. ● Attenuation terms are set using Pr6.49 “Command response/tuning filter attenuation term” .
2	38	B	Filter function switching	-32768 to 32767	—	Enables or disables the filter function. bit 0: Custom notch filter 0: Disabled 1: Enabled bit 1: Tuning filter 2 0: Disabled 1: Enabled *Do not switch tuning filter 2 between enabled and disabled during operation.
2	39	B	Custom notch compensation coefficient	0 to 1000	0.01	Sets the custom notch compensation coefficient. A set value of 100 or less disables compensation.
2	40	B	Custom notch compensation frequency 1	0 to 10000	0.1 Hz	Sets custom notch compensation frequency 1. A setup value of 0 disables compensation.
2	41	B	Custom notch compensation frequency 2	0 to 10000	0.1 Hz	Sets custom notch compensation frequency 2. A setup value of 0 disables compensation.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
2	42	B	Custom notch frequency	10 to 5000	Hz	Sets the notch frequency of the custom notch filter. A setup value of 5000 disables the custom notch filter.
2	43	B	Custom notch width	0 to 20	—	Sets the notch width of the custom notch filter.
2	44	B	Custom notch depth	0 to 99	—	Sets the notch depth of the custom notch filter.
2	46	B	Tuning filter 2	0 to 20000	0.01 ms	Sets the time constant of “Tuning filter 2” during two-degree-of-freedom control. Disabled when the set value is 0 to 3. ● Attenuation terms are set using Pr6.49 “Command response/tuning filter attenuation term” .
6	48	B	Tuning filter	0 to 2000	0.1 ms	Sets the time constant of the “tuning filter” in the two-degree-of-freedom control. ● When changing the torque filter setup, see the real-time auto tuning setting, and set a value close thereto. ● Finely tuning by checking the encoder position deviation of the settling area may improve overshoot or oscillatory waveform. ● Attenuation terms are set using Pr6.49 “Command response/tuning filter attenuation term” .
6	49	B	Command response/tuning filter attenuation term	0 to 99	—	Sets the “command response filter” and “tuning filter” attenuation terms in the two-degree-of-freedom control. ● Sets each filter in decimal notation. Ones: Command response filter Tens: Tuning filter <Target digit setting values> 0 to 4: No attenuation terms (operates as first order lag filter) 5 to 9: Attenuation term ζ is 1.0, 0.86, 0.71, 0.50, 0.35, in that order (operates as second order lag filter) ＜ Example of this parameter setup ＞ To set the command response filter to ζ = 1.0 and the tuning filter to ζ = 0.71, set the setting value to 75 (ones = 5 (ζ = 1.0), tens = 7 (ζ = 0.71)). Note that Pr2.22 “Positional command smoothing filter” is applied to the command response filter time constant.
6	50	B	Viscous friction compensating gain	0 to 10000	0.1 %/ (10000 r/min)	When the two-degree-of-freedom control mode is enabled, the product of the command speed and the setup value is used as the viscous friction torque compensation and the torque command is added to the torque. ● Setting the value of the viscous friction coefficient estimation of real-time auto tuning can improve the encoder position deviation of the settling area.

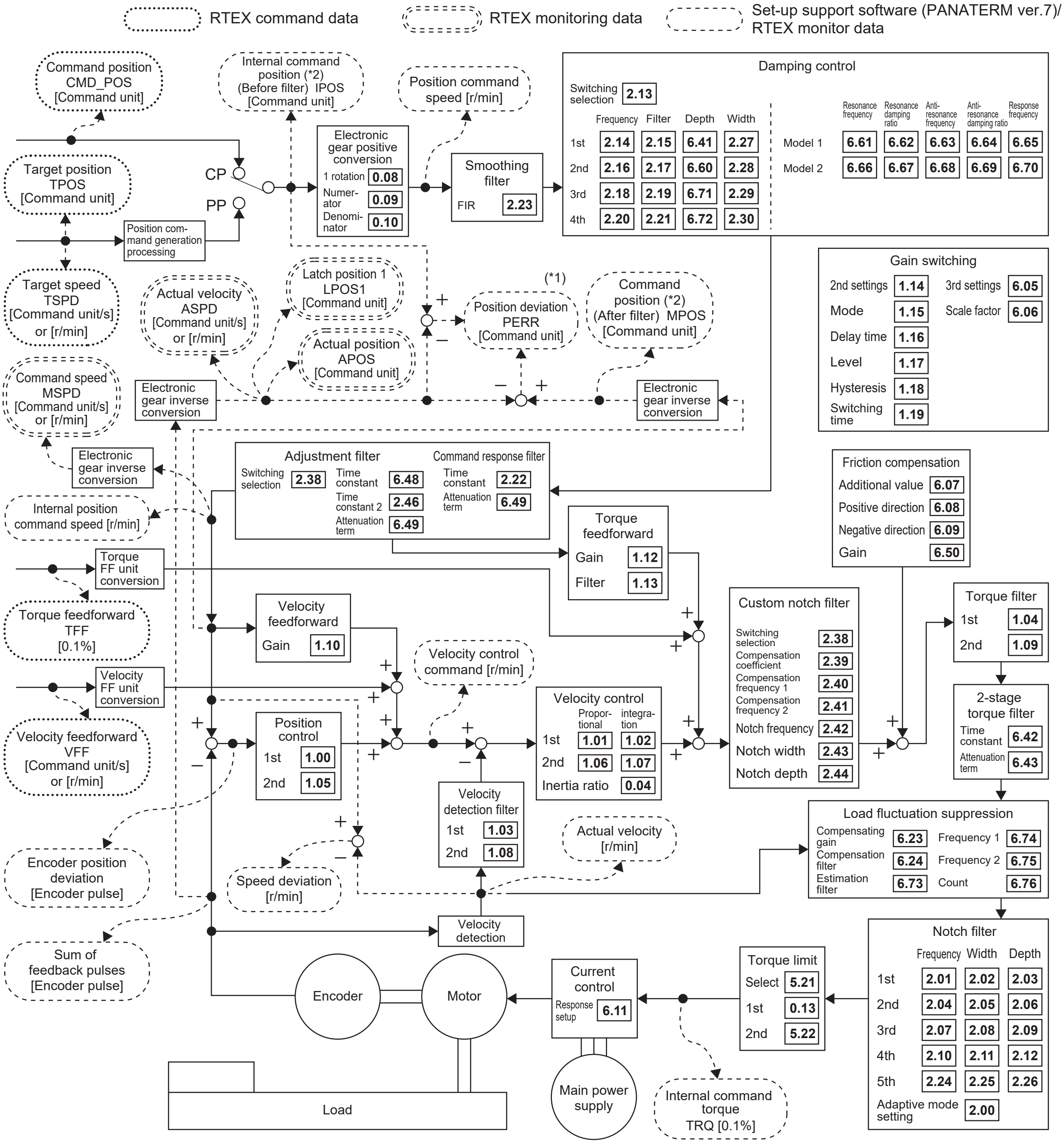
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	23	B	RTEX function expansion set-up 2	-32768 to 32767	—	bit 14: Position deviation [command unit] output setup 0: Internal command position (after filter) [command unit] - actual position [command unit] 1: Internal command position (before filter) [command unit] - actual position [command unit]
7	99	B	RTEX function expansion set-up 6	-32768 to 32767	—	bit 3: Command pulse accumulated value [command unit] output setting 0: Before filter 1: After filter

*1 For attributes, see *"6.3 List of Parameters"* .

■ How to use

For settings to enable two-degree-of-freedom control, see *"How to use"* "Two-degree-of-freedom control" of *"7.2.5 Two-degree-of-freedom Control Mode"* .

Control Block Diagram: Position Control (Two-degree-of-freedom Control Mode Enabled)



*1 Position deviation [command unit] operation criteria can be changed in Pr7.23 “RTEX function expansion setup 2” :bit 14.

*2 Position commands in Set-up Support Software (PANATERM ver.7) depend on Pr7.99 “RTEX function expansion setup 6” :bit 3 “Command pulse accumulated value [command unit] output setting” settings.

7.3.3 Position Control (Two-degree-of-freedom Control Mode is Disabled)

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control (semi-closed control)
Other	● Must be at servo-on. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally.

■ Setup value

—: None

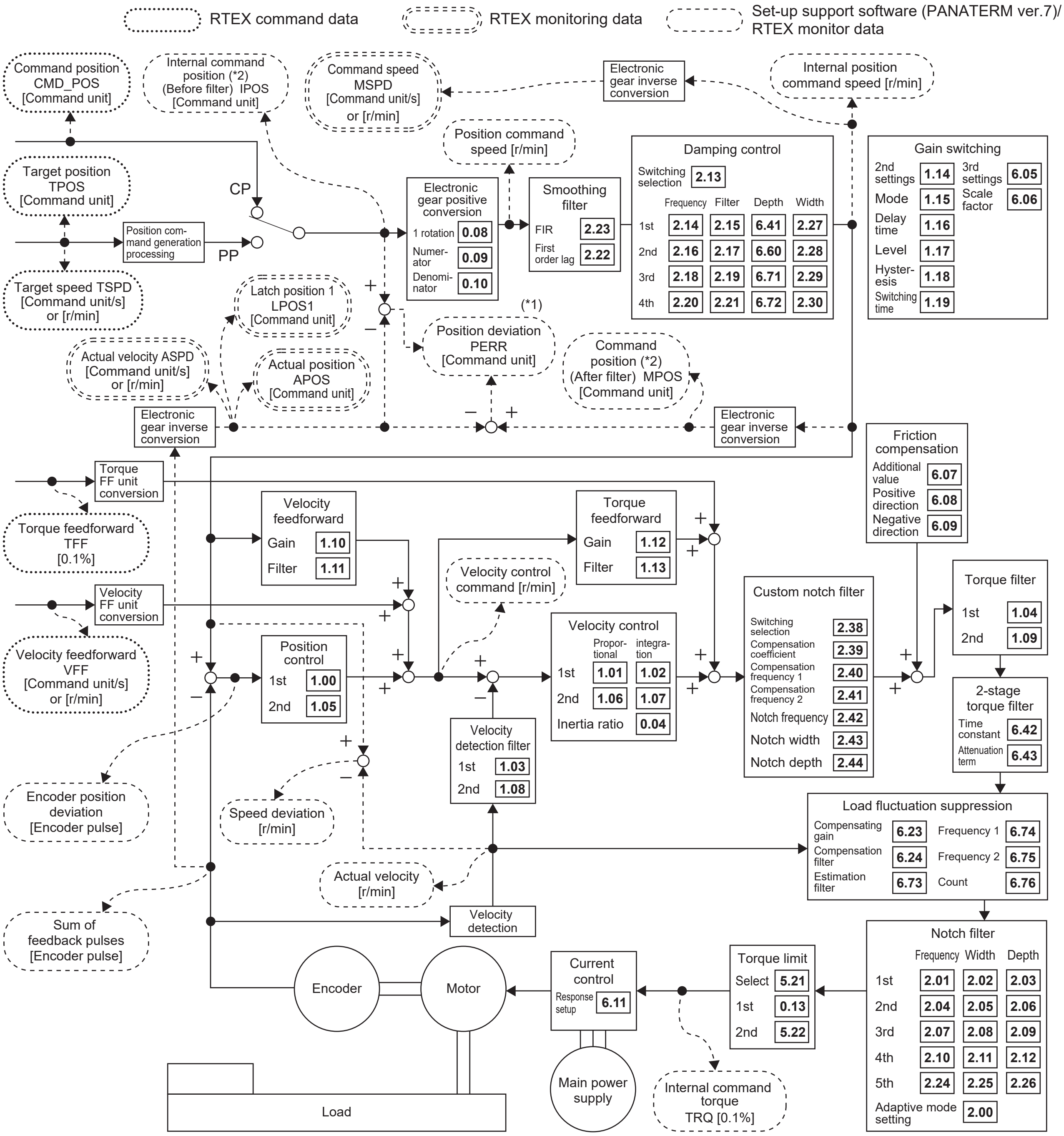
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Enables and disables two-degree-of-freedom control mode and sets standard or synchronization type. For details, see *"7.2.5 Two-degree-of-freedom Control Mode"* .
2	22	B	Positional command smoothing filter	0 to 10000	0.1 ms	When two-degree-of-freedom control mode is disabled, sets the time constant of the first order lag filter for the position command. For details, see Operating Instructions (Tuning).
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 14: Position deviation [command unit] output setup 0: Internal command position (after filter) [command unit] - actual position [command unit] 1: Internal command position (before filter) [command unit] - actual position [command unit]
7	99	B	RTEX function expansion setup 6	-32768 to 32767	—	bit 3: Command pulse accumulated value [command unit] output setting 0: Before filter 1: After filter

*1 For attributes, see *"6.3 List of Parameters"* .

■ How to use

For settings to disable two-degree-of-freedom control, see *"How to use"* "Two-degree-of-freedom control" of *"7.2.5 Two-degree-of-freedom Control Mode"* .

Control Block Diagram: Position Control (Two-degree-of-freedom Control Mode Disabled)



*1 Position deviation [command unit] operation criteria can be changed in Pr7.23 “RTEX function expansion setup 2” :bit 14.

*2 Position commands in Set-up Support Software (PANATERM ver.7) depend on Pr7.99 “RTEX function expansion setup 6” :bit 3 “Command pulse accumulated value [command unit] output setting” settings.

7.3.4 Positioning Complete Output (INP/INP2) Function

When in positioning complete state, outputs external output signal positioning complete output (INP) or positioning complete output 2 (INP2).

Turns ON when the absolute value of the position deviation counter parameter in the position control is within the positioning complete (in-position) range set using the parameter. Furthermore, the presence and absence of position command can be specified as one of the judgment conditions.

The position deviation calculation method (standard) differs as shown below depending on the setting of Pr7.23 “RTEX function expansion setup 2” :bit 14 “Command position deviation output switching” .

For details, see *“3.2.8 Wiring to Connector X7 (Connecting to External Monitor)”* .

—: N/A

Pr5.20 “Position setup unit select”	Pr7.23:bit 14	Position deviation counter value used
0	0	Position deviation [command unit] after filter
0	1	Position deviation [command unit] before filter
1	—	Encoder position deviation after filter [encoder unit]/Full-closed deviation after filter [external scale unit]

Can also check the positioning complete state in positioning complete (In_Position) of the RTEX communication status. For details, see *“4.2.4.2.3 Status Flag (Response Byte 2)”* .

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control and full-closed control

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	31	A	Positioning complete (In-position) range	0 to 2097152	Command unit	Sets the threshold value of position deviation that outputs the positioning complete signal (INP). The command unit is used as the default unit but can be replaced by the encoder unit or external scale unit by using Pr5.20 “Position setup unit select” . However, in such cases, note that the unit of Pr0.14 “Position deviation excess setup” will also be changed. The position deviation value can switch the command before and after the position command filter using the Pr7.23 “RTEX function expansion setup 2” :bit 14 setting. **— Precautions —** ● This setting value is also used as the detection threshold value of positioning complete (In_Position) in the RTEX communication status. However, if Pr7.24 “RTEX function expansion setup 3” : bit 3 = 1, it will always be the command unit regardless of the value of Pr5.20 “Position setup unit select” .

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	32	A	Positioning complete (In-position) output setup	0 to 10	—	Selects the conditions for outputting the positioning complete signal (INP). Whether or not there is a position command is determined by the command after the position command filter for setting values 1 to 5, and by the command before the position command filter for 6 to 10. The position deviation value can switch the command before and after the position command filter using the Pr7.23 “RTEX function expansion setup 2” :bit 14 setting. 0: ON when the position deviation is equal to or smaller than Pr4.31 “Positioning complete (In-position) range” . 1, 6: The signal turns ON when there is no position command and the position deviation is smaller than Pr4.31 “Positioning complete (In-position) range” . 2, 7: ON when there is no position command, the zero-speed detection signal is ON, and the position deviation is equal to or smaller than Pr4.31 “Positioning complete (In-position) range” . 3, 8: The signal turns ON when there is no position command and the position deviation is smaller than Pr4.31 “Positioning complete (In-position) range” . Subsequently, the ON state is maintained until Pr4.33 “INP hold time” has elapsed. After the INP hold time has elapsed, the INP output is switched ON/OFF according to the position command or position deviation status at that point. 4, 9: ON when positioning complete judgment starts after the delay time set by Pr4.33 “INP hold time” has elapsed after the change from with to no command, there is no position command, and the position deviation is equal to or smaller than Pr4.31 “Positioning complete (In-position) range” . 5, 10: ON when the positioning judgment delay time set by Pr4.33 “INP hold time” has elapsed after the change from with to no position command, within positioning complete (In-position) range, and positioning complete judgment sequence starts, if there is no position command and the position deviation is equal to or smaller than Pr4.31 “Positioning complete (In-position) range” . **— Precautions —** ● This setting value is also used as the detection threshold value of positioning complete (In_Position) in the RTEX communication status.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	33	A	INP hold time	0 to 30000	ms	● Sets the holding time when Pr4.32 “Positioning complete (In-position) output setup” = 3 or 8. 0: Holding time is maintained indefinitely. The ON state is maintained until the next positional command is received. 1 to 30000: ON state is maintained for the set value (ms) However, will change to OFF state if a position command is entered during the hold. ● Becomes positioning detection delay time if Pr4.32 “Positioning complete (In-position) output setup” = 4, 5, 9, or 10. 0: Positioning judgment delay time is zero. Positioning complete judgment begins immediately upon a change from “With position command” to “Without position command”. 1 to 30000: Positioning judgment start time is delayed by exactly the set value [ms]. However, if a position command is entered during the delay time, the delay time is reset, and after the position command becomes 0, the delay time measurement starts again from 0. **— Precautions —** ● This setting value is also used as the detection threshold value of positioning complete (In_Position) in the RTEX communication status.
4	42	A	Positioning complete (In-position) range 2	0 to 2097152	Command unit	Sets the threshold value of position deviation that outputs the positioning complete signal 2 (INP2). Regardless of Pr4.32 “Positioning complete (In-position) output setup” , INP2 always comes ON when the position deviation is less than this setting value (Not judged according to the presence or absence of a position command). The command unit is used as the default unit but can be replaced by the encoder unit or external scale unit by using Pr5.20 “Position setup unit select” . However, in such cases, note that the unit of Pr0.14 “Position deviation excess setup” will also be changed. The position deviation value can switch the command before and after the position command filter using the Pr7.23 “RTEX function expansion setup 2” :bit 14 setting.
5	20	C	Position setup unit select	0 to 1	—	Selects setup units for positioning complete (In-position) range and position deviation excess. 0: Command unit 1: Encoder unit (external scale unit) **— Precautions —** ● The positioning complete detection threshold value of the RTEX communication status is always in command units regardless of this setup value.
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 14: Position deviation [command unit] output setup 0: Internal command position (after filter) [command unit] - actual position [command unit] 1: Internal command position (before filter) [command unit] - actual position [command unit]

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	24	C	RTEX function expansion setup 3	-32768 to 32767	—	bit 3: RTEX communication In_Position judgment condition setting 0: Unit set by Pr5.20 “Position setup unit select” 1: Command unit fixed **— Precautions —** ● The positioning complete detection threshold value of the RTEX communication status is always in command units regardless of Pr5.20 “Position setup unit select” . For this reason, the In_Position judgment condition setting for RTEX communication is always in command units regardless of this setting value.

*1 For attributes, see *“6.3 List of Parameters”* .

7.4 Velocity Control

7.4.1 Velocity Control Overview

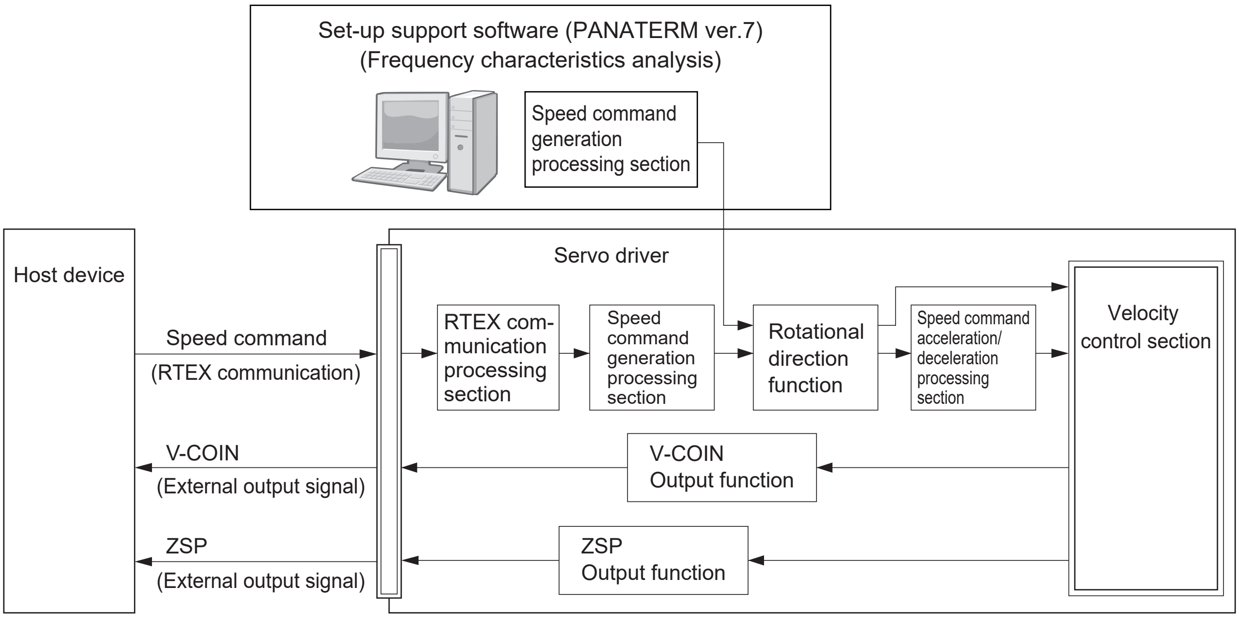
The following types of velocity control mode are available:

- Cyclic velocity control mode (CV):

  A velocity control mode in which the host device generates a speed command, and operates by updating (sending) the command speed in a communication cycle

For details on velocity control, see Technical Reference Communication Specification - .

A velocity control system overview is shown below.



— Precautions —

- To prevent sudden motor movement, see Operating Instructions (Tuning).
- When the motor speed reaches the velocity set in Pr4.36 “At-speed (Speed arrival)” , the speed arrival output (AT-SPEED) signal, which is an external output signal, is output.

  For details, see *“7.4.4 Speed Arrival Output (AT-SPEED)”* .
- If the speed command (before the acceleration/deceleration process) and motor speed match, a velocity coincidence output (V-COIN), which is an external signal, is output.

  For details, see *“7.4.5 Velocity Coincidence Output (V-COIN)”* .
- Control mode is forcibly switched inside this product according to its operation status, regardless of commands from the host device. Because this operation also affects input signal assignments, it is generally recommended to assign the same function to each terminal in all modes.

  The conditions for forcibly switching control modes are shown below.

Operation status if this product	Control mode after forced switching
When using Set-up Support Software (PANATERM ver.7) to perform frequency characteristics analysis	● During position loop characteristics analysis: Position control ● During velocity closed-loop characteristics analysis: Velocity control ● During torque speed (automatic) analysis: Position control ● During torque speed (vertical) analysis: Velocity control ● During torque speed (normal) analysis: Torque control
During trial run via Set-up Support Software (PANATERM ver.7)	● Position control
Operations with descriptions of “forcible position control” using various deceleration to stop functions (*“8.14”* to *“8.17”*)	● Position control
During retracting operations	● Position control

7.4.2 Velocity Control (Two-degree-of-freedom Control Mode is Enabled)

■ Operational Conditions

Item	Operational Conditions
Control mode	● Velocity control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Enables and disables two-degree-of-freedom control mode and sets standard or synchronization type. For details, see *"7.2.5 Two-degree-of-freedom Control Mode"* .
2	22	B	Positional command smoothing filter	0 to 10000	0.1 ms	Sets the time constant of the "command response filter" when two-degree-of-freedom control mode is enabled. ● Maximum value is limited to 640 (= 64.0 ms). **Notes** ● The parameter value itself is not limited, but the value applied in this product is limited. ● Decrease this parameter to speed up the command response, and increase it to slow down the command response.
2	38	B	Filter function switching	-32768 to 32767	—	Enables or disables the filter function. bit 0: Custom notch filter 0: Disabled 1: Enabled bit 1: Tuning filter 2 0: Disabled 1: Enabled *Do not switch tuning filter 2 between enabled and disabled during operation.
2	39	B	Custom notch compensation coefficient	0 to 1000	0.01	Sets the custom notch compensation coefficient. A set value of 100 or less disables compensation.
2	40	B	Custom notch compensation frequency 1	0 to 10000	0.1 Hz	Sets custom notch compensation frequency 1. A setup value of 0 disables compensation.
2	41	B	Custom notch compensation frequency 2	0 to 10000	0.1 Hz	Sets custom notch compensation frequency 2. A setup value of 0 disables compensation.
2	42	B	Custom notch frequency	10 to 5000	Hz	Sets the notch frequency of the custom notch filter. A setup value of 5000 disables the custom notch filter.
2	43	B	Custom notch width	0 to 20	—	Sets the notch width of the custom notch filter.
2	44	B	Custom notch depth	0 to 99	—	Sets the notch depth of the custom notch filter.

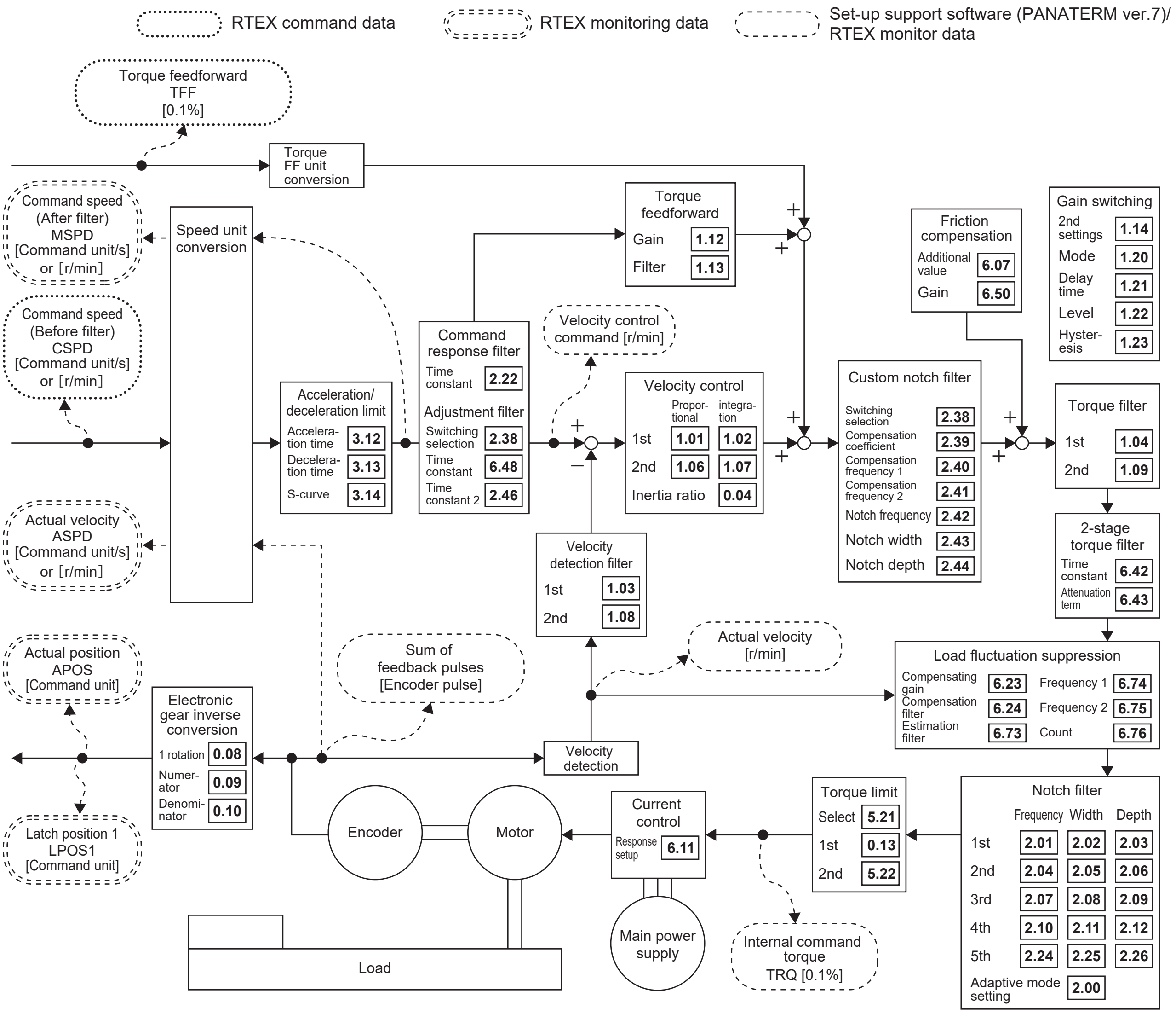
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
2	46	B	Tuning filter 2	0 to 20000	0.01 ms	Sets the time constant of “Tuning filter 2” during two-degree-of-freedom control. Disabled when the set value is 0 to 3. ● Attenuation terms are set using Pr6.49 “Command response/tuning filter attenuation term” .
6	48	B	Tuning filter	0 to 2000	0.1 ms	Sets the time constant of the “tuning filter” in the two-degree-of-freedom control. ● When changing the torque filter setup, see the real-time auto tuning setting, and set a value close thereto. ● During velocity control, Maximum value is limited to 640 (= 64.0 ms). The parameter value itself is not limited, but the value applied in this product is limited.
6	49	B	Command response/tuning filter attenuation term	0 to 99	—	Sets the “command response filter” and “tuning filter” attenuation terms in the two-degree-of-freedom control. ● Sets each filter in decimal notation. Ones: Command response filter Tens: Tuning filter <Target digit setting values> 0 to 4: No attenuation terms (operates as first order lag filter) 5 to 9: Attenuation term ζ is 1.0, 0.86, 0.71, 0.50, 0.35, in that order (operates as second order lag filter) ＜ Example of this parameter setup ＞ To set the command response filter to ζ = 1.0 and the tuning filter to ζ = 0.71, set the setting value to 75 (ones = 5 (ζ = 1.0), tens = 7 (ζ = 0.71)). Note that Pr2.22 “Positional command smoothing filter” is applied to the command response filter time constant.

*1 For attributes, see *“6.3 List of Parameters”* .

■ **How to use**

For settings to enable two-degree-of-freedom control, see *“How to use”* “Two-degree-of-freedom control” of *“7.2.5 Two-degree-of-freedom Control Mode”* .

Control Block Diagram: Velocity Control (Two-degree-of-freedom Control Mode Enabled)



7.4.3 Velocity Control (Two-degree-of-freedom Control Mode Disabled)

■ Operational Conditions

Item	Operational Conditions
Control mode	● Velocity control
Other	● Must be at servo-on. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally.

■ Setup value

—: None

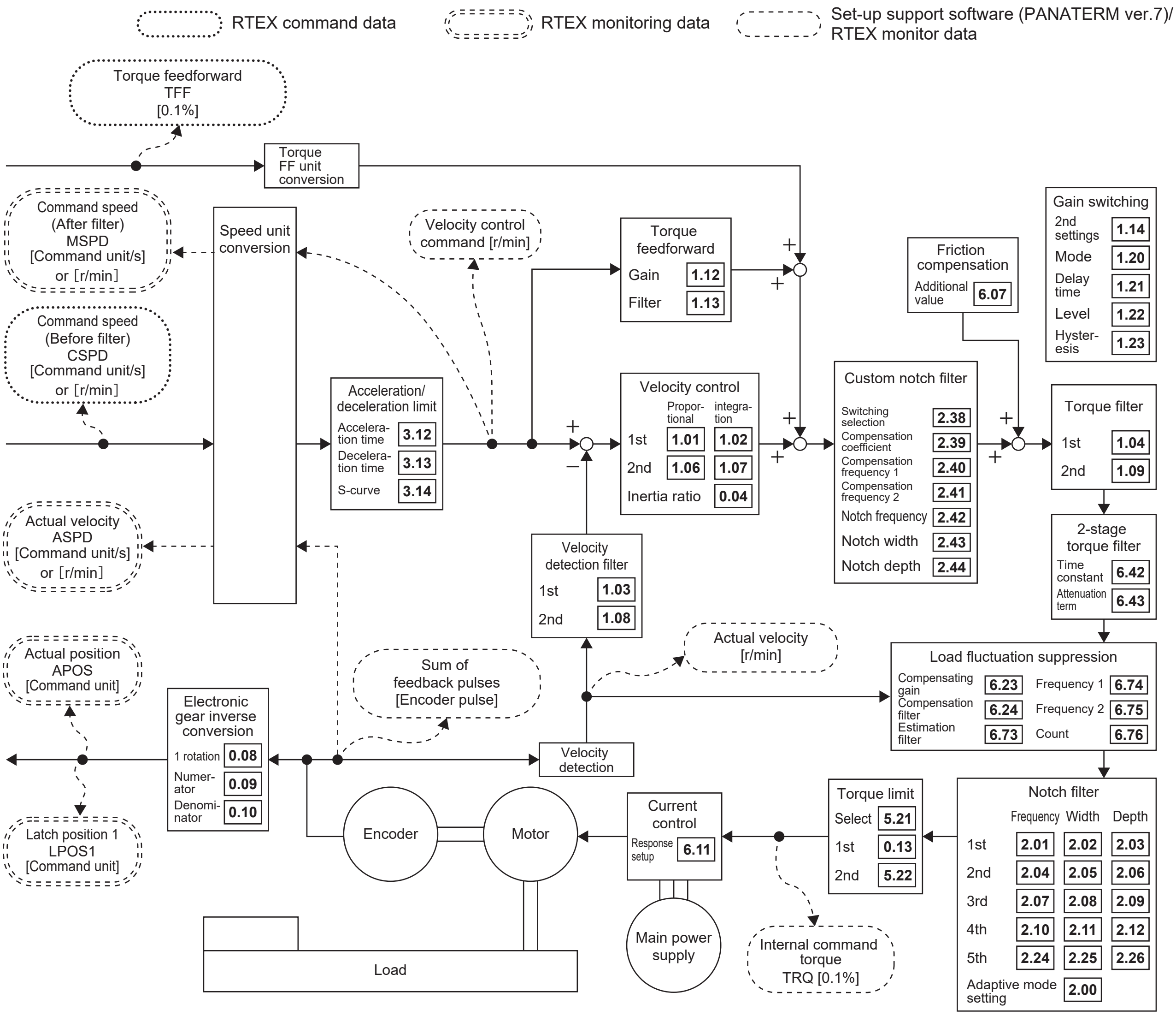
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Enables and disables two-degree-of-freedom control mode and sets standard or synchronization type. For details, see *"7.2.5 Two-degree-of-freedom Control Mode"* .

*1 For attributes, see *"6.3 List of Parameters"* .

■ How to use

For settings to disable two-degree-of-freedom control, see *"How to use"* "Two-degree-of-freedom control" of *"7.2.5 Two-degree-of-freedom Control Mode"* .

Control Block Diagram: Velocity Control (Two-degree-of-freedom Control Mode Disabled)



7.4.4 Speed Arrival Output (AT-SPEED)

When the motor speed exceeds the speed set in Pr4.36 “At-speed (Speed arrival)” , the speed arrival output (AT-SPEED) is output.

■ Operational conditions

Item	Operational conditions
Control mode	● Velocity control, torque control

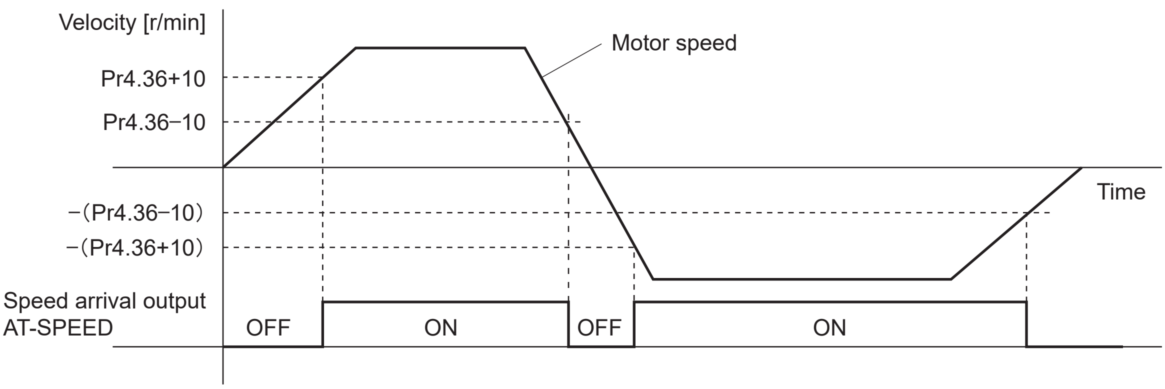
■ Setup value

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	36	A	At-speed (Speed arrival)	10 to 20000	r/min	Sets the detection threshold value for speed arrival output (AT-SPEED). When the motor speed exceeds this set value, the speed arrival output (AT-SPEED) is output. Detection is associated with 10 r/min hysteresis.

*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

The relationship between motor speed and speed arrival output (AT-SPEED) is as follows.



7.4.5 Velocity Coincidence Output (V-COIN)

If the speed command (before the acceleration/deceleration process) and motor speed match, a velocity coincidence output (V-COIN), which is an external signal, is output. A match is judged if the difference between the speed command from before the acceleration/deceleration process inside the driver and the motor speed is within Pr4.35 “Speed coincidence range” .

■ Operational conditions

Item	Operational conditions
Control mode	● Velocity control, torque control

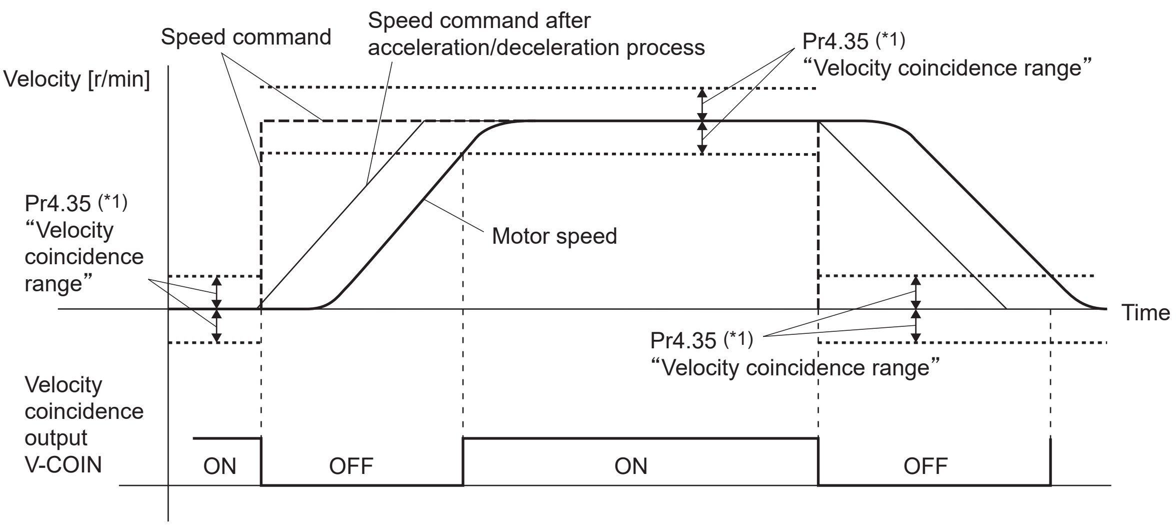
■ Setup value

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	35	A	Speed coincidence range	10 to 20000	r/min	Sets the detection threshold value for speed coincidence output (V-COIN). If the difference between speed command and motor speed is less than this setting value, outputs velocity coincidence output (V-COIN). Detection may cause 10 r/min hysteresis.

*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

The relationship between motor speed and velocity coincidence output (V-COIN) is as follows.



*1 Because the speed coincidence detection is associated with 10 r/min hysteresis, actual detection range is as shown below.

Velocity coincidence output Threshold value when OFF -> ON (Pr4.35 + -10) r/min

Velocity coincidence output Threshold value when ON -> OFF (Pr4.35 + 10) r/min

7.5 Torque Control

7.5.1 Torque Control Overview

The following types of torque control mode are available.

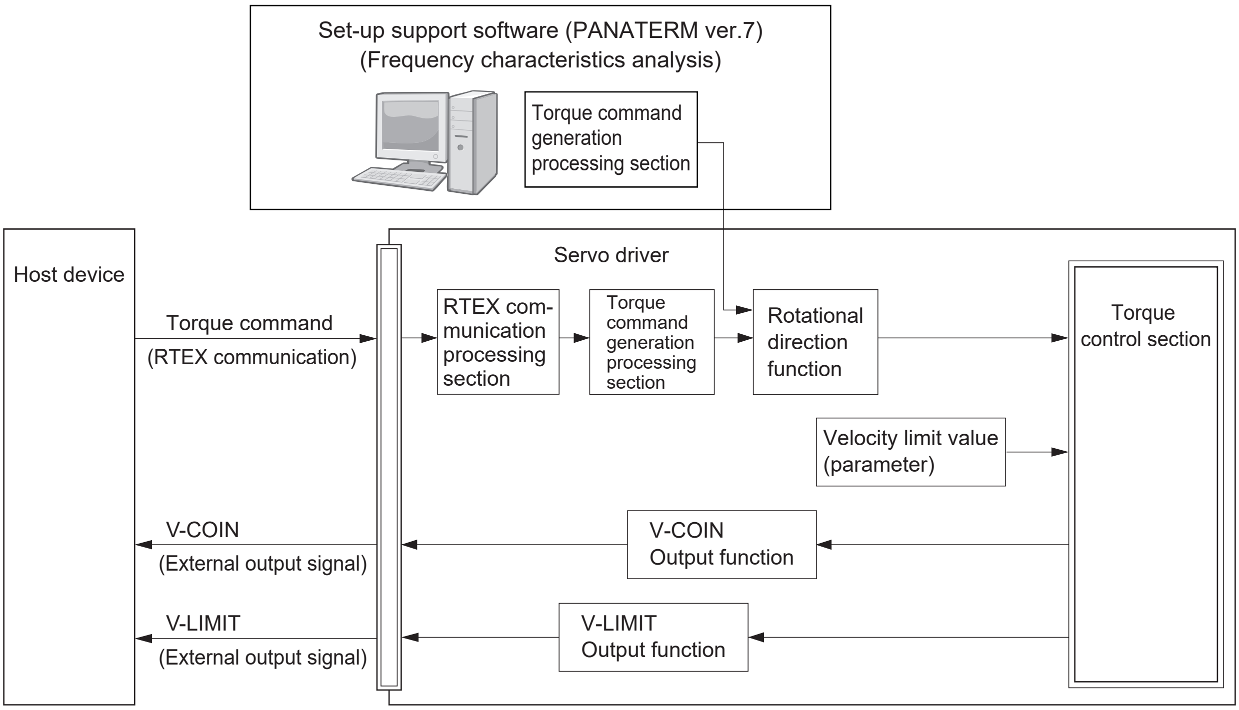
- Cyclic torque control mode (CT):

  This is a torque control mode in which the host device generates a torque command, and operates by updating (sending) the command torque at the communication cycle.

For details on torque control, see Technical Reference Communication Specification.

For torque control, a velocity limit command is required in addition to the torque command. The limit controls the rotational speed of the motor so that it does not exceed the velocity limit value.

A torque control system overview is shown below.



* The velocity coincidence output (V-COIN) has the same specifications as those for velocity control.

* The velocity limit output (V-LIMIT) outputs the same signal as the velocity coincidence output (V-COIN).

— Precautions —

- The default velocity limit value is 0. Set the velocity limit value (Pr3.21/Pr3.22) appropriately when using the torque control mode.
- Control mode is forcibly switched inside this product according to its operation status, regardless of commands from the host device. Because this operation also affects input signal assignments, it is generally recommended to assign the same function to each terminal in all modes.

  The conditions for forcibly switching control modes are shown below.

Operation status if this product	Control mode after forced switching
When using Set-up Support Software (PANATERM ver.7) to perform frequency characteristics analysis	● During position loop characteristics analysis: Position control ● During velocity closed-loop characteristics analysis: Velocity control ● During torque speed (automatic) analysis: Position control ● During torque speed (vertical) analysis: Velocity control ● During torque speed (normal) analysis: Torque control
During trial run via Set-up Support Software (PANATERM ver.7)	● Position control
Operations with descriptions of “forcible position control” using various deceleration to stop functions (*“8.14”* to *“8.17”*)	● Position control
During retracting operations	● Position control

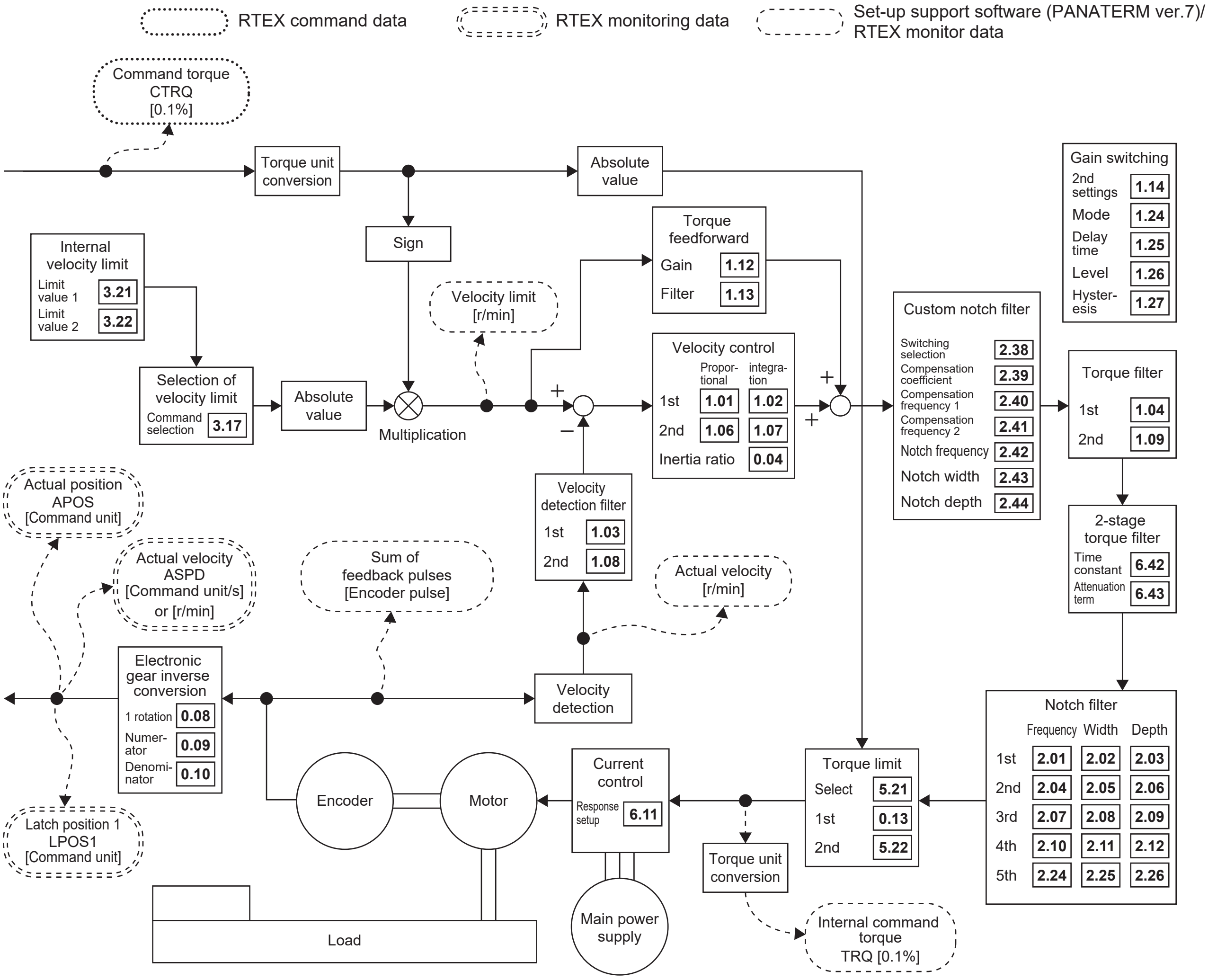
■ Operational Conditions

Item	Operational Conditions
Control mode	● Torque control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally.

■ Setup value

Torque control requires a velocity limit command. For setting values, see *“7.5.2 Velocity Limit Function”* .

Control Block Diagram: Torque Control



7.5.2 Velocity Limit Function

Limits velocity as protection during torque control.

Provides control to ensure that the velocity does not exceed the velocity limit value set during torque control.

Can be switched using the RTEX communication velocity limit switch command (SL_SW).

■ Operational Conditions

Item	Operational Conditions
Control mode	● Torque control

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
3	17	B	Selection of speed limit	0 to 1	—	Sets the velocity limit value selection method during torque control. Setup value / SL_SW = 0 / SL_SW = 1 0 / Pr3.21 / Pr3.21 1 / Pr3.21 / Pr3.22
3	21	B	Velocity limit value 1	0 to 20000	r/min	Sets the velocity limit value during torque control. During torque control, the speed set by the velocity limit value cannot be exceeded. Furthermore, the internal value is limited by Pr5.13 “Over-speed level setup” , Pr6.15 “2nd overspeed level setting” , and the smallest velocity set for the internal value of over-speed protection level.
3	22	B	Velocity limit value 2	0 to 20000	r/min	Sets the velocity limit value when Pr3.17 “Selection of speed limit” is set to 1, and SL_SW is 1. Furthermore, the internal value is limited by Pr5.13 “Over-speed level setup” , Pr6.15 “2nd overspeed level setting” , and the smallest velocity set for the internal value of over-speed protection level.

Setup value	SL_SW = 0	SL_SW = 1
0	Pr3.21	
1	Pr3.21	Pr3.22

*1 For attributes, see *“6.3 List of Parameters”* .

■ Precautions

- While being controlled by the velocity limit, torque commands to the motor do not follow torque commands from the host device. The torque commands to the motor are the result of velocity control provided so that the motor speed reaches the velocity limit value.
- If the motor is operating in the opposite direction to the torque command from the host device due to disturbances such as gravity, the velocity limit may not function.

  If this operation becomes a problem, set the velocity limit at which to stop the motor in Pr5.13 “Over-speed level setup” or Pr6.15 “2nd overspeed level setting” , and stop the motor if Err26.0.0 “Overspeed protection” or Err26.1.0 “2nd Overspeed protection” occurs.

  For details on overspeed protection, see *“8.18 Emergency Stop Function For When Alarm is Triggered”* .

7.6 Full-closed Control

7.6.1 Full-closed Control Overview

Full-closed control is a type of position control that uses an external scale to directly detect the position of the machine to be controlled and provide feedback. For example, it can provide control that is not affected by ball screw errors or position fluctuations due to temperature.

Constructing a full-closed control system makes it possible to achieve high-precision positioning on the order of submicrons.

Full-closed control is available for profile position control mode (PP) and cyclic position control mode (CP).

For details on full-closed control, see Technical Reference Communication Specification - , .

Switching from position control modes (PP and CP) to cyclic velocity control mode (CV) and to cyclic torque control mode (CT) during full-closed control is not possible. If 3□h (CV) or 4□h (CT) is set for the cyclic command during full-closed control, Err91.1.0 “RTEX Command error protection” is triggered.

For setting up the external scale ratio and hybrid deviation excess in the initial full-closed control setting, see *“7.6.4 External Scale Dividing Ratio Settings”* and *“7.6.5 Hybrid Deviation Excess Setup”* .

— Precautions —

- One command pulse (one command unit) when using an electronic gear ratio of 1/1 is one pulse for the external scale.

  In full-closed control, velocity control is performed by encoder feedback, and position control is performed by external scale feedback.
- Set Pr3.28 “Hybrid deviation excess setup” and Pr3.29 “Hybrid deviation clear setup” to appropriate values.

  If the excessive hybrid deviation range is set too wide, these detections will be delayed and the effect of anomaly detection will be lost. On the other hand, if the range is too small, the amount of motor or machine torsion generated during normal operation may be detected as an error. For details, see *“7.6.5 Hybrid Deviation Excess Setup”* .
- An external scale of 1/40 ≦ External scale ratio ≦ 20480 is recommended.

  Setting the external scale ratio to a smaller value than 50/position loop gain [Hz] may prevent control of the external scale in single pulse units.

  Increasing the external scale ratio may increase noise during operation.
- Using an incorrect external scale dividing ratio may trigger Err25.0.0 “Hybrid deviation excess protection” , especially when using a long stroke distance, even if the external scale and motor position are matched. In such cases, adjust the external scale dividing ratio to a value as close as possible and widen the excessive hybrid deviation range.

7.6.2 Full-closed Control (Two-degree-of-freedom Control Mode Enabled)

■ Operational Conditions

Item	Operational Conditions
Control mode	● Full-closed control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally. ● Driver type must be one other than standard type. ● For precautions for full-closed control, see *"7.6.1 Full-closed Control Overview"* .

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Enables and disables two-degree-of-freedom control mode and sets standard or synchronization type. For details, see *"7.2.5 Two-degree-of-freedom Control Mode"* .
2	22	B	Positional command smoothing filter	0 to 10000	0.1 ms	Sets the time constant of the "command response filter" when two-degree-of-freedom control mode is enabled. ● Maximum value is limited to 2000 (= 200.0 ms). **Notes** ● The parameter value itself is not limited, but the value applied in this product is limited. ● Decrease this parameter to speed up the command response, and increase it to slow down the command response. ● Attenuation terms are set using Pr6.49 "Command response/tuning filter attenuation term" .
2	38	B	Filter function switching	-32768 to 32767	—	Enables or disables the filter function. bit 0: Custom notch filter 0: Disabled 1: Enabled bit 1: Tuning filter 2 0: Disabled 1: Enabled *Do not switch tuning filter 2 between enabled and disabled during operation.
2	39	B	Custom notch compensation coefficient	0 to 1000	0.01	Sets the custom notch compensation coefficient. A set value of 100 or less disables compensation.
2	40	B	Custom notch compensation frequency 1	0 to 10000	0.1 Hz	Sets custom notch compensation frequency 1. A setup value of 0 disables compensation.
2	41	B	Custom notch compensation frequency 2	0 to 10000	0.1 Hz	Sets custom notch compensation frequency 2. A setup value of 0 disables compensation.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
2	42	B	Custom notch frequency	10 to 5000	Hz	Sets the notch frequency of the custom notch filter. A setup value of 5000 disables the custom notch filter.
2	43	B	Custom notch width	0 to 20	—	Sets the notch width of the custom notch filter.
2	44	B	Custom notch depth	0 to 99	—	Sets the notch depth of the custom notch filter.
2	46	B	Tuning filter 2	0 to 20000	0.01 ms	Sets the time constant of “Tuning filter 2” during two-degree-of-freedom control. Disabled when the set value is 0 to 3. ● Attenuation terms are set using Pr6.49 “Command response/tuning filter attenuation term” .
6	48	B	Tuning filter	0 to 2000	0.1 ms	Sets the time constant of the “tuning filter” in the two-degree-of-freedom control. ● When changing the torque filter setup, see the real-time auto tuning setting, and set a value close thereto. ● Finely tuning by checking the encoder position deviation of the settling area may improve overshoot or oscillatory waveform. ● Attenuation terms are set using Pr6.49 “Command response/tuning filter attenuation term” .
6	49	B	Command response/tuning filter attenuation term	0 to 99	—	Sets the “command response filter” and “tuning filter” attenuation terms in the two-degree-of-freedom control. ● Sets each filter in decimal notation. Ones: Command response filter Tens: Tuning filter <Target digit setting values> 0 to 4: No attenuation terms (operates as first order lag filter) 5 to 9: Attenuation term ζ is 1.0, 0.86, 0.71, 0.50, 0.35, in that order (operates as second order lag filter) ＜ Example of this parameter setup ＞ To set the command response filter to ζ = 1.0 and the tuning filter to ζ = 0.71, set the setting value to 75 (ones = 5 (ζ = 1.0), tens = 7 (ζ = 0.71)). Note that Pr2.22 “Positional command smoothing filter” is applied to the command response filter time constant.
6	50	B	Viscous friction compensating gain	0 to 10000	0.1 %/ (10000 r/min)	When the two-degree-of-freedom control mode is enabled, the product of the command speed and the setup value is used as the viscous friction torque compensation and the torque command is added to the torque. ● Setting the value of the viscous friction coefficient estimation of real-time auto tuning can improve the encoder position deviation of the settling area.

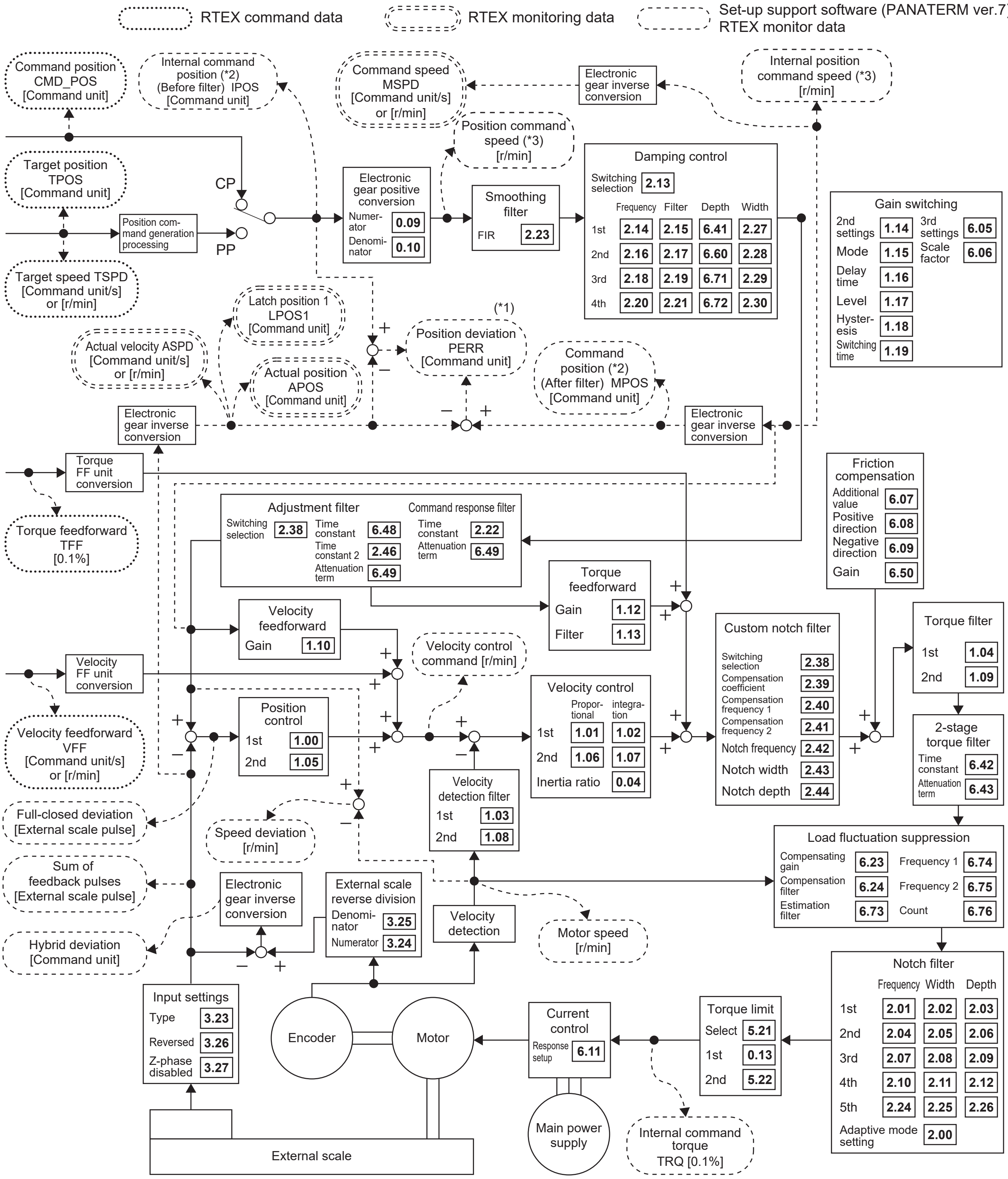
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	23	B	RTEX function expansion set-up 2	-32768 to 32767	—	bit 14: Position deviation [command unit] output setup 0: Internal command position (after filter) [command unit] - actual position [command unit] 1: Internal command position (before filter) [command unit] - actual position [command unit]
7	99	B	RTEX function expansion set-up 6	-32768 to 32767	—	bit 3: Command pulse accumulated value [command unit] output setting 0: Before filter 1: After filter

*1 For attributes, see *"6.3 List of Parameters"* .

■ How to use

For settings to enable two-degree-of-freedom control, see *"How to use"* "Two-degree-of-freedom control" of *"7.2.5 Two-degree-of-freedom Control Mode"* .

Control Block Diagram: Full-closed Control (Two-degree-of-freedom Control Mode Enabled)



*1 Position deviation [command unit] operation criteria can be changed in Pr7.23 “RTEX function expansion setup 2” :bit 14.

*2 Position commands in Set-up Support Software (PANATERM ver.7) depend on Pr7.99 “RTEX function expansion setup 6” :bit 3 “Command pulse accumulated value [command unit] output setting” settings.

*3 Velocity [r/min] unit calculated from encoder, not external scale.

7.6.3 Full-closed Control (Two-degree-of-freedom Control Mode Disabled)

■ Operational Conditions

Item	Operational Conditions
Control mode	● Full-closed control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally. ● Driver type must be one other than standard type. ● For precautions for full-closed control, see *“7.6.1 Full-closed Control Overview”* .

■ Setup value

—: None

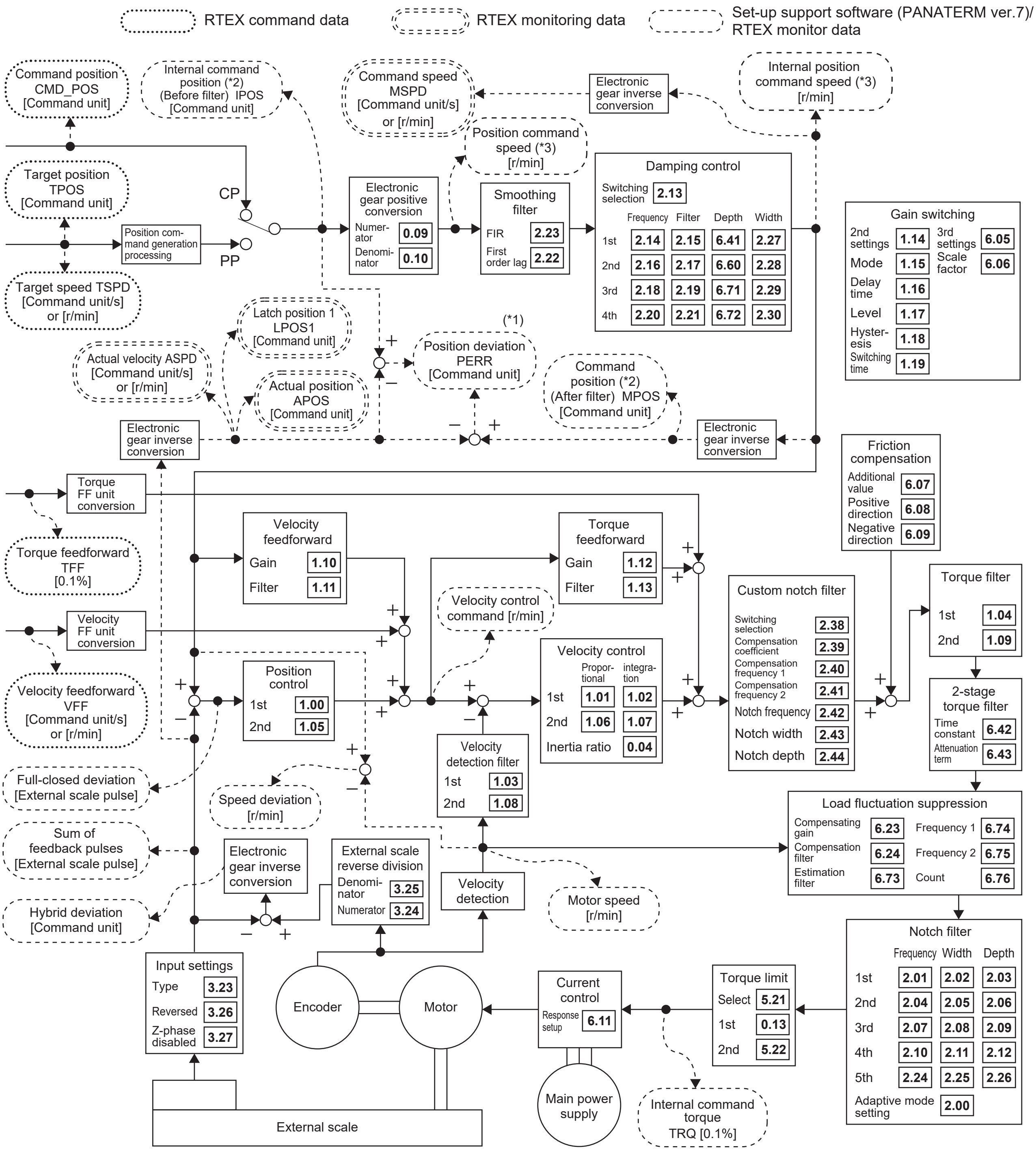
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	47	R	Function expansion setup 2	-32768 to 32767	—	Enables and disables two-degree-of-freedom control mode and sets standard or synchronization type. For details, see *“7.2.5 Two-degree-of-freedom Control Mode”* .
2	22	B	Positional command smoothing filter	0 to 10000	0.1 ms	When two-degree-of-freedom control mode is disabled, sets the time constant of the first order lag filter for the position command. For details, see Operating Instructions (Tuning).
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 14: Position deviation [command unit] output setup 0: Internal command position (after filter) [command unit] - actual position [command unit] 1: Internal command position (before filter) [command unit] - actual position [command unit]
7	99	B	RTEX function expansion setup 6	-32768 to 32767	—	bit 3: Command pulse accumulated value [command unit] output setting 0: Before filter 1: After filter

*1 For attributes, see *“6.3 List of Parameters”* .

■ How to use

For settings to disable two-degree-of-freedom control, see *“How to use”* “Two-degree-of-freedom control” of *“7.2.5 Two-degree-of-freedom Control Mode”* .

Control Block Diagram: Full-closed Control (Two-degree-of-freedom Control Mode Disabled)



*1 Position deviation [command unit] operation criteria can be changed in Pr7.23 “RTEX function expansion setup 2” :bit 14.

*2 Position commands in Set-up Support Software (PANATERM ver.7) depend on Pr7.99 “RTEX function expansion setup 6” :bit 3 “Command pulse accumulated value [command unit] output setting” settings.

*3 Velocity [r/min] unit calculated from encoder, not external scale.

7.6.4 External Scale Dividing Ratio Settings

A function that sets the dividing ratio of encoder resolution and feedback scale resolution.

■ Operational conditions

Item	Operational conditions
Control mode	● Full-closed control
Other	● Driver type must be one other than standard type. ● For precautions for full-closed control, see *"7.6.1 Full-closed Control Overview"* .

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
3	24	R	Numerator of external scale division	0 to 2^{27}	—	Sets numerator for external scale division setup. When this setup value is 0, encoder resolution is used as the division numerator.
3	25	R	Denominator of external scale division	1 to 2^{27}	—	Sets denominator for external scale division setup.

*1 For attributes, see *"6.3 List of Parameters"* .

■ How to use

Check the encoder pulse count per motor revolution and the external scale pulse count per motor revolution, and set Pr3.24 "Numerator of external scale division" and Pr3.25 "Denominator of external scale division" so that the following formula holds.

(Example) For a ball screw pitch of 10 mm, a scale of 0.1 μm/pulse, and an encoder resolution of 27 bits (134217728 pulses)

$$\text{External scale ratio} = \frac{\text{Pr3.24} \ \boxed{134217728}}{\text{Pr3.25} \ \boxed{100000}} = \frac{\text{Encoder pulse count per motor revolution [pulse]}}{\text{External scale pulse count per motor revolution [pulse]}}$$

If this ratio is wrong, the difference between the position calculated based on the encoder pulse and the position calculated based on the external scale pulse becomes large over a long travel distance and activates hybrid deviation excess error protection.

Setting Pr3.24 "Numerator of external scale division" to 0 automatically sets the encoder resolution as the numerator.

7.6.5 Hybrid Deviation Excess Setup

This function detects the difference between motor (encoder) position and load (external scale) position, and generates hybrid deviation excess error protection when the difference exceeds Pr3.28 “Hybrid deviation excess setup” .

Excessive hybrid deviation mainly occurs when there is an abnormality in the external scale, a wrong connection, or a loose connection between the motor and load.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Full-closed control
Other	● Driver type must be one other than standard type. ● For precautions for full-closed control, see *“7.6.1 Full-closed Control Overview”* .

■ Setup value

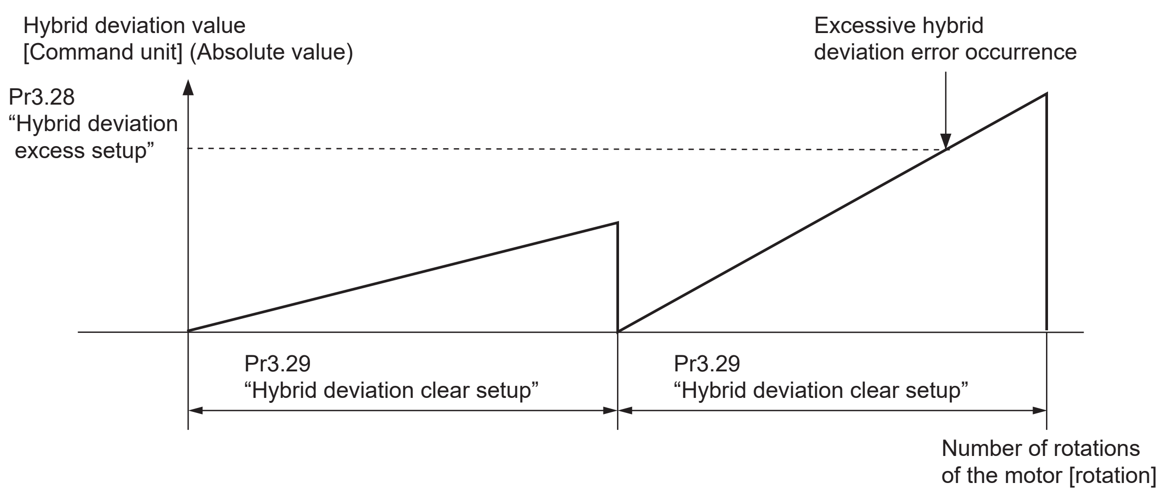
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
3	28	C	Hybrid deviation excess setup	1 to 2^{27}	Command unit	Sets the allowance (hybrid deviation) between motor (encoder) position and load (external scale) position in command units.
3	29	C	Hybrid deviation clear setup	0 to 100	Rotation	Clears the hybrid deviation to 0 each time the motor rotates for this setup value. If this setup value is 0, it will not clear hybrid deviation to zero using this setting.

*1 For attributes, see *“6.3 List of Parameters”* .

■ How to use

● Hybrid deviation clearing

Hybrid deviation is cleared to 0 each time the motor rotates by the number of rotations set in Pr3.29 “Hybrid deviation clear setup” . This function can also be used for applications where hybrid deviation accumulates due to slippage, etc.



* Number of rotations in the hybrid deviation clear setup is counted by using encoder feedback pulses.

— Precautions —

1 When using hybrid deviation clear, be sure to set Pr3.29 “Hybrid deviation clear setup” to an appropriate value. If the setting value of Pr3.28 “Hybrid deviation excess setup” is set to a small value, it may not function as a protection against abnormal operation caused by incorrect connection of the external scale.

Limit sensor should be used to assure safety.

2 In addition to the above, hybrid deviation is cleared to 0 at the following position information initialization.

- Absolute system when power supply is turned on
- When homing is completed
- When reset command (attribute C parameter enabled mode) is completed
- Upon completion of the following functions with Set-up Support Software (PANATERM ver.7)

  Trial run function, Z-phase search function, frequency characteristics analysis function (FFT function), One Minute TUNING function, Config execution, multi-turn data clear of absolute encoder

8 Application

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8.1 Torque Limit Switching Function

This function changes the torque limit values according to the operation direction or torque limit switching command (TL_SW) of RTEX communication.

For details, see *“4.2.4.1.4 Control Bits (command bytes 2 and 3)”* .

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, velocity control, and full-closed control (*1)
Other	● Must be in servo-on state. ● Elements other than servo parameters are appropriately set, enabling the motor to rotate normally.

*1 The “torque limit switching function” is disabled when using torque control and when analyzing frequency characteristics (in torque speed (normal) mode) using Set-up Support Software (PANATERM ver.7) , and only Pr0.13 “1st torque limit” is enabled.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	13	B	1st torque limit	0 to 500	%	Sets the 1st torque limit for the torque output by the motor.
5	11	B	Torque setup for emergency stop	0 to 500	%	Sets the torque limit for emergency stop. The normal torque limit is used when this setup value is 0.
5	21	B	Selection of torque limit	0 to 4	—	Sets the torque limit selection method.

Setup value	TL_SW = 0		TL_SW = 1	
	Negative direction	Positive direction	Negative direction	Positive direction
0	Internally set to 1.			
1	Pr0.13			
2	Pr5.22	Pr0.13	Pr5.22	Pr0.13
3	Pr0.13		Pr5.22	
4	Pr5.22	Pr0.13	Pr5.26	Pr5.25

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	22	B	2nd torque limit	0 to 500	%	Sets the 2nd torque limit for the torque output by the motor.
5	23	B	Torque limit switching setup 1	0 to 4000	ms/100 %	Sets the rate of change (gradient) from first to second for torque limit switching.
5	24	B	Torque limit switching setup 2	0 to 4000	ms/100 %	Sets the rate of change (gradient) from second to first for torque limit switching.
5	25	B	Positive direction torque limit	0 to 500	%	Sets the positive direction torque limit when torque limit switching is input.
5	26	B	Negative direction torque limit	0 to 500	%	Sets the negative direction torque limit when torque limit switching is input.

*1 For attributes, see *“6.3 List of Parameters”* .

*2 Torque limit setting ranges and factory default settings vary between different combinations of servo drivers and motors.
For details, see *"Operation"* Torque Limit Setting Range.

■ Operation

● The torque limit switching mode is shown in the table below:

—: None

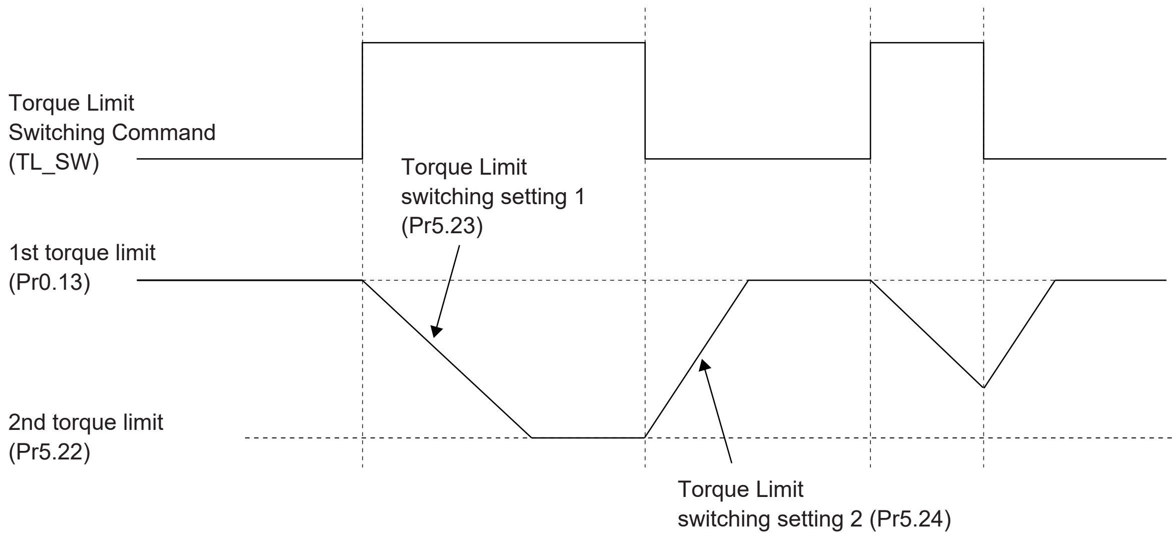
Pr5.21 "Selection of torque limit"	Torque limit switching command (TL_SW)	Torque limit switching setup (rate of change setting) Pr5.23 "Torque limit switching setup 1" Pr5.24 "Torque limit switching setup 2"	Positive direction torque limit	Negative direction torque limit
1	—	—	Pr0.13 "1st torque limit"	
2	—	—	Pr0.13 "1st torque limit"	Pr5.22 "2nd torque limit"
3	OFF	Enabled	Pr0.13 "1st torque limit"	
	ON		Pr5.22 "2nd torque limit"	
4	OFF	—	Pr0.13 "1st torque limit"	Pr5.22 "2nd torque limit"
	ON		Pr5.25 "Positive direction torque limit"	Pr5.26 "Negative direction torque limit"

● Rate of Change Settings for Torque Limit Switching

When the motor is used with Pr5.21 "Selection of torque limit" set to 3, a gradient can be applied to the changes when the torque limit switches. This function is disabled in other settings.

The rate of change (gradient) set in Pr5.23 "Torque limit switching setup 1" is applied when the 1st torque limit switches to the 2nd torque limit, and the rate of change (gradient) set in Pr5.24 "Torque limit switching setup 2" is applied when the 2nd torque limit switches to the 1st torque limit. The sign of the change rate (gradient) is automatically switched inside this product in accordance with the magnitude relationship between the 1st torque limit and the 2nd torque limit.

Switching occurs instantaneously when Pr5.23 "Torque limit switching setup 1" or Pr5.24 "Torque limit switching setup 2" is set to 0.



● Torque Limit Setup Range

- The torque limit setup range is 0 to 300 and the factory default value is 300, except for the motor and servo driver combinations listed in the table below.

For initial values, see *“6.3 List of Parameters”* .

- Pr0.13 “1st torque limit” , Pr5.22 “2nd torque limit” , Pr5.11 “Torque setup for emergency stop” , Pr5.25 “Positive direction torque limit” , and Pr5.26 “Negative direction torque limit” are subject to the torque limit values in the table below.

  Changing the motor model may change the torque limit values in the table below, so please reconfirm and reconfigure the parameter setup values to be limited.

Size	Driver part no.	Applicable motors	Torque limit value
A	MADN061N□	MHMG5AZU□1□□□	350
	MADN081N□	MHMG011U□1□□□	350
	MADN065N□	MHMG5AZU□1□□□	350
		MHMG012U□1□□□	350
	MADN085N□	MHMG022U□1□□□	350
B	MBDN121N□	MHMG021U□1□□□	350
	MBDN125N□	MHMG042U□1□□□	350
C	MCDN201N□	MHMG041U□1□□□	350
	MCDN205N□	MHMG082U□1□□□	350
D	MDDN405N□	MHMG092U□1□□□	350

■ Precautions

When the Pr0.13 “1st torque limit” and Pr5.22 “2nd torque limit” are changed via Set-up Support Software (PANATERM ver.7) or RTEX communication, the rate of change setting is ignored and the torque limit value after the change is immediately applied. The rate of change setting becomes effective only when switched by the torque limit switching command (TL_SW).

8.2 Torque Saturation Protection Function

Triggers an alarm when torque saturation condition lasts for a set amount of time.

■ Operational conditions

Item	Operational conditions
Control mode	● Position control, velocity control, and full-closed control

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	57	B	Torque saturation error protection detection time	0 to 5000	ms	Sets torque saturation error protection detection time. If torque saturation lasts for longer than the set time, Err16.1.0 “Torque saturation error protection” is triggered. When this setup value is 0, the setup value for Pr7.16 “Torque saturation error protection frequency” is enabled.
7	03	A	Output setup during torque limit	0 to 1	—	Set up judgment condition of output while torque is limited by torque control. 0: On at torque limit including torque command value 1: On at torque limit excluding torque command value
7	16	B	Torque saturation error protection frequency	0 to 30000	Incidences	If torque saturation persists for the preset count, Err16.1.0 “Torque saturation error protection” is triggered. The count increases by 1 every 0.25 ms. For example, when set to 30000, Err16.1.0 “Torque saturation error protection” is triggered if torque saturation persists for 7.5 seconds. The count is cleared when the torque saturation condition is removed. When the setup value for Pr6.57 “Torque saturation error protection detection time” is not 0, the setup value for Pr6.57 “Torque saturation error protection detection time” is enabled.

*1 For attributes, see *“6.3 List of Parameters”* .

Set both Pr6.57 “Torque saturation error protection detection time” and Pr7.16 “Torque saturation error protection frequency” to 0 to disable this function.

This function is disabled and Err16.1.0 “Torque saturation error protection” cannot be triggered during torque control.

This function is disabled and Err16.1.0 “Torque saturation error protection” cannot be triggered when the emergency stop alarm is triggered.

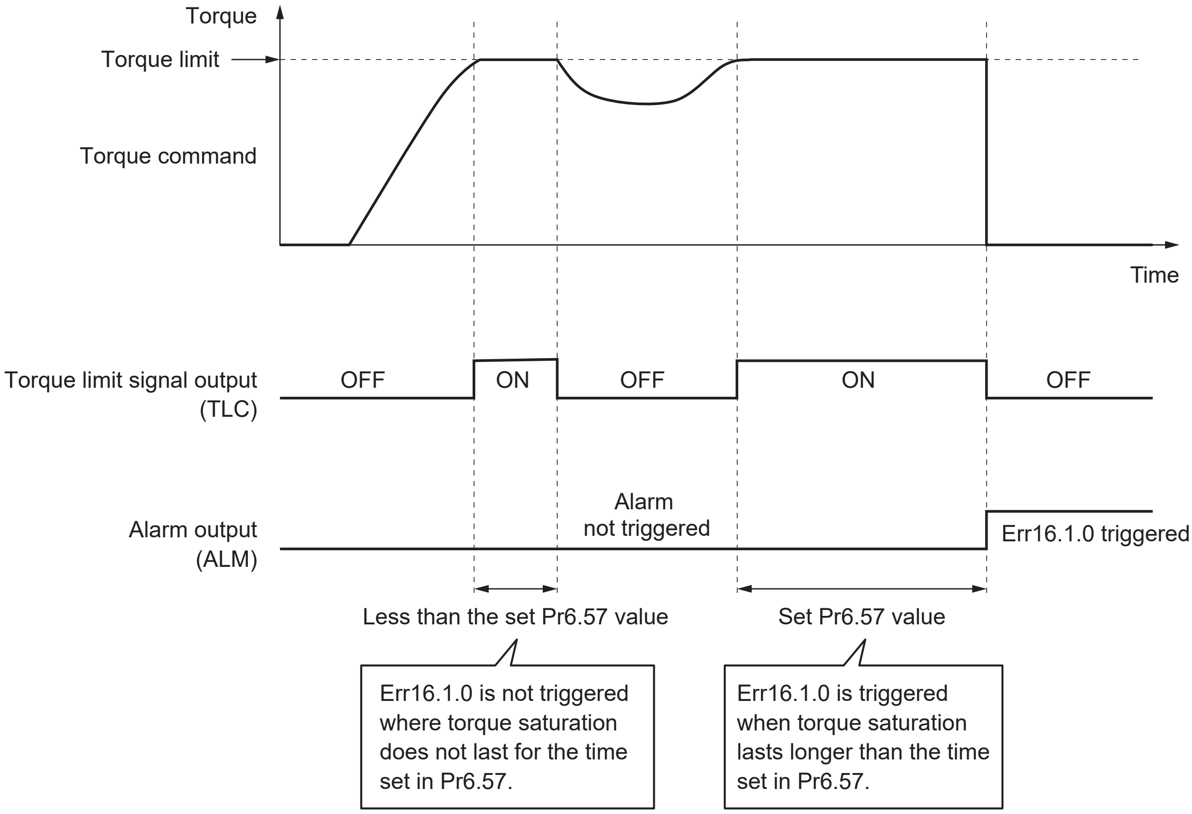
Torque saturation is determined using the currently enabled torque limit.

For details on torque limits, see *“8.1 Torque Limit Switching Function”* .

When this function is enabled, alarm detection is performed even when at servo-off.

■ Operation

Example of when torque saturation protection does and does not activate



8.3 Position Comparison Output Function

A general-purpose output or position comparison output terminal outputs a pulse signal when the actual position passes the position set for the parameter.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes (except virtual full-closed control mode)
Other	● RTEX communication has been established. ● Homing operation has been completed. (RTEX communication status flag bit 2 (Homing_Complete) = 1) ● Elements other than servo parameters are appropriately set, enabling the motor to rotate normally. ● Not in continuous rotating absolute encoder mode (Pr0.15 = 4).

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	44	R	Position comparison output pulse width setting	0 to 32767	0.1 ms	Sets the pulse width of the signal output during position comparison. When this setup value is 0, no pulse is output.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	45	R	Position comparison output polarity selection	0 to 7	—	Sets position comparison output (CMP-OUT) polarity for each output terminal. bit 0: Polarity for SO1 (general-purpose output) or OCMP1 (encoder/position comparison output terminal) bit 1: Polarity for SO2 (general-purpose output) or OCMP2 (encoder/position comparison output terminal) bit 2: Polarity for SO3 (general-purpose output) or OCMP3 (encoder/position comparison output terminal) bits 7 to 3: Not used (set each bit to 0) **Notes** ● When general-purpose output terminals (SO1 to SO3) are used as position comparison outputs (CMP-OUT), assign position comparison output to Pr4.10 “SO1 output selection” , Pr4.11 “SO2 output selection” , and Pr4.12 “SO3 output selection” for all control modes. *Position comparison output cannot be monitored using the Set-up Support Software (PANATERM ver.7) or RTEX communication. ● To use encoder output signals (OA, OB) as position comparison output (OCMP1 to 3), set Pr4.47 “Pulse output selection” to 1. ● For details, see *“3.2.5.5.1 Control Output Signal”* . Setup values for bits 2 to 0 0: The output photocoupler is turned ON for SO1, SO2, and SO3 and OCMP1, OCMP2 and OCMP3 are set to L level during pulse output. 1: The output photocoupler is turned OFF for SO1, SO2, and SO3 and OCMP1, OCMP2 and OCMP3 are set to H level during pulse output. **Notes** ● bits 2 to 0 should generally be set to 0.
4	47	R	Pulse output selection	0 to 1	—	Selects the signal output from the encoder output signal/position comparison output signal terminals (OA/OCMP1, OB/OCMP2, OCMP3). 0: Encoder output signal (use as OA, OB) 1: Position comparison output signal (use as OCMP1 through OCMP3)
4	48	A	Position comparison value 1	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 1.
4	49	A	Position comparison value 2	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 2.
4	50	A	Position comparison value 3	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 3.
4	51	A	Position comparison value 4	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 4.
4	52	A	Position comparison value 5	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 5.
4	53	A	Position comparison value 6	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 6.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	54	A	Position comparison value 7	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 7.
4	55	A	Position comparison value 8	-2147483648 to 2147483647	Command unit	Sets comparison value for position comparison 8.
4	56	B	Position comparison output delay compensation amount	-32768 to 32767	0.1 μs	Corrects position comparison output delay caused by the circuit.
4	57	R	Position comparison output assignment setting	-2147483648 to 2147483647	—	Sets the terminal(s) to output position comparison 1 to 8. bit 3 to 0: Position comparison 1 bit 7 to 4: Position comparison 2 bit 11 to 8: Position comparison 3 bit 15 to 12: Position comparison 4 bit 19 to 16: Position comparison 5 bit 23 to 20: Position comparison 6 bit 27 to 24: Position comparison 7 bit 31 to 28: Position comparison 8 Setup values for each setting bit Setup value 0 (0000b): Output disabled 1 (0001b): Output from SO1/OCMP1 terminal 2 (0010b): Output from SO2/OCMP2 terminal 3 (0011b): Output from SO3/OCMP3 terminal Other than the above: Manufacturer use (setting is prohibited) Multiple position comparison values can be set for one output terminal. For example, setting parameters bits 3 to 0 = 1, bits 7 to 4 = 1 the SO1/OCMP1 terminal can output Position Comparison 1 and Position Comparison 2.
6	97	B	Function expansion setup 3	-2147483648 to 2147483647	—	bit 10: Position comparison output function selection 0: Enabled 1: Disabled
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 8: RTEX status selection of In_Progress/AC_OFF 0: In_Progress 1: AC_OFF *Linked to the bit 15 setting. bit 15: In_Progress/AC_OFF/Pr7.112 value RTEX status selection expansion 0: As per Pr7.23: bit 8 setting (In_Progress or AC_OFF). 1: As per Pr7.112 setting

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	112	B	Selection of RTEX communication status flag	0 to 2	—	Selects the signal returned by the RTEX response status flag (byte 2:bit 1) when Pr7.23:bit 15 = 1. ● 0: Returns RET_Status (status when running retracting operation). ● 1: Returns V_Full_Status/Sensor_FB_Status (virtual full-closed control mode status/sensor feedback function status). ● 2: Returns CMP_OUT_Status (Position comparison output function enabled). 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

— Precautions —

- If the same location information is set in Pr4.48 through Pr4.55 and Pr4.57 is set to output from multiple output terminals, a time lag may occur in the output signal.
- Example of setting the same values for position comparison values 1 and 2 and assigning different output terminals to the position comparison output assignment settings

  <Position comparison value>

  Pr4.48: 1000000, Pr4.49: 1000000

  <Position comparison output assignment setting>

  Pr4.57: 00000021h (SO1/OCMP1 : Pr4.48, SO2/OCMP2 : Pr4.49 is assigned)

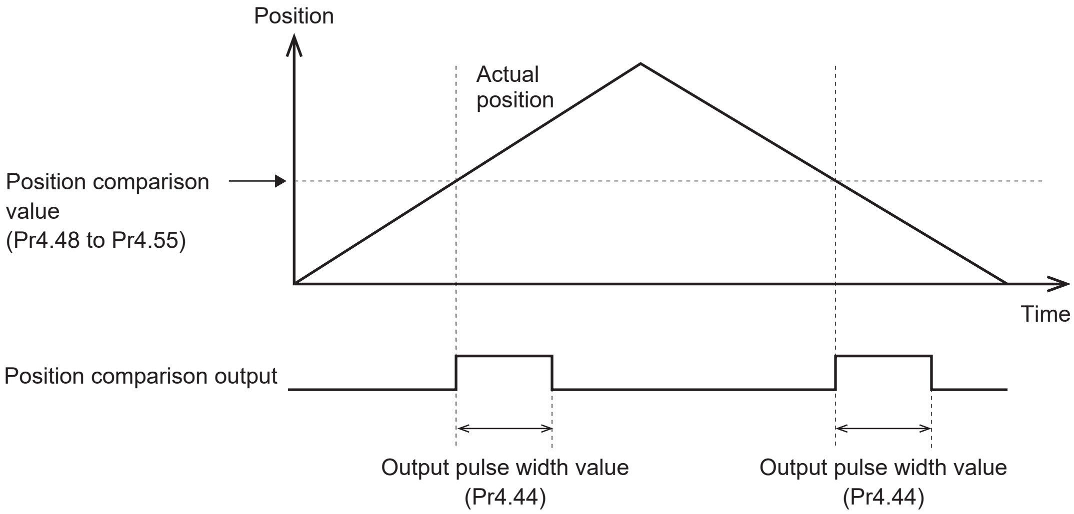
■ Operation

- Signal specifications

Trigger output	I/F	3-Outputs: Photocoupler (open collector) or 3-Outputs: Line driver
	Logic	Parameter settings (polarity can be set for each output)
	Pulse width	Parameter Setup 0.1 to 3276.7 ms (unit: 0.1 ms)
	Delay Correction	Supported
Compare source	Encoder (communication)	Supported
	External scale (communication)	Supported
	External scale (A/B-phase)	Supported
Position comparison value	Comparision number	8 points
	Setting range	Signed 32 bit

- Output example
  - When the actual position of the encoder passes the position comparison value (Pr4.48 to Pr4.55)

    Outputs a pulse of the duration set in Pr4.44 “Position comparison output pulse width setting” .

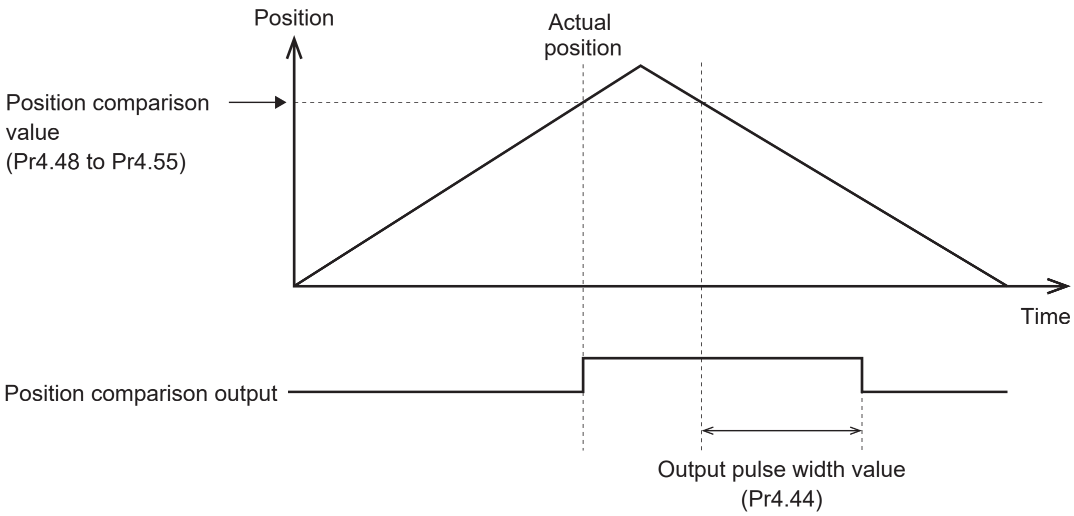


Regardless of the direction in which the encoder position is passed, a pulse is output when the magnitude relationship changes as it passes the position comparison value.

Multiple position comparison values can be set to one position comparison output.

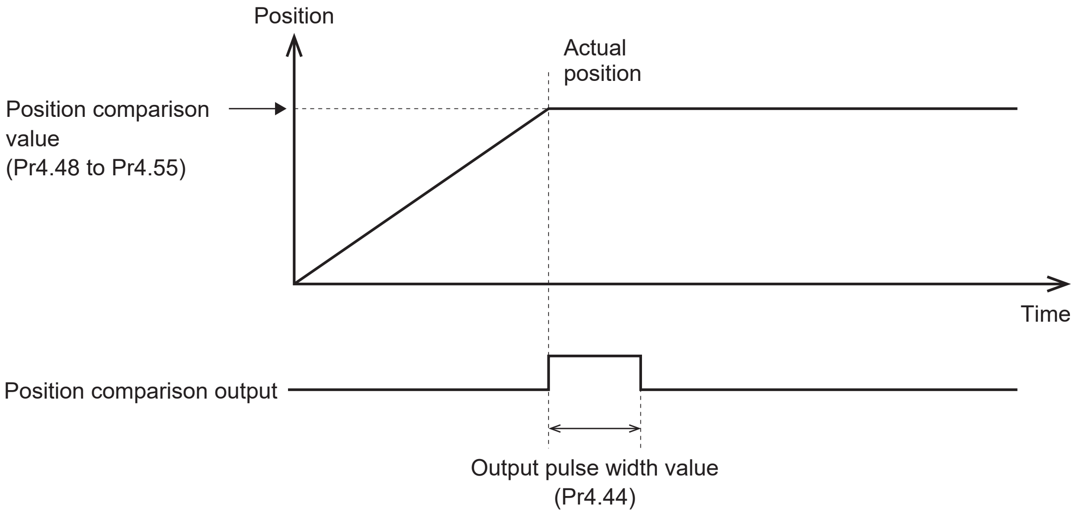
- When the actual position of the encoder passes the position comparison value (Pr4.48 to Pr4.55) during position comparison pulse output

  If the encoder position or external scale position passes the position comparison value during pulse output when the operation direction has been reversed or when multiple position comparison values have been set, the pulse output will continue to be ON from the time of the most recent passing for the duration set in the output pulse width settings.



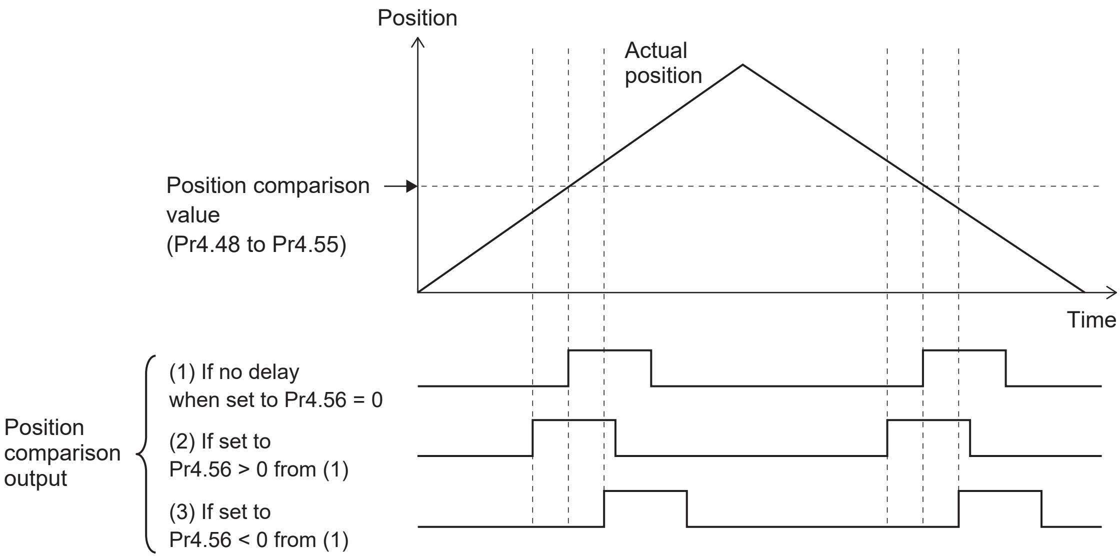
- If the actual position of the encoder is stopped at the same position as the position comparison value (Pr4.48 to Pr4.55)

  A pulse is output once, similarly to when a pass occurs.



- If the position comparison pulse output is automatically corrected before being output

  The position comparison output function sends outputs while automatically compensating, based on the previous motor speed, the errors caused by the delay time of encoder serial communication, etc. The amount of compensation can be tuned by setting the Pr4.56 “Position comparison output delay compensation amount” . For example, if the position comparison output function is used as an operating trigger for a camera or other external device, this can be set taking into account the delay time from when the external device receives the signal from the position comparison output until it operates.



■ Precautions

- The following conditions may reduce the accuracy of the position comparison output:
  - When the number of external scale pulses per motor revolution is extremely low compared to 23 bits with full-closed control.
- Do not use this when operating in virtual full-closed control mode.

8.4 Single-turn Absolute Function

This function uses the absolute encoder as an absolute system only for single-turn absolute position data without connecting the battery power.

The movable range of the motor is limited by single-turn data of the absolute encoder.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, velocity control, torque control
Other	● Absolute encoder is connected

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	15	C	Absolute encoder setup	0 to 4	—	Sets the method of use of the absolute encoder. During full-closed control, the absolute encoder is treated as an incremental system (setting = 1) by the internal control. 0: Use as an absolute system (absolute mode). 1: Use as an incremental system (incremental mode) (Detection of the following protection functions is disabled.). Err40.0.0 “Absolute system down error protection” Err41.0.0 “Absolute counter over error protection” Err42.0.0 “Absolute overspeed error protection” Err45.0.0 “Multi-turn counter error protection” 2: Use as an absolute system (absolute mode), but ignore multi-turn counter overs. 3: Use as an absolute system (absolute mode), but do not use the multi-turn counter (Single-turn absolute mode). 4: Use as absolute system (absolute mode), but any value can be set for the upper-limit value of the multi-turn counter. Ignore multi-turn counter overs (Continuous rotating absolute encoder mode).
7	13	C	Absolute home position offset	-2147483648 to 2147483647	Command unit	Sets the amount of offset between the encoder position (external scale position) and machine coordinates system position when using absolute encoder (absolute external scale). This setup value must be set so that the RTEX actual position and command position do not exceed 2^{31}. For details, refer to *“How to use”* Command Position Input Range.

*1 For attributes, see *“6.3 List of Parameters”* .

■ How to use

● Enabling the single-turn absolute function

This function is enabled by setting Pr0.15 “Absolute encoder setup” to 3.

When this function is enabled, multi-turn data for the absolute encoder is not used. Alarms (Err40.0.0 “Absolute system down error protection” , Err41.0.0 “Absolute counter over error protection” , Err42.0.0 “Absolute overspeed error protection” , Err45.0.0 “Multi-turn counter error protection”) and battery warnings for multi-turn data are not detected.

- Command position input range

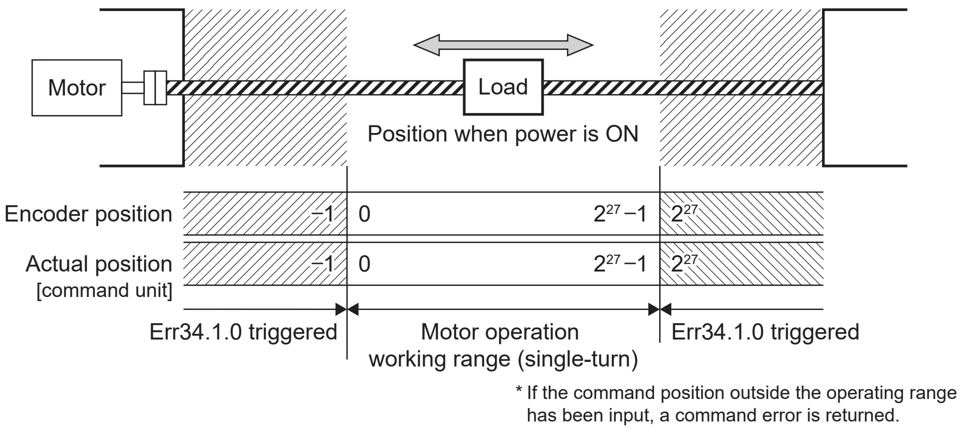
When this function is enabled, the command input range for RTEX communication is as shown in the table below.

	Electronic gear ratio	Absolute home position offset	Position command input range
Absolute encoder (27 bit)	1/1	0	0 to 2^{27}-1 (134217727)
	1/1	10000	10000 to 2^{27}-1 + 10000 (134227727)

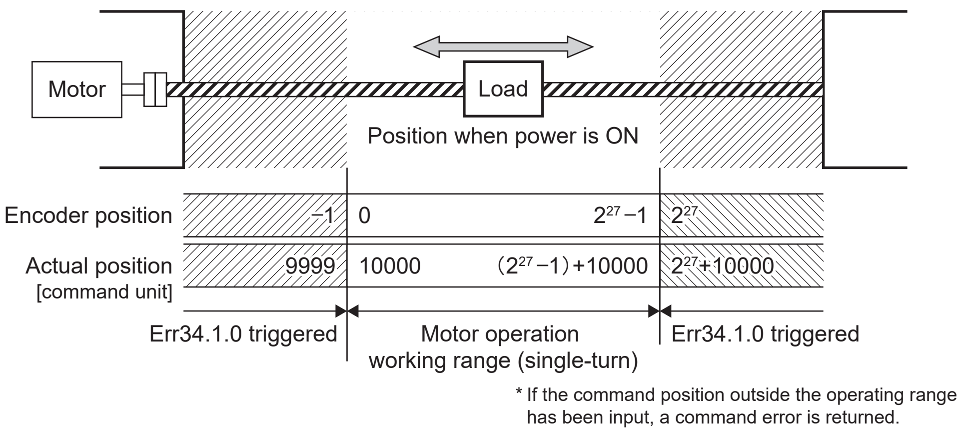
- Single-turn effective range

When using an absolute encoder, the effective range of a single turn is as follows.

• CCW = positive direction, electronic gear ratio (Pr0.09/Pr0.10) = 1/1, Pr7.13 “Absolute home position offset” = 0



• CCW = positive direction, electronic gear ratio (Pr0.09/Pr0.10) = 1/1, Pr7.13 “Absolute home position offset” = 10,000



If the motor (encoder) position exceeds the motor movable range (single-turn data of the encoder), Err34.1.0 “Single-turn absolute movable range error protection” is triggered. When Err34.1.0 “Single-turn absolute movable range error protection” is triggered, deceleration to stop is performed according to Pr5.10 “Sequence at alarm” .

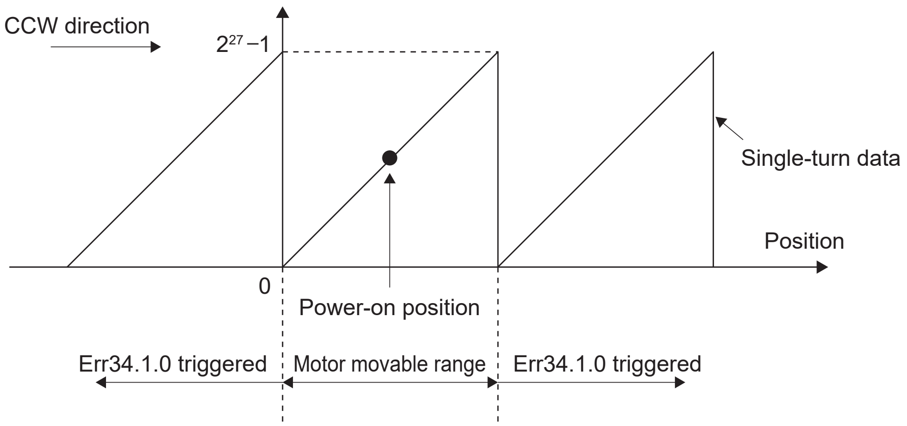
If the command position for RTEX communication is set outside of the motor movable range, a command error is returned.

- Motor position when switching the power on

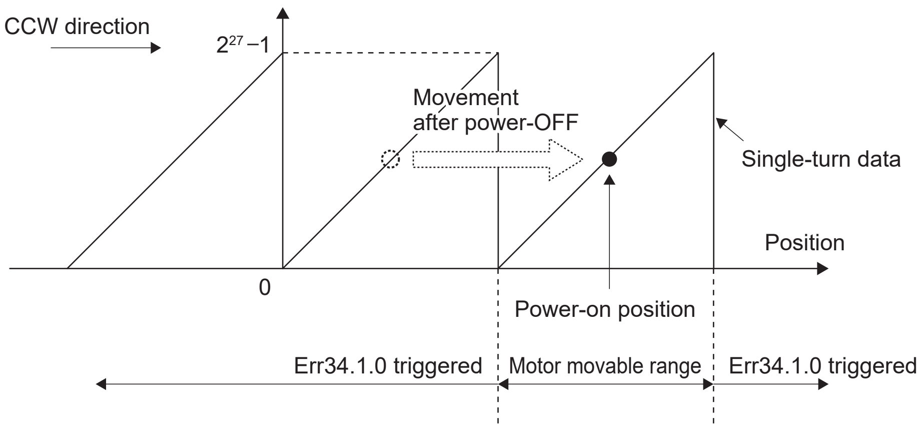
The motor working range is determined by the motor position upon power on.

The following shows examples of operations with an absolute encoder.

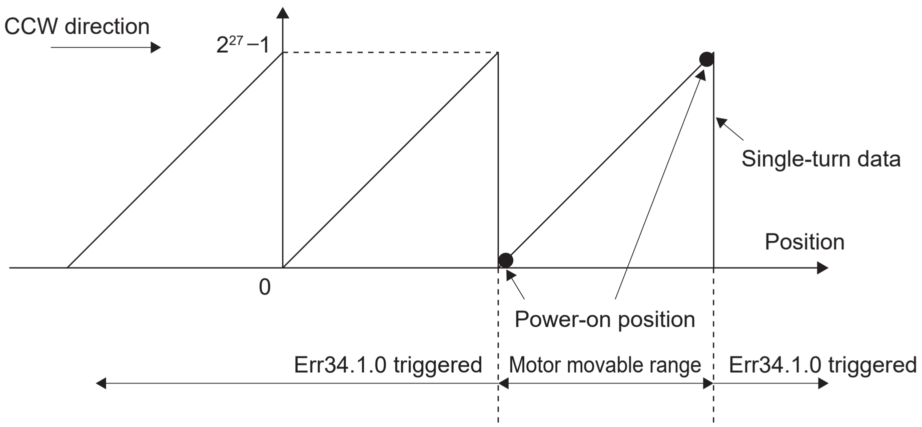
- When the power is turned on with the motor in the position shown in the figure below, the movable range of the motor is the single-turn data range from the position when powered on.



- When the power is turned off at the power-on position in the figure above and then turned on again after the motor is moved to the position in the figure below, the movable range of the motor changes.



- Note that if powered on in a position that is near the limit of the motor movable range, the movable range of the motor will be exceeded when the motor operates, even if only slightly, causing Err34.1.0 “Single-turn absolute movable range error protection” to be triggered.

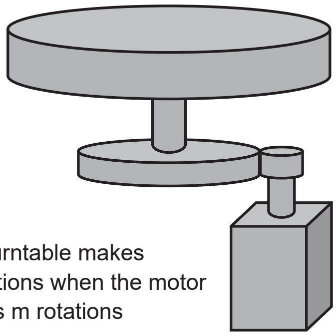


8.5 Continuous Rotating Absolute Encoder Function

This function sets any upper-limit value for absolute encoder multi-turn data.

With this function, it is possible to determine the turn angle (position) of a turntable and such other applications, even in the case of continuous rotation in one direction.

For the structure of the absolute system, see *"7.2.7 Absolute Encoder"* .



■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, velocity control, torque control
Other	● Requires a 27-bit resolution absolute encoder. ● The value for "command position per single-turn of the turntable = Encoder resolution (2^{27})/Electronic gear ratio/Reduction ratio [n/m]" must be an integer of 2^{31} or lower. ● Elements other than servo parameters are appropriately set, enabling the motor to rotate normally.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	15	C	Absolute encoder setup	0 to 4	—	Sets the method of use of the absolute encoder. During full-closed control, the absolute encoder is treated as an incremental system (setting = 1) by the internal control. 0: Use as an absolute system (absolute mode). 1: Use as an incremental system (incremental mode) (Detection of the following protection functions is disabled.). Err40.0.0 "Absolute system down error protection" Err41.0.0 "Absolute counter over error protection" Err42.0.0 "Absolute overspeed error protection" Err45.0.0 "Multi-turn counter error protection" 2: Use as an absolute system (absolute mode), but ignore multi-turn counter overs. 3: Use as an absolute system (absolute mode), but do not use the multi-turn counter (Single-turn absolute mode). 4: Use as absolute system (absolute mode), but any value can be set for the upper-limit value of the multi-turn counter. Ignore multi-turn counter overs (Continuous rotating absolute encoder mode).

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	88	C	Absolute encoder multi-turn data upper-limit value	0 to 65534	—	When set to absolute mode (Pr0.15 = 0 or 2), the absolute multi-turn data upper-limit value is 65535 regardless of the set value. When set to incremental mode (Pr0.15 = 1) or single-turn absolute mode (Pr0.15 = 3), this setting is disabled. ● Set Pr6.88 “Absolute encoder multi-turn data upper-limit value” to (m-1). m indicates the deceleration ratio denominator. ● RTEXSet Pr6.88 “Absolute encoder multi-turn data upper-limit value” and the electronic gear ratio so that the actual position and command position do not exceed 2^{31}. If (((Pr6.88 + 1) × encoder resolution) × (electronic gear inverse conversion value) - 1) is 2^{31} or more, Err93.8.□ “Parameter setup error protection 6” is triggered. The actual position of this product is set by considering Pr0.00 “Rotational direction setup” , Pr7.13 “Absolute home position offset” , etc. For details, see Technical Reference Communication Specification “5.4.6 Homing Operation” . When set to absolute mode (Pr0.15 = 0 or 2), the absolute multi-turn data upper-limit value is 65535 regardless of the set value. When set to incremental mode (Pr0.15 = 1) or single-turn absolute mode (Pr0.15 = 3), this setting is disabled.
7	13	C	Absolute home position offset	-1073741823 to 1073741823	Command unit	Set the amount of offset between the encoder position and machine coordinates system position when using an absolute encoder. ● Set Pr7.13 “Absolute home position offset” within the range of 0 to (((Pr6.88 + 1) × encoder resolution) × (electronic gear inverse conversion value) - 1). If set to a different value, Err93.8.□ “Parameter setup error protection 6” is triggered.

*1 For attributes, see *“6.3 List of Parameters”* .

■ How to use

● Examples

The continuous rotating absolute encoder function is enabled by setting Pr0.15 “Absolute encoder setup” to 4 and turning on the control power supply again or executing RTEX reset command attribute C parameter enabled mode.

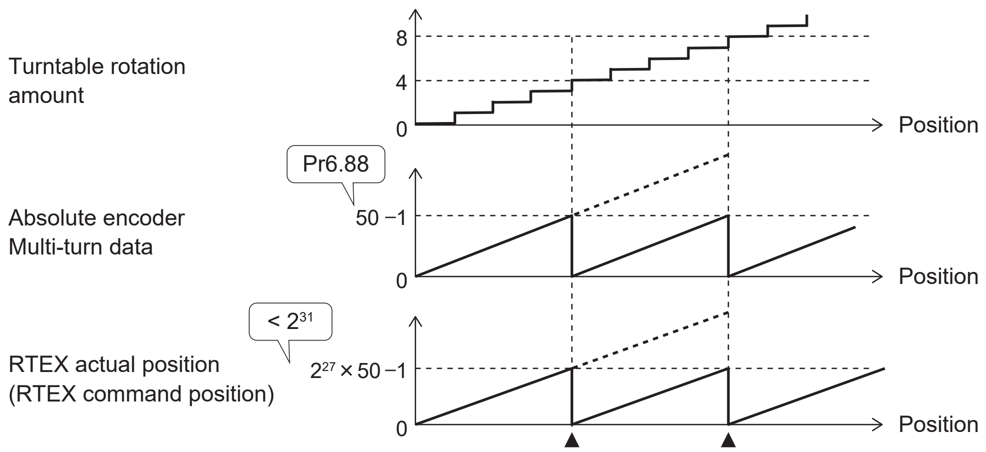
For example, the procedure is as shown below when used with these conditions: reduction ratio of 4 turntable rotations for 50 motor rotations (m = 50, n = 4, electronic gear ratio = 1 multiple).

1. Set Pr0.15 “Absolute encoder setup” = 4,Pr6.88 “Absolute encoder multi-turn data upper-limit value” = 49 and write to EEPROM.
2. Turn the control power of the product back on (Or execute attribute C enable command.).
3. The upper-limit value of the multi-turn data on the encoder side is automatically updated when this product is started up.
4. Err92.3.□ “Multi-turn data upper limit value disagreement error protection” is triggered.
5. Turn the control power of the product back on.
6. The multi-turn data upper-limit value is enabled and the RTEX actual position is generated as shown in the figure below.

7 The host device reads the RTEX actual position and the RTEX command position is initialized.

8 The RTEX actual position wraps around at $2^{27} \times 50\text{-}1$, the command position wraps around to match with the actual position, and the continuous rotating absolute encoder mode operates.

*Because the multi-turn data upper-limit value is retained inside the encoder, follow the steps from "6" above when turning on the driver control power at the next and subsequent operations.

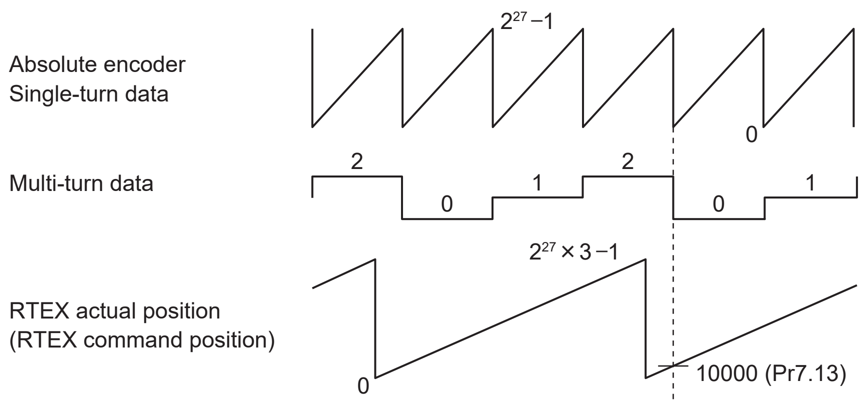


- Absolute home position offset

When the continuous rotating absolute encoder function is used, the absolute home position offset is as shown below.

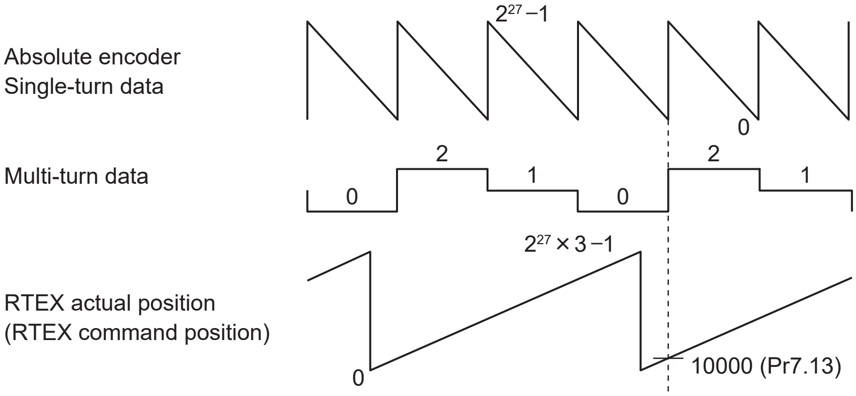
- CCW = positive direction, electronic gear ratio (Pr0.09/Pr0.10) = 1/1, Pr6.88 "Absolute encoder multi-turn data upper-limit value" = 2

  Pr7.13 "Absolute home position offset" = 10000



- CW = positive direction, electronic gear ratio (Pr0.09/Pr0.10) = 1/1, Pr6.88 "Absolute encoder multi-turn data upper-limit value" = 2

  Pr7.13 "Absolute home position offset" = 10000



■ Precautions

- The actual position wraps around at the position at which the multi-turn data wraps around.
  Give a command position so that the position will agree with this actual position.
  For details on wraparound processing, see Technical Reference Communication Specification.
- When using this function for the first time or when Pr6.88 “Absolute encoder multi-turn data upper-limit value” has been changed to any value and the control power has been switched on again, Err92.3.☐ “Multi-turn data upper limit value disagreement error protection” will always be triggered, but there is no error.
  Once the control power of the product is powered on again, the above alarm will not occur the next time.

8.6 Pulse Regeneration Function

This function outputs the amount of movement of the actual position with the A/B-phase pulse.

It can communicate the amount of movement from this product to the host device.

It sets the output resolution, B-phase logic, and output source (encoder, external scale) when outputting signals with parameters.

■ Operational Conditions

Item	Operational Conditions
Control mode	• Position control, velocity control, torque control and full-closed control (excluding virtual full-closed control)

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	11	R	Number of output pulses per motor revolution	1 to 33554432	pulse	Sets the pulse output resolution as the output pulse counts per single-turn for OA and OB respectively. The pulse count of the controller by 4 multiplications is as follows. Pulse output resolution per single-turn = Pr0.11 setup value × 4
0	12	R	Reversal of pulse output logic	0 to 3	—	Sets the pulse output B-phase logic and output source. With this parameter, you can reverse the phase relationship between the A-phase pulse and the B-phase pulse by reversing the B-phase logic. You can select either the encoder or external scale as the output source when the external scale position information monitoring function is active during semi-closed control, or during full-closed control. Select the encoder when not using full-closed control or when the external scale position information monitoring function is disabled in semi-closed control.
4	47	R	Pulse output selection	0 to 1	—	Selects signal output from pulse output / position comparison output terminal. 0: Encoder output signal 1: Position comparison output signal
5	03	R	Denominator of pulse output division	0 to 134217728	—	For applications where the number of output pulses per single turn is not an integer, this setup value can be set to a value other than 0 and the dividing ratio can be set by using Pr0.11 as numerator and Pr5.03 as denominator. Accordingly, the pulse count of the controller by 4 multiplications is as follows. Pulse output resolution per single-turn = (Pr0.11 value / Pr5.03 value) × encoder resolution
5	33	C	Pulse regenerative output limit setup	0 to 1	—	Enables or disables alarm detection (Err28.0.0 “Pulse regeneration limit protection”). 0: Disabled 1: Enabled

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	22	R	AB phase external scale pulse outputting method selection	0 to 1	—	Select the pulse regeneration method of ABZ parallel external scale. 0: Directly output the AB-Phase signals from ABZ parallel external scale. 1: Output regenerated A/B-phase signals from ABZ parallel external scale.

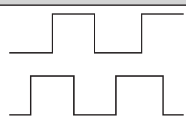
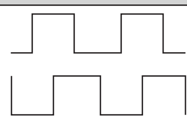
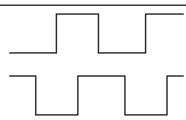
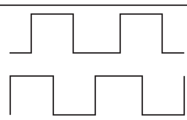
*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

Pulse regeneration output is as shown below by the combination of Pr0.11 "Number of output pulses per motor revolution" and Pr5.03 "Denominator of pulse output division" .

Pr0.11	Pr5.03	Pulse regeneration output operation
1 to 33554432	0	**When the output source is the encoder** Encoder pulse [pulse] → [Pr0.11 setting value] × 4 / Encoder resolution → Output pulse [pulse] * If Pr5.03 = 0, then the above process is performed based on the set value of Pr0.11. The number of pulses of pulse regeneration output OA and OB are the number of pulses set in Pr0.11. The output pulse resolution cannot be more than the encoder pulse resolution. **When the output source is the external scale** External scale pulse [pulse] → 1 / 1 → Output pulse [pulse] * When Pr5.03 = 0, the dividing ratio is 1:1.
1 to 33554432	1 to 134217728	Encoder FB pulse or external scale pulse [pulse] → [Pr0.11 setting value] / [Pr5.03 setting value] → Output pulse [pulse] * If Pr5.03 ≠ 0, the above process is performed based on set values of Pr0.11 and Pr5.03. This enables the system to support applications where the number of pulses per motor rotation is not an integer for pulse regeneration output OA and OB. However, the output pulse resolution cannot be more than the encoder pulse resolution.

The output pulse is as shown in the table below, depending on the setting of Pr0.12 "Reversal of pulse output logic" .

Pr0.12	B-phase Logic	Output source	CCW direction operating	CW direction operating
0	Non-reversed	Encoder	A-phase B-phase 	A-phase B-phase 
2		External scale		
1	Reversed	Encoder	A-phase B-phase 	A-phase B-phase 
3		External scale		

* Set values 2 and 3 are only enabled in any of the following conditions. If none of the following apply, set the values to 0 and 1.

- Full-closed control (excluding in virtual full-closed control mode)

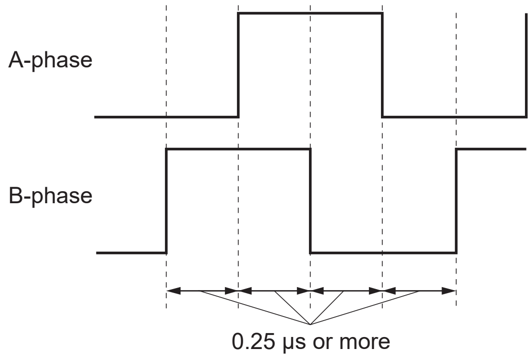
• When external scale position information monitoring function is enabled under semi-closed control

■ Precautions

- The maximum frequency of pulse regeneration output is 4 Mpulse/s (after being multiplied by 4). The regenerative function may not work properly when moved at a velocity exceeding this and a correct pulse may not be returned to the host device, which may cause incorrect positioning depending on the method of use.

  Therefore, when using the pulse regeneration output function, enable Pr5.33 “Pulse regenerative output limit setup” and confirm in advance that Err28.0.0 “Pulse regeneration limit protection” is not detected in the device environment.

  If Err28.0 is detected, tune the Pr0.11 “Number of output pulses per motor revolution” and Pr5.03 “Denominator of pulse output division” settings.



  By enabling Pr5.33 “Pulse regenerative output limit setup” , Err28.0.0 “Pulse regeneration limit protection” can be generated upon arriving at the pulse regeneration limit. Err28.0.0 “Pulse regeneration limit protection” is an alarm that is triggered when the pulse regeneration output limit is detected, and is not triggered at maximum output frequency.

  The Err28.0.0 “Pulse regeneration limit protection” may also be triggered if the frequency momentarily peaks and output limit is detected due to motor rotation wobble.

- Do not use this when operating in virtual full-closed control mode.
- Z-phase signals do not correspond to pulse regeneration.

8.7 Sensor Feedback Function

8.7.1 Displacement Control Function

This function directly inputs the output signal of the displacement sensor to the servo driver to achieve a constant clearance for workpieces with varying heights, complete within the driver.

Settings for adjusting the position compensation value, filter settings for noise filtering, and offset adjustment can be performed. For details, see Technical Reference Communication Specification.

■ Operational conditions

Item	Operational conditions
Control mode	● Position control and full-closed control

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	22	R	Sensor feedback control mode setup	0 to 1	—	Selects the sensor feedback control mode for this product. 0: Sensor feedback disabled 1: Sensor feedback enabled (position feedback)
3	33	B	Analog input gain	0 to 30000	Command unit/mV	Converts the voltage applied to the analog input to a position compensation value in command units.
3	34	B	Analog input polarity	0 to 1	—	Selects the specification method for the positive direction and negative direction of displacement control. 0: Not reversed 1: Reversed
3	35	B	Analog input integration time constant	0 to 100000	0.01 ms	Sets the integral time constant of the voltage applied to the analog input. When this setup value is 0 or 100000, the integral time constant setting is disabled.
3	36	B	Analog input integration limit	0 to 2147483647	Command unit	Sets the limit for the integral term of the voltage applied to the analog input in absolute value.
3	42	B	Sensor feedback control function extended setup	-32768 to 32767	—	Sensor feedback control function-related extended settings are made in bit units. bit 0: Displacement control function position command latch switching 0: Latch enabled 1: Latch disabled
4	22	B	Analog input (AIN) offset setting	-26666 to 26666	0.375 mV	Sets the offset adjustment value for the voltage applied to the analog input.
4	23	B	Analog input (AIN) filter setting	0 to 6400	0.01 ms	Sets the time constant of the first order lag filter relative to the voltage applied to the analog input. Disabled when the set value is 0 to 3.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	24	B	Analog input (AIN) excessive setting	0 to 100	0.1 V	Sets the excessive level for the applied voltage (after offset addition) of the analog input. If the absolute value of the applied voltage exceeds the setup value, Err39.0.0 “Analog input (AIN) excess protection” is triggered. ● Err39.0.0 trigger condition: 0 < Pr4.24 < Applied voltage (absolute value) ● Related control modes: All
4	65	A	Analog input internal offset setting	-32768 to 32767	mV	Sets the offset adjustment value for the voltage applied to the analog input.
4	66	A	Analog input deviation limit setting	0 to 65535	mV	Sets the limit value for analog voltage deviation as an absolute value. Disabled when set value is 0.
4	67	B	Analog input voltage dead zone setting	0 to 65535	mV	Sets the dead zone for the analog input voltage. When the displacement control function is enabled, the dead zone function for analog input voltage is enabled. Even if the displacement control function is enabled, if this setting value is 0, the dead zone function of the analog input voltage is disabled. For details on functions, see *“8.7.1 Displacement Control Function”* .

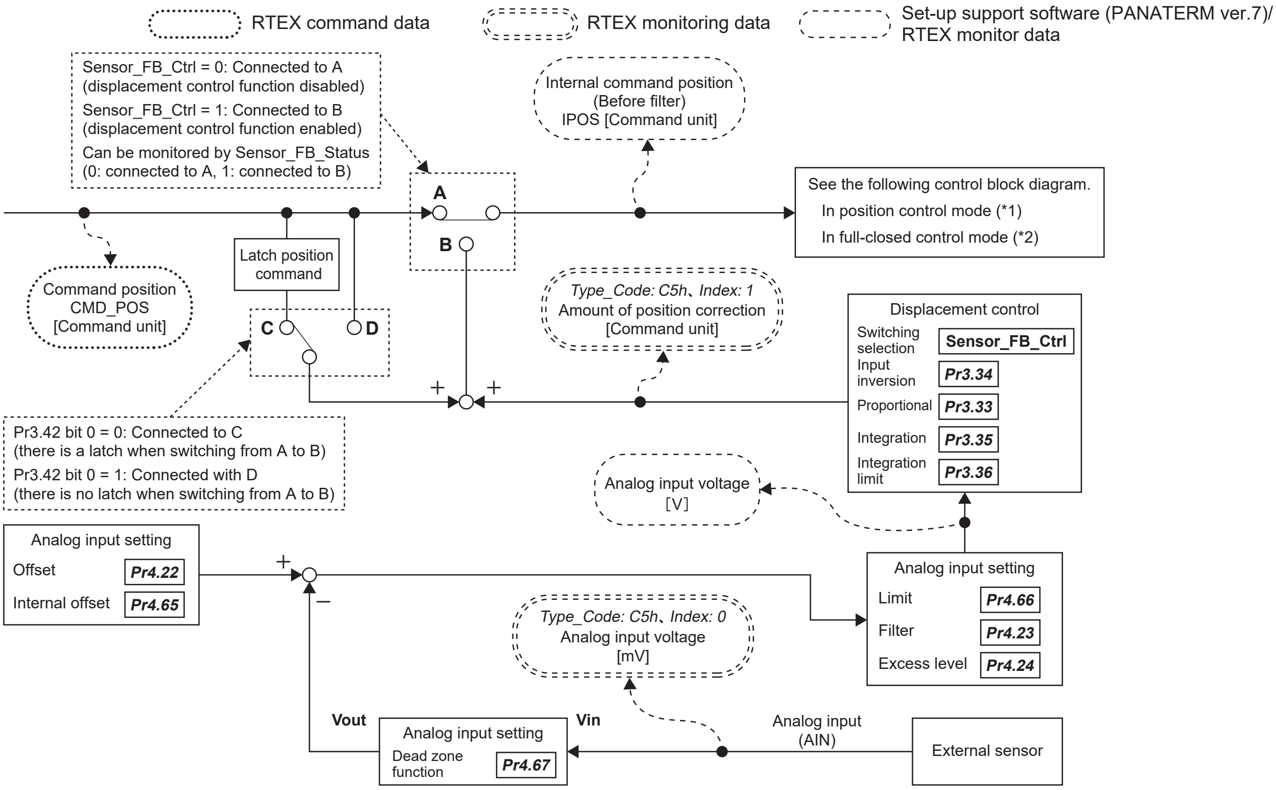
*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

● Alarms related to the displacement control functions

Alarm number			Name	Cause	Handling
Main	Sub	Primary cause			
39	0	0	Analog input (AIN) excess protection	A voltage higher than that set in Pr4.24 “Analog input (AIN) excessive setting” was applied to analog input.	● Correctly configure Pr4.24 “Analog input (AIN) excessive setting” correctly. ● Check the connection status of the input/output connector. ● Set Pr4.24 to 0 and disable the protection function.

Control block diagram: Displacement control



*1 *“7.3.2 Position Control (Two-degree-of-freedom Control Mode Enabled)” “Control Block Diagram: Position Control (Two-degree-of-freedom Control Mode Enabled) ”*

“7.3.3 Position Control (Two-degree-of-freedom Control Mode is Disabled)” “Control Block Diagram: Position Control (Two-degree-of-freedom Control Mode Disabled)”

*2 *“7.6.2 Full-closed Control (Two-degree-of-freedom Control Mode Enabled)” “Control Block Diagram: Full-closed Control (Two-degree-of-freedom Control Mode Enabled) ”*

“7.6.3 Full-closed Control (Two-degree-of-freedom Control Mode Disabled)” “Control Block Diagram: Full-closed Control (Two-degree-of-freedom Control Mode Disabled)”

8.8 Virtual Full-closed Control Mode Function

The virtual full-closed control mode function allows for continuous axis operation even when the external scale position does not change in full-closed control mode due to the mechanism of the device, by virtually estimating the external scale position from the encoder position information.

For information on full-closed control mode, see *"7.6 Full-closed Control"* .

■ Operational Conditions

Item	Operational Conditions
Control mode	• Full-closed control
Other	• The connected external scale is an A/B-phase output type or serial incremental type. • Non-servo parameters such as torque limit must be set properly to ensure the motor operates normally.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	01	R	Control mode setup	0 to 6	—	Selects a control mode for this product. 0: Semi-closed control (switchable between position/velocity/torque control) 1 to 5: Manufacturer use (setting is prohibited) 6: Full-closed control (position control only)
3	23	R	External scale selection	0 to 6	—	Select the type of external scale. 0: A/B-phase output type 1: Serial communication type (incremental) 2: Serial communication type (absolute) 3 to 6: Manufacturer use (setting is prohibited)
3	32	R	Threshold value of external scale position variation in virtual full-closed control mode	0 to 65534	External scale unit	Sets the threshold value for determining external scale position variation in virtual full-closed control mode.
6	98	R	Function expansion setup 4	-2147483648 to 2147483647	—	bit 9: Virtual full-closed control mode function 0: Disabled 1: Enabled **Notes** • Virtual full-closed control mode function is enabled if Pr0.01 = 6 (Pr3.23 = 0 or 1) and Pr6.98: bit 9 = 1.
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 8: RTEX status selection of In_Progress/AC_OFF 0: In_Progress 1: AC_OFF *Linked to the bit 15 setting. bit 15: In_Progress/AC_OFF/Pr7.112 value RTEX status selection expansion 0: As per Pr7.23: bit 8 setting (In_Progress or AC_OFF). 1: As per Pr7.112 setting

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	99	B	RTEX function expansion set-up 6	-32768 to 32767	—	bit 3: Command pulse accumulated value [command unit] output setting 0: Before filter 1: After filter
7	110	B	RTEX function expansion set-up 7	-2147483648 to 2147483647	—	bit 16: External scale position variation enabled during virtual full-closed control mode 0: Disabled 1: Enabled
7	112	B	Selection of RTEX communication status flag	0 to 2	—	Selects the signal returned by the RTEX response status flag (byte 2:bit 1) when Pr7.23:bit 15 = 1. ● 0: Returns RET_Status (status when running retracting operation). ● 1: Returns V_Full_Status/Sensor_FB_Status (virtual full-closed control mode status/sensor feedback function status). ● 2: Returns CMP_OUT_Status (Position comparison output function enabled). 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

■ How to use

Before using this function, confirm that it operates normally in full-closed control mode.

Furthermore, only switch between full-closed control and virtual full-closed control modes after positioning has been completed.

● Initiating/ending virtual full-closed control mode

1 Pre-settings

1-1 Set Pr6.98 “Function expansion setup 4” :bit 9 “Virtual full-closed control mode function” = 1 (enabled).

*If Pr0.01 “Control mode setup” is set to 0 (semi-closed control) or Pr3.23 “External scale selection” is set to 2 (serial communication type [absolute]) and then Pr6.98 “Function expansion setup 4” :bit 9 = 1, virtual full-closed control mode is disabled.

1-2 Set the following parameters to confirm whether or not you are in virtual full-closed control mode.

Pr7.23 “RTEX function expansion setup 2” :bit 15 = 1 (as per Pr7.112 settings)

Pr7.112 “Selection of RTEX communication status flag” = 1 (V_Full_Status [virtual full-closed control mode status] is returned.)

1-3 After EEPROM writing, reset the control power or run the RTEX communication reset command in software reset mode.

2 Confirming operation in full-closed control mode

Set RTEX command byte 2 bit 6 (V_Full) to 0 and confirm normal operation in full-closed control mode.

3 Switching from full-closed control mode to virtual full-closed control mode

3-1 Stop the position command and confirm that RTEX response byte 2 bit 0 (In_Position) is set to 1 (positioning complete state).

3-2 Set RTEX command byte 2 bit 6 (V_Full) to 1 and switch to virtual full-closed control mode.

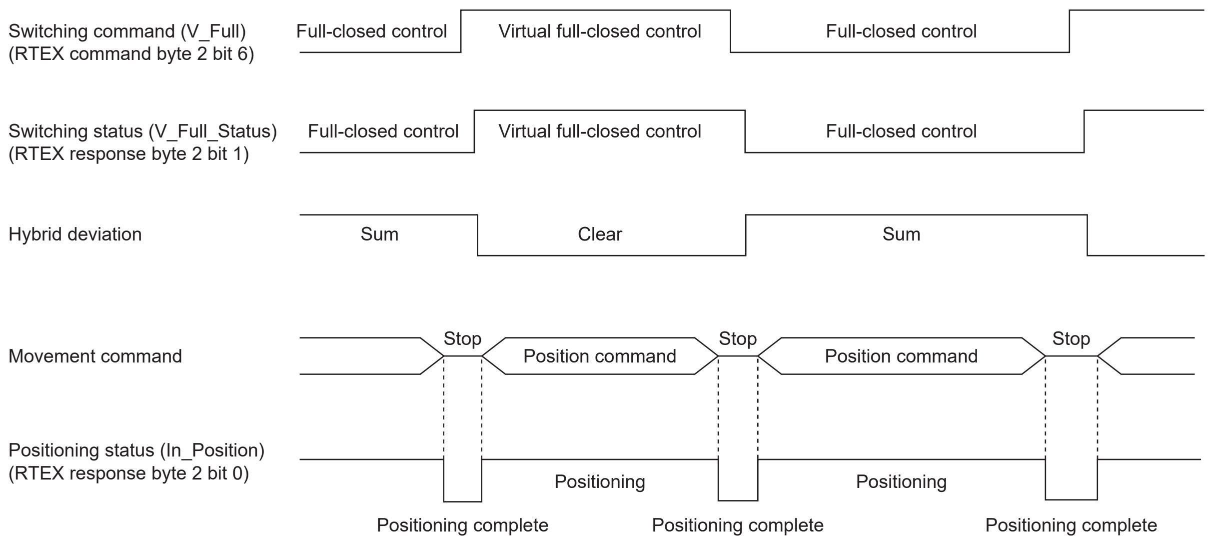
3-3 Confirm that the RTEX response byte 2 bit 1 (V_Full_Status) is 1 (virtual full-closed control mode).

4 Switching from virtual full-closed control mode to full-closed control mode

4-1 Stop the position command and confirm that RTEX response byte 2 bit 0 (In_Position) is set to 1 (positioning complete state).

4-2 Set RTEX command byte 2 bit 6 (V_Full) to 0 to switch to full-closed control mode.

4-3 Confirm that the RTEX response byte 2 bit 1 (V_Full_Status) is 0 (full-closed control mode).



● Determining external scale position variation in virtual full-closed control mode.

The RTEX response byte 2 bit 0 (In_Position) notifies when the external scale position variation during operation in virtual full-closed control mode exceeds a set value (set value for Pr3.32 “Threshold value of external scale position variation in virtual full-closed control mode”).

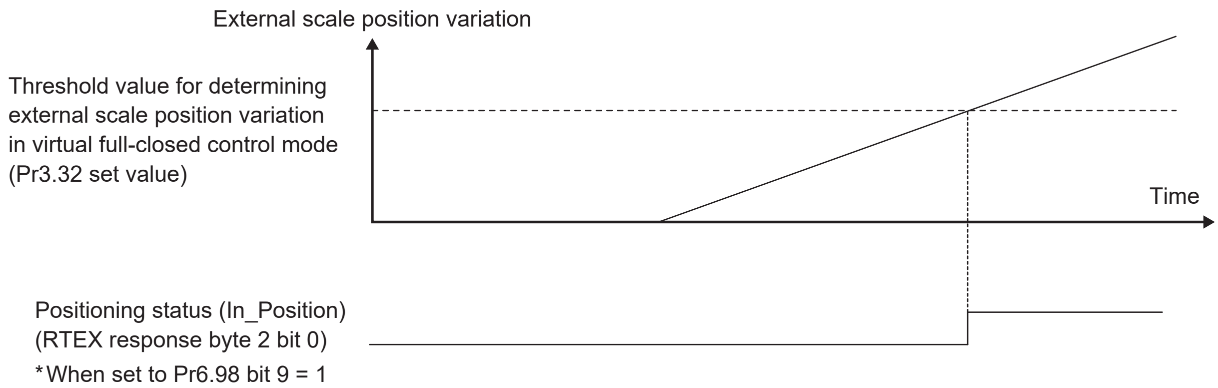
Refer to this as reference data for when external scale position variation determination is performed by a host device in virtual full-closed control mode.

To enable this function, set Pr6.98:bit 9 “Virtual full-closed control mode function” = 1 (enabled).

External scale position variation is the variation from external scale position information when moving to virtual full-closed control mode.

If the external scale position variation exceeds the set value for Pr3.32 “Threshold value of external scale position variation in virtual full-closed control mode” even once, it will remain in the determined state until the mode is switched to full-closed control mode.

If the set value for Pr3.32 “Threshold value of external scale position variation in virtual full-closed control mode” = 0, this function will remain enabled, and it will remain in the determined state if the mode is switched to virtual full-closed control mode.



■ Precautions

- Virtual full-closed control mode is a function that is enabled when temporary semi-closed control operation becomes necessary due to the presence of a region within the operational range of the motor where a full-closed system cannot be constructed.

  This function realizes virtual full-closed control using only encoder data (without using external scale data). The external scale position estimated from the encoder position data in virtual full-closed control mode may differ from the actual position of the external scale. Do not use this function for applications in which positioning precision is required or when the difference between the estimated external scale position and the actual position may be unsafe.
- Operation is possible in virtual full-closed control mode even when the wrong values are set for Pr3.24 “Numerator of external scale division” , Pr3.25 “Denominator of external scale division” and Pr3.26 “Reversal of direction of external scale” .

  An alarm will be triggered when switching from virtual full-closed control mode to full-closed control mode. Confirm normal operation in full-closed control mode before using this function.
- If any of the following settings are set with Pr6.98 “Function expansion setup 4” :bit 9 “Virtual full-closed control mode function” set to 1 (enabled), the virtual full-closed control mode function is disabled and Err93.8.□ “Parameter setup error protection 6” is triggered.
  - Set Pr0.01 “Control mode setup” to 0 (semi-closed control)
  - Set Pr3.23 “External scale selection” to 2 (serial communication type (absolute))
- This function is operated by the full-closed control settings and thus only corresponds to position control (CP, PP) control.

  Err91.1.0 “RTEX Command error protection” will be triggered if velocity control (CV) and torque control (CT) commands are run.
- Err25.0.0 “Hybrid deviation excess protection” will not be detected in order to normally clear hybrid deviation when operating in virtual full-closed control mode.
- Allow at least 2 ms when switching between full-closed control mode and virtual full-closed control mode. Err91.1.0 “RTEX Command error protection” will be triggered when switched between full-closed control mode and virtual full-closed control mode in under 2 ms.
- Do not use position comparison output function and pulse regeneration function when operating in virtual full-closed control mode.
- Set-up Support Software (PANATERM ver.7) trial runs, frequency characteristics analysis functions (FFT functions), Z-phase searches, and One Minute TUNING cannot be used in virtual full-closed control mode.
- The following operations will not be initiated and a command error (005Bh) is returned when in virtual full-closed control mode.
  - Homing command (□4h)
  - Profile command (17h)

    Profile position latch absolute positioning (12h)

    Profile position latch relative positioning (13h)

    Profile homing (31h-34h, 36h)
  - Reset command (□1h)

    Attribute C parameter enabling mode (11h)

  For details on commands and command errors, see Technical Reference Communication Specification.
- Command error (005Bh) is returned when a switch command to virtual full-closed control mode is received during the following operations.
  - Homing command (□4h)
  - If latch function initiated by homing command (□4h), changed to anything other than homing command, and latch is left unfinished

* Switching is possible after latch is finished.

- Profile command (17h)

  Profile position latch absolute positioning (12h)

  Profile position latch relative positioning (13h)

  Profile homing (31h-34h, 36h)

- Reset command (□1h)

  Attribute C parameter enabling mode (11h)

- While executing Set-up Support Software (PANATERM ver.7) trial runs, frequency characteristics analysis functions (FFT functions), Z-phase searches and One Minute TUNING

For details on commands and command errors, see Technical Reference Communication Specification.

8.9 External Scale Position Information Monitor Function for Semi-closed Control

This function monitors external scale position information under semi-closed control using RTEX communication.

By monitoring the position information, the servo driver operates in semi-closed control mode, but the host device can control the servo driver as if it were in full-closed control mode.

This function allows monitoring of external scale position information in all semi-closed control modes (PP, CP, CV, CT) and allows switching of control modes while controlling as in full-closed control.

External scale position (EXPOS) ← Reversal of direction of external scale Pr3.26 ← External scale

■ Operational conditions

Item	Operational conditions
Control mode	● Position control, velocity control, torque control
Other	● Driver type must be one other than standard type.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
3	23	R	External scale selection	0 to 2	—	Select the type of external scale. Ensure that the settings correspond to the type of external scale used. 0: A/B-phase output type 1: Serial communication type (incremental) 2: Serial communication type (absolute) For details, see *"7.2.8 External Scale Selection Function"*.
3	26	R	Reversal of direction of external scale	0 to 3	—	Set the reversal of external scale feedback counter. 0: Not reversed 1: Reversed 2, 3: Manufacturer use (setting is prohibited) For details, see *"7.2.8 External Scale Selection Function"*.
3	27	R	External scale Z phase disconnection detection disable	0 to 1	—	Enable/disable Z-phase disconnection detection when an A/B-phase output type external scale is used. 0: Enabled 1: Disabled
7	22	R	RTEX function expansion setup 1	-32768 to 32767	—	bit 4: External scale position information monitoring function setting for semi-closed control 0: Disabled 1: Enabled **Notes** ● External scale position information can be monitored during full-closed control, regardless of the setting of this bit.

*1 For attributes, see *"6.3 List of Parameters"*.

■ Operation

- Enabling this function enables the following functions in both full-closed control mode and semi-closed control mode (PP, CP, CV, CT). Note that the external scale alarm function is also enabled.
  - External scale position (EXPOS) read via RTEX communication monitor command
  - External scale ID (scale vendor ID, model ID) read via RTEX communication system ID command
  - External scale error detection function
    - Disconnection (Err93.3.□ “External scale connection error protection” , Err50.0.0 “External scale wiring error protection” , Err55.0.0 “A-phase connection error protection” to Err55.2.0 “Z-phase connection error protection”)
    - Communication error (Err50.1.□ “External scale communication error protection” , Err50.2.0 “External scale communication data error protection”)
    - Status error (Err51.0.0 “External scale status error protection 0” to Err51.5.0 “External scale status error protection 5”)
    - Warning (WngA8h “External scale error warning” , WngA9h “External scale communication warning”)

  Note that the external scale alarm function is also enabled.
- When this function is enabled, the below information will not be reflected in the external scale position (EXPOS) monitored by RTEX communication.
  - Rotational direction setup (Pr0.00)
  - Electronic gear (Pr0.08, Pr0.09, Pr0.10)
  - Absolute home position offset (Pr7.13)

  Reversal of direction of external scale (Pr3.26) is reflected.
- External scale position (EXPOS) is initialized when the following applies:
  - When control power is turned on
  - RTEX Communication reset command runs (software reset mode only)

  No initialization is performed when homing.

■ Precautions

- Set Pr3.23 “External scale selection” to a value appropriate for the specifications of the external scale connected. Err93.3.□ “External scale connection error protection” triggers if the settings are inappropriate.

8.10 Deterioration Diagnosis Warning Function

This is a function to check the changes in motor and connected equipment characteristics to output deterioration diagnosis warnings.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	66	A	Deterioration diagnosis convergence judgment time	0 to 10000	0.1 s	Sets the time until real-time auto tuning load characteristic estimations are seen as converged when the deterioration diagnosis warning function is enabled (Pr6.97:bit 1 = 1). When this set value is 0, it is set automatically inside the product in accordance with Pr6.31 “Real time auto tuning estimation speed” . **Notes** ● When Pr6.31 “Real time auto tuning estimation speed” = 0, the deterioration diagnosis warning judgment for load characteristics estimated values (inertia ratio/friction characteristics) is disabled.
5	67	A	Deterioration diagnosis inertia ratio upper limit	0 to 10000	%	Sets the upper-limit values and lower-limit values for inertia ratio estimate in deterioration diagnosis judgment when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and load characteristics estimate convergence has been completed.
5	68	A	Deterioration diagnosis inertia ratio lower limit	0 to 10000	%	
5	69	A	Deterioration diagnosis unbalanced load upper limit	-1000 to 1000	0.1%	Sets the upper-limit values and lower-limit values for unbalanced load estimate in deterioration diagnosis judgment when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and load characteristics estimate convergence has been completed. Set this setup value in 0.2 % increments.
5	70	A	Deterioration diagnosis unbalanced load lower limit	-1000 to 1000	0.1%	
5	71	A	Deterioration diagnosis dynamic friction upper limit	-1000 to 1000	0.1%	Sets the upper-limit values and lower-limit values for dynamic friction estimates in deterioration diagnosis judgment when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and load characteristics estimate convergence has been completed. Set this setup value in 0.2 % increments.
5	72	A	Deterioration diagnosis dynamic friction lower limit	-1000 to 1000	0.1%	

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	73	A	Deterioration diagnosis viscous friction upper limit	0 to 10000	0.1 %/(10000 r/min)	Sets the upper-limit values and lower-limit values for viscous friction coefficient estimate in deterioration diagnosis judgment when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and load characteristics estimate convergence has been completed. Set this setup value in 0.2 % increments.
5	74	A	Deterioration diagnosis viscous friction lower limit	0 to 10000	0.1 %/(10000 r/min)	
5	75	A	Deterioration diagnosis velocity setting	-20000 to 20000	r/min	Outputs deterioration diagnosis velocity output (V-DIAG) when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and the motor speed is within the range of Pr5.75 ± Pr4.35 (speed coincidence range). Deterioration diagnosis velocity output (V-DIAG) has a hysteresis of 10 r/min.
5	76	A	Deterioration diagnosis torque average time	0 to 10000	ms	Sets the torque command average value calculation time (weighted count) when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and diagnosis velocity output (V-DIAG) is on. The time from diagnosis velocity output (V-DIAG) on to the start judgment for the upper limit and lower limit of the torque command average value is also a part of the set time for this parameter. If the setup value is 0, the torque command average value is not calculated.
5	77	A	Deterioration diagnosis torque upper limit	-1000 to 1000	0.1%	Sets the upper-limit values and lower-limit values of torque command average value when deterioration diagnosis warning is enabled (Pr6.97:bit 1 = 1) and deterioration diagnosis velocity output (V-DIAG) is on.
5	78	A	Deterioration diagnosis torque lower limit	-1000 to 1000	0.1%	
6	97	B	Function expansion setup 3	-2147483648 to 2147483647	—	Enables or disables the deterioration diagnosis warning function using bit 1. 0: Disabled 1: Enabled

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

- Applicable range of deterioration diagnosis warning function
  - The deterioration diagnosis warning function for the below five types of data can be enabled by setting Pr6.97 "Function expansion setup 3" :bit 1 = 1.
    - Inertia ratio
    - Unbalanced load
    - Dynamic friction
    - Viscous friction coefficient
    - Torque command average value

    All types of deterioration diagnosis information can be confirmed using the RTEX communication monitor command. For details, see Technical Reference Communication Specification.
- Deterioration diagnosis warning for load characteristic estimates (inertia ratio, unbalanced load, dynamic friction, viscous friction coefficient)

- Deterioration diagnosis warning judgment for four load characteristic estimates (inertia ratio, unbalanced load, dynamic friction, and viscous friction coefficient) can be used when real-time auto tuning load characteristic estimation is enabled (See Operating Instructions (Tuning)).
- The above-mentioned deterioration diagnosis warning judgment is enabled when the required operational conditions for load characteristic estimates has continued in total for Pr5.66 “Deterioration diagnosis convergence judgment time” or more, and the load characteristic estimates have converged.

  Once activated, the deterioration diagnosis warning judgment remains in effect until Pr6.97 “Function expansion setup 3” :bit 1 is set to 0 (disabled) or the real-time auto tuning load characteristic estimate expires.
- As shown in the table below, the upper-limit values and lower-limit values for each load characteristic estimation value can be set in the parameter settings. If the load characteristic estimation value changes and upper-limit values or lower-limit values set by the parameters are exceeded, WngACh “Deterioration diagnosis warning” is generated.

  Note the following restrictions when setting upper-limit values and lower-limit values.
  - When the upper-limit value is set to the maximum value, the upper-limit judgment is disabled.
  - When the lower-limit value is set to the minimum value, the lower-limit judgment is disabled.
  - If upper-limit value ≤ lower-limit value, then both the upper-limit and lower-limit judgment are disabled.

	Inertia ratio	Unbalanced load	Dynamic friction	Viscous friction
Upper-limit value	Pr5.67	Pr5.69	Pr5.71	Pr5.73
Lower-limit value	Pr5.68	Pr5.70	Pr5.72	Pr5.74

Notes

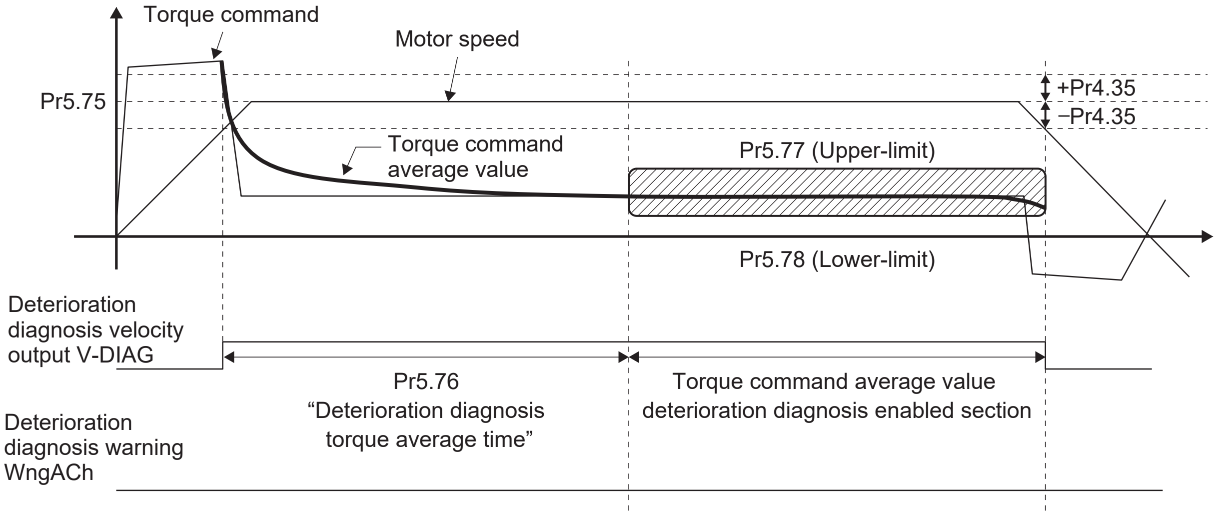
- If Pr6.31 “Real time auto tuning estimation speed” is set to 0 and estimation has been stopped from the start or before the load characteristic estimate results have been confirmed, deterioration diagnosis warning judgment is disabled even if real-time auto tuning load characteristic estimate is enabled.

- Deterioration diagnosis warning for constant velocity torque command average value
  - Deterioration diagnosis velocity output (V-DIAG) is active when the motor speed is within the Pr4.35 “Speed coincidence range” range of Pr5.75 “Deterioration diagnosis velocity setting” .
  - When deterioration diagnosis velocity output (V-DIAG) is on, calculation of the torque command average value is started based on Pr5.76 “Deterioration diagnosis torque average time” whereby, after the set time for Pr5.76 “Deterioration diagnosis torque average time” has elapsed, the deterioration diagnosis judgment is activated based on the torque command average value. This continues while the deterioration diagnosis velocity output (V-DIAG) remains on, however it reverts to disabled when the output is turned off.
  - The upper-limit values and lower-limit values for torque command average value can be set by setting parameters for Pr5.77 “Deterioration diagnosis torque upper limit” and Pr5.78 “Deterioration diagnosis torque lower limit” respectively.

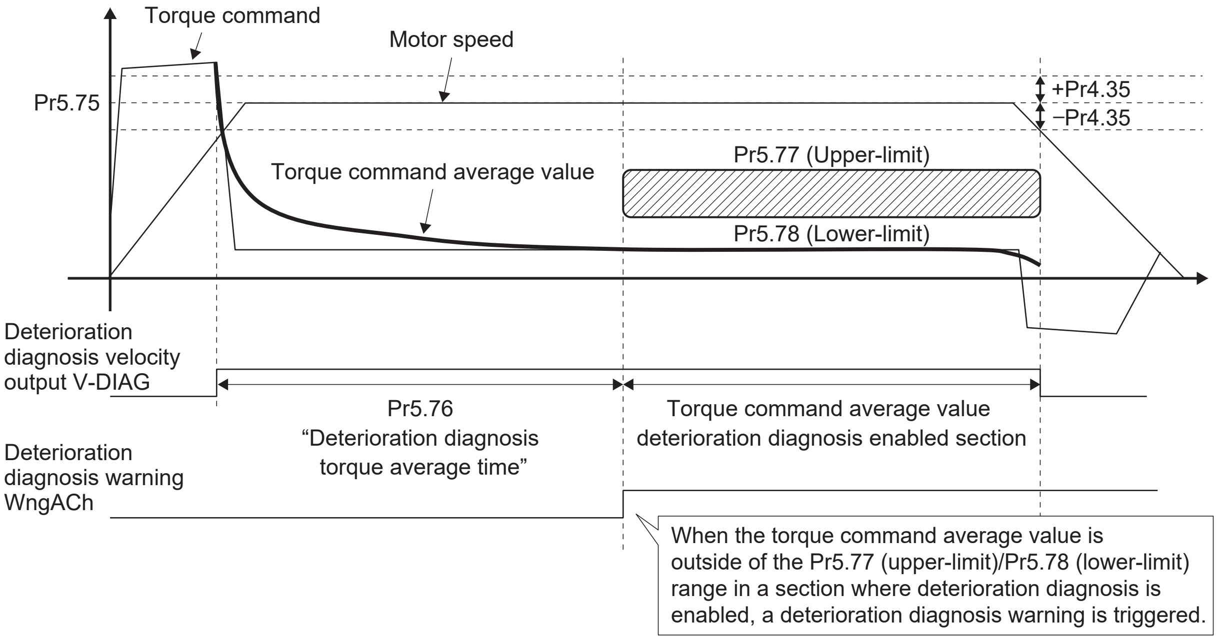
    If the torque command average value changes and upper-limit value or lower-limit values set by the parameters are exceeded, WngACh “Deterioration diagnosis warning” is generated.

    Note the following restrictions when setting upper-limit values and lower-limit values.
    - When the upper-limit value is set to the maximum value, the upper-limit judgment is disabled.
    - When the lower-limit value is set to the minimum value, the lower-limit judgment is disabled.
    - If upper-limit value ≤ lower-limit value, then both the upper-limit and lower-limit judgment are disabled.

- Example of when deterioration diagnosis warning for torque command average value is not triggered



- Example of when deterioration diagnosis warning for torque command average value is triggered



■ Precautions

Since there may be delays in communication between this product and Set-up Support Software (PANATERM ver.7) , the torque command average value acquired via Set-up Support Software (PANATERM ver.7) may differ from the actual value inside this product (The value may be shown as 0 even when the actual value is not 0.).

8.11 Latch Mode With Stop Function

This is the function to stop at the latched position with the input/output timing of latch trigger signal with stop function (hereafter referred to as the trigger signal), without initialization of position information.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, full-closed control (CP)
Other	● Must be in servo-on state. ● Elements other than servo parameters are appropriately set, enabling the motor to rotate normally. ● Set the communication cycle to 500 μs and the command update cycle to 1 ms. ● Set the electronic gear ratio to 1 or more.

— Precautions —

- Latch Mode with Stop Function does not start up with the following settings, but returns command error (005Fh).
  - With settings other than cyclic position control (CP)
  - With settings other than communication cycle 500 μs and command update cycle 1 ms
  - With an electronic gear ratio setting less than 1

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	78	C	Latch trigger signal reading setting with stop function	0 to 3	—	Selects the number of readings from latch trigger signal input until this product confirms logic internally in Latch Mode with Stop Function when external input signal is used as the trigger signal. 0: 0.1875 ms (3 times reading) 1: 0.0625 ms (1 times reading) 2: 0.125 ms (2 times reading) 3: 0.1875 ms (3 times reading) When the servo driver output signal is used as a trigger, logic is confirmed with one reading regardless of these parameter settings.
7	111	C	Trigger signal allocation setting of latch mode with stop function	0 to 64	—	Select the output signal to be used as the trigger signal in latch mode with stop function. 0: Disabled 1 to 5: Manufacturer use (setting is prohibited) 6: Output during torque limitation (TLC) 7 to 64: Manufacturer use (setting is prohibited)

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

- This function allows an external input signal (EXT1, EXT2, EXT3) to be set as the trigger signal.

  Furthermore, the servo driver output signal can also be set as the trigger signal.

  Use RTEX communication commands to select the trigger signal (external input signal or servo driver output signal).

For details, see Technical Reference Communication Specification.

- When an external input signal (EXT1, EXT2, EXT3) is selected as the trigger signal and this function is initiated, the motor is controlled according to the command position from the host device until the trigger signal is input, and it stops at the latch position while ignoring the command position from the host device when the trigger signal is input.
- When selecting an external input signal (EXT1, EXT2, EXT3) as the trigger signal and initiating this function, please allocate the trigger signal to one of SI5 to SI7 (which can be used as external latch inputs).

  Command error (0058h) is returned if it is initiated without allocating a trigger signal.
- When the servo driver output signal is selected as the trigger signal and this function is initiated, the command position from the host device is ignored and it will stop at the latch position if servo driver output signal output conditions are detected.
- When initiating this function with the servo driver output signal selected as a trigger signal, set 6 (Torque limitation output (TLC)) in Pr7.111. Command error (0058h) is returned if Pr7.111 "Trigger signal allocation setting of latch mode with stop function" is set to 0 (disabled).
- With this function, the position command filter is disabled in order to shorten the command output cycle to the stop position from the time when the trigger signal is detected until it stops at the position where the trigger signal is detected.

■ Precautions

- Err91.3.0 "RTEXCommand error protection2" is triggered if latch mode with stop function is released between input/output of the trigger signal and completion of operation. If this may be a problem, cancel without detection of the trigger signal, e.g. by stopping the motor.
- When an external input signal is used as the trigger signal, the amount of delay for the trigger signal detection may vary depending on the operating environment or aging deterioration.

  Set the delay correction time as necessary if latch precision is required.

  For details, see Technical Reference Communication Specification.

  If the servo driver output signal is used as the trigger signal, it is not affected by the delay correction time.

8.12 Retracting Operation Function

This function sets retracting operation initiation and the content of that operation when the main power supply is off or the retracting operation signal is input.

Retracting operation is performed using the velocity and amount of movement set in the parameters when the retracting operation initialization conditions are met.

An alarm triggers after the retracting operation is completed.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes
Other	● Set the communication cycle to 250 μs or longer. ● Must be in servo-on state. ● Non-control parameters such as torque limit settings must be set properly to ensure the motor runs normally. ● Trial run and frequency characteristic measuring functions are not operating.

— Precautions —

- Do not switch control modes during retracting operation.
- Operation cannot be guaranteed in the following circumstances.
  - When retracting operation is initiated during homing operation
  - When homing operation is initiated during retracting operation

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	08	B	L/V trip selection upon main power off	0 to 3	—	Select whether to trip LV or servo-off when there is amain power supply alarm. If the main power cut-off condition lasts longer than the time set in Pr7.14 “Main power off warning detection time” , set conditions for detection of main power off warning. bit 0: Operation selection with main power supply OFF 0: Servo-off according to the settings for Pr5.07 “Sequence upon main power off” Servo-on is then resumed when the main power is switched back on. 1: Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” detection ● Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is not triggered when the retracting operation is triggered by main power off. However, Err13.0.☐ “Main power supply undervoltage protection (voltage across PN)” may be triggered before the retracting operation finishes as the retracting operation runs off residual voltage from the capacitor. bit 1: Main power off warning condition detection time 0: Main power off warning only detected when servo-on 1: Main power off warning always detected

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	09	C	Detection time of main power off	20 to 2000	ms	Set the main power alarm detection time. ● Before using the servo driver, confirm that this set-up value is appropriate for the power supply environment. If this setup value is changed, reconfirm that the new setup value is appropriate for the power supply environment before use. For factory default values, see *"6.3 List of Parameters"* . ● Set this setup value to a value other than 2000 when main power off is used as the trigger. Main power off detection itself is disabled when this set-up value is set to 2000, and the retracting operation is not executed.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	85	C	Retracting operation condition setting	-32768 to 32767	—	Select the retracting operation initialization and stopping judgment conditions. bits 0 to 3: Retracting operation initialization conditions (I/O) 0: Retracting operation by I/O input disabled 1: RET input 2: RET/HOME input 3: Main power off detection ● Set Pr5.09 “Detection time of main power off” to a value other than 2000 when main power off is used as the trigger. When Pr5.09 is 2000, main power off detection itself is disabled. 4 to 15: Cannot be set ● An alarm is triggered when set to a value other than 0 to 3. The triggered alarm switches depends on Pr6.86 “Retracting operation alarm setting” :bit 15. If bit 15 = 0, Err85.2.0 is triggered (A5N compatible) If bit 15 = 1, Err85.2.0 is triggered (A6N compatible) bits 7 to 4: Retracting operation initialization conditions (communication) 0: Retracting operation disabled by Err84.0.0 “RTEX communication timeout error protection” or Err84.5.0 “RTEX communication cycle error protection” (conventional Err84.0.0 operation) 1: Retracting operation executed by Err84.0.0 “RTEX communication timeout error protection” triggering conditions 2: Retracting operation executed by Err84.0.0 “RTEX communication timeout error protection” or Err84.5.0 “RTEX communication cycle error protection” triggering conditions 3 to 15: Cannot be set ● An alarm is triggered when set to a value other than 0 to 2. The triggered alarm switches depends on Pr6.86 “Retracting operation alarm setting” :bit 15. If bit 15 = 0, Err85.2.0 is triggered (A5N compatible) If bit 15 = 1, Err87.3.☐ is triggered (A6N compatible) bits 9 to 8: Judgment condition for stopping retracting operation ● Set a value from 0 to 3. For details, see the table below. bits 15 to 10: Set to 0. ● An alarm triggers when set to a value other than 0. The triggered alarm switches depends on Pr6.86 “Retracting operation alarm setting” :bit 15. If bit 15 = 0, Err85.2.0 is triggered (A5N compatible) If bit 15 = 1, Err87.3.☐ is triggered (A6N compatible)

<table>
<tr><th>Class</th><th>No.</th><th>Attribute (*1)</th><th>Parameter name</th><th>Setting range</th><th>Unit</th><th>Function</th></tr>
<tr><td colspan="7">bits 9 to 8: Detailed determination conditions for stopping retracting operation
<table>
<tr><th>bits 9 to 8</th><th>Position command transfer judgment complete</th><th>Positioning complete (In_Position)</th></tr>
<tr><td>0</td><td>Determine before filter</td><td rowspan="2">Disabled</td></tr>
<tr><td>1</td><td>Determine after filter</td></tr>
<tr><td>2</td><td>Determine before filter</td><td rowspan="2">Enabled</td></tr>
<tr><td>3</td><td>Determine after filter</td></tr>
</table>
RTEX communication monitor (status flag) In_Position is used to complete positioning.
(Example) When bits 9 to 8 = 0, position command transfer judgment is executed before the filter and positioning judgment disabled is used as the condition for retracting operation stop.</td></tr>
<tr><td>6</td><td>86</td><td>C</td><td>Retracting operation alarm setting</td><td>-32768 to 32767</td><td>—</td><td>Sets the retracting operation alarm clear attributes and retracting operation-related alarm switching.
bit 0: Err85.0.0 “Retracting operation completion (I/O)” /Err87.1.0 “Retracting operation completion (I/O)”
0: Cannot be cleared
1: Can be cleared
bit 1: Err85.1.0 “Retracting operation completion (communication)” /Err87.2.0 “Retracting operation completion (communication)”
● Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is not triggered when the retracting operation is triggered by the main power off.
However, Err13.0.☐ “Main power supply undervoltage protection (voltage across PN)” may be triggered before the retracting operation finishes as the retracting operation runs off residual voltage from the capacitor.
0: Cannot be cleared
1: Can be cleared
bit 2: Err85.2.0 “Retracting operation error” /Err87.3.☐ “Retracting operation error”
0: Cannot be cleared
1: Can be cleared
bits 14 to 3: Not used Please fix to 0.
bit 15: Retracting operation-related alarm switching
0: Err85.0.0 “Retracting operation completion (I/O)” to Err85.2.0 “Retracting operation error” are triggered (A5N compatible)
1: Triggers Err87.1.0 “Retracting operation completion (I/O)” to Err87.3.☐ “Retracting operation error” (A6N compatible specification)</td></tr>
<tr><td>7</td><td>23</td><td>B</td><td>RTEX function expansion setup 2</td><td>-32768 to 32767</td><td>—</td><td>bit 8: RTEX status selection of In_Progress/AC_OFF
0: In_Progress
1: AC_OFF
*Linked to the bit 15 setting.
bit 15: In_Progress/AC_OFF/Pr7.112 value
RTEX status selection expansion
0: As per Pr7.23: bit 8 setting (In_Progress or AC_OFF).
1: As per Pr7.112 setting</td></tr>
</table>

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	25	C	RTEX velocity unit setup	0 to 1	—	Sets the unit of velocity data used in RTEX communication. Sets the units for both command data such as command speed and for response data such as actual velocity. 0: r/min 1: Command unit/s
7	112	B	Selection of RTEX communication status flag	0 to 2	—	Selects the signal returned by the RTEX response status flag (byte 2:bit 1) when Pr7.23:bit 15 = 1. ● 0: Returns RET_Status (status when running retracting operation). ● 1: Returns V_Full_Status/Sensor_FB_Status (virtual full-closed control mode status/sensor feedback function status). ● 2: Returns CMP_OUT_Status (Position comparison output function enabled). 0: Disabled 1: Enabled
8	01	B	Profile linear acceleration constant	1 to 429496	10000 Command unit/s^2	Sets acceleration during profile position control (PP) and retracting operation. Check that the set value is valid before initializing operation.
8	04	B	Profile linear deceleration constant	1 to 429496	10000 Command unit/s^2	Sets deceleration during profile position control (PP) and retracting operation. Check that the set value is valid before initializing operation.
8	17	B	Relative movement of retracting operation	-2147483647 to 2147483647	Command unit	Set the movement at retracting operation based on the command position before filter. If the movement amount after the electronic gears is 0, Err85.0.0 “Retracting operation completion (I/O)” and Err87.1.0 “Retracting operation completion (I/O)” or Err85.1.0 “Retracting operation completion (communication)” and Err87.2.0 “Retracting operation completion (communication)” are triggered with no retracting operation taking place. Check that the set value is valid before initializing operation. This parameter is used as the relative displacement for pre-filter command position standard. **— Precautions —** ● This parameter is signed data. Pay attention to the direction of retracting operation. ● To ensure safety, please confirm the direction of retracting operation with Pr8.17 set to a small value during initial configurations.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
8	18	B	Retracting operation speed	0 to 2147483647	Command unit/s or r/min	Sets the speed at retracting operation. Units are set using Pr7.25 “RTEX velocity unit set-up” . The maximum value is limited with the max. motor speed by internal processing. When setting in units of r/min, it is converted to command unit/s during internal computing, after which it is limited to within the following range. 00000001h to 7FFFFFFFh (1 to 2147483647) Check that the set value is valid before initializing operation.

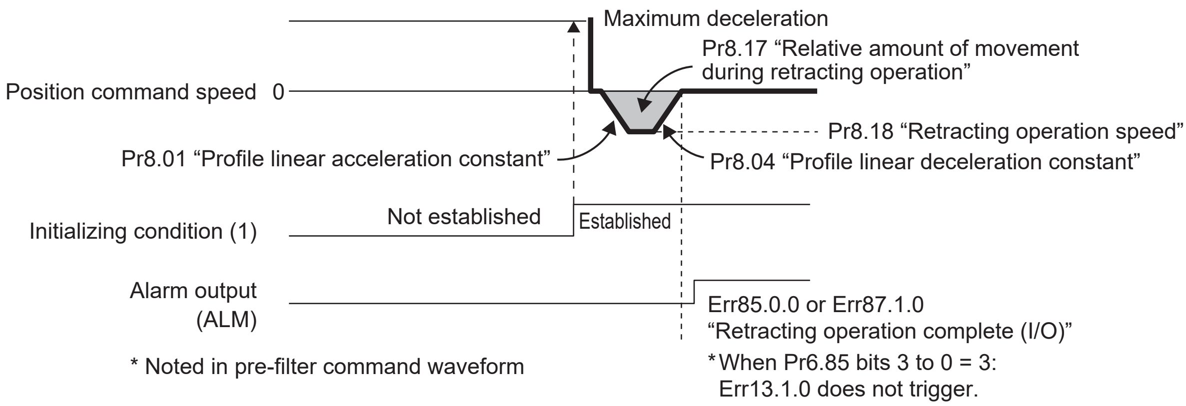
*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

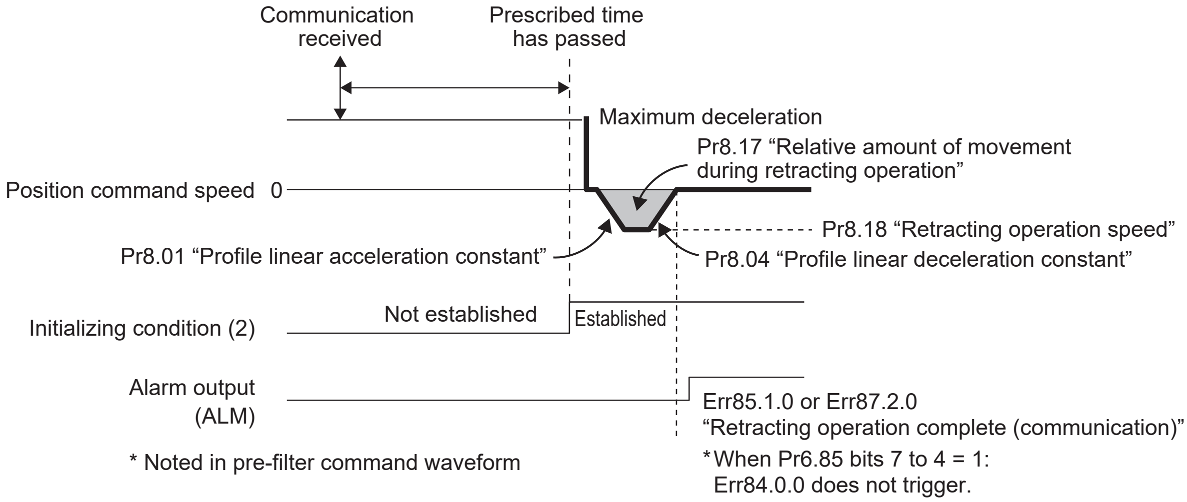
- Details of retracting operation
  - Retracting operation initialization conditions

    If condition (1) or condition (2) is met, the retracting operation is initialized.

    - Condition (1)
      - Pr6.85 bit 3 to 0 = 1 Retracting operation input (RET) is ON
      - Pr6.85 bit 3 to 0 = 2 Near home inputs (HOME) are both ON
      - Pr6.85 bit 3 to 0 = 3 Main power supply OFF is detected



    - Condition (2)
      - Pr6.85 bit 7 to 4 = 1 and RTEX Communication Timeout error is detected
      - Pr6.85 bit 7 to 4 = 2 and either RTEX Communication Timeout error or RTEX Communication cycle error are detected

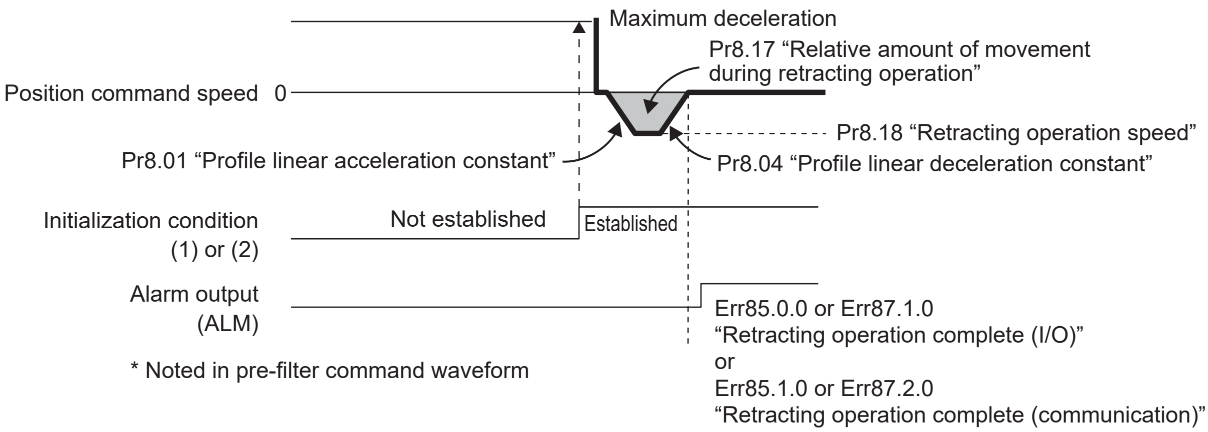


- External brake control when retracting operation is complete

  If Err85.0.0 “Retracting operation completion (I/O)” /Err87.1.0 “Retracting operation completion (I/O)” or Err85.1.0 “Retracting operation completion (communication)” /Err87.2.0 “Retracting operation completion (communication)” is triggered when the retracting operation is completed, it is possible to prevent components such as the robot arm from falling by keeping the motor energized from the moment the brake is released (BRK-OFF) until the external brake actually engages.

  For details, see *“8.19 Fall Prevention Function For When Alarm is Triggered”* .
- Retracting operation initialization during motor operation

  If retracting operation start-up conditions (1) or (2) are met during motor operation, it comes to a stop at the maximum deceleration and the retracting operation is performed.

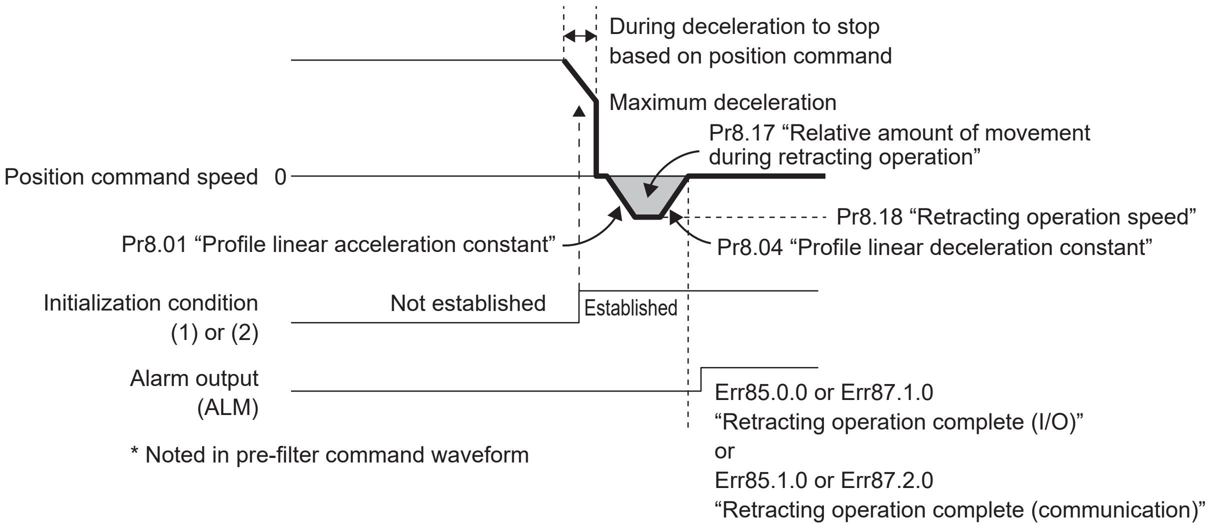


- Retracting operation initialization during motor deceleration

  If retracting operation start-up conditions (1) or (2) are met during the deceleration to stop operation, it comes to a stop at the maximum deceleration and the retracting operation is performed.

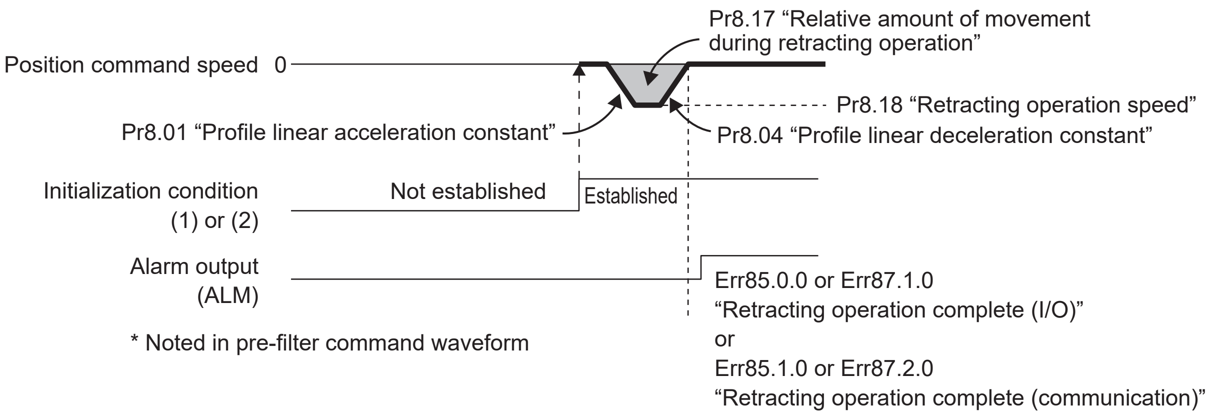
  The emergency stop and retracting operation will run when retracting operation initialization condition (1) or (2) is established during emergency stop deceleration to stop by over-travel inhibit input.

  When the retracting operation initialization condition (1) or (2) is established during over-travel inhibit input direct brake (DB) or free run, alarm-triggered mid-deceleration to stop, or with the servo-off or main power supply OFF (except when Pr6.85 bit 0 to 3 = 3 and the main power supply OFF is a retracting operation initialization condition), then the retracting operation is not run. Instead, the position command stops and deceleration begins in accordance with the deceleration sequence at alarm, after which Err85.2.0 “Retracting operation error” or Err87.3.□ “Retracting operation error” is triggered.



- Retracting operation from motor stop state

  The retracting operation will run when retracting operation initialization condition (1) or (2) is met during stop.

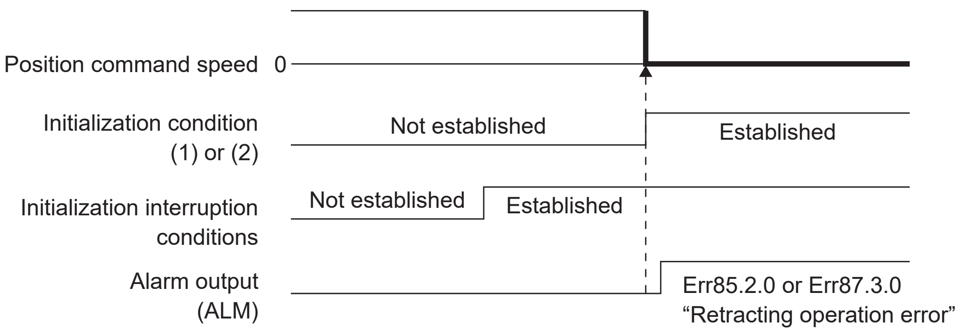


- Retracting operation initialization interruption conditions during motor operation

  If any of the following conditions are met for aborting start-up, the retracting operation will not be performed even if conditions (1) and (2) for starting the operation are met. Instead, the position command stops and deceleration begins in accordance with the deceleration sequence at alarm, after which Err85.2.0 “Retracting operation error” or Err87.3.□ “Retracting operation error” is triggered.

  The conditions for aborting start-up of the retracting operation are as below.

  - Over-travel inhibit input in direction of retracting operation (POT, NOT) is ON
  - Retracting operation stop input (STOP) is ON
  - RTEX communication not established (trial run mode, etc.)
  - Servo-off
  - Alarm trigger
  - Main power supply is OFF (*except when Pr6.85 bit 3 to 0 = 3)
  - STO input



* Noted in pre-filter command waveform

- Retracting operation termination conditions

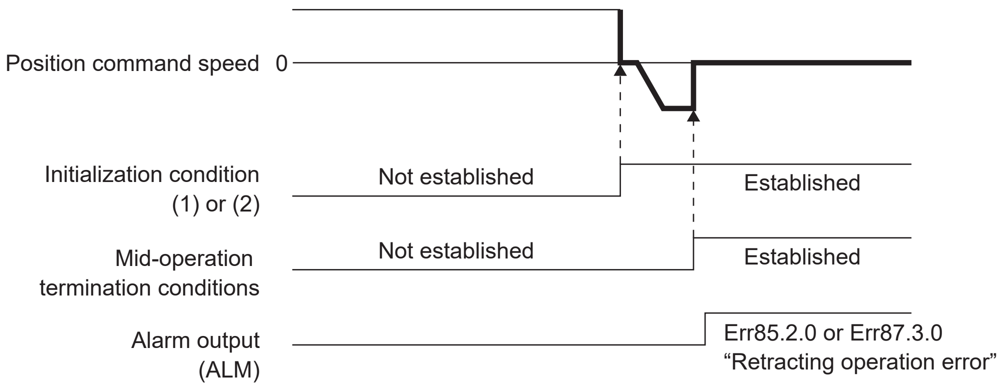
  If any of the following conditions for terminating a retracting operation are met, the retracting operation will be terminated and the position command is stopped. Depending on the conditions for terminating execution, deceleration begins in accordance with the alarm operation sequence, after which Err85.2.0 “Retracting operation error” or Err87.3.□ “Retracting operation error” is triggered.

  If the conditions for starting the retracting operation are not met during the retracting operation, the current operation continues.

  Retracting operation mid-operation termination conditions are shown below.

  - Over-travel inhibit input in direction of retracting operation (POT, NOT) is ON
  - Retracting operation stop input (STOP) is ON
  - When the *“retracting operation execution condition”* is (1), a servo-off command has been delivered from the host.
  - Alarm trigger
  - STO input
  - Main power supply is OFF (*except when Pr6.85 bit 3 to 0 = 3)
    - ● In order to prevent the retracting operation from being terminated when the main power supply is OFF other than when Pr6.85 bit 3 to 0 = 3, we recommend setting Pr5.09 “Detection time of main power off” to 2000 (disabled).

      However, when the main power supply converter voltage across PN drops below the specified value, Err13.0.□ “Main power supply undervoltage protection (voltage across PN)” will trigger and the retracting operation will terminate.



- Alarms related to the retracting operation function

Alarm number			Alarm Name	Primary cause (*1)
Main	Sub	Primary cause		
33	0	0	Input overlapping assignment error 1 protection	Triggered when input signal (SI1, SI2, SI3, SI4) function assignment settings overlap.
33	1	0	Input overlapping assignment error 2 protection	Triggered when input signal (SI5, SI6, SI7, SI8) function assignment settings overlap.
84	0	0	RTEX communication timeout error protection	Triggered when the number of incidences set with Pr7.97 “RTEX communication timeout error protection detection count” continues when communication data has not been received and the RTEX communication IC is not outputting the receipt interrupt processing initialization signal. However, when Pr6.85 “Retracting operation condition setting” :bit 7 to 4 = 1, Err84.0.0 “RTEX communication timeout error protection” is not triggered, and Err85.1.0 “Retracting operation completion (communication)” or Err87.2.0 “Retracting operation completion (communication)” will be triggered after retracting operation completes.
84	5	0	RTEX communication cycle error protection	Triggered when the receipt interrupt processing initialization signal was output from the RTEX communication IC, but the RTEX communication is out of sync with an error in output cycle.
85	0	0	Retracting operation completion (I/O)	Triggered when the I/O retracting operation completes normally.
85	1	0	Retracting operation completion (communication)	Triggered when the communication retracting operation completes normally.
85	2	0	Retracting operation error	Triggered when the retracting operation cannot run or is terminated.
87	1	0	Retracting operation completion (I/O)	Triggered when the I/O retracting operation completes normally.
87	2	0	Retracting operation completion (communication)	Triggered when the communication retracting operation completes normally.
87	3	0 to 6	Retracting operation error	Triggered when the retracting operation cannot run or is terminated.

*1 For details on causes and processing, see *“10.2.3 Protection Function Details”* .

■ Precautions

- Confirm it is in retracting operation by setting Pr7.23 “RTEX function expansion setup 2” bit 15 = 1 and Pr7.112 “Selection of RTEX communication status flag” :bit 0 = 0 and checking status flag (response byte 2) bit 1.

  0: Retracting operation not initialized/complete

  1: During retracting operation

- Ensure there is no overlap between the home position and RET input position.
- Mid-retracting operation, the control mode specified by the host is ignored and position control is forced.

  As a result, during retracting operations, actions such as the application of filters or the allocation of input/output signals will be those of position control.

  When changing control modes, wait until retracting operation completes before changing the values.

  Command error (002Eh) is returned if a control mode change command is issued mid-retracting operation.
- In incremental mode, after the retracting operation is completed (Err85.0.0 “Retracting operation completion (I/O)” /Err87.1.0 “Retracting operation completion (I/O)” , Err85.1.0 “Retracting operation completion (communication)” /Err87.2.0 “Retracting operation completion (communication)” or Err85.2.0 “Retracting operation error” /Err87.3.□ “Retracting operation error” is triggered), it will enter the homing incomplete state (Homing_Complete = 0). Please re-run homing after clearing the alarm.
- For acceptable RTEX communication commands during retracting operation, see *“4.2.4.1 Command Data Block Configuration (same for 16-byte and 32-byte modes)”* .
- When the retracting operation runs due to a communication timeout, RTEX communication will not be re-established until the retracting operation has executed (Err85.1.0 “Retracting operation completion (communication)” /Err87.2.0 “Retracting operation completion (communication)” is triggered).

8.13 Deceleration to Stop Function

Sets mid-deceleration and post-stop motor operations when over-travel inhibit input, main power supply OFF, an alarm is triggered, or servo-off has occurred.

The deceleration function has three types of operation: dynamic brake (DB) stop, free run (DB OFF), and emergency stop. The deceleration function is used to select the operation during deceleration and after stopping. The table below shows the deceleration function operations that can be selected during deceleration and after stopping.

Deceleration trigger conditions	Selectable mid-deceleration operations	Selectable post-stop operations
Over-travel inhibit input	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF) ● Emergency stop	When a mid-deceleration operation is not an emergency stop, torque command for over-travel inhibit direction is 0. When a mid-deceleration operation is an emergency stop, torque command is as normal.
Servo-off	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF) ● Emergency stop	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF)
Main power supply OFF	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF) ● Emergency stop	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF)
Alarm trigger	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF) ● Emergency stop	Set one of the following. ● Dynamic brake (DB) operation ● Free run (DB OFF)

For details on each deceleration trigger condition, see the sections below.

During over-travel inhibit input: *"8.14 Deceleration to Stop Function for Over-Travel Inhibit Inputs (POT, NOT)"*

During servo-off: *"8.15 Deceleration to Stop Function for Servo Off"*

When main power supply off: *"8.16 Deceleration to Stop Function for When Main Power Supply Is Off"*

When an alarm is triggered: *"8.17 Deceleration to Stop Function for When Alarm Is Triggered"*

The deceleration settings must be changed from their factory default values to values appropriate for the environment in which the device is used.

For the factory default values of each parameter, see *"6.3 List of Parameters"* .

8.14 Deceleration to Stop Function for Over-Travel Inhibit Inputs (POT, NOT)

This function sets the mid-deceleration and post-stop operations after over-travel inhibit input (POT, NOT) is input.

During homing operations, the edge of the over-travel inhibit input (POT, NOT) is used as the origin. For details on homing operations, see Technical Reference Communication Specification “5.4.6 Homing Operation” .

Over-travel inhibit status notifications can also be sent as warnings. For details, see *“10.2.3 Protection Function Details”* .

— Precautions —

- This must be set up so that the over-travel inhibit inputs (POT, NOT) can be input correctly.
  - Operation cannot be guaranteed if not set up correctly (NOT installed on the positive direction travel side, POT installed on the negative direction travel side, etc.).
  - Install the device at a position that takes into account the amount of movement required until deceleration stops.

    If the torque limit and deceleration set values are low, the amount of movement necessary until deceleration stops may increase.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	04	C	Over-travel inhibit input setup	0 to 2	—	Sets the operation for the over-travel inhibit inputs (POT, NOT). Set according to the host device specification. Normally set to 1 (disabled) in order for the host device to control the operation. ● 0: Deceleration to stop (deceleration to stop during over-travel inhibit input) Functions as POT -> positive direction travel inhibited, NOT -> negative direction travel inhibited. Stops as per Pr5.05 “Sequence at over-travel inhibit” when POT is input when operating in a positive direction. Operation is similar when NOT is input when operating in a negative direction. ● 1: Disabled Operation settings after over-travel inhibit input (POT/NOT) are disabled, but operation is not affected. If Pr5.04 “Over-travel inhibit input setup” is set to anything other than 1 (disabled) when POT is assigning functions to SI6 or NOT is assigning functions to SI7, Err38.2.0 “Over-travel inhibit input protection 3” is triggered. ● 2: Deceleration to stop (deceleration to stop during alarm) Inputting either POT or NOT triggers Err38.0.0 “Over-travel inhibit input protection 1” . Pr5.04 “Over-travel inhibit input setup” and Pr5.05 “Sequence at over-travel inhibit” settings are temporarily disabled during profile homing operation. When using the profile homing function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input. Simply setting Pr5.04 = 1 does not disable the function. For details on the profile homing function, see Technical Reference Communication Specification.
5	05	C	Sequence at over-travel inhibit	0 to 2	—	Sets the status for during deceleration and after coming to a stop after over-travel inhibit inputs (POT, NOT) are entered when Pr5.04 “Over-travel inhibit input setup” = 0. Pr5.04 “Over-travel inhibit input setup” and Pr5.05 “Sequence at over-travel inhibit” settings are temporarily disabled during profile homing operation. When using the profile homing function without using over-travel inhibit input, do not assign over-travel inhibit input (POT/NOT) to general-purpose input. Simply setting Pr5.04 = 1 does not disable the function. For details on the profile homing function, see Technical Reference Communication Specification.
5	11	B	Torque setup for emergency stop	0 to 500	%	Sets the torque limit for emergency stop. The normal torque limit is used when this setup value is 0.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	23	B	RTEX function expansion setup 2	-32768 to 32767	—	bit 2: RTEX status response condition setting with POT and NOT functions disabled RTEX status response condition setup with over-travel inhibit input (POT, NOT) input operation setting disabled (Pr5.04 = 1). 0: Enabled in RTEX status (responds) 1: Also disabled in RTEX status (does not respond) bit 3: POT and NOT RTEX status bit arrangement settings 0: POT is bit 1, NOT is bit 0 1: NOT is bit 1, POT is bit 0 bit 6: POT and NOT RTEX status logical settings 0: No inversion (1 when active) 1: Inversion (0 when active) bit 9: Command error return switching for commands received in the direction of over-travel inhibit input after over-travel inhibit deceleration to stop Select whether command errors are returned when a command is received in the direction of over-travel inhibit input after deceleration to stop due to over-travel inhibit input. 0: No command error response 1: Command error response

*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

- Operation for when setting Pr5.04 “Over-travel inhibit input setup” = 0 (Deceleration to stop [deceleration to stop during over-travel inhibit input])

  The table below shows the stopping method during deceleration and post-stop operations after over-travel inhibit input (POT, NOT) for each Pr5.05 “Sequence at over-travel inhibit” setting.

—: None

Pr5.04 (*3)	Pr5.05	Mid-deceleration (*2)		Post-stop (Approx. 30 r/min or below)	
		Stopping Method	Deviation	Post-stop Operation	Deviation
0	Common	● Forced to position control. ● Forced stop of position command generation processes When the Slow Stop function is enabled with Pr6.10 “Function expansion setup” :bit 15 and bit 10, it will come to a stop using Slow Stop rather than making an emergency stop. For details, see *“8.21 Slow Stop Function”* .	—	● Control mode is command-dependent Stop a command in over-travel inhibit direction with the over-travel inhibit input set to ON. If a command is issued in the over-travel inhibit direction, the command is ignored. When a command is issued in the over-travel inhibit direction while the over-travel inhibit input is ON, a command error is returned if bit 9 of the Pr7.23 “RTEX function expansion setup 2” parameter is set to 1.	—
	0	● Dynamic brake (DB) operation Stopping method is free run (DB OFF) in dynamic brake non-compatible models.	Clear (*1)	● Torque command = 0 in over-travel inhibit direction	Retained
	1	● Free run (DB OFF)	Clear (*1)	● Torque command = 0 in over-travel inhibit direction	Retained

Pr5.04 (*3)	Pr5.05	Mid-deceleration (*2)		Post-stop (Approx. 30 r/min or below)	
		Stopping Method	Deviation	Post-stop Operation	Deviation
0	2	● Emergency stop Emergency stop refers to a controlled immediate stop with servo-on. The torque command value is limited during emergency stop by Pr5.11 “Torque setup for emergency stop” . When an emergency stop is performed, operation is normal from signal input until the emergency stop begins, and when the command stops simultaneous to the signal input, torque restricted by the normal torque limit may be output. Continue to send normal commands for at least 4 ms after the signal input to stop the motor with the torque set in torque setup for emergency stop. The Pr6.14 “Emergency stop time at alarm” setting is invalid. ● Torque limit = Pr5.11 “Torque setup for emergency stop”	Clear (*1)	● Torque limit and torque command are as normal	Retained

*1 During deviation clearing, the process that makes the internal command position follow the feedback position is activated. At emergency stop and at the end of deceleration, position deviations/external scale deviations accumulated during deceleration are cleared.

*2 Deceleration period is the time required for the motor speed to decelerate to 30 r/min or less. Once the motor velocity drops below 30 r/min, any movement post-stop is treated as a stop state regardless of motor velocity.

*3 When the set value of Pr5.04 “Over-travel inhibit input setup” is 2, Err38.0.0 “Over-travel inhibit input protection 1” is triggered when POT or NOT is turned ON. Therefore, the system operates according to Pr5.10 “Sequence at alarm” , and not to this set value. Pr5.10 “Sequence at alarm” always has priority even if another error is triggered.

8.15 Deceleration to Stop Function for Servo Off

This function sets the stopping method during deceleration and post-stop operations when the servo is off.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	06	B	Sequence at servo-off	0 to 9	—	Sets mid-deceleration and post-stop state after servo-off.
5	11	B	Torque setup for emergency stop	0 to 500	%	Sets the torque limit for emergency stop. The normal torque limit is used when this setup value is 0.
4	37	B	Mechanical brake action at stalling setup	0 to 10000	ms	Sets the mechanical brake operating time at stalling setup.
4	38	B	Mechanical brake action at running setup	0 to 32000	ms	Sets the mechanical brake operating time at running setup.
4	39	B	Brake release speed setup	30 to 3000	r/min	Sets the threshold speed for determining mechanical brake output during operation.

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

● Details on Pr5.06 "Sequence at servo-off"

If an alarm is triggered during servo-off, the system operates according to Pr5.10 "Sequence at alarm" .

If the main power is turned off during servo-off, follow Pr5.07 "Sequence upon main power off" .

—: N/A

Pr5.06	Mid-deceleration (*3)		Post-stop (Approx. 30 r/min or below)	
	Stopping Method	Deviation	Post-stop Operation	Deviation
Common	● Forced to position control ● Forced stop of position command generation processes (*6)	—	● Forced to position control ● Forced stop of position command generation processes (*6)	—
0, 4	● Dynamic brake (DB) operation (*4)	Clear (*1)	● Dynamic brake (DB) operation (*4)	Clear (*1)
1, 5	● Free run (DB OFF)	Clear (*1)	● Dynamic brake (DB) operation (*4)	Clear (*1)
2, 6	● Dynamic brake (DB) operation (*4)	Clear (*1)	● Free (DB OFF)	Clear (*1)
3, 7	● Free run (DB OFF)	Clear (*1)	● Free (DB OFF)	Clear (*1)
8	● Emergency stop (*2) (*5) (*6) ● Torque limit = Pr5.11	Clear (*1)	● Dynamic brake (DB) operation (*4)	Clear (*1)

Pr5.06	Mid-deceleration (*3)		Post-stop (Approx. 30 r/min or below)	
	Stopping Method	Devia-tion	Post-stop Operation	Devia-tion
9	● Emergency stop (*2) (*5) (*6) ● Torque limit = Pr5.11	Clear (*1)	● Free (DB OFF)	Clear (*1)

*1 During deviation clearing, the process that makes the internal command position follow the feedback position is activated. As the motor may suddenly begin moving, please reconfigure the command coordinates on the host device side before running interpolation feed commands after servo-on.

*2 Emergency stop refers to a controlled immediate stop with servo-on. The torque command value is limited during emergency stop by Pr5.11 “Torque setup for emergency stop” .

When an emergency stop is performed, operation is normal from the servo-off command until the emergency stop begins, so torque restricted by the normal torque limit may be output.

Continue to send normal commands for at least 4 ms after the servo-off command input to stop the motor with the torque set in torque setup for emergency stop.

*3 Deceleration period is the time required for the motor speed to decelerate to 30 r/min or less.

Once the velocity drops below 30 r/min during deceleration, it comes to a stop, then transitions. Once operation shifts to post-stop, operation is as per post-stop regardless of the motor velocity.

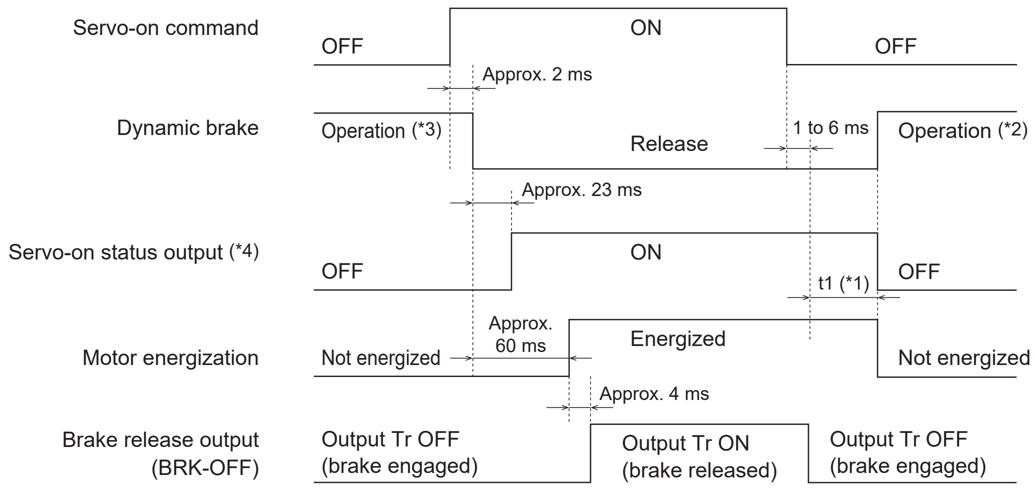
*4 Stopping method is free run (DB OFF) in dynamic brake non-compatible models.

*5 The Pr6.14 “Emergency stop time at alarm” setting is invalid.

*6 When the Slow Stop function is enabled with Pr6.10 “Function expansion setup” :bit 15 and bit 10, it will come to a stop using Slow Stop rather than making an emergency stop. For details, see *“8.21 Slow Stop Function”* .

● Servo-on/off operations when motor is stopped (servo lock) timing chart

(To turn the servo-on/off during normal operation, first stop the motor.)



*1 t1 depends on the set value for Pr4.37 “Mechanical brake action at stalling setup” .

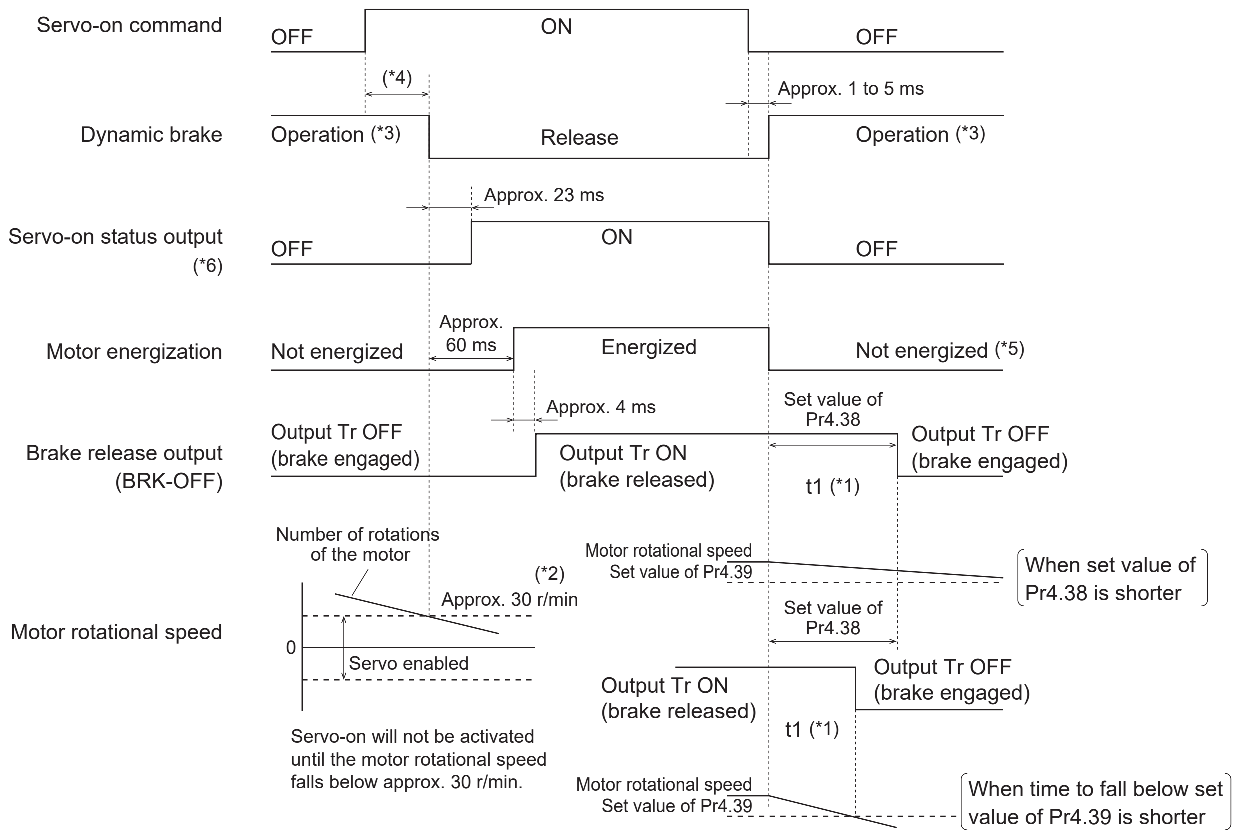
*2 The operation of the dynamic brake during servo-off depends on the set value of Pr5.06 “Sequence at servo-off” .

*3 Servo-on will not be activated until the motor rotational speed falls below approx. 30 r/min.

*4 Note that the servo-on status output is a signal indicating that servo-on command has been received, and is not an output indicating that a command input is possible.

● Mid-motor rotation servo-on/off operations timing chart

(Emergency stop or trip timing. Not for repeated use.)



*1 t1 is the set value of Pr4.38 “Mechanical brake action at running setup” or the time at which the motor rotational speed drops below the time set to Pr4.39 “Brake release speed setup” , whichever comes first.

*2 Even when the servo-on command is turned on again while the motor is decelerating, transition to servo-on is not performed until the motor stops.

*3 The operation of the dynamic brake during servo-off depends on the set value of Pr5.06 “Sequence at servo-off” .

*4 Servo-on will not be activated until the motor rotational speed falls below approx. 30 r/min.

*5 The motor energization state during deceleration at servo-off depends on the set value of Pr5.06 “Sequence at servo-off” .

*6 Note that the servo-on status output is a signal indicating that servo-on command has been received, and is not an output indicating that a command input is possible.

8.16 Deceleration to Stop Function for When Main Power Supply Is Off

This function sets the stopping method during deceleration and post-stop operations after the main power supply is turned off.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	07	B	Sequence upon main power off	0 to 9	—	Sets mid-deceleration and post-stop state upon main power off.
5	08	B	L/V trip selection upon main power off	0 to 3	—	Select whether to trip LV or servo-off when there is amain power supply alarm. If the main power cut-off condition lasts longer than the time set in Pr7.14 “Main power off warning detection time” , set conditions for detection of main power off warning. bit 0: Operation selection with main power supply OFF 0: Servo-off according to the settings for Pr5.07 “Sequence upon main power off” Servo-on is then resumed when the main power is switched back on. 1: Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” detection ● Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is not triggered when the retracting operation is triggered by main power off. However, Err13.0.☐ “Main power supply undervoltage protection (voltage across PN)” may be triggered before the retracting operation finishes as the retracting operation runs off residual voltage from the capacitor. bit 1: Main power off warning condition detection time 0: Main power off warning only detected when servo-on 1: Main power off warning always detected
5	09	C	Detection time of main power off	20 to 2000	ms	Set the main power alarm detection time. Main power off detection is disabled when the setup value is 2000. Before using the servo driver, confirm that this setup value is appropriate for the power supply environment. If this setup value is changed, reconfirm that the new setup value is appropriate for the power supply environment before use. For factory default values, see *“6.3 List of Parameters”* .
5	11	B	Torque setup for emergency stop	0 to 500	%	Sets the torque limit for emergency stop. The normal torque limit is used when this setup value is 0.
6	36	R	Dynamic brake operation input setup	0 to 1	—	Enables/disables the dynamic brake (DB) operation input according to I/O. This function is available only when the main power is turned off. 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

Details of mid-deceleration and post-stop status after the main power supply has been turned off are shown in the table below.

—: None

Pr5.07	Mid-deceleration (*3) (*4)		Post-stop (Approx. 30 r/min or below) (*4)		
	Stopping Method	Devia-tion	Post-stop Operation		Devia-tion
			Pr6.36 = 0	Pr6.36 =1	
Common	● Forced to position control ● Forced stop of position command generation processes (*8)	—	● Forced to position control ● Forced stop of position command generation processes (*8)		—
0, 4	● Dynamic brake (DB) operation (*5)	Clear (*1)	● Dynamic brake (DB) operation (*5)	The dynamic brake operates according to the dynamic brake switching input (DB-SEL) state. (*6)	Clear (*1)
1, 5	● Free run (DB OFF)	Clear (*1)	● Dynamic brake (DB) operation (*5)		Clear (*1)
2, 6	● Dynamic brake (DB) operation (*5)	Clear (*1)	● Free (DB OFF)		Clear (*1)
3, 7	● Free run (DB OFF)	Clear (*1)	● Free (DB OFF)		Clear (*1)
8	● Emergency stop (*2) (*7) (*8) ● Torque limit = Pr5.11	Clear (*1)	● Dynamic brake (DB) operation (*5)		Clear (*1)
9	● Emergency stop (*2) (*7) (*8) ● Torque limit = Pr5.11	Clear (*1)	● Free (DB OFF)		Clear (*1)

*1 During deviation clearing, the process that makes the internal command position follow the feedback position is activated. Please re-configure the command coordinates on the host device side before running interpolation feed commands after servo-on. The motor may suddenly begin moving.

*2 Emergency stop refers to a controlled immediate stop with servo-on. The torque command value is limited during emergency stop by Pr5.11 “Torque setup for emergency stop” .

If the commands are stopped at the same time as main power OFF detection, torque restricted by the normal torque limit may be output. Continue to send normal commands for at least 4 ms after main power off detection to stop the motor with the torque set in torque setup for emergency stop.

*3 Deceleration period is the time required for the motor speed to decelerate to 30 r/min or less.

Once the motor transitions from a decelerating state to a stopping state with a velocity of less than 30 r/min, it operates according to the post-stop operation rather than relying on the velocity of the motor.

*4 If an alarm is triggered with the main power supply turned off, the system operates according to Pr5.10 “Sequence at alarm” .

When the main power supply is turned off in the servo-on state, Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is triggered if Pr5.08 “L/V trip selection upon main power off” :bit 0 = 1, and the system operates according to Pr5.10 “Sequence at alarm” .

*5 Stopping method is free run (DB OFF) in dynamic brake non-compatible models.

*6 When Pr6.36 “Dynamic brake operation input setup” = 1, dynamic brake switching input (DB-SEL) is enabled.

By assigning DB-SEL to the control input signal, the product's built-in dynamic brake can be operated when the main power supply is OFF (See *“3.2.5.4.2 Control Input Signal”* for how to assign.).

When a-contact (Normally open: function OFF with no input) setting:

- Isolator is OFF (current is interrupted) → Dynamic brake is in effect
- Isolator is ON (current is flowing) → Dynamic brake is released

This input is disabled during servo-on, during trips, safety state or when the main power supply is switched on and will follow the normal sequence setting.

*7 The Pr6.14 “Emergency stop time at alarm” setting is invalid.

*8 When the Slow Stop function is enabled with Pr6.10 “Function expansion setup” :bit 15 and bit 10, it will come to a stop using Slow Stop rather than making an emergency stop. For details, see *“8.21 Slow Stop Function”* .

8.17 Deceleration to Stop Function for When Alarm Is Triggered

This function sets the stopping method during deceleration and post-stop operations when an alarm is triggered.

■ Operational Conditions

Item	Operational Conditions
Control mode	• All control modes

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	10	B	Sequence at alarm	0 to 7	—	Sets the mid-deceleration and post-stop operations when an alarm is triggered.
4	38	B	Mechanical brake action at running setup	0 to 32000	ms	Sets the mechanical brake operating time at running set-up.
4	39	B	Brake release speed setup	30 to 3000	r/min	Sets the threshold speed for determining mechanical brake output during operation.

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

Details of mid-deceleration and post-stop states when an alarm is triggered are shown below.

—: None

<table>
<tr><th rowspan="2">Pr5.10</th><th colspan="3">Mid-deceleration (*3)</th><th colspan="2">Post-stop (Approx. 30 r/min or below)</th></tr>
<tr><th colspan="2">Stopping Method</th><th>Devia-tion</th><th>Post-stop Operation</th><th>Devia-tion</th></tr>
<tr><td>Common</td><td colspan="2">• Forced to position control
• Forced stop of position command generation processes (*6)</td><td>—</td><td>• Forced to position control
• Forced stop of position command generation processes (*6)</td><td>—</td></tr>
<tr><td>0</td><td colspan="2">• Dynamic brake (DB) operation (*5)</td><td>Clear (*1)</td><td>• Dynamic brake (DB) operation (*5)</td><td>Clear (*1)</td></tr>
<tr><td>1</td><td colspan="2">• Free run (DB OFF)</td><td>Clear (*1)</td><td>• Dynamic brake (DB) operation (*5)</td><td>Clear (*1)</td></tr>
<tr><td>2</td><td colspan="2">• Dynamic brake (DB) operation (*5)</td><td>Clear (*1)</td><td>• Free (DB OFF)</td><td>Clear (*1)</td></tr>
<tr><td>3</td><td colspan="2">• Free run (DB OFF)</td><td>Clear (*1)</td><td>• Free (DB OFF)</td><td>Clear (*1)</td></tr>
<tr><td rowspan="2">4</td><td>Operation A (*2)</td><td>• Emergency stop (*2) (*4) (*6)
• Torque limit = Pr5.11</td><td>Clear (*1)</td><td rowspan="2">• Dynamic brake (DB) operation (*5)</td><td rowspan="2">Clear (*1)</td></tr>
<tr><td>Operation B (*2)</td><td>• Dynamic brake (DB) operation (*5)</td><td>Clear (*1)</td></tr>
<tr><td>5</td><td>Operation A (*2)</td><td>• Emergency stop (*2) (*4) (*6)
• Torque limit = Pr5.11</td><td>Clear (*1)</td><td>• Dynamic brake (DB) operation (*5)</td><td>Clear (*1)</td></tr>
</table>

Pr5.10	Mid-deceleration (*3)			Post-stop (Approx. 30 r/min or below)	
	Stopping Method		Deviation	Post-stop Operation	Deviation
5	Operation B (*2)	● Free run (DB OFF)	Clear (*1)	● Dynamic brake (DB) operation (*5)	Clear (*1)
6	Operation A (*2)	● Emergency stop (*2) (*4) (*6) ● Torque limit = Pr5.11	Clear (*1)	● Free (DB OFF)	Clear (*1)
	Operation B (*2)	● Dynamic brake (DB) operation (*5)	Clear (*1)		
7	Operation A (*2)	● Emergency stop (*2) (*4) (*6) ● Torque limit = Pr5.11	Clear (*1)	● Free (DB OFF)	Clear (*1)
	Operation B (*2)	● Free run (DB OFF)	Clear (*1)		

*1 During deviation clearing, the process that makes the internal command position follow the feedback position is activated. Please re-configure the command coordinates on the host device side before running interpolation feed commands after servo-on. The motor may suddenly begin moving.

*2 When this setting value is 4 to 7, either operation A or B is performed in the event of an alarm.

When an emergency stop alarm triggers, an emergency stop is performed as per Operation A.

When a non-emergency stop alarm is triggered, dynamic brake (DB) or free run will run as per operation B (See *“8.18 Emergency Stop Function For When Alarm is Triggered”*).

Please maintain the main circuit power supply until deceleration to stop.

For details on alarms relating to emergency stops, see *“10.2.2 List of Protection Functions”* .

*3 Deceleration period is the time required for the motor speed to decelerate to 30 r/min or less. Once the motor velocity drops below 30 r/min, any movement post-stop is treated as a stop operation regardless of motor velocity.

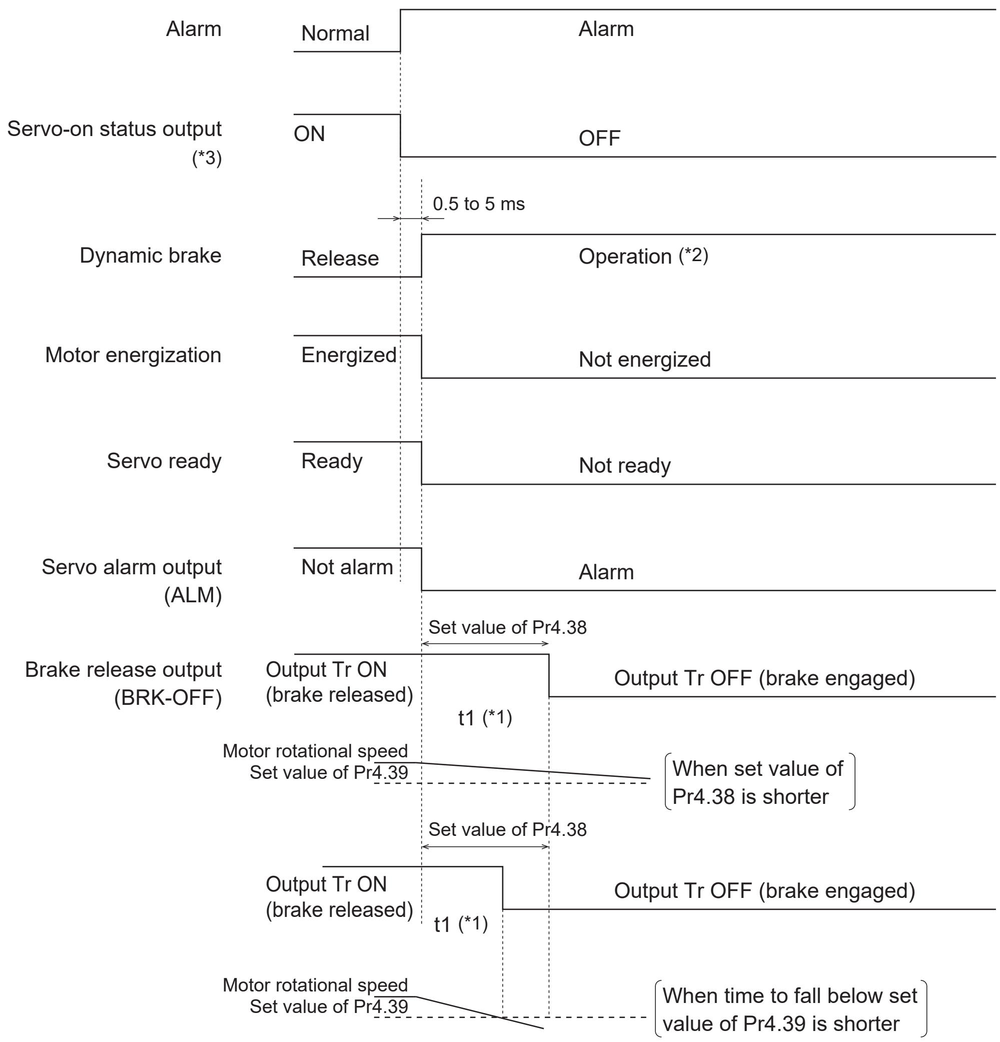
*4 If an emergency stop alarm is triggered during a dynamic brake (DB) operation or a free run operation as a result of the over-travel inhibit input sequence, sequence at servo-off, or sequence upon main power off, operation B is performed.

*5 Stopping method is free run (DB OFF) in dynamic brake non-compatible models.

*6 When the Slow Stop function is enabled with Pr6.10 “Function expansion setup” :bit 15 and bit 10, it will come to a stop using Slow Stop rather than making an emergency stop. For details, see *“8.21 Slow Stop Function”* .

■ Error (alarm) timing chart (servo-on command state) (DB deceleration, free run deceleration)

The below timings will vary dependent on the setting of Pr5.10 “Sequence at alarm” .



*1 t1 is the value set to Pr4.38 “Mechanical brake action at running setup” or the time at which the motor rotational speed drops below the time set to Pr4.39 “Brake release speed setup” , whichever comes first.

*2 The operation of dynamic brake when an alarm is triggered depends on the set value of Pr5.10 “Sequence at alarm” .

*3 Note that the servo-on status output is a signal indicating that servo-on command has been received, and is not an output indicating that a command input is possible.

8.18 Emergency Stop Function For When Alarm is Triggered

This function sets the stopping operations when an emergency stop alarm is triggered.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes

■ Setup value

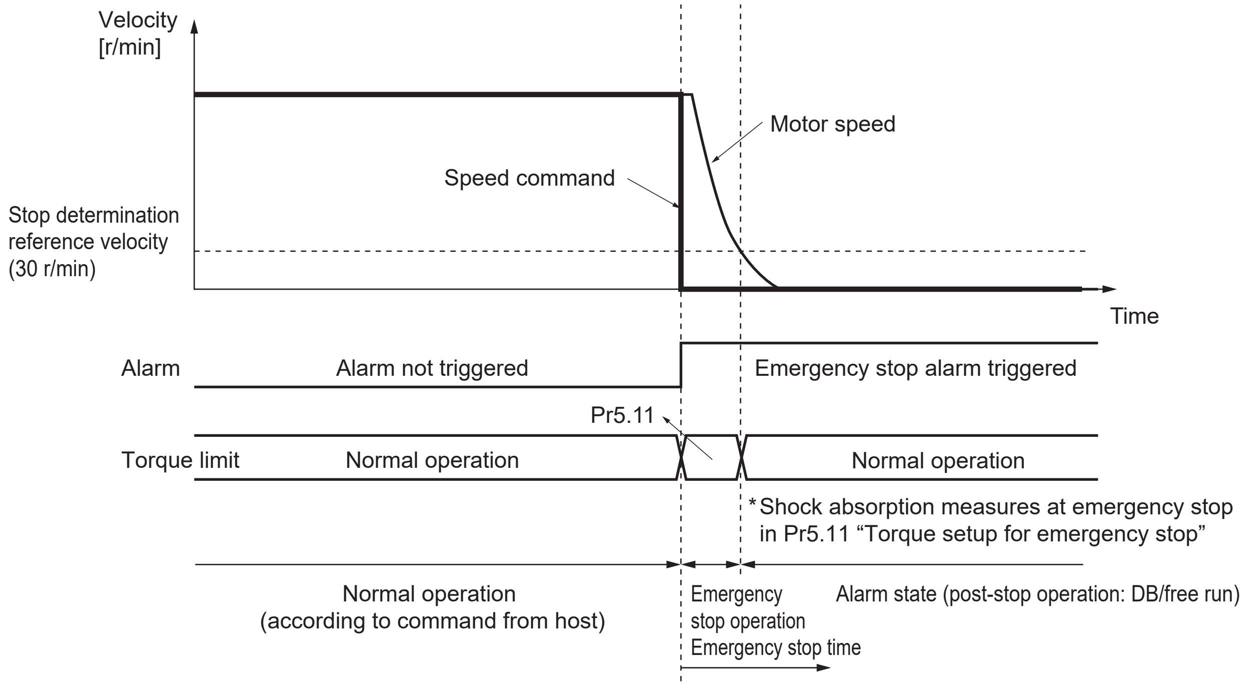
—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	10	B	Sequence at alarm	0 to 7	—	Sets the mid-deceleration and post-stop operations when an alarm is triggered. Emergency stop is enabled when the setup value is 4 to 7. For details, see *"8.17 Deceleration to Stop Function for When Alarm Is Triggered"* .
5	11	B	Torque setup for emergency stop	0 to 500	%	Sets the torque limit for emergency stop. The normal torque limit is used when this setup value is 0.
5	13	B	Over-speed level setup	0 to 20000	r/min	Sets the detection level for Err26.0.0 "Overspeed protection" . If the motor speed exceeds this setup value, Err26.0.0 "Overspeed protection" is triggered. When the setup value is 0, the internal overspeed protection level value is used. The internal value is restricted by the overspeed level of the applicable motor.
6	14	B	Emergency stop time at alarm	0 to 1000	ms	Sets the time allowed to complete emergency stop when an alarm is triggered. An alarm state is forced if this set value is exceeded. When this setup value is 0, an immediate alarm state will be triggered without executing an emergency stop.
6	15	B	2nd overspeed level setting	0 to 20000	r/min	Sets the detection level for Err26.1.0 "2nd Overspeed protection" . If the motor speed exceeds this setup value, Err26.1.0 "2nd Overspeed protection" is triggered. When the setup value is 0, the internal overspeed protection level value is used. The internal value is restricted by the overspeed level of the applicable motor.
4	38	B	Mechanical brake action at running setup	0 to 32000	ms	Sets the mechanical brake operating time at running setup.
4	39	B	Brake release speed setup	30 to 3000	r/min	Sets the threshold speed for determining mechanical brake output during operation.

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

● Emergency stop operation when an emergency stop alarm is triggered



* After an emergency stop alarm is triggered, if the speed has not dropped to 30 r/min or less after the time set by Pr6.14 "Emergency stop time at alarm" , an alarm state is triggered. The system also enters the alarm state if a non-emergency stop alarm is triggered in this product during emergency stop.

When an emergency stop alarm is triggered, operation is normal (normal torque limit is enabled) until the emergency stop operation begins. If the command is stopped while normal operation is in progress, torque limited by the normal torque limit may be output.

In order to stop at the torque limit set in Pr5.11 "Torque setup for emergency stop" when an emergency stop alarm is triggered, the command should be sent continuously for at least 4 ms after the alarm notification.

For example, please do not run the following processes.

- Stop commands at the same time as forced alarm input (E-STOP) is turned on.

● Pr5.13 "Over-speed level setup" and Pr6.15 "2nd overspeed level setting" settings

the motor may not stop as normal, even if the emergency stop function is used.

As shown below, when the motor speed exceeds Pr5.13 "Over-speed level setup" , although the emergency stop function is activated, the motor speed may increase if it cannot be normally controlled.

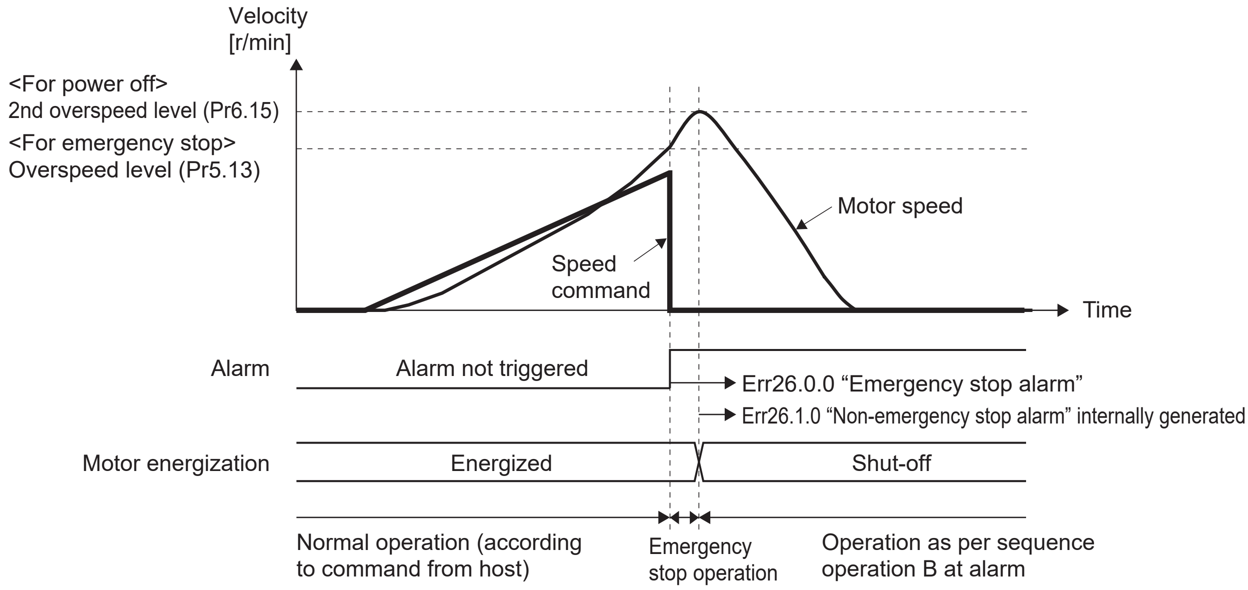
Err26.1.0 "2nd Overspeed protection" is provided as a safety measure in such cases.

Because Err26.1.0 "2nd Overspeed protection" is a non-emergency stop alarm, it shuts off motor current and stops according to the sequence at alarm operation B. In Pr6.15 "2nd overspeed level setting" , set the allowable overspeed level.

Set Pr5.13 "Over-speed level setup" to a low value, leaving a sufficient margin for Pr6.15 "2nd overspeed level setting" . Err26.0.0 "Overspeed protection" and Err26.1.0 "2nd Overspeed protection" may be detected at the same time if the margin is too small or the set values are the same.

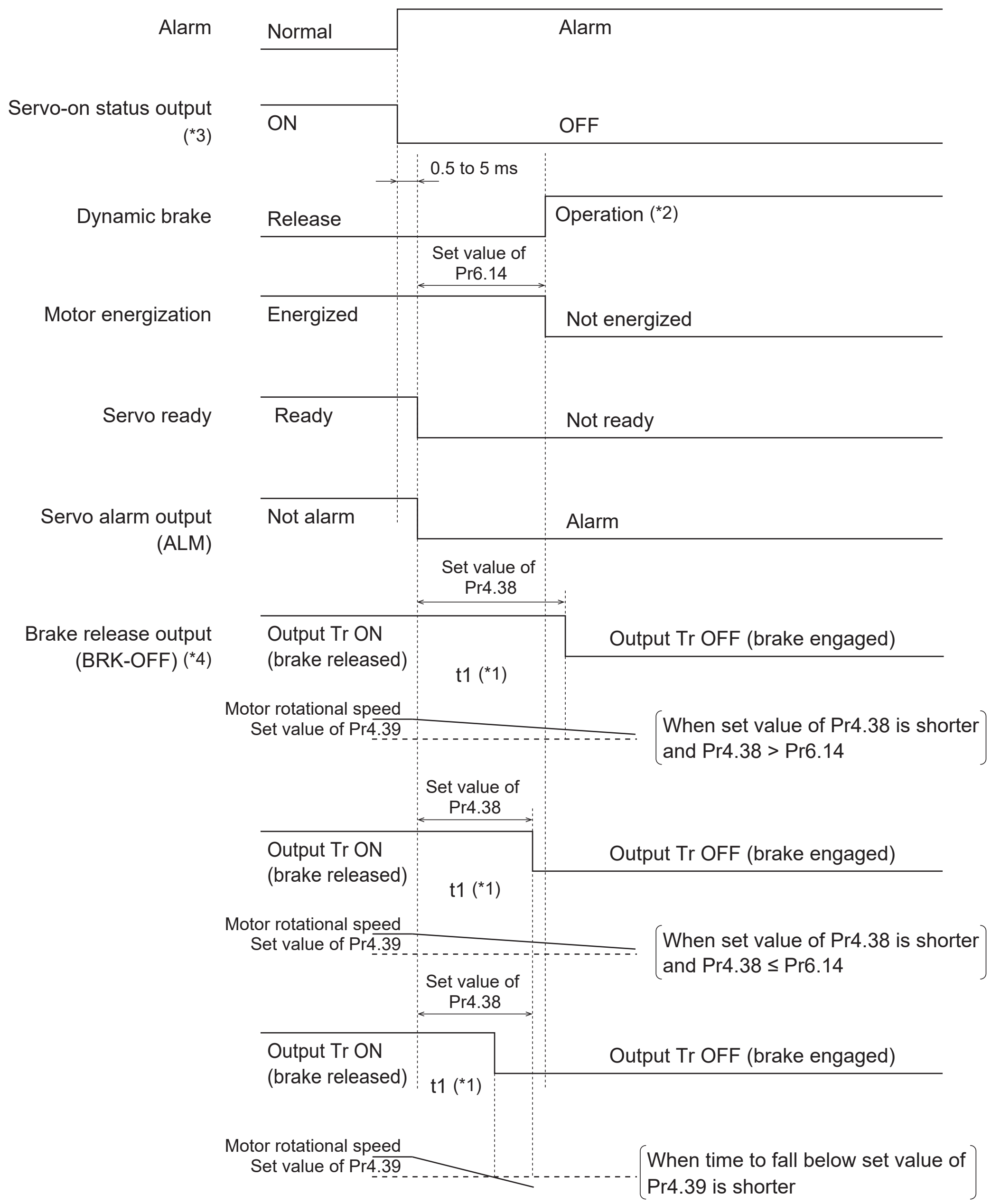
If this happens, Err26.0.0 "Overspeed protection" is shown on the display, but an emergency stop is not performed as the non-emergency stop alarm takes priority in operations.

If the set value of Pr6.15 "2nd overspeed level setting" is lower than that of Pr5.13 "Over-speed level setup" , Err26.1.0 "2nd Overspeed protection" is triggered before Err26.0.0 "Overspeed protection" , so emergency stop is not performed.



* When the velocity exceeds the velocity set in Pr6.15 “2nd overspeed level setting” , turns off the current and operates according to sequence at alarm operation B.

- Error (alarm) timing chart (servo-on command state) (emergency stop operation)
  - The below timings will vary dependent on the setting of Pr5.10 “Sequence at alarm” .
  - For operation timing charts for when the Slow Stop function in enabled, see *“8.21 Slow Stop Function”* .



*1 t1 is the set value of Pr4.38 “Mechanical brake action at running setup” or the time at which the motor speed drops below the time set to Pr4.39 “Brake release speed setup” , whichever comes first.

*2 The operation of dynamic brake when an alarm is triggered depends on the set value of Pr5.10 “Sequence at alarm” .

*3 Note that the servo-on status output is a signal indicating that servo-on command has been received, and is not an output indicating that a command input is possible.

*4 We recommend a setting where Pr4.38 “Mechanical brake action at running setup” = Pr6.14 “Emergency stop time at alarm” .

When Pr4.38 ≤ Pr6.14, the brake is engaged once the time set for Pr4.38 has passed.

When Pr4.38 > Pr6.14, the brake is not engaged even when the time set for Pr4.38 has passed, and will engage when shifting to an un-powered state.

8.19 Fall Prevention Function For When Alarm is Triggered

In this product, when an alarm is triggered, the brake release output (BRK-OFF) is turned OFF and the external brake operates, but it takes some time until the external brake operates after the brake release output (BRK-OFF) is turned OFF. In the event of an alarm being triggered, motor energization is interrupted, so vertical axes of robot arms or other parts cannot be held and will fall until the external brake is activated.

This function uses the emergency stop of the deceleration stop function in the event of an alarm being triggered to keep the motor energized until the external brake is activated in order to prevent robot arms or other parts from falling in the event of an alarm.

By keeping the motor energized, vertical axes of robot arms or other parts can be held in place until the external brake is activated.

■ Operational Conditions

Item	Operational Conditions
Control mode	● All control modes
Other	● The alarm that has been triggered is not a non-emergency stop alarm. ● The deceleration to stop function in the event of an alarm is set to emergency stop. For details, see *“8.17 Deceleration to Stop Function for When Alarm Is Triggered”* and *“8.18 Emergency Stop Function For When Alarm is Triggered”* .

■ Setup value

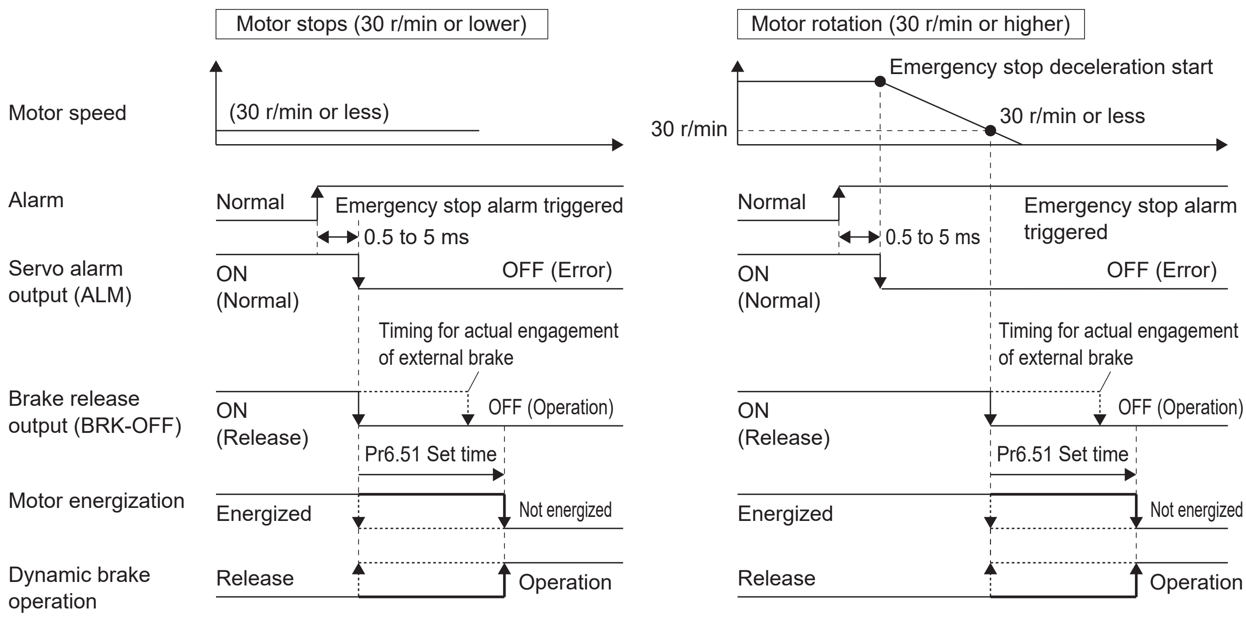
—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	10	B	Sequence at alarm	0 to 7	—	Set mid-deceleration and post-stop states when an alarm is triggered. Emergency stop is enabled when the setup value is 4 to 7.
6	10	B	Function expansion setup	-32768 to 32767	—	Sets the bit for the fall prevention function. bit 10: Fall prevention function during an alarm 0: Disabled 1: Enabled Normally set to 1 to enable the fall prevention function.
6	51	B	Wait time for emergency stop	0 to 10000	ms	Sets the time to maintain the motor energization when an emergency stop alarm is triggered after turning OFF the brake release output (BRK-OFF). If this setting value is 0, the fall prevention function is disabled. **— Precautions —** ● Although this parameter is enabled even if Pr6.10 “Function expansion setup” : bit 10 is set to a value other than 1, Pr6.10 “Function expansion setup” : bit 10 must be set to 1 to enable the fall prevention function.

*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

- For details on alarms relating to emergency stops, see *“10.2.2 List of Protection Functions”* .
- Fall prevention operation timings for emergency stop alarms are given in the figure below.


Motor stops (30 r/min or lower)
Motor rotation (30 r/min or higher)
Motor speed
(30 r/min or less)
Emergency stop deceleration start
30 r/min
30 r/min or less
Alarm
Normal
Emergency stop alarm triggered
0.5 to 5 ms
Servo alarm output (ALM)
ON (Normal)
OFF (Error)
Timing for actual engagement of external brake
Brake release output (BRK-OFF)
ON (Release)
OFF (Operation)
Pr6.51 Set time
Motor energization
Energized
Not energized
Dynamic brake operation
Release
Operation

8.20 Fall Prevention Function For Servo-on

This function eliminates the delay in torque command rise at the servo-on command input timing and prevents the equipment from falling by retaining the torque feedforward values sent from the host device inside the driver.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, velocity control, and full-closed control

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	24	C	RTEX function expansion setup 3	-32768 to 32767	—	bit 7: Internal value status selection of TFF from RTEX communication (fall prevention when servo-on) ● 0: Clear Internal values are cleared at the following times. • During servo-off • During deceleration due to over-travel inhibit input and when stopped • Safety status ● 1: Internal value retained **— Precautions —** ● When this setting value is set to 1, set the torque feedforward value below the value of Pr5.11 “Torque setup for emergency stop” .
7	35	C	RTEX command setup 1	0 to 2	—	Sets the non-cyclic command Command_Data3. Set to 1 or 2 to enable the feedforward function. 0: Disabled 1: Velocity feedforward [command unit/s] or [r/min] 2: Torque feedforward [0.1 %]
7	36	C	RTEX command setup 2	0 to 2	—	Sets the subcommand Sub_Command_Data2. Set to 1 or 2 to enable the feedforward function. 0: Disabled 1: Velocity feedforward [command unit/s] or [r/min] 2: Torque feedforward [0.1 %]
7	37	C	RTEX command setup 3	0 to 2	—	Sets the subcommand Sub_Command_Data3. Set to 1 or 2 to enable the feedforward function. 0: Disabled 1: Velocity feedforward [command unit/s] or [r/min] 2: Torque feedforward [0.1 %]

*1 For attributes, see *“6.3 List of Parameters”* .

■ Operation

Set Pr7.24 bit 7 to 1 (internal value retained) and any of Pr7.35 to Pr7.37 parameter setup values to 2 (torque feedforward). Then execute the CONFIG command, or reset the control power after writing EEPROM, to enable the fall prevention function during servo-on.

The torque feedforward values sent from the host device to the driver are retained as internal values under the following conditions:

- During servo-off
- During deceleration due to over-travel inhibit input
- When stopped
- STO state

This function uses torque feedforward from retained values to eliminate the delay in torque command rise at the servo-on command input timing after internal value retention, and prevents the equipment from falling.

For details on the torque feedforward function, see Technical Reference Communication Specification.

8.21 Slow Stop Function

This function allows for control to remain functioning in servo-on, allowing the motor to stop smoothly, when over-travel inhibit input, servo-off, main power supply off, or an emergency stop alarm is detected with emergency stop settings.

■ Operational Conditions

Item	Operational Conditions
Control mode	● Position control, velocity control, torque control
Other	● Must be in servo-on state. ● Non-servo parameters such as torque limit must be set properly to ensure the motor rotates normally.

— Precautions —

- During an emergency stop, it is forced to position control.
- The Slow Stop function is not supported with full-closed control, so full-closed control must be disabled.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	05	C	Sequence at over-travel inhibit	0 to 2	—	Over-travel inhibit input when Pr5.04 “Over-travel inhibit input setup” = 0 Sets mid-deceleration and post-stop state after (POT, NOT) input. Set to emergency stop when Slow Stop function is enabled.
5	06	B	Sequence at servo-off	0 to 9	—	Sets mid-deceleration and post-stop state after servo-off. Set to emergency stop when Slow Stop function is enabled.
5	07	B	Sequence upon main power off	0 to 9	—	Sets mid-deceleration and post-stop state upon main power off. Set to emergency stop when Slow Stop function is enabled.
5	10	B	Sequence at alarm	0 to 7	—	Sets the mid-deceleration and post-stop operations when an alarm is triggered. Set to emergency stop when Slow Stop function is enabled.
5	56	B	Slow stop deceleration time setting	0 to 10000	ms/(1000 r/min)	Sets deceleration time for Slow Stop deceleration processing. When Pr6.10 “Function expansion setup” :bit 15 “Slow stop function” = 1 is set, this parameter is enabled.
5	57	B	Slow stop S-shape acceleration and deceleration setting	0 to 1000	ms	Sets the deceleration processing S-curve time during Slow Stop. When Pr6.10 “Function expansion setup” :bit 15 “Slow stop function” = 1 is set, this parameter is enabled.

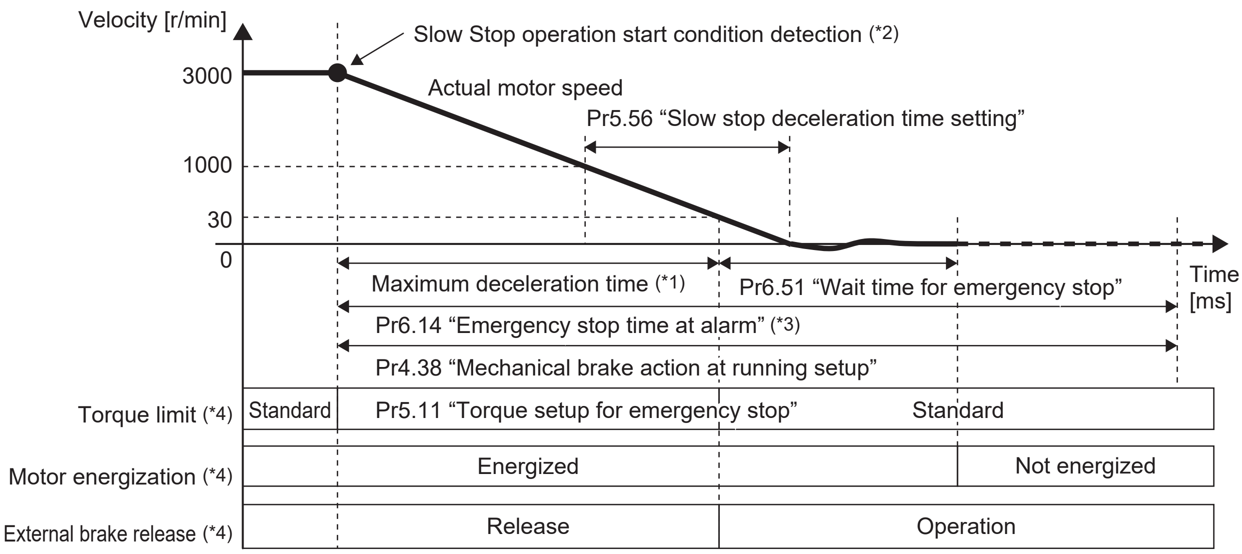
Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	10	B	Function expansion setup	-32768 to 32767	—	bit 10: Fall prevention function during an alarm 0: Disabled 1: Enabled Please normally set to 1 when the Slow Stop function is enabled. bit 15: Slow stop function 0: Disabled 1: Enabled Set to 0 with full-closed control.
6	14	B	Emergency stop time at alarm	0 to 1000	ms	Sets the time allowed to complete emergency stop when an alarm is triggered. An alarm state is forced if this set value is exceeded. When this setup value is 0, an alarm state is triggered without executing an emergency stop. When using the Slow Stop function, ensure the setting is sufficiently longer than the maximum deceleration time, as the motor speed will have a delay from the deceleration to stop command. This parameter is only enabled by the deceleration to stop function when an alarm is triggered. Disabled with drive inhibition deceleration to stop function, servo-off deceleration to stop function, and main power off deceleration to stop function. For maximum deceleration times, see *"Operation"* in this section.
4	38	B	Mechanical brake action at running setup	0 to 32000	ms	Sets the mechanical brake operating time at running setup.

*1 For attributes, see *"6.3 List of Parameters"* .

■ Operation

● Slow Stop operation during alarm

Operation examples are shown in the figure below.



*1 The maximum deceleration time is approximately the value obtained by the following formula:

Maximum deceleration time [ms]

$$= \frac{\text{Maximum velocity under normal operation pattern [r/min]} \times \text{Pr5.56 [ms/(1000 r/min)]}}{1000} + \text{Pr5.57 [ms]}$$

*2 Refers to detection of the following conditions:

- Over-travel inhibit input with Slow Stop function enabled setting
- Servo-off with Slow Stop function enabled setting
- Main power off with Slow Stop function enabled setting
- Emergency stop alarm triggered with Slow Stop function enabled setting

For details on alarms relating to emergency stops, see *"10.2.2 List of Protection Functions"* .

*3 Set Pr6.14 “Emergency stop time at alarm” to a value that is sufficiently longer in length than the completion of the Slow Stop operation. The stop judgment under Slow Stop operation is based on actual velocity. Therefore, the time required for the actual deceleration may take longer than the maximum deceleration time.

In the emergency stop operation from emergency stop alarm, if the emergency stop duration exceeds Pr6.14 “Emergency stop time at alarm” , an alarm state is triggered regardless of the actual motor velocity.

The system also immediately enters the alarm state if a non-emergency stop alarm is triggered in the driver during emergency stop.

*4 There is a maximum variance of about 5 ms in the switching timing.

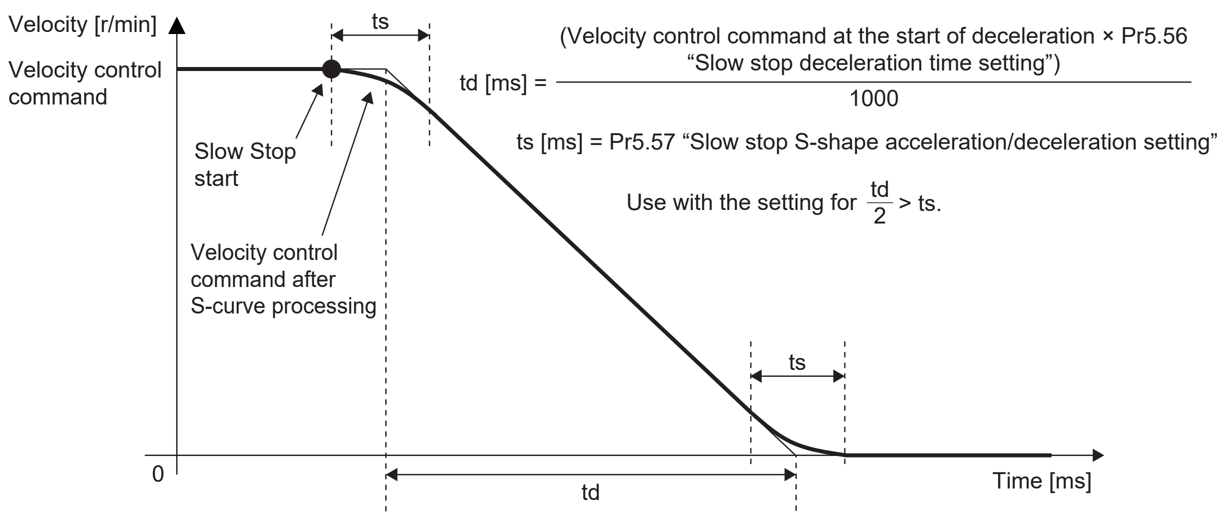
— Precautions —

- Please maintain the main circuit power supply until deceleration to stop.

- Slow Stop S-curve process

S-curve processing can be performed during Slow Stop operation by setting Pr5.57 “Slow stop S-shape acceleration and deceleration setting” .

See the figure below and set Pr5.57 “Slow stop S-shape acceleration and deceleration setting” .



* Velocity control command at the time of starting Slow Stop operation is calculated from the actual velocity.

- Braking distance

When Pr5.56 “Slow stop deceleration time setting” and Pr5.57 “Slow stop S-shape acceleration and deceleration setting” are set, the braking distance during an emergency stop increases approximately by the amount calculated using the formula below.

Please confirm the effect on actual machine operation before use.

- With linear deceleration (Pr5.57 = 0)

  Linear deceleration time [s]

  $$= \frac{\text{Velocity control command at time deceleration begins [r/min]} \times \text{Pr5.56 [ms/(1000 r/min)]}}{1000 \times 1000}$$

  Linear deceleration braking distance [rotations]

  $$= \frac{\text{Velocity control command at time deceleration begins [r/min]} \times \text{Linear deceleration time [s]}}{60 \times 2}$$

  $$= \frac{(\text{Velocity control command at time deceleration begins [r/min]})^2 \times \text{Pr5.56 [ms/(1000 r/min)]}}{60 \times 2 \times 1000 \times 1000}$$

- With S-curve deceleration (Pr5.57 ≠ 0)

  S-curve deceleration braking distance [rotations]

  $$= \text{Linear deceleration braking distance [rotations]} + \frac{\text{Velocity control command at time deceleration begins [r/min]} \times \text{Pr5.57 [ms]}}{60 \times 1000 \times 2}$$

— Precautions —

- The formulas above indicate braking distances for the velocity control command. In actual operation, motor control delay must be taken into account.

  Furthermore, if the torque command under deceleration is restricted by the torque setup for emergency stop, the braking distance may not be as per the formulas above.

8.22 Driver Derating Function

This function applies derating to the servo driver's overload protection time characteristic according to the derating scale factor set by the parameter.

■ Setup value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
5	110	A	Driver derating factor	0 to 100	%	Sets the derating factor for servo driver overload protection time characteristics.

*1 For attributes, see *"6.3 List of Parameters"* .

■ How to use

See "Derating Specifications" in *"2.1.4.1 Basic Specifications"* and set the driver derating factor according to the ambient operating conditions. The overload protection time characteristics of the servo driver vary depending on the derating factor. When the driver rated current ratio reaches the driver overload protection time characteristic, WngE1h "Driver overload warning" is triggered. At this time, the driver derating monitor is set to 100%. Check the driver derating monitor and adjust the operating conditions so that the servo driver overload protection time characteristics are not reached.

Check the following for the driver derating monitor.

- See *"3.4.3 7-segment LED"* for details on the 7-segment LED.
- Monitor signal output For details, see *"3.2.8 Wiring to Connector X7 (Connecting to External Monitor)"* .
- Refer to Technical Reference Communication Specification for details of the RTEX communication monitor command.
- Set-up Support Software (PANATERM ver.7) waveform measurement function driver derating monitor
- Set-up Support Software (PANATERM ver.7) monitor screen driver derating monitor

9 Safety Function

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9.1 Safe Torque Off (STO) Function

9.1.1 Supported Standards

Details of supported standards are indicated below.

Safety Parameters

Parameters	With SSU diagnostic	With EDM diagnostic	With neither EDM nor SSU diagnostic
Safety integrity level	EN 61508 (SIL3) EN IEC 62061 (maximum SIL 3)	EN 61508 (SIL3) EN IEC 62061 (maximum SIL 3)	EN 61508 (SIL2) EN IEC 62061 (maximum SIL 2)
Performance level	EN ISO 13849-1:2015 Category 3 PL e	EN ISO 13849-1:2015 Category 3 PL e	EN ISO 13849-1:2015 Category 3 PL d
Safety function	EN 61800-5-2 (SIL 3, STO)	EN 61800-5-2 (SIL 3, STO)	EN 61800-5-2 (SIL 2, STO)
Probability of dangerous failure per unit of time	PFH=0.88 $\times 10^{-8}$ [1/h] (% SIL3=8.8 %)	PFH=0.88 $\times 10^{-8}$ [1/h] (% SIL3=8.8 %)	PFH=0.91$\times 10^{-8}$ [1/h] (% SIL2=0.91 %)
Average time to dangerous failure	MTTFd: High (100 years)	MTTFd: High (100 years)	MTTFd: High (100 years)
Average self-diagnosis coverage	DC: Medium 94.6 [%]	DC: Medium 94.6 [%]	DC: Low 68.1 [%]
Mission time	15 years	15 years	15 years
Stop category	IEC 60204-1 (stop category 0)	IEC 60204-1 (stop category 0)	IEC 60204-1 (stop category 0)

For details about diagnostics via SSU and EDM, see *“9.1.4 STO Function Diagnostics”* .

When exporting, follow the statutory provisions of the destination country.

— Precautions —

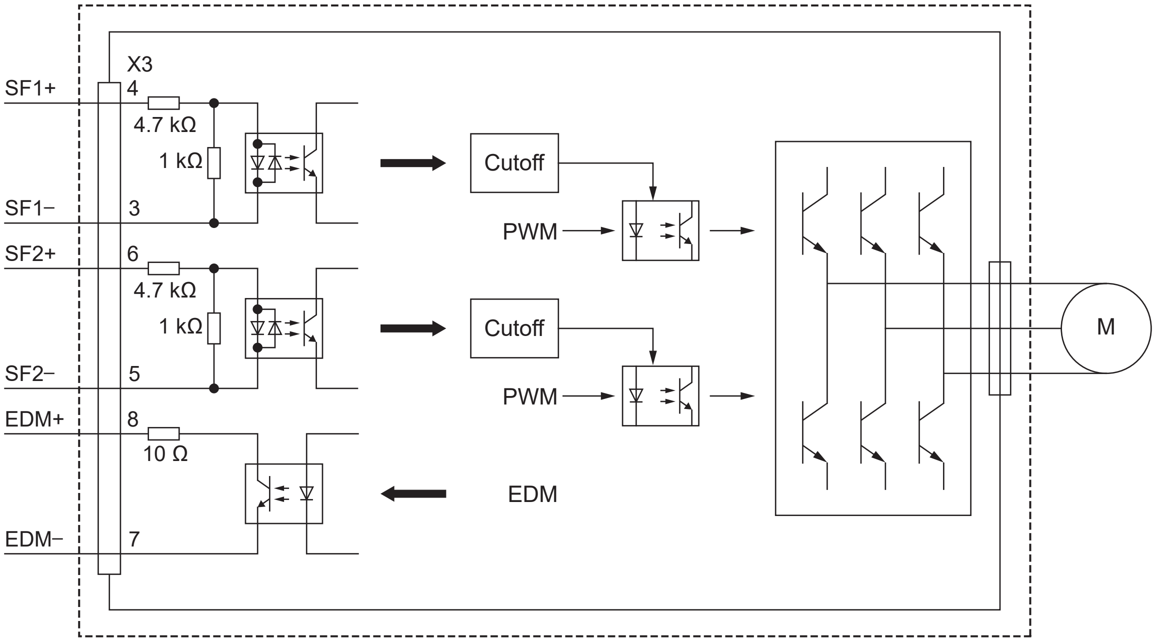
- The standard type does not support the functional safety standards.
- This product is not subject to China Compulsory Certification (CCC).

9.1.2 Operation Overview

This function turns off the motor output torque by forcibly turning off the driving signal of the power transistor inside the servo driver from the safety input signal by means of an electric circuit (hardware), thereby cutting off the motor current.

The servo driver's internal power transistor driving signal, which controls the motor current, is forcibly turned off by a safety input signal.

The STO function is compliant with stop category 0 of IEC 60204-1.



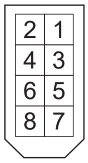
SF1 +, SF1 − : Safety input 1 signal
SF2 +, SF2 − : Safety input 2 signal
EDM +, EDM − : External device monitor (EDM) output signal

9.1.3 Input and Output Signals

1 Safety function connector (connector X3) specifications

The safety function connector (connector X3) specifications are indicated below.

Pinout diagram



Signal name	Symbol	Connector pin no.	Description
—	—	1	This terminal is for the safety bypass, so do not connect anything other than the safety bypass plug.
	—	2	
Safety input 1	SF1-	3	● Input 1 for operating the STO function. This input interrupts the power transistor upper arm driving signal. ● Make sure that it is connected so that the input circuit photocoupler turns OFF when the STO function is activated.
	SF1+	4	
Safety input 2	SF2-	5	● Input 2 for operating the STO function. This input interrupts the power transistor lower arm driving signal. ● Make sure that it is connected so that the input circuit photocoupler turns OFF when the STO function is activated.
	SF2+	6	
EDM output	EDM-	7	This is a monitoring output for monitoring safety function failures. Do not use this monitor output when using the SSU function.
	EDM+	8	
Frame ground	FG	Shell	Connected to the earth terminal inside the servo driver.

2 Input signal

The STO function compatible servo driver types have two safety input circuit channels for the STO function.

- In the case of both safety inputs 1 and 2, the STO function operates within 5 ms after input, and the motor output torque is turned off.
- Input the same signal for both safety inputs 1 and 2.

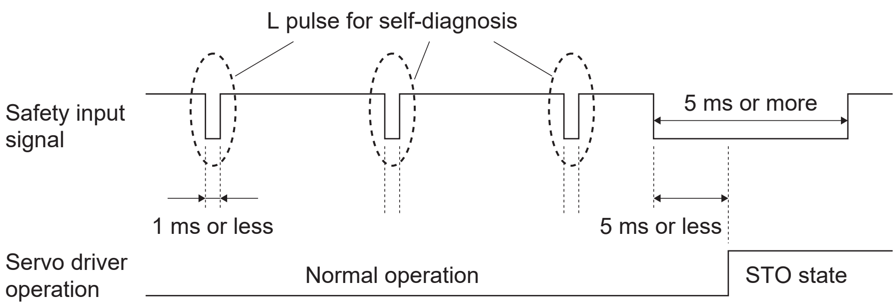
— Precautions —

- Safety equipment L pulse for self-diagnosis

  When safety sensors and other safety devices are connected, their safety output signals (i.e. safety input signals to the servo driver) may include an L pulse for self-diagnosis.

  To prevent the L pulse from erroneously triggering the STO function, the safety input circuit has a built-in filter that removes the self-diagnosis L pulse.

  As such, the safety input circuit will not recognize safety input signal OFF time of 1 ms or less as OFF. Let the safety input signal remain OFF for 5 ms or more in order to enable the safety input circuit to reliably recognize that it is OFF.



3 Output signal

The STO function-supporting types of servo driver are provided with external device monitor output (EDM output) for monitoring safety input signal status, using an external device.

Be sure to connect the servo driver EDM output signal to the external device monitor terminals of safety sensors and other safety devices.

Do not use EDM output when using the STO Signal Unmatch (SSU) function.

For more information on the SSU function, see *"9.1.4 STO Function Diagnostics"* ("2" Diagnostics via SSU (STO Signal Unmatch) function).

4 Logical relationship between safety input signal and EDM output signal

EDM outputs corresponding to ON/OFF of safety inputs 1 and 2 during normal operation indicate the ON/OFF status.

When both safety inputs 1 and 2 (SF1, SF2) are OFF, i.e. when the safety input indicates that the STO function safety input is operating in both channels, the photocoupler in the EDM output circuit turns ON.

Signal name	Symbol	Photocoupler logic			
Safety input	SF1	ON	ON	OFF	OFF
	SF2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

Monitoring the abovementioned photocoupler logic (in all four statuses) via an external device enables detection of malfunctions in the safety input circuit and EDM output circuit.

In the event of an error, the following conditions are detected.

- The photocoupler of the EDM output circuit turns ON even though both safety inputs 1 and 2 (SF1 and SF2) are ON.
- The photocoupler of the EDM output circuit turns ON even though one of the safety inputs 1 and 2 (SF1 and SF2) is turned on.
- The photocoupler in the EDM output circuit does not turn ON even though both safety inputs 1 and 2 (SF1 and SF2) are OFF.

The maximum delay time from input of safety input 1 and 2 signals to output of the EDM output signal is 6 ms.

9.1.4 STO Function Diagnostics

In order to achieve the safety levels SIL3 and PL e, EDM output, and the SSU function is needed for STO function diagnosis (maximum diagnosis interval is 3 months). Safety levels are SIL 2 and PL d when no STO function diagnosis is performed.

1 Diagnostics via EDM output

Switch OFF safety input 1 and safety input 2 for at least 6 ms, monitor the EDM output signal and check that it is in accordance with the photocoupler logic chart given above.

2 Diagnostics via SSU (STO Signal Unmatch)

The SSU function detects errors within the internal circuits of safety input 1 and safety input 2. Switch OFF safety input 1 and safety input 2 for at least 10 s, and confirm that no error occurs.

When diagnosing, if a safety input signal SF1 or SF2 logic error persists for longer than 10 seconds, the diagnostic result will generate Err31.0.12 “Safety function error protection 1”.

Notes

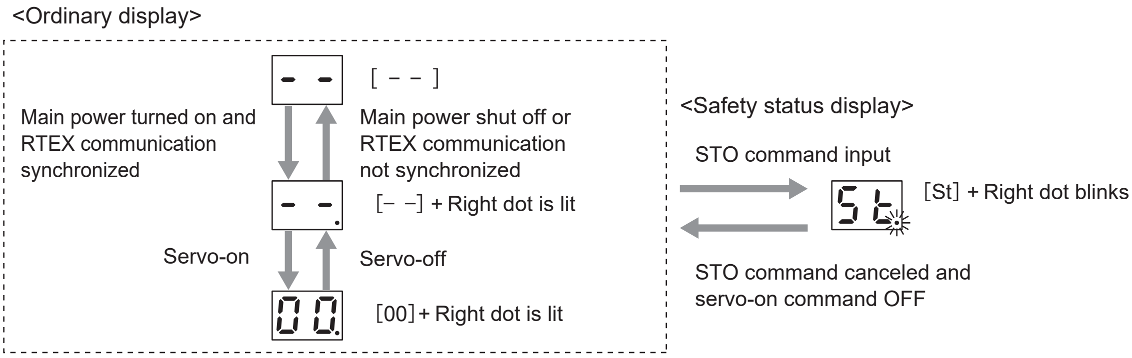
- Diagnostics via the SSU function do not use EDM output signals, so the EDM output signal does not need to be monitored using an external device.

9.1.5 Operation

When the STO function operates, the servo-ready output signal (S-RDY) of the servo driver is turned off, and is in STO status.

When in STO status, the servo driver is not in alarm status.

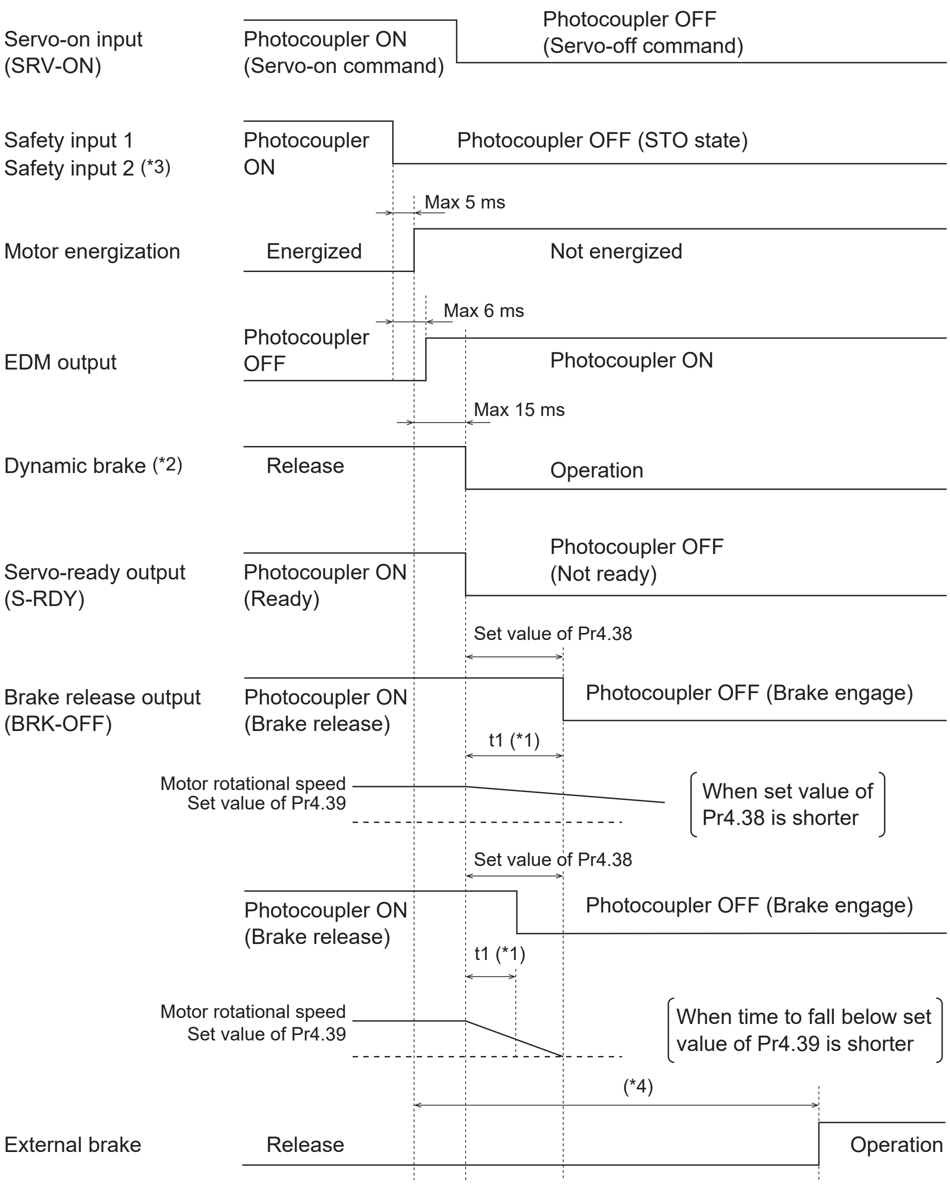
“St” is displayed on the 7-segment LED on the front panel.



After STO status transition, STO input is canceled, and when the servo-on input is turned OFF (servo-off command), STO status is canceled, and automatically transitions to servo ready status.

The operation timings during the transition to STO status and during return from STO status are shown below.

1 Figure of operation timing during the transition to “STO status”



*1 The time (t1) from the time that the servo-ready output (S-RDY) changed from ON (ready status) to OFF (not-ready status), and from release of mechanical braking until the changeover to operation, is shorter than the time until the value falls below the value set for Pr4.38 “Mechanical brake action at running setup” or the motor rotational speed falls below Pr4.39 “Brake release speed setup” .

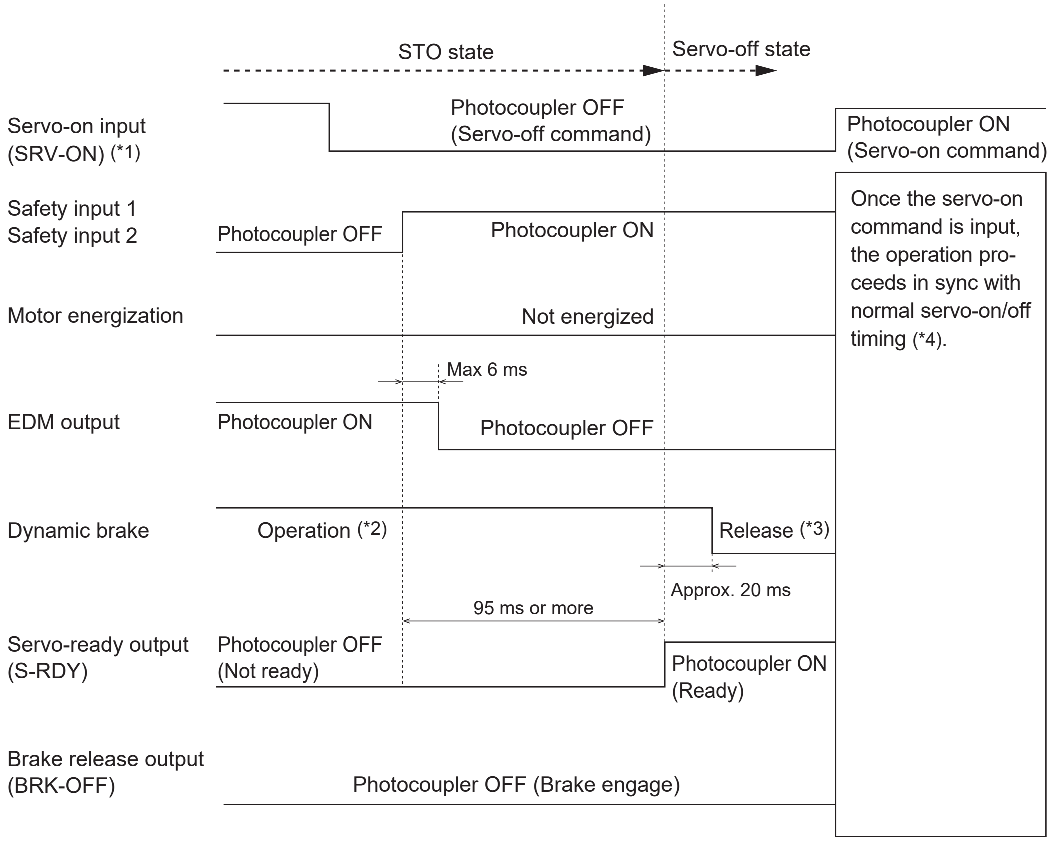
*2 Dynamic brake operation follows the setting of Pr5.10 “Sequence at alarm” .

(“Sequence at alarm” is also applicable even if there is no alarm in STO status)

*3 Turn OFF safety inputs 1 and 2 simultaneously when the STO function is used.

*4 There is a drop on the vertical axis, since servo lock is not possible during the interval from the time the motor power is turned off until the external brake operates. Ensure that this does not pose a problem.

2 Figure of operation timing during the return from “STO status”



*1 When photocouplers for safety input 1 and 2 are returned to ON, be sure to perform the operation with servo-on input turned OFF. When photocouplers for safety input 1 and 2 are returned to ON, servo ready status is automatically restored. Nor is there any need to clear an alarm.

*2 Due to STO status during dynamic brake operation, dynamic brake setting follows Pr5.10 “Sequence at alarm” .
(“Sequence at alarm” is applicable even if there is no alarm)

*3 Since it is in servo-off during dynamic brake release, the dynamic brake setting follows Pr5.06 “Sequence at servo-off” .

*4 *“7.1 Startup Operation”* Please see the timing chart given in *“Operation”* .

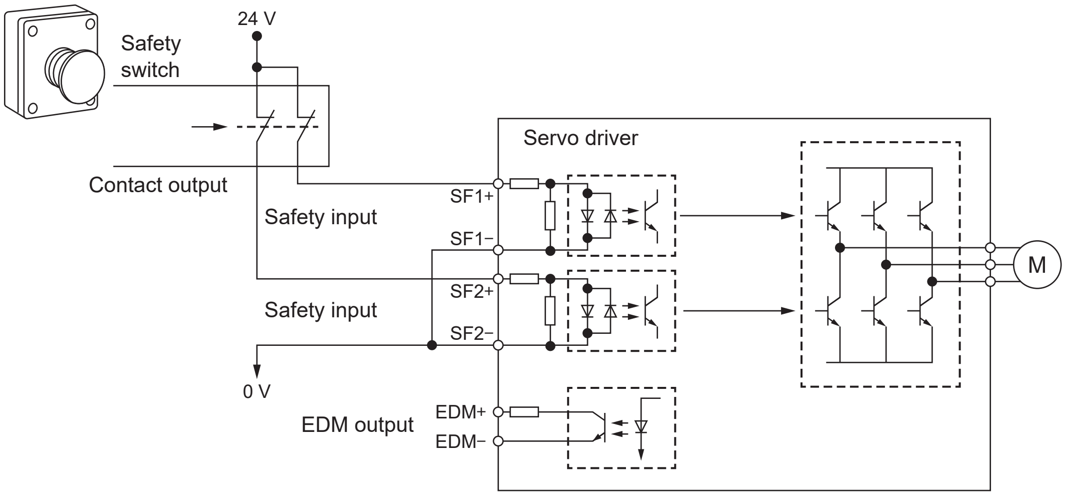
9.1.6 Example Connection

The following shows an example of safety device connection to a servo driver.

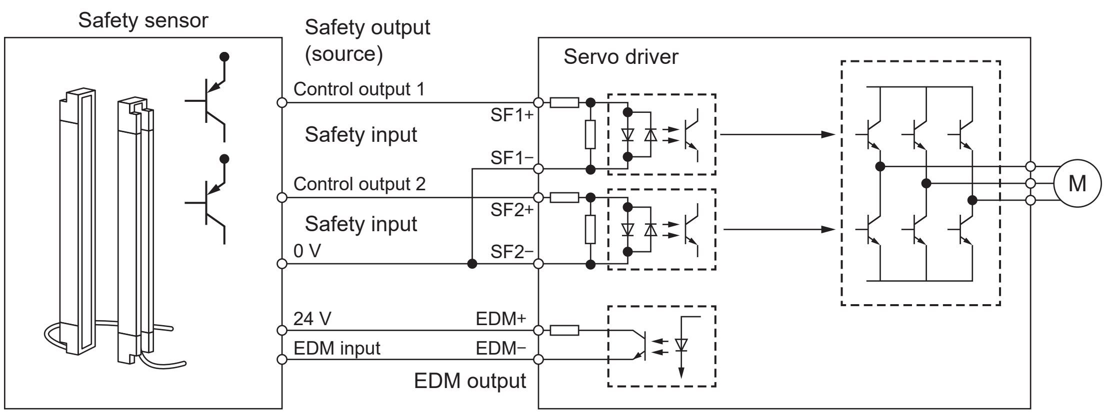
— Precautions —

- Depending on the safety device connected, it may be necessary to turn the servo driver power on first.
  In this case, the servo driver is in STO status.
  The method of return from STO status is as follows.
  1 Turn OFF the servo-on command.
  2 The photocouplers for safety input 1 and 2 are returned to ON.
  3 There is an automatic return to servo ready status.
  For details, see *"9.1.5 Operation"* (Diagram of operation timing during the return from "2" "STO status").

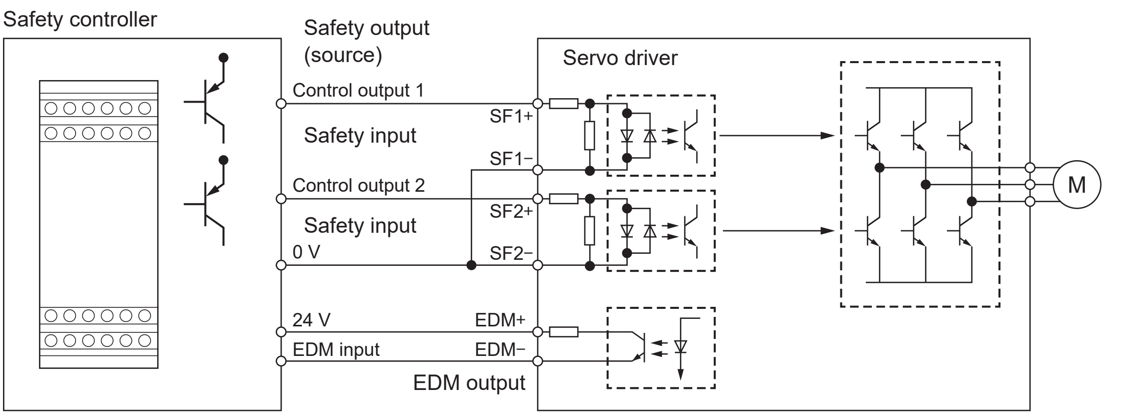
1 **Example of connection to a safety switch**



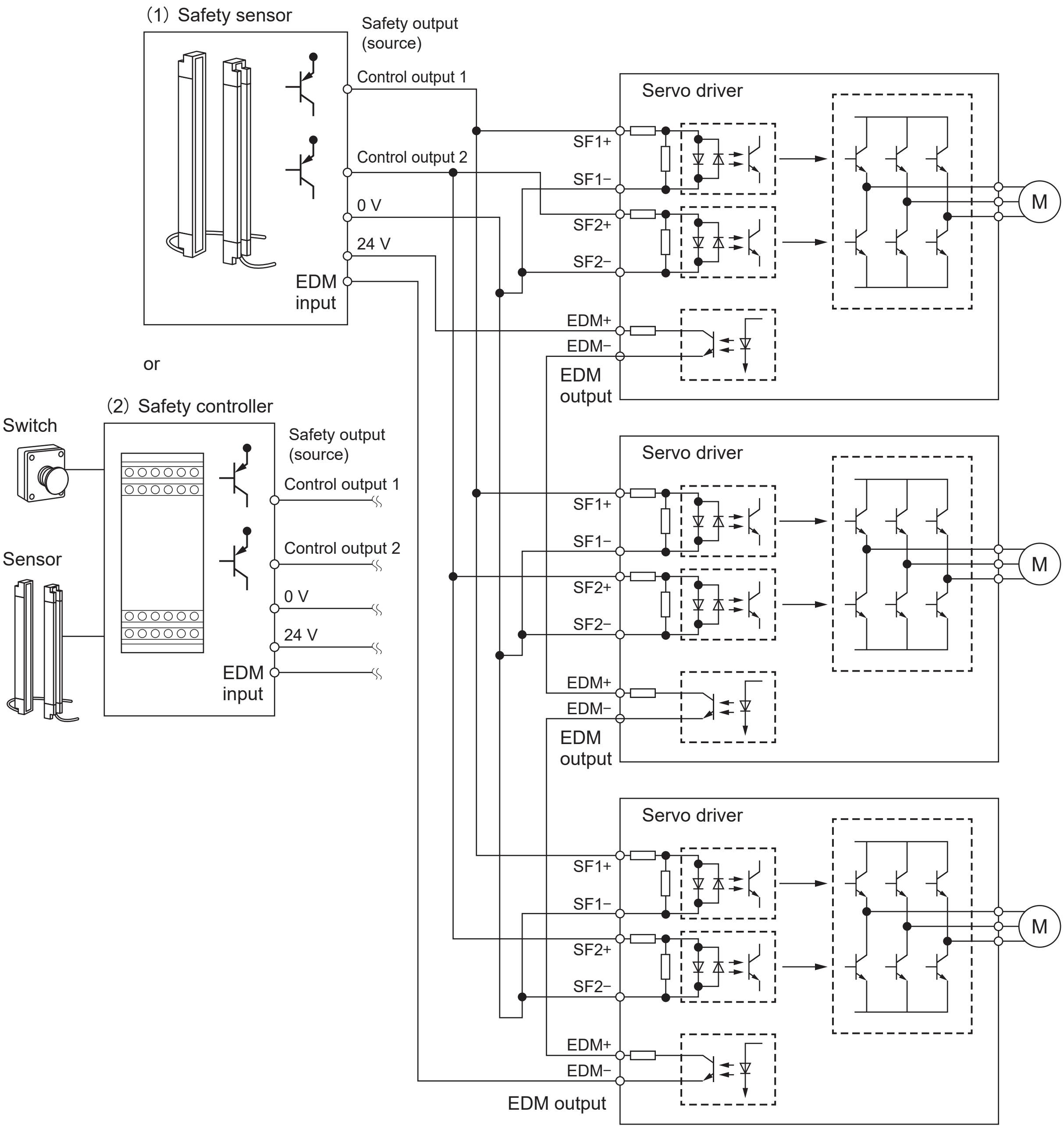
2 **Example of connection to a safety sensor**



3 Example of connection to a safety controller



4 Example of connection when using multiple axes



*1 The maximum number of axes connectible is a reference value.

The maximum number of axes connectible is limited, since the collector saturation voltage V_{ce} (sat) of the built-in photocoupler is approximately 1 when EDM outputs are serially connected. Moreover, this V_{ce} (sat) varies depending on the collector current.

Since approximately 6.1 mA per circuit flows to the SF inputs, the current is increased proportionally as the number of axes connected increases. The number of axes connected must be limited so as not to exceed the maximum output current on the safety device side.

* Required current capacity per safety output (source) channel: the number of connected axes × 6.1 (mA)

* 24 V DC allowable power supply voltage: 24 V ± 15%

* Maximum number of axes connectible: 8 axes

9.1.7 Safety Precautions

- When using the STO function, be sure to confirm that the system satisfies safety requirements by conducting a risk assessment of the device.

  Use without fulfilling safety requirements may lead to personal injury, depending on the circumstances.
- Always take safety into account during risk assessment, since there are the following risks, even when the STO function is operating.

  Incorrect use may lead to personal injury, depending on the circumstances.
  - Devise means such as an external brake, etc., as necessary to secure the motor, since the motor may move when external force (e.g. gravity on the vertical axis) is exerted on it. Also note that the servo motor with brake is only for holding, and cannot be used for braking purposes.
  - When Pr5.10 “Sequence at alarm” is set to free run (and dynamic brake is disabled), the motor is in free run status, and requires a longer stop distance even if no external force is applied. Ensure that this does not pose a problem.

    (The “deceleration to stop at alarm” is also applicable in STO status, even if there is no alarm.)
  - A malfunctioning power transistor, etc. may cause the motor to move by an electrical angle of approximately 180 degrees. Ensure that this does not pose a problem.
  - Power to the motor is turned off by the STO function, but power to the servo driver is not turned off, and it is not electrically insulated. Devise means such as separately turning off power to a servo driver during servo driver maintenance, etc.
- The EDM output signal is not safety output. Do not use for other purposes than as a malfunction monitoring function.

  Incorrect use may lead to personal injury, depending on the circumstances.
- STO (Safe Torque Off) status monitor output signal is not a safety-related part. In system design, confirm no risks will be present when the STO status monitor output signal cannot output normally.

  Incorrect use may lead to personal injury, depending on the circumstances.
- The dynamic brake and external brake release signal output are not safety-related features. In system design, confirm that malfunctioning external brake release will not present a risk during STO status.

  Incorrect use may lead to personal injury, depending on the circumstances.
- Only connect devices that are compliant with safety standards when using the STO function.

  Use of devices that are not compliant with safety standards may lead to personal injury, depending on the circumstances.

10 Protection Function, Warning Function, Time Stamp Function

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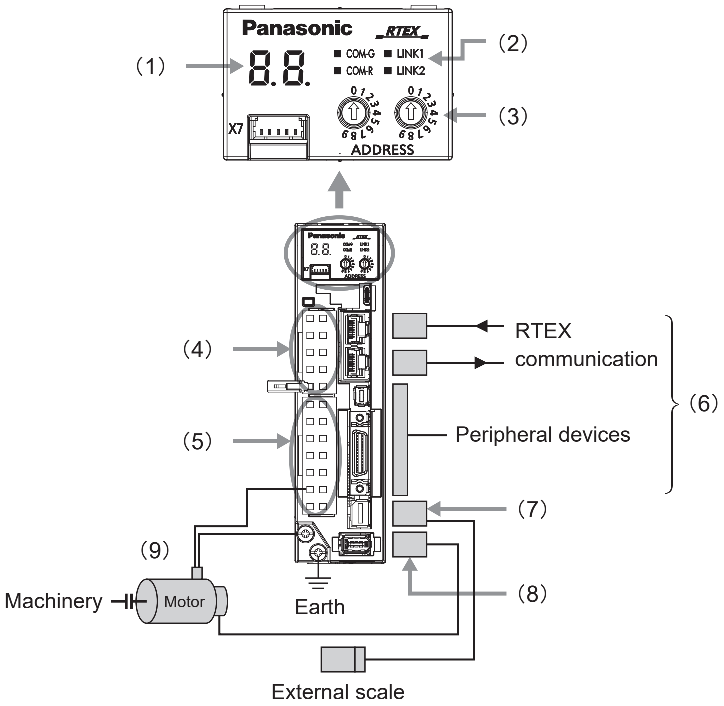
10.4 Timestamp Function 511

10.1 Where to Check

The places to check and a description of items that should be checked when there is trouble or an error is generated are shown below.



No.	Where to Check	What to check
(1)	7-segment LED	Does an error number appear?
(2)	Network status LED	Are both LINK1 and COM-G lit green? For details, see *"3.4.4 Network Status List"* .
(3)	Node address setting rotary switch	Is there an incorrect node address or parameter setting? For details, see *"3.4.2 Node Address"* .
(4)	Connector XA	Has the power supply voltage changed? Is power being input? Is there a loose connection?
(5)	Connector XB	Has the connector been disconnected? (Broken wire, contact) Is the connector wiring correct? Has the connector been removed? Has the short wire been removed?
(6)	Connectors X2, X3, X4	Is the connector wiring correct? Is a connector disconnected?
(7)	Connector X5	In the case of full-closed control, is the connector wiring correct? Is a connector disconnected?
(8)	Connector X6	Is the connector wiring correct? Is a connector disconnected?
(9)	Motor	Is there an abnormal noise coming from the motor? Is the holding brake engaged? Is the connection loose?

10.2 Protection Functions

Protection functions ensure safety by stopping the motor when errors are detected in the equipment.

Protection functions are assigned alarm numbers beginning with “Err”.

Alarm numbers are divided into main numbers, sub-numbers, and cause numbers.

For example, in the case of Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” , the main number is 13, the sub-number is 1, and the cause number is 0.

10.2.1 Operation

- Operation when a protection function is triggered

  Various types of protection function are built into this product and constantly monitor the operating state of the device.

  If an equipment error is detected and the protection function is triggered, the motor of this product is stopped and put into an alarm state and the alarm output signal (ALM) is turned off.

  When the alarm is triggered, an alarm number is displayed in the 7-segment LED on the front panel.

  For an example of alarm number display, see *“3.4.3 7-segment LED”* .

- Clearing alarms

  There are two types of alarms triggered by the protection function: alarms that support alarm clearing and alarms that do not support alarm clearing. For the alarm clear attribute, see *“10.2.2 List of Protection Functions”* .

  When an alarm capable of being cleared is triggered, the alarm can be cleared using the alarm command or Set-up Support Software (PANATERM ver.7) . Be sure to clear the alarm while the equipment is stopped and after confirming it is safe to do so.

  For details on clearing alarms, see Technical Reference Communication Specification.

  When an alarm that does not support alarm clearing is generated, once the source of the alarm has been eliminated, shut off and then reset the control power.

10.2.2 List of Protection Functions

A list of protection functions is shown below.

○: Supported ×: Not supported -: N/A

Alarm number (*1)			Alarm Name	Attribute			COM-R LED display (*4)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)	
11	0	0	Control power supply undervoltage protection	×	○	×	×
12	0	0	Overvoltage protection	○	○	×	×
13	0	0 to 1	Main power supply undervoltage protection (voltage across PN)	×	○	○	×
	1	0	Main power supply undervoltage protection (AC interrupt detection)	×	○	○	×
	2	0	Main power supply phase loss protection (AC interception detection)	×	○	○	×
14	0	0	Overcurrent protection 1	○	×	×	×
	1	0	Overcurrent protection 2	○	×	×	×
		1	Overheat protection 2	○	×	×	×
		2	Overheat protection 3	○	×	×	×
15	0	0	Overheat protection 1	○	×	○	×
	1	0	Encoder overheat error protection	○	×	○	×
16	0	0	Overload protection	○	○ (*5)	×	×
	1	0	Torque saturation error protection	○	○	×	×
18	0	0	Regenerative overload protection	○	×	○	×
	1	0	Regenerative transistor error protection	○	×	×	×
21	0	0 to 1 90	Encoder communication disconnection error protection	○	×	×	×
	1	0 to 3	Encoder communication error protection	○	×	×	×
23	0	0	Encoder communication data error protection	○	×	×	×
24	0	0	Position deviation excess protection	○	○	○	×
	1	0	Speed deviation excess protection	○	○	○	×
25	0	0	Hybrid deviation excess protection	○	×	○	×
26	0	0	Overspeed protection	○	○	○	×
	1	0	2nd Overspeed protection	○	○	×	×
27	1	0	Absolute clear protection	○	×	×	×

Alarm number (*1)			Alarm Name	Attribute			COM-R LED display (*4)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)	
27	4	0	Position command error protection	○	×	○	×
	5	0	Command generation error protection	○	×	○	×
	6	0 to 2	Operation command contention protection	○	○	×	×
	7	0	Position information initialization error protection	○	×	×	×
28	0	0	Pulse regeneration limit protection	○	○	○	×
29	1	0	Counter overflow protection 1	○	×	×	×
	2	0 to 5	Counter overflow protection 2	○	×	×	×
31	0	0 to 2 10 to 12 20 to 25 30 to 37 40 to 43	Safety function error protection 1	○	×	×	×
	2	0 to 3	Safety function error protection 2	○	×	×	×
33	0	0	Input overlapping assignment error 1 protection	○	×	×	×
	1	0	Input overlapping assignment error 2 protection	○	×	×	×
	2	0	Input function number error 1 protection	○	×	×	×
	3	0	Input function number error 2 protection	○	×	×	×
	4	0	Output function number error 1 protection	○	×	×	×
	5	0	Output function number error 2 protection	○	×	×	×
	8	0	Latch input assignment error protection	○	×	×	×
34	0	0	Motor movable range setup error protection	○	○	×	×
	1	0	Single-turn absolute movable range error protection	○	○	×	×
36	0 to 1	0	EEPROM parameter error protection	×	×	×	×
37	0 to 2	0	EEPROM check code error protection	×	×	×	×
38	0	0	Over-travel inhibit input protection 1	×	○	×	×
	1	0	Over-travel inhibit input protection 2	×	○	×	×
	2	0	Over-travel inhibit input protection 3	○	×	×	×

Alarm number (*1)			Alarm Name	Attribute			COM-R LED display (*4)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)	
39	0	0	Analog input (AIN) excess protection	○	○	○	×
40	0	0	Absolute system down error protection	○	○ (*6)	×	×
41	0	0	Absolute counter over error protection	○	×	×	×
42	0	0	Absolute overspeed error protection	○	○ (*6)	×	×
44	0	0	Single-turn counter error protection	○	×	×	×
45	0	0	Multi-turn counter error protection	○	×	×	×
47	0	0	Absolute status error protection	○	×	×	×
50	0	0	External scale wiring error protection	○	×	×	×
	1	0 to 2	External scale communication error protection	○	×	×	×
	2	0	External scale communication data error protection	○	×	×	×
51	0	0	External scale status error protection 0	○	×	×	×
	1	0	External scale status error protection 1	○	×	×	×
	2	0	External scale status error protection 2	○	×	×	×
	3	0	External scale status error protection 3	○	×	×	×
	4	0	External scale status error protection 4	○	×	×	×
	5	0	External scale status error protection 5	○	×	×	×
	8	0	External scale and other error protection	○	×	×	×
55	0	0	A-phase connection error protection	○	×	×	×
	1	0	B-phase connection error protection	○	×	×	×
	2	0	Z-phase connection error protection	○	×	×	×
68	0	0	Internal communication processing error protection1	○	×	×	×
	3	0 to 3	Internal communication processing error protection4	○	×	×	×
	5	0	Internal communication processing error protection6	○	×	×	×

Alarm number (*1)			Alarm Name	Attribute			COM-R LED display (*4)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)	
68	6	0	Internal communication processing error protection7	○	×	×	×
	7	0	Internal communication processing error protection8	○	×	×	×
	8	0	Internal communication processing error protection9	○	×	×	×
	9	0	Internal communication processing error protection10	○	×	×	×
	10	0	Internal communication processing error protection11	○	×	×	×
	11	0	Internal communication processing error protection12	○	×	×	×
	14	0	Internal communication processing error protection15	○	×	×	×
	19	0	Internal communication processing error protection20	○	×	×	×
	21	0	Internal communication processing error protection22	○	×	×	×
70	0	0	U-phase current detector error protection 1	○	×	×	×
		1	U-phase current detector error protection 2	○	×	×	×
	1	0	W-phase current detector error protection 1	○	×	×	×
		1	W-phase current detector error protection 2	○	×	×	×
72	0	0	Thermal error protection	○	×	×	×
75	0	0 to 1	External memory access error protection	○	×	×	×
77	0	0	Microcomputer error protection 1	○	×	×	×
	2	0	Microcomputer error protection 3	○	×	×	×
	6	0	Microcomputer error protection7	○	×	×	×
80	3	0	Incomplete PLL error protection	○	○	×	Blinking red
82	0	0	RTEX node address setting error protection	○	×	×	Red light
83	0	0	RTEX continuous communication error protection 1	○	○	○	Blinking red

Alarm number (*1)			Alarm Name	Attribute			COM-R LED display (*4)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)	
83	1	0	RTEX continuous communication error protection2	○	○	○	Blinking red
84	0	0	RTEX communication timeout error protection	○	○	○	Blinking red
	3	0	RTEX communication synchronization error protection	○	×	×	Red light
	5	0	RTEX communication cycle error protection	○	○	○	Blinking red
85	0	0	Retracting operation completion (I/O) (*7)	○	(*8)	○	×
	1	0	Retracting operation completion (communication) (*7)	○	(*8)	○	×
	2	0	Retracting operation error (*7)	○	(*8)	○	×
86	0	0	RTEX cyclic data error protection 1	○	○	○	Blinking red
	1	0	RTEX cyclic data error protection 2	○	○	○	Blinking red
	2	0	RTEX_Update Counter error protection	○	×	○	Red light
87	0	0	Forced alarm input protection	×	○	○	×
	1	0	Retracting operation completion (I/O) (*7)	○	(*8)	○	×
	2	0	Retracting operation completion (communication) (*7)	○	(*8)	○	×
	3	0 to 6	Retracting operation error (*7)	○	(*8)	○	×
90	2	0	RTEX multi-axis synchronization error protection	○	×	×	Red light
91	1	0	RTEX Command error protection	○	○	×	Blinking red
	3	0	RTEXCommand error protection2	○	○	×	Blinking red
92	0	0	Encoder data recovery error protection	○	×	×	×
	1	0	External scale data recovery error protection	○	×	×	×
	3	0 to 2	Multi-turn data upper limit value disagreement error protection	○	×	×	×
93	0	0	Parameter setup error protection 1	○	×	×	×
	2	0	Parameter setup error protection 2	○	×	×	×

Alarm number (*1)			Alarm Name	Attribute			COM-R LED display (*4)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)	
93	3	0 to 5	External scale connection error protection	○	×	×	×
	5	0	Parameter setup error protection 4	○	×	×	×
	8	0	Parameter setup error protection 6	○	×	×	×
94	2	0	Homing error protection	○	○	×	×
	3	0	Homing error protection 2	○	○	×	×
95	0	0	Motor automatic recognition error protection 1	×	×	×	×
	1	0	Motor automatic recognition error protection 2	×	×	×	×
	2	0	Motor automatic recognition error protection 3	×	×	×	×
	3	0	Motor automatic recognition error protection 4	×	×	×	×
	4	0	Motor automatic recognition error protection 5	×	×	×	×
	5	0	Motor automatic recognition error protection 6	×	×	×	×
96	4	0	Host controller error protection 3	○	×	×	×
	6	0	Host controller error protection 5	○	×	×	×
98	1	0	RTEX hardware error protection 1	○	×	×	Red light
	2	0	RTEX hardware error protection 2	○	×	×	Red light
	3	0	RTEX hardware error protection 3	○	×	×	Red light
	5	0	Hardware self-diagnostic error protection 1	×	×	×	×
Other numbers			Other error protection	–	–	–	–
Special 7-segment display 71 72 73 75 76 77			System error protection	×	×	×	×

*1 The alarm number is displayed in the 7-segment LED when the alarm is generated.

For details on 7-segment LED operation when an alarm is generated, see *"3.4.3 7-segment LED"* .

*2 When an alarm marked with a circle ○ under "History" (supported) is triggered, the history of the triggered alarm is saved in EEPROM.

*3 When a supported (○) emergency stop alarm triggers, an emergency stop will be performed if 4 to 7 is set in Pr5.10 "Sequence at alarm" .

For details, see *"8.17 Deceleration to Stop Function for When Alarm Is Triggered"* .

*4 The COM-R LED display lights up or blinks in red when an RTEX communication-related alarm is triggered.

For details on COM-R LED display, see *"3.4.4 Network Status List"* .

*5 Err16.0.0 "Overload protection" When issued, it can be cleared 10 seconds after issuance.

If the device is not in a clearable state when the alarm clear command is sent, only the alarm clear command is accepted, and then the clearing process is performed when the device is in a clearable state.

*6 If Err40.0.0 “Absolute system down error protection” or Err42.0.0 “Absolute overspeed error protection” occurs, the alarm cannot be cleared until an absolute clear is executed.

*7 The alarm generated during the retracting operation is switched by Pr6.86:bit 15 “Retracting operation-related alarm switching” .

- When bit 15 = 0: Err85.0.0 “Retracting operation completion (I/O)” , Err85.1.0 “Retracting operation completion (communication)” or Err85.2.0 “Retracting operation error” are triggered
- When bit 15 = 1: Err87.1.0 “Retracting operation completion (I/O)” , Err87.2.0 “Retracting operation completion (communication)” or Err87.3.□ “Retracting operation error” are triggered

*8 Alarm clear is switched between enabled and disabled by Pr6.86:bits 2 to 0 “Retracting operation alarm clear attribute”.

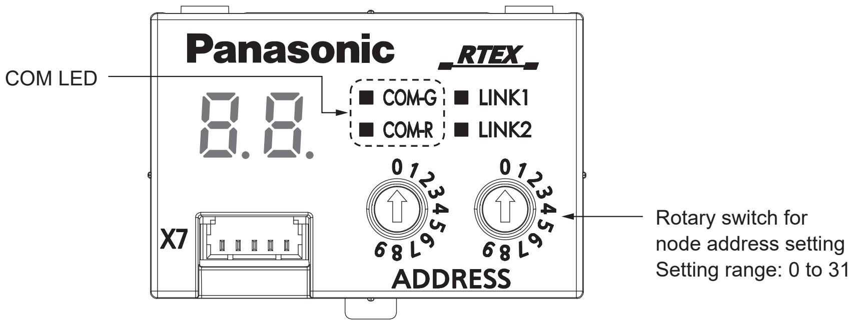
- bit 0: Err85.0.0 “Retracting operation completion (I/O)” , Err87.1.0 “Retracting operation completion (I/O)” alarm clear attribute
- bit 1: Err85.1.0 “Retracting operation completion (communication)” , Err87.2.0 “Retracting operation completion (communication)” alarm clear attribute
- bit 2: Err85.2.0 “Retracting operation error” , Err87.3.□ “Retracting operation error” alarm clear attribute

In all cases, 0: Alarm clear disable, 1: Alarm clear enable.

10.2.3 Protection Function Details

This shows details of protection functions.

The COM LED and rotary switch referred to in the detailed explanation of the protective function for RTEX communication-related errors (alarms) are located on the front panel. For specific locations, review the front panel configuration diagram shown below.



Err11.0.0 "Control power supply undervoltage protection"

Primary cause	The voltage across PN of the control power supply converter has fallen and dropped below the specified value. Consider the following causes. 1 There was a momentary power failure due to low power supply voltage or a drop in power supply voltage. 2 Power supply voltage dropped due to inrush current on powering up the main power supply leading to insufficient power supply capacity. 3 The product is malfunctioning.
Handling	Measure the L1C-L2C line voltage of connector and terminal block. Next, take the actions listed in "1" to "3" below for the cause with the respective corresponding number. 1 Increase the supply voltage or replace the power supply with another one. 2 Increase the power supply capacity. 3 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err12.0.0 "Overvoltage protection"

Primary cause	● Power supply voltage exceeds the allowable input voltage across PN of the converter. ● Power supply voltage is high. ● A voltage surge has occurred due to the phase advance capacitor or UPS (Uninterruptible Power Supply). Consider the following causes. 1 The regenerative resistor was disconnected. 2 The external regenerative resistor is unsuitable and unable to absorb the regenerative energy. 3 The product is malfunctioning.

Handling	Measure the line voltage between connectors (L1, L2, L3). Input the correct voltage. Remove the phase advance capacitor. Next, take the actions listed in "1" to "3" below for the cause with the respective corresponding number. 1 Use a tester to measure the resistance of the external resistor between the P and B terminals of this product and replace the external resistor if the tester reads ∞, as this means a broken connection. 2 Change to the specified regenerative resistance value and wattage. 3 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err13.0.☐ "Main power supply undervoltage protection (voltage across PN)" , Err13.1.0 "Main power supply undervoltage protection (AC interrupt detection)"

- Err13.0.0 to Err13.0.1 "Main power supply undervoltage protection (voltage across PN)"
- Err13.1.0 "Main power supply undervoltage protection (AC interrupt detection)"

Primary cause	● When Pr5.08 "L/V trip selection upon main power off" :bit 0 = 1, power is instantaneously interrupted between L1 and L3 for at least the time set with Pr5.09 "Detection time of main power off" . ● The voltage across PN of the main power supply converter has fallen and dropped below the specified value during servo-on. Consider the following causes. 1 There was a momentary power failure due to low power supply voltage or a drop in power supply voltage. 2 Momentary power failure has occurred even though power supply voltage is normal. 3 Power supply capacity was insufficient. Power supply voltage dropped due to inrush current on powering up the main power supply. 4 The product is malfunctioning.
Handling	Measure the line voltage between connectors (L1, L2, L3). Next, take the actions listed in "1" to "4" below for the cause with the respective corresponding number. 1 Increase the power supply voltage, change the power supply, eliminate whatever caused the electromagnetic contactor in the main power supply to drop, then turn the power back on. 2 Check the setting for Pr5.09 "Detection time of main power off" and set it properly for each phase of the power supply. 3 Increase the power supply capacity. For information on power supply capacity, see *"1.8.2.2 List of Peripheral Devices"* . 4 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err13.2.0 "Main power supply phase loss protection (AC interception detection)"

Primary cause	Missing phases of connectors (L1, L2, L3) were detected with main power supply established when Pr6.104 "Open-phase monitoring setup" = 2 (alarm enabled) or when using a 3-phase input dedicated servo driver and Pr6.104 = 0 (automatic) is set. The cause may be that phases L1, L2, and L3 are disconnected or dropped, or that a three-phase input specification servo driver has operated with a single-phase power supply. Additionally, consider the following causes. 1 L1-L2 line voltage, L2-L3 line voltage, and L1-L3 line voltage are not balanced. 2 Main power supply voltage is low. 3 The product is malfunctioning.
Handling	Check the connection of the main power input line. If there is no problem with the connection, measure the line voltage between connectors (L1, L2, L3). Next, take the actions listed in "1" to "3" below for the cause with the respective corresponding number. 1 Measure the line voltage between connectors (L1, L2, L3) and eliminate line voltage imbalance. 2 Confirm that the line voltage between connectors (L1, L2, L3) is the specified value. 3 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Related parameters

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	104	B	Open-phase monitoring setup	0 to 3	—	Sets open-phase monitoring. A setting value of 0 (automatic) disables open-phase monitoring for servo drivers with single-phase/three-phase common specifications, and enables alarms for servo drivers with three-phase input only. 0: Automatic 1: Warning enabled 2: Alarm enabled 3: Disabled

*1 For attributes, see *"6.3 List of Parameters"* .

Err14.0.0 "Overcurrent protection 1" , Err14.1.0 "Overcurrent protection 2"

Primary cause	Current through the converter has exceeded the specified value. Consider the following causes. 1 If this alarm occurs immediately when the motor cables are disconnected and after servo-on, the product is malfunctioning. (Circuit, IGBT component failure) 2 Short in motor cables U, V, W. 3 Check the insulation resistance between motor cables U, V, W and the motor earth cable and if there is an insulation failure, there is an earth fault in the motor wire. 4 Check the resistance balance between the various motor cables and if there is an imbalance, the motor is burned out. 5 Connection fault in motor cables. 6 Dynamic brake relay has fused due to frequent servo-on/servo-off operation. 7 The timing of the command input is either the same as or earlier than servo-on.
Handling	Take the actions listed in "1" to "7" below for the cause with the respective corresponding number. 1 Replace the servo driver with a new one. 2 Check for any stray strands in the lead wires at the connectors, and connect the motor cables correctly. 3 Replace the motor. 4 Replace the motor. 5 Remove and check the connector pins in the U, V, W, connectors on the motor and firmly secure to ensure they are not loose or disconnected. 6 Replace the servo driver. Do not operate or stop via servo-on/off after replacement. 7 Wait at least 100 ms after servo-on before inputting a command.

Err14.1.1 "Overheat protection 2"

Primary cause	Temperature of the power element of this product has risen over the specified temperature. Consider the following causes. 1 The ambient temperature of this product has risen over the specified temperature. 2 Used with overload.

Handling	Take the actions listed in <u>“1”</u> to <u>“2”</u> below for the cause with the respective corresponding number. 1 Improve the ambient temperature and cooling conditions of this product. 2 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load.

Err14.1.2 “Overheat protection 3”

Primary cause	The dynamic brake circuit overheated and the thermal fuse has blown.
Handling	Replace the servo driver.

Err15.0.0 “Overheat protection 1”

Primary cause	Temperature of the heat sink of this product has risen over the specified temperature. Consider the following causes. 1 The ambient temperature of this product has risen over the specified temperature. 2 Used with overload.
Handling	Make sure that the ambient temperature of this product does not exceed the operating temperature range. Next, take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Improve the ambient temperature and cooling conditions of this product. 2 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load.

Err15.1.0 “Encoder overheat error protection”

Primary cause	The encoder temperature has exceeded the encoder overheat error level. Consider the following causes. 1 The ambient temperature of the motor is high. 2 Used with overload.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Improve the ambient temperature and cooling conditions of the motor. 2 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load.

Related parameters

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	10	B	Function expansion setup	-32768 to 32767	—	bit 11: Encoder overheat error protection detection 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

Err16.0.0 “Overload protection”

Primary cause	When the actual running value of the torque command exceeds the overload level set by Pr5.12 “Motor overload level setup” , overload protection will be triggered based on the time characteristics. Consider the following causes. 1 Operation was continued for a long time under a heavy load and with the effective torque exceeding the rated torque. 2 Due to poor gain adjustment, oscillation or hunting operation, or vibration or abnormal noise from the motor occurred, or the Pr0.04 “Inertia ratio” setting is abnormal. 3 Motor is wired incorrectly or there is a disconnection. 4 The equipment to which the motor is mounted is interfering in some way. Or the load was suddenly increased due to a problem with the equipment to which the motor is mounted. 5 Operated with the holding brake engaged. 6 When wiring multiple machines, there was a wiring error with the motor cable connected to the wrong axis. 7 Pr5.12 “Motor overload level setup” is too low.
Handling	● Check that the torque (current) waveform does not oscillate or fluctuate excessively up and down in the analog output or communication. ● Check the overload warning display and load factor on the front panel or in the communication. Next, take the actions listed in “1” to “7” below for the cause with the respective corresponding number. 1 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load. 2 Readjust the gain. 3 Connect the motor wiring according to the wiring diagram, and if this does not improve the problem, replace the cables. 4 Eliminate problems with the machinery and lighten the load. 5 Measure the brake terminal voltage and release the brake. 6 Wire the motor cables and encoder cables correctly to match the axes. 7 Set Pr5.12 “Motor overload level setup” = 0. (Set to the maximum value allowed for the motor) **Notes** ● For details on how to confirm the overload protection time characteristics, see *“10.2.5 Overload Protection Time Characteristics Confirmation Method”* .

Err16.1.0 “Torque saturation error protection”

Primary cause	The torque saturation condition continued between Pr7.16 “Torque saturation error protection frequency” or Pr6.57 “Torque saturation error protection detection time” setting values.
Handling	Check the operating state of this product and take the same action as for Err16.0.0.

Err18.0.0 “Regenerative overload protection”

Primary cause	The regenerative energy has exceeded the processing capacity of the regenerative resistor. Consider the following causes. 1 The converter voltage was increased by the regenerative energy during deceleration due the size of the load inertia, which further increased the voltage due to insufficient absorption of energy by the regenerative resistor. 2 Regenerative energy was not absorbed in the specified deceleration time due to high number of rotations of the motor. 3 The operating limit of the external resistor is limited to 10% duty.
Handling	Check the regenerative resistance load factor on the front panel or in the communication. Cannot be used with continuous regeneration control. Next, take the actions listed in “1” to “3” below for the cause with the respective corresponding number. 1 When checking the operating pattern (velocity monitor), check the regenerative resistance load factor and the over-regeneration warning display and take the following actions. ● Increase the capacity of the motor and servo driver. ● Increase the acceleration/deceleration time. ● Install an external regenerative resistor. 2 When checking the operating pattern (velocity monitor), check the regenerative resistance load factor and the over-regeneration warning display and take the following actions. ● Increase the capacity of the motor and servo driver. ● Increase the acceleration/deceleration time. ● Reduce the number of rotations of the motor. ● Install an external regenerative resistor. 3 Set Pr0.16 “External regenerative resistor setup” to 2. Be sure to install external protection such as a thermal fuse when Pr0.16 “External regenerative resistor setup” is set to 2. **— Precautions —** ● If external protection is not installed, regenerative resistor protection may be lost, so that the regenerative resistor heats up abnormally and burns out.

Err18.1.0 “Regenerative transistor error protection”

Primary cause	The regenerative drive transistor of this product is malfunctioning.
Handling	Replace the servo driver.

Err21.0.☐ “Encoder communication disconnection error protection”

- Err21.0.0 to Err21.0.1 “Encoder communication disconnection error protection”
- Err21.0.90 “Encoder communication disconnection error protection”

Primary cause	Communication between the encoder and this product has been interrupted a set number of times, triggering the disconnection detecting function.
Handling	● Wire the encoder cables correctly. ● Connect the connector pin correctly.

Err21.1.☐ “Encoder communication error protection”

● Err21.1.0 to Err21.1.3 “Encoder communication disconnection error protection”

Primary cause	This is primarily a data error due to noise. ● There is a communication error in data from the encoder. ● The encoder cables are connected but there is an error in the communication data.
Handling	● Keep the encoder power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the encoder cables are long. ● If the motor cables and encoder cables are bundled together, separate them. ● Connect shielding to FG.

Err23.0.0 “Encoder communication data error protection”

Primary cause	This is primarily a data error due to noise. ● Communication data from the encoder has become abnormal, even though there is not a communication error. ● The encoder cables are connected but there is an error in the communication data.
Handling	● Keep the encoder power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the encoder cables are long. ● If the motor cables and encoder cables are bundled together, separate them. ● Connect shielding to FG.

Err24.0.0 “Position deviation excess protection”

Primary cause	The position deviation pulse has exceeded the setting for Pr0.14 “Position deviation excess setup” . Consider the following causes. 1 Motor movement is not tracking commands. 2 The value of Pr0.14 “Position deviation excess setup” is low.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Take the following actions. ● Check that the motor is rotating according to position command pulses. ● Check whether the torque output by the torque monitor is saturated. ● Adjust the gain. ● Maximize Pr0.13 “1st torque limit” and Pr5.22 “2nd torque limit” . ● Wire the encoder connections according to the wiring diagram. ● Increase the acceleration/deceleration time. ● Lighten the load and decrease the velocity. 2 Increase the value set for Pr0.14.

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	14	A	Position deviation excess setup	0 to 2^{30}	Command unit	Sets the position deviation excess setup range. Err24.0.0 “Position deviation excess protection” detection is disabled when the setup value is 0. Units follow Pr5.20 “Position setup unit select” . The factory default value is equivalent to 10 motor revolutions at 23 bits. If the command pulse per single-turn is changed, this setup value will also be affected. Configure settings appropriately according to the safety features of the equipment.

*1 For attributes, see *“6.3 List of Parameters”* .

Err24.1.0 “Speed deviation excess protection”

Primary cause	The difference between the internal position command speed and the actual speed (speed deviation) has exceeded the value set for Pr6.02 “Speed deviation excess setup” . **— Precautions —** ● If the internal position command speed is forcibly set to 0 by an emergency stop caused by an over-travel inhibit input in a positive direction or negative direction, the speed deviation increases in that instant. Make sure there is enough allowance in the setting because the internal position command speed rise time and the speed deviation will also be large in this case.
Handling	● Increase the value set for Pr6.02 “Speed deviation excess setup” . ● Lengthen the acceleration/deceleration time for the internal position command speed, or improve tracking by adjusting the gain. ● Disable excessive speed deviation detection (Pr6.02 = 0).

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	02	A	Speed deviation excess setup	0 to 20000	r/min	Sets the threshold for Err24.1.0 “Speed deviation excess protection” . Detection of speed deviation excess protection is disabled when this setup value is 0.

*1 For attributes, see *“6.3 List of Parameters”* .

Err25.0.0 “Hybrid deviation excess protection”

Primary cause	When in full-closed control, the load position from the external scale and the motor position from the encoder have shifted more than the number of pulses set by Pr3.28 “Hybrid deviation excess setup” .
Handling	● Check the motor and load connections. ● Check connection of the external scale and this product. ● If the load has moved, check that the change in motor position (encoder feedback value) and the change in load position (external scale feedback value) have the same sign. ● Check if Pr3.24 “Numerator of external scale division” , Pr3.25 “Denominator of external scale division” , and Pr3.26 “Reversal of direction of external scale” are set correctly.

Err26.0.0 “Overspeed protection”

Primary cause	The motor rotational speed has exceeded the value set for Pr5.13 “Over-speed level setup” .
Handling	● Do not give excessively high speed commands. ● Check the input frequency of command pulses and the dividing/multiplying ratio. ● Adjust the gain if overshoot is generated due to poor gain adjustment. ● Wire the encoder cables according to the wiring diagram.

Err26.1.0 “2nd Overspeed protection”

Primary cause	The motor rotational speed has exceeded the value set for Pr6.15 “2nd overspeed level setting” .

Handling	● Do not give excessively high speed commands. ● Check the input frequency of command pulses and the dividing/multiplying ratio. ● Adjust the gain if overshoot is generated due to poor gain adjustment. ● Wire the encoder cables according to the wiring diagram.

Err27.1.0 “Absolute clear protection”

Primary cause	Absolute encoder multi-turn data clear was executed with Set-up Support Software (PANATERM ver.7) .
Handling	Confirm that absolute encoder multi-turn data clear was executed with Set-up Support Software (PANATERM ver.7) . **Notes** ● Err27.1.0 “Absolute clear protection” is a safety measure and not an error. ● When multi-turn data has been cleared by RTEX communication, no alarm is issued, but be sure to reset the control power source.

Err27.4.0 “Position command error protection”

Primary cause	The position command variation (value after electronic gear) exceeded the specified value.
Handling	● Confirm that there is no great position command variation as a result of cyclic position control (CP). ● Check the electronic gear ratio. ● Check whether Update_Counter is changed in the correct cycle. ● If this is issued when changing from servo-off to servo-on, check whether the position command is correctly initialized at the actual position when Servo_Active is 0. ● Check whether parameter settings related to the communication cycle or the command update cycle are consistent with the specifications of the host device.

Err27.5.0 “Command generation error protection”

Primary cause	An error, such as position command generation processing exceeding the computation range, has occurred.
Handling	Confirm that the electronic gear ratio and acceleration/deceleration constraints are fulfilled.

Err27.6.0 “Operation command contention protection”

Primary cause	When Pr7.99 “RTEX function expansion setup 6” :bit 0 = 1, a servo-on command was received by RTEX communication while the frequency characteristics analysis function (FFT function) that operates with this product alone, as well as a trial run, were being executed.
Handling	When Pr7.99 “RTEX function expansion setup 6” :bit 0 = 1, check whether the host device has sent a servo-on command by RTEX communication during frequency characteristics analysis function (FFT function) or trial run execution.

Err27.6.1 “Operation command contention protection”

Primary cause	When Pr7.99 “RTEX function expansion setup 6” :bit 0 = 0, RTEX communication was established while the frequency characteristics analysis function (FFT function) that operates with this product alone, as well as a trial run, were being executed.
Handling	When Pr7.99 “RTEX function expansion setup 6” :bit 0 = 0, check whether RTEX communication has been established during frequency characteristics analysis function (FFT function) or trial run execution.

Err27.6.2 “Operation command contention protection”

Primary cause	A request to switch to virtual full-closed control mode was received from Set-up Support Software (PANATERM ver.7) during trial run, frequency characteristics analysis function (FFT), Z-phase search, or One Minute TUNING.
Handling	Please check that a request to switch to virtual full-closed control mode was not transmitted by Set-up Support Software (PANATERM ver.7) during trial run, frequency characteristics analysis function (FFT), Z-phase search, or One Minute TUNING.

Err27.7.0 “Position information initialization error protection”

Primary cause	Servo-on was executed during attribute C parameter enabling mode processing of a reset command in RTEX communication.
Handling	Check if in servo-off status during attribute C parameter enabling mode processing of a reset command in RTEX communication.

Err28.0.0 “Pulse regeneration limit protection”

Primary cause	The output frequency of pulse regeneration has exceeded the limit.
Handling	● Check the setup values of Pr0.11 “Number of output pulses per motor revolution” and Pr5.03 “Denominator of pulse output division” . ● Set Pr5.33 “Pulse regenerative output limit setup” to 0. **— Precautions —** ● This disables detection of the pulse regeneration limit. Note that this action does not resolve the primary cause.

Err29.1.0 “Counter overflow protection 1”

Primary cause	The calculated value of absolute encoder (absolute external scale) position [pulse unit]/electronic gear ratio exceeded 32 bit width when the position information initialization process was performed under the following conditions. ● After turning on control power in absolute mode ● After executing attribute C parameter enabling mode ● When clearing multi-turn data via Set-up Support Software (PANATERM ver.7) ● When clearing multi-turn data via RTEX communication ● When the operation (trial run, frequency characteristics analysis functions (FFT functions), Z-phase search, One Minute TUNING) is completed with Set-up Support Software (PANATERM ver.7) ● When Config is executed by Set-up Support Software (PANATERM ver.7)
Handling	Check the operational range for the absolute encoder (absolute external scale) position and review the electronic gear ratio.

Err29.2.☐ “Counter overflow protection 2”

● Err29.2.0 to Err29.2.5 “Counter overflow protection 2”

Primary cause	● When using semi-closed control The value of position deviation in pulse units has exceeded ± (2^{34}–1) (17179869183). The value of position deviation in command units has exceeded ± 2^{30} (1073741824). ● When using full-closed control The value of position deviation in pulse units has exceeded ± 2^{30} (1073741824). The value of position deviation in command units has exceeded ± 2^{30} (1073741824).
Handling	● Check whether the motor is rotating according to the position command. ● Check whether the torque output by the torque monitor is saturated. ● Tune the gain. ● Maximize the torque limit setting. ● Wire the encoder connections according to the wiring figure.

Err31.0.☐ "Safety function error protection 1"

- Err31.0.0 to Err31.0.2 "Safety function error protection 1"
- Err31.0.10 to Err31.0.12 "Safety function error protection 1"
- Err31.0.20 to Err31.0.25 "Safety function error protection 1"
- Err31.0.30 to Err31.0.37 "Safety function error protection 1"
- Err31.0.40 to Err31.0.43 "Safety function error protection 1"

Primary cause	A safety function has detected an error.
Handling	● If this repeats even after taking action to resolve the error, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair). ● When any of Err31.0.10 to Err31.0.12 occurs, please check that a state of differing logic between SF1 and SF2 has not persisted for more than 10 seconds.

Err31.2.☐ "Safety function error protection 2"

- Err31.2.0 to Err31.2.3 "Safety function error protection 2"

Primary cause	A safety function has detected an error.
Handling	If this repeats even after taking action to resolve the error, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err33.0.0 "Input overlapping assignment error 1 protection"

Primary cause	There are overlapping input signal (SI1, SI2, SI3, and SI4) function assignment settings.
Handling	Assign the functions correctly to the connector pins.

Err33.1.0 "Input overlapping assignment error 2 protection"

Primary cause	There are overlapping input signal (SI5, SI6, SI7, and SI8) function assignment settings.
Handling	Assign the functions correctly to the connector pins.

Err33.2.0 "Input function number error 1 protection"

Primary cause	● There are undefined numbers specified in input signal (SI1, SI2, SI3, and SI4) function assignments. Or there is an error in logical settings. ● When using External servo-on input (EX-SON), dynamic brake switching input (DB-OFF), forced alarm input (E_STOP) at input signals SI1, SI2, SI3, and SI4, only one or two control modes were set.
Handling	Assign the functions correctly to the connector pins.

Err33.3.0 “Input function number error 2 protection”

Primary cause	● Undefined numbers have been specified in the input signal (SI5, SI6, SI7, SI8) function assignment settings. Or there is an error in logical settings. ● When using External servo-on input (EX-SON), dynamic brake switching input (DB-OFF), forced alarm input (E_STOP) at input signals SI5, SI6, SI7, and SI8, only one or two control modes were set.
Handling	Assign the functions correctly to the connector pins.

Err33.4.0 “Output function number error 1 protection”

Primary cause	An undefined number has been specified in the output signal (SO1) function assignment setting.
Handling	Assign the functions correctly to the connector pins.

Err33.5.0 “Output function number error 2 protection”

Primary cause	There are undefined numbers specified in output signals (SO2 and SO3) function assignments.
Handling	Assign the functions correctly to the connector pins.

Err33.8.0 “Latch input assignment error protection”

Primary cause	There are errors in latch correction pin (SI5, SI6, and SI7) function assignments. ● EXT1, EXT2 and EXT3 are assigned to pins other than SI5 to SI7. ● Not all the control modes have been assigned.
Handling	Assign the functions correctly to the connector pins.

Err34.0.0 “Motor movable range setup error protection”

Primary cause	When a position command within the specified range is input, the motor has operated outside its movable range specified in Pr5.14 “Motor working range setup” . Consider the following causes. 1 The gain is not suitable. 2 The value set for Pr5.14 is low. 3 When Pr6.97 “Function expansion setup 3” :bit 2 = 1, the conditions for forcibly issuing Err34.0.0 were fulfilled.
Handling	Next, take the actions listed in “1” to “3” below for the cause with the respective corresponding number. 1 Check the gain (balance between position loop gain and speed loop gain) and inertia ratio. 2 Increase the value set for Pr5.14, or set Pr5.14 to 0 and disable the protection function. 3 Review the setting and operating conditions. See *“7.2.4 Motor Working Range Setup Function”* .

Err34.1.0 “Single-turn absolute movable range error protection”

Primary cause	When an absolute encoder is connected and Pr0.15 “Absolute encoder setup” = 3, the motor (encoder) position has exceeded the motor movable range (encoder single-turn data).
Handling	● Confirm the working range of the absolute encoder (absolute scale) position including absolute home position offset, and review the electronic gear ratio. ● Return the motor (encoder) position to within the motor movable range (in the encoder single-turn data).

Err36.☐.0 “EEPROM parameter error protection”

● Err36.0.0 to Err36.1.0 “EEPROM parameter error protection”

Primary cause	Data in the parameter storage area has been damaged when reading the data from EEPROM at power-on.
Handling	● Reset all parameters. ● If this happens repeatedly, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err37.☐.0 “EEPROM check code error protection”

● Err37.0.0 to Err37.2.0 “EEPROM check code error protection”

Primary cause	Data for EEPROM write confirmation was damaged when the data was read from the EEPROM at power-on.
Handling	● The product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err38.0.0 “Over-travel inhibit input protection 1”

Primary cause	● Positive direction/negative direction over-travel inhibit input (POT, NOT) were both switched ON when Pr5.04 “Over-travel inhibit input setup” = 0. ● One of positive direction/negative direction over-travel inhibit input (POT, NOT) was switched ON when Pr5.04 “Over-travel inhibit input setup” = 2.
Handling	Check that there are no anomalies with the switches, cables or power supply connected to the positive direction over-travel inhibit input/negative direction over-travel inhibit input. In particular, check that the rise in the control signal power supply (12 to 24 V DC) is not delayed.

Err38.1.0 “Over-travel inhibit input protection 2”

Primary cause	● An operating command (trial run, frequency characteristics analysis function (FFT function), etc.) was received from Set-up Support Software (PANATERM ver.7) while Pr5.04 “Over-travel inhibit input setup” = 0 and RTEX communication is in an off state and either POT or NOT are in an on state. ● POT or NOT was turned on while an operating command from Set-up Support Software (PANATERM ver.7) was in operation.
Handling	Check that there are no anomalies with the switches, cables or power supply connected to the positive direction/negative direction over-travel inhibit input. In particular, check that the rise in the control signal power supply (12 to 24 V DC) is not delayed.

Err38.2.0 “Over-travel inhibit input protection 3”

Primary cause	POT or NOT was set to a value other than Pr5.04 “Over-travel inhibit input setup” = 1 (disabled) while the assignment function implemented any of SI5 to SI7.
Handling	Check that Pr5.04 “Over-travel inhibit input setup” = 1 (disabled) is configured.

Err39.0.0 “Analog input (AIN) excess protection”

Primary cause	A voltage higher than that set in Pr4.24 “Analog input (AIN) excessive setting” was applied to analog input.
Handling	● Correctly configure Pr4.24 “Analog input (AIN) excessive setting” correctly. ● Check the connection status of the input/output connector. ● Set Pr4.24 to 0 and disable the protection function.

Err40.0.0 “Absolute system down error protection”

Primary cause	1 The power supply to the absolute encoder and the battery power supply are down and the built-in capacitor voltage dropped below the specified value. 2 The absolute encoder has not been cleared even once by the batteryless absolute encoder.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Connect the absolute encoder battery and then clear the absolute encoder (battery backup). 2 Clear the batteryless absolute encoder. For absolute encoder clearing operation, see *“2.4.3 Setup (Initialization) of Absolute Encoder”* .

Err41.0.0 “Absolute counter over error protection”

Primary cause	The multi-turn counter of the absolute encoder has exceeded the specified value.
Handling	● Clear the absolute encoder near the center of the movable range such that the amount of movement from the center of the movable range is within 32765 rotations. ● Change Pr0.15 “Absolute encoder setup” to the setting value 2 (absolute system: ignore multi-turn counter over), and consider monitoring the multi-turn data with the host device.

Err42.0.0 “Absolute overspeed error protection”

Primary cause	If this happens while using an absolute encoder (battery backup), consider the following causes. 1 The motor rotational speed has exceeded the specified value when only battery power is being supplied during a power failure. 2 The encoder power has been interrupted for some reason during normal operation and switched to power failure mode, and the rotational speed has exceeded the specified value. **Notes** ● This does not happen with a batteryless absolute encoder.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. To clear the alarm, in addition to performing the following actions, the absolute encoder must be cleared. For absolute encoder clearing operation, see *“2.4.3 Setup (Initialization) of Absolute Encoder”* . 1 Check whether there is external drive during the power failure and check the rotational speed if there is, and operate at a speed below the specified value. 2 Take the following actions. ● Check the power supply voltage (5 V ±5%) on the encoder side. ● Check the connection status of the Connector X6.

Err44.0.0 “Single-turn counter error protection”

Primary cause	A single-turn counter error has been detected.
Handling	Replace the motor with a new one. Return the motor that generated the alarm to the vendor for examination (repair).

Err45.0.0 “Multi-turn counter error protection”

Primary cause	A multi-turn counter error has been detected.
Handling	Replace the motor with a new one. Return the motor that generated the alarm to the vendor for examination (repair).

Err47.0.0 “Absolute status error protection”

Primary cause	The encoder turned more than the specified value during power-up.
Handling	Set so that the motor does not operate during power-up.

Err50.0.0 “External scale wiring error protection”

Primary cause	Communication between the external scale and this product has been interrupted more than a set number of times, triggering the disconnection detecting function.
Handling	● Wire the external scale wiring according to the connections. ● Reconnect connector pins connected incorrectly.

Err50.1.☐ “External scale communication error protection”

● Err50.1.0 to Err50.1.2 “External scale communication error protection”

Primary cause	This is primarily a data error due to noise. ● There is a communication error in data from the external scale. ● The external scale connection cable is connected but there is an error in the communication data.
Handling	● Keep the external scale power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the external scale connection cable is long. ● If the motor cables and external scale connection cable are bundled together, separate them. ● Connect shielding to FG. For details on wiring, see *“3.2.6 Wiring to Connector X5 (Connecting to External Scale)”* .

Err50.2.0 “External scale communication data error protection”

Primary cause	This is primarily a data error due to noise. ● There was an error in communication data from the external scale even though there was not a communication error. ● The external scale connection cable is connected but there is an error in the communication data.
Handling	● Keep the external scale power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the external scale connection cable is long. ● If the motor cables and external scale connection cable are bundled together, separate them. ● Connect shielding to FG. For details on wiring, see *“3.2.6 Wiring to Connector X5 (Connecting to External Scale)”* .

Err51.0.0 “External scale status error protection 0”

Primary cause	1 was returned for bit 0 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.1.0 “External scale status error protection 1”

Primary cause	1 was returned for bit 1 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.2.0 “External scale status error protection 2”

Primary cause	1 was returned for bit 2 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.3.0 “External scale status error protection 3”

Primary cause	1 was returned for bit 3 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.4.0 “External scale status error protection 4”

Primary cause	1 was returned for bit 4 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.5.0 “External scale status error protection 5”

Primary cause	1 was returned for bit 5 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.8.0 “External scale and other error protection”

Primary cause	An external scale error clear command was issued.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err55.0.0 “A-phase connection error protection”

Primary cause	An error, such as a broken wire, has occurred in the A-phase wiring of the external scale.
Handling	Check the A-phase wiring of the external scale.

Err55.1.0 “B-phase connection error protection”

Primary cause	An error, such as a broken wire, has occurred in the B-phase wiring of the external scale.
Handling	Check the B-phase wiring of the external scale.

Err55.2.0 “Z-phase connection error protection”

Primary cause	An error, such as a broken wire, has occurred in the Z-phase wiring of the external scale.
Handling	Check the Z-phase wiring of the external scale.

Err68.☐.☐ “Internal communication processing error protection☐”

- Err68.0.0 “Internal communication processing error protection1”
- Err68.3.0 to Err68.3.3 “Internal communication processing error protection4”
- Err68.5.0 “Internal communication processing error protection6”
- Err68.6.0 “Internal communication processing error protection7”
- Err68.7.0 “Internal communication processing error protection8”
- Err68.8.0 “Internal communication processing error protection9”
- Err68.9.0 “Internal communication processing error protection10”
- Err68.10.0 “Internal communication processing error protection11”
- Err68.11.0 “Internal communication processing error protection12”
- Err68.14.0 “Internal communication processing error protection15”
- Err68.19.0 “Internal communication processing error protection20”
- Err68.21.0 “Internal communication processing error protection22”

Primary cause	An error has occurred in the internal microcomputer-to-microcomputer communication.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err70.0.0 “U-phase current detector error protection 1”

Primary cause	● There is an error in the U-phase current detection offset value.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err70.0.1 “U-phase current detector error protection 2”

Primary cause	Detected U-phase current sticking.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err70.1.0 “W-phase current detector error protection 1”

Primary cause	● There is an error in the W-phase current detection offset value.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err70.1.1 “W-phase current detector error protection 2”

Primary cause	Detected W-phase current sticking.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err72.0.0 “Thermal error protection”

Primary cause	A thermal error has occurred.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err75.0.☐ “External memory access error protection”

● Err75.0.0 to Err75.0.1 “External memory access error protection”

Primary cause	An error occurred in the access process with peripheral components.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err77.0.0 “Microcomputer error protection 1”

Primary cause	An error has occurred in the internal microcontroller.

Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err77.2.0 “Microcomputer error protection 3”

Primary cause	An error has occurred in the internal microcontroller.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err77.6.0 “Microcomputer error protection7”

Primary cause	An error has occurred in the internal microcontroller.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err80.3.0 “Incomplete PLL error protection”

Primary cause	Phase lock (PLL lock) between RTEX communication synchronization could not be completed even when one second had elapsed since the start of the synchronization process.
Detection timing	● While the RTEX communication IC status is RUNNING ● During synchronous RTEX communication establishment process execution
Internal processing upon detection	● RTEX communication cannot be established (stopped with synchronization incomplete). ● RTEX communication IC status transitions to INITIAL.
Handling	● Confirm that the communication cycle set in Pr7.20 “RTEX communication cycle setup” and Pr7.91 “RTEX communication cycle expansion setup” matches the transmission cycle from the host device. ● Confirm that the synchronous mode among multiple axis in Pr7.22 “RTEX function expansion setup 1” :bit 1 matches the setting of the host device. ● Confirm that there are no problems in processing on the host device side. ● Confirm that there have been no errors in cycles in which RTEX communication data is sent from the host device. ● Set the precision of the cycles in which RTEX communication data is sent from the host device to within ±0.05 %. ● If the communication cycle is 250 μs or less, the Update_Counter must be changed correctly even when the command update cycle is the same time as the communicate cycle. Confirm that there is no problem with the Update_Counter. ● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).
Alarm clear	○
COM-R LED display	Blinking red

Err82.0.0 “RTEX node address setting error protection”

Primary cause	The rotary switch value for node address setting was set to a value other than 0 to 31.
Detection timing	● When turning the control power of the product on ● When restarting using a reset command
Internal processing upon detection	● RTEX communication cannot be established (stopped with initialization incomplete). ● The RTEX communication IC status continues to be (or transitions to) INITIAL.
Handling	● Check the rotary switch value for node address setting. ● After correctly setting the rotary switch value for node address setting (0 to 31), restart the control power for the product.
Alarm clear	×
COM-R LED display	Red light

Err83.0.0 “RTEX continuous communication error protection 1”

Primary cause	An error (CRC error) that occurred during reading of received data addressed to the local node persisted for the number of times set for Pr7.95 “RTEX continuous communication error protection 1 detection count” .
Detection timing	● While the RTEX communication IC status is RUNNING ● When reading received data by communication cycle
Internal processing upon detection	● Received data is discarded. ● Data received during the previous normal status is used in processing (with an alarm on the servo-side). ● The response is returned with byte 1 as FFh. ● The RTEX communication IC status continues to be RUNNING. **Notes** ● Commands such as alarm clear can be received if received normally after an alarm is triggered, since communication continues.
Handling	● Confirm that excessive noise is not being applied to the communication cable. ● Confirm that there are no problems with the communication cable wiring length, layout arrangement, connection status, etc. ● Confirm that the communication cable is a shielded twisted pair (STP) of category CAT5e or higher as prescribed in the TIA/EIA-568 standard. ● Replace the communication cable with a new one. ● Attach a ferrite core to the communication cable. ● Increase the value set for Pr7.95 “RTEX continuous communication error protection 1 detection count” .
Alarm clear	○
COM-R LED display	Blinking red

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	95	R	RTEX continuous communication error protection 1 detection count	0 to 17	Incidences	Sets the RTEX continuous communication error protection 1 detection count. Err83.0.0 “RTEX continuous communication error protection 1” is triggered if a persistent CRC error greater than or equal to the setup value for this parameter occurs. When this parameter setting is 0 or 1, it is set to 2 internally.

*1 For attributes, see *"6.3 List of Parameters"* .

Err83.1.0 “RTEX continuous communication error protection2”

Primary cause	An error (CRC error, receiving failure, or cyclic data error) that occurred during reading of received data addressed to the local node persisted for the number of times set for Pr7.96 “RTEX continuous communication error protection 2 detection count” . An alarm is detected even when errors (CRC errors, receiving failures, or cyclic data errors) occur one after another.
Detection timing	● While the RTEX communication IC status is RUNNING ● When reading received data by communication cycle **Notes** ● Only receiving failures are detected when synchronization is established.
Internal processing upon detection	● Received data is discarded. ● Data received during the previous normal status is used in processing (with an alarm on the servo-side). ● The response is returned with byte 1 as FFh. ● The RTEX communication IC status continues to be RUNNING. **Notes** ● Since communication continues, commands such as alarm clear can be received if received normally after an alarm is triggered.
Handling	● Confirm that excessive noise is not being applied to the communication cable. ● Confirm that there are no problems with the communication cable wiring length, layout arrangement, connection status, etc. ● Confirm that the communication cable is a shielded twisted pair (STP) of category CAT5e or higher as prescribed in the TIA/EIA-568 standard. ● Replace the communication cable with a new one. ● Attach a ferrite core to the communication cable. ● Increase the value set for Pr7.96 “RTEX continuous communication error protection 2 detection count” .
Alarm clear	○
COM-R LED display	Blinking red

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	96	R	RTEX continuous communication error protection 2 detection count	0 to 17	Incidences	Sets the RTEX continuous communication error protection 2 detection count. Err83.1.0 “RTEX continuous communication error protection2” is triggered when an interrupt processing omission, CRC error, MAC-ID error, C/R error, or cyclic data error occurs persistently for more than the setup value for this parameter. When this parameter setting is 0 or 1, it is set to 2 internally.

*1 For attributes, see *“6.3 List of Parameters”* .

Err84.0.0 “RTEX communication timeout error protection”

Primary cause	The number of incidences set with Pr7.97 “RTEX communication timeout error protection detection count” continues when communication data has not been received and the RTEX communication IC is not outputting the receipt interrupt processing initialization signal (receiving failure).
Detection timing	● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● When reading out communication data by communication cycle
Internal processing upon detection	● Data received during the previous normal status is used in processing until alarm detection. ● After alarm detection, RTEX communication IC status transitions to INITIAL. ● RTEX communication synchronization established status transitions to not-established status. **Notes** ● Since communication stopped, communication establishment processing must be re-executed by the host device.
Handling	● Confirm that the communication cable is not broken. ● Confirm that transmission by the upstream node is not disabled (power off, reset, etc.). **Notes** ● To identify the locations of abnormalities, see Technical Reference Communication Specification . ● Confirm that there have been no errors in cycles in which RTEX communication data is sent from the host device. ● Confirm that the communication cycle set in Pr7.20 “RTEX communication cycle setup” and Pr7.91 “RTEX communication cycle expansion setup” matches the transmission cycle from the host device. ● Confirm that excessive noise is not being applied to the communication cable. ● Confirm that there are no problems with the communication cable wiring length, layout arrangement, connection status, etc. ● Confirm that the communication cable is a shielded twisted pair (STP) of category CAT5e or higher as prescribed in the TIA/EIA-568 standard. ● Replace the communication cable with a new one. If the frequency of occurrence changes when the communication cable is replaced, there may be bad contact with the connector. Use a connector plug from a different manufacturer. If a connector socket on the product side is suspected to be faulty, replace with a new servo driver. ● Attach a ferrite core to the communication cable. ● Increase the value set for Pr7.97 “RTEX communication timeout error protection detection count” .
Alarm clear	○
COM-R LED display	Blinking red

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	97	R	RTEX communication timeout error protection detection count	0 to 17	Incidences	Sets the RTEX communication timeout error protection detection count. When this parameter setting is 0 or 1, it is set to 2 internally.

*1 For attributes, see *“6.3 List of Parameters”* .

Err84.3.0 “RTEX communication synchronization error protection”

Primary cause	An error occurred in the internal synchronization process.
Detection timing	● After completion of servo driver initialization ● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● During synchronous RTEX communication establishment process execution
Internal processing upon detection	During synchronous RTEX communication establishment process execution ● RTEX communication cannot be established (stopped with initialization incomplete). ● The RTEX communication IC status continues to be (or transitions to) INITIAL. RTEX communication synchronization established status ● Data received during the previous normal status is used in processing until alarm detection. ● After alarm detection, RTEX communication IC status transitions to INITIAL. ● RTEX communication synchronization established status transitions to not-established status.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Alarm clear	×
COM-R LED display	Red light

Err84.5.0 “RTEX communication cycle error protection”

Primary cause	A receive interrupt startup signal was received from the RTEX communication IC, but there was an error in the output cycle, and RTEX communication was out of sync.
Detection timing	● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● When a receive interrupt startup signal is output
Internal processing upon detection	● Data received during the previous normal status is used in processing until alarm detection. ● After alarm detection, RTEX communication IC status transitions to INITIAL. ● RTEX communication synchronization established status transitions to not-established status. **Notes** ● Since communication stopped, communication establishment processing must be re-executed by the host device.
Handling	● Confirm that there have been no errors in cycles in which RTEX communication data is sent from the host device. ● Confirm that the communication cycle set in Pr7.20 “RTEX communication cycle setup” and Pr7.91 “RTEX communication cycle expansion setup” matches the transmission cycle from the host device. ● Confirm that excessive noise is not being applied to the communication cable. ● Confirm that there are no problems with the communication cable wiring length, layout arrangement, connection status, etc. ● Confirm that the communication cable is a shielded twisted pair (STP) of category CAT5e or higher as prescribed in the TIA/EIA-568 standard. ● Replace the communication cable with a new one. ● Attach a ferrite core to the communication cable.
Alarm clear	○
COM-R LED display	Blinking red

Err85.0.0 “Retracting operation completion (I/O)”

Primary cause	Triggered when the I/O retracting operation completes normally. The alarm generated during the retracting operation is switched by Pr6.86:bit 15 “Retracting operation-related alarm switching” .
Handling	This is a safety measure to notify the operator that the retracting operation has been run, and is not a problem as long as the retracting operation was intended. Be sure to run homing after clearing the alarm.

Err85.1.0 “Retracting operation completion (communication)”

Primary cause	Triggered when the communication retracting operation completes normally. The alarm generated during the retracting operation is switched by Pr6.86:bit 15 “Retracting operation-related alarm switching” .
Handling	This is a safety measure to notify the operator that the retracting operation has been run, and is not a problem as long as the retracting operation was intended. Be sure to run homing after clearing the alarm.

Err85.2.0 “Retracting operation error”

Primary cause	Issued in cases such as the following when a retracting operation cannot be executed or is interrupted. ● When the Pr6.85 “Retracting operation condition setting” setting has an error ● When the retracting operation is enabled and the communication cycle is set to less than 250 μs ● When over-travel inhibit input (POT, NOT) or retracting operation stop input (STOP) has been detected during the retracting operation ● When main power OFF (when Pr6.85 “Retracting operation condition setting” :bits 0 to 3 are not 3), servo-off, or an alarm is triggered, or STO is input during the retracting operation ● When retracting operation execution conditions were fulfilled while over-travel inhibit input (POT, NOT) or retracting operation stop input (STOP) was detected ● When retracting operation execution conditions were fulfilled during operations (trial run or frequency measurement functions) other than communication commands from the host ● When the retracting operation could not be started due to something like a servo-off state The alarm generated during the retracting operation is switched by Pr6.86:bit 15 “Retracting operation-related alarm switching” .
Handling	● Check that there are no problems with the parameter settings. ● Check that there are no problems with the operating environment. ● Be sure to run homing after clearing the alarm.

Err86.0.0 “RTEX cyclic data error protection 1” , Err86.1.0 “RTEX cyclic data error protection 2”

<table>
<tr><td>Primary cause</td><td>
● There is an error in cyclic command area data (C/R, MAC-ID, or cyclic command).
● There continued to be an error in Sub_Chk while in 32-byte mode for the number of times set for Pr7.98 “RTEX cyclic data error protection 1/2 detection count” .
<table>
<tr><th>Alarm number</th><th colspan="2">Detection site</th><th>Primary cause</th></tr>
<tr><td rowspan="3">Err86.0.0 “RTEX cyclic data error protection 1”</td><td>byte 0:bit 4 to 0</td><td>MAC-ID</td><td>Does not match the rotary switch setup value.</td></tr>
<tr><td>byte 0:bit 7</td><td>C/R</td><td>Set to 1.</td></tr>
<tr><td>byte 16:bit 7</td><td>Sub_Chk</td><td>Set to 0.</td></tr>
<tr><td>Err86.1.0 “RTEX cyclic data error protection 2”</td><td>byte 1:bit 6 to 4</td><td>Cyclic command</td><td>Undefined.</td></tr>
</table>
</td></tr>
<tr><td>Detection timing</td><td>
● While the RTEX communication IC status is RUNNING
● RTEX communication synchronization established status
● When reading received data by RTEX communication cycle
</td></tr>
<tr><td>Internal processing upon detection</td><td>
● A command error occurred together with an alarm issuance.
<table>
<tr><th>Alarm number</th><th colspan="2">Detection site</th><th>Error_Code</th></tr>
<tr><td rowspan="3">Err86.0.0 “RTEX cyclic data error protection 1”</td><td>byte 0:bit 4 to 0</td><td>MAC-ID</td><td>0011h</td></tr>
<tr><td>byte 0:bit 7</td><td>C/R</td><td rowspan="2">0012h</td></tr>
<tr><td>byte 16:bit 7</td><td>Sub_Chk</td></tr>
<tr><td>Err86.1.0 “RTEX cyclic data error protection 2”</td><td>byte 1:bit 6 to 4</td><td>Cyclic command</td><td>0021h</td></tr>
</table>
Notes
● For details of command errors, refer to Technical Reference Communication Specification .
● Received data is discarded.
● Data received during the previous normal status is used in processing (with an alarm on the servo-side).
● The RTEX communication IC status continues to be RUNNING.
Notes
● Commands such as alarm clear can be received if received normally after an alarm is triggered, since communication continues.
</td></tr>
<tr><td>Handling</td><td>
● Confirm that there are no errors in cyclic command area data (the aforementioned detection site).
● Confirm that there are no problems in processing on the host device side.
● Increase the value set for Pr7.98 “RTEX cyclic data error protection 1/2 detection count” .
</td></tr>
<tr><td>Alarm clear</td><td>○</td></tr>
<tr><td>COM-R LED display</td><td>Blinking red</td></tr>
</table>

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	98	R	RTEX cyclic data error protection 1/2 detection count	0 to 17	Inci-den-ces	Sets the RTEX cyclic data error protection 1 detection count and RTEX cyclic data error protection 2 detection count. Err86.0.0 “RTEX cyclic data error protection 1” or Err86.1.0 “RTEX cyclic data error protection 2” is triggered if a persistent cyclic error greater than or equal to the set-up value for this parameter occurs. When this parameter setting is 0 or 1, it is set to 2 internally.

*1 For attributes, see *“6.3 List of Parameters”* .

Err86.2.0 “RTEX_Update Counter error protection”

Primary cause	Update_Counter was not updated normally due to the cumulative total exceeding the number of times set for Pr7.38 “RTEX_Update_Counter error protection setup” . If Pr7.38 “RTEX_Update_Counter error protection setup” is 0 or 1, this alarm is disabled. **— Precautions —** ● Note that this alarm indicates that a mismatch in command update cycle has been detected between the host device and this product, and normal detection is therefore impossible unless the communication cycles match.
Detection timing	● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● When reading out received data by command update cycle
Internal processing upon detection	● The data received is incorporated as it is. ● The RTEX communication IC status continues to be RUNNING. ● RTEX communication synchronization established status continues.
Handling	● Confirm that there are no problems in processing on the host device side. ● Check whether there is a problem with cycle settings on the host device side or with the cycle settings of this product. ● Increase the value set for Pr7.38 “RTEX_Update_Counter error protection setup” . ● If the Update_Counter is not used with the ratio of the communication cycle to the command update cycle at 1:1, set Pr7.38 “RTEX_Update_Counter error protection setup” = 0 or 1 so that this alarm is not triggered.
Alarm clear	×
COM-R LED display	Red light

Err87.0.0 “Forced alarm input protection”

Primary cause	Forced alarm input (E-STOP) has been entered.
Handling	If this alarm occurs unintentionally, check the wiring as the input state of the forced alarm input (E-STOP) may be in an unintended state.

Err87.1.0 “Retracting operation completion (I/O)”

Primary cause	The I/O retracting operation has been completed normally.

Handling	This is a safety measure to notify the operator that the retracting operation has been run, and is not a problem as long as the retracting operation was intended. Be sure to run homing after clearing the alarm.

Err87.2.0 “Retracting operation completion (communication)”

Primary cause	The communication retracting operation has been completed normally.
Handling	This is a safety measure to notify the operator that the retracting operation has been run, and is not a problem as long as the retracting operation was intended. Be sure to run homing after clearing the alarm.

Err87.3.☐ “Retracting operation error”

● Err87.3.0 to Err87.3.6 “Retracting operation error”

Primary cause	Issued in the following cases when retracting operation execution is disabled. ● When the Pr6.85 “Retracting operation condition setting” setting has an error ● When the retracting operation is enabled and the communication cycle is set to less than 250 μs ● When over-travel inhibit input (POT, NOT) or retracting operation stop input (STOP) has been detected in the retraction direction during the retracting operation ● When main power OFF (when Pr6.85:bits 0 to 3 are not 3), servo-off, when an alarm is triggered, or if STO is input during the retracting operation ● When retracting operation execution conditions were met while over-travel inhibit input (POT, NOT) or retracting operation stop input (STOP) was detected in the retraction direction ● When retracting operation execution conditions were fulfilled during operations (trial run function or frequency measurement function) other than communication commands from the host ● When the retracting operation could not be started due to something like a servo-off state The alarm generated during the retracting operation is switched by Pr6.86:bit 15 “Retracting operation-related alarm switching” .
Handling	● Check that there are no problems with the parameter settings. ● Check that there are no problems with the operating environment. ● Be sure to run homing after clearing the alarm.

Err90.2.0 “RTEX multi-axis synchronization error protection”

Primary cause	A communication error occurred or communication was lost while transitioning to synchronization establishment in full-synchronous mode.
Detection timing	● While the RTEX communication IC status is RUNNING ● Transitioning to RTEX communication synchronization establishment
Internal processing upon detection	● After alarm detection, RTEX communication IC status transitions to INITIAL. ● RTEX communication synchronization not established status
Handling	Take the same action as for Err83.0.0 “RTEX continuous communication error protection 1” or Err84.0.0 “RTEX communication timeout error protection” .
Alarm clear	×
COM-R LED display	Red light

Err91.1.0 “RTEX Command error protection”

Primary cause	Issued when a cyclic command is defined (byte 1:bits 6 to 4), but is not received normally. ● The control mode does not support parameters that are in the supported mode table (for communication cycle, semi-closed or full-closed ,16-byte mode, or 32-byte mode). For the Supported Mode Table, see *“4.1.4 Supported Mode Table”* . ● The control mode was switched in a cycle shorter than 2 ms. ● The control mode was switched during a profile position latch positioning or profile homing (Type_Code = 12h, 13h, 31h, 32h, 33h, 34h, or 36h) operation. ● The control mode was switched during non-cyclic command processing (Busy = 1). ● A homing command (□4h) was executed during a profile position latch positioning or profile homing (Type_Code = 12h, 13h, 31h, 32h, 33h, 34h, or 36h) operation. ● The initialization mode (Type_Code = 1□h or 31h) of a homing command (□4h) was executed during a profile positioning or profile continuous rotation (Type_Code = 10h, 11h or 20h) operation. ● Type_Code was changed during profile position control (PP). ● Homing commands (□4h) Type_Code = 1□h, 2□h were executed during velocity control (CV) or torque control (CT). ● There was a switch to velocity control (CV) or full-closed control during two-degree-of-freedom control mode (synchronization type). ● Was set to two-degree-of-freedom control mode (synchronization type) during velocity control (CV) or full-closed control. ● A Trial Run with Set-up Support Software (PANATERM ver.7) was executed when the communication cycle is 62.5 μs.
Detection timing	● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● When reading received data by communication cycle
Internal processing upon detection	● A command error occurred together with an alarm issuance. **Notes** ● For details of command errors, refer to Technical Reference Communication Specification . ● The RTEX communication IC status continues to be RUNNING.
Handling	Confirm that there are no problems with host device processing. ● Let 2 ms or more elapse after control mode switching before switching to the next mode. ● Confirm the compatibility of the executed functions with the control mode. For compatibility, see *“4.1.4 Supported Mode Table”* . ● When executing a trial run using Set-up Support Software (PANATERM ver.7) , set the communication cycle to 125 μs or more. Etc.
Alarm clear	○
COM-R LED display	Blinking red

Err91.3.0 “RTEXCommand error protection2”

Primary cause	Issued when the timing of a homing cancellation does not enable cancellation during homing command execution. ● The host device canceled one of the following homing commands during position information initialization processing immediately before homing completion. • CP homing when command code = 20h • PP homing when a HardStop command is received • PP homing when a SmoothStop command is received ● If any of the following homing cancellations has occurred during a return operation immediately after home detection for PP homing. • When a HardStop command is received • When a SmoothStop command is received • When a servo-off command is received • When main power off is detected • When STO is detected • When an alarm is detected • When both POT and NOT signals are detected • When HOME signal OFF is detected in HOME + Z-phase (type code = 31h)
Detection timing	● During position information initialization processing immediately before homing completion ● During the return operation after home detection for PP homing
Internal processing upon detection	● Latch mode with stop function is canceled. ● Homing is canceled. ● The RTEX communication IC status continues to be RUNNING. **Notes** ● Commands such as alarm clear can be received if received normally after an alarm is triggered, since communication continues. ● RTEX communication synchronization established status continues.
Handling	● Check whether homing command is being canceled in proximity to the home signal. (We recommend stopping the motor before canceling.)
Alarm clear	○
COM-R LED display	Blinking red

Err92.0.0 “Encoder data recovery error protection”

Primary cause	The internal position information initialization process was not executed normally when in semi-closed control and absolute mode.
Handling	● Keep the encoder power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the encoder cables are long. ● If the motor cables and encoder cables are bundled together, separate them. ● Connect shielding to FG.

Err92.1.0 “External scale data recovery error protection”

Primary cause	The internal position information initialization process was not executed normally when in full-closed control and absolute mode.
Handling	● Keep the external scale power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the external scale connection cable is long. ● If the motor cables and external scale connection cable are bundled together, separate them. ● Connect shielding to FG. See *“3.2.6 Wiring to Connector X5 (Connecting to External Scale)”* .

Err92.3.☐ “Multi-turn data upper limit value disagreement error protection”

● Err92.3.0 to Err92.3.2 “Multi-turn data upper limit value disagreement error protection”

Primary cause	In continuous rotating absolute encoder mode, the encoder multi-turn data upper-limit value does not agree with the multi-turn data upper-limit value for the driver parameters.
Handling	Check the parameter setup values.

Err93.0.0 “Parameter setup error protection 1”

Primary cause	The electronic gear ratio exceeded the allowable range.
Handling	Check the value set for the parameter, and set it so that the electronic gear ratio is in the range of 1/1000 to 128000 times.

Err93.2.0 “Parameter setup error protection 2”

Primary cause	The external scale ratio was outside the allowable range.
Handling	Check the value set for the parameter, and set it so that it is in the range of 1/40 ≦ External scale ratio ≦ 20480.

Err93.3.☐ “External scale connection error protection”

● Err93.3.0 to Err93.3.5 “External scale connection error protection”

Primary cause	● The value set for Pr3.23 “External scale selection” does not match the external scale type for the connected serial communication type.
Handling	● Set Pr3.23 “External scale selection” in accordance with the connected external scale type. ● Review the setting of Pr3.23 “External scale selection” .

Err93.5.0 “Parameter setup error protection 4”

Primary cause	1 Pr7.20 “RTEX communication cycle setup” , Pr7.91 “RTEX communication cycle expansion setup” , Pr7.21 “RTEX command updating cycle ratio setup” and Pr7.22 “RTEX function expansion setup 1” :bit 0 “RTEX communication data size” combination conditions are not supported. 2 Pr7.35 to Pr7.37 feedforward settings are overlapping.
Handling	Check the parameter setup values. For the correct setting conditions, see *“4.1.4 Supported Mode Table”* .

Err93.8.0 “Parameter setup error protection 6”

Primary cause	● Set to continuous rotating absolute encoder mode with anything other than a 27-bit or 23-bit resolution absolute encoder. ● The absolute home position offset was set to a value exceeding the upper-limit value of the command position in continuous rotating absolute encoder mode. ● The upper-limit values for actual position and command position were set to 2^{31} or more in continuous rotating absolute encoder mode. ● The virtual full-closed control mode setting is valid, but is not a full-closed control mode setting (Pr0.01 = 6). ● The virtual full-closed control mode setting is valid, but an absolute type external scale type was not set.
Handling	Check the parameter setup values.

Err94.2.0 “Homing error protection”

Primary cause	An error occurred during the profile homing operation.
Handling	Confirm that there are no errors in sensor settings, etc.

Err94.3.0 “Homing error protection 2”

Primary cause	● Either positive direction or negative direction over-travel inhibit input (POT or NOT) was turned ON during the return operation to the Z-phase position detected during homing using Z-phase when Pr7.41 “RTEX function expansion setup 5” :bit 7 = 1. ● An error occurred in EEPROM writing of Pr7.13 “Absolute home position offset” during a homing operation in absolute mode.
Handling	● Increase the distance between the Z-phase and the positive direction over-travel inhibit input (POT)/negative direction over-travel inhibit input (NOT). ● After ensuring safety, set Pr7.41:bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 0 (disabled). ● Clear the alarm, then re-run the homing operation. If the alarm still occurs after performing the homing operation again, this product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err95.☐.0 “Motor automatic recognition error protection ☐”

Primary cause	The motor and this product do not match.
Handling	Replace the motor with one that matches this product.

Err96.4.0 “Host controller error protection 3”

Primary cause	An error occurred in the host controller of this product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
7	108	R	RTEX communication synchronization setup	0 to 7	—	Sets the tolerance value for delays that occur during driver transmission and reception processing when delays occur due to factors such as unstable transmission timings from the host device. If delays in driver transmission and reception processing are unacceptable, setting this parameter to 0 (expansion settings) will trigger Err96.4.0 when a delay is encountered. 0: Expansion setup 1 to 6: Manufacturer use 7: Normal setup

*1 For attributes, see *“6.3 List of Parameters”* .

Err96.6.0 “Host controller error protection 5”

Primary cause	An error occurred in the host controller of this product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err98.□.0 “RTEXHardware error protection □”

● Err98.1.0 to Err98.3.0 “RTEXHardware error protection □”

Primary cause	An error occurred in the internal RTEX communication circuit.
Detection timing	● When turning the control power of the product on ● When restarting using a reset command
Internal processing upon detection	● RTEX communication cannot be established (stopped with initialization incomplete). ● The RTEX communication IC status continues to be (or transitions to) INITIAL.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Alarm clear	×
COM-R LED display	Red light

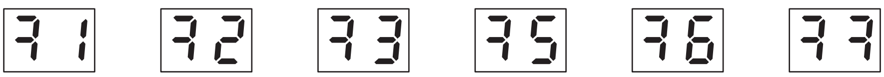
Err98.5.0 “Hardware self-diagnostic error protection 1”

Primary cause	● The current detector has malfunctioned.
Handling	Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Other numbers “Other error protection”

Primary cause	● The control circuit has malfunctioned due to excessive noise, etc. ● The self-diagnosis function of this product was started and an error of some kind occurred inside this product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Special 7-segment display “System error protection”

Front panel display: 

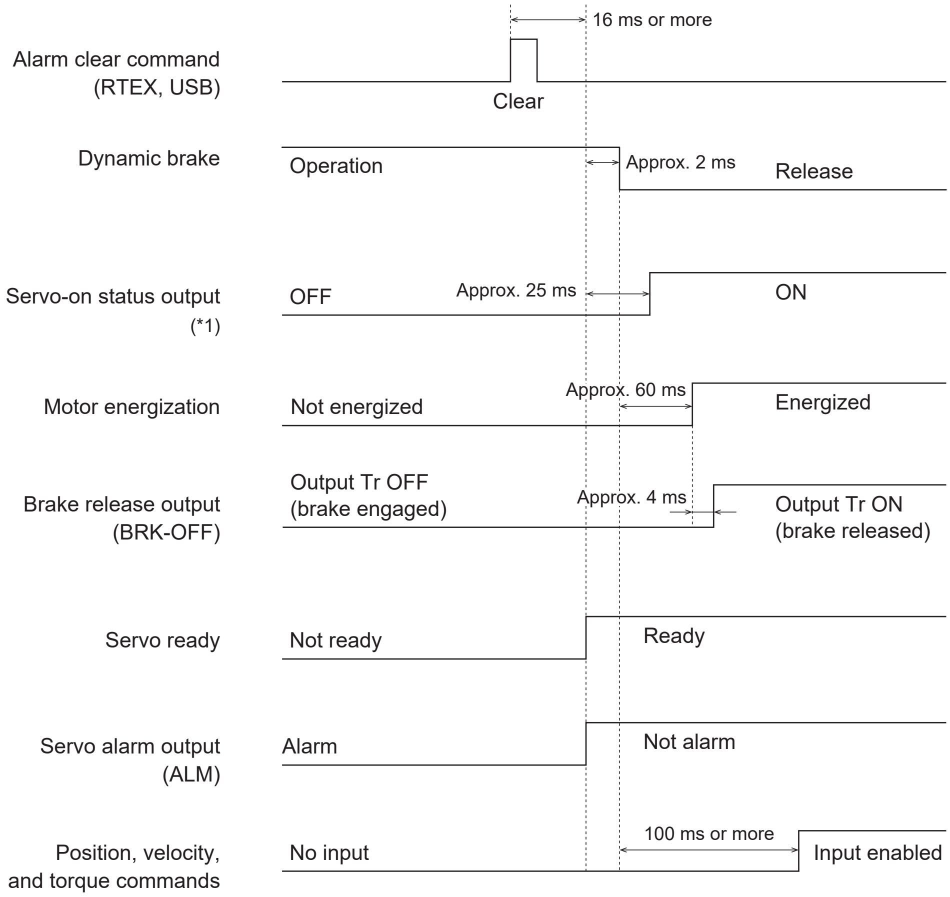
For details, see *“3.2.5.5.1 Control Output Signal”* of *“Precautions”* “5”.

Primary cause	An error has occurred inside the product.

Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

10.2.4 Timing Chart

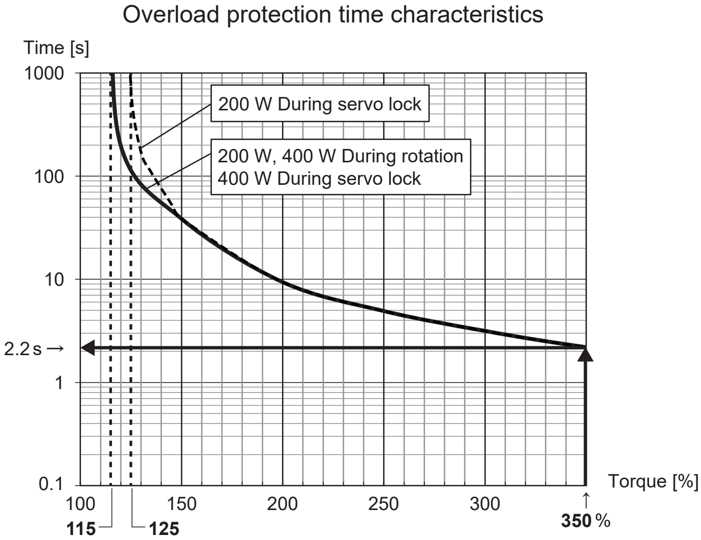
The operation timing chart when clearing an alarm (servo-on command state) is shown below.



*1 Note that the servo-on status output is a signal indicating that a servo-on command has been received and is not an output indicating that a command input is possible.

10.2.5 Overload Protection Time Characteristics Confirmation Method

When operating a motor within its instantaneous operating range, use it for less than the time on the overload protection time characteristics curve.



The above figure shows the overload protection time characteristics curve for a 200 W motor. If the motor is instantaneously made by a command (torque limit) from the driver to output 350% torque, which is outside the continuous operating range, protection is engaged after 2.2 seconds in accordance with the overload protection time characteristic curve and operation is stopped.

For the overload protection time characteristics, see *“2.2.5 Overload Protection Time Characteristics (Motor)”* .

Depending on motor operating condition, the value of Pr5.12 “Motor overload level setup” may not match the value of overload load factor when Err16.0.0 “Overload protection” occurs.

Similarly, the values of Pr6.95 “Motor overload warning detection level” and Pr6.96 “Motor overload warning release level” may not match the values of overload load factor when WngA0h “Motor overload warning” occurs.

(Example) When characteristics of the dashed line in the figure above (at 200 W servo lock) is performed, overload load factor may exceed Pr5.12 “Motor overload level setup” when Err16.0.0 “Overload protection” occurs.

10.3 Warning Functions

Warning functions generate a warning before a protection function is triggered to alert the operator in advance of a condition, such as an overload.

If use continues in a warning environment, it may stop, reduce life, or failure due to the protection function of the servo drive. Please do not use until the cause of the warning is ruled out.

Warning functions have the following two modes.

- Warning non-latch mode: Mode in which, if the primary cause of the warning is resolved, it is automatically cleared after 1 s and returns to the state before the warning was triggered
- Warning latch mode: Mode in which the warning state is maintained even if the primary cause of the warning is resolved

You can switch between the two modes with Pr6.27 “Warning latch state setup” . The warning state is cleared by the same procedure as used for clearing a protection function alarm. If the primary cause is not resolved, the warning may be cleared but will be detected again.

However, battery warnings are latched on the encoder side. The latch state on the encoder side can be cleared and the warning canceled by clearing the alarm after replacing the battery.

10.3.1 Setup Value

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
4	40	A	Selection of alarm output 1	0 to 32767	—	Selects the warning that is output with Warning output 1 (WARN1). If this setup value is 0, OR output of all warning outputs will be obtained. If this setup value is 1 or more, see *“10.3.2 List of Warning Functions”* .
4	41	A	Selection of alarm output 2	0 to 32767	—	Select the warning that is output with Warning output 2 (WARN2). If this setup value is 0, OR output of all warning outputs will be obtained. If this setup value is 1 or more, see *“10.3.2 List of Warning Functions”* .
5	12	A	Motor overload level setup	0 to 500	%	Sets the motor overload level of effective torque. If this setting value is 0, the motor overload level setup is 115%. Use 0 under normal conditions. Set the level only if using a lower motor overload level. This setting value is restricted to a motor rating of 115%. Values exceeding 115% cannot be set. For details on how to confirm the overload protection time characteristics, see *“10.2.5 Overload Protection Time Characteristics Confirmation Method”* .

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	27	C	Warning latch state setup	0 to 3	–	Sets the warning latch state. General warnings and expanded warnings can be set. ● bit 0: Expanded warnings 0: Non-latch 1: Latch ● bit 1: General warnings 0: Non-latch 1: Latch
6	37	B	Oscillation detecting level	0 to 1000	0.1%	Sets the threshold for oscillation detection. When torque vibration beyond this setting is detected, an oscillation detection warning is activated. When this setup value is 0, this function is disabled and no warning is triggered.
6	38	C	Warning mask setup	-32768 to 32767	–	Set up the warning detection mask. If the corresponding bit is set to 1, detection of the corresponding warning is disabled.
6	39	C	Warning mask setup 2	-32768 to 32767	–	
6	47	R	Function expansion setup 2	-32768 to 32767	–	bit 2: Encoder communication error/warning judgment setup 0: Standard specification (judges errors and warnings using the system specified value) 1: Relaxed specification (judges errors and warnings using twice the system specified value)
6	95	A	Motor overload warning detection level	0 to 114	%	Set the threshold for detecting a warning when the overload load factor has increased. Set the overload load factor. When set to 0, a motor overload warning will be detected according to past conditions (85 % of motor overload level). Motor overload warning detection will also be performed according to past conditions (85 % of motor overload level) when this is set to anything other than “Pr6.96 ≤ Pr6.95 < (motor overload level)”.
6	96	A	Motor overload warning release level	0 to 114	%	Sets the threshold for releasing the warning when the load factor decreases from when the motor overload warning was triggered. Set the overload load factor. When set to 0, a motor overload warning will be detected according to past conditions (85 % of motor overload level). Motor overload warning detection will also be performed according to past conditions (85 % of motor overload level) when this is set to anything other than “Pr6.96 ≤ Pr6.95 < (motor overload level)”.
6	104	B	Open-phase monitoring setup	0 to 3	–	Enables and disables open-phase monitoring setup. 0: Automatic 1: Warning enabled 2: Alarm enabled 3: Disabled
6	126	C	Warning 2 mask setup	-2147483648 to 2147483647	–	Set up the warning detection mask. If the corresponding bit is set to 1, detection of the corresponding warning is disabled.

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	127	C	Warning 3 mask setup	-2147483648 to 2147483647	%	Set up the warning detection mask. If the corresponding bit is set to 1, detection of the corresponding warning is disabled.
7	14	C	Main power off warning detection time	0 to 2000	ms	Set the time until the main power off warning is detected when there is a continuous interruption to the main power supply. When main power off is detected, the RTEX communication status AC_OFF is set to 1. Warning detection is disabled when the setup value is 0 to 9, or 2000.
7	26	A	RTEX continuous communication error warning setup	0 to 32767	Incidences	Sets the number of consecutive communication errors before a communication error warning is detected. If the number of consecutive communication errors exceeds this setting, WngC0h “RTEX continuous communication error warning” is triggered. When this setup value is 0, this function is disabled and no warning is triggered.
7	27	A	RTEX accumulated communication error warning setup	0 to 32767	Incidences	Sets the number of communication errors before a communication error warning is detected. If the number of consecutive communication errors exceeds this setting, WngC1h “RTEX accumulated communication error warning” is triggered. When this setup value is 0, this function is disabled and no warning is triggered.
7	28	A	RTEX_Update_Counter error warning setup	0 to 32767	Incidences	Sets the number of times Update_Counter does not update normally before a communication error warning is detected. If the number of consecutive communication errors exceeds this setting, WngC2h “RTEX_Update_Counter error warning” is triggered. When this setup value is 0 or 1, this function is disabled and no warning is triggered.
7	99	B	RTEX function expansion setup 6	-32768 to 32767	—	bit 0: Enable/disable FFT execution while RTEX communication is established 0: Disabled 1: Enabled

*1 For attributes, see *“6.3 List of Parameters”* .

10.3.2 List of Warning Functions

Warning functions have the following two types.

General warnings: Warnings common to the A7 family

Expanded warnings: Warnings unique to the MINAS A7N Series

A list of warning functions is shown below.

■ General warnings

Warning No. (hex.)	Warning Name	Description	Warning Latch	Output Setting	Warning Mask
			Pr6.27 (*1)	Pr4.40, Pr4.41 (*2)	Pr6.38/ Pr6.39 supported bit (*3)
A0	Motor overload warning	The warning detection specifications vary depending on the values of Pr6.95 “Motor overload warning detection level” and Pr6.96 “Motor overload warning release level” . For details, see the table below. The motor overload warning detection specifications can be switched to the expanded specifications with the settings for Pr6.95 and Pr6.96.	○	1	Pr6.38 bit 7

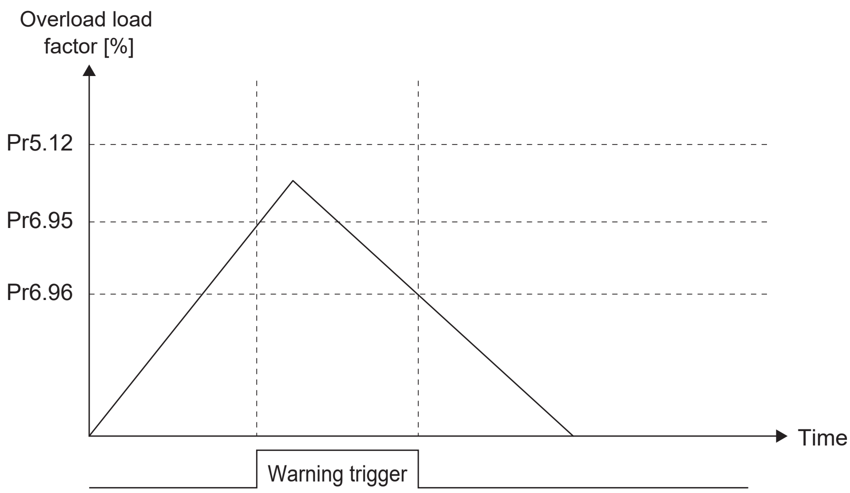
- Details of warning No. A0 (Motor overload warning)

Pr6.95	Pr6.96	Size relationship between Pr6.95 and Pr6.96	Warning detection specifications	Warning release specifications	Remarks
Other than 0	Other than 0	Pr6.95 ≥ Pr6.96	Load factor ≥ Pr6.95	Load factor < Pr6.96	Expanded specification
		Pr6.95 < Pr6.96	Load factor is ≥ 85% of protection level	Load factor is < 85% of protection level	Do not set.
	0	—			
0	Other than 0				
	0				Conventional specifications

- Details on expanded specifications

  The warning latch function is disabled in the expanded specifications.

  - When Pr6.95 “Motor overload warning detection level” and Pr6.96 “Motor overload warning release level” are anything other than 0 and Pr6.96 ≤ Pr6.95 and Pr6.95 < Pr5.12 “Motor overload level setup”

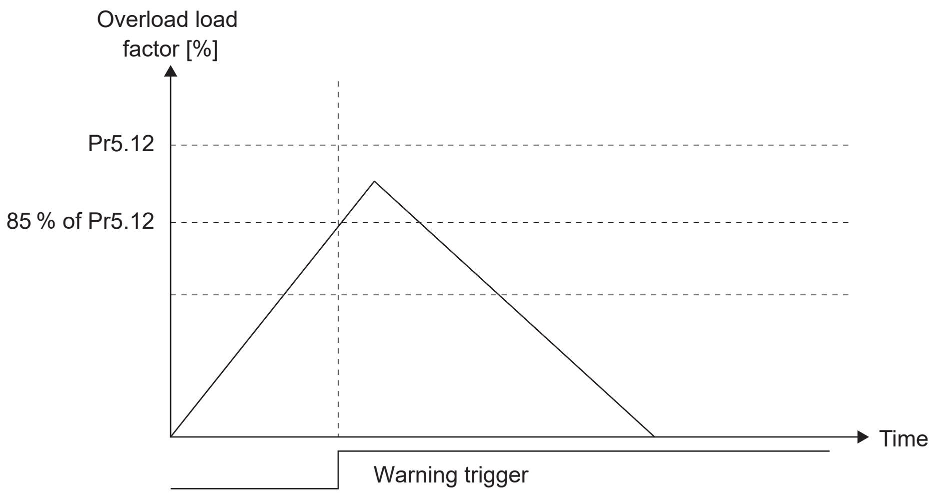


<table>
<tr><th rowspan="2">Warn-ing No. (hex.)</th><th rowspan="2">Warning Name</th><th rowspan="2">Description</th><th>Warning Latch</th><th>Output Setting</th><th>Warning Mask</th></tr>
<tr><th>Pr6.27 (*1)</th><th>Pr4.40, Pr4.41 (*2)</th><th>Pr6.38/ Pr6.39 sup-ported bit (*3)</th></tr>
<tr><td colspan="6">

● Details on conventional specifications

In the conventional specifications, the warning latch function is dependent on the setting for Pr6.27 “Warning latch state setup” .

• Under conditions other than expanded functions



When the warning latch function setting is enabled, if the setting for Pr6.95 or Pr6.96 is changed to switch the motor overload warning detection specification to the expanded specification after a motor overload warning is triggered, latched motor overload warnings will be cleared because the warning latch function is disabled.

</td></tr>
<tr><td>A1</td><td>Over-regeneration warning</td><td>The regenerative load factor exceeded 85% of the protection level.</td><td>○</td><td>2</td><td>Pr6.38 bit 5</td></tr>
<tr><td>A2</td><td>Battery warning</td><td>Battery voltage is 3.2 V or less.
The battery warning will not be detected when Pr0.15 = 1 (incremental mode) or Pr0.15 = 3 (single-turn absolute mode) with an absolute encoder (battery backup), or when a batteryless absolute encoder is used.</td><td>Fixed latch</td><td>3</td><td>Pr6.38 bit 0</td></tr>
<tr><td>A3</td><td>Fan lock warning</td><td>Fan stopped status continued for 1 second.</td><td>○</td><td>4</td><td>Pr6.38 bit 6</td></tr>
<tr><td>A4</td><td>Encoder communication warning</td><td>The number of consecutive occurrences of encoder communication errors exceeded the standard value.</td><td>○</td><td>5</td><td>Pr6.38 bit 4</td></tr>
<tr><td>A5</td><td>Encoder overheat warning</td><td>The encoder temperature exceeded the standard value.
Take measures such as lowering the ambient temperature, reducing the load, and/or reviewing heat dissipation.</td><td>○</td><td>6</td><td>Pr6.38 bit 3</td></tr>
<tr><td>A6</td><td>Oscillation detection warning</td><td>Oscillation was detected.</td><td>○</td><td>7</td><td>Pr6.38 bit 13</td></tr>
<tr><td>A7</td><td>Lifetime detection warning</td><td>The remaining life of the capacitor or fan was below the specified level.</td><td>Fixed latch</td><td>8</td><td>Pr6.38 bit 2</td></tr>
<tr><td>A8</td><td>External scale error warning</td><td>An external scale detected a warning.</td><td>○</td><td>9</td><td>Pr6.38 bit 8</td></tr>
<tr><td>A9</td><td>External scale communication warning</td><td>The number of consecutive occurrences of external scale communication errors exceeded the standard value.</td><td>○</td><td>10</td><td>Pr6.38 bit 14</td></tr>
<tr><td>AB</td><td>Fan speed reduction warning</td><td>Low fan speed detected.</td><td>○</td><td>43</td><td>Pr6.126 bit 9</td></tr>
</table>

Warning No. (hex.)	Warning Name	Description	Warning Latch	Output Setting	Warning Mask
			Pr6.27 (*1)	Pr4.40, Pr4.41 (*2)	Pr6.38/ Pr6.39 supported bit (*3)
E1	Driver overload warning	Driver derating monitor is more than 100 %.	○	44	Pr6.126 bit 10
E2	Lifetime detection warning 2	The remaining life of the nonvolatile memory is below the specified value.	○	45	Pr6.126 bit 11

*1 The "○" part can be switched between non-latch mode (latched for 1 s) and latched mode using Pr6.27 "Warning latch state setup" . Battery warning and lifetime detection warning are fixed in latch mode and cannot be switched.

*2 The warning that is output in warning output signal 1 (WARN1) and warning output signal 2 (WARN2) is selected using Pr4.40 "Selection of alarm output 1" and Pr4.41 "Selection of alarm output 2" . In case of setting value 0, OR output of all warnings will be obtained. In addition, do not use the setup values other than those listed in the above table.

*3 Each warning detection can be disabled with Pr6.38 "Warning mask setup" , Pr6.39 "Warning mask setup 2" and Pr6.126 "Warning 2 mask setup" .

Supported bits are indicated in the table. Warning detection is disabled by setting the corresponding bit to 1.

For expanded warnings, it is possible to disable warning detection with the respective setting parameters.

■ Expanded warnings

Warning No. (hex.)	Warning Name	Description	Warning Latch	Output Setting	Warning Mask
			Pr6.27 (*1)	Pr4.40, Pr4.41 (*2)	Pr6.38/ Pr6.39 supported bit (*3)
C0	RTEX continuous communication error warning	The number of consecutive error (CRC error) detections during reading of received data addressed to the local node was equal to or in excess of the value set for Pr7.26 "RTEX continuous communication error warning setup" .	○	11	Pr6.38 bit 9
C1	RTEX accumulated communication error warning	The total number of times that an error (CRC error) was detected during reading of received data addressed to the local node was equal to or in excess of the value set for Pr7.27 "RTEX accumulated communication error warning setup" .	Fixed latch	12	Pr6.38 bit 10
C2	RTEX_Update_Counter error warning	Update_Counter was not updated normally due to the cumulative total exceeding the number of times set for Pr7.28 "RTEX_Update_Counter error warning setup" .	Fixed latch	13	Pr6.38 bit 11
C3	Main power off warning	When the setting for Pr7.14 "Main power off warning detection time" is 10 to 1999, power is instantaneously interrupted between L1 and L3 for at least the time set with Pr7.14.	○	14	Pr6.38 bit 12
CA	Main power phase loss warning	An open phase was detected in the main power supply when Pr6.104 "Open-phase monitoring setup" had warnings enabled.	○	42	Pr6.126 bit 8
D2	Set-up Support Software (PANATERM ver.7) command execution warning	Operation commands (trial run, frequency characteristics analysis function (FFT function), Config, etc.) by Set-up Support Software (PANATERM ver.7) were executed when RTEX communication was established with bit 0 of Pr7.99 "RTEX function expansion setup 6" set to 1.	○	30	Pr6.39 bit 8

*1 The "○" part can be switched between non-latch mode (latched for 1 s) and latched mode using Pr6.27 "Warning latch state setup" . Battery warning and lifetime detection warning are fixed in latch mode and cannot be switched.

*2 The warning that is output in warning output signal 1 (WARN1) and warning output signal 2 (WARN2) is selected using Pr4.40 “Selection of alarm output 1” and Pr4.41 “Selection of alarm output 2” . In case of setting value 0, OR output of all warnings will be obtained. In addition, do not use the setup values other than those listed in the above table.

*3 Each warning detection can be disabled with Pr6.38 “Warning mask setup” , Pr6.39 “Warning mask setup 2” and Pr6.126 “Warning 2 mask setup” .

Supported bits are indicated in the table. Warning detection is disabled by setting the corresponding bit to 1.

For expanded warnings, it is possible to disable warning detection with the respective setting parameters.

10.3.3 Warning Function Details

Details about expanded warnings are shown below.

For general warnings among the warning functions, check the warning names and warning descriptions in the table in *"10.3.2 List of Warning Functions"* and check the corresponding parts.

WngC0h "RTEX continuous communication error warning"

Primary cause	The number of consecutive error (CRC error) detections during reading of received data addressed to the local node was equal to or in excess of the value set for Pr7.26 "RTEX continuous communication error warning setup" . If Pr7.26 "RTEX continuous communication error warning setup" is 0 or Pr6.38 "Warning mask setup" :bit 9 is 1, this warning is disabled.
Detection timing	● While the RTEX communication IC status is RUNNING ● When reading received data by communication cycle
Internal processing upon detection	● Received data is discarded. ● Data received during the previous normal status is used in processing. ● The response is returned with byte 1 as FFh. ● The RTEX communication IC status continues to be RUNNING. ● RTEX communication synchronization established status continues. **Notes** ● Since communication continues, commands such as alarm clear can be received if received normally after a warning is generated.
Handling	● Confirm that excessive noise is not being applied to the communication cable. ● Confirm that there are no problems with the communication cable wiring length, layout arrangement, connection status, etc. ● Confirm that the communication cable is a shielded twisted pair (STP) of category CAT5e or higher as prescribed in the TIA/EIA-568 standard. ● Replace the communication cable with a new one. ● Attach a ferrite core to the communication cable. ● If the alarm still occurs after the above measures are taken, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngC1h “RTEX accumulated communication error warning”

Primary cause	The total number of times that an error (CRC error) was detected during reading of received data addressed to the local node was equal to or in excess of the value set for Pr7.27 “RTEX accumulated communication error warning setup” . If Pr7.27 “RTEX accumulated communication error warning setup” is 0 or Pr6.38 “Warning mask setup” :bit 10 is 1, this warning is disabled.
Detection timing	● While the RTEX communication IC status is RUNNING ● When reading received data by communication cycle
Internal processing upon detection	● Received data is discarded. ● Data received during the previous normal status is used in processing. ● The response is returned with byte 1 as FFh. ● The RTEX communication IC status continues to be RUNNING. ● RTEX communication synchronization established status continues. **Notes** ● Since communication continues, commands such as alarm clear can be received if received normally after a warning is generated.
Handling	● Confirm that excessive noise is not being applied to the communication cable. ● Confirm that there are no problems with the communication cable wiring length, layout arrangement, connection status, etc. ● Confirm that the communication cable is a shielded twisted pair (STP) of category CAT5e or higher as prescribed in the TIA/EIA-568 standard. ● Replace the communication cable with a new one. ● Attach a ferrite core to the communication cable. ● If the alarm still occurs after the above measures are taken, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngC2h “RTEX_Update_Counter error warning”

Primary cause	Update_Counter was not updated normally due to the cumulative total exceeding the number of times set for Pr7.28 “RTEX_Update_Counter error warning setup” . If Pr7.27 “RTEX accumulated communication error warning setup” is 0 or 1, or Pr6.38 “Warning mask setup” :bit 11 is 1, this alarm is disabled. **— Precautions —** ● Note that this warning indicates that a mismatch in command update cycle has been detected between the host device and the product, and normal detection is therefore impossible unless the communication cycles match.
Detection timing	● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● When reading out received data by command update cycle
Internal processing upon detection	● The data received is incorporated as it is. ● The RTEX communication IC status continues to be RUNNING. ● RTEX communication synchronization established status continues. **Notes** ● Since communication continues, commands such as alarm clear can be received if received normally after a warning is generated.
Handling	● Check whether there is a problem with cycle settings on the host device side or with the cycle settings of this product. ● Disable this warning when not using Update_Counter with the ratio of the communication cycle to the command update at 1:1.
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngC3h “Main power off warning”

Primary cause	When the setting for Pr7.14 “Main power off warning detection time” is 10 to 1999, power is instantaneously interrupted between L1 and L3 for at least the time set with Pr7.14.
Detection timing	Always after startup
Internal processing upon detection	No
Handling	Measure the voltage in the lines between connectors (L1, L2, L3) and take the following actions. ● Increase the power supply voltage, change the power supply, eliminate whatever caused the electromagnetic contactor in the main power supply to drop, then turn the power back on. ● Check the setting for Pr7.14 “Main power off warning detection time” and set it properly for each phase of the power supply. ● Increase the power supply capacity. For information on power supply capacity, see *“1.8.2.2 List of Peripheral Devices”* . ● Properly connect each phase (L1, L2, L3) of the power supply. Use L1, L3 for single phase 100 V and single phase 200 V. ● Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngCAh “Main power phase loss warning”

Primary cause	An open phase was detected in the main power supply when Pr6.104 “Open-phase monitoring setup” had warnings enabled.
Detection timing	Always after startup
Internal processing upon detection	No
Handling	● Check the connection of the main power input line. ● Measure the line voltage between connectors (L1, L2, L3) and eliminate line voltage imbalance. ● Confirm that the line voltage between connectors (L1, L2, L3) is the specified value. ● Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngD2h “Set-up Support Software (PANATERM ver.7) command execution warning”

This warning notifies that an operation command (trial run, frequency characteristics analysis function (FFT function), Z-phase search, One Minute TUNING) or Config execution was run by Set-up Support Software (PANATERM ver.7) while RTEX communication is established with Pr7.99 “RTEX function expansion setup 6” :bit 0 is 1.

This warning is not generated when a device error is detected.

The following RTEX commands cannot be used while this warning is generated.

- Reset command (attribute C parameter enabling mode)
- Homing command
- Parameter command (parameter writing)

Primary cause	Operation commands (trial run, frequency characteristics analysis function (FFT function), etc.) by Set-up Support Software (PANATERM ver.7) were executed or Config was executed when RTEX communication was established with Pr7.99 “RTEX function expansion setup 6” :bit 0 set to 1.
Detection timing	● While the RTEX communication IC status is RUNNING ● RTEX communication synchronization established status ● An operation command and a CONFIG command were executed by Set-up Support Software (PANATERM ver.7) while in the state mentioned above.
Internal processing upon detection	● The RTEX communication IC status continues to be RUNNING. ● RTEX communication synchronization established status continues. **Notes** ● Since communication continues, commands such as alarm clear can be received if received normally after a warning is generated.
Handling	Stop the operating command through Set-up Support Software (PANATERM ver.7) .
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

10.4 Timestamp Function

This function adds the time when the alarm occurred to the alarm supplementary information, and adds the time of measurement to the waveform information measured by the waveform measurement function using Set-up Support Software (PANATERM ver.7) .

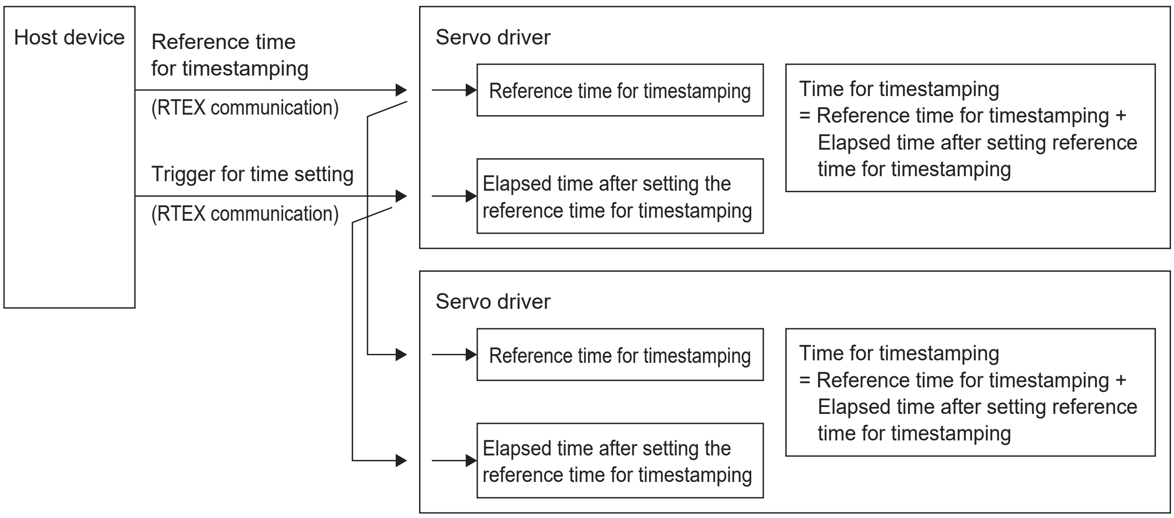
■ Operational Conditions

Item	Operational conditions
Control mode	• All control modes

■ Operation

- Timestamp time

Timestamping is enabled when the time setting trigger (Type_code = 030h Index0) is set to 1 after setting the timestamp reference time (Type_code = 030h Index1, 2) with reset command (command code = □1h), and the elapsed time from the timestamp reference time is displayed in nanosecond increments.



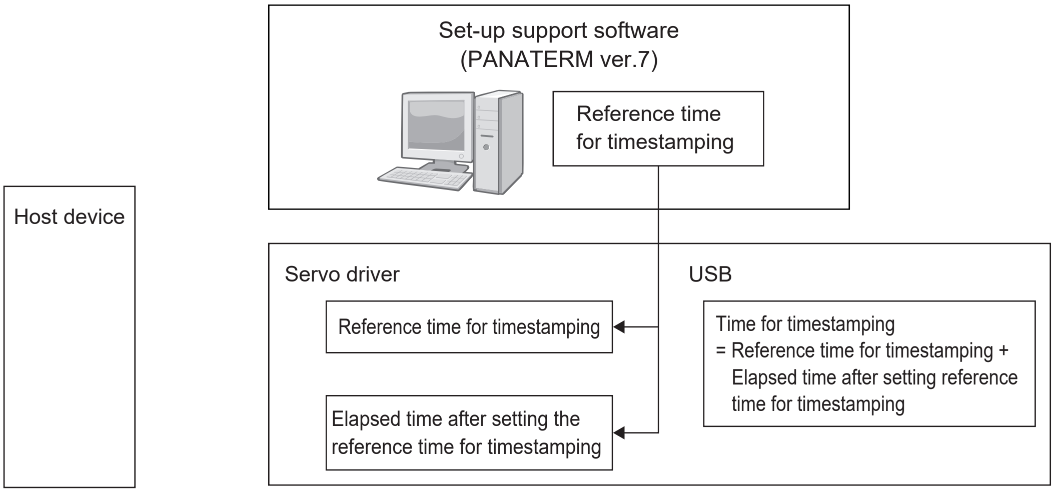
The reference time for timestamping should be set to the elapsed time in ns units, starting at 0:00:0:0 on January 1, 2000.

(Setting example) Set 0A2E59AF97450000h (= 733622400000000000) for April 1, 2023, 00:00:00.

If the timestamp reference time is set near the maximum value (e.g., year 2584) and the count-up value reaches the maximum value (FFFFFFFFFFFFFFFFh), counting up is stopped. The timestamp will display the maximum value.

If the timestamp reference time is not sent from the host device, the timestamp displayed is fixed at 0000000000000000h. For details, see Technical Reference Communication Specification.

Timestamps when used with Set-up Support Software (PANATERM ver.7) are enabled when “Timestamp Reference Time” is set. The elapsed time is displayed in nanosecond increments from the timestamp reference time.



- Time synchronization between multiple axes

  This product synchronizes each axis by receiving time synchronization information (timestamp reference time and time setting trigger) from the host device. Multiple axes must be synchronized via a network connection (RTEX).

  When Set-up Support Software (PANATERM ver.7) is used, settings are made for each individual unit and the time information is not synchronized between axes, resulting in errors in time information.

- Timestamps for the waveform measurement function with Set-up Support Software (PANATERM ver.7)

  When measuring motor operating waveforms and displaying the results in a waveform graph, the trigger time for waveform measurement can be displayed. If triggers for waveform measurement were not set, the waveform measurement start time is displayed. For details on the waveform measurement function, see Set-up Support Software (PANATERM ver.7) Operating Manual.

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11.1 Overview

The following is a list of solutions to malfunctions or errors that may occur with the servo driver and servo motor.

For information on Set-up Support Software (PANATERM ver.7) , see *"12.1 Set-up Support Software (PANATERM ver.7)"* .

11.2 Motor Does Not Rotate

Classification	Cause	Item(s) to check	Action(s) to take
Parameters	Control mode setup is not correct.	Is the wrong control mode currently being used as the monitor mode in the Set-up Support Software (PANATERM ver.7) ?	Reset Pr0.01 "Control mode setup" . See *"4.1 Network Outline"* .
	Command pulse division/ multiplication setup is not correct (Position).	Does the motor move the expected amount relative to the command pulse input?	Check the settings for Pr0.08 "Number of command pulses per one motor revolution" , Pr0.09 "Numerator of electronic gear" and Pr0.10 "Denominator of electronic gear" again. See *"7.2.3 Electronic Gear Function"* .
Wiring	The connector X4 positive direction over-travel inhibit input (POT) and negative direction over-travel inhibit input (NOT) have been released.	Are the Pin No. corresponding to the positive direction over-travel inhibit input (POT) and negative direction over-travel inhibit input (NOT) in the Set-up Support Software (PANATERM ver.7) monitor mode in "A" state?	• Check the wiring of the input signals for the positive direction over-travel inhibit input (POT) and negative direction over-travel inhibit input (NOT). • Set Pr5.04 "Over-travel inhibit input setup" to 1 (disable) and reset the power supply.
Installation	Main power is shut off.	Is the Pin No. corresponding to S-RDY in the monitor mode in the Set-up Support Software (PANATERM ver.7) in "–" state?	Check the wiring and voltage of the main power to the driver (L1, L2, L3).
	The motor output axis drags. It does not turn.	• Check that you can turn the motor axis, after turning off the driver power and separating it from the machine. • Check that you can turn the motor axis while applying 24 V DC to the brake in case of the motor with holding brake.	If you cannot turn the motor axis, consult with the dealer where you purchased the motor for repair.

11.3 Unstable Rotation (Not Smooth)

Classification	Cause	Handling
Adjustment	Gain is poorly adjusted.	● Increase the Pr1.01 “1st velocity loop gain” set values. ● Enter Pr1.04 “1st torque filter time constant” and increase the set value of Pr1.01 “1st velocity loop gain” again. See Operating Instructions (Tuning).
Wiring	There is chattering with the connector X4 servo-on signal.	● Check the wiring and connection of connector X4. ● Rewire and reconnect it so that the servo-on signal is normally on. ● Carefully examine the host device. See *“3.2.5 Wiring to Connector X4 (Connecting to I/O)”* .

11.4 Positioning Accuracy is Poor

Classification	Cause	Handling
System	The positioning command is not correct (Amount of command pulse).	Repeatedly go back and forth the same distance and count the feedback pulses with the Set-up Support Software (PANATERM ver.7) monitor function. If the same value is not returned, carefully examine the host device.
Adjustment	Position loop gain is small.	Check the amount of position deviation with the Set-up Support Software (PANATERM ver.7) monitor function. Increase the set value for Pr1.00 “1st gain of position loop” within a range that does not cause oscillation and check again. See Operating Instructions (Tuning).
Parameters	Setup of the positioning complete (In-position) range is large.	Decrease the set value for Pr4.31 “Positioning complete (In-position) range” to within a range where chattering with the complete signal does not occur. See *“7.3.4 Positioning Complete Output (INP/INP2) Function”* .
	Division/multiplication setup is not correct.	Check if the repetition accuracy is the same.
	The speed loop gain will switch to proportional action when the motor is stopped.	Set Pr1.02 “1st velocity loop integration time constant” and Pr1.07 “2nd velocity loop integration time constant” to 9999 or less.
Wiring	There is chattering with the connector X4 servo-on signal.	● Check the wiring and connection of connector X4. ● Rewire and reconnect it so that the servo-on signal is normally on. ● Carefully examine the host device. See *“3.2.5 Wiring to Connector X4 (Connecting to I/O)”* .
Installation	Load inertia is high.	Use the Set-up Support Software (PANATERM ver.7) to check the overshoot in the waveform graphic when the motor is stopped. If this is not fixed by adjusting the gain, increase the motor and driver capacity.

11.5 Home Position Misalignment

Classification	Cause	Handling
System	Z-phase is not detected when finding home.	● Check that the Z-phase aligns to the center of the proximity switch. ● Perform homing correctly in coordination with the host device.
	Home creep speed is fast.	● Decrease the homing speed in proximity to home. ● Lengthen the home sensor.
Wiring	Chattering in output from the near home sensor (proximity switch sensor).	Use an oscilloscope to check the proximity switch sensor input signal on the host device. Carefully examine the wiring near the proximity switch and take measures to reduce noise, etc.
	Noise accumulates in the encoder cable.	Take measures such as reducing noise (install noise filter or insert ferrite core), shield treatment of I/F cables, using twisted pair wires or separating power and signal cables.

11.6 Abnormal Noise or Vibration from Motor

Classification	Cause	Handling
Adjustment	Gain setup is large.	Lower the gain by reducing the settings for Pr1.01 “1st velocity loop gain” , Pr1.06 “2nd velocity loop gain” , Pr1.00 “1st gain of position loop” and Pr1.05 “2nd gain of position loop” . See Operating Instructions (Tuning)
Installation	Resonance of the machine and the motor.	● Set Pr1.04 “1st torque filter time constant” and Pr1.09 “2nd torque filter time constant” and readjust. ● Use the Set-up Support Software (PANATERM ver.7) frequency characteristics analysis (FFT function) to see whether there is mechanical resonance. ● If there is resonance, set notch frequency Pr2.01 “1st notch frequency” , Pr2.04 “2nd notch frequency” , Pr2.07 “3rd notch frequency” and Pr2.10 “4th notch frequency” . See Operating Instructions (Tuning).
	Motor bearing abnormality.	● Drive the motor under no load and check for noise and vibration near the bearings. ● Replace the motor with a new one and check. ● Return the motor that generated the error to the vendor for examination (repair).
	Electromagnetic sound, gear noise, rubbing noise at brake engagement, hub noise or rubbing noise from encoder.	● Drive the motor under no load. ● Replace the motor with a new one and check. ● Return the motor that generated the error to the vendor for examination (repair).

11.7 Undershoot, Overshoot, Motor Overheating (Motor Burnout)

Classification	Cause	Handling
Adjustment	Gain is poorly adjusted.	Check the waveform graphic in the Set-up Support Software (PANATERM ver.7) or monitor mode to make the correct gain adjustment. See Operating Instructions (Tuning)
Installation	Load inertia is high.	● Check the waveform graphic in the Set-up Support Software (PANATERM ver.7) or monitor mode to make the correct gain adjustment. ● Increase the motor and driver capacity and decrease the inertia ratio. ● Use a decelerator.
	Looseness or slip in the equipment (machinery).	Carefully examine components that are mounted to the equipment (machinery).
	Ambient temperature, environment.	Reduce the temperature by installing a cooling fan if the temperature of the ambient environment exceeds the specified value.
	Stalled cooling fan, dirt in fan ventilation duct.	● Inspect the equipment and driver cooling fans. ● Request repair if the driver cooling fan needs to be replaced.
	Failure of motor bearing.	● Turn off the power and manually turn the motor shafts to check for a rumbling noise. ● Replace the motor with a new one if there is a rumbling noise. ● Return the motor that generated the error to the vendor for examination (repair).
	Holding brake left engaged (forgot to release brake).	● Check the voltage at the holding brake terminals. ● Apply power (24 V DC) to release the holding brake.
	Motor failure (Oil, water or other).	Avoid high temperature, high humidity locations and atmospheres full of oil, dust or iron powder.
	Motor has been turned by external force while dynamic brake was engaged.	Check the running pattern, working condition and operating status. Do not use external force to rotate the motor.

11.8 Number of Rotations Does Not Reach Set Velocity, High or Low Amount of Rotation (Travel)

Classification	Cause	Handling
Adjustment	Position loop gain is low.	Set Pr1.00 “1st gain of position loop” and Pr1.05 “2nd gain of position loop” to approximately 1000. See Operating Instructions (Tuning)
	Unsuitable division/multiplication.	Review the set values for Pr0.08 “Number of command pulses per one motor revolution” ,Pr0.09 “Numerator of electronic gear” and Pr0.10 “Denominator of electronic gear” and set the correct values. See *“7.2.3 Electronic Gear Function”*

11.9 Parameter Returns to Previous Setup Value

Classification	Cause	Handling
Parameters	Parameters are not being written to EEPROM before the driver power is turned off.	For parameter attributes, see *“6.3 List of Parameters”* .

11.10 Communication Not Established

Classification	Cause	Item(s) to check	Action(s) to take
Wiring	Network cable is broken.	Is the network status LED [LINK1] lit?	If it is not lit, check the network cable connected to the respective servo driver receiver-side (RX) connector to see if there is a problem such as a disconnection or bad contact, and then reconnect it. See *"3.4.4 Network Status List"* .
		Was Err84.0.0 "RTEX communication timeout error protection" triggered?	If the [LINK1] LED was flashing green ● Check to see if the cable connected to the priority servo driver RX generating Err84.0.0 "RTEX communication timeout error protection" has any problems, such as a disconnection or bad contact, and then reconnect it. ● Check to see if the servo driver connected immediately before the priority servo driver generating Err84.0.0 "RTEX communication timeout error protection" has been reset.

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12.1 Set-up Support Software (PANATERM ver.7)

12.1.1 Overview

Connecting a computer with the Set-up Support Software (PANATERM ver.7) installed with this product enables simple procedures including monitoring of parameter settings and control status, set-up support and device analysis.

Set-up Support Software (PANATERM ver.7) is compatible with the following functions.

- USB communication
- Reading and writing servo parameters
- Status monitoring inside the driver and of input/output terminals
- Alarm detail display, history display, and clearing
- Auto gain tuning execution
- Graphic display of motor operation waveforms
- Trial run, frequency characteristics analysis function (FFT function)

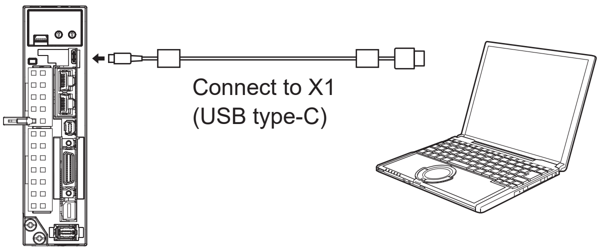
Etc.

For details on Set-up Support Software (PANATERM ver.7) , see Set-up Support Software (PANATERM ver.7) Operating Manual.

Install the Set-up Support Software (PANATERM ver.7) to the computer after downloading it from the Panasonic website. We do not have CD-ROMs or other media available for distribution.

12.1.2 Connections

12.1.2.1 When Connecting via USB Cable



- USB cables

  Use a USB Type-C cable for the connector on the servo driver side.

  Use a compatible connector for the PC specifications on the PC side.

  To reduce the effects of noise, we recommend installing ferrite cores at both ends of the cable. For information on ferrite cores, see *“12.4.3 Ferrite Core”* .

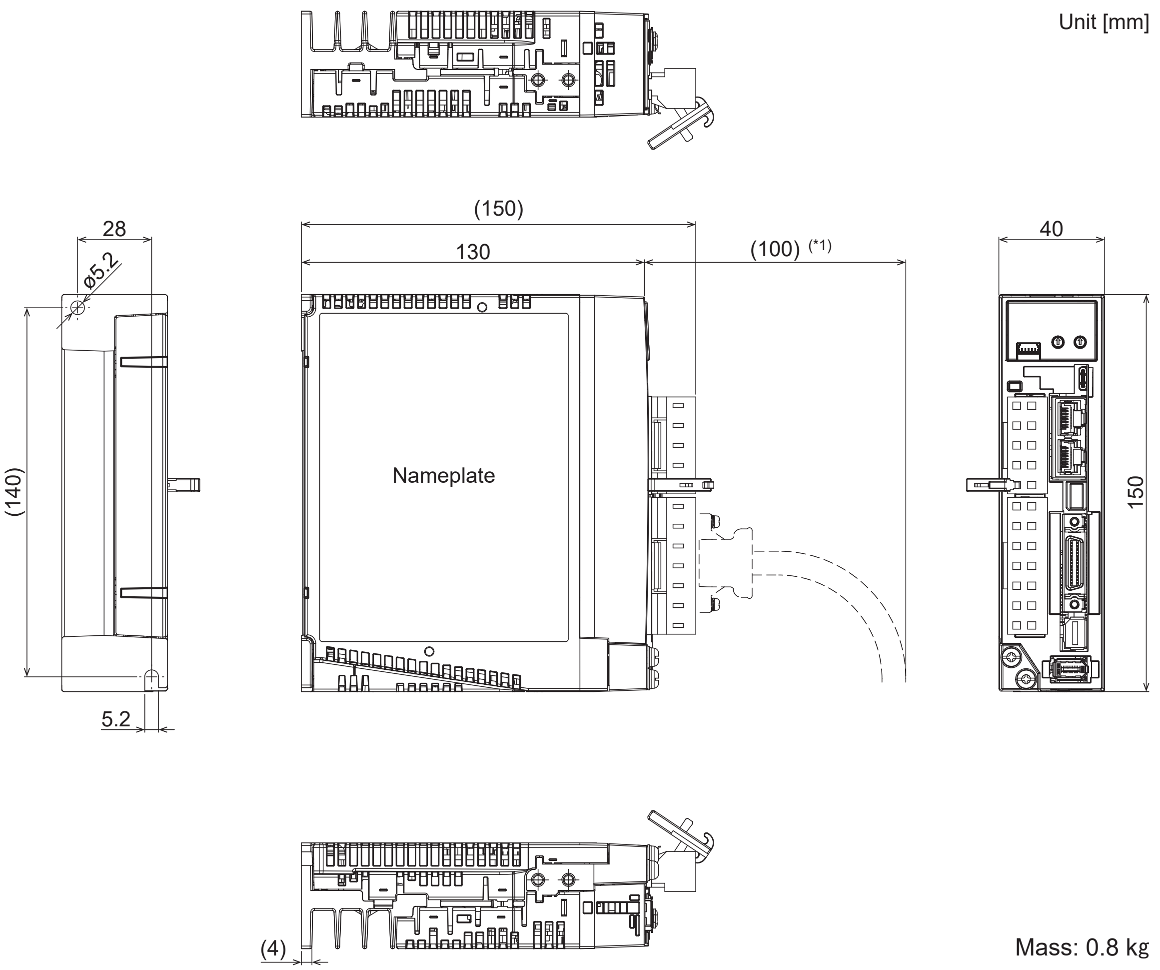
12.2 Dimensions

12.2.1 Driver

The dimensions are the same for the standard type, multi-function type, and application specialized type for each size. The figure is for the multi-function type.

12.2.1.1 Size A (100 V/200 V)

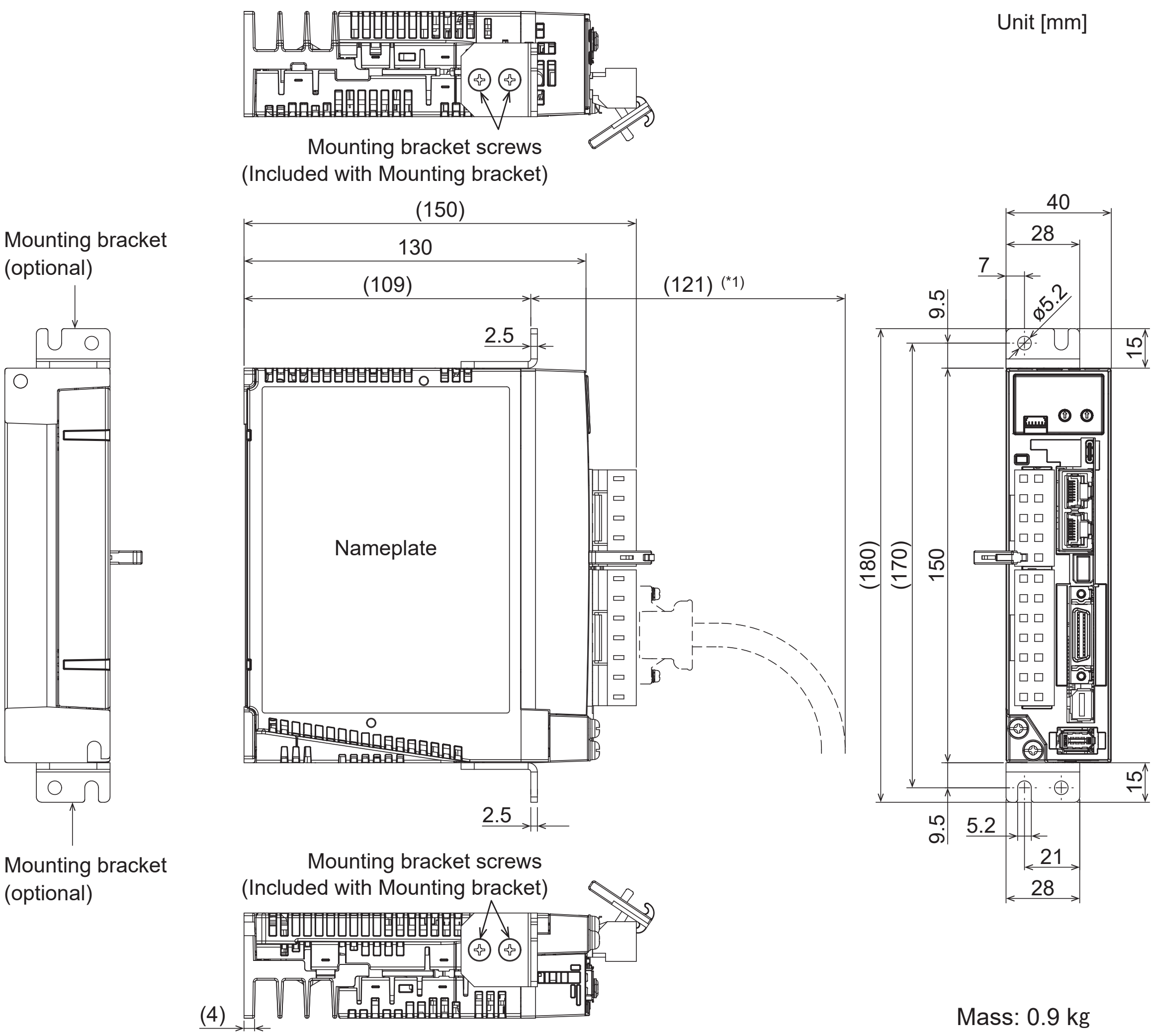
■ **Base mount (standard: rear-mount)**



*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

■ Rack mount (using optional parts: front-mount)



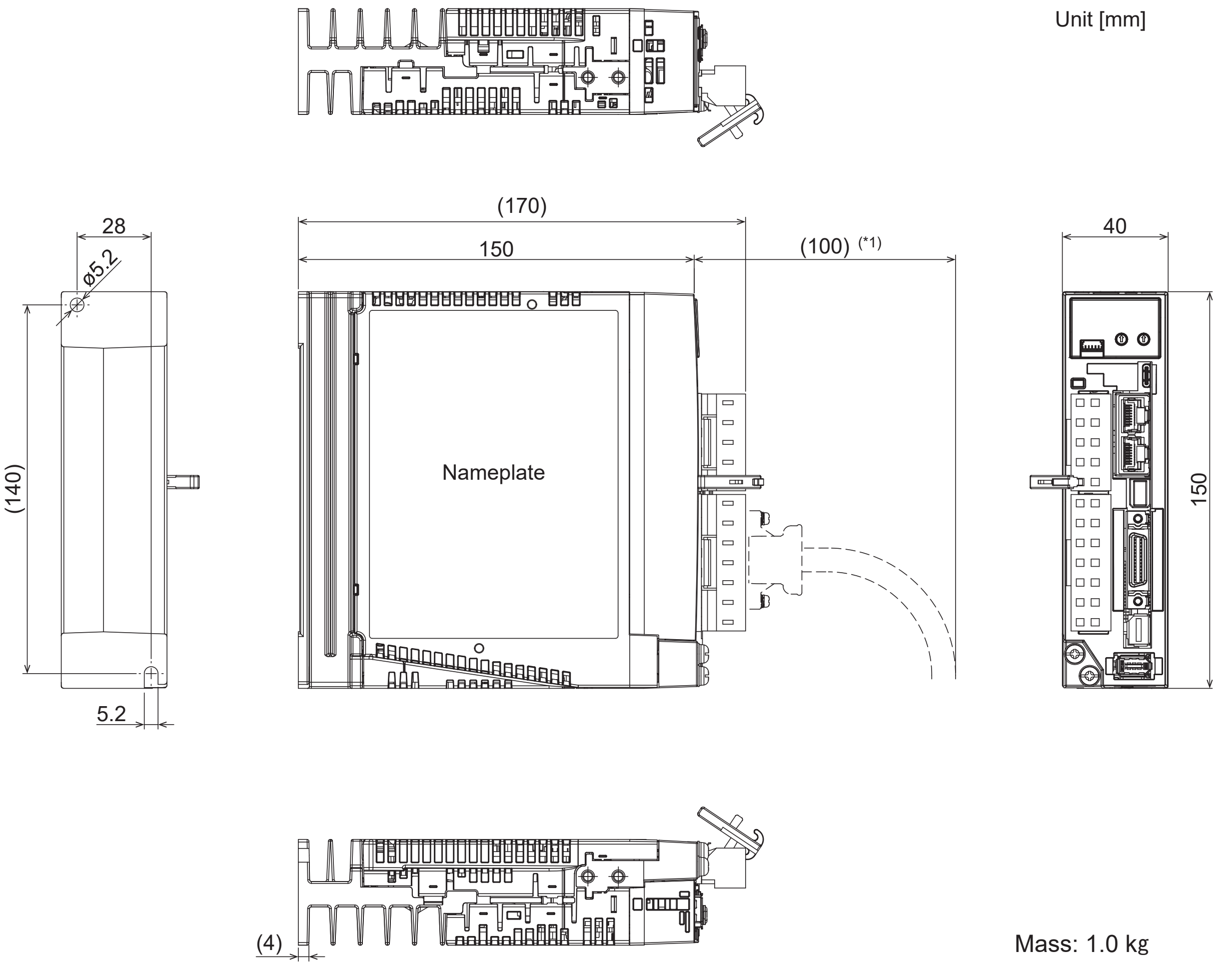
*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

* Mounting brackets are optional parts. They are not included with the product.

12.2.1.2 Size B (100 V/200 V)

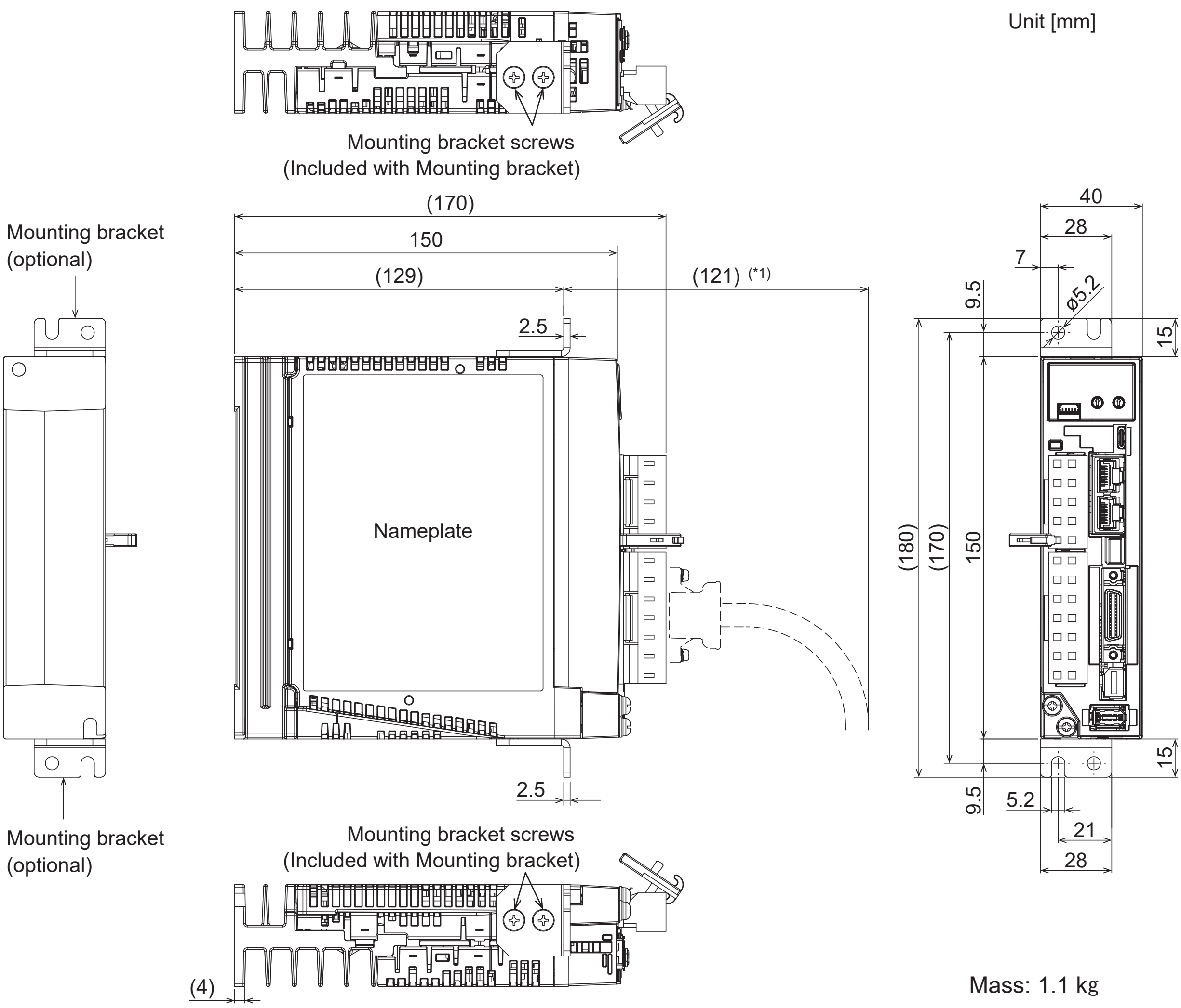
■ **Base mount (standard: rear-mount)**



*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

■ Rack mount (using optional parts: front-mount)



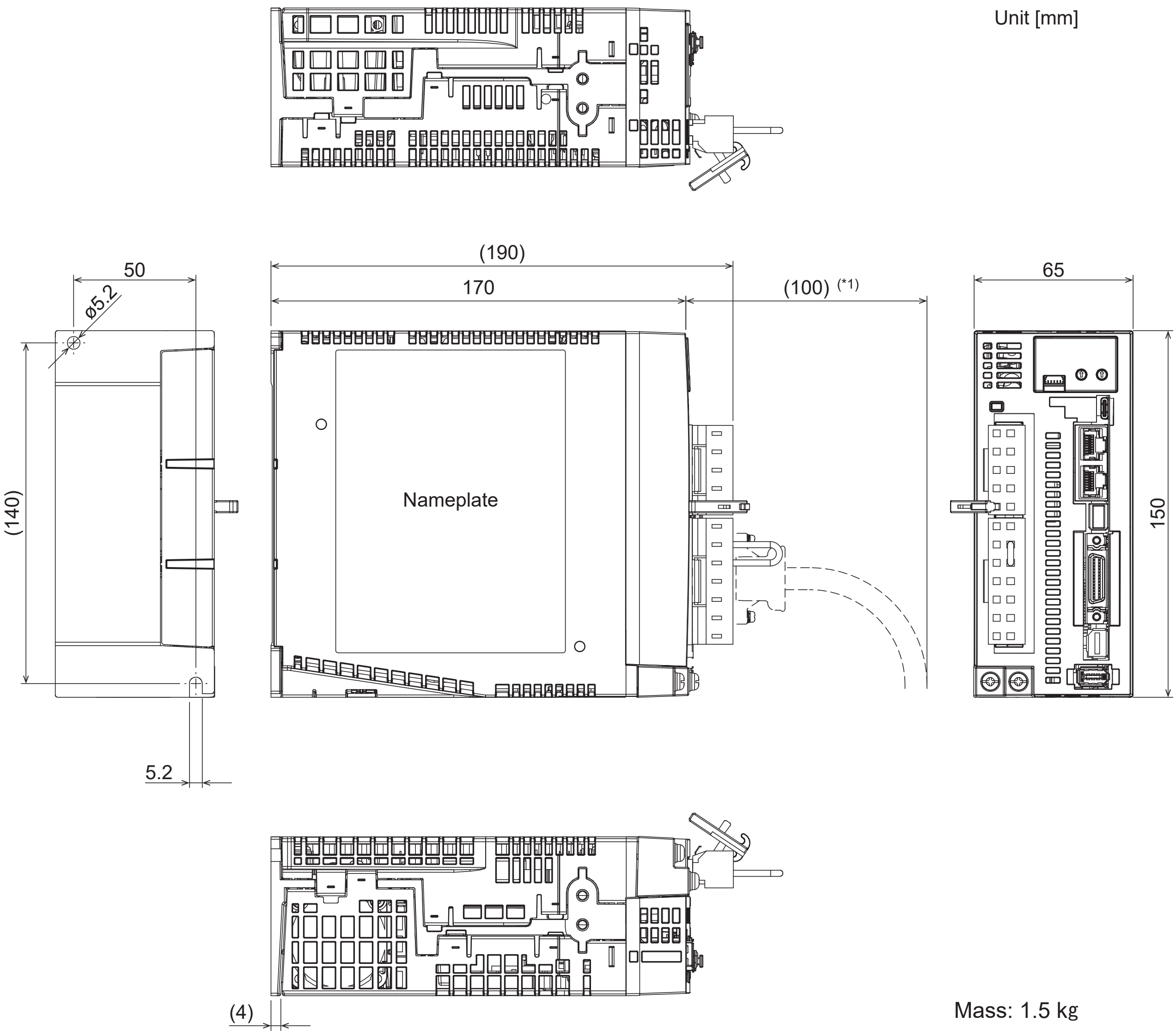
*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

* Mounting brackets are optional parts. They are not included with the product.

12.2.1.3 Size C (100 V/200 V)

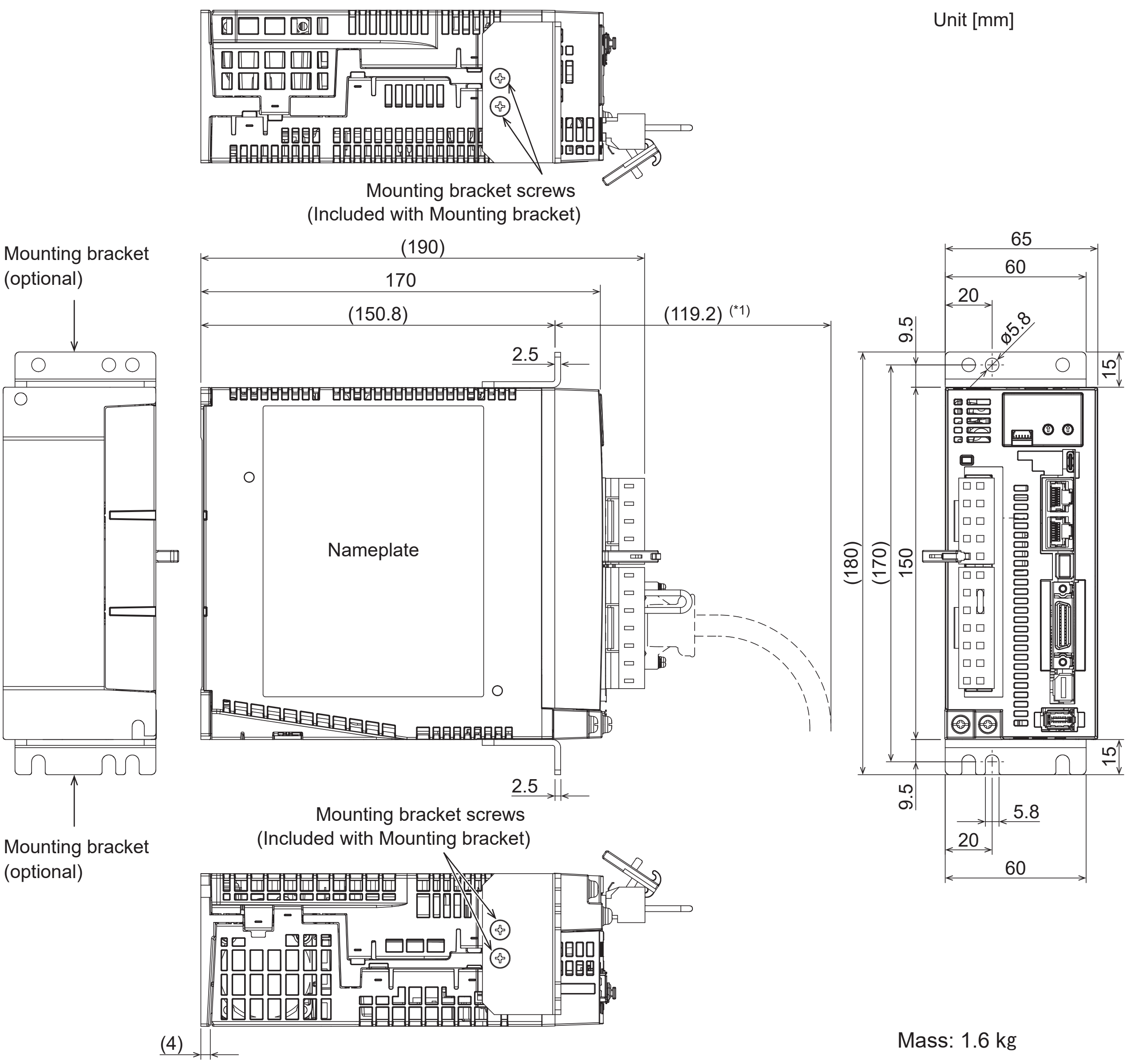
■ **Base mount (standard: rear-mount)**



*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

■ Rack mount (using optional parts: front-mount)



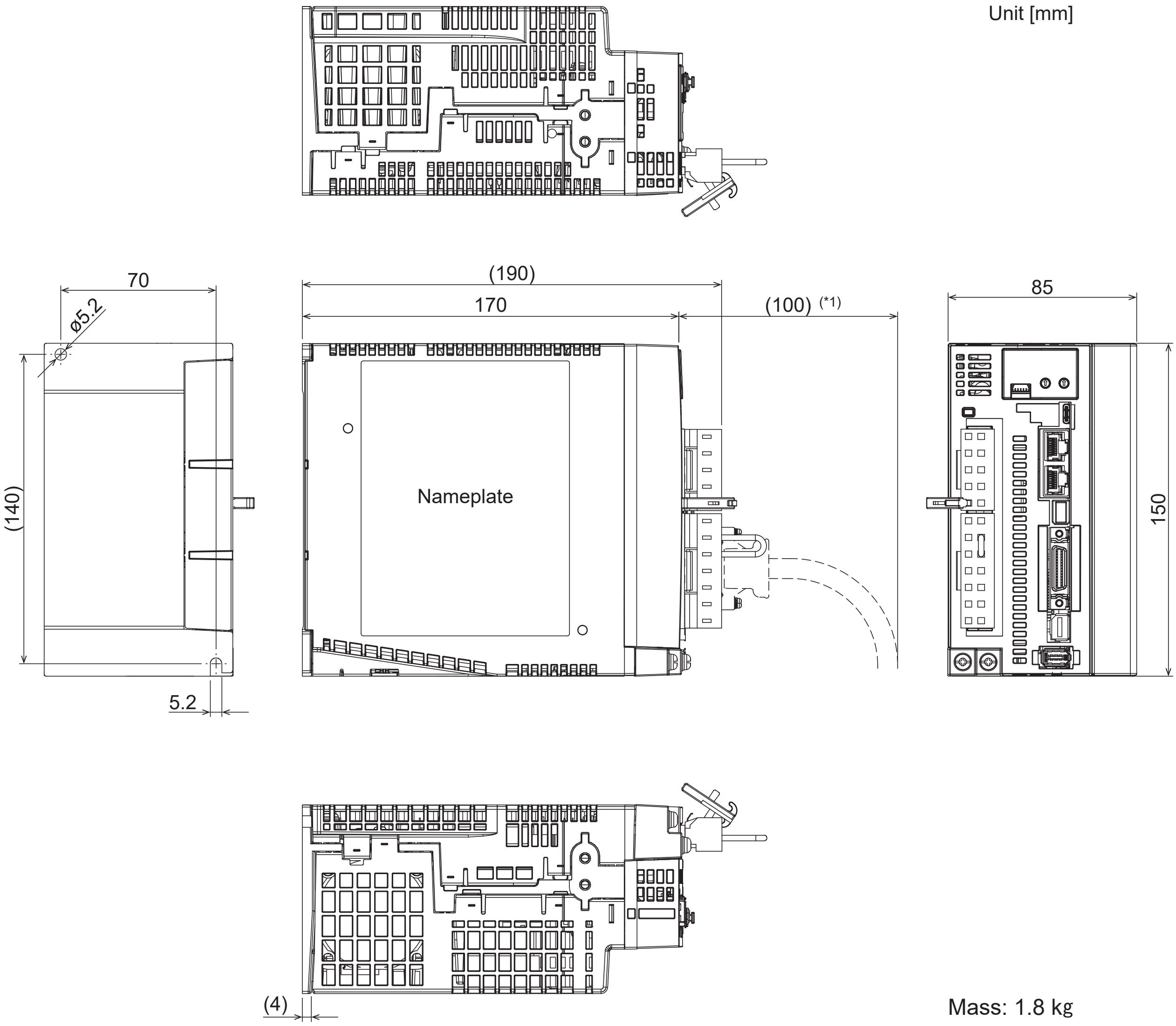
*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

* Mounting brackets are optional parts. They are not included with the product.

12.2.1.4 Size D (200 V)

■ **Base mount (standard: rear-mount)**

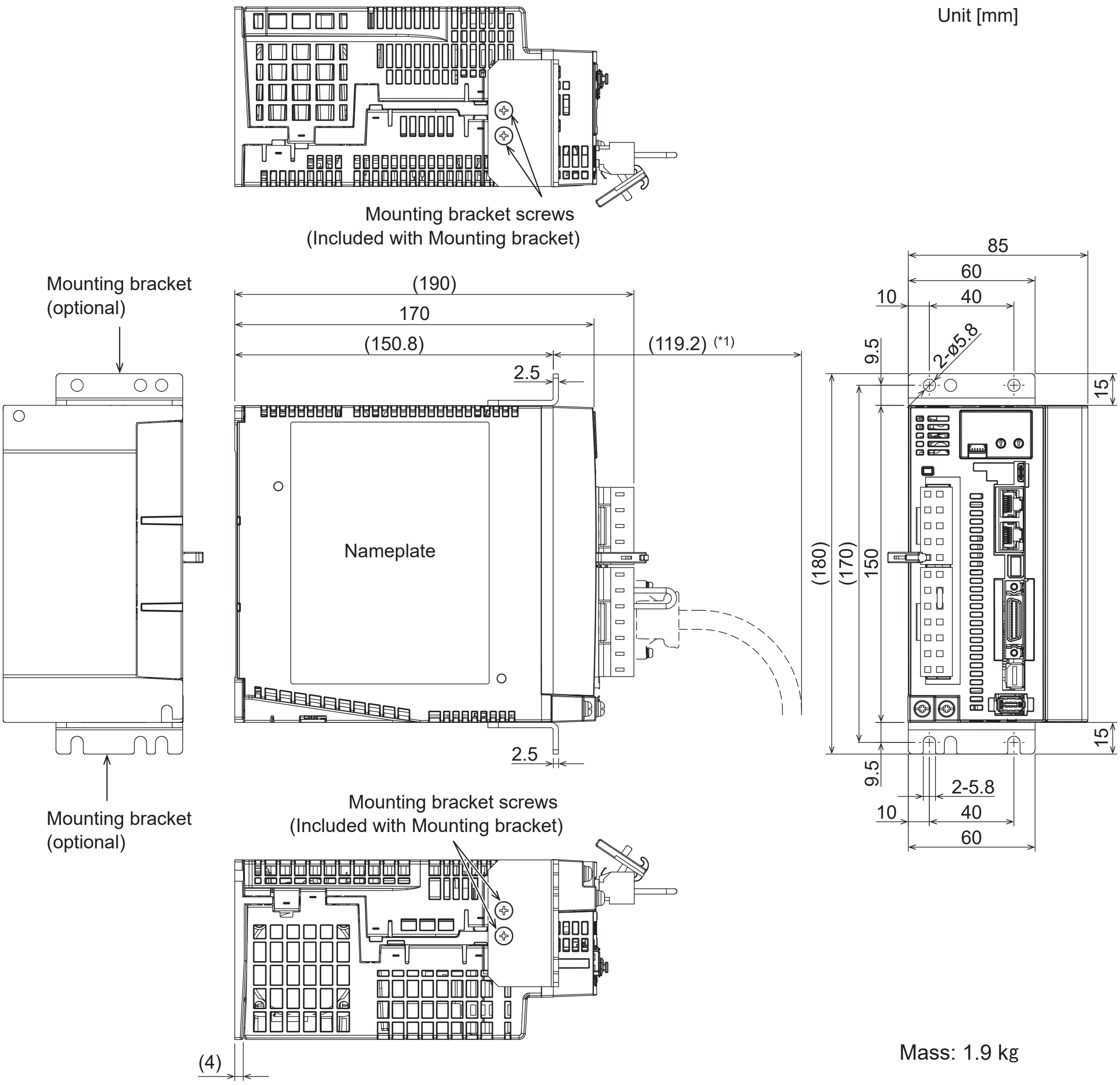


Mass: 1.8 kg

*1 Ensure an appropriate distance for the cables used.

* Do not use screw holes for which no dimensions are shown.

■ Rack mount (using optional parts: front-mount)



*1 Ensure an appropriate distance for the cables used.

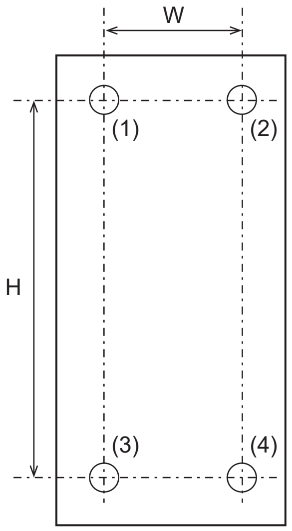
* Do not use screw holes for which no dimensions are shown.

* Mounting brackets are optional parts. They are not included with the product.

12.2.1.5 Mounting Hole Dimensions

Use mounting holes to firmly fix the servo driver to a surface.

Recommended mounting hole drilling diagram

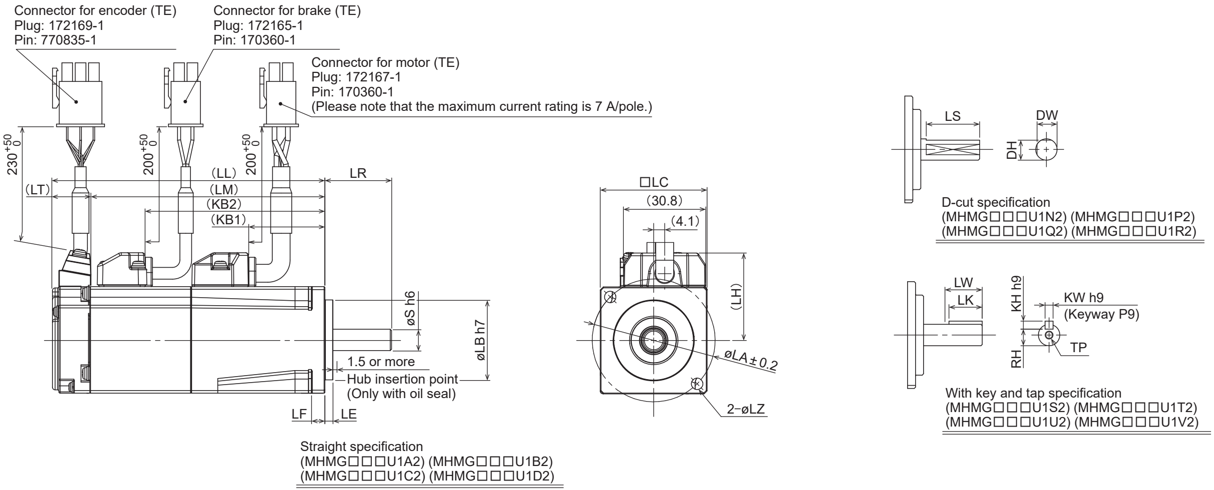


Size	Mounting hole machining dimensions [mm]				Mounting holes		Mounting screws (*1)	
	Base mount		Rack mount		Base mount	Rack mount	Nominal	Tightening torque [N·m]
	H	W	H	W				
A	140 ± 0.5	28 ± 0.5	170 ± 0.5	–	(2), (3)	(1), (3)	M5	2.7 to 3.3
B	140 ± 0.5	28 ± 0.5	170 ± 0.5	–	(2), (3)	(1), (3)	M5	2.7 to 3.3
C	140 ± 0.5	50 ± 0.5	170 ± 0.5	–	(2), (3)	(1), (3)	M5	2.7 to 3.3
D	140 ± 0.5	70 ± 0.5	170 ± 0.5	40 ± 0.5	(2), (3)	(1), (2), (3), (4)	M5	2.7 to 3.3

*1 Hexagon socket head cap screws (JIS B 1176:2006) are recommended for use as mounting screws. If the thickness of the mounting plate is 10 mm, use mounting screws with a minimum length of 14 mm.

12.2.2 Motor (Absolute Encoder Specification)

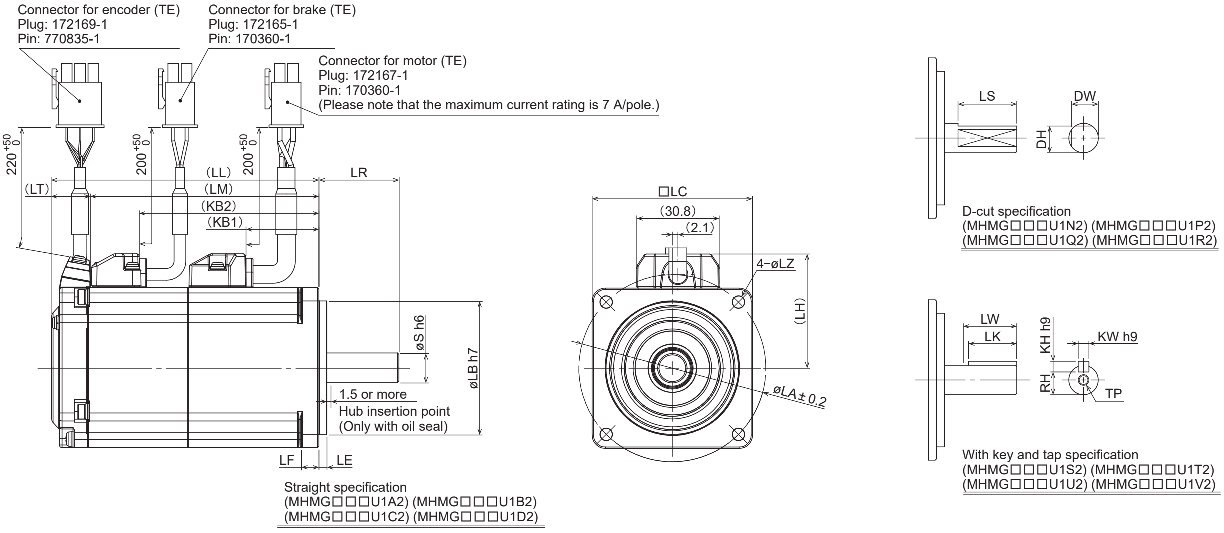
■ MHMG 50 W to 100 W



MHMG 50 W to 100 W (High inertia)

Rated output			50 W		100 W	
Motor product number			5AZU1□2		01□U1□2	
Brake			No	Yes	No	Yes
LL	Without oil seal	mm	53.8	90	66	102.2
	With oil seal	mm	53.8	90	66	102.2
LM		mm	39.8	76	52	88.2
LT		mm	14			
KB1		mm	16.3	16.3	28.5	28.5
KB2		mm	—	55.1	—	67.3
LR		mm	25			
S		mm	8			
LA		mm	46			
LB		mm	30			
LC		mm	40			
LE		mm	3			
LF		mm	5			
LH		mm	32.7			
LZ		mm	4.3			
Dimensions with key	LW	mm	14			
	LK	mm	12.5			
	KW	mm	3			
	KH	mm	3			
	RH	mm	6.2			
	TP	mm	M3 depth 6			
D-cut dimensions	LS	mm	20			
	DW	mm	7.5			
	DH	mm	7.5			
Mass	Without oil seal	kg	0.29	0.51	0.37	0.60
	With oil seal		0.30	0.52	0.38	0.61

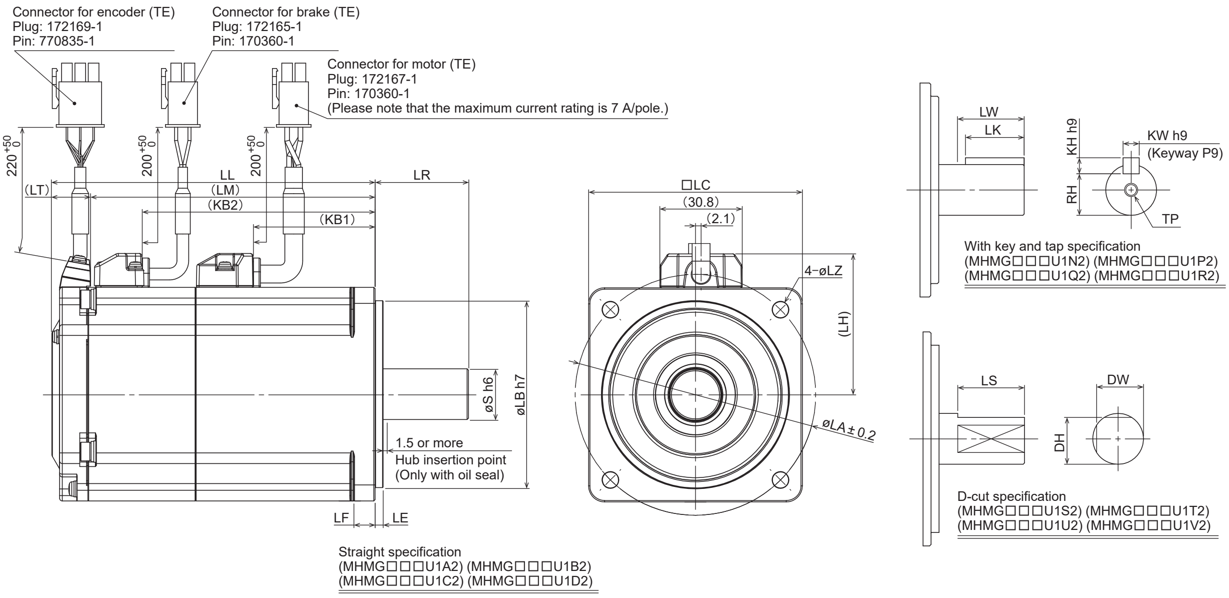
■ MHMG 200 W to 400 W



MHMG 200 W to 400 W (High inertia)

Rated output			200 W		400 W	
Motor product number			02□U1□2		04□U1□2	
Brake			No	Yes	No	Yes
LL	Without oil seal	mm	65.5	100.2	82	116.7
	With oil seal	mm	65.5	100.2	82	116.7
LM		mm	52	86.7	68.5	103.2
LT		mm	13.5			
KB1		mm	27.3	27.3	43.8	43.8
KB2		mm	–	67.2	–	83.7
LR		mm	30			
S		mm	11		14	
LA		mm	70			
LB		mm	50			
LC		mm	60			
LE		mm	3			
LF		mm	6.5			
LH		mm	42.7			
LZ		mm	4.5			
Dimensions with key	LW	mm	20		25	
	LK	mm	18		22.5	
	KW	mm	4		5	
	KH	mm	4		5	
	RH	mm	8.5		11	
	TP	mm	M4 depth 8		M5 depth 10	
D-cut dimensions	LS	mm	22			
	DW	mm	10		12.5	
	DH	mm	10		12.5	
Mass	Without oil seal	kg	0.73	1.2	1.0	1.5
	With oil seal		0.74	1.2	1.0	1.5

■ MHMG 750 W to 1000 W

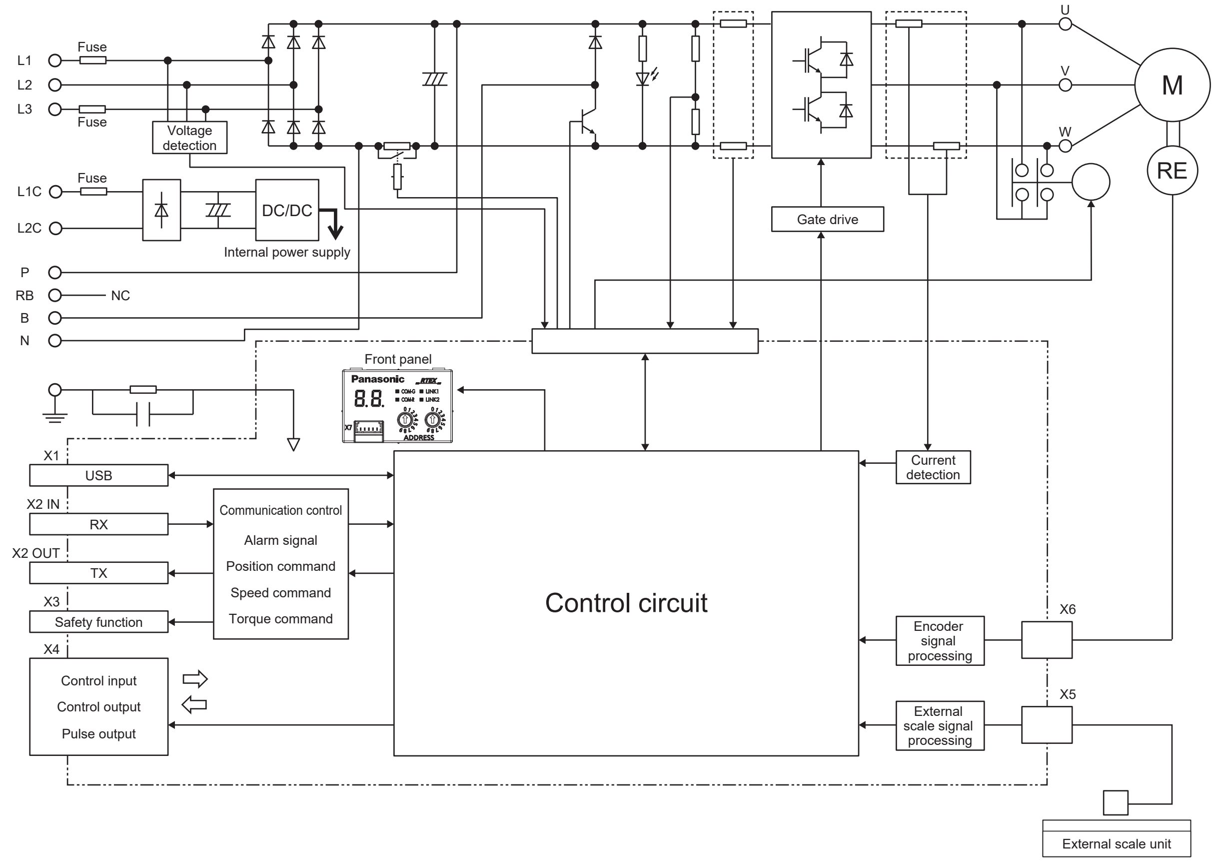


MHMG 750 W to 1000 W (High inertia)

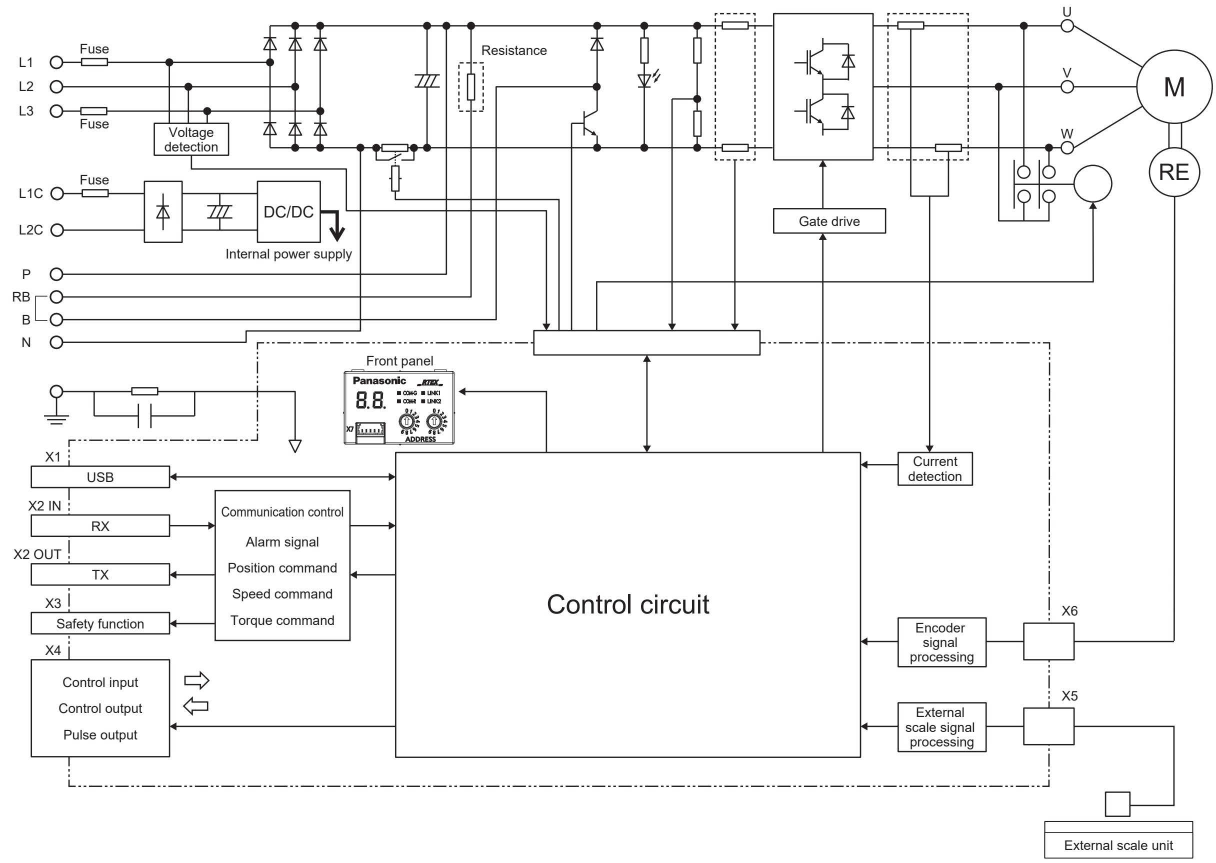
Rated output			750 W		1000 W	
Motor product number			082U1□2		092U1□2	
Brake			No	Yes	No	Yes
LL	Without oil seal	mm	86	121.2	97.2	132.4
	With oil seal	mm	86	121.2	97.2	132.4
LM		mm	72.5	107.7	83.7	118.9
LT		mm	13.5			
KB1		mm	45.6	45.6	56.8	56.8
KB2		mm	—	87.2	—	98.4
LR		mm	35			
S		mm	19			
LA		mm	90			
LB		mm	70			
LC		mm	80			
LE		mm	3			
LF		mm	8			
LH		mm	52.7			
LZ		mm	6			
Dimensions with key	LW	mm	25			
	LK	mm	22			
	KW	mm	6			
	KH	mm	6			
	RH	mm	15.5			
	TP	mm	M5 depth 10			
D-cut dimensions	LS	mm	25			
	DW	mm	17.5			
	DH	mm	17.5			
Mass	Without oil seal	kg	1.9	2.7	2.3	3.1
	With oil seal		1.9	2.7	2.3	3.1

12.3 Servo Driver Block Diagram

■ Sizes A, B (100 V/200 V)



■ Size C (100 V/200 V), Size D (200 V)



12.4 Optional Parts

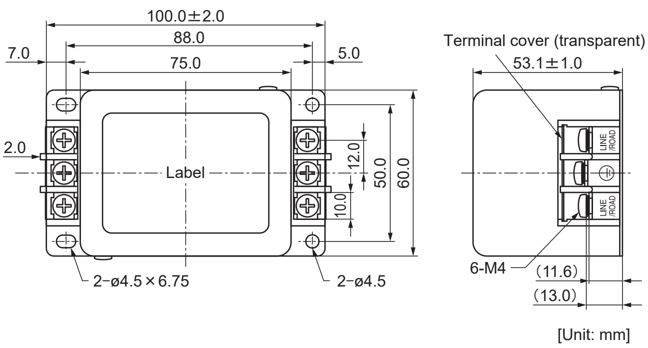
12.4.1 Noise Filter

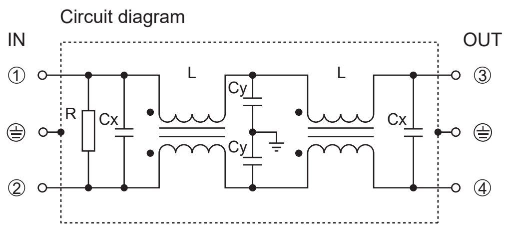
If using multiple servo drivers and installing one noise filter for all the power supply parts collectively, consult the manufacturer of the noise filter. If a noise margin is required, connect 2 filters in series to emphasize effectiveness.

■ Optional parts

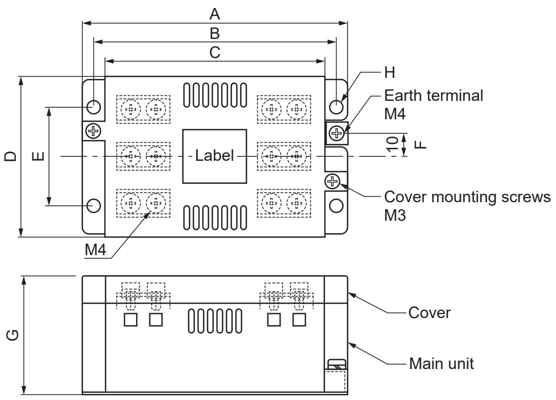
Driver part no.	Driver voltage specifications	Noise filter		
		Optional product number	Manufacturer product number	Manufacturer
MADN061□□	Single phase 100 V	DV0PM4170	SUP-EK5-ER-6	Okaya Electric Industries
MADN081□□				
MBDN121□□				
MCDN201□□		DV0PM20042	3SUP-HU10-ER-6	
MADN065□□	Single phase/3-phase 200 V	DV0PM4170 (for single phase) or DV0PM20042 (for 3-phase)	SUP-EK5-ER-6 (for single phase) or 3SUP-HU10-ER-6 (for 3-phase)	
MADN085□□				
MBDN125□□				
MCDN205□□		DV0PM20042	3SUP-HU10-ER-6	
MDDN405□□		DV0P4220	3SUP-HU30-ER-6	

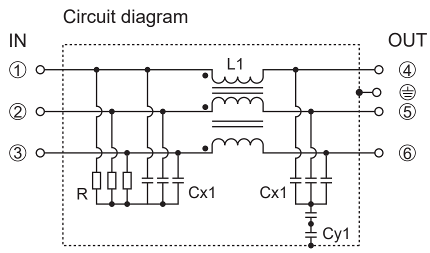
DV0PM4170





DV0PM20042, DV0P4220





* Dimensions [Unit: mm]

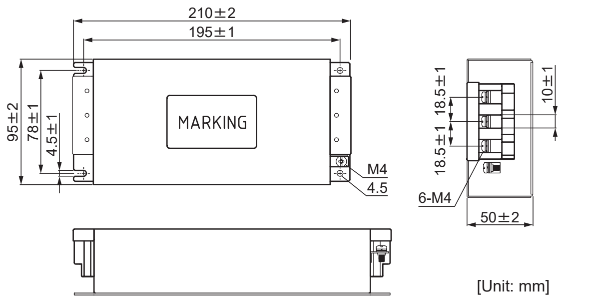
Optional product number	A	B	C	D	E	F	G	H
DV0PM20042	115	105	95	70	43	10	52	5.5
DV0P4220	145	135	125	70	50	10	52	5.5

For single phase, use two of the three terminals. Do not connect anything to the remaining terminal.

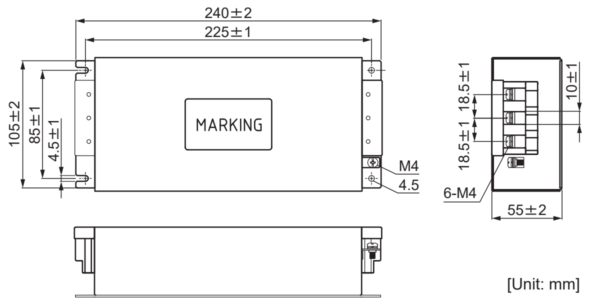
■ Other recommended parts

Applicable (servo driver size)	Driver voltage specifications	Noise filter		
		Manufacturer product number	Rated current	Manufacturer
MADN061□□	Single phase 100 V	RTHN-5010	10 A	TDK-Lambda Corporation
MADN081□□				
MBDN121□□				
MCDN201□□				
MADN065□□	Single phase/3-phase 200 V			
MADN085□□				
MBDN125□□				
MCDN205□□				
MDDN405□□		RTHN-5030	30 A	

RTHN-5010



RTHN-5030



— Precautions —

- Select a noise filter with a capacity that matches the power supply capacity (considering load conditions).
- For the detailed specifications of each noise filter, contact the manufacturer.
- Use options properly, reading their respective operating instructions and sufficiently checking precautions before use. Please avoid placing excessive stress on products and cables.

12.4.2 Surge Absorber

Install the surge absorber on the primary side of the noise filter.

■ **Compatible parts**

Driver voltage specifications	Manufacturer Product Number	Manufacturer
3-phase 200 V	RSPD-250-U4	Okaya Electric Industries
Single-phase 100 V, 200 V	RSPD-250-Q4	

— Precautions —

- Always remove the surge absorber before high voltage insulation testing machinery and equipment. Failure to do so may result in damage to the surge absorber.

12.4.3 Ferrite Core

Ensure all cables (motor cables, encoder cables, interface cables, USB cables) have a ferrite core.

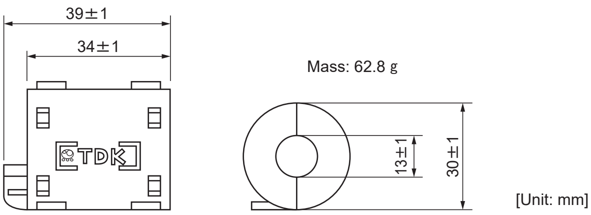
■ Optional parts

Encoder cable, interface cable, and USB cables

Optional Product Number	Manufacturer Product Number	Manufacturer
DV0P1460	ZCAT3035-1330	TDK Corporation

* The quantity at the time of purchase is 4.

DV0P1460



— Precautions —

- Fix the ferrite core to prevent excessive stress on cables.
- Adjust the length of the jacket as needed when installing the connector XB cable.

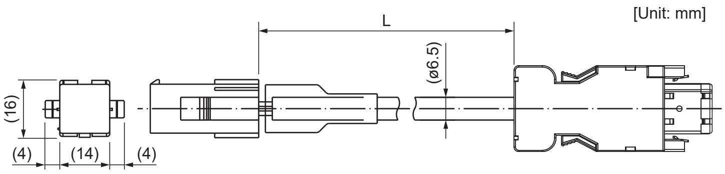
12.4.4 Relay Cable for Encoder

Product name	Optional product number	Compatible motor outputs	Remarks
Relay cable for absolute encoder	MFECA0**0EAD (*1)	MHMG 50 W and 1000 W (□80) (Lead wire type)	No battery box

*1 The ** in product numbers indicates the “L” dimension in the dimensions shown below.

** section	L (m)
03	3
05	5
10	10

MFECA00EAD**



Components

Name	Manufacturer product number	Manufacturer
Connector (driver side)	3E206-0100KV	3M Japan or equivalent product
Shell kit	3E306-3200-008	
Connector (motor side)	172161-1	Tyco Electronics Japan G.K.
Connector pin	170365-1	
Cable	0.20 mm^2 × 3P (6-core)	Oki Electric Cable Co., Ltd.

— Precautions —

- Optional cables not compatible with IP65 or IP67.

12.4.5 Motor Relay Cable

Refer to *"1.8.2.3.2 Wire Specifications by Model"* when selecting wire sizes in order to comply with international standards.

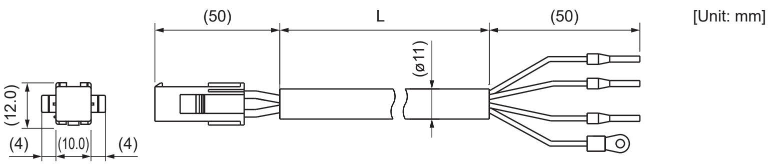
Check with the manufacturer for the pin product numbers of the appropriate connectors.

Product name	Optional product number	Compatible motor outputs
Relay cable for motor (no brake)	MFMCA0**OEED (*1)	MHMG 50 W and 1000 W (□ 80) (Lead wire type)

*1 The ** in product numbers indicates the "L" dimension in the dimensions shown below.

** section	L (m)
03	3
05	5
10	10
20	20

MFMCA0OEED**



Components

Name	Manufacturer product number	Manufacturer
Connector	172159-1	Tyco Electronics Japan G.K.
Connector pin	170366-1	
Terminal	AI0.75+8GY	Phoenix Contact
Nylon-insulated ring tongue terminal	N1.25-M4	J.S.T. Mfg. Co., Ltd.
Cable	ROBO-TOP 600 V AWG18 (0.75 mm^2) 4-core	Dyden Corporation

— Precautions —

- Optional cables not compatible with IP65 or IP67.

12.4.6 Relay Cable for Brake

Refer to *"1.8.2.3.2 Wire Specifications by Model"* when selecting wire sizes in order to comply with international standards.

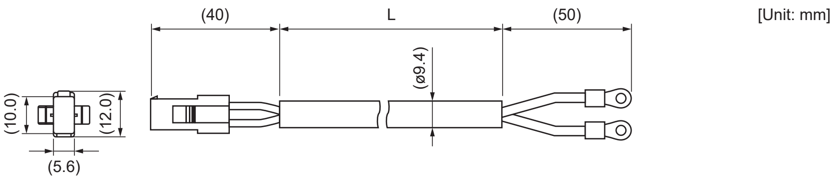
Check with the manufacturer for the pin product numbers of the appropriate connectors.

Product name	Optional product number	Compatible motor outputs
Relay cable for brake	MFMCB0**0GET (*1)	MHMG 50 W and 1000 W (□80) (Lead wire type)

*1 The ** in product numbers indicates the "L" dimension in the dimensions shown below.

** section	L (m)
03	3
05	5
10	10
20	20

MFMCB00GET**



Components

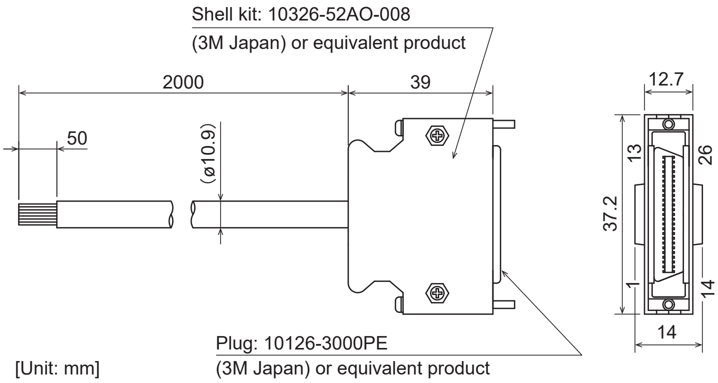
Name	Manufacturer product number	Manufacturer
Connector	172157-1	Tyco Electronics Japan G.K.
Connector pin	170366-1, 170362-1	
Nylon-insulated ring tongue terminal	N1.25-M4	J.S.T. Mfg. Co., Ltd.
Cable	ROBO-TOP 600 V AWG18 (0.75 mm^2) 2-core	Dyden Corporation

— Precautions —

- Optional cables not compatible with IP65 or IP67.

12.4.7 Interface Cable

Product name	Optional product number
Interface cable	DV0PM24679



An AWG26 core wire with 2 m of electric wire is connected.

Wiring table

Pin No.	Signal name	Core wire color
1*	BRK-OFF+	Orange (Red 1)
2*	BRK-OFF-	Orange (Black 1)
3*	ALM+	Gray (Red 1)
4*	ALM-	Gray (Black 1)
5*	SI-MON5	White (Red 1)
6	SI-COM	White (Black 1)
7*	POT	Yellow (Red 1)
8*	NOT	Yellow (Black 1)
9*	SI-MON1	Pink (Red 1)

Pin No.	Signal name	Core wire color
10*	HOME	Pink (Black 1)
11*	EXT2	Orange (Red 2)
12*	EXT3	Orange (Black 2)
13*	SI-MON4	Gray (Red 2)
14	BTP-I	Gray (Black 2)
15	BTN-I	White (Red 2)
16	GND	White (Black 2)
17	OA+/OCMP1+	Yellow (Red 2)
18	OA-/OCMP1-	Yellow (Black 2)

Pin No.	Signal name	Core wire color
19	OB-/OCMP2-	Pink (Red 2)
20	OB+/OCMP2+	Pink (Black 2)
21	OCMP3+	Yellow (Red 3)
22	OCMP3-	Yellow (Black 3)
23	AIN (NC)	Pink (Red 3)
24	GND (NC)	Pink (Black 3)
25*	EX-OUT1+	Orange (Red 4)
26*	EX-OUT1-	Orange (Black 4)

* Signal assignments for pin No. marked with an asterisk (*) in the table are the initial values.

* For details on signal assignment, see *"3.2.5 Wiring to Connector X4 (Connecting to I/O)"* .

Notes

- The lead wires of the core cables are marked with colors and dots. Using for pin No. 1 as an example, orange in the wiring table indicates the color of the lead wire of the core cable, while (red 1) indicates a single red dot mark.

  The shield of the interface cable connects to the connector shell but not to the terminals.
- In the above table, the 23-pin analog input (AIN) and 24-pin ground connection (GND) can only be used for the application specialized type. Do not use for connecting the standard type or multi-function type (NC).

12.4.8 Connector Kits

12.4.8.1 Connector Kit for Interface

Product name	Option product number
Connector kit for interface	DV0P0770

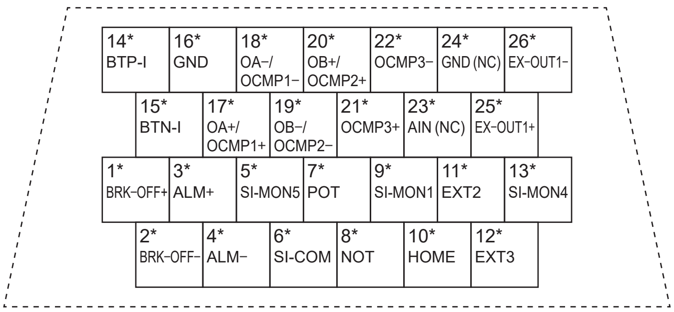
Components

Name	Manufacturer product number	Manufacturer	Remarks
Connector	10126-3000PE	3M Japan	For X4 connector (26-pin)
Connector cover	10326-52A0-008		

Other recommended parts

Name	Manufacturer product number	Manufacturer	Remarks
Connector	DF02P026F22A1	Japan Aviation Electronics Industry, Ltd.	For X4 connector (26-pin)
Connector cover	DF02D026B22		

Pin arrangement for connector (26-pin) (figure as seen from the cable side)



* Signal assignments for pin No. marked with an asterisk (*) in the figure are the initial values.

* For details on signal assignment, see *"3.2.5 Wiring to Connector X4 (Connecting to I/O)"* .

— Precautions —

- When wiring, also check the pin numbers marked on the connector body.
- In the above figure, the 23-pin analog input (AIN) and 24-pin ground connection (GND) can only be used for the application specialized type. Do not use for connecting the standard type or multi-function type (NC).

Notes

- Check the required crimping tools for cable production on the manufacturer's website, or with the manufacturer directly. For manufacturer contact information, see *"12.4.14 List of Peripheral Device Manufacturers"* .

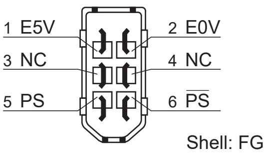
12.4.8.2 Connector Kit for Encoder

Product name	Optional product number
Connector kit for encoder	DV0PM20010

Components

Name	Manufacturer product number	Manufacturer	Remarks
Connector (driver side)	3E206-0100KV	3M Japan	For X6 connector
Shell kit	3E306-3200-008	3M Japan	

Pin arrangement for X6 connector

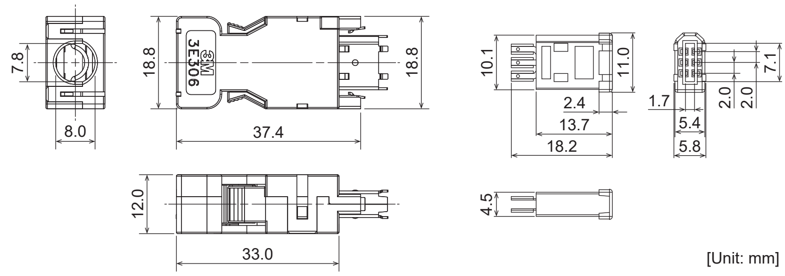


(View from the cable side)

<<Caution>>
Do not connect anything to the pin labeled “NC”.

Dimensions diagram

〈Shell kit〉 〈Connector〉



Other recommended parts

Name	Manufacturer product number	Manufacturer	Remarks
Connector (driver side) *With shell kit	2271871-1	Tyco Electronics Japan G.K.	For X6 connector

12.4.8.3 Connector Kit for Power Supply Input

Product name	Optional product number	Remarks
Connector kit for power supply input	DV0PM24685	For sizes A to D: 1-row type

Components

Name	Manufacturer product number	No. of pcs.	Manufacturer	Remarks
Connector	05JFAT-SAXGSAK-KM7.5 (LA)	1	J.S.T. Mfg. Co., Ltd.	For XA connector
Control lever	J-FAT-OT-EXL	1		

12.4.8.4 Connector Kit for Motor

Product name	Optional product number
Connector kit for motor	DV0PM24687

Components

Name	Manufacturer product number	No. of pcs.	Manufacturer	Remarks
Connector	07JFAT-SAXGSAK-KM7.5 (LA)	1	J.S.T. Mfg. Co., Ltd.	For XB connector
Control lever	J-FAT-OT-EXL	1		

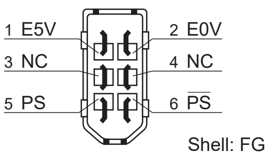
12.4.8.5 Connector Kit for Motor Encoder

Product name	Optional product number	Compatible motor outputs	Remarks
Connector kit for motor encoder	DV0P4290	MHMG 50 W and 1000 W (□80)	Without brake

Components

Name	Manufacturer product number	No. of pcs.	Manufacturer	Remarks
Connector (driver side)	3E206-0100KV	1	3M Japan or equivalent product	For X6 connector (6-pin)
Shell kit	3E306-3200-008	1		
Connector	172161-1	1	Tyco Electronics Japan G.K.	For encoder cable (9-pin)
Connector pin	170365-1	9		
Connector	172159-1	1		For motor cable (4-pin)
Connector pin	17036601	4		

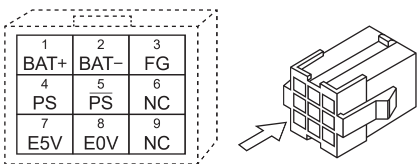
Pin arrangement for X6 connector



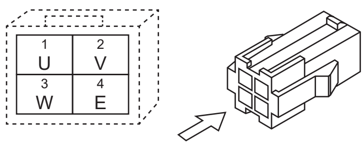
(View from the cable side)

<<Caution>>
Do not connect anything to the pin labeled "NC".

Pin arrangement for encoder cable connector



Pin arrangement for motor cable connector



— Precautions —

- The customer must carry out appropriate processing when IP65 or IP67 is required.
- Check the required crimping tools for cable production on the manufacturer's website, or with the manufacturer directly. For manufacturer contact information, see *"12.4.14 List of Peripheral Device Manufacturers"* .

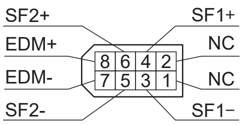
Other recommended parts

Name	Manufacturer product number	No. of pcs.	Manufacturer	Remarks
Connector (driver side) *With shell kit	2271871-1	1	Tyco Electronics Japan G.K.	For X6 connector (6-pin)

12.4.8.6 Connector Kit for Safety

Product name	Optional product number
Connector kit for safety	DV0PM20103

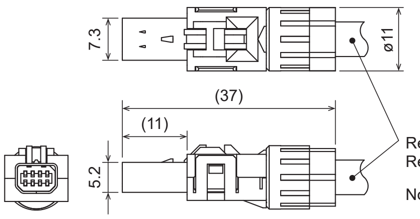
Pin arrangement for X3 connector



Shell: FG
(View from the cable side)

<<Caution>>
Do not connect anything to the pin labeled “NC”.

Dimensions diagram



[Unit: mm]

Recommended wire diameter: ø6 mm
Recommended core wire diameter: AWG26 to AWG30

Note: Electric wires are not included.

Components

Name	Manufacturer product number	Manufacturer	Remarks
Connector	CIF-PCNS08KK-071R	J.S.T. Mfg. Co., Ltd.	For X3 connector (8-pin)

Notes

- Cannot be used for the standard type.

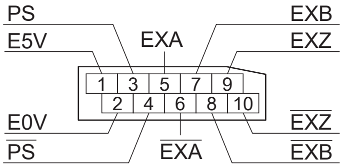
Other recommended parts

Name	Manufacturer product number	Manufacturer	Remarks
Connector	2013595-1	Tyco Electronics Japan G.K.	For X3 connector (8-pin)
	2201855-1		For X3 connector (8-pin) Piercing type

12.4.8.7 Connector Kit for External Scale

Product name	Optional product number
Connector kit for external scale	DV0PM20026

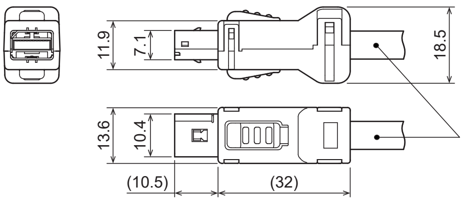
Pin arrangement for X5 connector



(View from the cable side)

Dimensions diagram

[Unit: mm]



Recommended wire diameter: ø6 mm
Recommended core wire diameter: AWG26 to AWG30
Note: Electric wires are not included.

Components

Name	Manufacturer product number	Manufacturer	Remarks
Connector	MUF-PK10K-X	J.S.T. Mfg. Co., Ltd.	For X5 connector (10-pin)

Notes

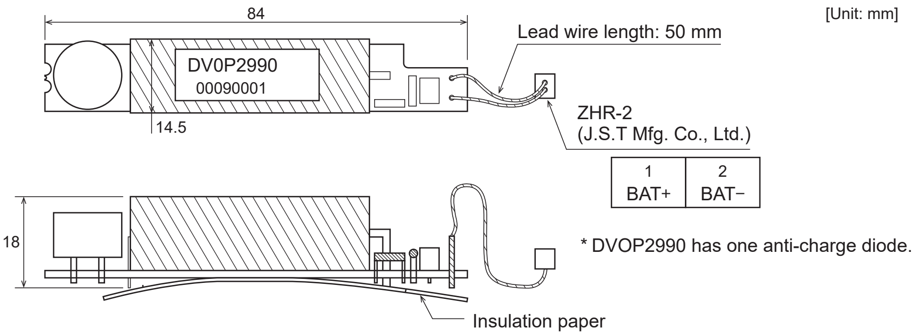
- Cannot be used for the standard type.

12.4.9 Battery for Absolute Encoder

■ Battery

Product name	Optional product number
Battery	DV0P2990

Lithium battery: 3.6 V 2000 mAh



— Precautions —

- Applications for shipment as a hazardous material may be required for air shipments (both passenger and cargo aircraft).
  Consult with the shipping company (airline) when requesting air shipments.

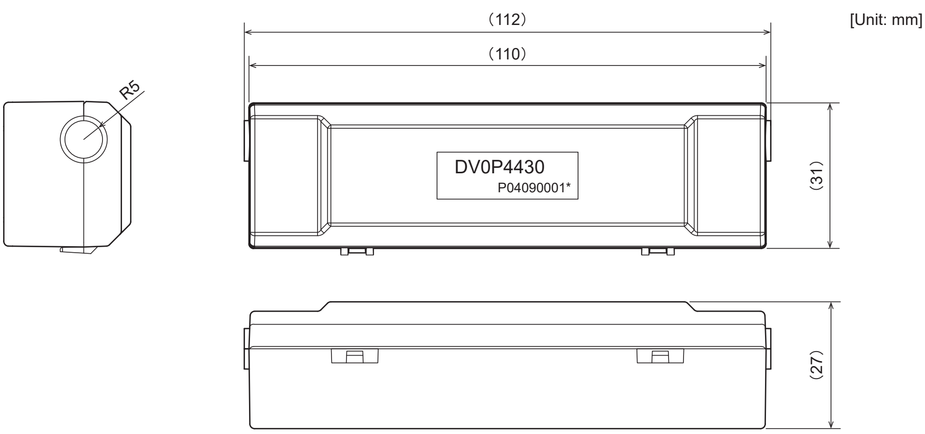
■ Connectors for connecting absolute encoder batteries

Name	Product number	Manufacturer
Connector	ZMR-2	J.S.T. Mfg. Co., Ltd.
Connector pin	SMM-003T-P0.5	J.S.T. Mfg. Co., Ltd.
Recommended manual clamping jig	YRS-800	J.S.T. Mfg. Co., Ltd.

■ Battery box

Product name	Optional product number
Battery box	DV0P4430

Components



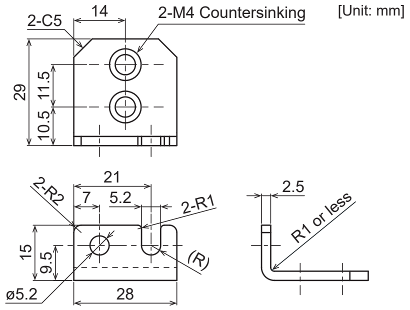
12.4.10 Mounting Bracket

Product name	Optional product number	Applicable servo driver size symbol	Quantities of optional items
Mounting bracket	DV0PM24689	Size A Size B	• Upper and lower brackets: 2 pcs. • M4 × 6 flat head screws: 4 pcs.
	DV0PM24690	Size C Size D	• Upper bracket: 1 pc. • Lower bracket: 1 pc. • M4 × 6 flat head screws: 4 pcs.

■ Dimensions

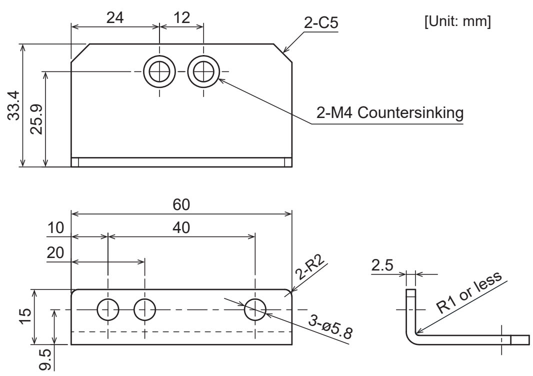
DV0PM24689

Same for upper and lower

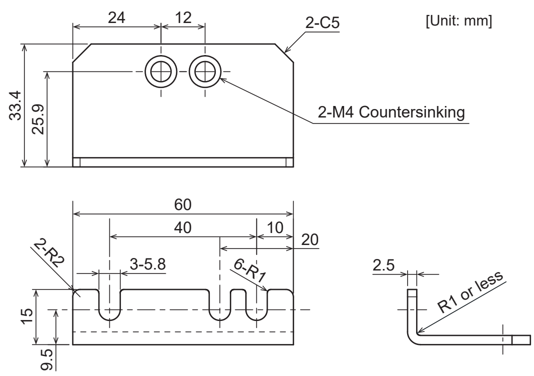


DV0PM24690

Upper



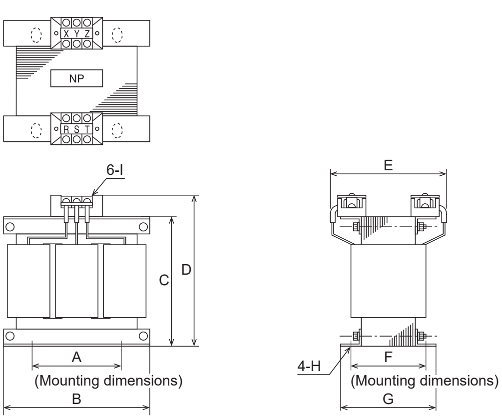
Lower

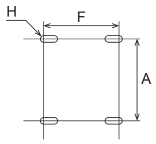


12.4.11 Reactor

Product name	Figure	Optional product number	A (mm)	B (mm)	C (mm)	D (mm)	E (Max) (mm)	F (mm)	G (mm)	H (mm)	I (mm)	Inductance (mH)	Rated current (A)
Reactor	Figure 1	DV0P220	65 ± 1	125 ± 1	(93)	136Max	155	70+3/-0	85 ± 2	4-7φ×12	M4	6.81	3
		DV0P222	60 ± 1	150 ± 1	(113)	155Max	140	70+3/-0	85 ± 2	4-7φ×12	M4	2	8
	Figure 2	DV0P227	55 ± 0.7	76.5 ± 1	66.5 ± 1	110Max	90	43.6 ± 2	56 ± 2	4-5φ×10	M3.5	4.02	5
		DV0P228	55 ± 0.7	76.5 ± 1	66.5 ± 1	110Max	95	48.0 ± 2	61 ± 2	4-5φ×10	M3.5	2	8

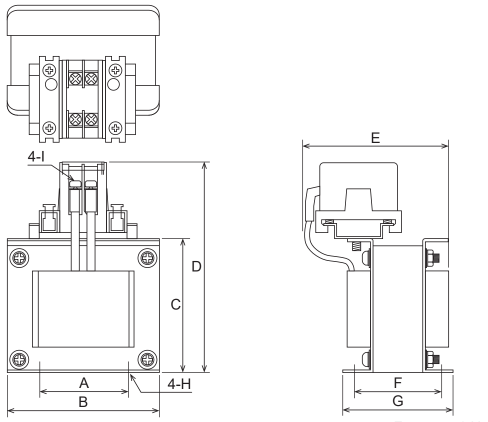
Figure 1

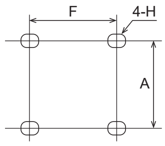




F: Distance between centers of outer arcs

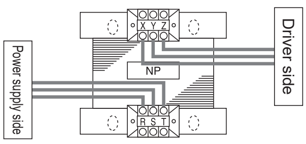
Figure 2



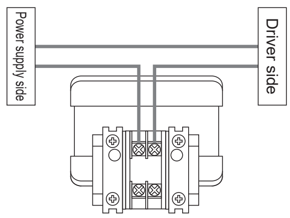


F: Distance between centers of long holes

Wiring example
(for 3-phase power supply)



Wiring example
(for single-phase power supply)



Driver part no.	Voltage specification	Motor rated output	Reactor product number
MADN061☐☐	Single phase 100 V	50 W	DV0P227
MADN081☐☐		100 W	
MBDN121☐☐		200 W	DV0P228
MCDN201☐☐		400 W	
MADN065☐☐	Single phase 200 V	50 W	DV0P227
MADN065☐☐		100 W	
MADN085☐☐		200 W	
MBDN125☐☐		400 W	DV0P228
MCDN205☐☐		750 W	
MDDN405☐☐		1000 W	
MADN065☐☐	3-phase 200 V	50 W	DV0P220
MADN065☐☐		100 W	

Driver part no.	Voltage specification	Motor rated output	Reactor product number
MADN085□□	3-phase 200 V	200 W	DV0P220
MBDN125□□		400 W	
MCDN205□□		750 W	
MDDN405□□		1000 W	DV0P222

Select a reactor that matches the driver product number and voltage specifications.

Notes

- For driver and motor combinations, refer *"2.3 Driver and Motor Combinations"* .

■ Harmonics suppression measures

Harmonics suppression measures vary by country. Install in accordance with local regulations.

In September 1994, the Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry (formerly the Ministry of International Trade and Industry) established the "Guidelines for harmonics suppression measures on heavy consumers who receive power through high voltage systems or extra-high voltage systems" and "Guidelines for harmonics suppression measures on household electrical appliances and general-purpose articles" for products sold in Japan. According to these guidelines, the Japan Electrical Manufacturers' Association (JEMA) has prepared technical references (procedures to implement harmonics suppression measures: JEM-TR 198, JEMTR 199 and JEM-TR 201) and has requested cooperation and understanding from users. Beginning in January 2004, general-purpose inverters and servo drivers were excluded from the "Guidelines for harmonics suppression measures on household electrical appliances and general-purpose articles". Subsequently, the "Guidelines for harmonics suppression measures on household electrical appliances and general-purpose articles" were abolished on September 6, 2004.

The procedure to implement harmonics suppression measures on general-purpose inverters and servo drivers has now been modified as follows.

1. Regarding general-purpose inverters and servo drivers for heavy consumers, products whose input current exceeds 20 A are subject to the "Guidelines for harmonics suppression measures for users who receive power through high-voltage or extra-high voltage systems". All consumers required to apply these guidelines must calculate the equivalent capacity and harmonic outflow current based on the guidelines. If the harmonic current is found to exceed the limit value predetermined for the contract demand, appropriate measures must be taken.

   Furthermore, when calculating the equivalent capacity, assume that the conversion factor of the servo driver is K31 = 3.4 (See JEM-TR 210 and JEM-TR 225.*).

2. The "Guidelines for harmonics suppression measures on household electrical appliances and general-purpose articles" was abolished on September 6, 2004. However, based on conventional guidelines, JEMA applies the technical references JEM-TR226 and JEM-TR227 to any users who do not fit into the "Guidelines for harmonics suppression measures on heavy consumers who receive power through high voltage system or extra high voltage system" from a perspective on enlightenment on general harmonics suppression measures. The purpose of these guidelines is to ensure implementation of harmonics suppression measures by users on all devices possible, as before the changes.

   * Technical reference issued by the Japan Electrical Manufacturers' Association (JEMA).

12.4.12 External Regenerative Resistor

The following resistors are recommended for use as external regenerative resistors.

Product name	Optional product number	Manufacturer (*3) format	Specifications					Internal thermal protector operating temperature
			Resistance value	Core cable outer diameter	Mass	Rated power (reference value) (*1)		
						Free air	Fan used (*2)	
			Ω	mm	kg	W	W	
External regenerative resistor	DV0P4280	RF70M	50	φ1.27 (AWG18) Stranded wire	0.1	10	25	140 ± 5 °C B contact Switching capacity (resistance load) 1 A 125 V AC 6000 times 0.5 A 250 V AC 10000 times
	DV0P4281	RF70M	100		0.1	10	25	
	DV0P4282	RF180B	25		0.4	17	50	
	DV0P4283	RF180B	50		0.2	17	50	
	DV0P4284	RF240	30		0.5	40	100	

*1 Power available without running the built-in thermal protector

Each regenerative resistor has a built-in thermal fuse and thermal protector for safety.

When using a thermal protector, configure the circuit to turn off the power supply (Refer to *“3.2.1 Wiring to the Main Circuit”*).

The built-in thermal fuse may break due to heat dissipation conditions, operating temperature range, power supply voltage, or load fluctuation.

When operating in conditions where the regenerative resistor is likely to generate heat (e.g., when the power supply voltage is high, when load inertia is large, or when deceleration times are short), incorporate it into the device to ensure that the surface temperature of the regenerative resistor remains at less than 100°C and confirm the operation thereof.

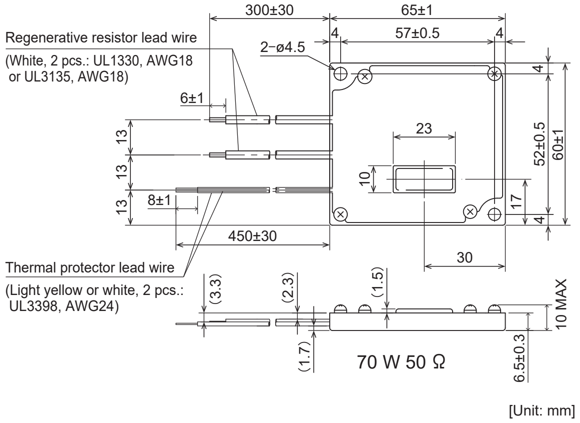
*2 If the fan is used for wind speeds of at least 1 m/s

*3 Manufacturer: Iwaki Musen Kenkyusho

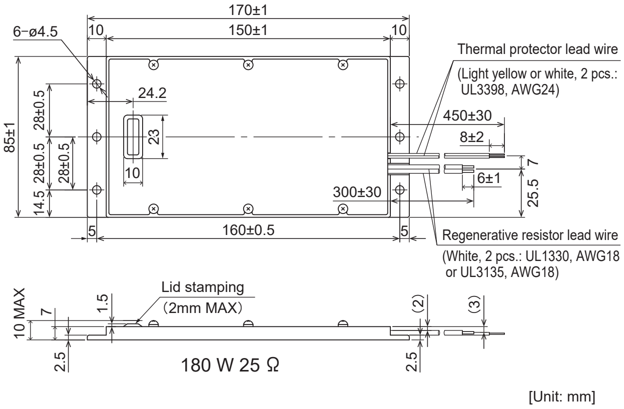
Driver and external regenerative resistor combinations are shown below.

Driver part no.	Driver voltage specifications	Regenerative resistor
		Optional product number
MADN061□□	Single phase 100 V	DV0P4280
MADN081□□		
MBDN121□□		DV0P4283
MCDN201□□		DV0P4282
MADN065□□	Single phase/3-phase 200 V	DV0P4281
MADN085□□		DV0P4283
MBDN125□□		
MCDN205□□		
MDDN405□□		DV0P4284

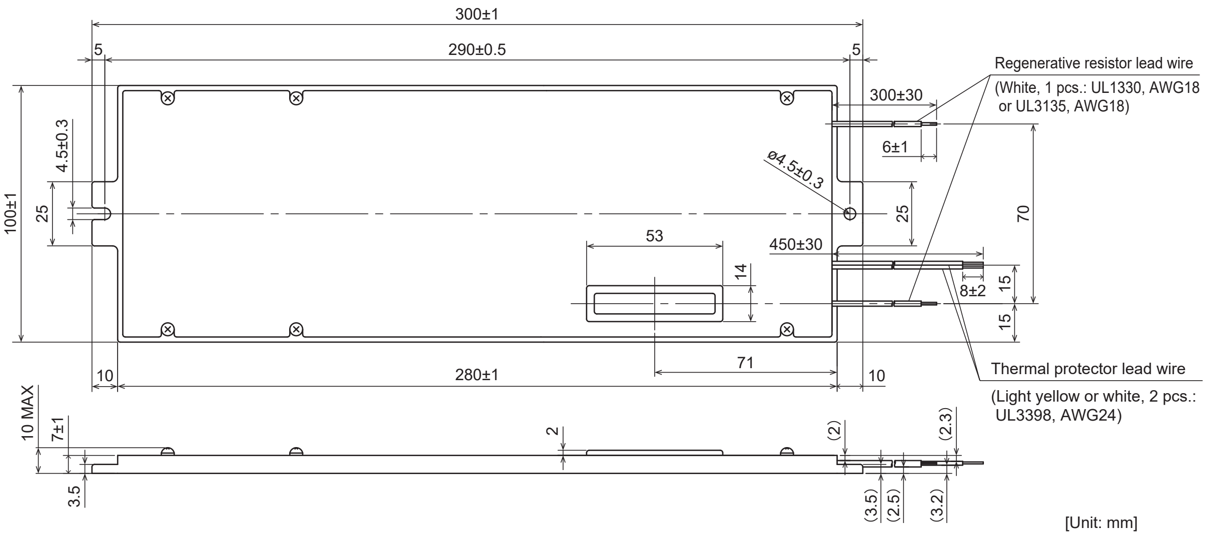
DV0P4280, DV0P4281



DV0P4282, DV0P4283



DV0P4284



— Precautions —

- Regenerative resistors can become hot.
  - Structure circuits such that the thermal protector in the regenerative resistor works by cutting off the power supply.
  - The thermal protectors recover automatically. Create an external self-holding circuit to prevent unsafe conditions if the thermal protector activates suddenly.
  - When drivers malfunction, the outer surface of the regenerative resistor may reach temperatures higher than operating temperatures before the thermal protector activates.
  - The thermal fuses in regenerative resistors are intended to prevent combustion of regenerative resistors when drivers malfunction, and not for control of resistor surface temperatures.
- Install the regenerative resistor to nonflammable materials such as metal.
- Install the regenerative resistor so that it cannot be touched directly, such as by covering it with non-combustible material.
- Sections that can be touched directly should be kept to less than 70°C.
- Do not install regenerative resistors near flammable materials.

12.4.13 Surge Absorber for Motor Brake

Recommended parts

Motor		Manufacturer product number	Manufacturer
MHMG	50 W to 1000 W (□80)	TND14V-271K	Nippon Chemi-con

12.4.14 List of Peripheral Device Manufacturers

Manufacturer	Phone number		Peripheral device name
Iwaki Musen Kenkyusho	044-833-4311		Regenerative resistor
Nippon Chemi-con	Kanto Region Chubu Region Kansai Region	03-5436-7711 052-772-8551 06-6338-2331	Surge absorber for holding brake
SEMITEC Corporation	Kanto Region Kansai Region	03-3621-2703 06-6391-6491	
KOA CORPORATION Musashino Plant	042-336-5300		
TDK Corporation	Kanto Region Chubu Region Kansai Region	03-5201-7229 052-971-1712 06-6632-8140	Ferrite core
Nisshin Electric Co., LTD. (MICROMETALS)	04-2934-4151		
Konno Kogyosho Co., Ltd.	0184-53-2307		
Okaya Electric Industries	East Japan West Japan	03-4544-7040 06-6341-8815	Surge absorber Noise filter
Japan Aviation Electronics Industry, Ltd.	Kanto Region Chubu Region Kansai Region	03-3780-2717 0565-34-0600 06-6447-5255	Connector
3M Japan	Kanto Region Chubu Region Kansai Region	03-5716-7290 052-220-7083 06-6447-3944	
Tyco Electronics Japan G.K.CIS Business Unit	044-844-8052		
Molex Japan LLC	Kanto Region Chubu Region Kansai Region	0462-65-2313 052-232-3977 06-6377-6760	
J.S.T. Mfg. Co., Ltd.	Kanto Region Chubu Region Kansai Region	045-543-1271 0561-33-0600 06-6210-2130	
Dyden Corporation	Kanto Region Chubu Region Kansai Region	03-5805-5880 052-968-1710 06-6229-1881	Cable
Magnescale Co., Ltd.	03-6632-7923		External scale
Nidec Instruments Corporation	03-5740-3000		
Renishaw plc	Tokyo HQ Nagoya Branch	03-5366-5317 052-961-9511	
Fagor Automation S.Coop	+34-943-719-200 *"http://www.fagorautomation.com"*		
Nidec Machine Tool Corporation	075-861-3313		
RSF Elektronik GmbH	03-3234-7781		
Soshin Electric Co., Ltd.	Kanto Region Chubu Region Kansai Region	03-5730-8001 052-930-5051 06-6396-7701	Noise filter
Schaffner EMC	03-5712-3650		
TDK-Lambda Corporation	03-5201-7140		

The above contact information is current as of January 2024.

The List of Peripheral Device Manufacturers is intended only as a reference, and is subject to change without prior notice.

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13 Warranty

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The following cases are excluded even during the warranty period.

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- When caused by usage outside the scope of product specifications
- When caused by fire, earthquake, lightning, wind or water damage, salt damage, voltage anomalies, or other natural disaster or force majeure
- When caused by infiltration of water, oil, metal flakes or other foreign matter
- When individual parts with listed standard lifetimes which have exceeded said lifetimes

Warranty Coverage

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- When caused by the combination of the device and devices it is incorporated into
- When we are unable to process your request regarding this document
- When the device malfunction is otherwise not attributable to our company

Warranty Service

If you require warranty service (fault cause investigation, repair, etc.), please contact the retailer from which you purchased the product.

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As a general rule, you will be responsible for shipping costs.

14 Glossary

Abbreviations used in this document and their official names are shown below.

Abbreviation	Official Name
CCW	Counterclockwise Rotation
CP	Cyclic Position Mode
CP	Continuous Path
CT	Cyclic Torque Mode
CV	Cyclic Velocity Mode
CW	Clockwise Rotation
DB	Dynamic Brake
EDM	External Device Monitoring
EXPOS	External scale position
FB	Feedback
FF	Feed Forward
FFT	Fast Fourier Transform
FIR	Finite Impulse Response
HPF	High Pass Filter
LSD	Least Significant Digit
LV	Low Voltage
MSD	Most Significant Digit
OSS	Open Source Software
PP	Profile Position Mode
Recv	Receive
RTAT	Real-Time Auto Tuning
SRV	Servo
SSU	STO Signal Unmatch
STO	Safe Torque Off
TFF	Torque Feed Forward

REVISIONS

Date	Rev.	Page	Description
Jan. 7, 2025	0.0	–	NEWLY ISSUED
Apr. 1, 2025	0.1	1.5.4	Changed Function (Add to Unsupported Features) ● Monitor Signal Output
Apr. 11, 2025	1.0	1.5.2, 1.5.5	Software version upgrade ● CPU1: Ver1.04→Ver1.05
		1.5.4	Remove from the list of Unsupported Features ● Monitor Signal Output
		3.2.8.1	Added description of operating conditions for Monitor Signal Output
		5.3.3	Corrected typographical errors ● Protection Functions Description
May 28, 2025	1.1	7.3.2, 7.4.2, 7.6.2, 7.6.2, 7.6.3 , 8.7.1, 10.2.5	Added Description
		10.3.2	Corrected typographical errors

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