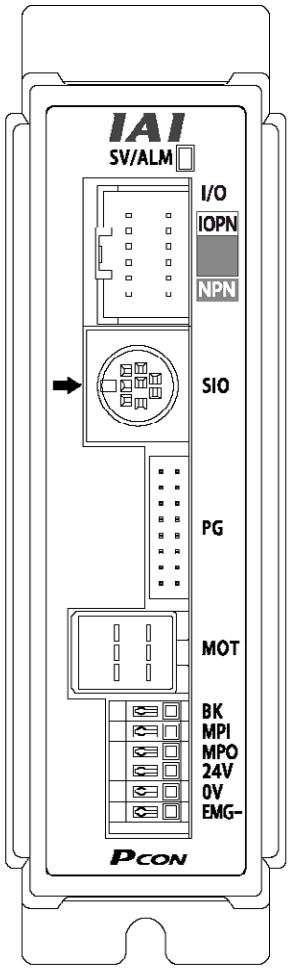
PCON

PCON-CY Controller
Solenoid Valve Type

Operation Manual Fifteenth Edition



IAI Corporation

Please Read Before Use

Thank you for purchasing our product.

This Operation Manual explains the handling methods, structure and maintenance of this product, among others, providing the information you need to know to use the product safely.

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.
The CD or DVD that comes with the product contains operation manuals for IAI products.
When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

After reading the Operation Manual, keep it in a convenient place so that whoever is handling this product can reference it quickly when necessary.

[Important]

- This Operation Manual is original.
- The product cannot be operated in any way unless expressly specified in this Operation Manual. IAI shall assume no responsibility for the outcome of any operation not specified herein.
- Information contained in this Operation Manual is subject to change without notice for the purpose of product improvement.
- If you have any question or comment regarding the content of this manual, please contact the IAI sales office near you.
- Using or copying all or part of this Operation Manual without permission is prohibited.
- The company names, names of products and trademarks of each company shown in the sentences are registered trademarks.

PCON	CAUTION

1. Use Environment

PCON controllers can be used in an environment corresponding to pollution degree 2 or equivalent.

2. PC Software and Teaching Pendant Models

New functions have been added to the entire PCON controller series.
To support these new features, the communication protocol has been changed to the general Modbus (Modbus-compliant) mode. As a result, the existing PC software programs and teaching pendants compatible with RCP2 controllers can no longer be used.
If you are using this controller, use a compatible PC software program and/or teaching pendant selected from the following models.

	Model	Remarks
PC software (with RS232C communication cable)	RCM-101-MW	All are compatible with existing RCP2 controllers.
PC software (with USB communication cable)	RCM-101-USB	
Teaching pendant	RCM-T	
Simple teaching pendant	RCM-E	
Data setting unit	RCM-P	

3. Recommendation for Backing Up Latest Data

This product uses nonvolatile memory to store the position table and parameters. Normally the memory will retain the stored data even after the power is disconnected. However, the data may be lost if the nonvolatile memory becomes faulty.

We strongly recommend that the latest position table and parameter data be backed up so that the data can be restored quickly when the controller must be replaced for a given reason.

The data can be backed up using the following methods:
[1] Save to a CD or FD from the PC software.
[2] Create a position table sheet or parameter sheet and keep a written record of backup.

4. Using Rotary Actuators in Multi-rotation Specification

Rotary actuators of multi-rotation specification models can be set to operate in the multi-rotation mode or limited-rotation mode using a parameter.

4.1 Note

Pay attention to the PIO pattern parameter setting for the following controllers.
Each controller does not support relative coordinate specification in the PIO pattern specified below:

[1] PCON-C/CG: PIO pattern = 5 (User parameter No. 25)
[2] PCON-CY: PIO pattern = 0 (User parameter No. 25)

4.2 Applicable Models

Actuators	RCP2-RTBL-I-28P-20-360-*	Controllers	PCON-C-28PI-*
	RCP2-RTBL-I-28P-30-360-*		PCON-CG-28PI-*
	RCP2-RTCL-I-28P-20-360-*		PCON-CY-28PI-*
	RCP2-RTCL-I-28P-30-360-*		PCON-SE-28PI-*

CE Marking

If a compliance with the CE Marking is required, please follow Overseas Standards Compliance Manual (ME0287) that is provided separately.

Table of Contents

Safety Guide

"Safety Guide" has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

No.	Operation Description	Description
1	Model Selection	● This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications. 1) Medical equipment used to maintain, control or otherwise affect human life or physical health. 2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility) 3) Important safety parts of machinery (Safety device, etc.) ● Do not use the product outside the specifications. Failure to do so may considerably shorten the life of the product. ● Do not use it in any of the following environments. 1) Location where there is any inflammable gas, inflammable object or explosive 2) Place with potential exposure to radiation 3) Location with the ambient temperature or relative humidity exceeding the specification range 4) Location where radiant heat is added from direct sunlight or other large heat source 5) Location where condensation occurs due to abrupt temperature changes 6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid) 7) Location exposed to significant amount of dust, salt or iron powder 8) Location subject to direct vibration or impact ● For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	● When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. ● Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the operation manual for each model. ● Do not step or sit on the package. ● Do not put any heavy thing that can deform the package, on it. ● When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. ● When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit. ● Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. ● Do not get on the load that is hung on a crane. ● Do not leave a load hung up with a crane. ● Do not stand under the load that is hung up with a crane.
3	Storage and Preservation	● The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. ● Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
4	Installation and Start	(1) Installation of Robot Main Body and Controller, etc. ● Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Also, be equipped for a fall-over or drop due to an act of God such as earthquake. ● Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. ● When using the product in any of the places specified below, provide a sufficient shield. 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets

No.	Operation Description	Description
4	Installation and Start	(2) Cable Wiring ● Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. ● Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. ● Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. ● When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. ● Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. ● Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire.
		(3) Grounding ● The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation. ● For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness 0.5mm^2 (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards). ● Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).

No.	Operation Description	Description
4	Installation and Start	(4) Safety Measures ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury. ● Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. ● Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. ● Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. ● When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury. ● Take the measure so that the work part is not dropped in power failure or emergency stop. ● Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. ● Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.
5	Teaching	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign "Under Operation" at the position easy to see. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Description
6	Trial Operation	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. ● When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. ● Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. ● Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	● Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. ● Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication. ● Make sure to operate automatic operation start from outside of the safety protection fence. ● In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. ● When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.

No.	Operation Description	Description
8	Maintenance and Inspection	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. ● When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign “Under Operation” at the position easy to see. ● For the grease for the guide or ball screw, use appropriate grease according to the Operation Manual for each model. ● Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. ● The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. ● Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
9	Modification and Dismantle	● Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When removing the actuator for disposal, pay attention to drop of components when detaching screws. ● Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	● Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. ● See Overseas Specifications Compliance Manual to check whether complies if necessary. ● For the handling of actuators and controllers, follow the dedicated operation manual of each unit to ensure the safety.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Operation Manual for each model.

Level	Degree of Danger and Damage	Symbol
Danger	This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.	 Danger
Warning	This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.	 Warning
Caution	This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage.	 Caution
Notice	This indicates lower possibility for the injury, but should be kept to use this product properly.	 Notice

1. Overview

1.1 Introduction

As a dedicated controller for our RCP2 and RCP3 actuators, this controller becomes smaller and more affordable and incorporates a new set of features to offer greater convenience and safety, while maintaining the functions of the RCP2 controller.
This controller also provides power-saving functions to address the growing need for saving energy.
The key features and functions of this controller are summarized below.

- Limited I/O positioning points (3 points)
  The I/O signals are designed to function in the same manner as those of air cylinders. Two operation types are supported. The movement complete signals have different meanings in each type.
  - Proximity switch type --- Each movement complete signal works as an auto switch. Even when positioning operation is not performed, a movement complete signal is output once the specified position is passed.
  - Standard type --- A movement complete signal is output only when positioning operation has completed following a move command.

  * The controller is configured to support the proximity switch type before shipment.
- Separate zone output limits for each of 3 positions (rear end, intermediate point, front end)
  Before, the zone output limits were set by parameters and thus fixed to a certain width for all positions. To increase flexibility, setting fields have been added to the position table to allow different limits to be set for each position.
  This function is useful in preventing contact with peripheral equipment or reducing the tact time.
- Independent acceleration and deceleration settings
  The position table now has separate fields for acceleration and deceleration.
  The purpose of this change is to prevent works made of certain materials or having certain shapes from receiving impact or vibration when the actuator decelerates to a stop.
  By reducing the deceleration setting, a more gradual deceleration curve can be achieved.
- Limitation of feed speed during adjustment by test operation
  The feed speed during adjustment by test operation can be limited to ensure safety.
- Power-saving measures
  In general, pulse motors consume more holding current in standstill state than AC servo motors. Accordingly, this controller provides power-saving means by assuming situations where the motor is used in applications requiring a long standby time.

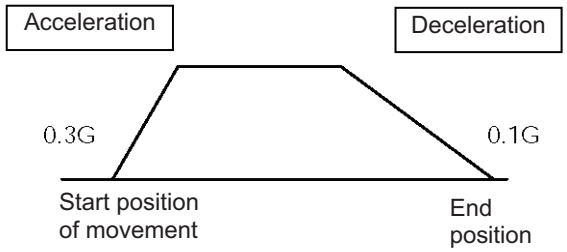
When actually starting your system or if you have encountered any problem, also refer to the manuals for the actuator, teaching pendant, PC software and/or any other component you are using, in addition to this manual.

This manual does not cover all possible deviations from normal operations or unexpected phenomena such as complex signal changes resulting from critical timings. Therefore, the reader should assume that items not described in this manual are “not permitted,” as a rule.

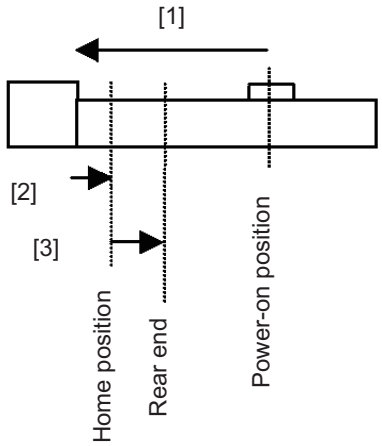
* This manual has been prepared with the utmost attention to ensure accuracy and completeness. However, there may still be inaccuracies and omissions. Should you find any inaccurate description or if you have any comment, please contact IAI.
Keep this manual in a convenient place so that you can easily reference it whenever necessary.

1.2 Differences from Air Cylinders in Control Functions

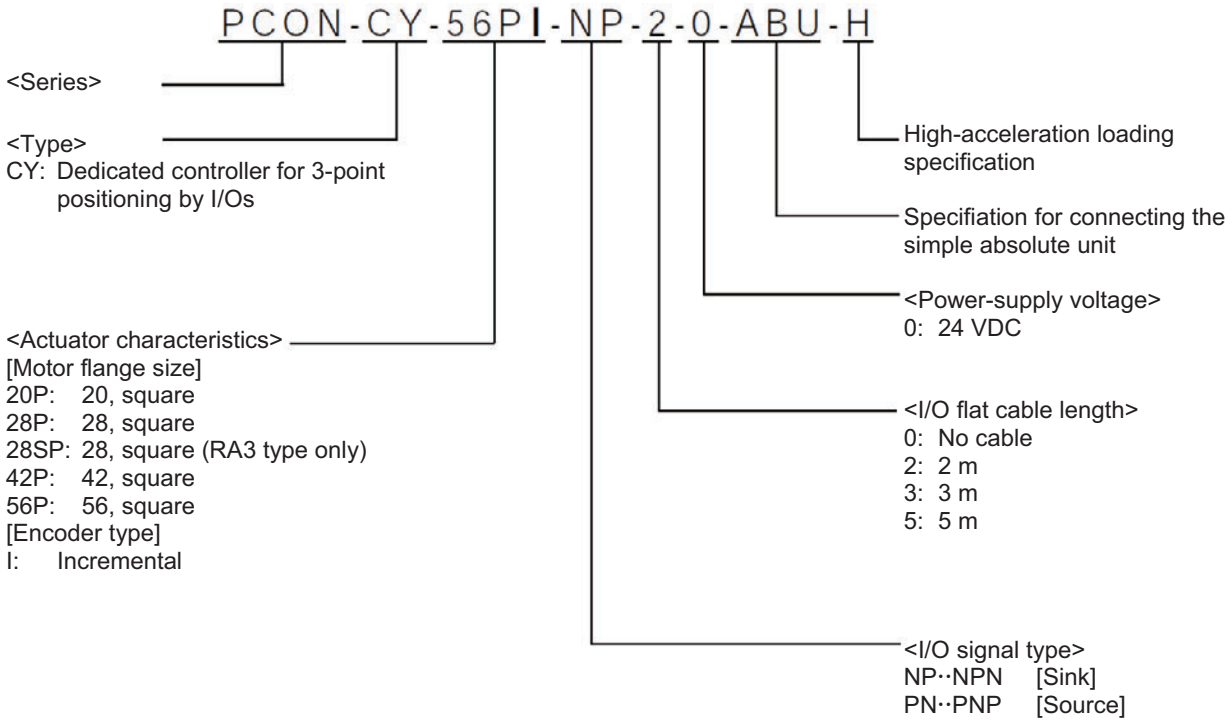
For those of you who have been using air cylinders and have never used motorized cylinders before, this section gives a brief explanation of how this controller is different from air cylinders.
Read the following information and implement controls appropriate for your system.

<table>
<tr><th>Item</th><th>Air cylinder</th><th>PCON</th></tr>
<tr><td>Drive method</td><td>Air pressure by solenoid valve control.</td><td>Ball screw or timing belt drive using a pulse motor.</td></tr>
<tr><td>Target position setting</td><td>Mechanical stopper (including shock absorber).</td><td>Entry of a coordinate value in the “Position” field of the position table.
A value can be entered by keying in a number from a PC/teaching pendant, or by moving the actuator to a desired position and then reading the achieved position directly.
Example) Example of entry of “400 mm” stroke
<table>
<tr><th>Position No.</th><th>Position</th></tr>
<tr><td>0</td><td>5 (mm), rear end</td></tr>
<tr><td>1</td><td>400 (mm), front end</td></tr>
<tr><td>2</td><td>200 (mm), intermediate point</td></tr>
</table></td></tr>
<tr><td>Target position detection</td><td>Installation of a reed switch or other external detection sensor.</td><td>Judgment based on internal coordinates determined by the position information received from the position detector (encoder).
No external detection sensor is required.</td></tr>
<tr><td>Speed setting</td><td>Adjustment by a speed controller.</td><td>Entry of a feed speed in the “Speed” field of the position table (unit: mm/sec).
Note that the rated speed is set automatically as the default feed speed.</td></tr>
<tr><td>Acceleration/ deceleration setting</td><td>In accordance with the load, air supply volume, and speed controller/solenoid valve performance.</td><td>Entry in the “Acceleration” and “Deceleration” fields of the position table (minimum setting unit: 0.01 G).
Reference: 1 G = Gravitational acceleration
Note that the rated acceleration and deceleration are set automatically as the default acceleration and deceleration.
Desired values can be set in fine steps to achieve gradual acceleration/deceleration curves.
 

The greater the set value, the steeper the curve becomes. On the other hand, the smaller the set value, the more gradual the curve becomes.</td></tr>
</table>

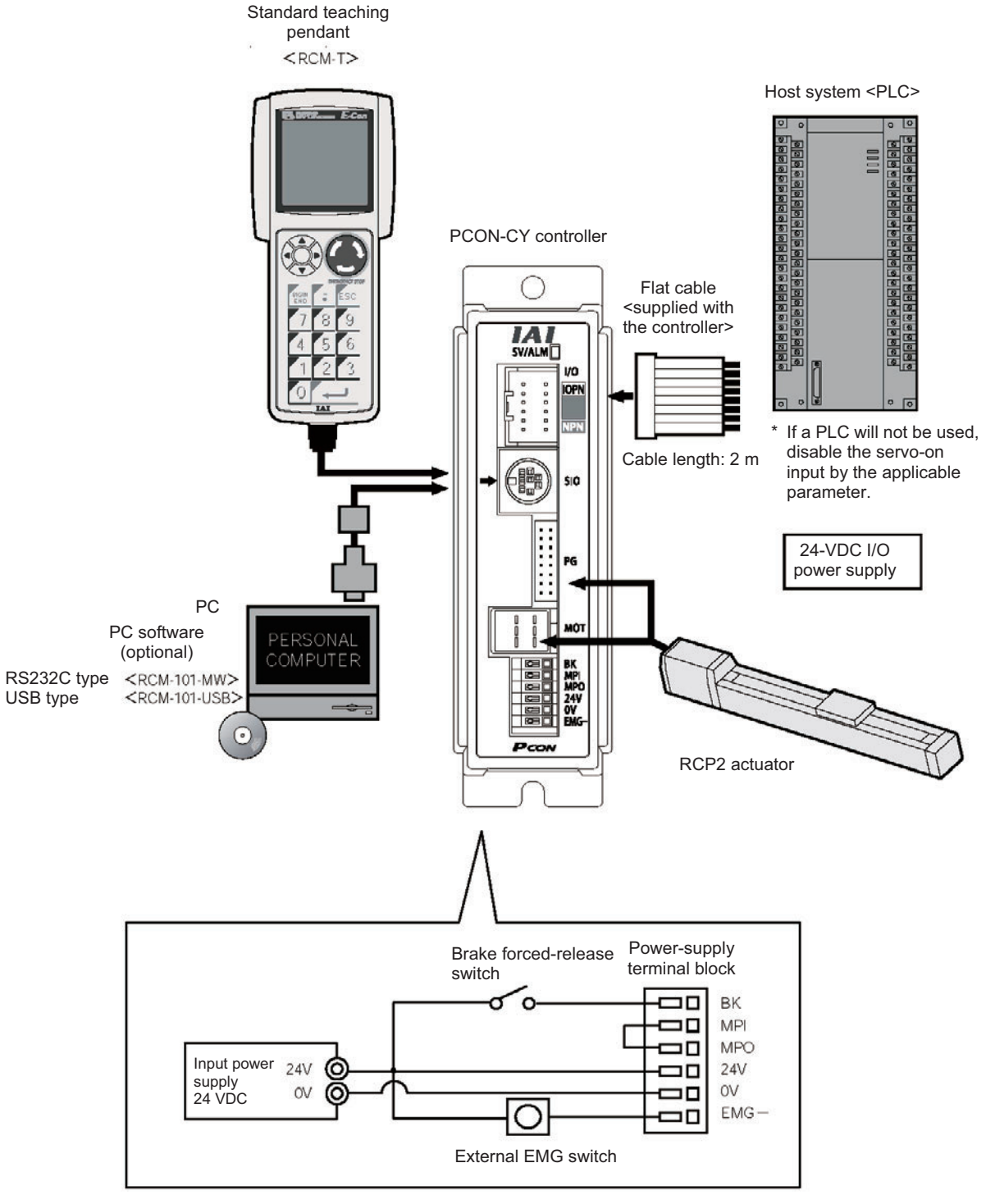
Item	Air cylinder	PCON
Position check upon power on	Judgment using a reed switch or other external detection sensor.	When the power is turned on, mechanical coordinates are not stored in the controller and thus the current position is not yet determined. For this reason, a rear end move command must be executed after the power has been turned on, in order to establish coordinates. The actuator performs homing first, and then moves to the rear end.  [1] The actuator moves toward the mechanical end on the motor side at the homing speed. [2] The actuator contacts the mechanical end, reverses its direction, and stops temporarily at the home position. [3] The actuator moves to the rear end at the speed set in the “Speed” field of the position table. (Note) Make sure there is no obstacle along the homing path.

1.3 How to Read Model Name



1.4 System Configuration

This controller performs positioning to 3 points (rear end, intermediate point, front end) via a PLC and I/O signals.



⚠ Caution: If the actuator is not equipped with a brake, the BK terminal need not be connected.

1.5 Steps from Unpacking to Adjustment by Trial Operation

If you are using this controller for the first time, refer to the steps explained below and perform the specified tasks carefully by making sure you check all necessary items and connect all required cables.

1. Checking the items in the package

Should you find any of the following items missing or of a wrong model type, please contact your IAI sales agent.

- Controller PCON-CY
- Actuator
- I/O flat cable CB-PACY-PIO ***
- Motor cycle CB-RCP2-MA ***
- Encoder cable CB-RCP2-PA ***
- Operation manual

<Options>

- Teaching pendant
  RCM-T (standard)
  RCM-E (simple)
  RCM-P (data setting)
- PC software
  RS232C type <RCM-101-MW>
  USB type <RCM-101-USB>
  (Each software program comes with a cable.)

2. Installation

[1] Affix the actuator and install the robot hand → Refer to the operation manual for your actuator.
[2] Install the controller → Chapter 3, “Installation and Wiring”

3. Wiring/connection

- Wire the 24-V power supply.
- Wire the brake forced-release switch (if the actuator is equipped with a brake).
- Connect the grounding wire to ground.
- Wire the emergency stop circuit and motor drive power supply.
- Connect the motor cable and encoder cable.
- Connect the I/O flat cable.

4. Turning on the power and checking for alarms

Confirm first that the emergency stop circuit is not actuated, and then supply the 24-V power.
If the monitor LED [SV/ALM] on the front face of the controller illuminates in orange for 2 seconds and then turns off, the controller is normal.
If the [SV/ALM] illuminates in red, it means that an alarm is present.
In this case, connect a PC or teaching pendant and check the nature of the alarm, and remove the cause by referring to Chapter 7, “Troubleshooting.”

5. Setting a PIO pattern/safety speed

Set the MANU operation mode to [Teaching mode 1: Enable safety speed / Inhibit PIO] on the PC or teaching pendant.
In this condition, set appropriate values in parameter No. 25 (PIO pattern selection) and parameter No. 35 (Safety speed).
* The factory settings of PIC pattern and safety speed are “Standard type” and “100 mm/s or less,” respectively.
→ Chapter 6, “Parameter Settings”

6. Operating when the servo is ON

Confirm that the slider or rod is not contacting a mechanical end.
If the slider or rod is contacting a mechanical end, move it away from the mechanical end.
If the actuator is equipped with a brake, move the actuator after turning ON the forced brake release switch to forcibly release the brake.
At this time, be careful not to get your hand pinched or the robot hand damaged by the actuator dropping suddenly due to its dead weight.

Turn ON the servo using the PC or teaching pendant.
If the actuator enters a servo lock state and the monitor LED [SV/ALM] on the front face of the controller illuminates in green, the controller is normal.

7. Confirming the safety circuit operation

Confirm that the emergency cutoff circuit (or motor drive-power cutoff circuit) operates normally.

→ Chapter 3, “Installation and Wiring”

8. Setting a target position

Use the teaching pendant or PC to set a target position in the “Position” field of the position table (rear end, front end, intermediate point).

* If any movement operation is started without setting a target position first, the message “No movement data” will be displayed. Determine an appropriate target position by fine-tuning the work or robot hand.
* Once a target position is set, other items (speed, acceleration/deceleration, positioning band, etc.) will be set to their defaults automatically.

→ Chapter 4, “Position Table Settings”

9. Adjustment by test operation

Input a move command from the PLC to perform positioning.
If necessary, perform the following fine adjustments:

- Depending on the weight, material and/or shape of the work, vibration or noise may occur. If you notice undesirable vibration or noise, lower the speed, acceleration and/or deceleration.
- You may also want to adjust the zone output signal limits and positioning band to prevent contact with peripheral equipment or reduce the tact time.
- If push-motion operation will be performed, select optimal current-limiting value, push-motion completion judgment time and push speed.

→ Chapter 4, “Position Table Settings”
→ Chapter 5, “Operation Using I/O Signals”

1.6 Warranty

1.6.1 Warranty Period

One of the following periods, whichever is shorter:

- Elapse of 18 months after the shipment from IAI
- Elapse of 12 months after the delivery to the specified location

1.6.2 Scope of Warranty

Our products are covered by warranty when all of the following conditions are met. Faulty products covered by warranty will be replaced or repaired free of charge:

(1) The breakdown or problem in question pertains to our product as delivered by us or our authorized dealer.
(2) The breakdown or problem in question occurred during the warranty period.
(3) The breakdown or problem in question occurred while the product was in use for an appropriate purpose under the conditions and environment of use specified in the operation manual and catalog.
(4) The breakdown or problem in question was caused by a specification defect or problem, or by the poor quality of our product.

Note that breakdowns due to any of the following reasons are excluded from the scope of warranty:

[1] Anything other than our product
[2] Modification or repair performed by a party other than us (unless we have approved such modification or repair)
[3] Anything that could not be easily predicted with the level of science and technology available at the time of shipment from our company
[4] A natural disaster, man-made disaster, incident or accident for which we are not liable
[5] Natural fading of paint or other symptoms of aging
[6] Wear, depletion or other expected result of use
[7] Operation noise, vibration or other subjective sensation not affecting function or maintenance

Note that the warranty only covers our product as delivered and that any secondary loss arising from a breakdown of our product is excluded from the scope of warranty.

1.6.3 Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

1.6.4 Limited Liability

[1] We shall assume no liability for any special damage, consequential loss or passive loss such as a loss of expected profit arising from or in connection with our product.
[2] We shall not be liable for any program or control method created by the customer to operate our product or for the result of such program or control method.

1.6.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

(1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.

(2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:

[1] Medical equipment pertaining to maintenance or management of human life or health
[2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
[3] Important safety parts of mechanical equipment (such as safety devices)
[4] Equipment used to handle cultural assets, art or other irreplaceable items

(3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or operation manual.

1.6.6 Other Items Excluded from Warranty

The price of the product delivered to you does not include expenses associated with programming, the dispatch of engineers, etc. Accordingly, a separate fee will be charged in the following cases even during the warranty period:

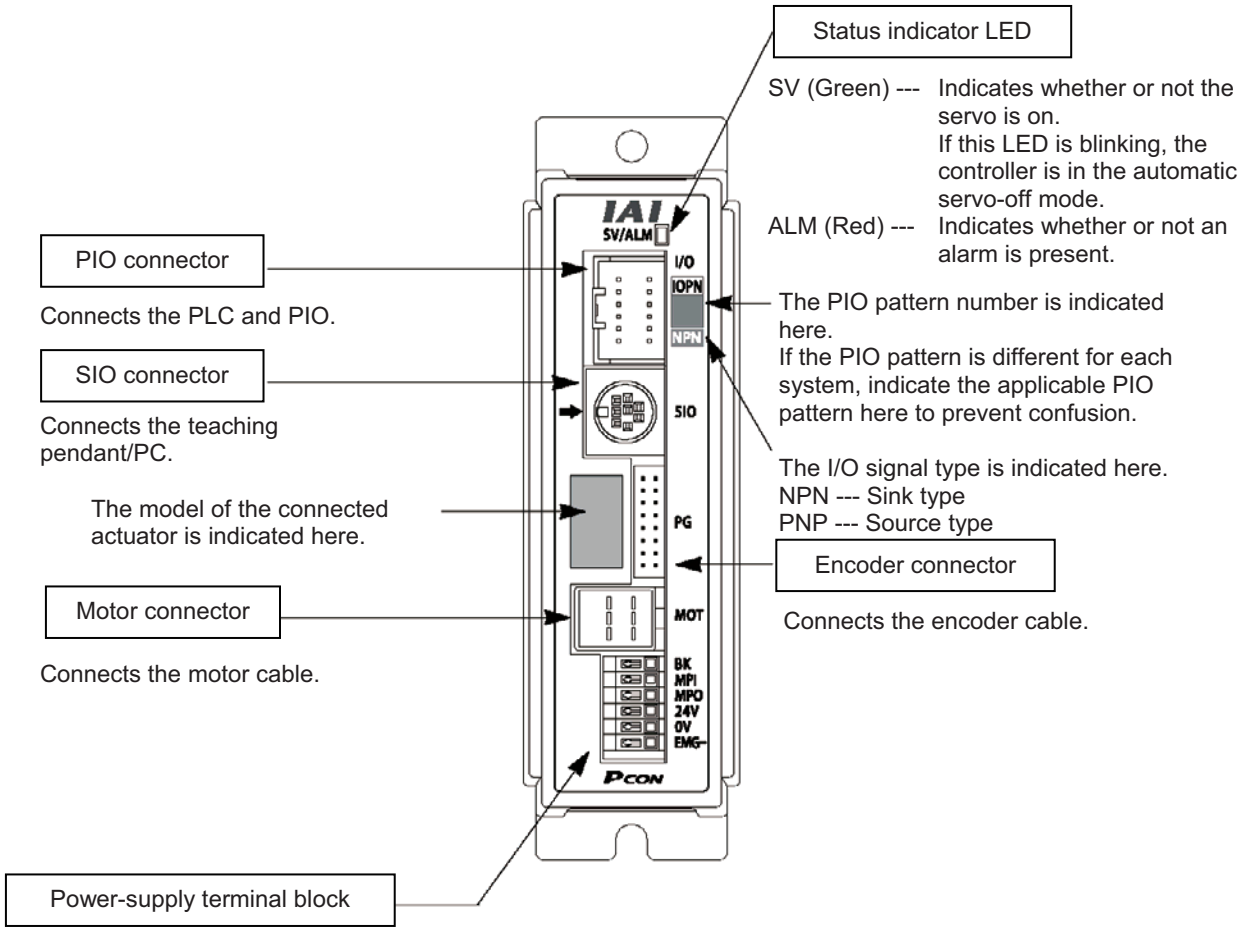
[1] Guidance for installation/adjustment and witnessing of test operation
[2] Maintenance and inspection
[3] Technical guidance and education on operating/wiring methods, etc.
[4] Technical guidance and education on programming and other items related to programs

2. Specifications

2.1 Basic Specifications

Specification item		Description
Model		PCON-CY
Number of controlled axes		1 axis per unit
Power-supply voltage		24 VDC +10%/-10%
Power-supply capacity		2 A max.
Control method		Field-weakening vector control (patent pending)
Encoder resolution		800 P/rev
Positioning command		Separate commands for positioning to rear end, front end and intermediate point
Backup memory		Position number data and parameters are stored in the nonvolatile memory. Serial EEPROM life: Approx. 100,000 times of rewriting
PIO interface		24-VDC insulation 4 input points • Front end move command • Rear end move command • Intermediate point move command • Servo-on 6 output points • Front end movement complete • Rear end movement complete • Intermediate point movement complete • Ready (or zone output under the standard type) • Homing complete • *Alarm
LED indicator		SV (green) --- Whether or not the servo is on / ALM (red) --- Whether or not an alarm is present.
Serial communication		RS485, 1 channel (conforming to the Modbus protocol)
Encoder interface		Incremental specification conforming to EIA RS-422A/423A
Forced release of electromagnetic brake		24 V is applied to the BK terminal on the power-supply terminal block.
Cable length		Actuator cable: 20 m or shorter
		I/O flat cable: 5 m or shorter
Dielectric strength		500 VDC 10 mΩ
Environment	Surrounding air temperature	0 to 40°C
	Surrounding humidity	85% RH or below (non-condensing)
	Surrounding environment	Refer to 3.1 Installation Environment
	Storage temperature	-10 to 65°C
	Storage humidity	90% RH or below (non-condensing)
	Vibration resistance	10 to 57 Hz in all X/Y/Z directions / Single amplitude: 0.035 mm (continuous), 0.075 mm (intermittent)
Protection class		Natural air cooling (IP20)
Weight		128 g or below
External dimensions		35 (W) x 120 (H) x 68 (D) mm

2.2 Name and Function of Each Part of the Controller



BK	Connection terminal for the brake forced-release switch to be used when the actuator is equipped with a brake. Connect the opposite side of the switch to 24 V.
MPI, MPO	Contacts for cutting off the motor drive power to achieve a safety level of safety category 1. MPI and MPO connect to the input side and output side of the motor power supply, respectively. (If these contacts are not used, connect them using a jumper cable. The controller is shipped with MPI and MPO connected by a jumper cable.)
24 V	Positive side of the 24-VDC input power supply.
0 V	Negative side of the 24-VDC input power supply.
EMG -	Connection terminal for the emergency stop circuit (for cutting of motor drive signals). A common ground is used, so connect the opposite side of the emergency stop switch (or contacts) to the positive side of the 24-VDC input power supply.

■ Model indication of the connected actuator type

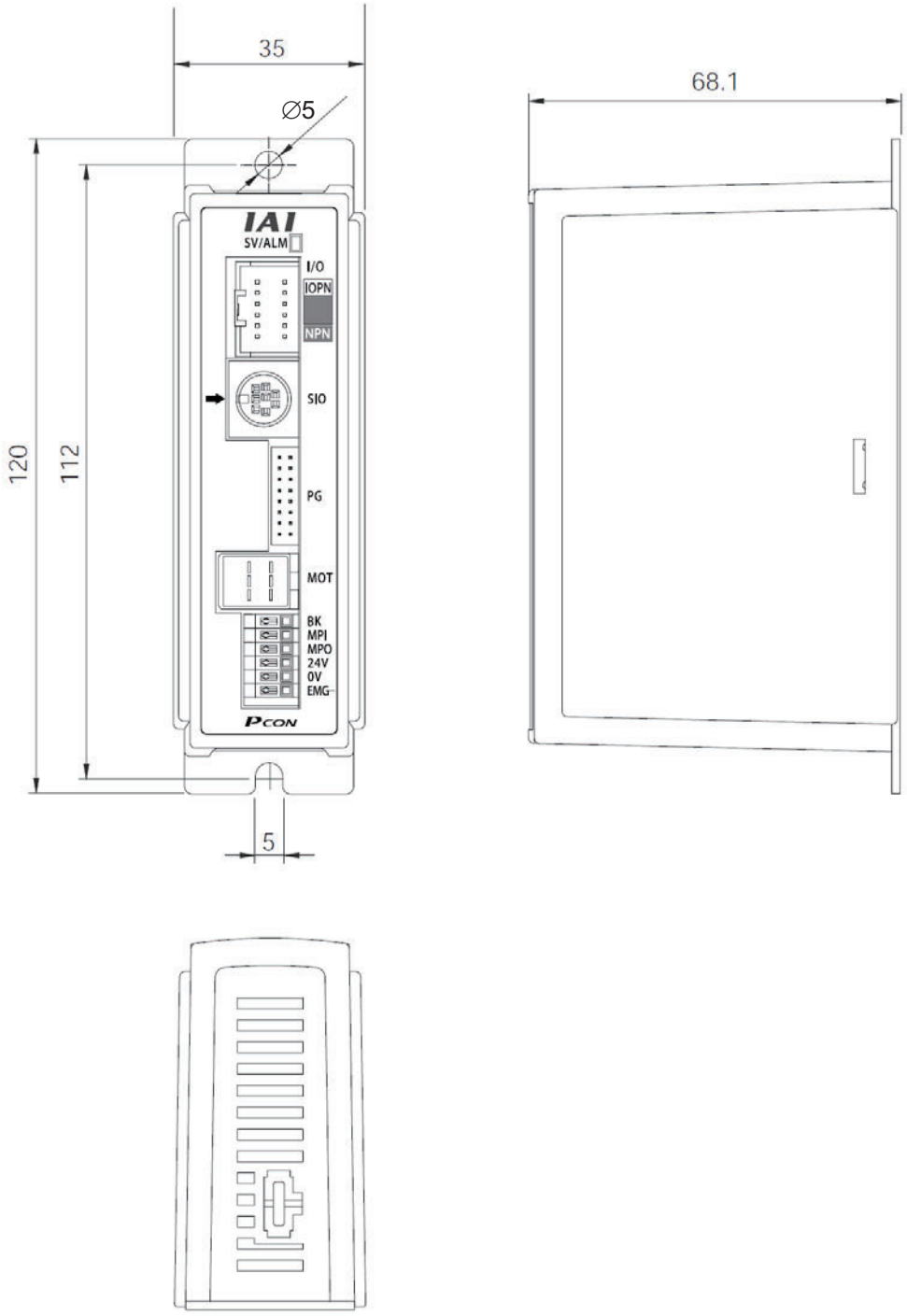
The type, ball screw lead and stroke of the actuator are indicated. When connecting the cables, confirm that the actuator is of the correct specifications.

Example of indication:

RA4C ← The actuator type is RA4C.
L：5mm ← The ball screw lead is 5 mm.
ST：200 ← The stroke is 200 mm.

2.3 External Dimensions

An external view and dimensions of this product are shown below.



3. Installation and Wiring

Pay due attention to the environment where the controller is installed.

3.1 Installation Environment

This product is capable for use in the environment of pollution degree 2[*1] or equivalent.
*1 Pollution Degree 2 : Environment that may cause non-conductive pollution or transient conductive pollution by frost (IEC60664-1)

[1] Installation Environment

Do not use this product in the following environment.

- Location where the surrounding air temperature exceeds the range of 0 to 40°C
- Location where condensation occurs due to abrupt temperature changes
- Location where relative humidity exceeds 85%RH
- Location exposed to corrosive gases or combustible gases
- Location exposed to significant amount of dust, salt or iron powder
- Location subject to direct vibration or impact
- Location exposed to direct sunlight
- Location where the product may come in contact with water, oil or chemical droplets
- Environment that blocks the air vent [Refer to 3.3 Noise Elimination Measures and Grounding]

When using the product in any of the locations specified below, provide a sufficient shield.

- Location subject to electrostatic noise
- Location where high electrical or magnetic field is present
- Location with the mains or power lines passing nearby

[2] Storage and Preservation Environment

- Storage and preservation environment follows the installation environment. Especially, when the product is to be left for a long time, pay special attention to condensed water.
  Unless specially specified, moisture absorbency protection is not included in the package when the machine is delivered. In the case that the machine is to be stored in an environment where dew condensation is anticipated, take the condensation preventive measures from outside of the entire package, or directly after opening the package.

3.2 Supplied Voltage

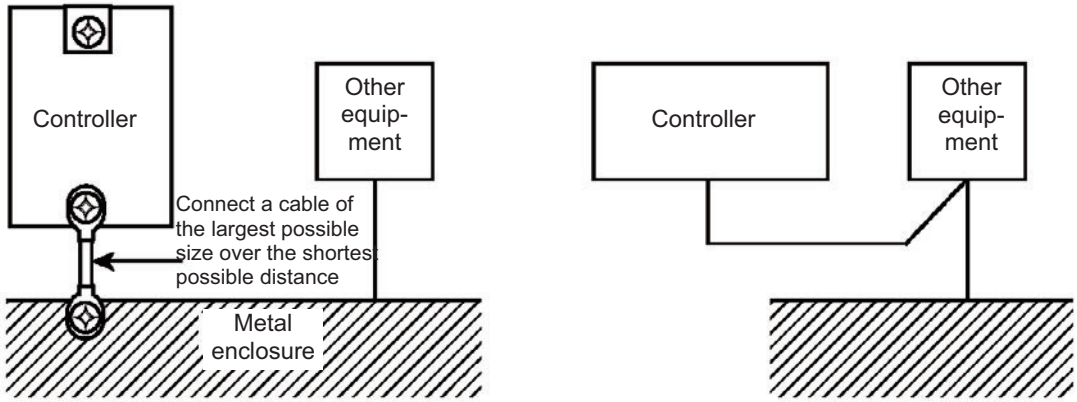
The controller takes a supplied voltage of 24 VDC ± 10%.
(Maximum power-supply current: 2 A)

3.3 Noise Elimination Measures and Grounding

The following explains the noise elimination measures that should be taken when using this controller.

(1) Wiring and power connection

[1] Provide dedicated class-D grounding using a grounding wire with a size of 2.0 to 5.5 mm^2 or larger.



Class-D grounding Good Avoid this pattern.

[2] Cautions on wiring method

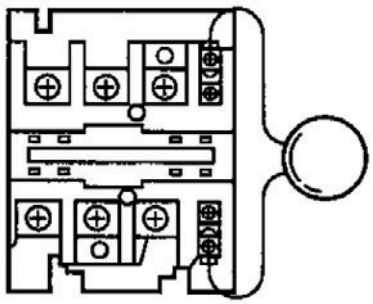
Use a twisted cable to connect the 24-VDC external power supply.
Separate the controller wiring from high-power lines of motive power circuits, etc. (Do not tie them together or place in the same cable duct.)
If you want to extend the motor or encoder cable beyond the length of the supplied cable, contact IAI.

(2) Noise sources and elimination

Noise generates from many sources, but the most common sources of noise you should consider when designing a system are solenoid valves, magnet switches and relays. Noise generation from these components can be prevented by the method explained below.

AC solenoid valves, magnet switches, relays

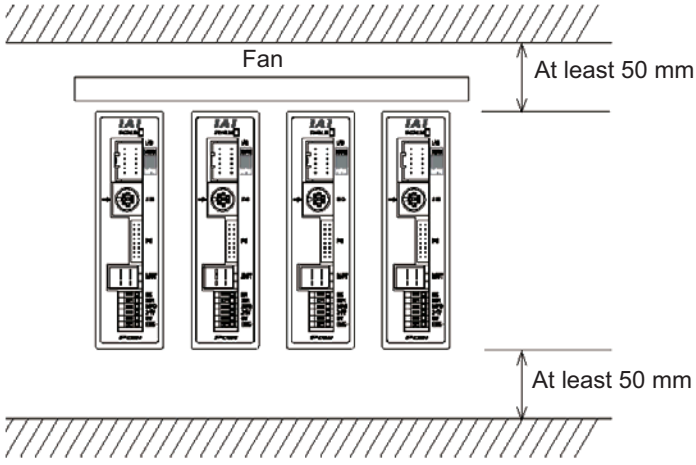
Method --- Install a surge absorber in parallel with the coil

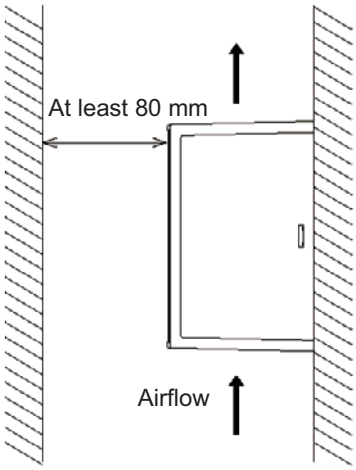


← Point
Connect to each coil over the shortest possible wiring distance.
When a surge absorber is installed on the terminal block, etc., its noise elimination effect will decrease if the distance from the coil is long.

3.4 Heat Radiation and Installation

Design the control panel size, controller layout and cooling method so that the temperatures around the controller will always be kept to 40°C or below.
Mount the controller vertically on the wall, as shown below. Since cooling is provided by means of natural convection, follow this orientation and provide a minimum clearance of 50 mm above and below the controller to allow sufficient airflows to circulate.
If you are installing multiple controllers side by side, provide a fan on top of the controllers to agitate the airflows as an effective way to keep the surrounding air temperatures constant.
Provide a minimum clearance of 80 mm between the front face of the controller and the wall (cover).



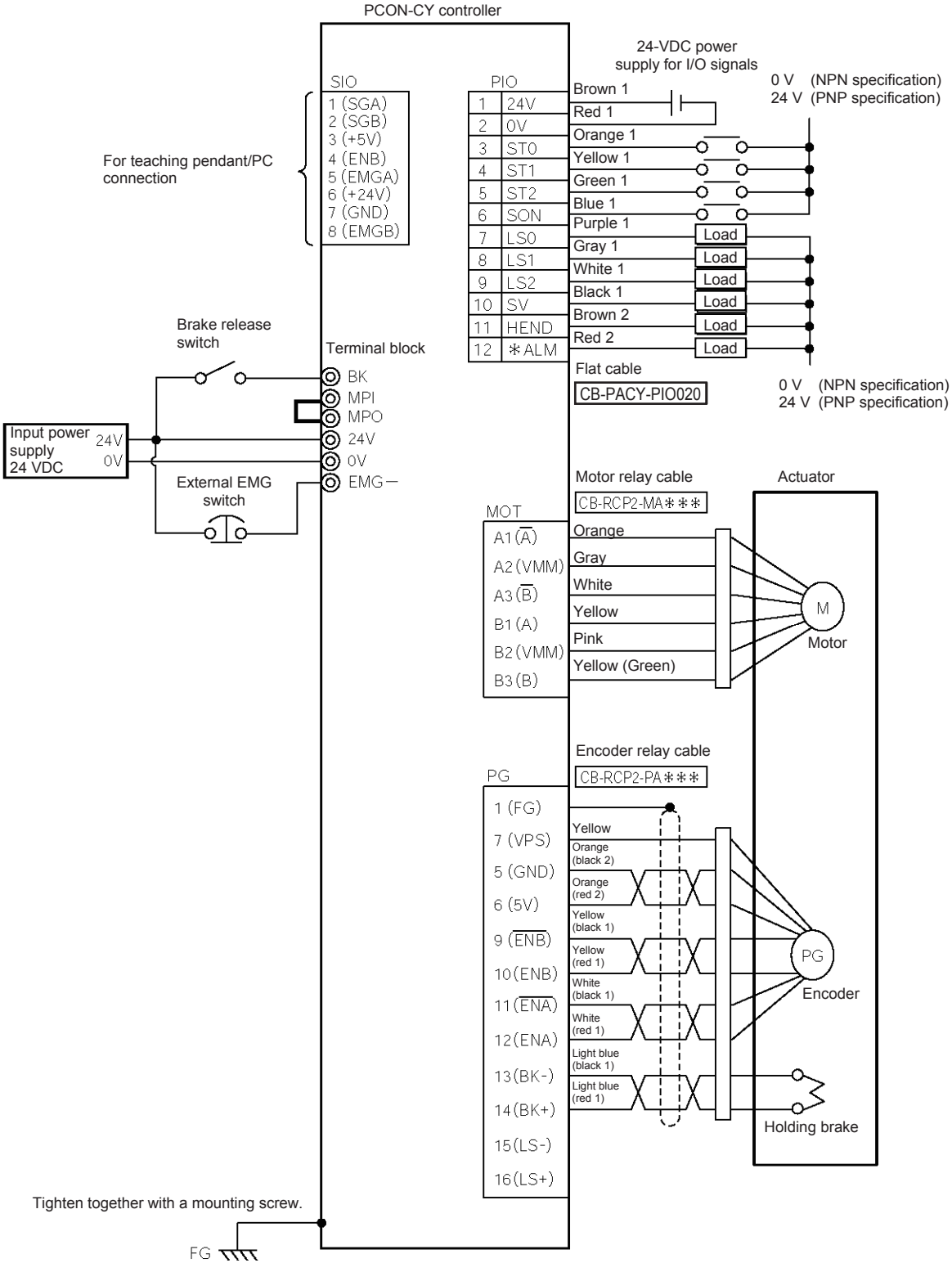


Regardless of whether you are installing one or more controllers, provide sufficient clearances around each controller to permit easy access for installation and removal of the controller.

3.5 External Connection Diagram

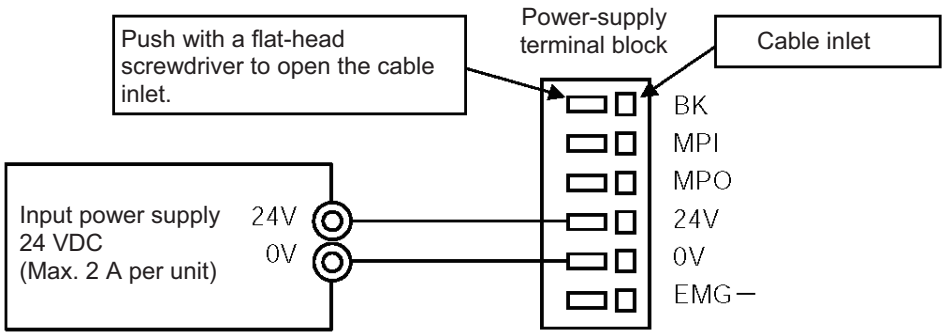
An example of standard wiring is shown below.

(Note) The PIO signal names are those based on the proximity switch type.
The color of the encoder relay cable is different for the robot cable specification. Refer to 3.9.2, “Encoder Relay Cable.”

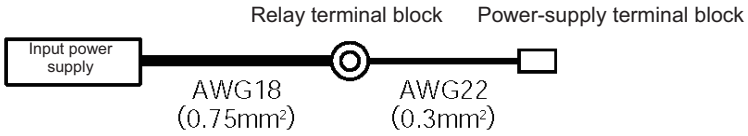
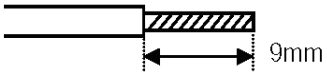


3.6 Wiring the Power Supply

Connect the positive side and negative side of the 24-VDC power supply to the 24-V terminal and N terminal on the power-supply terminal block, respectively.

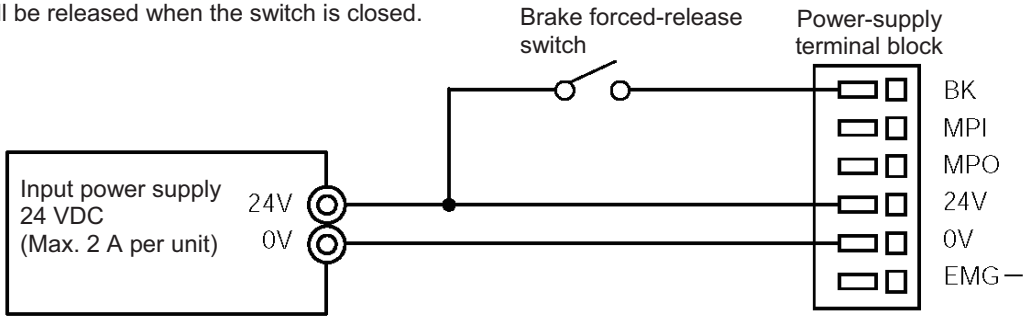


Use a wire satisfying the following specifications.

Item	Specification
Applicable wire	Twisted wire: AWG 22 (0.3 mm^2) (copper wire) (Note) Provide proper termination to prevent shorting due to contact with wire offcut. If the wiring path is long, provide a relay terminal block and connect the original wire to another wire of a different size. 
Temperature rating of insulation sheath	60°C or above
Length of bare wire	

3.7 Wiring the Brake Forced-release Switch

If the actuator is equipped with a brake, provide a forced-release switch to permit a reset means during startup adjustment or in case of emergency.
The customer must provide the switch (24 VDC, with a minimum contact capacity of 0.2 A).
Connect one side of the switch to the positive side of the 24-VDC power supply, and connect the other side to the BK terminal on the power-supply terminal block.
The brake will be released when the switch is closed.



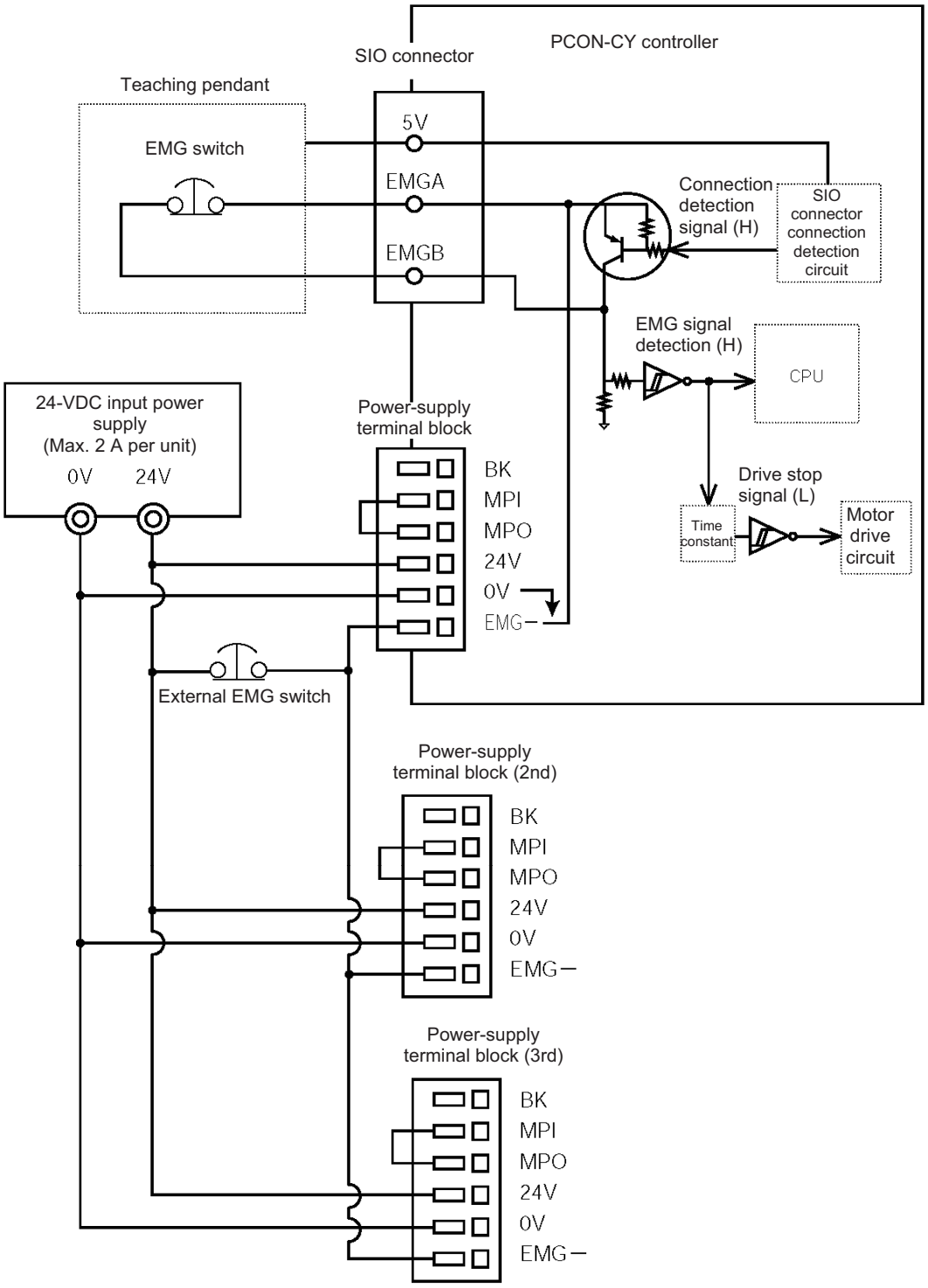
Danger: If the actuator is oriented vertically, exercise due caution when releasing the brake to prevent the slider/rod from dropping unexpectedly to pinch your hand or damage the robot hand or work.

3.8 Wiring the Emergency Stop Circuit

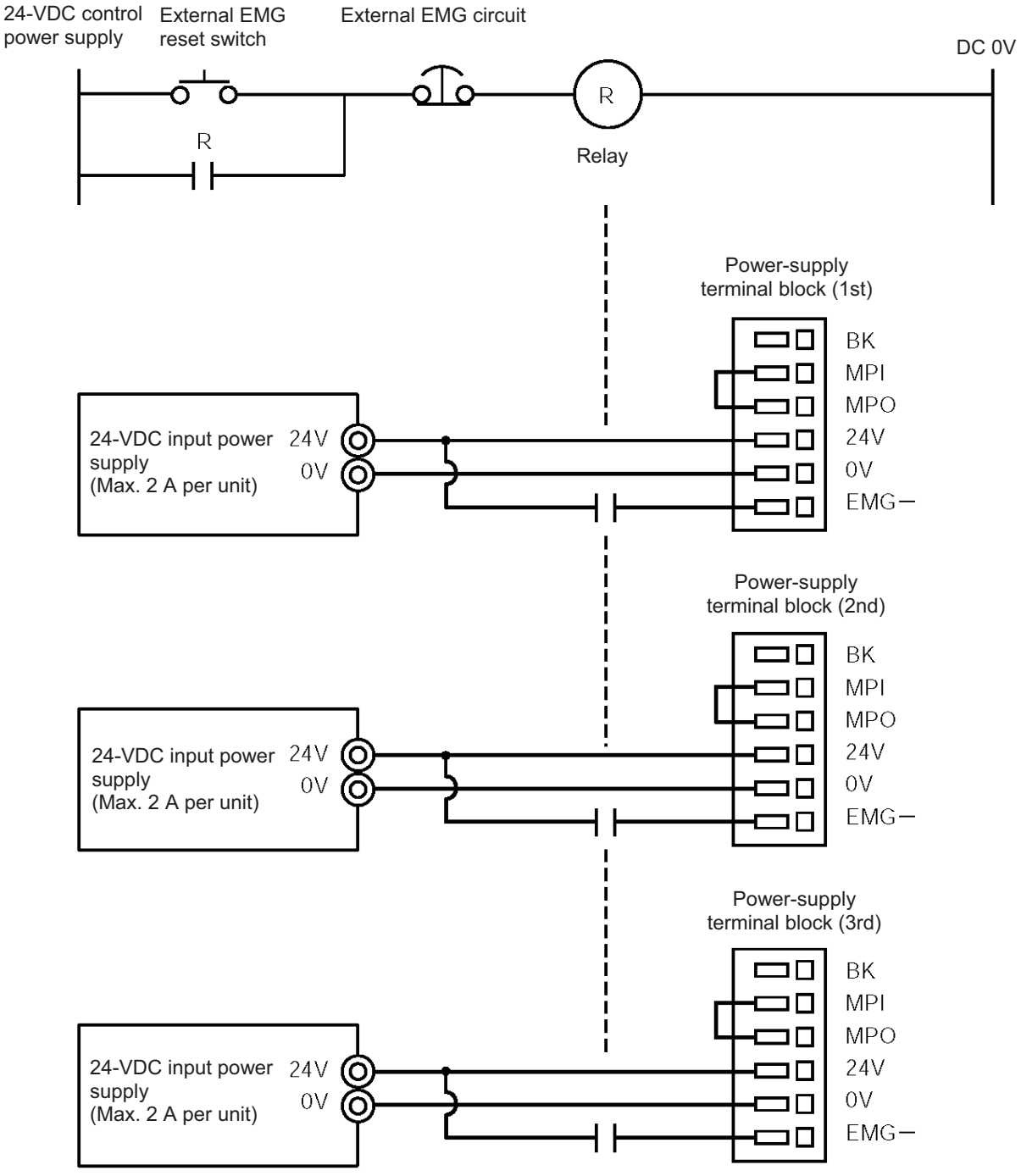
3.8.1 Cutting Off the Drive Signal (Standard)

Connect one side of the external EMG switch to the positive side of the 24-VDC power supply, and connect the other side to the BK terminal.

(Note) The EMG switch on the teaching pendant works only on the controller connected to the switch.



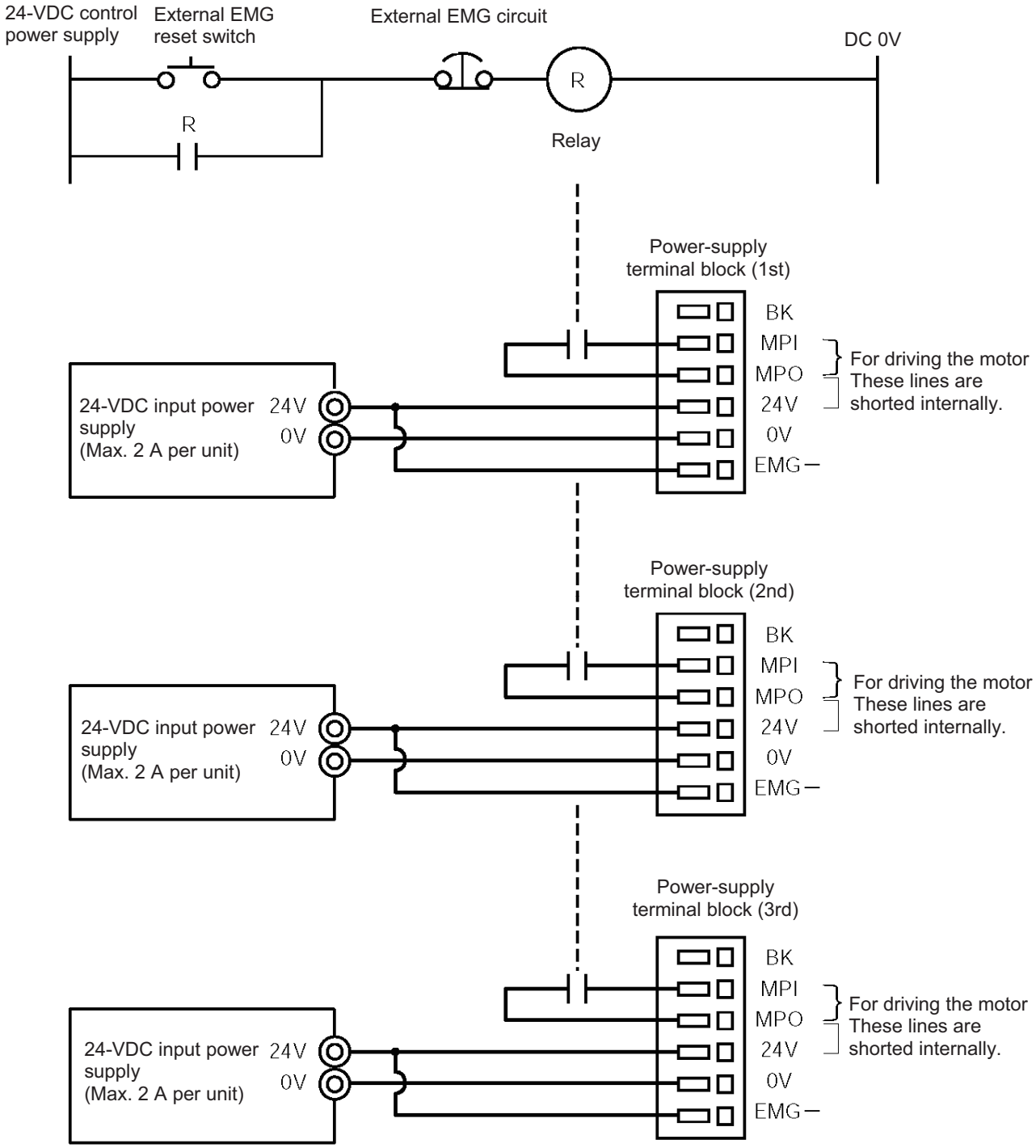
If a separate emergency stop circuit is provided to stop the entire system, or when multiple controllers are linked together and each controller has a different power supply, connect external EMG relay contacts.



3.8.2 Cutting Off the Motor Drive Power

If the motor drive power must be cut off in order to meet the required safety category of the entire system, connect external EMG relay contacts between the MPI terminal and MPO terminal.
Also connect the 24-V controller power supply to the EMG terminal.

(Note) The EMG switch on the teaching pendant cuts off the motor driver signal. It does not cut off the motor drive power.



3.9 Connecting the Actuator

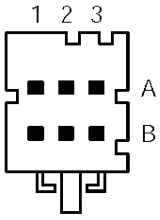
3.9.1 Motor Relay Cable

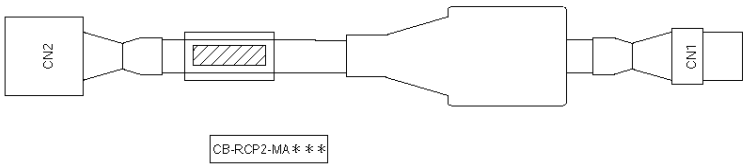
• Connect the motor relay cable to the MOT connector.
Signal table of controller-end connector (CN2)

Pin No.	Signal	Wire color	Description
A1	$\overline{A}$	Orange	Motor drive line (phase -A)
A2	VMM	Gray	Motor power line
A3	$\overline{B}$	White	Motor drive line (phase -B)
B1	A	Yellow	Motor drive line (phase +A)
B2	VMM	Pink	Motor power line
B3	B	Yellow (Green)	Motor drive line (phase +B)

Controller end

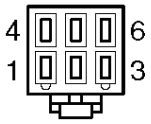
CN2 pin layout





Actuator end

CN1 pin layout



CN2

Cable color	Signal abbreviation	Pin No.
Orange	$\overline{A}$	A1
Gray	VMM	A2
White	$\overline{B}$	A3
Yellow	A	B1
Pink	VMM	B2
Yellow (Green)	B	B3

Housing: 1-1318119-3 (AMP)
Receptacle contact: 1318107-1

CN1

Pin No.	Signal abbreviation	Cable color
1	A	Yellow
2	VMM	Gray
3	$\overline{A}$	Orange
4	B	Yellow (Green)
5	VMM	Pink
6	$\overline{B}$	White

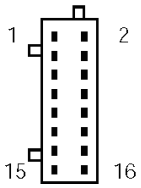
Housing: SLP-06V (J.S.T. Mfg.)
Socket contact: BSF-21T-P1.4

3.9.2 Encoder Relay Cable

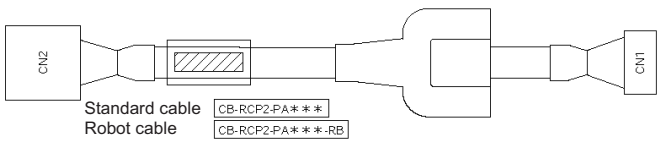
• Connect the encoder relay cable to the PG connector.
Signal table of controller-end connector (CN2)

Pin No.	Signal abbreviation	Description
1	F.G	Shielded wire
2	-	(Not used)
3	-	(Not used)
4	-	(Not used)
5	GND	Encoder power output
6	5V	
7	VPS	Encoder control signal output
8	-	(Reserved)
9	$\overline{\text{ENB}}$	Encoder differential signal phase-B input
10	ENB	
11	$\overline{\text{ENA}}$	Encoder differential signal phase-A input
12	ENA	
13	BK -	Brake power –
14	BK +	Brake power +
15	-	(Not used)
16	-	

Controller end
CN2 pin layout



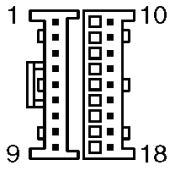
CN2



Standard cable CB-RCP2-PA***
Robot cable CB-RCP2-PA***-RB

Enter the cable length (L) in *** (up to 20 m).
Example) 080 = 8 m

Actuator end
CN1 pin layout



Cable color		Signal abbreviation	Pin No.
Robot cable	Standard cable		
–	–	-	16
–	–	-	15
Purple	Red	BK+	14
White (with purple)	Gray	BK-	13
Blue	Brown	ENA	12
White (with blue)	Green	$\overline{\text{ENA}}$	11
Yellow	Purple	ENB	10
White (with yellow)	Pink	$\overline{\text{ENB}}$	9
–	–	(Reserved)	8
Green	Yellow	VPS	7
Red	Orange	5V	6
White (with red)	Blue	GND	5
–	–	–	4
–	–	–	3
–	–	–	2
Drain	Drain	F.G	1

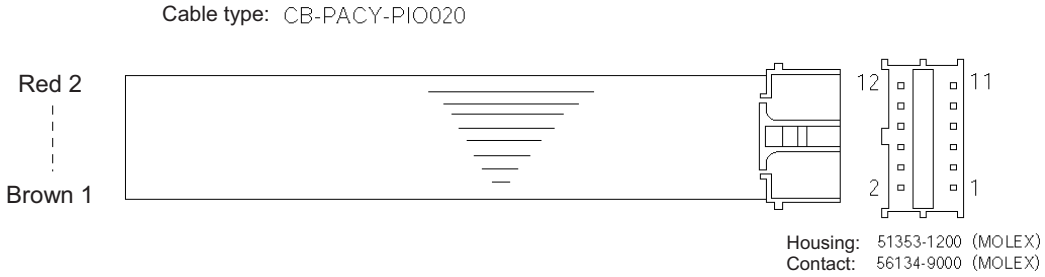
Housing: PHDR-16VS (J.S.T. Mfg.)
Contact: SPHD-001T-P0.5

CN1

Pin No.	Signal abbreviation	Cable color	
		Standard cable	Robot cable
1	ENA	Brown	Blue
2	$\overline{\text{ENA}}$	Green	White (with blue)
3	ENB	Purple	Yellow
4	$\overline{\text{ENB}}$	Pink	White (with yellow)
5	–	–	–
6	–	–	–
7	–	–	–
8	–	–	–
9	GND	Blue	White (with red)
10	5V	Orange	Red
11	VPS	Yellow	Green
12	–	–	–
13	–	–	–
14	–	–	–
15	–	–	–
16	BK+	Red	Purple
17	BK-	Gray	White (with purple)
18	F.G	Drain	Drain

Housing: XMP-18V (J.S.T. Mfg.)
Contact: BXA-001T-P0.6
Retainer: XMS-09V

3.10 Connecting the I/O Flat Cable



No.	Signal name		Color	Wiring
	Proximity switch type	Standard type		
1	24 V		Brown-1	Flat cable (pressure-welded)
2	0 V		Red-1	
3	Rear end move command input	Rear end move command	Orange-1	
4	Front end move command input	Front end move command	Yellow-1	
5	Intermediate point move command input	Intermediate point move command	Green-1	
6	Servo-on command input	Servo-on command input	Blue-1	
7	Rear end detection output	Rear end positioning complete output	Purple-1	
8	Front end detection output	Front end positioning complete output	Gray-1	
9	Intermediate point detection output	Intermediate point positioning complete output	White-1	
10	Ready output	Zone output	Black-1	
11	Homing complete output	Homing complete output	Brown-2	
12	Alarm output	Alarm output	Red-2	

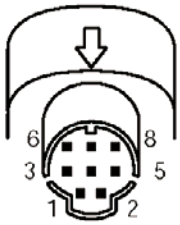
⚠ Warning: When checking the continuity of the flat cable, exercise due caution not to bend the female pins on the connector outward. It may cause contact failure, resulting in malfunction.

3.11 Connecting the Communication Cable

Connect the communication cable to the SIO connector.

CB-RCA-SIO＊＊＊

Pin layout of cable-end connector



Cable color	Signal abbreviation	Pin No.
Brown	5V	1
Yellow	SGA	2
Red	GND	3
Orange	SGB	4
Blue	GND	5
Green	5V	6

Shorting wire UL1004AWG28 (Black)

Not connected to the shield.

Pin No.	Signal abbreviation	Cable color
1	SGA	Yellow
2	SGB	Orange
3	5V	Brown/Green
4	ENB	—
5	EMGA	Black
6	24V	—
7	GND	Red/Blue
8	EMGB	Black
FG		Shield

4. Position Table Settings

To move the actuator to a specified position, basically you must enter the target position in the “Position” field of the position table.
A target position can be specified as an absolute coordinate indicating a distance from the home (absolute mode), or as a relative coordinate indicating a relative travel from the current position (incremental mode).
Once a target position is entered, all other fields will be automatically populated by the defaults set by the corresponding parameters.
The defaults vary depending on the actuator characteristics.

4.1 Details of the Position Table

The position table is explained by using the PC software screen as an example.
(The display on the teaching pendant is different.)

No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Threshold [%]	Positioning band [mm]
0	5.00	300.00	0.30	0.30	0	0	0.10
1	380.00	300.00	0.30	0.10	0	0	0.10
2	200.00	300.00	0.30	0.10	0	0	0.10

Zone + [mm]	Zone – [mm]	Acceleration/ deceleration mode	Incremental	Command mode	Standstill mode	Comment
100.00	0.00	0	0	0	4	Rear end
400.00	300.00	0	0	0	0	Front end
250.00	150.00	0	0	0	0	Intermediate point

(1) No.

- Each number indicates a position data number. The respective numbers are defined as follows:
  No. 0 --- Entry field for conditions to move to the rear end.
  No. 1 --- Entry field for conditions to move to the front end.
  No. 2 --- Entry field for conditions to move to the intermediate point.

(2) Position

- Enter a target position of the front end, rear end or intermediate point, in mm.
  Absolute mode: Enter a distance from the actuator home.
  Incremental mode: The actuator is assumed to operate at a constant pitch. Enter a relative travel from the current position.
  For example, you can move the actuator to the front end from the intermediate point via incremental moves at a 30-mm pitch.
  (Use of the standard type is recommended because zone output signals are available in this type.)

No	Position
0	5.00
1 =	30.00
2	200.00

Absolute mode: The rear end is positioned 5 mm away from the home.
Incremental mode: The front end is positioned 30 mm away from the current position.
Absolute mode: The intermediate point is positioned 200 mm away from the home.

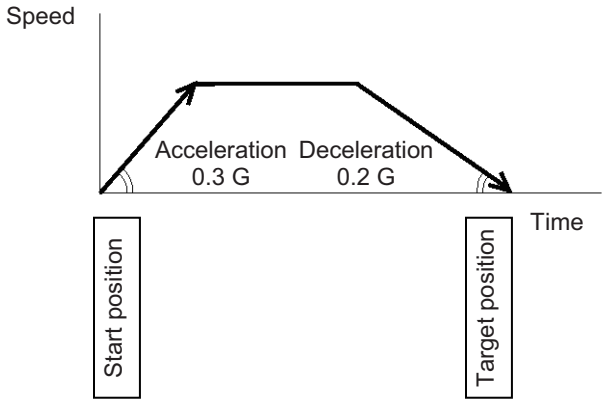
* On the teaching pendant, an equal sign indicates that the applicable position is set in the incremental mode.

(3) Speed

- Enter a speed at which to move the actuator, in mm/sec.
  The default speed varies depending on the actuator type.

(4) Acceleration/ deceleration

- Enter an acceleration/deceleration at which to move the actuator, in G.
  Basically, specify values inside the rated acceleration/deceleration range shown in the catalog.
  The input range is greater than the rated range specified in the catalog. This is to accommodate situations where “the tact time must be reduced when the work is substantially lighter than the rated load capacity.”
  If the work generates detrimental vibration during acceleration/deceleration, decrease the acceleration/deceleration settings.



Increasing the set value makes deceleration/deceleration quicker, while decreasing it makes deceleration/deceleration more gradual.

⚠ Caution:	When setting speed and acceleration/deceleration, refer to the supplied specification list of supported actuators and also consider the installation condition and load shape to determine appropriate values that will not cause the actuator to receive excessive impact or vibration. To set values higher than the recommended values, the payload should be considered and the actuator characteristics vary depending on the model. Therefore, for the maximum settings allowed for each actuator model, please contact IAI’s Sales Engineering Section.

(5) Push

- Select “positioning operation” or “push-motion operation.”
  The factory setting is “0.”
  0: Normal positioning operation
  Other than 0: The set value indicates a current-limiting value, meaning that push-motion operation is performed.

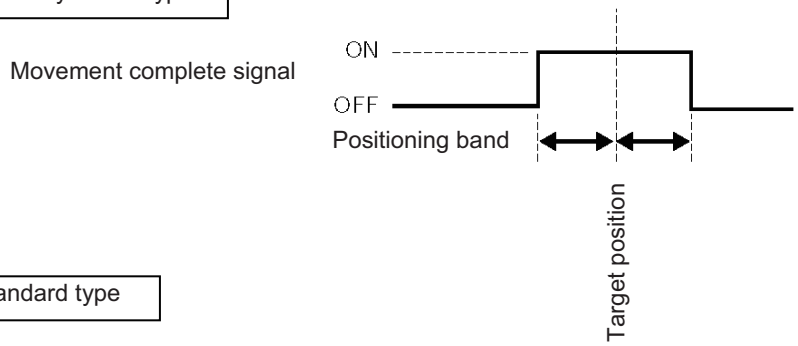
(6) Threshold

- This field is not used with this controller.
  The factory setting is “0.”

(7) Positioning band

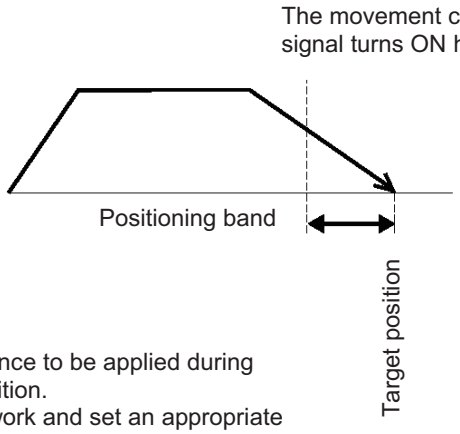
- What this field means is different in “positioning operation” and “push-motion operation.”
  “Positioning operation”:
  In the proximity switch type, this field defines the width within which the movement complete signal turns ON.
  In the standard type, this field defines how far before the target position the movement complete signal turns ON.
  The factory setting is “0.1” mm.

Proximity switch type

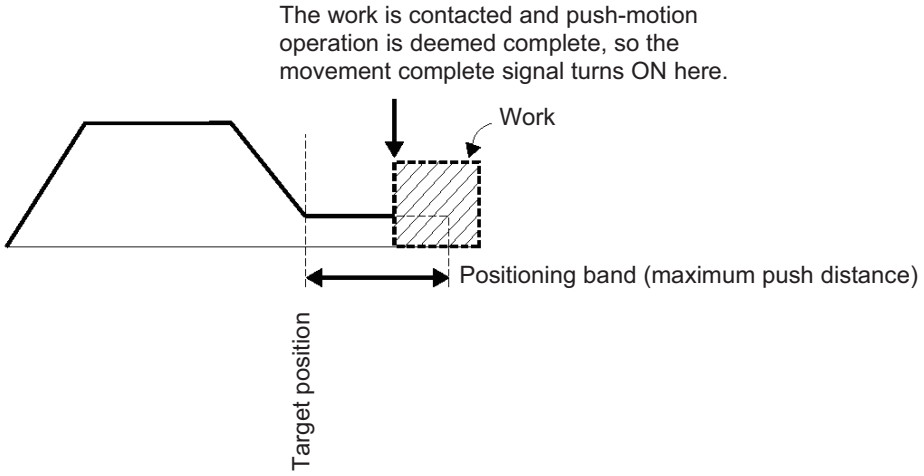


Standard type

Increasing the positioning band quickens the starting of next sequence operation, and consequently the tact time becomes shorter. Set an optimal value by considering the balance of the entire system.



“Push-motion operation”:
This field defines the maximum push distance to be applied during push-motion operation from the target position.
Consider the mechanical variation of the work and set an appropriate positioning band so that positioning will not complete before the work is contacted.



(8) Zone +/–

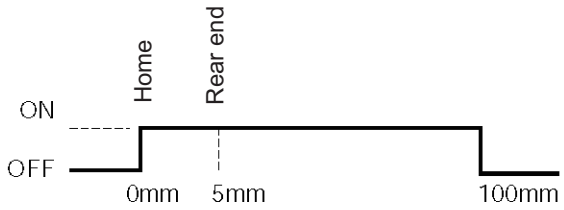
- This field defines the range within which the zone output signal turns ON during operation of the standard type.
  To increase flexibility, a different range can be set for each target position.

[Setting example]

No	Position [mm]	Zone + [mm]	Zone – [mm]	Comment
0	5.00	100.00	0.00	Rear end
1	380.00	400.00	300.00	Front end
2	200.00	250.00	150.00	Intermediate point

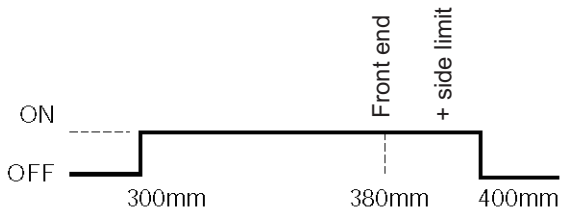
Move command to the rear end

Zone output signal



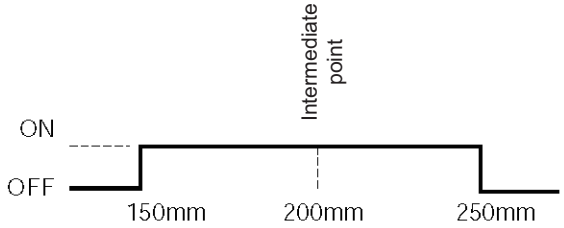
Move command to the front end

Zone output signal



Move command to the intermediate point

Zone output signal



(9) Acceleration/ deceleration mode

- This field is not used with this controller.
  The factory setting is “0.”

(10) Incremental

- This field defines whether to use the absolute mode or incremental mode.
  The factory setting is “0.”

0: Absolute mode
1: Incremental mode

⚠ Warning: When using the proximity switch type, be sure to specify the absolute mode. If the incremental mode is specified, a position data error will occur.

(11) Command mode

- This field is not used with this controller.
  The factory setting is “0.”

(12) Standstill mode

- This field defines the power-saving mode to be applied while the actuator is standing by after completing the positioning to the target position set in the “Position” field under the applicable position number.
  0: All power-saving modes are disabled. * The factory setting is “0” (disabled).
  1: Automatic servo-off mode. The delay time is defined by Parameter No. 36.
  2: Automatic servo-off mode. The delay time is defined by Parameter No. 37.
  3: Automatic servo-off mode. The delay time is defined by Parameter No. 38.
  4: Full servo control mode

Full servo control mode

Holding current can be reduced by servo-controlling the pulse motor.

Automatic servo-off mode

After positioning is completed,the servo will turn off automatically upon elapse of a specified time.

※ For details,refer to 5.4,"Power-saving Modes at Standby Positions."

4.2 Notes on the ROBO Gripper

(1) Finger Operation

[1] Definition of position

With the two-finger type, the stroke specification indicates the total sum of travels by both fingers. In other words, the travel by one finger is one-half this stroke.

A position is specified as a travel by one finger from the home position toward the closing direction.

Therefore, the maximum command value is 5 mm for the GRS type, and 7 mm for the GRM type.

[2] Definition of speed and acceleration

The command value applies to one finger.

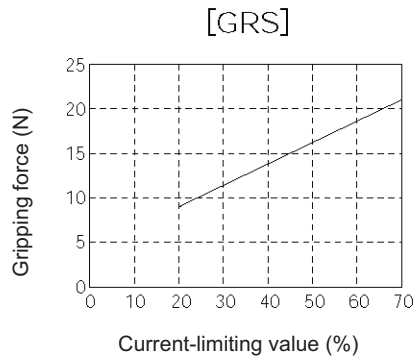
With the two-finger type, the relative speed and acceleration are double the command values, respectively.

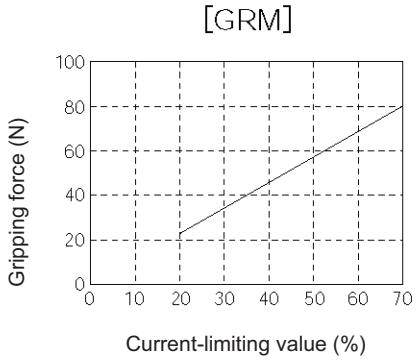
[3] Gripper operation mode

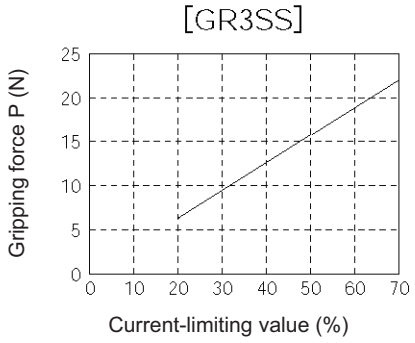
In applications where the work is to be gripped, be sure to use the “push-motion mode.”

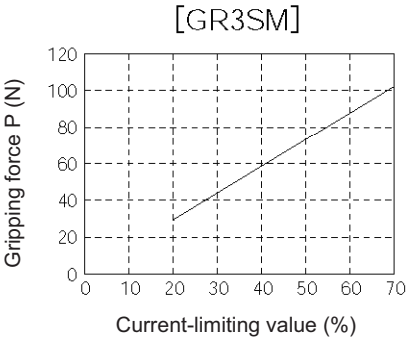
(Note) If the “positioning mode” is used, a servo error may occur while the work is gripped.

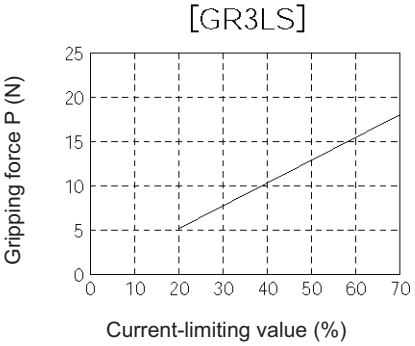
[Diagram of gripping force and current-limiting value]

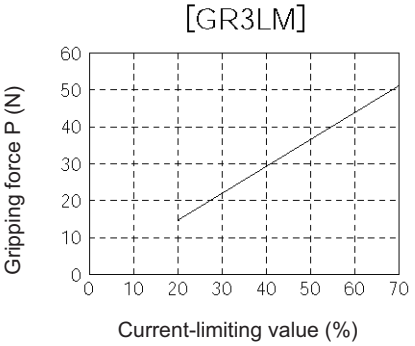












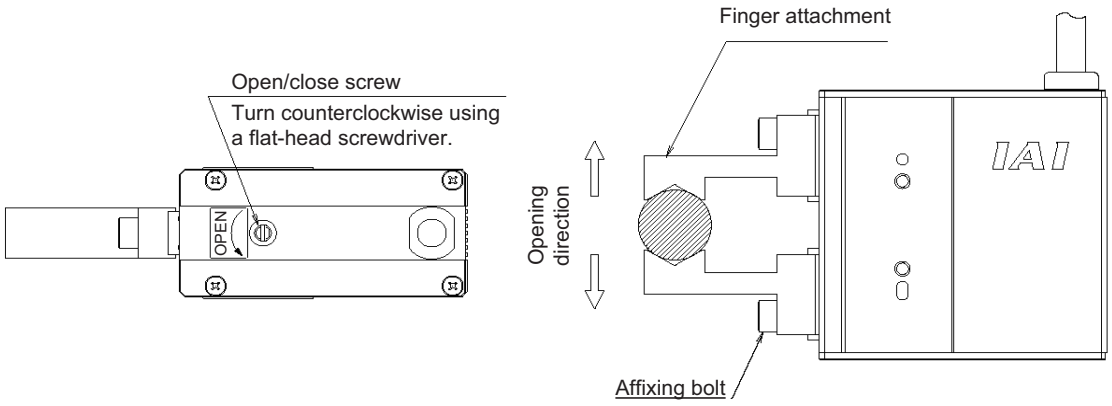
(2) Removing the gripped work

The ROBO Gripper is structured in such a way that even when the controller power is cut off, the work gripping force will still be maintained by a self-lock mechanism.

If you must remove the gripped work while the power is cut off, turn the open/close screw or remove one of the finger attachments to release the work.

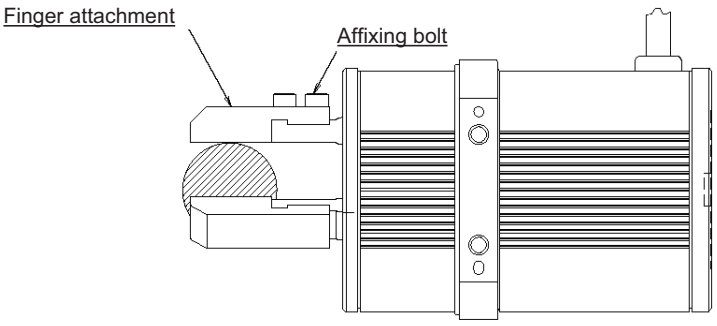
[Two-finger type]

Turn the open/close screw or remove one of the finger attachments.



[Three-finger type]

Remove one of the finger attachments.



5. Operation Using I/O Signals

This chapter explains the wiring/connection and operation timings you should know to perform positioning operation using a PLC and I/O signals.
For PIO pattern, two types are available. The movement complete signals have different meanings in each type, so select an appropriate type according to your specific application.
* The factory setting is to use the LS mode.

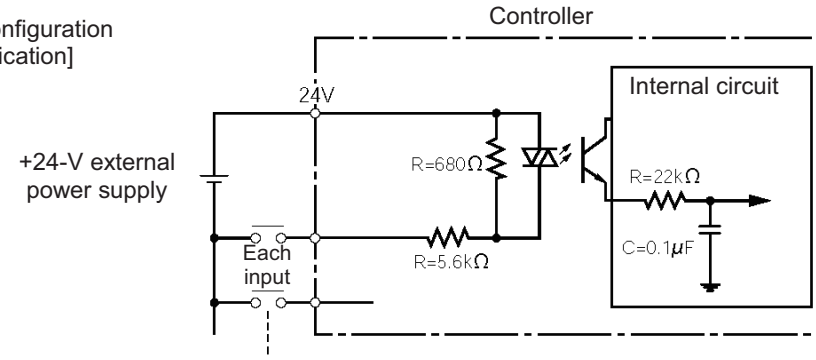
5.1 Interface Circuit

The standard interface circuit conforms to the NPN specification, but the PNP specification type is also available as an option. To simplify wiring, a common power line is used for both the NPN specification and PNP specification. Accordingly you need not reverse the power connections when using the PNP specification.

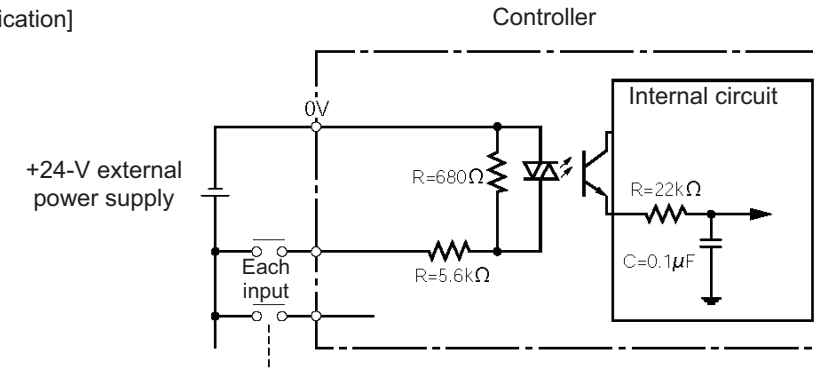
5.1.1 External Input Specifications

Item	Specification
Number of input points	4 points
Input voltage	24 VDC ± 10%
Input current	5 mA per circuit
Operating voltage	ON voltage: Min. 18 V (3.5 mA) OFF voltage: Max. 6 V (1 mA)
Leak current	Max. 1 mA per point
Insulation method	Photocoupler

Internal circuit configuration
[NPN specification]



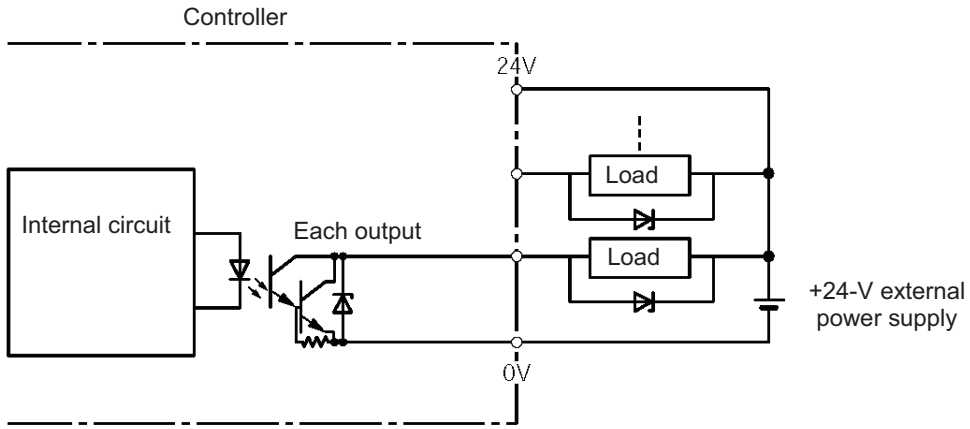
[PNP specification]



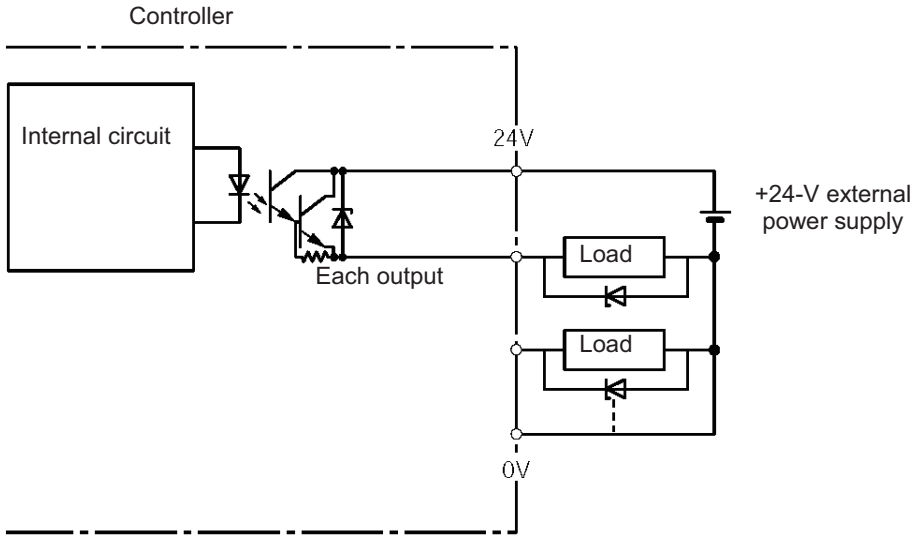
5.1.2 External Output Specifications

Item	Specification
Number of input points	6 points
Rated load voltage	24 VDC
Maximum current	50 mA per point
Residual voltage	Max. 2 V
Insulation method	Photocoupler

Internal circuit configuration
[NPN specification]

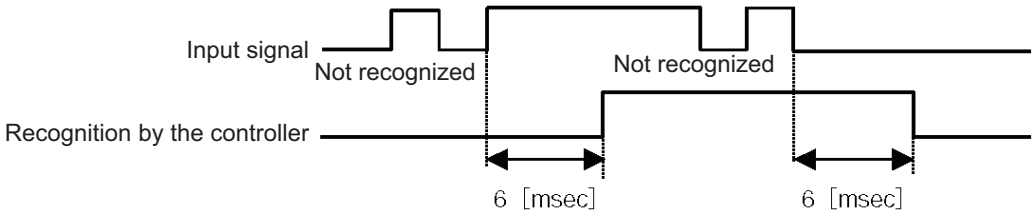


[PNP specification]



5.1.3 Recognition of Input Signals

The input signals of this controller have an input time constant to prevent malfunction due to chattering, noise, etc.
Each input signal is switched when the new signal state has continued for at least 6 msec.
In other words, when the input is switched from OFF to ON, the controller will recognize that the input signal is ON after 6 msec. The same applies when the input is switched from ON to OFF.



5.2 Proximity Switch Type

This type assumes applications where the servo is turned on/off frequently by the PLC or the automatic servo-off function is used. Use this type if your application meets the following conditions:

[1] The servo is turned off as a secondary safety measure when the emergency stop circuit is configured to directly cut off the input power.
(Note) When the servo-on signal is turned OFF, the actuator will decelerate to a stop at the emergency stop torque for a specified time, after which the servo will turn off.

[2] The servo is turned off to reduce power consumption in case the standby time is long.

[3] The actuator is equipped with a brake, and when reactive force is applied upon stopping due to clamping of the work, etc., the servo is turned off to apply brake force to supplement the built-in brake.

* Do not use push-motion operation.

⚠ Caution: The controller is shipped with the proximity switch type pre-selected, so you need not change any parameter if the proximity switch type is to be used.

5.2.1 Explanation of I/O Signals

Pin No.	Wire color	Signal name	Signal abbreviation	Function overview
1	Brown 1	+24 V	P24V	I/O power supply
2	Red 1	0 V	N	
3	Orange 1	Rear end move command input	ST0	Move command to the rear end
4	Yellow 1	Front end move command input	ST1	Move command to the front end
5	Green 1	Intermediate point move command input	ST2	Move command to the intermediate point
6	Blue 1	Servo-on command input	SON	The servo remains on while this signal is ON. The servo remains off while this signal is OFF.
7	Purple 1	Rear end detection output	LS0	This signal remains ON while the rear end is recognized.
8	Gray 1	Front end detection output	LS1	This signal remains ON while the front end is recognized.
9	White 1	Intermediate point detection output	LS2	This signal remains ON while the intermediate point is recognized.
10	Black 1	Ready output	SV	This signal is output when the servo is on.
11	Brown 2	Homing complete output	HEND	This signal is OFF immediately after the power is turned on, and turns ON once homing is completed.
12	Red 2	Alarm output	*ALM	This signal remains ON while the actuator is normal, and turns OFF if an alarm has occurred.

■ Move Command Input for Each Position (ST0, ST1, ST2)

Since the number of positioning points is limited to three, you can use these inputs just like when controlling an air cylinder.
While each signal remains ON, the actuator moves to the target position.
If the signal turns OFF before the movement is completed, the actuator will decelerate to a stop.
Before executing each move command, enter a target position as an absolute coordinate in the “Position” field under one of Nos. 0 to 2 in the position table.

Input signal	Target position	Remarks
ST0	Rear end	The target position is defined in the “Position” field under Position No. 0.
ST1	Front end	The target position is defined in the “Position” field under Position No. 1.
ST2	Intermediate point	The target position is defined in the “Position” field under Position No. 2.

■ Servo-on Command Input (SON)

The servo remains on while this signal is ON.
To ensure safety, it is recommended that the PLC be configured to monitor the condition of the entire system and turn ON this signal once all conditions required for movement are satisfied.

■ Detection Output for Each Position (LS0, LS1, LS2)

Just like the LS signals of an air cylinder, each signal turns ON when the current actuator position is inside the positioning band set for the applicable target position.

(Note) Even if the servo turns off or an emergency stop is actuated while the actuator is standing still at the target position, the signal will remain ON as long as the actuator position is inside the positioning band.

Output signal	Position detected	Remarks
LS0	Rear end	The detection position is defined in the “Position” and “Positioning band” fields under Position No. 0.
LS1	Front end	The detection position is defined in the “Position” and “Positioning band” fields under Position No. 1.
LS2	Intermediate point	The detection position is defined in the “Position” and “Positioning band” fields under Position No. 2.

■ Ready Output (SV)

This signal is a monitor signal indicating that the servo is on and the motor can be driven.
While this signal is ON, the SV LED (green) on the front face of the enclosure is lit.
The SV LED (green) blinks during the auto servo-off mode.
Use this signal as a condition for starting a move command on the PLC side.

■ Homing Complete Output (HEND)

This signal is OFF immediately after the power is turned on.
To establish the initial coordinate, only a rear end move command is accepted after power on. Once a rear end move command has been input, the actuator performs homing and then moves to the rear end.
This signal will turn ON after the homing is completed.
Once turned ON, this signal will remain ON until the input power is cut off.
Use this signal as an interlock signal before homing.

(Reference) Acceptance of each move command before homing is explained below:

[1] A rear end move command is accepted.

[2] An intermediate point move command is not accepted.

[3] A front end move command is accepted, but once the actuator moves forward at the homing speed and contacts the mechanical end, the actuator will stop and a front end detection output (LS1) will turn ON. In this case, the LS1 signal should be recognized as a tentative signal.
Movement to the front end is permitted to accommodate a situation where there is an obstacle between the actuator and the rear end.

■ Alarm Output (*ALM)

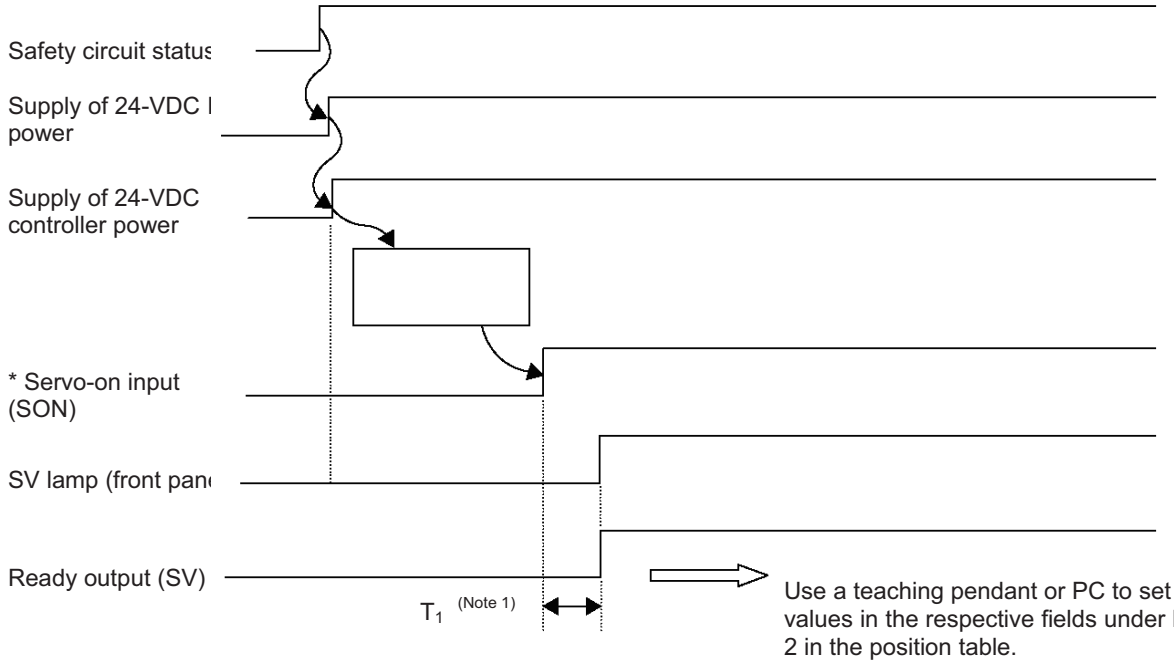
This signal remains ON while the actuator is normal, and turns OFF if an alarm has occurred.
Cause the PLC to monitor the OFF state of this signal and provide an appropriate safety measure for the entire system.
Check the nature of each alarm by connecting a PC/teaching pendant, and remove the cause. For details of alarms, refer to Chapter 7, “Troubleshooting.”

5.2.2 Timings after Power On

- Steps from Initial Startup to Actuator Adjustment

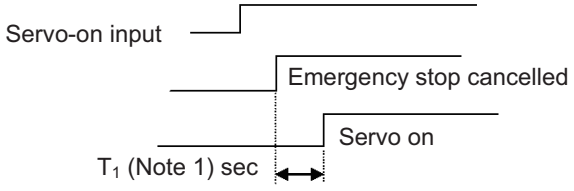
[1] Confirm that the slider or rod is not contacting a mechanical end or that the work is not contacting any peripheral equipment.
[2] Cancel the emergency stop or connect the motor drive power.
[3] Supply the 24-VDC I/O power (PIO connector pins 1 and 2).
[4] Supply the 24-VDC controller power (24-V and 0-V terminals on the power-supply terminal block).
[5] Set the minimum required parameters.
(Example)
- To temporarily disable the servo-on input because the PLC is not yet ready to accept the input, change the value of Parameter No. 21 (Servo-on input disable selection) to "1."
- To change the feed speed during teaching, change the value of Parameter No. 35 (Safety speed).

[6] Input a servo-on signal from the PLC (if the servo-on input is enabled).
[7] Connect a PC or teaching pendant to adjust the actuator.
- Set optimal values in the "Position," "Speed," "Acceleration," "Deceleration" and other fields under Nos. 0



* If you have changed the value of Parameter No. 21 (Servo-on input disable selection) to "1," the servo-on input signal is not required.

⚠ Caution: In the "Emergency stop actuated → Turn on the power → Servo-on input → Cancel the emergency stop" sequence, the servo will turn on up to T_1 (Note 1) after the emergency stop is cancelled.

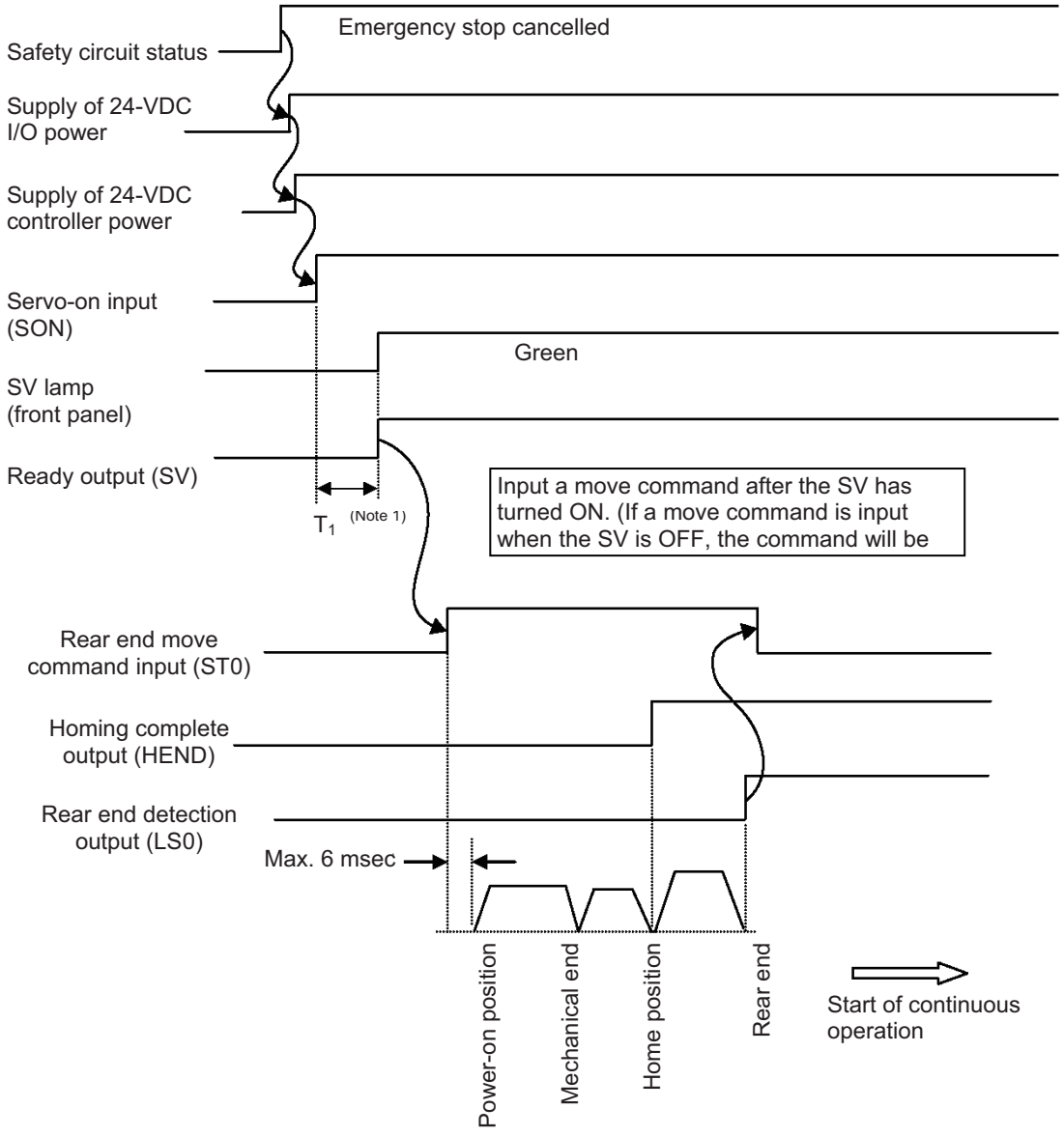


(Note 1) : Excited-pole detection time = 0.2 to 12 sec
Normally the detection of excited pole completes in approx. 0.2 sec, although the exact time varies from one actuator to another due to individual differences and also depending on the load condition. If the detection of excited pole has failed, the excited-pole detection operation will be continued for up to 12 sec.

- Normal Operating Procedure

The operating procedure in a normal condition is explained below.

[1] Confirm that the slider or rod is not contacting a mechanical end or that the work is not contacting any peripheral equipment.
[2] Cancel the emergency stop or connect the motor drive power.
[3] Supply the 24-VDC I/O power.
[4] Supply the 24-VDC controller power.
[5] Input a servo-on signal from the PLC (if the servo-on input is enabled).
[6] First, input a rear end move command signal from the PLC (to cause the actuator to stand by at the rear end).
[7] Start automatic operation.



(Note 1) : Excited-pole detection time = 0.2 to 12 sec
Normally the detection of excited pole completes in approx. 0.2 sec, although the exact time varies from one actuator to another due to individual differences and also depending on the load condition. If the detection of excited pole has failed, the excited-pole detection operation will be continued for up to 12 sec.

⚠ Warning: Since the drive motor is a pulse motor, the excited phase is detected when the servo is turned on for the first time after turning on the power.
Therefore, one condition for the servo to turn on is that the actuator can move once the servo is turned on.
If the slider or rod is contacting a mechanical end or the work is contacting any peripheral equipment, the excited phase may not be detected correctly and an erroneous movement or excitation detection error may occur.
In this case, move the actuator manually to an appropriate position before turning the servo on.
If the actuator is equipped with a brake, the brake must be forcibly released by turning on the brake release switch. At this time, be careful not to pinch your hand or damage the robot hand or work by the slider/rod, as the slider/rod may drop unexpectedly by its dead weight. If the actuator cannot be moved by hand, you can change Parameter No. 28 (Direction of excited phase signal detection). Before changing this parameter, contact IAI.

5.2.3 Position Table and Parameter Settings Required for Operation

■ Test Operation

Immediately after the system has been started, the movement speed can be reduced as follows to ensure safety of the operator and prevent damage to the jigs, etc.
Change the applicable parameters as necessary.
→ For details on the change operation, refer to the operation manual for the PC/teaching pendant you are using.

Safety speed during manual feed

The feed speed that applies when the actuator is moved with a PC/teaching pendant is defined by Parameter No. 35.
The factory setting of this parameter is 100 mm/s. Change the setting if necessary.
Note that the maximum speed is limited to 250 mm/s.

Speed override for move commands from the PLC

You can reduce the feed speed that applies when the actuator is moved by outputting a rear end, front end or intermediate point move command from the PLC.
You can override the “Speed” field of the position table based on the value of Parameter No. 46, in order to reduce the actual speed to below the speed set in the “Speed” field.
Actual movement speed = [Speed set in the position table] x [Value of Parameter No. 46] ÷ 100

Example)	Value in the “Speed” field of the position table	500 (mm/s)
	Value of Parameter No. 46	20 (%)

Under the above settings, the actual movement speed becomes 100 mm/s.
The minimum setting unit is 1 (%), and the input range is 1 to 100 (%). The factory setting is 100 (%).

■ Full-scale Operation

In situations where the actuator remains standstill for a long time at a standby position, this controller provides several modes to reduce power consumption in such standstill state as part of the controller's energy-saving function.
Use these modes after confirming that they will not cause problems in any part of the system.

Power-saving when the standby time after power on is long

In this case, you can select full servo control by Parameter No. 53 (Default standstill mode). (The setting in the "Standstill mode" field of the position table is ignored.)

→ For details, refer to 5.4, "Power-saving Modes at Standby Positions" and 6.2.2, "Parameters Relating to Actuator Operating Characteristics."

Power-saving when the standby time at the target position is long

In this case, you can select one of two modes depending on the value set in the "Standstill mode" field of the position table. (The setting of Parameter No. 53 is ignored.)

[1] Full servo control
[2] Automatic servo-off

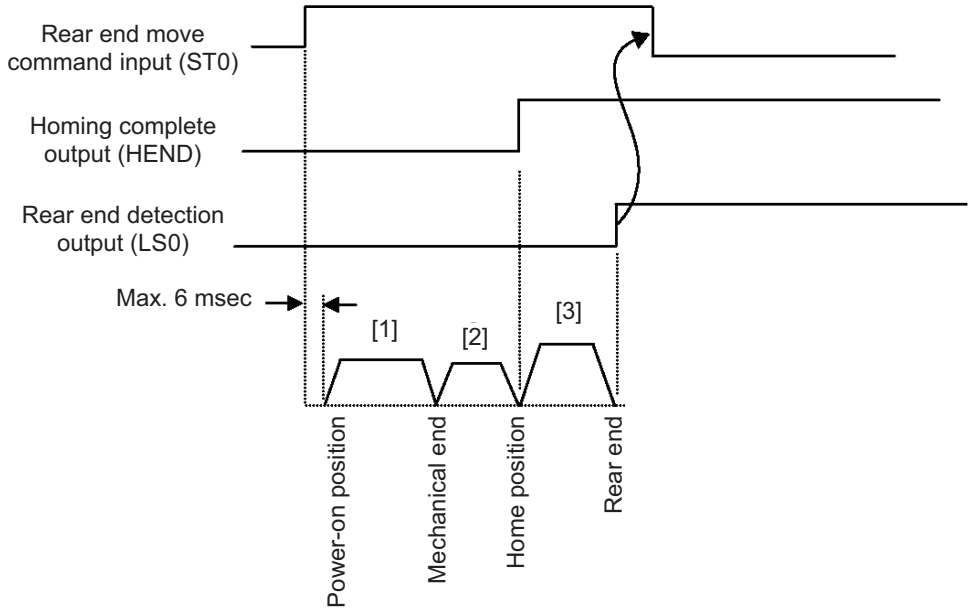
→ For details, refer to 5.4, "Power-saving Modes at Standby Positions" and 6.2.2, "Parameters Relating to Actuator Operating Characteristics."

5.2.4 Homing

This controller adopts an incremental position detector (encoder), so once the power is cut off, the mechanical coordinates will be lost.
Accordingly, homing must be performed to establish the initial mechanical coordinate every time the power is turned on.
To perform homing, input a rear end move command (ST0).

Operation timings

PLC processing 1: The rear end move command signal (ST0) turns ON when the start button is pressed.
Operation:
[1] The actuator starts moving toward the mechanical end on the home side.
[2] After contacting the mechanical end, the actuator reverses its direction and temporarily stops at the home position.
→ The homing complete signal (HEND) turns ON.
[3] The actuator moves toward the rear end, and stops at the rear end.
→ The rear end detection output (LS0) turns ON.
PLC processing 2: The rear end move command signal (ST0) turns OFF.
PLC processing 3: The actuator starts continuous operation.



⚠ Caution: Take note of the following points regarding homing:
[1] Confirm that no obstacle exists between the actuator and the rear end.
[2] If an obstacle exists between the actuator and the rear end, move the actuator toward the front end and remove the obstacle. The controller accepts a front end move command prior to homing to accommodate the aforementioned condition.
In this case, the actuator moves forward at the homing speed and once the mechanical end is reached, the front end detection output (LS1) will turn ON.
This LS1 signal should be recognized as a tentative signal.
[3] Do not input an intermediate move command. (Even if an intermediate move command is input, it will be ignored.)

5.2.5 Positioning Operation

This section explains how to move the actuator from the rear end to the front end, by using an actuator with a 400-mm stroke as an example.
Although the actuator is not stopped at the intermediate point in this example, you can increase the positioning band and use the intermediate point detection output signal (LS2) just like the zone output signal.

Example of position table

No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Comment
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	300.00	0.30	0.30	0	0.10	Front end
2	200.00	300.00	0.30	0.30	0	50.00	Intermediate point

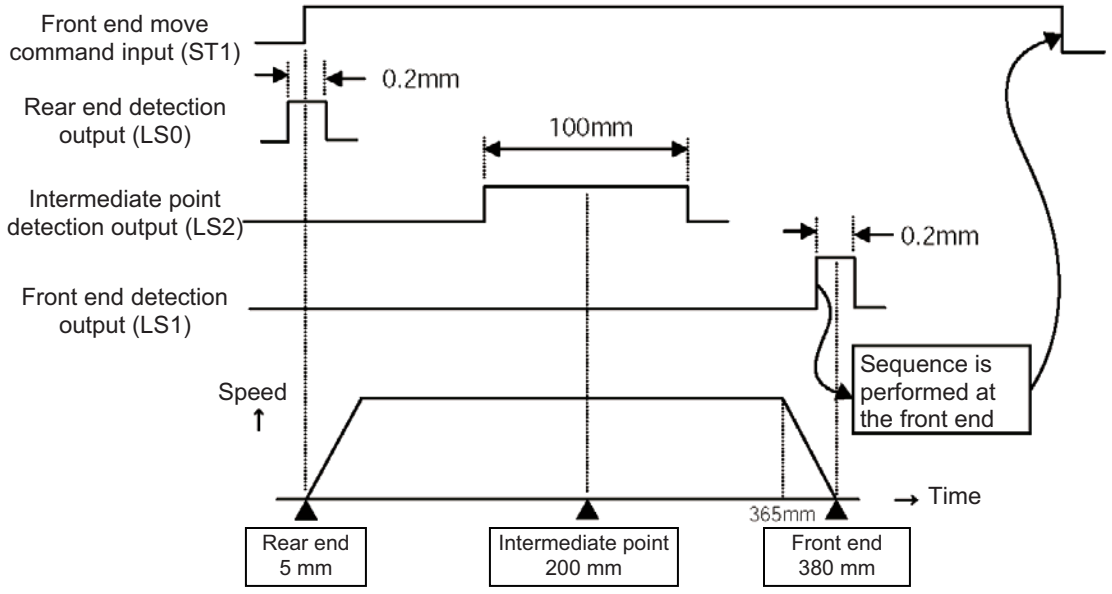
Operation timings

PLC processing 1: The rear end move command signal (ST0) and intermediate point move command signal (ST2) turn OFF, and the front end move command signal (ST1) turns ON.

Operation:
[1] The actuator starts moving toward the front end.
[2] When the actuator passes the position corresponding to 5.1 mm, the rear end detection output (LS0) turns OFF.
[3] When the actuator reaches the position corresponding to 150 mm, the intermediate point detection output (LS2) turns ON. The LS2 turns OFF once the actuator passes the position corresponding to 250 mm.

PLC processing 2: If necessary, use the intermediate point detection output (LS2) as a trigger signal for peripheral equipment.
[4] The actuator starts decelerating after reaching the position corresponding approx. 365 mm.
[5] When the actuator passes the position corresponding to 379.9 mm, the front end detection output (LS1) turns ON.
[6] The actuator stops after reaching the position corresponding to 380 mm.

PLC processing 3: When the front end detection output (LS1) turns ON, the sequence processing is performed at the front end. Once the sequence processing is completed, the front end move command signal (ST1) turns OFF.



⚠ Caution: Design a ladder sequence circuit where only one move command signal turns ON at a given time. If two or more signals are input simultaneously, the signals will be processed according to the set priorities.
Priorities: [1] Rear end, [2] front end, [3] intermediate point

- Meaning of Position Detection Output Signals (LS0, LS1, LS2)

  These signals are handled in the same way as limit switches (LSs). They turn ON when the following conditions are met:
  [1] The homing complete output signal (HEND) is ON.
  [2] The current position is within the allowable distance before or after each target position (inside the positioning band).
  Accordingly, each output signal also turns ON when the actuator is manually moved while the servo is off, in addition to when the actuator is moving following the applicable move command.
  If an emergency stop is actuated while the actuator is moving and operation must be resumed from the PLC when none of the position detection output signals (LS0, LS1, LS2) is ON, move the actuator manually to the target position to turn on the corresponding position detection output signal.

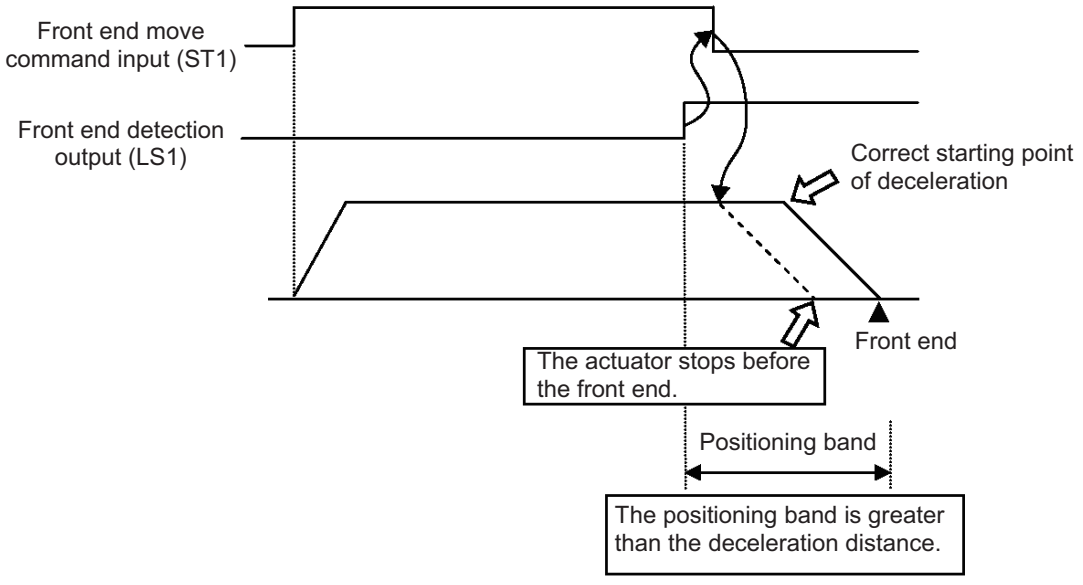
⚠ Caution: All position detection outputs will turn OFF once a phase A/B open detection alarm generates.

- Notes on Setting the Positioning Band

  The positioning band setting defines the range of coordinates at which the position detection output signal will turn ON.
  Condition for a position detection output signal to turn ON = Target position ± (positioning band)

  With a normal move command, once the position detection output signal turns ON, the sequence processing will be performed and the move command input signal will turn OFF.
  Take note that if the positioning band is wide and the move command input signal turns OFF too quickly, the target position may not be achieved.

  (Example) If the feed speed is 300 mm/s and deceleration is 0.3 G, the deceleration distance is approx. 15 mm. If the positioning band is set to 30 mm, the position detection output signal will turn ON before the actuator starts decelerating. If the PLC turns OFF the move command input signal immediately thereafter, the controller will start the deceleration stop processing. As a result, the actuator will stop before the target position.



- Speed Change during Movement

If the work is made of soft material or is a bottle or has other shape that tips over easily, one of the following two methods can be used to prevent the work from receiving vibration or impact upon stopping:

[1] Decrease the deceleration to make the deceleration curve more gradual.

[2] Initially move the actuator at the rated speed, and decrease the feed speed shortly before the target position.

An example of [2], or decreasing the feed speed, is explained.

(Example) When moving the actuator from the rear end to the front end, use the intermediate point as a dummy point. Set the feed speed to 300 mm/s to the intermediate point, and decrease it to 20 mm/s after the intermediate point.

Example of position table

No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Comment
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	20.00	0.30	0.30	0	0.10	Front end
2	300.00	300.00	0.30	0.30	0	30.00	Intermediate point

Operation timings

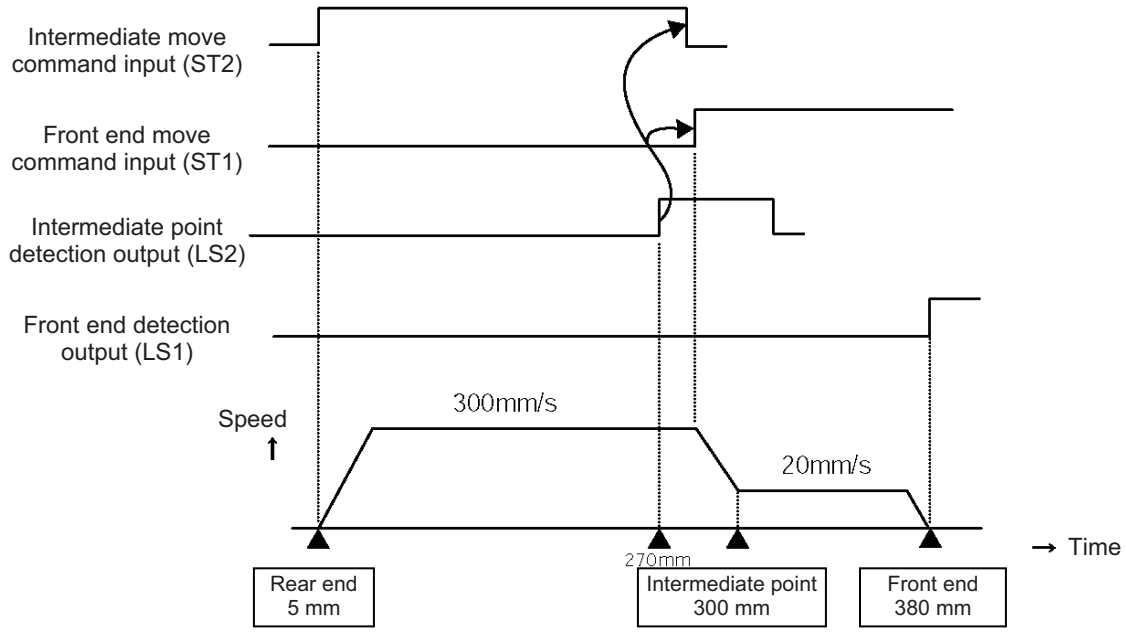
PLC processing 1: The rear end move command signal (ST0) and front end move command signal (ST1) turn OFF, and the intermediate point move command signal (ST2) turns ON.

Operation: [1] The actuator starts moving toward the intermediate point.

[2] When the actuator reaches the position corresponding to 270 mm, the intermediate point detection output (LS2) turns ON.

PLC processing 2: The intermediate point move command signal (ST2) turns OFF, and the front end move command signal (ST1) turns ON.

[3] The actuator decelerates from 300 mm/s to 20 mm/s, and stops at the front end.

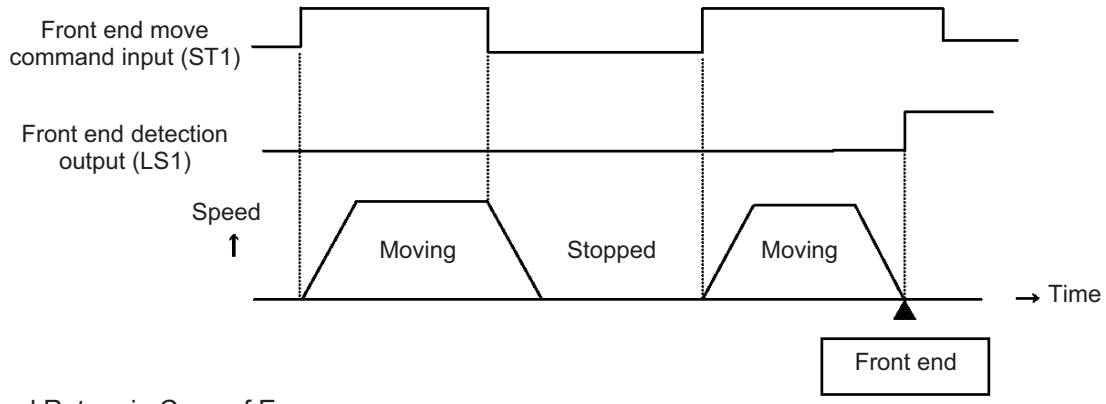


⚠ Caution: By setting a wide positioning band for the intermediate point, smooth speed change can be achieved without the actuator stopping at the intermediate point.

- Pausing during Movement

Move commands are implemented based on signal levels. Accordingly, the actuator moves while the signal is ON, and once the signal turns OFF, the actuator will decelerate to a stop and the operation will end.
If you want to pause the actuator as a secondary safety measure, turn the move command signals OFF.

(Example) Pausing the actuator while moving toward the front end



- Forced Return in Case of Emergency

The following example explains how to return the actuator to the standby position (rear end) after an emergency situation occurred while the actuator was moving.

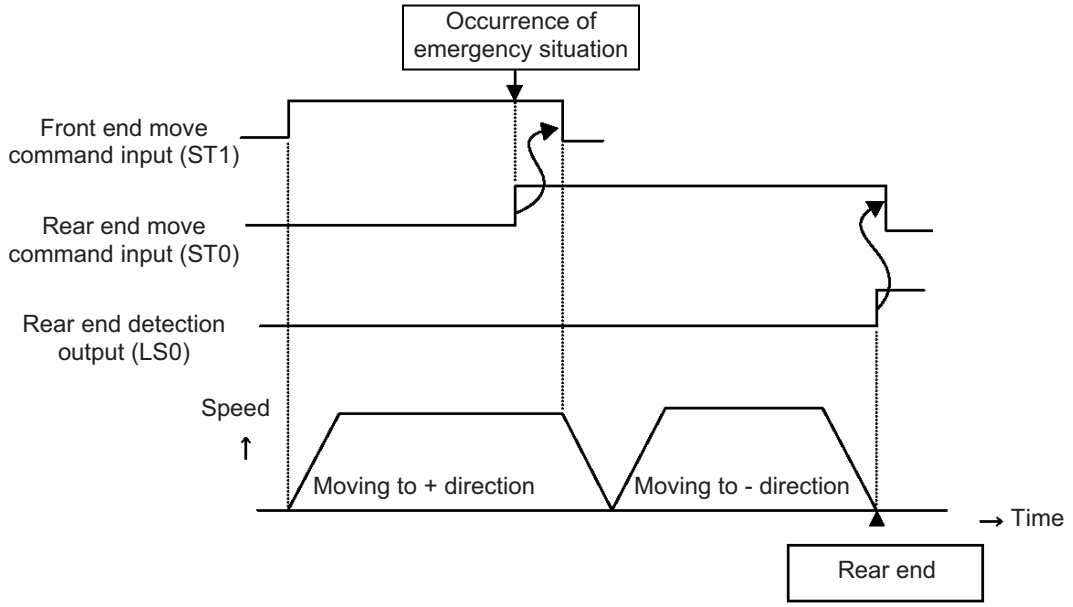
(Example) Return the actuator to the standby position (rear end) after an emergency situation occurred while the actuator was moving toward the front end

Operation timings

PLC processing 1: Upon occurrence of an emergency situation, the rear end move command signal (ST0) turns ON, and then the front end move command signal (ST1) turns OFF.

Operation:
[1] After the front end move command signal (ST1) turns OFF, the actuator decelerates to a stop.
[2] The actuator reverses its direction and starts moving toward the rear end.
[3] When the actuator reaches the rear end, the rear end positioning complete output (PE0) turns ON.

PLC processing 2: The rear end move command signal (ST0) turns OFF.



5.3 Standard Type

This type assumes situations where the system must achieve high productivity or uses push-motion operation. Use this type if your application meets the following conditions:

[1] Use the zone output signal to quicken the operation timings with respect to the respective equipment and thereby reduce the tact time.
[2] Use the zone output signal as an interlock signal to prevent contact with peripheral equipment.
[3] When missed work must be detected in push-motion operation, use the zone output signal as a “simple yardstick” to determine if the work has been contacted properly or missed.

⚠ Caution: The controller is shipped with the proximity switch type pre-selected. If you want to use the standard type, set the value of Parameter No. 25 (PIO pattern selection) to “1.”
→ Refer to Chapter 6, “Parameter Settings”

5.3.1 Explanation of I/O Signals

Pin No.	Wire color	Signal name	Signal abbreviation	Function overview
1	Brown 1	+24 V	P24V	I/O power supply
2	Red 1	0 V	N	
3	Orange 1	Rear end move command input	ST0	Move command to the rear end
4	Yellow 1	Front end move command input	ST1	Move command to the front end
5	Green 1	Intermediate point move command input	ST2	Move command to the intermediate point
6	Blue 1	Servo-on command input	SON	The servo remains on while this signal is ON. The servo remains off while this signal is OFF.
7	Purple 1	Rear end positioning complete output	PE0	This signal turns ON upon completion of movement to the rear end.
8	Gray 1	Front end positioning complete output	PE1	This signal turns ON upon completion of movement to the front end.
9	White 1	Intermediate point positioning complete output	PE2	This signal turns ON upon completion of movement to the intermediate point.
10	Black 1	Zone output	PZONE	This signal remains ON while the actuator is inside the range set in the “Zone +” and “Zone –” fields of the position table.
11	Brown 2	Homing complete output	HEND	This signal is OFF immediately after the power is turned on, and turns ON once homing is completed.
12	Red 2	Alarm output	*ALM	This signal remains ON while the actuator is normal, and turns OFF if an alarm has occurred.

■ Move Command Input for Each Position (ST0, ST1, ST2)

Since the number of positioning points is limited to three, you can use these inputs just like when controlling an air cylinder.
While each signal remains ON, the actuator moves to the target position.
If the signal turns OFF before the movement is completed, the actuator will decelerate to a stop.
Before executing each move command, enter a target position as an absolute coordinate in the “Position” field under one of Nos. 0 to 2 in the position table.

Input signal	Target position	Remarks
ST0	Rear end	The target position is defined in the “Position” field under Position No. 0.
ST1	Front end	The target position is defined in the “Position” field under Position No. 1.
ST2	Intermediate point	The target position is defined in the “Position” field under Position No. 2.

■ Servo-on Command Input (SON)

The servo remains on while this signal is ON.
To ensure safety, it is recommended that the PLC be configured to monitor the condition of the entire system and turn ON this signal once all conditions required for movement are satisfied.

■ Positioning Complete Output for Each Position (PE0, PE1, PE2)

After a move command, the corresponding positioning complete output turns ON when the actuator has entered the positioning band before the target position.
When the next move command to a different position is issued, the positioning complete output turns OFF.

(Note) If the servo turns off or an emergency stop is actuated while the actuator is standing still at the target position, the positioning complete output will turn OFF. When the servo subsequently turns on, the output will turn ON again if the actuator is still inside the positioning band.

Output signal	Position detected	Remarks
PE0	Rear end	The output position is defined in the “Position” and “Positioning band” fields under Position No. 0.
PE1	Front end	The output position is defined in the “Position” and “Positioning band” fields under Position No. 1.
PE2	Intermediate point	The output position is defined in the “Position” and “Positioning band” fields under Position No. 2.

■ Zone Output (PZONE)

This signal can be used as a limit switch (LS) at the intermediate point, or as a simple yardstick during push-motion operation.
The zone output signal remains ON while the actuator is inside the range specified by the “Zone +” and “Zone –” fields of the position table, and turns OFF once the actuator leaves the range.

(Note) This signal is enabled after the coordinate system has been established following the completion of homing. It will not be output immediately after the power is turned on.
As long as homing has already been completed, this signal remains effective while the servo is off or an emergency stop is actuated.

■ Homing Complete Output (HEND)

This signal is OFF immediately after the power is turned on.
To establish the initial coordinate, only a rear end move command is accepted after power on. Once a rear end move command has been input, the actuator performs homing and then moves to the rear end.
This signal will turn ON after the homing is completed.
Once turned ON, this signal will remain ON until the input power is cut off.
Use this signal as an interlock signal before homing.

(Reference) Acceptance of each move command before homing is explained below:
[1] A rear end move command is accepted.
[2] An intermediate point move command is not accepted.
[3] A front end move command is accepted, but once the actuator moves forward at the homing speed and contacts the mechanical end, the actuator will stop and a front end positioning complete output (PE1) will turn ON.
In this case, the PE1 signal should be recognized as a tentative signal.
Movement to the front end is permitted to accommodate a situation where there is an obstacle between the actuator and the rear end.

■ Alarm Output (*ALM)

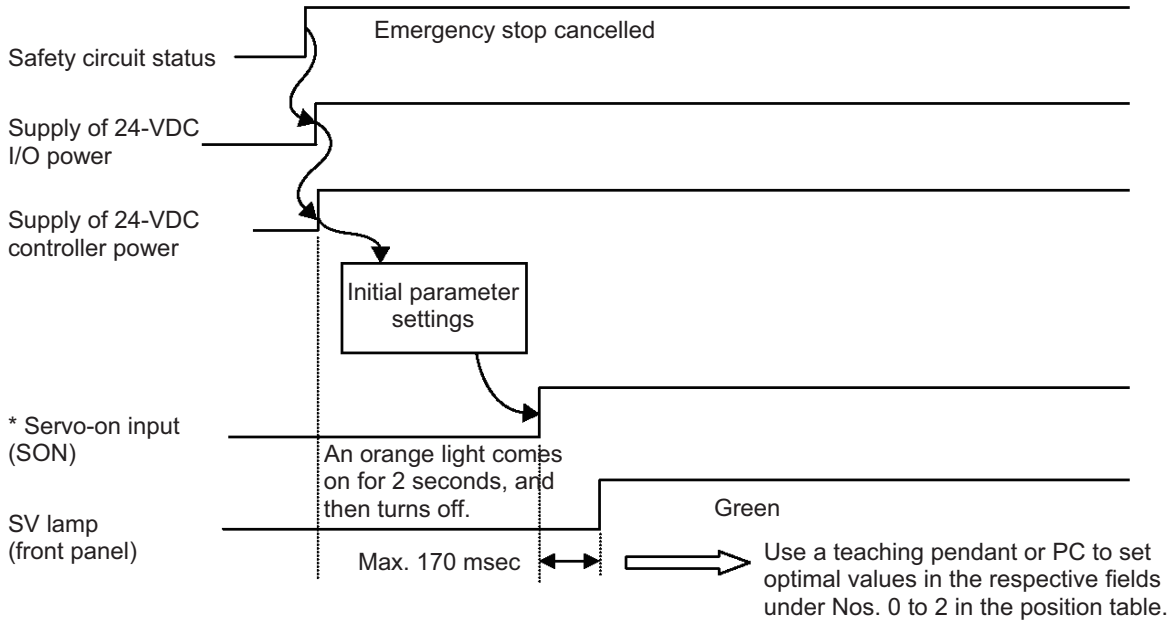
This signal remains ON while the actuator is normal, and turns OFF if an alarm has occurred.
Cause the PLC to monitor the OFF state of this signal and provide an appropriate safety measure for the entire system.
Check the nature of each alarm by connecting a PC/teaching pendant, and remove the cause. For details of alarms, refer to Chapter 7, “Troubleshooting.”

5.3.2 Timings after Power On

- Steps from Initial Startup to Actuator Adjustment

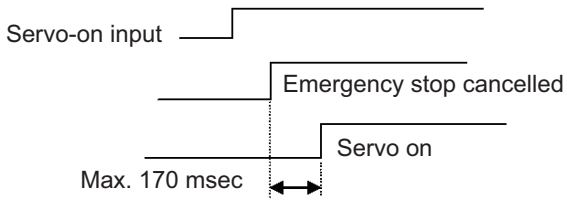
[1] Confirm that the slider or rod is not contacting a mechanical end or that the work is not contacting any peripheral equipment.
[2] Cancel the emergency stop or connect the motor drive power.
[3] Supply the 24-VDC I/O power (PIO connector pins 1 and 2).
[4] Supply the 24-VDC controller power (24-V and 0-V terminals on the power-supply terminal block).
[5] Set the minimum required parameters.
(Example)
- To switch to the standard type, change the value of Parameter No. 25 (PIO pattern selection) to "1."
- To temporarily disable the servo-on input because the PLC is not yet ready to accept the input, change the value of Parameter No. 21 (Servo-on input disable selection) to "1."
- To change the feed speed during teaching, change the value of Parameter No. 35 (Safety speed).

[6] Input a servo-on signal from the PLC.
[7] Connect a PC or teaching pendant to adjust the actuator.
- Set optimal values in the "Position," "Speed," "Acceleration," "Deceleration" and other fields under Nos. 0 to 2 in the position table.



* If you have changed the value of Parameter No. 21 (Servo-on input disable selection) to "1," the servo-on input signal is not required.

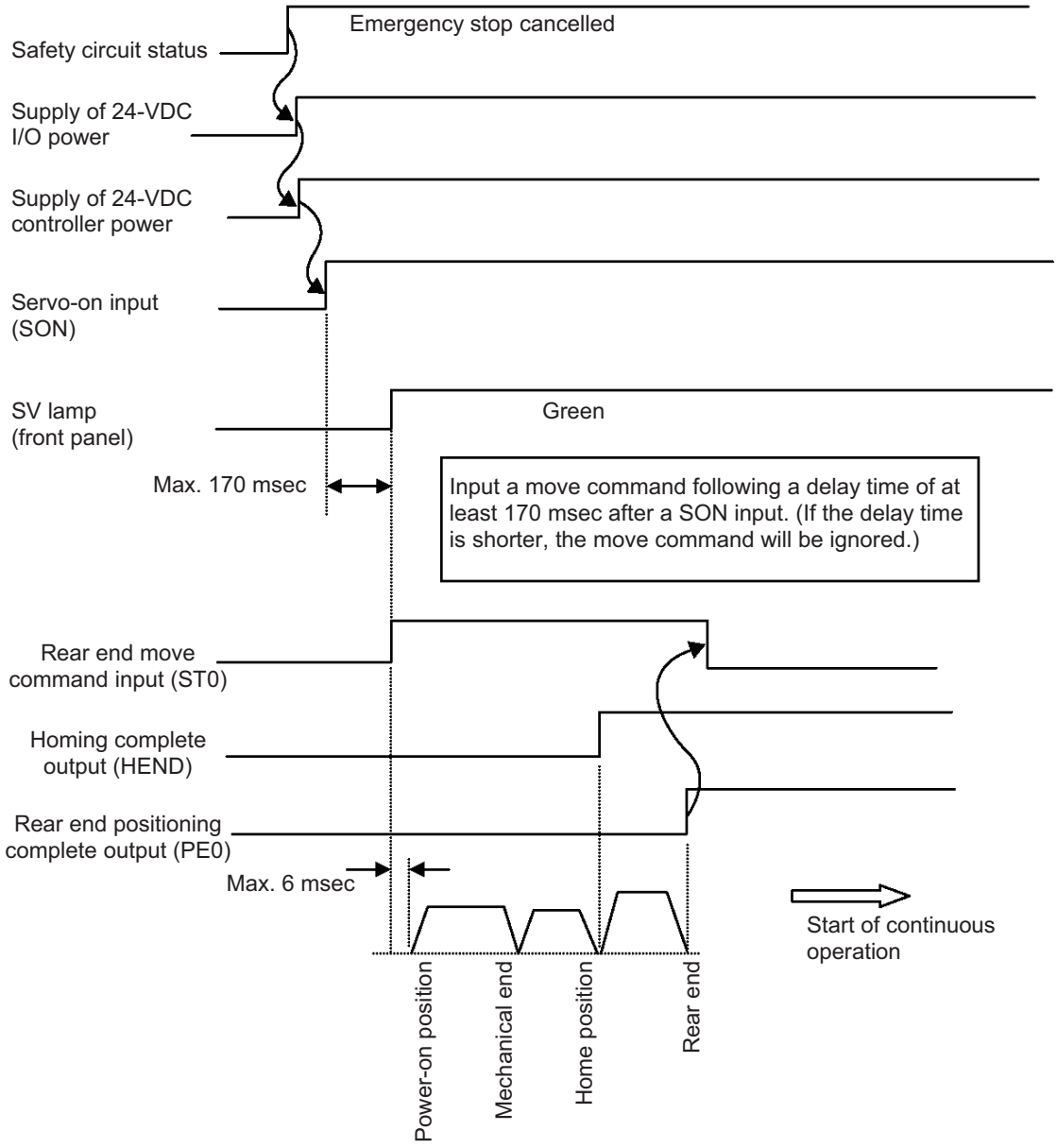
⚠ Caution: In the "Emergency stop actuated → Turn on the power → Servo-on input → Cancel the emergency stop" sequence, the servo will turn on up to 170 msec after the emergency stop is cancelled.



- Normal Operating Procedure

The operating procedure in a normal condition is explained below.

[1] Confirm that the slider or rod is not contacting a mechanical end or that the work is not contacting any peripheral equipment.
[2] Cancel the emergency stop or connect the motor drive power.
[3] Supply the 24-VDC I/O power.
[4] Supply the 24-VDC controller power.
[5] Input a servo-on signal from the PLC.
[6] First, input a rear end move command signal from the PLC (to cause the actuator to stand by at the rear end).
[7] Start automatic operation.



⚠ Warning: Since the drive motor is a pulse motor, the excited phase is detected when the servo is turned on for the first time after turning on the power.
Therefore, one condition for the servo to turn on is that the actuator can move once the servo is turned on.
If the slider or rod is contacting a mechanical end or the work is contacting any peripheral equipment, the excited phase may not be detected correctly and an erroneous movement or excitation detection error may occur.
In this case, move the actuator manually to an appropriate position before turning the servo on.
If the actuator is equipped with a brake, the brake must be forcibly released by turning on the brake release switch. At this time, be careful not to pinch your hand or damage the robot hand or work by the slider/rod, as the slider/rod may drop unexpectedly by its dead weight. If the actuator cannot be moved by hand, you can change Parameter No. 28 (Direction of excited phase signal detection). Before changing this parameter, contact IAI.

5.3.3 Position Table and Parameter Settings Required for Operation

■ Test Operation

Immediately after the system has been started, the movement speed can be reduced as follows to ensure safety of the operator and prevent damage to the jigs, etc.
Change the applicable parameters as necessary.
→ For details on the change operation, refer to the operation manual for the PC/teaching pendant you are using.

Safety speed during manual feed

The feed speed that applies when the actuator is moved with a PC/teaching pendant is defined by Parameter No. 35. The factory setting of this parameter is 100 mm/s. Change the setting if necessary.
Note that the maximum speed is limited to 250 mm/s.

Speed override for move commands from the PLC

You can reduce the feed speed that applies when the actuator is moved by outputting a move command from the PLC. You can override the “Speed” field of the position table based on the value of Parameter No. 46, in order to reduce the actual speed to below the speed set in the “Speed” field.
Actual movement speed = [Speed set in the position table] x [Value of Parameter No. 46] ÷ 100
Example) Value in the “Speed” field of the position table 500 (mm/s)
Value of Parameter No. 46 20 (%)
Under the above settings, the actual movement speed becomes 100 mm/s.
The minimum setting unit is 1 (%), and the input range is 1 to 100 (%). The factory setting is 100 (%).

■ Full-scale Operation

In situations where the actuator remains standstill for a long time at a standby position, this controller provides several modes to reduce power consumption in such standstill state as part of the controller's energy-saving function.
You can also select the positioning complete signal state to be applied when the servo turns off or "position deviation" occurs while the actuator is standing still after completion of positioning.
Use these modes after confirming that they will not cause problems in any part of the system.

Power-saving when the standby time after power on is long

In this case, you can select full servo control by Parameter No. 53 (Default standstill mode). (The setting in the "Standstill mode" field of the position table is ignored.)

→ For details, refer to 5.4, "Power-saving Modes at Standby Positions" and 6.2.2, "Parameters Relating to Actuator Operating Characteristics."

Power-saving when the standby time at the target position is long

In this case, you can select one of two modes depending on the value set in the "Standstill mode" field of the position table. (The setting of Parameter No. 53 is ignored.)

[1] Full servo control
[2] Automatic servo-off

→ For details, refer to 5.4, "Power-saving Modes at Standby Positions" and 6.2.2, "Parameters Relating to Actuator Operating Characteristics."

Complete signal output mode

You can select the positioning complete signal state to be applied when the servo turns off or "position deviation" occurs while the actuator is standing still after completion of positioning.
This setting uses Parameter No. 39. Select an appropriate mode by considering the characteristics of the specific control.

→ For details, refer to 6.2.3, "Parameters Relating to External Interface."

5.3.4 Homing

This controller adopts an incremental position detector (encoder), so once the power is cut off, the mechanical coordinates will be lost.
Accordingly, homing must be performed to establish the initial mechanical coordinate every time the power is turned on.
To perform homing, input a rear end move command (ST0).

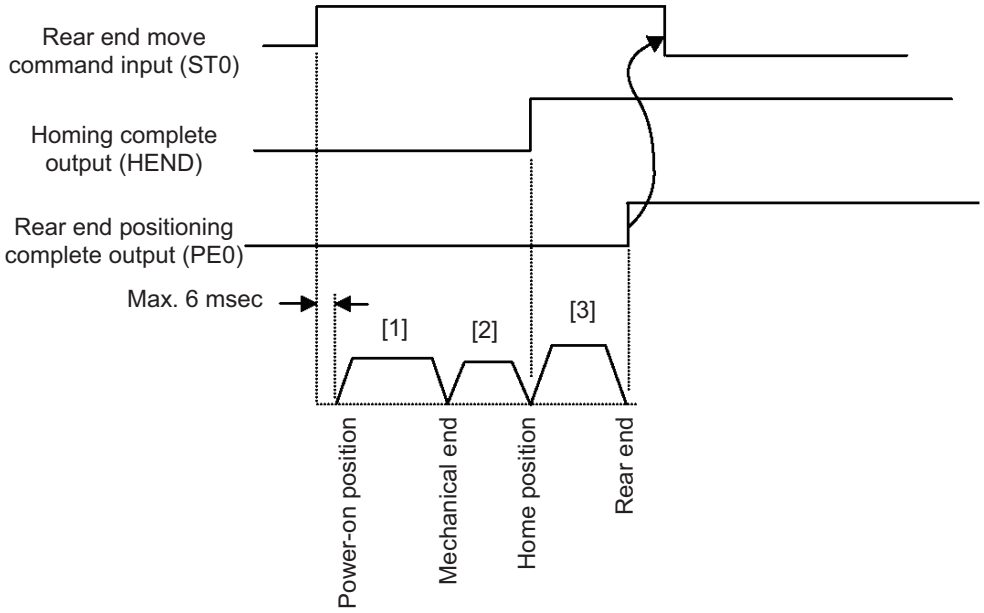
Operation timings

PLC processing 1: The rear end move command signal (ST0) turns ON when the start button is pressed.

Operation:
[1] The actuator starts moving toward the mechanical end on the home side.
[2] After contacting the mechanical end, the actuator reverses its direction and temporarily stops at the home position.
→ The homing complete signal (HEND) turns ON.
[3] The actuator moves toward the rear end, and stops at the rear end.
→ The rear end positioning complete output (PE0) turns ON.

PLC processing 2: The rear end move command signal (ST0) turns OFF.

PLC processing 3: The actuator starts continuous operation.



⚠ Caution: Take note of the following points regarding homing:
[1] Confirm that no obstacle exists between the actuator and the rear end.
[2] If an obstacle exists between the actuator and the rear end, move the actuator toward the front end and remove the obstacle. The controller accepts a front end move command prior to homing to accommodate the aforementioned condition.
In this case, the actuator moves forward at the homing speed and once the mechanical end is reached, the front end positioning complete output (PE1) will turn ON.
This PE1 signal should be recognized as a tentative signal.
[3] Do not input an intermediate move command. (Even if an intermediate move command is input, it will be ignored.)

5.3.5 Positioning Operation

This section explains how to move the actuator from the rear end to the intermediate point and then to the front end, by using an actuator with a 400-mm stroke as an example.

Example of position table

No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Comment
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	300.00	0.30	0.30	0	0.10	Front end
2	200.00	300.00	0.30	0.30	0	0.10	Intermediate point

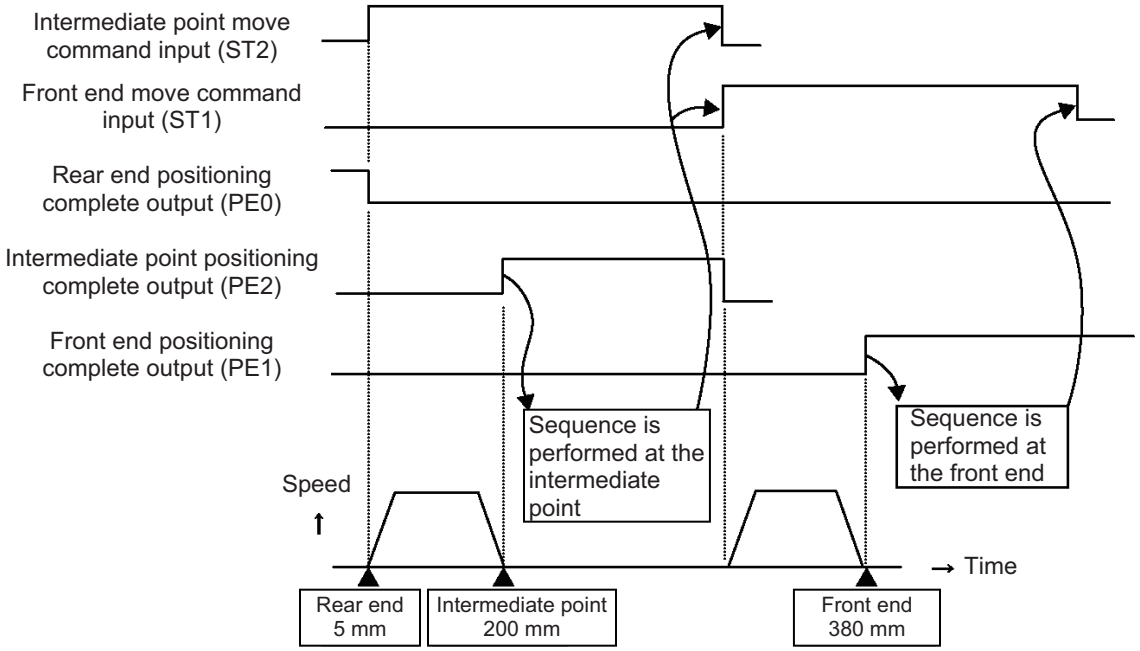
Operation timings

PLC processing 1: The rear end move command signal (ST0) and front end move command signal (ST1) turn OFF, and the intermediate point move command signal (ST2) turns ON.

Operation:
[1] The actuator starts moving toward the intermediate point, and the rear end positioning complete output (PE0) turns OFF.
[2] When the actuator reaches the position corresponding to 199.9 mm, the intermediate point positioning complete output (PE2) turns ON.
[3] After reaching the position corresponding to 200 mm, the actuator stops.

PLC processing 2: When the intermediate point positioning complete output (PE2) turns ON, the sequence processing is performed at the intermediate point.
Once the sequence processing is completed, the intermediate point move command signal (ST2) turns OFF, and the front end move command signal (ST1) turns ON.
[4] The actuator starts moving toward the front end, and the intermediate point positioning complete output (PE2) turns OFF.
[5] When the actuator reaches the position corresponding to 379.9 mm, the front end positioning complete output (PE1) turns ON.
[6] After reaching the position corresponding to 380 mm, the actuator stops.

PLC processing 3: When the front end positioning complete output (PE1) turns ON, the sequence processing is performed at the front end.
Once the sequence processing is completed, the front end move command signal (ST1) turns OFF.



⚠ Caution: Design a ladder sequence circuit where only one move command signal turns ON at a given time. If two or more signals are input simultaneously, the signals will be processed according to the set priorities.
Priorities: [1] Rear end, [2] front end, [3] intermediate point

- Meaning of Positioning Complete Output Signals (PE0, PE1, PE2)

These signals indicate that the target position has been reached. They turn ON when the following conditions are met:
[1] The homing complete output signal (HEND) is ON.
[2] The actuator has entered the positioning band before the target position.
Each signal can be used as trigger signal for peripheral equipment when the target position is reached.
Increasing the positioning band quickens the timing of the next command issued to peripheral equipment, and consequently the tact time becomes shorter.
(Note) If the servo turns off or an emergency stop is actuated while the actuator is standing still at the target position, the output will turn OFF. When the servo subsequently turns on, the output will turn ON again if the actuator is still inside the positioning band.

⚠ Caution: All position detection outputs will turn OFF once a phase A/B open detection alarm generates.

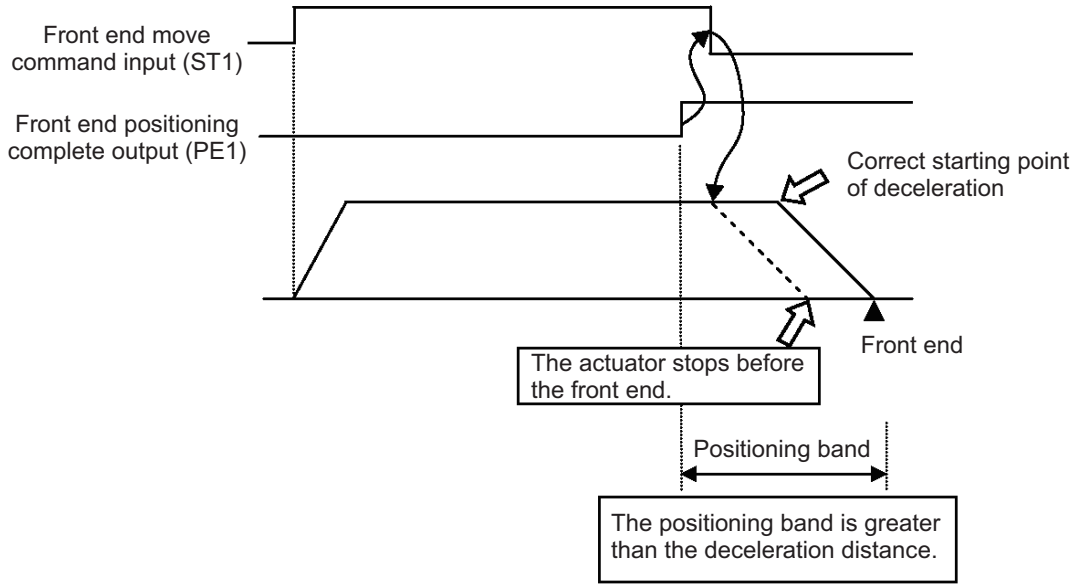
- Notes on Setting the Positioning Band

The positioning band setting defines the range of coordinates at which the positioning complete output signal will turn ON.

Condition for a positioning complete output signal to turn ON = The actuator enters the positioning band before the target position

With a normal move command, once the positioning complete output signal turns ON, the sequence processing will be performed and the move command input signal will turn OFF.
Take note that if the positioning band is wide and the move command input signal turns OFF too quickly, the target position may not be achieved.

(Example) If the feed speed is 300 mm/s and deceleration is 0.3 G, the deceleration distance is approx. 15 mm. If the positioning band is set to 30 mm, the positioning complete output signal will turn ON before the actuator starts decelerating.
If the PLC turns OFF the move command input signal immediately thereafter, the controller will start the deceleration stop processing.
As a result, the actuator will stop before the target position.



- Speed Change during Movement

If the work is made of soft material or is a bottle or has other shape that tips over easily, one of the following two methods can be used to prevent the work from receiving vibration or impact upon stopping:

[1] Decrease the deceleration to make the deceleration curve more gradual.

[2] Initially move the actuator at the rated speed, and decrease the feed speed shortly before the target position.

An example of [2], or decreasing the feed speed, is explained.

(Example) When moving the actuator from the rear end to the front end, use the intermediate point as a dummy point. Set the feed speed to 300 mm/s to the intermediate point, and decrease it to 20 mm/s after the intermediate point.

Example of position table

No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Comment
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	20.00	0.30	0.30	0	0.10	Front end
2	300.00	300.00	0.30	0.30	0	30.00	Intermediate point

Operation timings

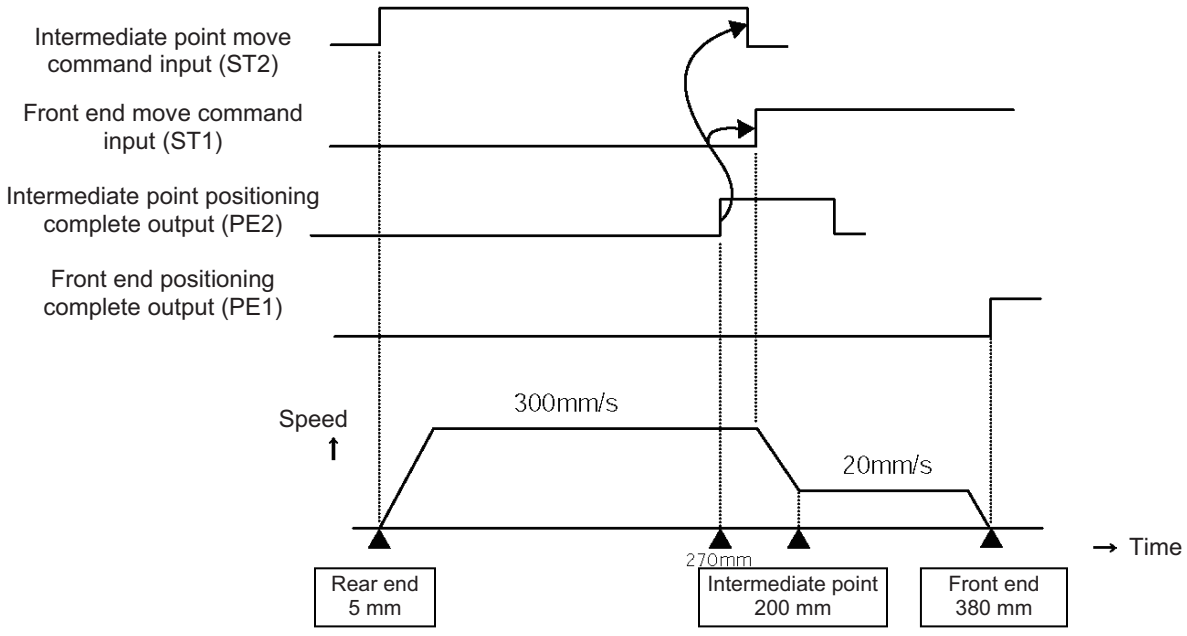
PLC processing 1: The rear end move command signal (ST0) and front end move command signal (ST1) turn OFF, and the intermediate point move command signal (ST2) turns ON.

Operation: [1] The actuator starts moving toward the intermediate point.

[2] When the actuator reaches the position corresponding to 270 mm, the intermediate point positioning complete output (PE2) turns ON.

PLC processing 2: The intermediate point move command signal (ST2) turns OFF, and the front end move command signal (ST1) turns ON.

[3] The actuator decelerates from 300 mm/s to 20 mm/s, and stops at the front end.

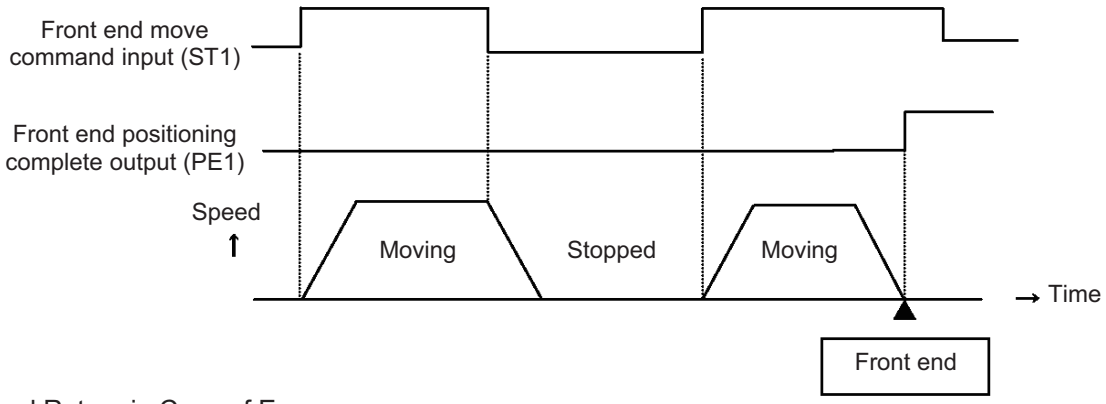


⚠ Caution: By setting a wide positioning band for the intermediate point, smooth speed change can be achieved without the actuator stopping at the intermediate point.

- Pausing during Movement

Move commands are implemented based on signal levels. Accordingly, the actuator moves while the signal is ON, and once the signal turns OFF, the actuator will decelerate to a stop and the operation will end.
If you want to pause the actuator as a secondary safety measure, turn the move command signals OFF.

(Example) Pausing the actuator while moving toward the front end



- Forced Return in Case of Emergency

The following example explains how to return the actuator to the standby position (rear end) after an emergency situation occurred while the actuator was moving.

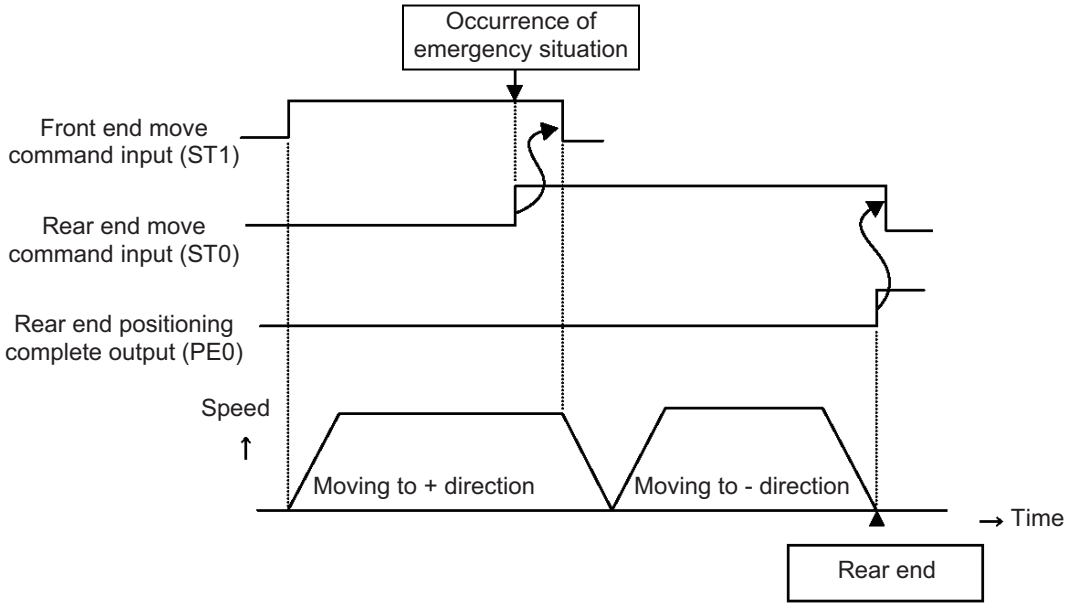
(Example) Return the actuator to the standby position (rear end) after an emergency situation occurred while the actuator was moving toward the front end

Operation timings

PLC processing 1: Upon occurrence of an emergency situation, the rear end move command signal (ST0) turns ON, and then the front end move command signal (ST1) turns OFF.

Operation:
[1] After the front end move command signal (ST1) turns OFF, the actuator decelerates to a stop.
[2] The actuator reverses its direction and starts moving toward the rear end.
[3] When the actuator reaches the rear end, the rear end positioning complete output (PE0) turns ON.

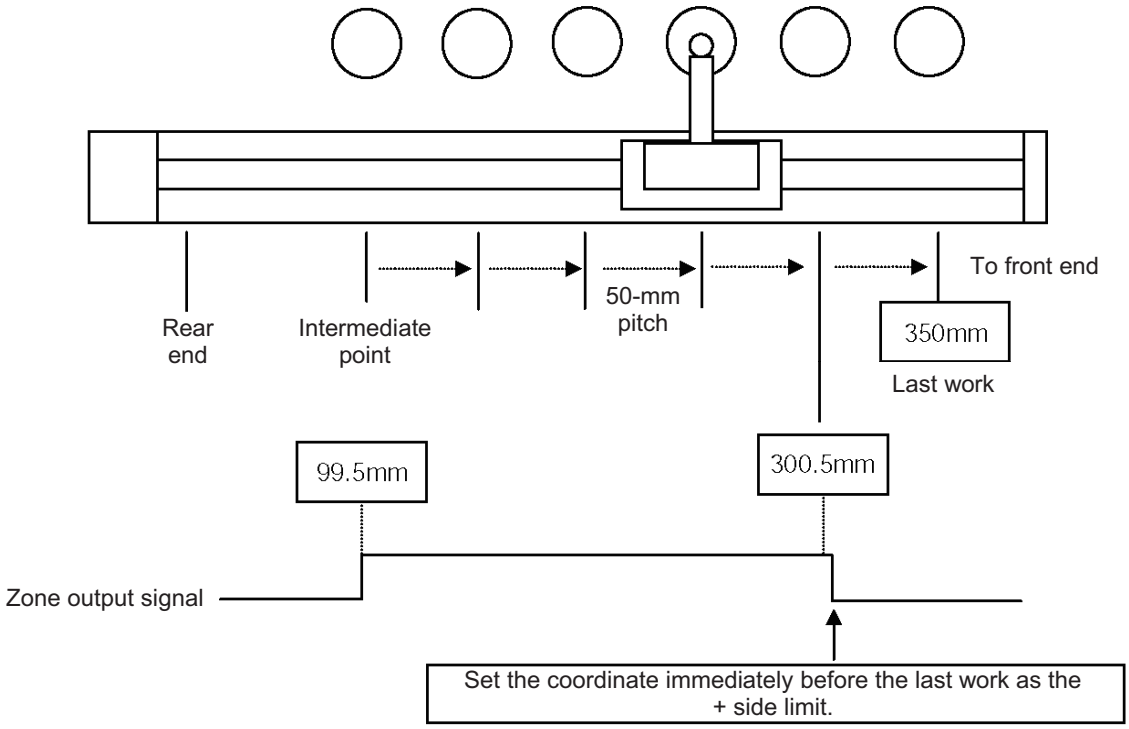
PLC processing 2: The rear end move command signal (ST0) turns OFF.



- Constant Pitch Feed

  Since a target position can also be set as a relative distance, an application where the actuator performs positioning to a series of works placed at equal intervals is also possible.

  (Example) How to move the actuator from the intermediate point to the front end at a 50-mm pitch is explained.
  Under No. 1 in the position table, enter “50” (mm) in the “Position” field and “1” in the “Incremental” field. (1 defines that 50 mm is a relative distance.)
  The PLC manages the number of movements to determine the end of positioning. To be doubly sure, the zone output signal can also be used concurrently.



Example of position table

No	Position [mm]	Zone + [mm]	Zone – [mm]	Incremental	Comment
0	5.00	300.50	99.50	0	Rear end (Standby position)
1 =	50.00	300.50	99.50	1	Front end (Pitch)
2	100.00	300.50	99.50	0	Intermediate point (Starting point)

(Note) When issuing a rear end move command and different zone limits must be set, change the zone limits.

* On the teaching pendant, an equal sign indicates that the applicable position is set in the incremental mode.

Operation timings

PLC processing 1: The rear end move command signal (ST0) and front end move command signal (ST1) turn OFF, and the intermediate point move command signal (ST2) turns ON.

Operation: [1] The actuator starts moving, and when it reaches the intermediate point, the intermediate point positioning complete output (PE2) turns ON. The zone output signal also turns ON.

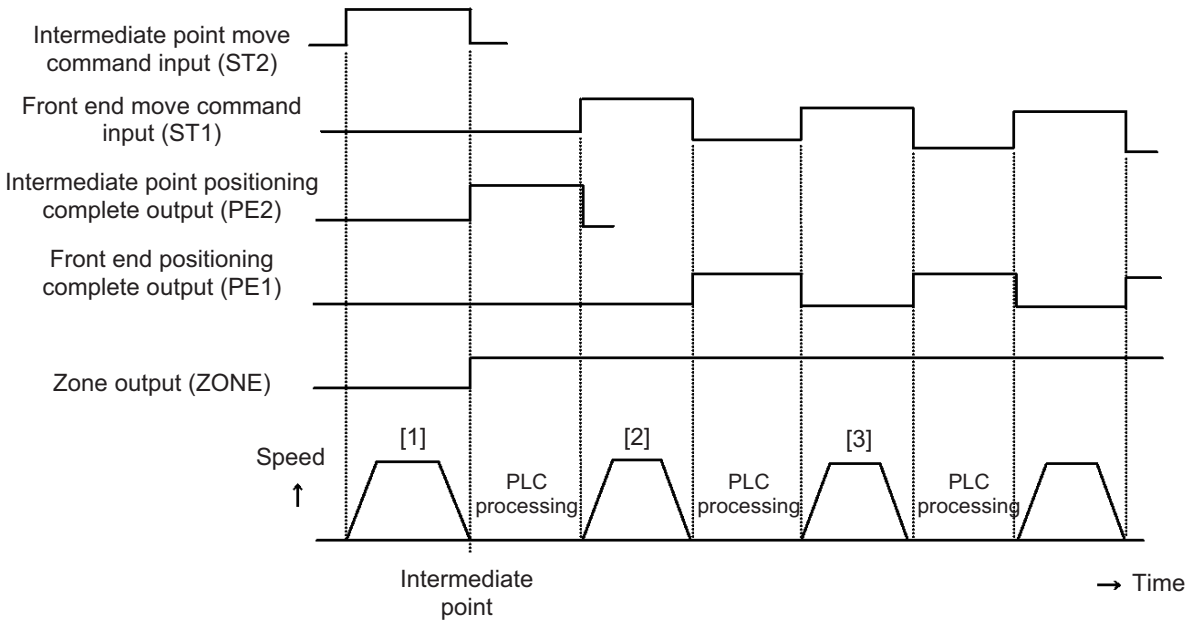
PLC processing 2: The intermediate point move command signal (ST2) turns OFF and the sequence processing is performed.
Once the sequence processing is completed, the front end move command signal (ST1) turns ON.

[2] When the actuator starts moving toward the front end, the intermediate point positioning complete output (PE2) turns OFF.
When the actuator moves 50 mm thereafter, the front end positioning complete output (PE1) turns ON.

PLC processing 3: The front end move command signal (ST1) turns OFF, and the sequence processing is performed.
Once the sequence processing is completed, the front end move command signal (ST1) turns ON.

[3] When the actuator starts moving toward the front end, the front end positioning complete output (PE1) turns OFF.
When the actuator moves 50 mm thereafter, the front end positioning complete output (PE1) turns ON again.

* The same steps are repeated for the number of works.
The PLC should be programmed so that if the zone output signal is OFF when the signal ON/OFF state is checked upon completion of positioning, the PLC will recognize that the applicable work is the last work.
If the PLC count and the zone output signal state do not match, the signal timings may not be synchronized.



⚠ Caution: Note on checking positioning complete signals
When a move command signal turns ON, the relevant positioning complete output signal turns OFF temporarily. To determine if positioning has completed, therefore, check the leading edge of the positioning complete output signal after it has turned OFF.

5.3.6 Zone Output Signal

This signal remains ON while the actuator is inside the zone set in the position table.
The zone output signal can be set only at a single point, but a different zone can be set for the move command corresponding to each target position (rear end, front end, or intermediate point).

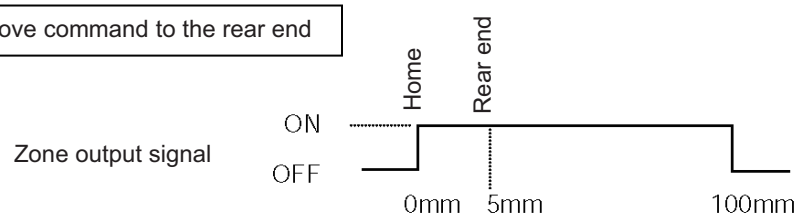
Use the zone output signal in the following situations.

[1] Set an interlock signal to prevent contact with peripheral equipment.
[2] Set a trigger signal for peripheral equipment to reduce the tact time.
[3] Detect missed work during push-motion operation.
[4] Determine the end point when positioning to a series of aligned works via constant pitch feed.
(Note) In constant pitch feed, the “Position” field indicates a relative distance. However, the zone is still set as an absolute coordinate from the home.

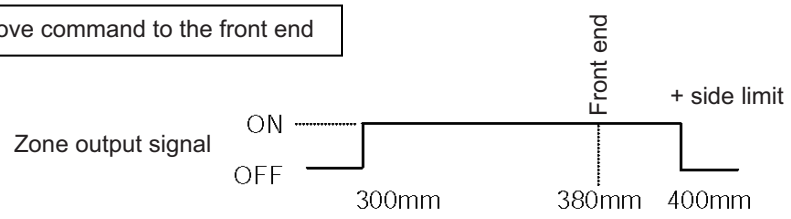
[Setting example]

No	Position [mm]	Zone + [mm]	Zone – [mm]	Comment
0	5.00	100.00	0.00	Rear end
1	380.00	400.00	300.00	Front end
2	200.00	250.00	150.00	Intermediate point

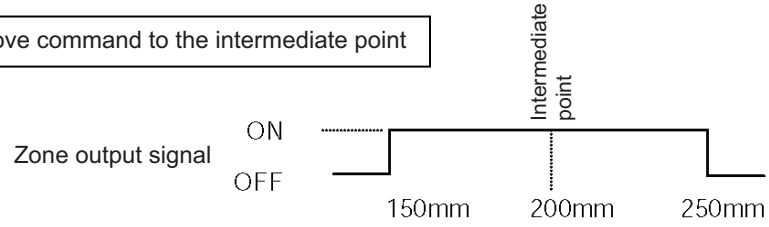
Move command to the rear end



Move command to the front end



Move command to the intermediate point



5.3.7 Push-motion Operation

Just like you can with an air cylinder, you can maintain the actuator in a condition where the tip of the rod is pushing a work. Accordingly, the actuator can be used with systems that clamp, press-fit or otherwise push works.
This function is enabled by entering a current-limiting value in the “Push” field of the position table.

* If the “Push” field contains “0,” positioning operation is applied. If the value in this field is other than “0,” push-motion operation is applied.

The push torque [N] is determined by the current-limiting value [%] in the “Push” field.

[Basics of push-motion operation]

[1] Enter a current-limiting value in the “Push” field for the front end (Position No. 1) to define that a front end command will be implemented as push-motion operation.
  * Determine an appropriate push force based on the characteristics of the work (shape, material, etc.), and obtain a current-limiting value by using the “push force vs. current-limiting value” correlation diagram (explained later) of the actuator as a reference.

[2] In the “Positioning band” field, enter the maximum travel (relative distance) from the front end permitted during push-motion operation.
(Consider a position error that may generate when the work is installed, as well as a possible depression if the work is made of elastic material.)

[3] If it is possible for the system to miss the work, use the zone output signal to detect missed work. To do this, enter appropriate values in the “Zone +” and “Zone –” fields to specify a range within which the work is deemed to have been contacted successfully.

[4] Change the value of Parameter No. 6 (Push-motion completion judgment time), if necessary.
(The factory setting is 255 msec, which is the maximum value that can be set for this parameter.)

[5] Change the value of Parameter No. 34 (Push speed), if necessary.
(The factory setting is different in accordance with the actuator model.)
  * For details on these parameters, refer to Chapter 6, “Parameter Settings.”

(Example) An example with a rod actuator with a 200-mm stroke, where the current-limiting value is set to 40%, maximum travel in push-motion operation to 20 mm, and successful contact range to between 180 and 185 mm, is explained.
Under No. 1 in the position table, enter “160” (mm) in the “Position” field, “40” (%) in the “Push” field, “30” mm in the “Positioning band” field, “185” (mm) in the “Zone +” field, and “180” (mm) in the “Zone –” field.

Example of position table

No	Position [mm]	Push [%]	Positioning band [mm]	Zone + [mm]	Zone – [mm]	Comment
0	5.00	0	0.10	100.00	4.90	Rear end (Standby position)
1	160.00	40	30.00	185.00	180.00	Front end
2	*	*	*	*	*	Intermediate point

Operation timings

PLC processing 1: The rear end move command signal (ST0) and intermediate point move command signal (ST2) turn OFF, and the front end move command signal (ST1) turns ON.

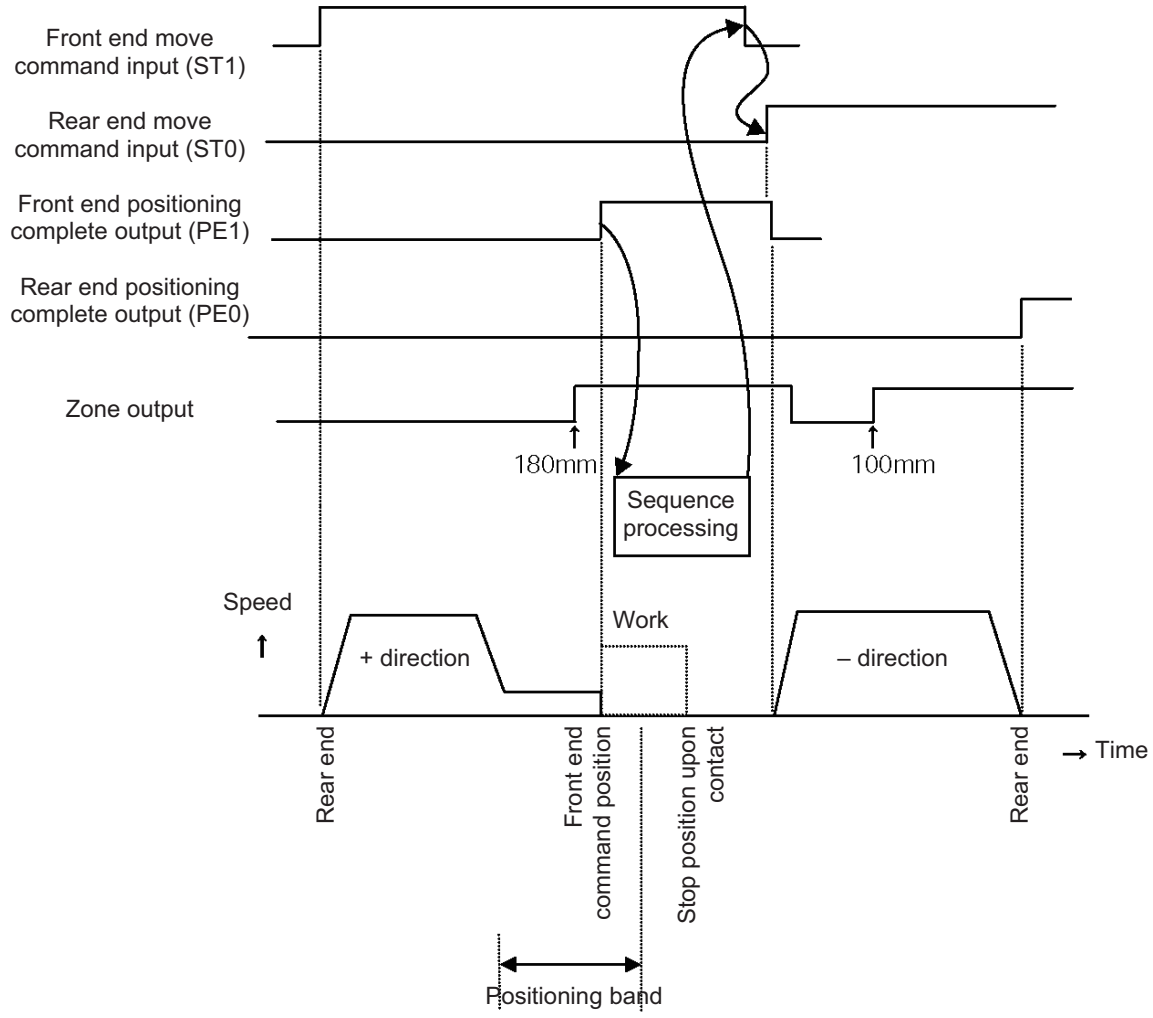
Operation: [1] The actuator starts moving and upon reaching the front end (160 mm), the actuator decelerates to the push speed and continues moving at the new speed.
When the actuator contacts the work and the "push-motion completion" condition is satisfied, the front end positioning complete output (PE1) turns ON.
If the stopped position is between 180 and 185 mm, the zone output signal turns ON.

PLC processing 2: When the zone output signal turns ON to indicate that the work has been successfully contacted, the sequence processing is performed in a "condition where the work is being pushed."
Once the sequence processing is completed, the front end move command signal (ST1) turns OFF and the rear rend move command signal (ST0) turns ON.

[2] When the actuator starts moving toward the rear end, the front end positioning complete output (PE1) turns OFF and the zone output signal also turns OFF temporarily. Once the actuator returns to the position corresponding to 100 mm, the zone output signal turns ON again. When the actuator reaches the rear end thereafter, the rear end positioning complete output (PE0) turns ON.

PLC processing 3: To issue a command to peripheral equipment while the actuator is returning to the rear end, in order to reduce the tact time, you can use the zone output signal as a trigger signal (the signal turns ON once the actuator has returned to the position corresponding to 100 mm).

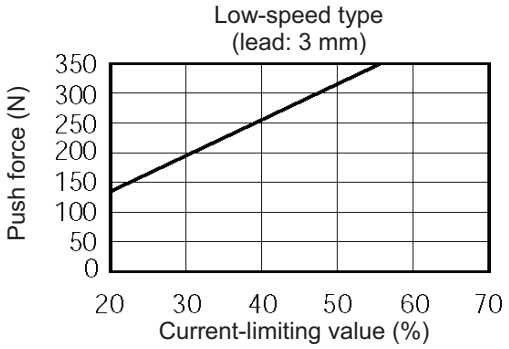
* If the zone output signal dose not turn ON when the front end positioning complete output (PE1) is ON, the condition should be interpreted as "missed work" or "abnormal work installation position."

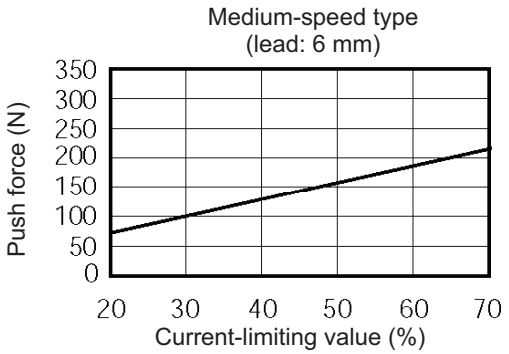


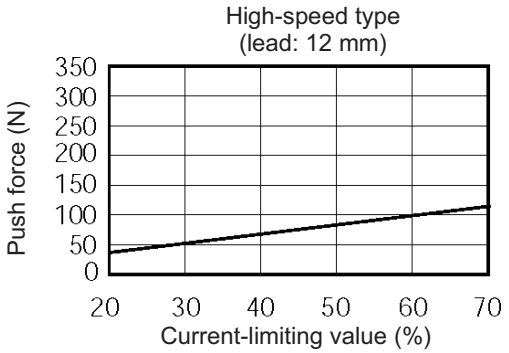
The correlation diagram of current-limiting value [%] and push force [N] is shown below for each actuator.
Note: For the specific data with the RCP3, check the operation manual for the RCP3.

- Slider Type

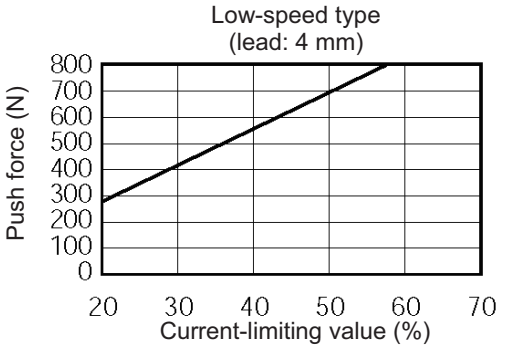
(1) SA5C/SA6C/SS7C type

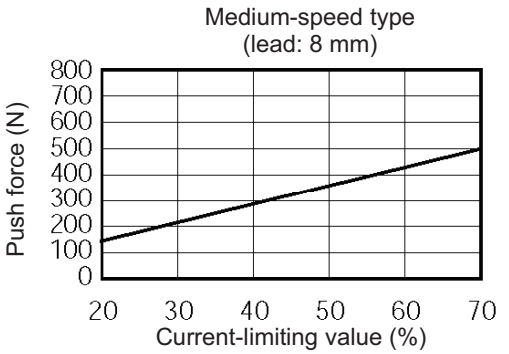


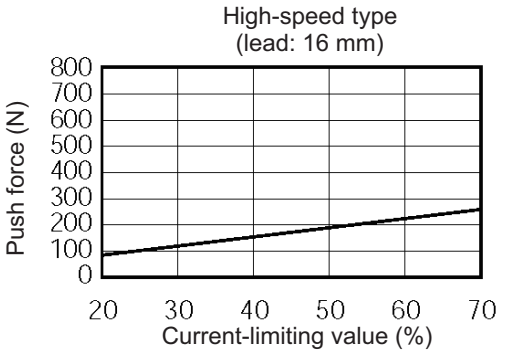




(2) SA7C type



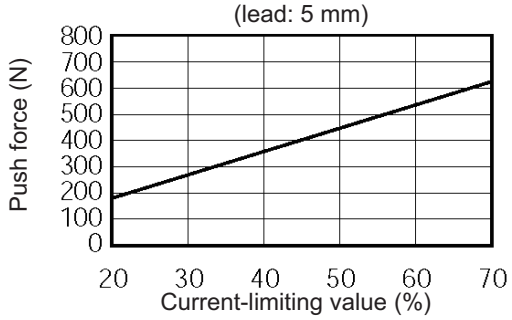




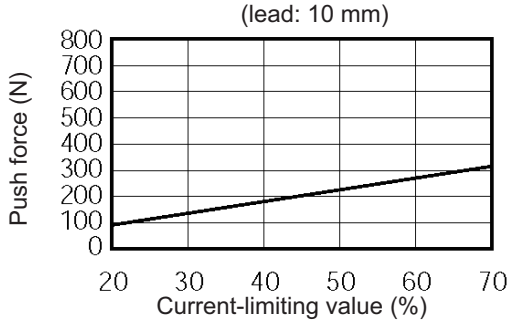
⚠ Caution: Accuracy of push force while the actuator is standing still is not guaranteed. The above figures should be used for reference purposes only.
Take note that if the push force is too small, the actuator may malfunction during push-motion operation due to slide resistance, etc.
The maximum current-limiting values are as shown in the graphs above. The minimum current-limiting values should be at least 20%.

(3) SS8C type

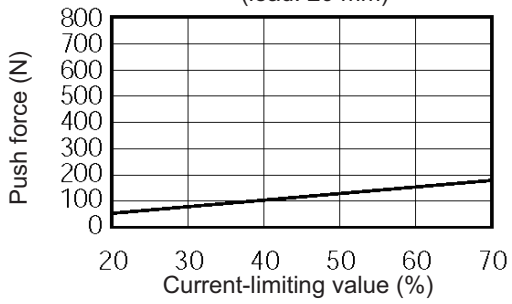
Low-speed type
(lead: 5 mm)



Medium-speed type
(lead: 10 mm)



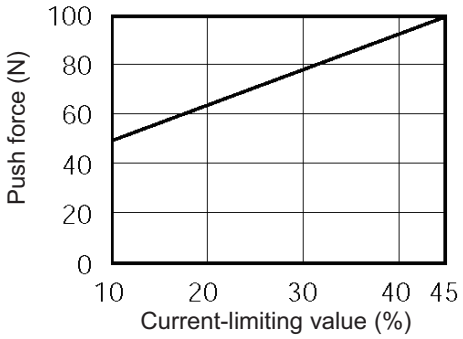
High-speed type
(lead: 20 mm)



⚠ Caution: Accuracy of push force while the actuator is standing still is not guaranteed. The above figures should be used for reference purposes only.
Take note that if the push force is too small, the actuator may malfunction during push-motion operation due to slide resistance, etc.
The maximum current-limiting values are as shown in the graphs above. The minimum current-limiting values should be at least 20%.

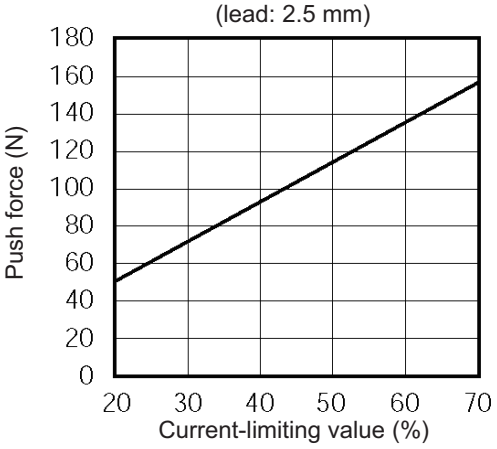
- Rod Type

(1) RA2C type

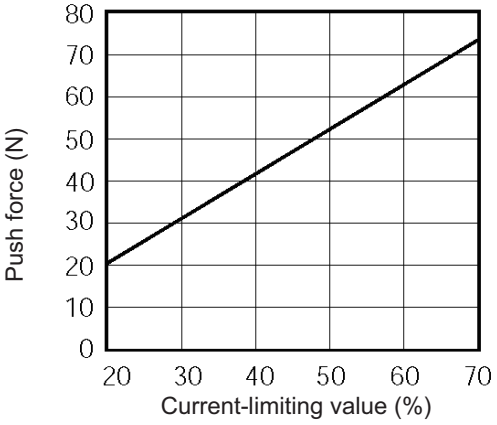


(2) RA3C type

Low-speed type
(lead: 2.5 mm)

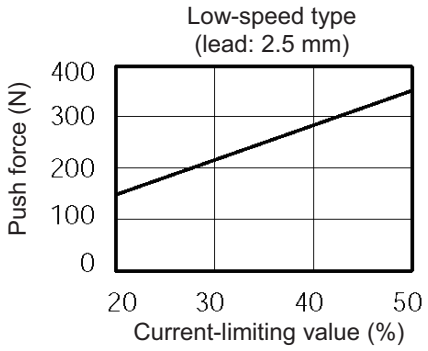


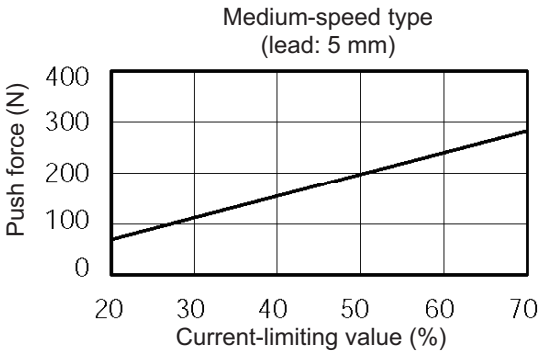
Medium-speed type
(lead: 5 mm)

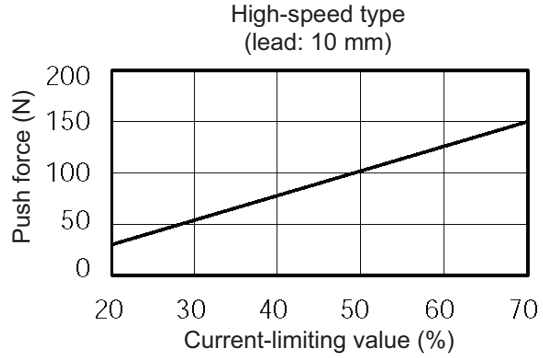


⚠ Caution:	Accuracy of push force while the actuator is standing still is not guaranteed. The above figures should be used for reference purposes only. Take note that if the push force is too small, the actuator may malfunction during push-motion operation due to slide resistance, etc. The maximum current-limiting values are as shown in the graphs above. The minimum current-limiting values should be at least 20%.

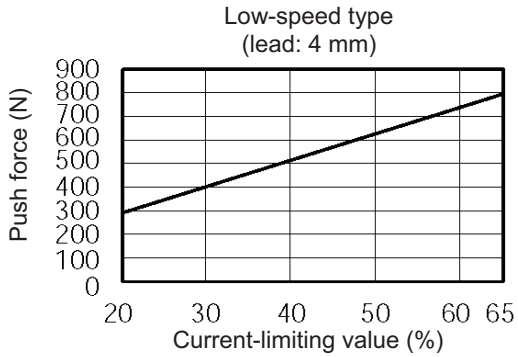
(3) RA4C type

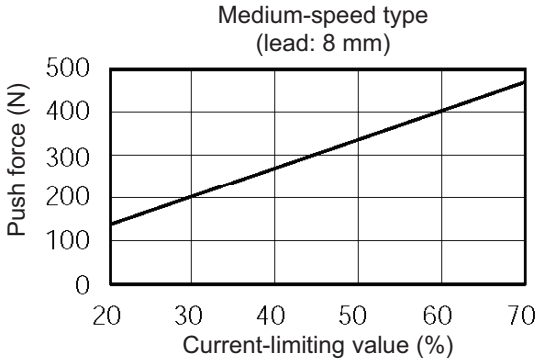


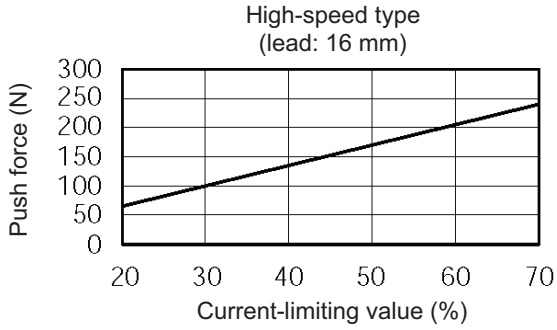




(4) RA6C type





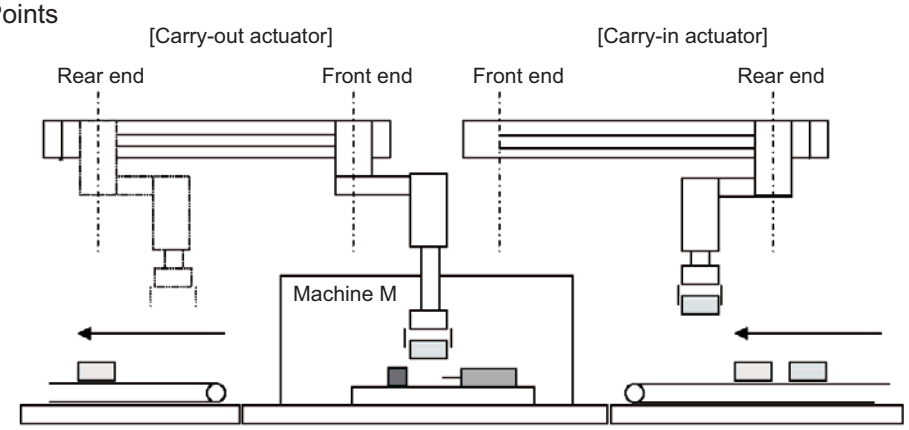


⚠ Caution:	Accuracy of push force while the actuator is standing still is not guaranteed. The above figures should be used for reference purposes only. Take note that if the push force is too small, the actuator may malfunction during push-motion operation due to slide resistance, etc. The maximum current-limiting values are as shown in the graphs above. The minimum current-limiting values should be at least 20%.

5.3.8 Examples of Tact Time Reduction Combining Zone Outputs and 3 Stop Points

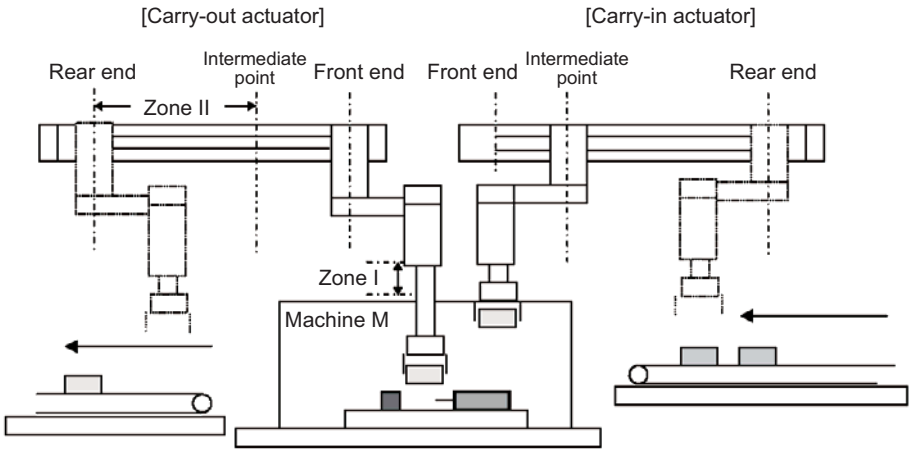
This section explains how the tact time is reduced differently between an application with two stop points only, and an application with three stop points where zone output signals are also used.

- 2 Stop Points



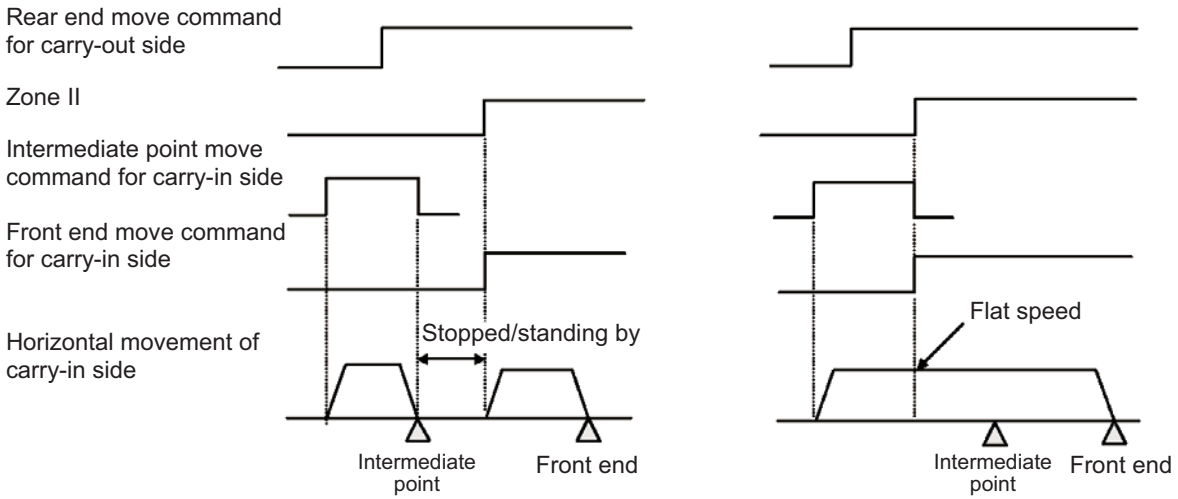
Assume that Machine M has completed processing. If there are two stop points, the vertical axis rises from the condition shown above, and thereafter the carry-in side cannot move toward the front end unless it is confirmed that the carry-out side is at the rear end.
Machine M stands by during the sequence of “Carry-out side drops → Carry-out side rises → Carry-out side moves backward → Carry-out side is confirmed to be at the rear end → Carry-in side moves forward → Carry-in side is confirmed to be at the front end → Carry-in side drops → Carry-in side rises.”
Because there are only two stop points, the up/down heights must also be aligned between the actuators.

- 3 Stop Points Combined with Zone Output Signals



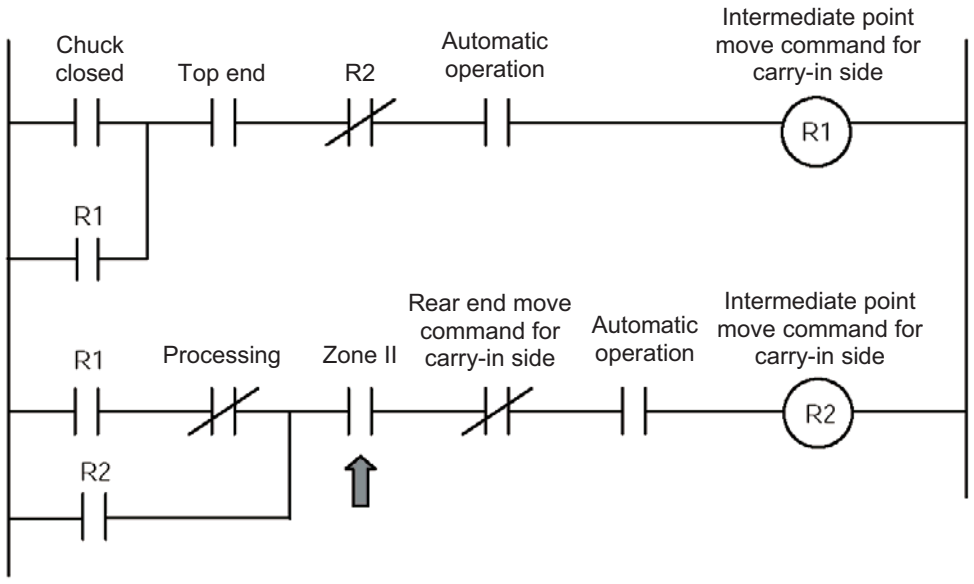
If there are three stop points, the carry-in side can move to the intermediate point regardless of the condition of the carry-out side. Also, a desired passing point can be set using a zone output signal. In the above example, when the Zone I signal turns ON while the carry-out side is rising, Machine M becomes operable and the carry-out side can move backward. When the Zone II signal turns ON, the carry-in side can move forward. As both actuators can move independently, the tact time can be reduced.
Because there are three stop points, there is no need to align the up/down heights between the actuators and a desired layout can be implemented.
Control is also simple. When the carry-out side is inside the contact range (the Zone II signal is OFF), the carry-in side is moved to the intermediate point if currently at the top end with the chucks closed. If the Zone II signal turns ON during the aforementioned movement, the command is switched to one that moves the carry-in side toward the front end. Since the carry-in side moves all the way to the front end, the tact time can be further reduced.

(Reference) Timing Charts and Example of Ladder Sequence Circuit



Machine M is processing.

The Zone II signal turns ON while moving to the intermediate point.



5.4 Power-saving Modes at Standby Positions

This controller possesses Automatic Servo-off and Full Servo functions to reduce the power consumption while the actuator is stopped. Read the description in this chapter carefully to save power so that the controller can be operated safely.
Automatic Servo-off function automatically turns the servo OFF in certain time after positioning process is finished. The next positioning command is issued to turn the servo ON automatically and achieve the positioning. No holding current flows in the stop state to allow the power consumption to be saved.
3 types of patterns can be set for the time since positioning complete until servo turned OFF, and either one can be selected.
In the Full Servo Function, it is able to reduce the power consumption by controlling the pulse motor which consumes comparatively high current during a stop.
For the power saving function, which of Parameter No.53 or “Stop Mode” in the position table is to be used is determined by the actuator condition. The details are shown below.

Status	Description
Standby with the servo turned ON after the power is supplied (Positioning to the target point is not done)	Power saving function executed with the values set in Parameter No.53 (Stop Mode of the position number is invalid)
Standby after the positioning is complete to the target position set in the position table	Power saving function executed with the values set in “Stop Mode” in each position number (Setting of Parameter No.53 is invalid)

⚠Warning: Do not use this function if the automatic servo OFF is followed by pitch feed (relative movement).
Servo ON/OFF may cause slight position shift to occur. If position shift occurs due to external force during servo OFF, positioning to the correct position is disabled. It is because pitch feed is operated based on the position at start used as the base point.

⚠Caution: Automatic Servo-off Function and Full Servo Function is not effective while in pressing operation. Do not use. It becomes effective at completion of positioning. In pressing, the function becomes effective only when miss-pressing occurs (the status at the completion of operation without pressing is the same as that at the completion of positioning).
No retaining torque is provided in automatic servo-off. The actuator can move with an external force. Pay attention to the interference to the peripherals and the safety in the installation.

⚠Caution: Full Servo Function is not effective while in jog operation and inching operation.

(1) Setting of periods taken until automatic servo OFF
Three periods from completion of positioning to automatic servo OFF can be set in the following parameters in seconds [sec].

Parameter No.	Description
36	Auto Servo Motor OFF Delay Time 1 (Unit: sec)
37	Auto Servo Motor OFF Delay Time 2 (Unit: sec)
38	Auto Servo Motor OFF Delay Time 3 (Unit: sec)

(2) Set of power-saving mode
Select a proper power-saving mode from the conditions below. Set the corresponding value in the stop mode or parameter No.53 of the position table.

Set Value	Operation after completion of positioning
0	Servo ON not changed
1	Automatic servo off in a certain time (set in Parameter No.36)
2	Automatic servo off in a certain time (set in Parameter No.37)
3	Automatic servo off in a certain time (set in Parameter No.38
4	Full Servo Control

(3) Status of positioning complete signal in selection of automatic servo OFF
Automatic servo OFF causes the actuator to be in other than the positioning complete state due to the servo OFF. Positioning complete signal (PEND) is turned OFF. Changing the PEND signal to the in-position signal judging whether the actuator is stopped within the positioning width zone instead of the positioning complete signal allows PEND not to be turned OFF during servo OFF.
This setting is reflected on complete position numbers PM1 to PM** in PIO patterns 0 to 3 confirming the positioning complete position No. or current position numbers PE* in PIO patterns 4.
Define the setting in Parameter No.39.

Value set in Parameter No.39	Content of PEND signal	Signal outputs during automatic servo OFF		
		PEND	PM1 to PM**	PE**
0	Positioning Completion Signal	OFF	OFF	OFF
1	In-position Signal	ON	ON	ON

(Note) The SV on the front panel blinks green during the automatic servo OFF.

[For Parameter No.39 = 0]

Operation of actuator	Positioning operation	Automatic servo OFF standby	Servo OFF	Positioning operation
Servo Condition	ON	ON	OFF	ON
Completed Position No. Output (Current position number output)	PM1 to ** =0 (PE** = OFF)	PM1 to ** = Output (PE** = ON)	PM1 to ** = 0 (PE** = OFF)	PM1 to ** = 0 (PE** = OFF)
Positioning Completion Signal PEND	OFF	ON	OFF	OFF

Servo OFF Delay Time (Parameter No.36 to 37)

[For Parameter No.39 = 1]

Operation of actuator	Positioning operation	Automatic servo OFF standby	Servo OFF	Positioning operation
Servo Condition	ON	ON	OFF	ON
Completed Position No. Output (Current position number output)	PM1 to ** = 0 (PE** = OFF)	PM1 to ** = Output (PE** = ON)	PM1 to ** = 0 Output (PE** = ON)	PM1 to ** = 0 (PE** = OFF)
Positioning Completion Signal PEND	OFF	ON	ON	OFF

Servo OFF Delay Time (Parameter No.36 to 37)

5.5 Using Rotary Actuators in Multi-rotation Specification

Rotary actuators of multi-rotation specification models can be set to operate in the multi-rotation mode or limited-rotation mode using a parameter.

5.5.1 How to Use

(1) Homing
When a homing command is issued, a signal of the limit switch located in the home direction is detected. Once a limit switch signal is detected, the actuator reverses its direction. Thereafter, the actuator moves until a limit switch signal is no longer detected, and then moves further by the distance specified in Parameter No. 22, “Home offset,” upon which the homing is completed.

(2) Operation commands

Limited-rotation specification (Normal mode [Selected by parameter No. 79])		Multi-rotation specification (Index mode [Selected by parameter No. 79])	
Push-motion operation permitted		Push-motion operation inhibited	
Absolute coordinate specification	- 0.15° to 360.15°	Absolute coordinate specification	0.00° to 359.99°
Relative coordinate specification	- 360.15° to 360.15°	Relative coordinate specification	- 360.00° to 360.00°

Note

Pay attention to the PIO pattern parameter for the following controllers.
Each controller does not support relative coordinate specification in the PIO pattern specified below:
[1] PCON-C/CG: PIO pattern = 5 (User parameter No. 25)
[2] PCON-CY: PIO pattern = 0 (User parameter No. 25)

- Rotational axes of simple absolute unit specification do not support the index mode. Accordingly, the multi-rotation specification cannot be selected for these axes.

Applicable Models

Actuators		Controllers	
	RCP2-RTBL-I-28P-20-360-*		PCON-C-28PI-*
	RCP2-RTBL-I-28P-30-360-*		PCON-CG-28PI-*
	RCP2-RTCL-I-28P-20-360-*		PCON-CY-28PI-*
	RCP2-RTCL-I-28P-30-360-*		PCON-SE-28PI-*

6. Parameter Settings

6.1 Parameter List

The parameters are classified into the following four types depending on their function:
Types:

a: Parameter relating to actuator stroke range
b: Parameter relating to actuator operating characteristics
c: Parameter relating to external interface
d: Servo gain adjustment

No.	Type	Symbol	Name	Unit	Factory default
1	a	ZONM	Zone limit 1 + side	mm	Effective length of the actuator
2	a	ZONL	Zone limit 1 – side	mm	Effective length of the actuator
3	a	LIMM	Soft limit + side	mm	Effective length of the actuator
4	a	LIML	Soft limit – side	mm	Effective length of the actuator
5	a	ORG	Home direction [0: Reverse / 1: Forward]	-	(As specified at the time of order)
6	b	PSWT	Push-motion completion judgment time	msec	255
7	d	PLG0	Servo gain number	-	Set individually in accordance with the actuator characteristics.
8	b	VCMD	Default speed	mm/sec	Set individually in accordance with the actuator characteristics.
9	b	ACMD	Default acceleration/deceleration	G	Set individually in accordance with the actuator characteristics.
10	b	INP	Default positioning band (in-position)	mm	0.10
12	b	SPOW	Current-limiting value at standstill after positioning	%	Set individually in accordance with the actuator characteristics.
13	b	ODPW	Current-limiting value during homing	%	Set individually in accordance with the actuator characteristics.
16	c	BRSL	SIO communication speed	bps	38400
17	c	RTIM	Minimum delay time for slave transmitter activation	msec	5
18	B	LS	Home sensor input polarity	-	Set individually in accordance with the actuator characteristics.
21	c	FPIO	Servo-on input disable selection [0: Enable / 1: Disable]	-	0 [Enable]
22	a	OFST	Home offset	mm	Set individually in accordance with the actuator characteristics.
23	a	ZNM2	Zone limit 2 + side	mm	Effective length of the actuator
24	a	ZNL2	Zone limit 2 – side	mm	Effective length of the actuator
25	c	IOPN	PIO pattern selection	-	0 [Proximity switch type]
28	b	PHSP1	Default direction of excited phase signal detection [0: Reverse / 1: Forward]	-	Set individually in accordance with the actuator characteristics.
29	b	PHSP2	Excited phase signal detection time	msec	Set individually in accordance with the actuator characteristics.
31	d	VLPG	Speed loop proportional gain	-	Set individually in accordance with the actuator characteristics.
32	d	VLPT	Speed loop integral gain	-	Set individually in accordance with the actuator characteristics.
33	d	TRQF	Torque filter time constant	-	Set individually in accordance with the actuator characteristics.
34	b	PSHV	Push speed	mm/sec	Set individually in accordance with the actuator characteristics.
35	b	SAFV	Safety speed	mm/sec	100
36	b	ASO1	Automatic servo-off delay time 1	sec	0
37	b	ASO2	Automatic servo-off delay time 2	sec	0
38	b	ASO3	Automatic servo-off delay time 3	sec	0
39	c	FPIO	Positioning complete signal output mode [0: PEND / 1: INP]	-	0 [PEND]
42	b	FPIO	Enable function [0: Enable / 1: Disable]	-	1 [Disable]
43	b	AIOF	Home check sensor input polarity	-	(As specified at the time of order)
45	c	SIVM	Silent interval multiplication factor	times	0 [Multiplication factor disabled]
46	b	OVRD	Speed override	%	100
53	b	CTLF	Default standstill mode	-	0 [Complete stop]
77	b	LEAD	Ball screw lead	-	Set individually in accordance with the actuator characteristics.
78	b	ATYP	Axis operation type	-	Set individually in accordance with the actuator characteristics.
79	b	ATYP	Rotational axis mode selection	-	Set individually in accordance with the actuator characteristics.
80	b	ATYP	Shortcut selection for rotational axis	-	Set individually in accordance with the actuator characteristics.
83	b	ETYP	Absolute unit [0: Do not use / 1: Use]	-	Set individually in accordance with the actuator characteristics.

(Note) The parameter numbers are shown in the PC software, but not on the teaching pendant.
Missing numbers are not used and therefore skipped.
The classification symbols are provided for the sake of convenience and are not shown either in the PC software or on the teaching pendant.

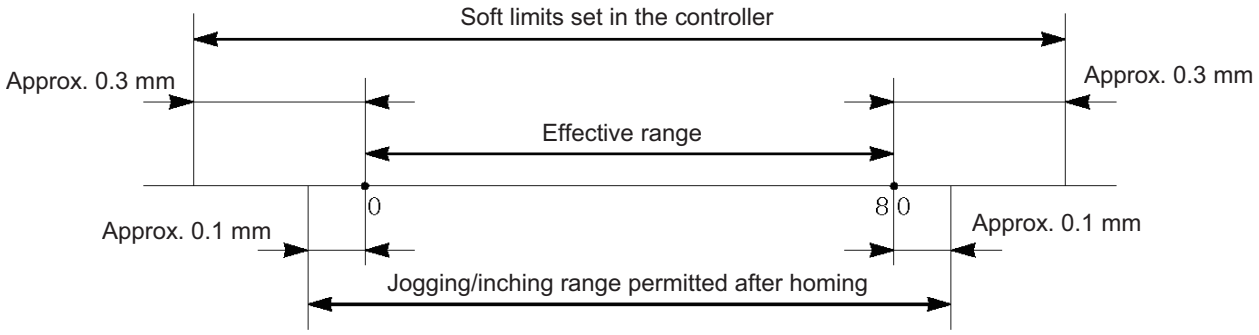
6.2 Detail Explanation of Parameters

If you have changed any parameter, be sure to restart the controller via a software reset or reconnect the controller power.

6.2.1 Parameters Relating to Actuator Stroke Range

- Soft Limits (No.3/4 LIMM/LIML)

Set the + soft limit in parameter No. 3 and – soft limit in parameter No. 4.
Both parameters have been set to the effective actuator length at the factory. Change the parameter settings if necessary, such as when an obstacle is present and collision between the actuator and obstacle must be prevented or when the actuator must be operated beyond the effective length.
Exercise due caution when setting these parameters, as wrong settings will cause collision with the mechanical end.
The minimum setting unit is 0.01 mm.
(Note) To change these parameters, set values corresponding to positions that are 0.3 mm wider than the desired effective range.
Example) Set the effective range to between 0 and 80 mm
Parameter No. 3 (+ side): 80.3
Parameter No. 4 (– side): -0.3



- Home Direction (No.5 ORG)

If not specified by the user, the home direction is set to the motor side before shipment.
If you must change the home direction after the actuator has been assembled to your equipment, change the setting of parameter No. 5.
Also change the parameters for home offset, soft limits and default direction of excited phase signal detection, if necessary.

⚠ Caution: Rod-type actuators do not permit reversing of the home direction.

- Home Offset (No.22 OFST)

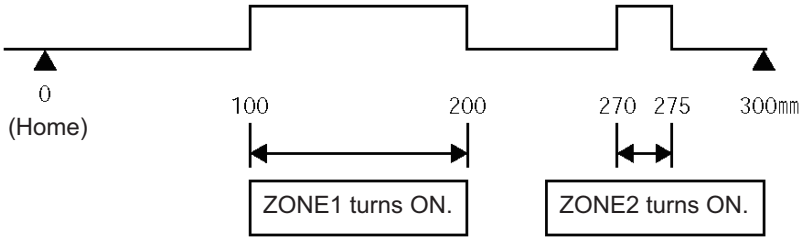
Parameter No. 22 has been set to an optimal value at the factory so that the distance from the mechanical end to home will remain constant.
The minimum setting unit is 0.01 mm.
This parameter can be adjusted in the following conditions:
[1] Align the actuator's home with the mechanical home on the equipment after the actuator has been assembled to the equipment.
[2] Set the home position again after reversing the factory-set home direction.
[3] Correct the minor position deviation that has generated after the actuator was replaced.

⚠ Caution: If you have changed the home offset, the soft limit parameters must also be reviewed.

- Zone Limits (1: No. 1/2 ZONM/ZONL 2: No. 23/24 ZNM2/ZNL2)

This parameter is not used with this controller. It applies to controllers of general-purpose and serial communication types.
If this parameter is to be used, set the range within which the zone output signal (ZONE1 or ZONE2) will turn ON.
The zone output signal turns ON when the current coordinate is between the (-) setting and (+) setting.
For the ZONE1 signal, set the positive-side coordinate in Parameter No. 1 and negative-side coordinate in Parameter No. 2.
For the ZONE2 signal, set the positive-side coordinate in Parameter No. 23 and negative-side coordinate in Parameter No. 24.
The minimum setting unit is 0.01 mm.

Example) On an actuator with a 300-mm stroke, ZONE1 is used as an intermediate point LS in a range of 100 to 200 mm, while ZONE2 is used as a simple yardstick in a range of 270 to 275 mm.
Parameter No. 1 (+ side): 200 Parameter No. 2 (– side): 100
Parameter No. 23 (+ side): 275 Parameter No. 24 (– side): 270



6.2.2 Parameters Relating to Actuator Operating Characteristics

- Default Speed (No.8 VCMD)

The factory setting is the rated speed of the actuator.
This value is recognized as speed data corresponding to each position number when a target position is entered for that position in the position table where speed is not yet entered.
To decrease the default speed from the rated speed, change the value set in Parameter No. 8.

- Default Acceleration/Deceleration (No.9 ACMD)

The factory setting is the rated acceleration/deceleration of the actuator.
This value is recognized as acceleration/deceleration data corresponding to each position number when a target position is entered for that position in the position table where acceleration/deceleration is not yet entered.
To decrease the default acceleration/deceleration from the rated acceleration/deceleration, change the value set in Parameter No. 9.

- Default Positioning Band (In-position) (No.10 INP)

The factory setting is “0.10” mm.
This value is recognized as positioning band data corresponding to each position number when a target position is entered for that position in the position table where positioning band is not yet entered.
Increasing this parameter value causes the positioning complete signal to output more quickly. If necessary, change the value set in Parameter No. 10.

> ⚠ Caution: For the positioning band, set the value greater than that of the encoder resolution.
> Setting it smaller may cause a servo error.

- Current-limiting Value during Homing (No.13 ODPW)

Before shipment, this parameter is set to a current level appropriate for the standard specification of the actuator.
Increasing this parameter value increases the homing torque.
This parameter need not be changed in normal conditions of use. However, if the actuator is used in vertical orientation and the slide resistance increases due to the affixing method, load condition, etc., homing may complete before the correct position. In this case, the value set in Parameter No. 13 must be increased.
(As a guide, the setting should not exceed 100% for the RXA type or 75% for all other types.)

- Current-limiting Value at Standstill after Positioning (No.12 SPOW)

Before shipment, this parameter is set to a current level appropriate for the standard specification of the actuator.
Increasing this parameter value increases the holding torque.
This parameter need not be changed in normal conditions of use. If the actuator receives large external force while standing still, however, hunting will occur. In this case, the value set in Parameter No. 12 must be increased.
(As a guide, the setting should not exceed 100% for the RA3C/RGD3C type or 75% for all other types.)

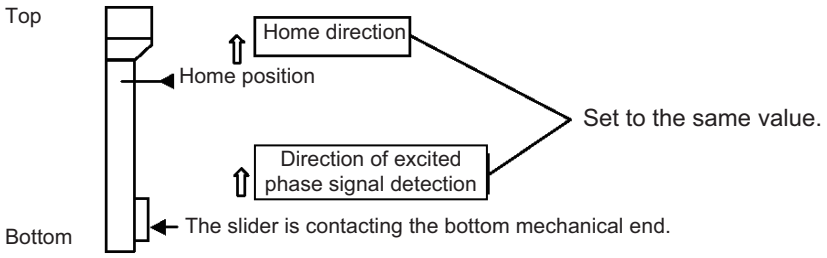
- Speed Override (No.46 OVRD)

Use this parameter if you want to move the actuator at a slow speed to prevent danger during test operation.
When issuing move commands from the PLC, the movement speed set in the “Speed” field of the position table can be overridden based on the value set in Parameter No. 46.
Actual movement speed = [Speed set in the position table] x [Value of Parameter No. 46] ÷ 100
Example) Value in the “Speed” field of the position table 500 (mm/s)
Value of Parameter No. 46 20 (%)
Under the above settings, the actual movement speed becomes 100 mm/s.
The minimum setting unit is 1 (%), and the input range is 1 to 100 (%). The factory setting is “100” (%).
(Note) This function is not effective on move commands issued from the PC or teaching pendant.

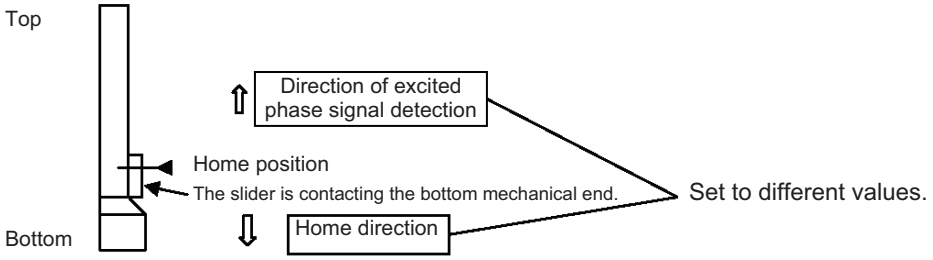
- Default Direction of Excited Phase Signal Detection (No.28 PHSP)

The excited phase is detected when the servo is turned on for the first time after turning on the power. This parameter defines the direction of this detection.
This parameter need not be changed in normal conditions of use. However, if the actuator is contacting a mechanical end or any obstacle when the power is turned on and cannot be moved by hand, change the direction of detection to one in which the motor can be driven easily.
To do this, set the value of Parameter No. 28 to either “0” or “1.” If the direction of detection is to be the same as the home direction, specify the same value currently set in Parameter No. 5, “Home direction.”
To set the direction opposite to the home direction, specify the value different from the one currently set in Parameter No. 5, “Home direction.”

(Example 1) The power is turned on when the slider is contacting the bottom mechanical end in a configuration where the motor is positioned at the top.



(Example 2) The power is turned on when the slider is contacting the bottom mechanical end in a configuration where the motor is positioned at the bottom.



- Excited Phase Signal Detection Time (No.29 PHSP)

The excited phase is detected when the servo is turned on for the first time after turning on the power. This parameter defines the time of this detection.
Before shipment, this parameter is set to a detection time appropriate for the standard specification of the actuator, and thus the setting need not be changed in normal conditions of use.
Should an excitation detection error or abnormal operation occur when the servo is turned on for the first time after turning on the power, you can try changing the detection time set in Parameter No. 29 as a possible countermeasure.
Before changing this parameter, contact IAI.

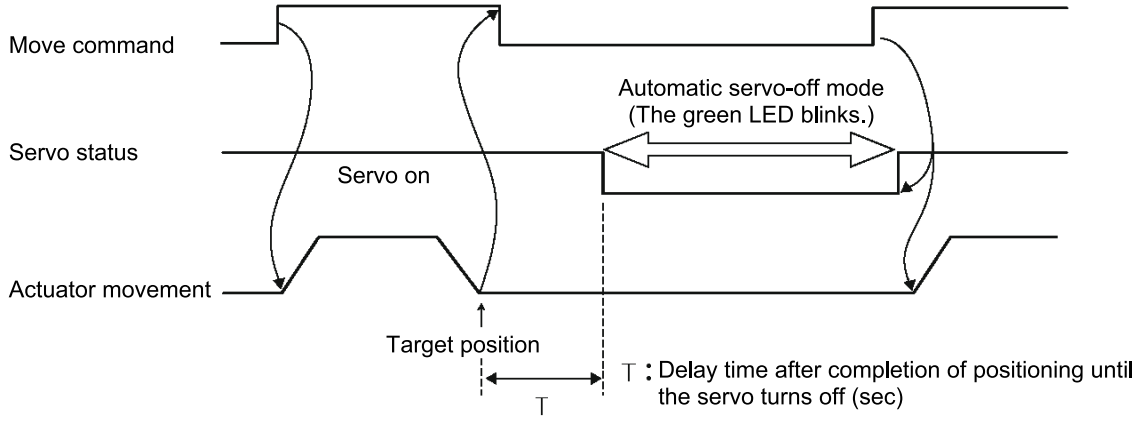
- Safety Speed (No.35 SAFV)

This parameter defines the feed speed during manual operation.
The factory setting is “100” [mm/sec].
To change the speed, set an optimal value in Parameter No. 35.
Since the maximum speed is limited to 250 mm/sec, set the safety speed to below this level.

- Automatic Servo-off Delay Time (No.36 ASO1/ No.37 ASO2/ No.38 ASO3)

This parameter defines the delay time after positioning is completed until the servo turns off automatically when the “Standstill mode” field in the position table is set to any value from “1” to “3” (the automatic servo-off mode is enabled) or the setting of Parameter No. 53 (Default standstill mode) is set to any value from “1” to “3” (the automatic servo-off mode is enabled).
Meaning of set value: If this parameter is set to “1,” T takes the value of Parameter No. 36.
If this parameter is set to “2,” T takes the value of Parameter No. 37.
If this parameter is set to “3,” T takes the value of Parameter No. 38.

The factory setting is “0” [sec].

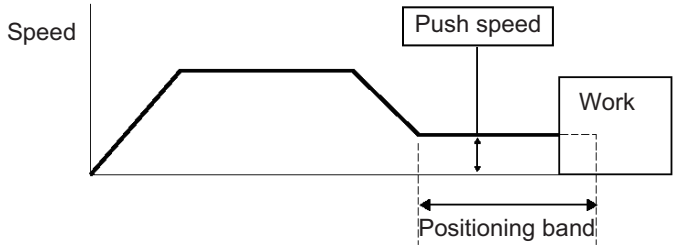


- Default Standstill Mode (No.53 CTLF)

This parameter defines the power-saving modes.
For details,refer to 5.4,"Power-saving Modes at Standby Positions."

- Push Speed (No.34 PSHV)

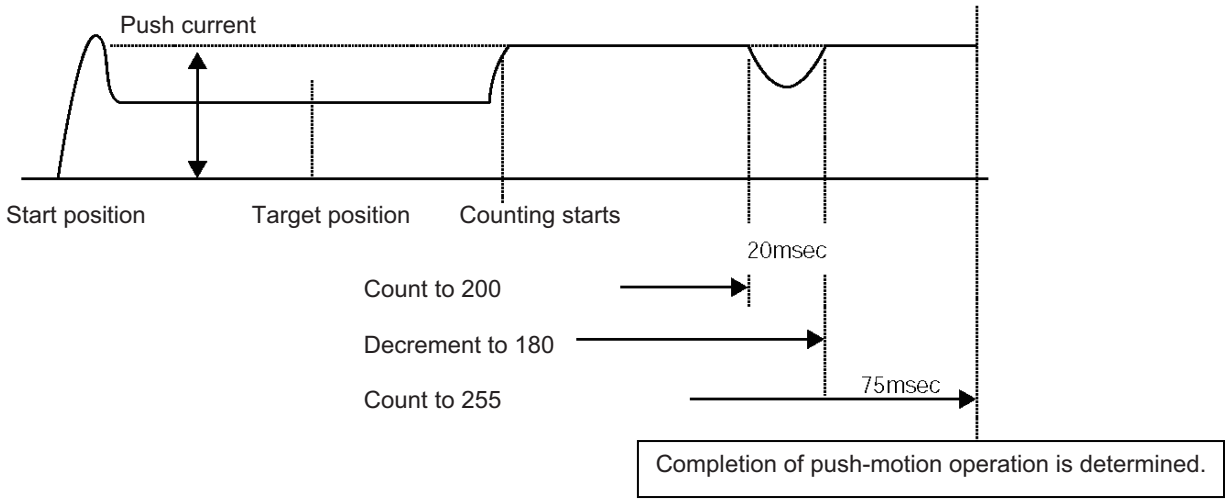
This parameter defines the push speed that applies after the target position has been reached in push-motion operation.
Before shipment, a default speed appropriate for the actuator characteristics is set.
Depending on the material and shape of the work, etc., set an appropriate speed in Parameter No. 34.
Note that, while the maximum speed varies according to the actuator, it should not exceed 20 mm/sec even with the high-speed type. Set a push speed below the maximum speed.



⚠ Caution: It is recommended that the push speed be set to 5 mm/sec or above to reduce the effect of varying push force.

- Push-motion Completion Judgment Time (No.6 PSWT)

This parameter is used as a condition for determining if the work is contacted and push-motion operation is completed.
Specifically, push-motion operation is deemed complete if the current-limiting value set in the position table has been maintained for the time set in Parameter No. 6.
Depending on the material and shape of the work, etc., set an optimal value in combination with the current-limiting value.
The minimum setting unit is 1 msec, and the maximum value is 9,999 msec. The factory setting is “255” [msec].
(Note) The following shows a case in which the work has shifted and current has changed during push-motion completion judgment. In this example, the judgment time is set to 255 msec.



If the push current is maintained for 200 msec and then drops for 20 msec thereafter, the counter is decremented by 20. Upon recovery of the push current, counting resumes from 180. If the push current is maintained for 75 msec, the counter will have counted up to 255 and thus completion of push-motion operation is determined.
In this case, the judgment requires a total of 295 msec.

- Enable Function (No.42 FPIO)

Whether to enable or disable the deadman switch function on the ANSI-type teaching pendant is set in Parameter No. 42.
* The ANSI-type teaching pendant is currently under development.

	Setting
Enable (Use)	0
Disable (Do not use)	1

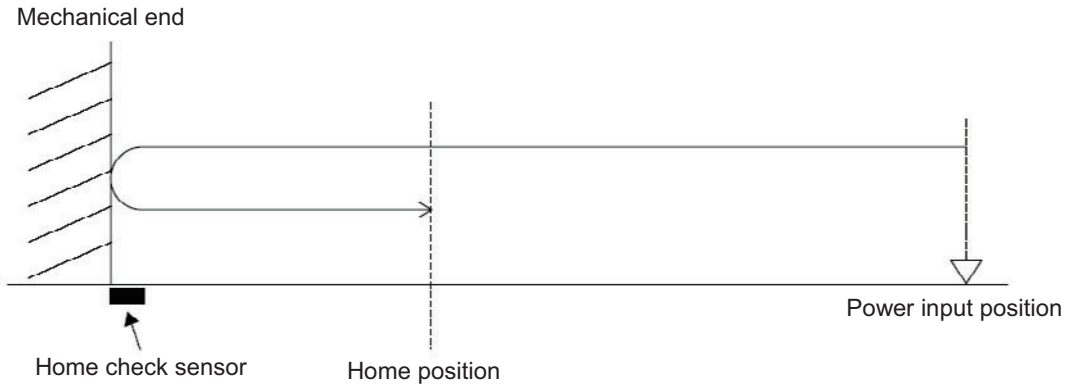
The factory setting is “1” [Disable].

- Home Check Sensor Input Polarity (No.43 AIOF)

The home check sensor is not included in the standard specification, but it can be installed as an option.
This parameter need not be changed in normal conditions of use. To change the factory-set mode, change the value of Parameter No. 43.

Definition of settings: 0 (Standard specification; no sensor)
1 (Use the home check sensor, and the sensor polarity conforms to “contact a” logic)
2 (Use the home check sensor, and the sensor polarity conforms to “contact b” logic)

[Explanation of operation]
[1] When a homing command is issued, the actuator moves until it contacts a mechanical end, upon which a home check sensor signal is detected.
[2] Next, the actuator reverses its direction and stops at the home position.
[3] If the home check sensor signal has changed its signal state, the controller determines that the homing was completed successfully. If the signal state has not changed, the controller recognizes “position deviation.” Accordingly, the controller generates a “home sensor non-detection error” and outputs an alarm signal.



- Home Sensor Input Polarity (No. 18, LS)

  This parameter is supported by the rotational axes of RCP2-RTB/RTC types adopting the home sensor method.
  Definition of settings: 0 (Sensor not used)
  1 (Sensor polarity of contact a)
  2 (Sensor polarity of contact b)

- Ball Screw Lead (No. 77, LEAD)

  This parameter defines the ball screw lead.
  Before shipment, a default value appropriate for the actuator characteristics is set.

- Axis Operation Type (No. 78, ATYP)

  This parameter defines the type of the actuator used.
  Definition of settings: 0 (Linear axis)
  1 (Rotational axis)

- Rotational Axis Mode Selection (No. 79, ATYP)

  If the axis operation type (No. 78) is set to “Rotational axis,” selecting the index mode fixes the current value to within a range of 0 to 359.99. If the index mode is selected, short-cut control is enabled.
  Definition of settings: 0 (Normal mode)
  1 (Index mode)

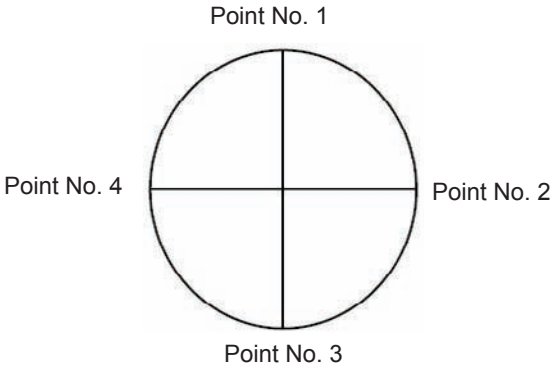
⚠ Note: Push-motion operation cannot be performed in the index mode. Even if data is set in the “Push” field of the position data, in the index mode the data becomes invalid and the actuator moves as normal. Also in the index mode, the positioning band corresponds to the default positioning band set by a parameter.

- Shortcut Selection for Rotational Axis (No. 80, ATYP)

  This parameter is set in certain conditions, such as when you want to turn a rotational axis in a specific direction.
  Shortcut refers to operating an actuator in such a way that it always moves to a point that is closest to the next point.

	Setting
Do not select	0
Select	1

You can cause the actuator to rotate in a specific direction by selecting the shortcut mode.



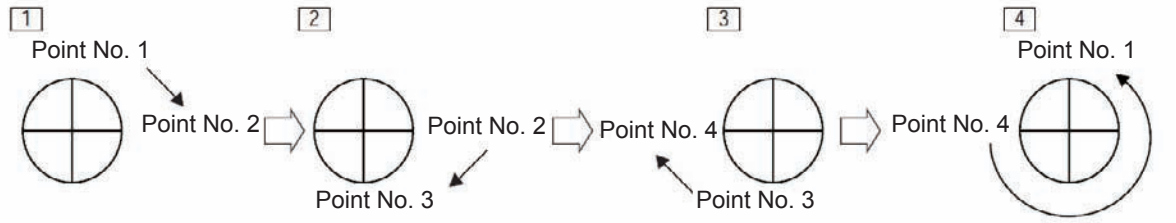
Positions

Point No.	Setting
1	0
2	90
3	180
4	270

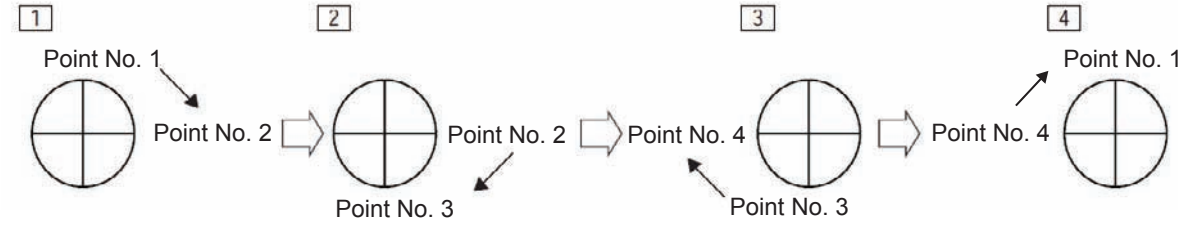
As for position data, 1° corresponds to 1 mm.

If the actuator is to be moved in the sequence of 1 → 2 → 3 → 4, the specific operation will vary depending on whether or not the shortcut mode is selected, as shown below.

Shortcut mode is not selected



Shortcut mode is selected



- Absolute Unit (No. 83, ETYP)

  Parameter No. 83 sets whether or not to use the optional simple absolute unit.

	Setting
Do not use	0
Use	1

6.2.3 Parameters Relating to External Interface

- PIO Pattern Selection (No.25 IOPN)

Parameter No. 25 is used to select a desired PIO operation pattern.
This is a basic operation parameter, so be sure to set it at the beginning.

Setting of Parameter No. 25	Features of PIO pattern
0	Proximity switch type Each movement complete signal is handled in the same manner as an auto switch of an air cylinder. A movement complete signal is output as the actuator passes the applicable position, even when positioning is not performed. A ready output signal is provided, but no zone output signal is available.
1	Standard type A movement complete signal is output upon completion of positioning following a move command. A zone output signal is provided, but no ready output signal is available.

The factory setting is “0” [Proximity switch type].

- Positioning Complete Signal Output Mode (No.39FPIO)

This parameter defines the positioning complete signal state to be applied when the servo turns off or “position deviation” occurs while the actuator is standing still after completion of positioning in the standard type.
The following two scenarios can be considered:
[1] The actuator position has deviated beyond the value set in the “Positioning band” field of the position table, due to external force applied while the servo was on.
[2] The actuator position has deviated beyond the value set in the “Positioning band” field of the position table, due to external force applied while the servo was off.
This parameter provides flexibility as to how the “positioning complete signal state” is monitored in accordance with the characteristics of the applicable system or sequence circuit of the PLC.
The table below shows how the ON/OFF state of a positioning complete signal changes in accordance with each setting of Parameter No. 39.

Setting of Parameter No. 39	Definition of rear end complete (PE0), front end complete (PE1), and intermediate point complete (PE2) signal state
0 [PEND]	[1] When the servo is on The signal remains ON even when the current position has deviated from the range corresponding to the value set for the target position in the “Positioning band” field of the position table. [2] When the servo is off The signal turns OFF unconditionally regardless of the current position.
1 [INP]	Regardless of the servo on/off status, the signal turns ON if the current position is inside the corresponding to the value set for the target position in the “Positioning band” field of the position table, and turns OFF if it the current position is outside the range. * The signal effectively functions in the same manner as an auto switch of an air cylinder.

The factory setting is “0” [PEND].

- Servo-on Input Disable Selection (No.21 FPIO)

Parameter No. 21 is used to set whether enable or disable the servo-on input signal.

	Setting
Enable (Use)	0
Disable (Do not use)	1

The factory setting is “0” [Enable].

- SIO Communication Speed (No.16 BRSL)

This parameter is not used with this controller. It applies to controllers of serial communication type.
If this parameter is set, it sets the communication speed to be used when the controller implements serial communication control via the PLC’s communication module.
Set Parameter No. 16 to a value appropriate for the specification of the communication module.
9600, 19200, 38400 or 115200 bps can be selected as the communication speed.
The factory setting is “38400” bps.

- Minimum Delay Time for Slave Transmitter Activation (No.17 RTIM)

This parameter is not used with this controller. It applies to controllers of serial communication type.
If this parameter is set, it defines the minimum delay before the controller’s transmitter is activated following the completion of command reception, when the controller implements serial communication control via the PLC’s communication module.
The factory setting is “5” msec. If the communication module specification exceeds 5 msec, set the required time in Parameter No. 17.

- Silent Interval Multiplication Factor (No.45 SIVM)

This parameter is not used with this controller. It applies to RS485 serial communication commands.
If this parameter is set, it defines the multiplication factor of silent interval time to be used for delimiter judgment in the RTU mode.
The factory setting is the communication time corresponding to 3.5 characters in accordance with the Modbus specification.
This parameter need not be changed in normal conditions of use where the actuator is operated using a PC or teaching pendant.
If the character sending interval exceeds the silent interval because the scan time of the PLC is not ideal, however, you can extend the silent interval time through Parameter No. 45.
The minimum setting unit is 1 (times), and the input range is 0 to 10. If “0” is set, it means that the silent interval multiplication factor is disabled.

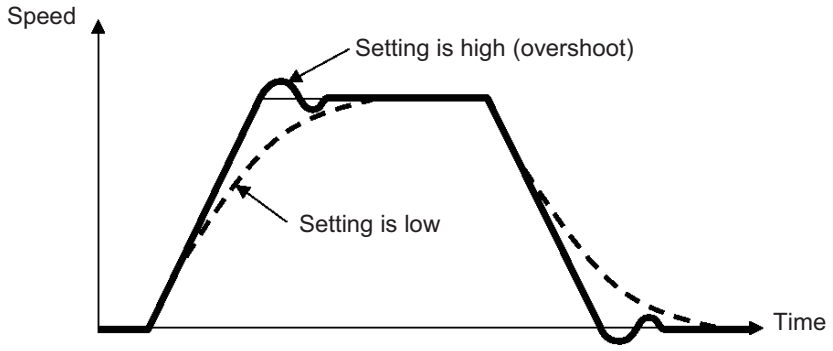
6.2.4 Servo Gain Adjustment

Since the servo has been adjusted at the factory in accordance with the standard specification of the actuator, the servo gain need not be changed in normal conditions of use.
However, vibration or noise may occur depending on how the actuator is affixed, specific load condition, and so on, and therefore the parameters relating to servo adjustment are disclosed to allow the customer to take quick actions should adjustment become necessary.
Particularly with custom models (whose ball screw lead or stroke is longer than the that of the standard model), vibration/noise may occur due to external conditions.
In this case, the parameters shown below must be changed. Contact IAI for details.

- Servo Gain Number (No.7 PLG0)

Parameter number	Unit	Input range	Default
7	5 rad/sec	0 ~ 31	6

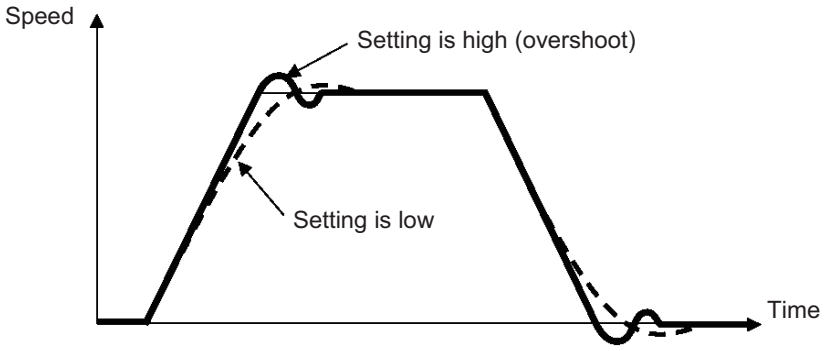
This parameter determines the level of response with respect to a position control loop.
Increasing the setting improves compliance with the position command.
However, increasing the setting too much increases the tendency of the actuator to overshoot.
If the setting is low, compliance with the position command drops and the positioning time increases as a result.



- Speed Loop Proportional Gain (No.31 VLPG)

Parameter number	Unit	Input range	Default
31	---	1 ~ 27661	Set individually in accordance with the actuator characteristics.

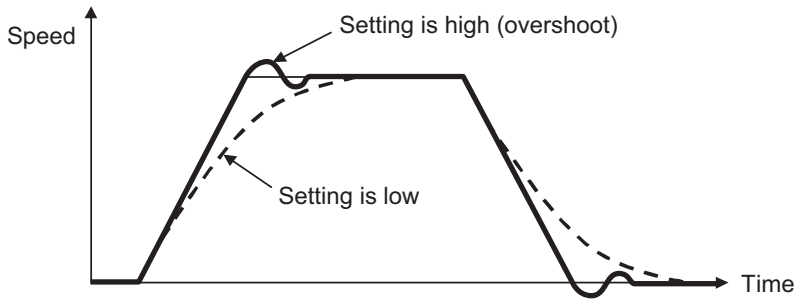
This parameter determines the level of response with respect to a speed control loop.
Increasing the setting improves compliance with the speed command (i.e., servo rigidity increases).
The greater the load inertia, the higher the setting should be.
However, increasing the setting too much increases the tendency of the actuator to overshoot or oscillate, resulting in increased mechanical vibration.



- Speed Loop Integral Gain (No.32 VLPT)

Parameter number	Unit	Input range	Default
32	---	1 ~ 217270	Set individually in accordance with the actuator characteristics.

This parameter determines the level of response with respect to a speed control loop.
Decreasing the setting results in lower response to the speed command and decreases the reactive force upon load change. If the setting is too low, compliance with the position command drops and the positioning time increases as a result.
Increasing the setting too much increases the tendency of the actuator to overshoot or oscillate, resulting in increased mechanical vibration.



- Torque Filter Time Constant (No.33 TRQF)

Parameter number	Unit	Input range	Default
33	---	1 ~ 2500	Set individually in accordance with the actuator characteristics.

This parameter determines the filter time constant applicable to the torque command.
If the mechanical resonance frequency is equal to or lower than the servo loop response frequency, the motor will vibrate. This mechanical resonance can be suppressed by increasing the setting of this parameter.
It should be noted, however, that increasing the setting too much may affect the stability of the control system.

7. Troubleshooting

7.1 What to Do When A Problem Occurs

If you encountered a problem, follow the steps below to conduct the specified checks to gather information needed to implement quick recovery and prevent recurrence of the problem.

a. Check the status indicator lamps
   SV (green) --- The servo is on.
   ALM (red) --- An alarm is present or emergency stop has been actuated, or the motor drive power is cut off.
b. Check the host controller for abnormality.
c. Check the voltage of the 24-VDC main power supply.
d. Check the voltage of the 24-VDC power supply for I/O signals.
e. Check for alarms.
   Check the details of each alarm on the PC or teaching pendant.
f. Check the cables for miswiring, disconnection and pinching.
   Before checking the continuity of cables, turn off the power (to prevent a runaway actuator) and disconnect all wirings (to prevent the power from being supplied unexpectedly due to a sneak path).
g. Check the I/O signals.
h. Check the noise elimination measure (ground connection, surge killer installation, etc.).
i. Identify how the problem occurred and the operating condition when the problem occurred.
j. Check the serial numbers of the controller and actuator.
k. Analyze the cause.
l. Take an action.

Before contacting IAI, please check the items in a through j above. Provide the information to our technical staff.

(Reference) Changes in indicators and *ALM output signal in each status

	Servo off	Servo on	Emergency stop actuated	Motor drive power cut off
SV (lamp)	Unlit	Lit	Unlit	Unlit
ALM (lamp)	Unlit	Unlit	Lit	Lit
*ALM (signal)	OFF	OFF	ON	ON

(Note 2) The *ALM output signal is a contact-b signal.
After the power is input, these signals remain ON while the controller is normal. They turn OFF when the power is cut off.
These signals cannot be used for providing a contact-b interlock when the power is not supplied to the controller.

7.2 Alarm Level Classification

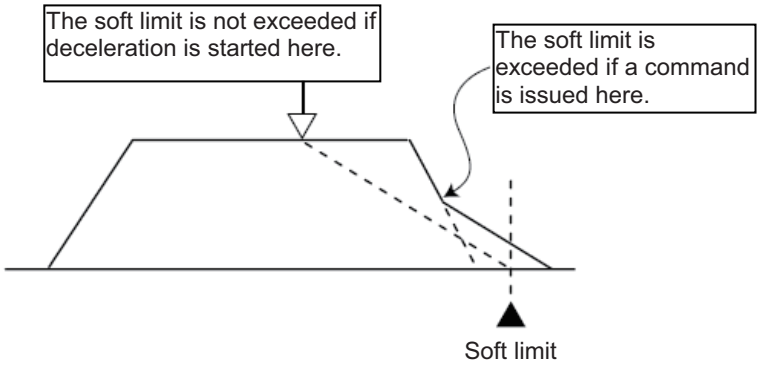
The alarms are classified into three levels based on the corresponding symptoms.

Alarm level	ALM lamp	*ALM signal	Condition at occurrence of alarm	How to reset
Operation cancellation	Lit	Output	The actuator decelerates to a stop, and then the servo turns off.	Execute reset using the PC/teaching pendant.
Cold start	Lit	Output	The actuator decelerates to a stop, and then the servo turns off.	Reconnect the power.

Note: Whatever the alarm, always investigate the cause of the alarm and remove the cause before resetting the alarm. If the cause of the alarm cannot be removed, or when the alarm cannot be reset even after the cause has been removed, please contact IAI.
If the same error occurs again after a reset, the cause of the alarm still exists.

7.3 Alarms, Causes and Actions

(1) Operation Cancellation Alarms

Code	Error	Cause/action
0A1	Parameter data error	Cause: The parameter data does not meet the specified input range. (Example) This alarm generates when a pair of values clearly has an inappropriate magnitude relationship, such as when the soft limit + setting is 200.3 mm, while the soft limit – setting is 300 mm. Action: Change the settings to appropriate values.
0A2	Position data error	Cause: [1] A move command was input when a target position was not yet set in the "Position" field. [2] The target position in the "Position" field is outside the soft limit range. [3] A target position was specified as a relative coordinate in the "Position" field when the proximity switch type was selected. Action: [1] Set a target position first. [2] Change the target position to a value inside the soft limit range. [3] Specify the target position as an absolute coordinate.
0A7	Command deceleration error	If the target position is near a soft limit and the deceleration setting is low, issuing a command that specifies this position number while the actuator is moving may cause the actuator to overshoot beyond the soft limit.  Cause: When the speed was changed while the actuator was moving, the next move command was not issued quick enough. Action: Quicken the switching timing so that the actuator will not overshoot beyond the soft limit.
0BA	Home sensor not yet detected	This alarm indicates that the actuator equipped with a home check sensor did not complete homing successfully. Cause: [1] The work contacted peripheral equipment during the homing. [2] The slide resistance of the actuator is large in some areas. [3] The home check sensor is not installed properly, or the sensor is faulty or its circuit is open. Action: If the work is not contacting any peripheral equipment, [2] and [3] are suspected. Contact IAI.
0BE	Homing timeout	Cause: After the start of homing, homing does not complete after elapse of the time set by the manufacturer's parameter. (This alarm does not generate during normal operation.) Action: As one possible cause, the controller and actuator combination may be incorrect. Contact IAI.

Code	Error	Cause/action
0C0	Excessive actual speed	Cause: The motor speed exceeds the maximum speed set by the manufacturer's parameter. This alarm does not generate during normal operation, but it may occur if the load decreased before a servo error was detected and the motor speed has increased as a result. This condition occurs due to the following reasons: [1] The slide resistance of the actuator is large in some areas. [2] The load increased due to momentary application of external force. Action: Check the assembly condition of mechanical parts for any abnormality. If the actuator itself is suspected as the cause, contact IAI.
0C1	Servo error	This alarm indicates that after the acceptance of the move command, the motor could not operate for 2 seconds or more before the actuator reached the target position. Cause: [1] The connector of the motor relay cable is loose or its circuit is open. [2] If the actuator is equipped with a brake, the brake cannot be released. [3] The load increased due to application of external force. [4] The sliding resistance of the actuator itself is high. [5] The positioning band setting is smaller than the encoder resolution. Action: [1] Check the wiring condition of the motor relay cable. [2] Check the wiring condition of the brake cable, and also turn on/off the brake release switch to check if "click" sound is heard. [3] Check the assembly condition of mechanical parts for any abnormality. [4] If the load is normal, cut off the power and move the actuator by hand to check the slide resistance. If the actuator itself is suspected as the cause, contact IAI. [5] Set the positioning band value greater than that of the encoder resolution.
0C9	Excessive motor power-supply voltage	This alarm indicates that the voltage of the motor power supply is excessive (24 V + 20%: 28.8 V or above). Cause: [1] The voltage of the 24-V input power supply is high. [2] Faulty part in the controller Action: Check the input power-supply voltage. If the voltage is normal, contact IAI.
0CA	Overheat	This alarm indicates that the temperature around the power transistor in the controller is excessive (95°C or above). Cause: [1] High surrounding temperature [2] Defective part in the controller Action: [1] Lower the temperature around the controller. If the condition in [1] is not applicable, contact IAI.
0CC	Excessive control power-supply voltage	This alarm indicates that the voltage of the 24-V input power supply is excessive (24 V + 20%: 28.8 V or above). Cause: [1] The voltage of the 24-V input power supply is high. [2] Faulty part in the controller Action: Check the input power-supply voltage. If the voltage is normal, contact IAI.

Code	Error	Cause/action
0CE	Low control power-supply voltage	This alarm indicates that the voltage of the 24-V input power supply is low (24 V - 20%: 19.2 V or below). Cause: [1] The voltage of the 24-V input power supply is low. [2] Faulty part in the controller Action: Check the input power-supply voltage. If the voltage is normal, contact IAI.
0D8	Deviation overflow	The position deviation counter has overflowed. Cause: [1] The speed dropped while the actuator was moving due to external force, etc. [2] Unstable excitation detection operation after the power was turned on Action: [1] Check the load condition, such as whether the work is contacting any peripheral equipment or the brake is released, and remove the cause of the identified problem. [2] Overload condition is suspected, so check the load.
0D9	Software limit overshoot error	Cause: [1] The actuator installed in vertical configuration overshot and exceeded a soft limit when the target position was near the soft limit and the load was large or the deceleration setting was high. [2] The actuator was moved to a position outside the soft limits with the servo turned OFF, and then the servo was turned ON. Action: [1] Set a deceleration curve that will not cause the actuator to overshoot when stopping. [2] Return the actuator to within the soft limits first, and then turn ON the servo.

(2) Cold Start Alarms

Code	Error	Cause/action
0B8	Excitation detection error	This controller detects the excited phase when the servo is turned on for the first time after turning on the power. This alarm indicates that the specified encoder signal level cannot be detected after excitation for the time set by Parameter No. 29 (Excited phase signal detection time). Cause: [1] The connector of the motor relay cable is loose or its circuit is open. [2] If the actuator is equipped with a brake, the brake cannot be released. [3] The load increased due to application of external force. [4] The power was turned on when the actuator was contacting a mechanical end. [5] The sliding resistance of the actuator itself is high. Action: [1] Check the wiring condition of the motor relay cable. [2] Check the wiring condition of the brake cable, and also turn on/off the brake release switch to check if “click” sound is heard. [3] Check the assembly condition of mechanical parts for any abnormality. [4] Move the actuator away from the mechanical end, and then turn on the power again. [5] If the load is normal, cut off the power and move the actuator by hand to check the slide resistance. If the actuator itself is suspected as the cause, contact IAI.
0E5	Encoder receive error	Cause: [1] When the 24-V power is turned on, the controller is powered up before the simple absolute unit. [2] When the detail code is H’0001: The controller cannot communicate with the simple absolute unit properly due to noise, etc. [3] When the detail code is H’0002: The controller cannot communicate with the simple absolute unit properly due to disconnection of the communication wire in the encoder cable, etc. Action: [1] Always turn on the power to the simple absolute unit before (or simultaneously as) the controller power. [2] Change the installation location of the controller. Implement noise measures such as installing a FG, noise filter or clamp filter. [3] Check the encoder relay cable between the controller and simple absolute unit for a loose connector or connectors. If both connectors on the cable are engaged properly, replace the cable.
0E8	Open phase A/B detected	Encoder signals cannot be detected correctly.
0E9	Open phase A detected	Cause: [1] The connector of the encoder relay cable is loose or its circuit is open. [2] The connector of the supplied actuator cable is loose or its circuit is open. Action: Check the connection condition of the encoder relay cable and perform continuity check. If no abnormality is found, contact IAI.
0EA	Open phase B detected	

Code	Error	Cause/action
0ED	Absolute encoder error (1)	Cause: [1] When the power was turned off and then on again following an absolute reset, the current position changed due to an external factor, etc., while the controller was communicating with the absolute unit. [2] When an absolute reset was executed, the current position changed due to an external factor, etc., while the controller was communicating with the absolute unit. Action: [1] When the detail code is H'0001: Turn off the power and then turn it back on in a condition where the actuator is not receiving vibration, etc. [2] When the detail code is H'0002: Perform homing again in a condition where the actuator is not receiving vibration, etc.
0EE	Absolute encoder error (2)	Cause: [1] The power has been turned on for the first time after the battery was connected to the simple absolute unit. [2] When the detail code is H'0001: The battery voltage has dropped to a level where the encoder counter in the simple absolute unit can no longer retain data. [3] When the detail code is H'0002: The encoder connector was unplugged during a power outage, or the encoder cable became disconnected. [4] When the detail code is H'0003: A related parameter was changed. Action: If [1], [3] or [4] is the case, perform an absolute reset by referring to the operation manual for the simple absolute unit (5.2, "How to Perform an Absolute Reset"). If [2] is the case, supply power for at least 48 hours to fully charge the battery, and then perform an absolute reset.
0EF	Absolute encoder error (3)	Cause: The current value has changed at a speed corresponding to or exceeding the rotational speed setting, due to an external factor, etc., while the power was cut off. Action: Change the applicable setting of the simple absolute unit and also implement measures to prevent the actuator from moving at a speed corresponding to or exceeding the set speed while the power is cut off. When the battery has enough retention time, set the motor speed setting high. Reference: Refer to: 5.1.1, "Piano Switch Settings" in the operation manual for the simple absolute unit. Should this error occur, perform an absolute reset according to the specified procedure (5.2, "How to Perform an Absolute Reset").

Code	Error	Cause/action
0F4	Inconsistent PCB	This controller uses a different motor drive circuit depending on the motor capacity, and therefore the installed printed circuit board (PCB) is also different with each controller. During the initialization after starting, the controller checks if the motor type set by the manufacturer's parameter matches the actual PCB installed. This alarm indicates that the two do not match. Cause: The parameter may not be entered correctly or the PCB may not be assembled correctly. Action: If you have encountered this error, contact IAI.
0F5	Nonvolatile memory verification error after write	When data has been written to the nonvolatile memory, the written data is read and compared (verified) against the written data for confirmation. This alarm indicates that the read data does not match the written data. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal life of the nonvolatile memory is 100,000 rewrite operations.) Action: If the problem still persists after the power has been reconnected, contact IAI.
0F6	Nonvolatile memory timeout after write	This alarm indicates that no response was received within the specified time after writing data to the nonvolatile memory. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal life of the nonvolatile memory is 100,000 rewrite operations.) Action: If the problem still persists after the power has been reconnected, contact IAI.
0F8	Damaged nonvolatile memory	Abnormal data was detected in the nonvolatile memory check after starting. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal life of the nonvolatile memory is 100,000 rewrite operations.) Action: If the problem still persists after the power has been reconnected, contact IAI.
0FA	CPU error	The CPU is not operating correctly. Cause: [1] Faulty CPU [2] Malfunction due to noise Action: If the problem still persists after the power has been reconnected, contact IAI.

7.4 Messages Displayed during Teaching Pendant Operation

This section explains the warning messages that may be displayed while operating the teaching pendant.

Code	Message	Description
112	Input data error	An inappropriate value was input as a user parameter setting. (Example) "9601" was input as the serial communication speed by mistake. Input an appropriate value again.
113 114	Input value too small Input value too large	The input value is under the setting range. The input value is over the setting range. Input an appropriate value again by referring to the actuator specifications and parameter list.
115	Homing not yet complete	The current position was written before homing was complete. Perform homing first.
117	No movement data	No target position is set under the selected position number. Input a target position first.
11E	Inconsistent data pair	The magnitude relationship of a pair of data is inappropriate. (Example) The same value is set in both the + and – soft limit parameters. Input appropriate values again.
11F	Absolute value too small	The minimum travel toward a target position is determined by the lead of the drive system and encoder resolution. This message indicates that the input target position is less than this minimum travel. (Example) If the lead is 20 mm, the encoder resolution is 800 pulses and therefore the minimum travel is calculated as 0.025 mm/pulse (20 ÷ 800). If 0.02 mm is input as the target position, this message will be displayed.
121	Push search end over	The final position in push-motion operation exceeds a soft limit. No harm is done as long as the actuator contacts the work. If it misses the work, however, the actuator will reach the soft limit and this message will be displayed. Change either the target position or positioning band.
122	Multiple axes connected at assignment	An axis number was assigned when multiple axes were connected. Always assign an axis number when only one axis is connected.
180 181 182 183	Axis number change OK Controller initialization OK Home change all clear I/O function changed	This is an operation check message. (It does not indicate misoperation or error.)
202	Emergency stop	An emergency stop is currently actuated.
20A	Servo OFF during movement	The servo ON signal (SON) was turned OFF by the PLC while the actuator was moving. As a result, the servo turned OFF and the actuator stopped.

Code	Message	Description
20C	CSTR-ON during operation	A move command signal from the PLC turned ON while the actuator was moving, resulting in redundant move commands.
20E	Soft limit over	A soft limit was reached.
221	Write inhibited in monitor mode	A position table field or parameter was written in the monitor mode.
223	Operation inhibited in monitor mode	The actuator was moved in the monitor mode.
301 302 304 305 306 308 30A 30B	Overrun error (M) Framing error (M) SCIR-QUE OV (M) SCIS-QUE OV (M) R-BF OV Response timeout (M) Packet R-QUE OV Packet S-QUE OV	An error occurred in serial communication with the controller. Cause: [1] Garbage data due to noise [2] Duplicate slave numbers when multiple actuators are controlled via serial communication Action: [1] Revise the wiring, equipment layout, etc., to eliminate noise. [2] Change the slave numbers to eliminate duplication. If the message persists, please contact IAI.
307	Memory command denied	A command was denied in serial communication with the controller.
309	Write address error	An indeterminable write address error occurred in serial communication with the controller. These messages do not generate during normal operation. Should either of them occur, record the entire error list before turning off the power. The recorded error list will help us identify the cause of the problem. Also contact IAI.
30C	No connected axis	The controller axis number cannot be recognized. Cause: [1] The controller is not operating properly. [2] Only the communication line of the supplied cable (SGA/SGB) is open. [3] If the SIO converter is used, the link cable is not connected although the converter is receiving 24 V. [4] When multiple controllers are linked, the ADRS switch is set to the same number by mistake on two or more controllers. Action: [1] Check if the RDY LED on the controller is lit. If this LED is not lit, the controller is faulty. [2] If you have a spare teaching pendant, change to the spare teaching pendant. Or, switch to the PC software mode and see if the message will disappear. [3] Connect all pairs of converter and controller using link cables, and then supply the power. [4] Set each ADRS switch to a unique number. If the message persists, please contact IAI.

7.5 Common Problems and Recommended Actions

- I/O Signals Cannot Be Sent or Received to/from the PLC.

  Cause: [1] The 24-V I/O power supply is connected in reverse polarities.
  (In this case, input circuits are not affected, but output circuits will be damaged.)
  [2] If an output circuit presents this problem, electrical current exceeding the maximum current flowed due to a large load and a circuit component was damaged.
  [3] Poor contact at the connector or relay terminal block on the PLC side.
  [4] The female pins on the flat cable connector are bent outward, thus causing contact failure with the male pins on the controller connector.

  Action: Check the connection condition of the power supply and connector, as well as the load on the output side. If [1] or [2] is suspected, the controller must be replaced. If [4] is likely, the flat cable must be replaced. Either way, contact IAI.

⚠ Warning: When checking the continuity of the flat cable, exercise due caution not to bend the female pins on the connector outward. It may cause contact failure, resulting in malfunction.

- The ALM Lamp Illuminates after the Power Is Turned On.

  (An alarm is present, emergency stop is actuated, or the motor power is cut off.)
  * If the ALM output signal is OFF, an alarm is present. Connect a PC or teaching pendant to check the nature of the error and remove the cause.
  * If the ALM output signal is ON, the emergency stop circuit is actuated.

  Check the following items:
  [1] Is the emergency stop switch on the operation panel pressed by mistake? Is the necessary interlock canceled?
  [2] Is the emergency stop switch on the teaching pendant pressed by mistake?
  [3] Is Parameter No. 42 (Enable function) enabled by mistake when a teaching pendant is connected that does not support the enable switch?
  [4] If multiple controllers are linked together, are they wired correctly?

- After Turning On the Power, the SV Lamp Does Not Illuminate upon Servo-on Signal Input.

  (The Servo Does Not Turn On.)

  Cause: [1] Contact failure of the flat cable
  [2] Faulty controller
  Check the servo-on signal (SON) in the I/O monitor screen on the PC or teaching pendant. If the signal is input, the controller may be faulty. Contact IAI.

- With an Actuator Installed in Vertical Orientation, Positioning Completes Prematurely.

  Cause: [1] The load exceeds the rated load capacity.
  [2] The ball screw is receiving torsional stress due to the actuator affixing method, uneven tightening of bolts, etc.
  [3] The slide resistance of the actuator itself is high.

  Action: If [1] is suspected, increase the value of User Parameter No. 13 (Current-limiting value during homing). Increasing the parameter value increases the homing torque. As a guide, however, the setting should not exceed 100% for the RA3C/RGD3C types or 75% for all other types.
  [2] To check if the condition in [2] is present, loosen the affixing bolts and check if the slider moves smoothly. If the slider moves smoothly, adjust the affixing method and bolt tightening method.
  [3] If the slide resistance of the actuator itself is high, contact IAI.

- With an Actuator Installed in Vertical Orientation, Noise Generates during Downward Movement.

  Cause: The load exceeds the rated load capacity.

  Action: [1] Decrease the speed.
  [2] Decrease the value set in User Parameter No. 7 (Servo gain number). As a guide, do not decrease the setting to below 3.

- Vibration Occurs when the Actuator Is at Standstill.

  Cause: The slider is receiving external force.

  Action: If external force cannot be removed, increase the value set in User Parameter No. 12 (Current-limiting value at standstill after positioning).
  Increasing the setting of this parameter increases the holding torque. As a guide, keep the current limiting value to 70% or below.

- The Actuator Overshoots while Decelerating to a Stop.

  Cause: The load inertia is high due to an inappropriate balance of the load and deceleration.

  Action: Decrease the set deceleration.

- Stopped Position Sometime Deviates from the Home Position or Target Position.

  Cause: [1] Encoder waveforms are disturbed due to noise.
  [2] If the actuator is of rod type, non-rotational error increased due to application of rotational moment to the rod.

  Action: [1] Check if the grounding is provided correctly, and also check for any equipment that may be generating noise.
  [2] Depending on the condition, the actuator may have to be replaced. Contact IAI.

- The Actuator Moves Slow during Push-motion Operation.

  Cause: The set current-limiting value is low with respect to the load and slide resistance.

  Action: Increase the current-limiting value during push-motion operation.

- The Actuator Moves Only a Half, or as Much as Twice, the Specified Travel.

  Cause: [1] The controller and actuator combination is incorrect.
  The ball screw lead varies according to the actuator type. If the actuator is not combined with an appropriate controller, the travel and speed will change.
  [2] Pre-shipment setting error at IAI

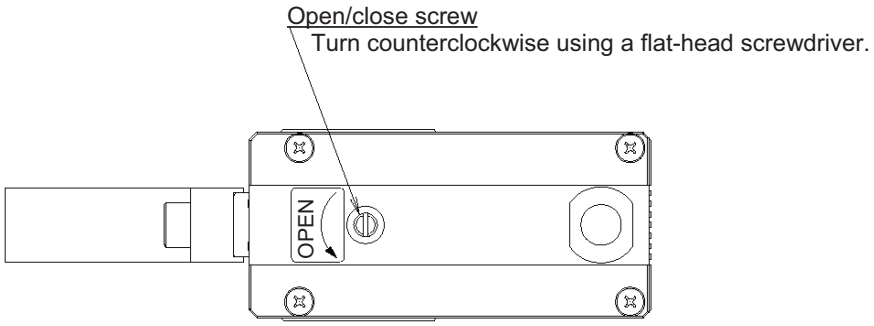
  Action: [1] If multiple actuators of different types are used, check the label on each actuator or use other means to see if they are connected to correct controllers.
  [2] Contact IAI.

- A Servo Error Occurred while the ROBO Gripper Was Moving.

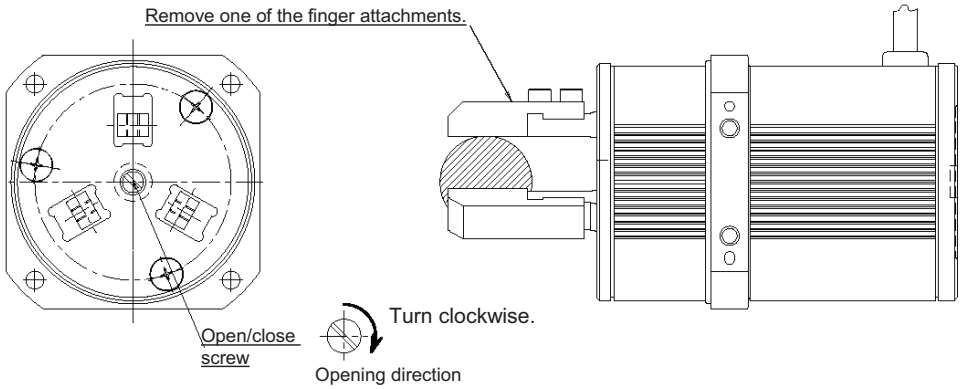
  Cause: The work was not positioned properly and a finger attachment contacted the work in the positioning mode.
  Action: Consider how much the work deviates and adjust the start position of push-motion operation, as well as the thickness of the finger attachment (including buffer material), so that the work can be clamped properly in the push-motion mode.
  Before resetting the error, be sure to turn the open/close screw and loosen the finger attachments first, because the feed mechanism may be locked.

⚠ Caution:	If the alarm is reset when the servo-on signal is disabled or while the servo-on signal is ON, the servo will turn on. Turning the open/close screw in this condition only results in the screw returning to the original position, and the feed mechanism remains locked. Therefore, the alarm will generate again the next time a move command is issued.

[Two-finger type]



[Three-finger type]
Remove one of the finger attachments and take out the work, and then turn the open/close screw clockwise.



- The Actuator Malfunctions when the Servo Is Turned On after Turning On the Power.

  Cause: Excited phase detection is not performed properly when the servo is turned on, because one of the following conditions exists when the power was turned on:
  [1] The slider or rod was contacting a mechanical end.
  [2] The work was pushed by a strong external force.

  Action: [1] Check if the slider or rod is not contacting a mechanical end. If the slider/rod is contacting a mechanical end, separate the slider/rod from the mechanical end.
  If the actuator is equipped with a brake, turn on the brake release switch to forcibly release the brake before moving the actuator. At this time, be careful not to pinch your hand or damage the robot hand or work by the slider/rod, as the slider/rod may drop unexpectedly by its dead weight.
  If the actuator cannot be moved by hand, one measure is to check the direction of excited phase signal detection and change the direction of detection as necessary. If you wish to change the direction, contact IAI beforehand.
  For details, refer to the applicable parameter explained in 6.2.2, “Parameters Relating to Actuator Operating Characteristics.”
  [2] Check if the work is not contacting any peripheral equipment.
  If the work is contacting peripheral equipment, separate the work from the equipment by providing a minimum clearance of 1 mm in between.
  If neither [1] nor [2] applies, contact IAI.

- The SV Lamp Blinks.

  The automatic servo-off mode is active. (This is not an error or failure.)

* Appendix

List of Specifications of Connectable Actuators

The specifications included in this specification list are limited to those needed to set operating conditions and parameters. For other detailed specifications, refer to the catalog or operation manual for your actuator.

⚠ Caution

- The push force is based on the rated push speed (factory setting) indicated in the list, and provides only a guideline.
- Make sure the actual push force is equal to or greater than the minimum push force. If not, the push force will not stabilize.
- Do not change the setting of push speed (parameter No. 34). If you must change the push speed, consult IAI.
- If, among the operating conditions, the positioning speed is set to a value equal to or smaller than the push speed, the push speed will become the set speed and the specified push force will not generate.

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (rod type)	RA2C	Ball screw	800	1	Horizontal/ vertical	1.25	25	0.05	50	100	3
	RA3C	Ball screw	800	5	Horizontal/ vertical	6.25	187	0.2	21	73.5	20
				2.5	Horizontal/ vertical	3.12	114		50	156.8	
	RGD3C	Ball screw	800	5	Horizontal/ vertical	6.25	187	0.2	21	73.5	20
				2.5	Horizontal	3.12	114		50	156.8	
					Vertical		93				
	RA4C	Ball screw	800	10	Horizontal/ vertical	12.5	458 (at to 250st) 350 (at 300st)	0.2	30	150	20
				5	Horizontal/ vertical	6.25	250 (at 50 to 200st) 237 (at 250st) 175 (at 300st)		75	284	
				2.5	Horizontal	3.12	125 (at 50 to 200st) 118 (at 250st) 87 (at 300st)		150	358	
					Vertical		114				
	RGS4C	Ball screw	800	10	Horizontal/ vertical	12.5	458 (at to 250st) 350 (at 300st)	0.2	30	150	20
				5	Horizontal/ vertical	6.25	250 (at 50 to 200st) 237 (at 250st) 175 (at 300st)		75	284	
				2.5	Horizontal	3.12	125 (at 50 to 200st) 118 (at 250st) 87 (at 300st)		150	358	
					Vertical		114				

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (rod type)	RGD4C	Ball screw	800	10	Horizontal/ vertical	12.5	458 (at to 250st) 350 (at 300st)	0.2	30	150	20
				5	Horizontal/ vertical	6.25	250 (at 50 to 200st) 237 (at 250st) 175 (at 300st)		75	284	
				2.5	Horizontal	3.12	125 (at 50 to 200st) 118 (at 250st) 87 (at 300st)		150	358	
					Vertical		114				
	RA6C	Ball screw	800	16	Horizontal	20	450	0.2	75	240	20
					Vertical		400				
				8	Horizontal/ vertical	10	210		130	470	
				4	Horizontal/ vertical	5	130		300	800	
	RGS6C	Ball screw	800	16	Horizontal	20	450	0.2	75	240	20
					Vertical		400				
				8	Horizontal/ vertical	10	210		130	470	
				4	Horizontal/ vertical	5	130		300	800	
	RGD6C	Ball screw	800	16	Horizontal	20	450	0.2	75	240	20
					Vertical		400				
				8	Horizontal/ vertical	10	210		130	470	
				4	Horizontal/ vertical	5	130		300	800	
	SRA4R	Ball screw	800	5	Horizontal/ vertical	6.25	250	0.3	26	90	20
				2.5	Horizontal	3.12	124	0.2	50	170	
					Vertical		125				
	SRGS4R	Ball screw	800	5	Horizontal/ vertical	6.25	250	0.3	26	90	20
				2.5	Horizontal	3.12	124	0.2	50	170	
					Vertical		125				
	SRGD4R	Ball screw	800	5	Horizontal/ vertical	6.25	250	0.3	26	90	20
				2.5	Horizontal	3.12	124	0.2	50	170	
					Vertical		125				

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (slider type)	SA5C	Ball screw	800	20	Horizontal	25	380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 860 (at 250st) 940 (at 300st) 1000 (at 350 to 550st) 980 (at 600st) 850 (at 650st) 740 (at 700st) 650 (at 750st) 580 (at 800st)	0.7	11	39	20
					Vertical		380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 800 (at 250 to 600st) 740 (at 700st) 650 (at 750st) 580 (at 800st)	0.2			
				12	Horizontal	15	300 (at 50st) 460 (at 100st) 600 (at 150 to 550st) 540 (at 600st) 460 (at 650st) 400 (at 700st) 360 (at 750st) 300 (at 800st)	0.7	40	115	
					Vertical			0.3			
				6	Horizontal	7.5	295 (at 50st) 300 (at 100 to 550st) 270 (at 600st) 230 (at 650st) 200 (at 700st) 180 (at 750st) 150 (at 800st)	0.7	70	210	
					Vertical			0.3			
				3	Horizontal	3.75	150 (at to 550st) 135 (at 600st) 115 (at 650st) 100 (at 700st) 90 (at 750st) 75 (at 800st)	0.7	140	330	
					Vertical			0.3			
	SA5R	Ball screw	800	12	Horizontal	15	300 (at 50st) 460 (at 100st) 600 (at 150 to 550st) 540 (at 600st) 460 (at 650st) 400 (at 700st) 360 (at 750st) 300 (at 800st)	0.3	–	–	–
					Vertical			0.2			
				6	Horizontal	7.5	295 (at 50st) 300 (at 100 to 550st) 270 (at 600st) 230 (at 650st) 200 (at 700st) 180 (at 750st) 150 (at 800st)	0.3	–	–	–
					Vertical			0.2			
				3	Horizontal	3.75	150 (at to 550st) 135 (at 600st) 115 (at 650st) 100 (at 700st) 90 (at 750st) 75 (at 800st)	0.2	–	–	–
					Vertical			0.2			

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (slider type)	SA6C	Ball screw	800	20	Horizontal	25	380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 860 (at 250st) 940 (at 300st) 1000 (at 350 to 550st) 980 (at 600st) 850 (at 650st) 740 (at 700st) 650 (at 750st) 580 (at 800st)	0.7	11	39	20
					Vertical		380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 800 (at 250 to 600st) 740 (at 700st) 650 (at 750st) 580 (at 800st)	0.2			
				12	Horizontal	15	300 (at 50st) 460 (at 100st) 600 (at 150 to 550st) 540 (at 600st) 460 (at 650st) 400 (at 700st) 360 (at 750st) 300 (at 800st)	0.7	40	115	
					Vertical			0.3			
				6	Horizontal	7.5	295 (at 50st) 300 (at 100 to 550st) 270 (at 600st) 230 (at 650st) 200 (at 700st) 180 (at 750st) 150 (at 800st)	0.7	70	210	
					Vertical			0.3			
				3	Horizontal	3.75	150 (at to 550st) 135 (at 600st) 115 (at 650st) 100 (at 700st) 90 (at 750st) 75 (at 800st)	0.7	140	330	
					Vertical			0.3			
	SA6R	Ball screw	800	12	Horizontal	15	300 (at 50st) 460 (at 100st) 600 (at 150 to 550st) 540 (at 600st) 460 (at 650st) 400 (at 700st) 360 (at 750st) 300 (at 800st)	0.3	–	–	–
					Vertical			0.2			
				6	Horizontal	7.5	295 (at 50st) 300 (at 100 to 550st) 270 (at 600st) 230 (at 650st) 200 (at 700st) 180 (at 750st) 150 (at 800st)	0.3	–	–	–
					Vertical			0.2			
				3	Horizontal	3.75	150 (at to 550st) 135 (at 600st) 115 (at 650st) 100 (at 700st) 90 (at 750st) 75 (at 800st)	0.2	–	–	–
					Vertical			0.2			

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (slider type)	SA7C	Ball screw	800	16	Horizontal	20	380 (at 50st) 470 (at 100st) 533 (at 150 to 750st) 480 (at 800st)	0.3	90	250	20
					Vertical			0.2			
				8	Horizontal	10	266 (at 50 to 700st) 240 (at 800st)	0.3	150	500	
					Vertical			0.2			
				4	Horizontal	5	133 (at 50 to 700st) 120 (at 800st)	0.2	280	800	
					Vertical			0.2			
	SA7R	Ball screw	800	16	Horizontal	20	380 (at 50st) 470 (at 100st) 533 (at 150 to 750st) 480 (at 800st)	0.3	–	–	–
					Vertical		400	0.2			
				8	Horizontal	10	266 (at 50 to 700st) 240 (at 800st)	0.3	–	–	–
					Vertical			0.2			
				4	Horizontal	5	133 (at 50 to 700st) 120 (at 800st)	0.2	–	–	–
					Vertical			0.2			
	SS7C	Ball screw	800	12	Horizontal	15	600 (at 50 to 500st) 470 (at 600st)	0.3	40	120	20
					Vertical			0.2			
				6	Horizontal	7.5	300 (at 50 to 500st) 230 (at 600st)	0.3	75	220	
					Vertical			0.2			
				3	Horizontal	3.75	150 (at 50 to 500st) 115 (at 600st)	0.2	140	350	
					Vertical			0.2			
	SS7R	Ball screw	800	12	Horizontal	15	600 (at 50 to 500st) 470 (at 600st)	0.3	–	–	–
					Vertical		440 (at 50 to 500st) 440 (at 600st)	0.2			
				6	Horizontal	7.5	250 (at 50 to 500st) 230 (at 600st)	0.3	–	–	–
					Vertical			0.2			
				3	Horizontal	3.75	105 (at 50 to 500st) 105 (at 600st)	0.2	–	–	–
					Vertical			0.2			
	SS8C	Ball screw	800	20	Horizontal	25	666 (at 50 to 800st) 625 (at to 900st) 515 (at to 1000st)	0.3	50	180	20
					Vertical		600 (at 50 to 800st) 600 (at to 900st) 515 (at to 1000st)	0.2			
				10	Horizontal	12.5	333 (at 50 to 800st) 310 (at to 900st) 255 (at to 1000st)	0.3	95	320	
					Vertical		300 (at 50 to 800st) 300 (at to 900st) 255 (at to 1000st)	0.2			
				5	Horizontal	6.25	165 (at 50 to 800st) 155 (at to 900st) 125 (at to 1000st)	0.2	180	630	
					Vertical		150 (at 50 to 800st) 150 (at to 900st) 125 (at to 1000st)	0.2			

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (slider type)	SS8R	Ball screw	800	20	Horizontal	25	600 (at 50 to 800st) 600 (at to 900st) 515 (at to 1000st)	0.3	–	–	–
					Vertical		333 (at 50 to 800st) 333 (at to 900st) 333 (at to 1000st)	0.2			
				10	Horizontal	12.5	300 (at 50 to 800st) 300 (at to 900st) 255 (at to 1000st)	0.3	–	–	–
					Vertical		250 (at 50 to 800st) 250 (at to 900st) 250 (at to 1000st)	0.2			
				5	Horizontal	6.25	160 (at 50 to 800st) 155 (at to 900st) 125 (at to 1000st)	0.2	–	–	–
					Vertical		140 (at 50 to 800st) 140 (at to 900st) 140 (at to 1000st)	0.2			
	HS8C	Ball screw	800	30	Horizontal	37.5	1200 (at 50 to 800st) 1000 (at to 900st) 800 (at to 1000st)	0.3	–	–	–
					Vertical		750 (at 50 to 800st) 750 (at to 900st) 750 (at to 1000st)	0.2			
	HS8R	Ball screw	800	30	Horizontal	37.5	1200 (at 50 to 800st) 1000 (at to 900st) 800 (at to 1000st)	0.3	–	–	–
					Vertical		750 (at 50 to 800st) 750 (at to 900st) 750 (at to 1000st)	0.2			
RCP2 (belt type)	BA6/ BA6U	Belt	800	Equivalent to 54	Horizontal	67.5	1000	0.5	–	–	–
	BA7/ BA7U	Belt	800	Equivalent to 54	Horizontal	67.5	1500	0.5	–	–	–
RCP2 (gripper type)	GRSS	–	800	1.57	–	1.96	78	–	4	14	20
	GRLS	–	800	12	–	15 (deg/s)	600 (deg/s)	–	1.8	6.4	5 (deg/s)
	GRS	–	800	1	–	1.25	33.3	–	9	21	5
	GRM	–	800	1.1	–	1.37	36.7	–	23	80	5
	GRST	–	800	1.05	–	1.31	34	–	15	40	5
		–	800	2.27	–	2.83	75	–	7.5	20	5
	GR3LS	–	800	12	–	15	200	–	5	18	5 (deg/s)
	GR3LM	–	800	12	–	15	200	–	15	51	5 (deg/s)
	GR3SS	–	800	2.5	–	3.12	40	–	7	22	5
	GR3SM	–	800	3	–	3.75	50	–	30	102	5
	GRHM	–	800	2	–	2.5	100	–	25	125	5
	GRHB	–	800	2	–	2.5	100	–	60	200	5

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (rotary type)	RTBS	–	800	Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
		–		Gear ratio: 1/45	–	10 (deg/s)	266 (deg/s)	–	–	–	–
	RTBSL	–	800	Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
		–		Gear ratio: 1/45	–	10 (deg/s)	266 (deg/s)	–	–	–	–
	RTCS	–	800	Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
		–		Gear ratio: 1/45	–	10 (deg/s)	266 (deg/s)	–	–	–	–
	RTCSL	–	800	Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
		–		Gear ratio: 1/45	–	10 (deg/s)	266 (deg/s)	–	–	–	–
	RTB	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTBL	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTC	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTCL	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTBB	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTBBL	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTCB	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–
	RTCBL	–	800	Gear ratio: 1/20	–	22.5 (deg/s)	600 (deg/s)	–	–	–	–
		–		Gear ratio: 1/30	–	15 (deg/s)	400 (deg/s)	–	–	–	–

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (rod type)	RA2AC	Lead screw	800	4	Horizontal/ vertical	5	180 (at 25st) 200 (at 50 to 100st)	0.2	0.9	16.1	5
				2		2.5	100		1.9	28.3	
				1		1.25	50		3.8	39.5	
	RA2BC	Lead screw	800	6	Horizontal/ vertical	7.5	180 (at 25st) 280 (at 50st) 300 (at 75 to 150st)	0.2	0.6	11.9	5
				4		5	180 (at 25st) 200 (at 50 to 150st)		0.9	16.1	
				2		2.5	100		1.9	28.3	
	RA2AR	Lead screw	800	4	Horizontal/ vertical	5	180 (at 25st) 200 (at 50 to 150st)	0.2	0.9	16.1	5
				2		2.5	100		1.9	28.3	
				1		1.25	50		3.8	39.5	
	RA2BR	Lead screw	800	6	Horizontal/ vertical	7.5	180 (at 25st) 280 (at 50st) 300 (at 75 to 150st)	0.2	0.6	11.9	5
				4		5	180 (at 25st) 200 (at 50 to 150st)		0.9	16.1	
				2		2.5	100		1.9	28.3	
RCP3 (slider type)	SA2AC	Lead screw	800	4	Horizontal	5	180 (at 25st) 200 (at 50 to 100st)	0.2	–	–	–
				2		2.5	100				
				1		1.25	50				
	SA2BC	Lead screw	800	6	Horizontal	7.5	180 (at 25st) 280 (at 50st) 300 (at 75 to 150st)	0.2	–	–	–
				4		5	180 (at 25st) 200 (at 50 to 150st)				
				2		2.5	100				
	SA2AR	Lead screw	800	4	Horizontal	5	180 (at 25st) 200 (at 50 to 100st)	0.2	–	–	–
				2		2.5	100				
				1		1.25	50				
	SA2BR	Lead screw	800	6	Horizontal	7.5	180 (at 25st) 280 (at 50st) 300 (at 75 to 150st)	0.2	–	–	–
				4		5	180 (at 25st) 200 (at 50 to 150st)				
				2		2.5	100				
	SA3C	Ball screw	800	6	Horizontal	7.5	300	0.3	9	15	20
					Vertical			0.2			
				4	Horizontal	5	200	0.3	14	22	
					Vertical			0.2			
				2	Horizontal	2.5	100	0.2	27	44	
					Vertical			0.2			
	SA3R	Ball screw	800	6	Horizontal	7.5	300	0.3	9	15	–
					Vertical			0.2			
				4	Horizontal	5	200	0.3	14	22	
					Vertical			0.2			
				2	Horizontal	2.5	100	0.2	27	44	
					Vertical			0.2			

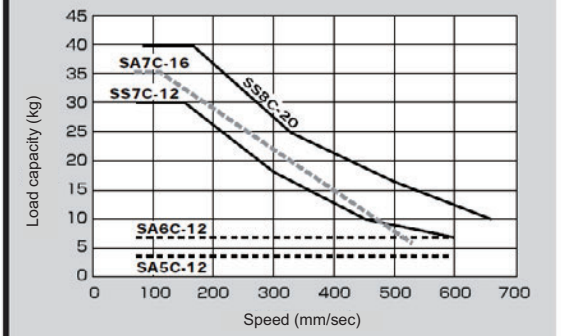
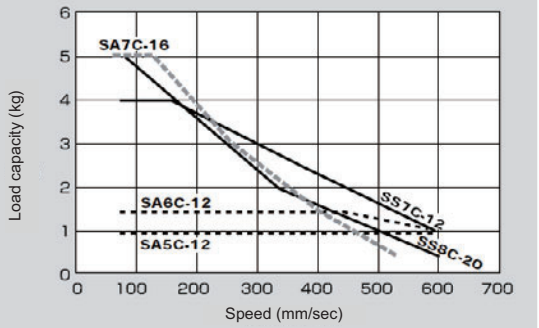
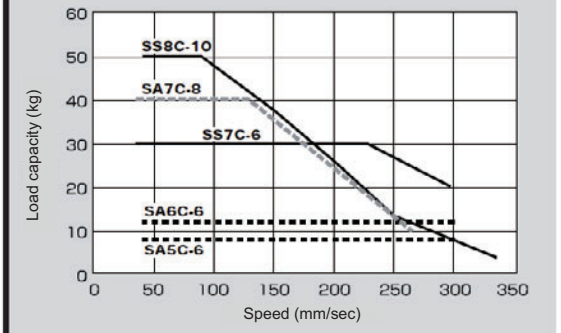
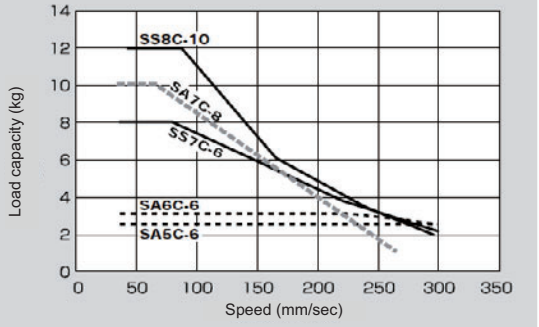
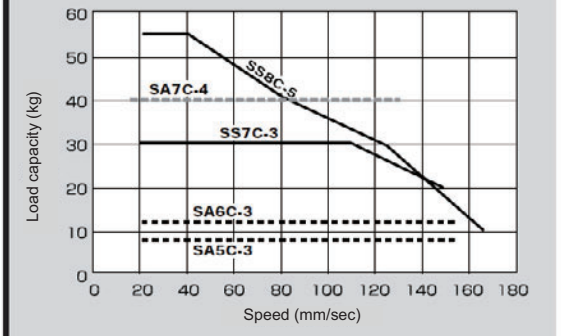
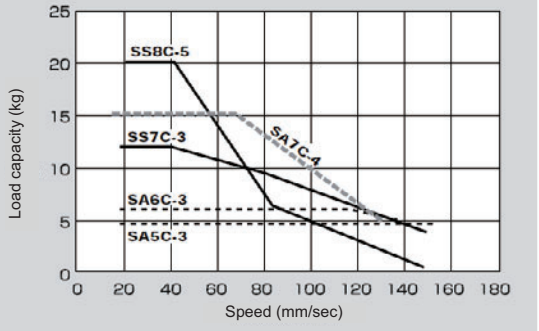
Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (slider type)	SA4C	Ball screw	800	10	Horizontal	12.5	380 (at 50st) 500 (at 100st to 500st)	0.7	20	34	20
					Vertical			0.3			
				5	Horizontal	6.25	250	0.7	40	68	
					Vertical			0.3			
				2.5	Horizontal	3.12	125	0.7	82	136	
					Vertical			0.3			
	SA4R	Ball screw	800	10	Horizontal	12.5	380 (at 50st) 500 (at 100st to 500st)	0.3	20	34	–
					Vertical			0.2			
				5	Horizontal	6.25	250	0.3	40	68	
					Vertical			0.2			
				2.5	Horizontal	3.12	125	0.2	82	136	
					Vertical			0.2			
	SA5C	Ball screw	800	20	Horizontal	25	380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 860 (at 250st) 940 (at 300st) 1000 (at 350 to 600st) 910 (at 650st) 790 (at 700st) 690 (at 750st) 610 (at 800st)	0.7	17	28	20
					Vertical		380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 800 (at 250 to 650st) 790 (at 700st) 690 (at 750st) 610 (at 800st)	0.2			
				12	Horizontal	15	380 (at 50st) 540 (at 100st) 600 (at 150st to 550st) 570 (at 600st) 490 (at 650st) 425 (at 700st) 370 (at 750st) 330 (at 800st)	0.7	28	47	
					Vertical			0.3			
				6	Horizontal	7.5	300 (at 50st to 550st) 285 (at 600st) 245 (at 650st) 210 (at 700st) 185 (at 750st) 165 (at 800st)	0.7	57	95	
					Vertical			0.3			
				3	Horizontal	3.75	150 (at 50st to 550st) 140 (at 600st) 120 (at 650st) 105 (at 700st) 90 (at 750st) 80 (at 800st)	0.7	113	189	
					Vertical			0.3			

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (slider type)	SA5R	Ball screw	800	12	Horizontal	15	380 (at 50st) 540 (at 100st) 600 (at 150st to 550st) 570 (at 600st) 490 (at 650st) 425 (at 700st) 370 (at 750st) 330 (at 800st)	0.3	30	47	20
					Vertical			0.2			
				6	Horizontal	7.5	300 (at 50st to 550st) 285 (at 600st) 245 (at 650st) 210 (at 700st) 185 (at 750st) 165 (at 800st)	0.3	58	95	
					Vertical			0.2			
				3	Horizontal	3.75	150 (at 50st to 550st) 140 (at 600st) 120 (at 650st) 105 (at 700st) 90 (at 750st) 80 (at 800st)	0.2	112	189	
					Vertical			0.2			
	SA6C	Ball screw	800	20	Horizontal	25	380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 860 (at 250st) 940 (at 300st) 1000 (at 350 to 600st) 910 (at 650st) 790 (at 700st) 690 (at 750st) 610 (at 800st)	0.7	17	28	20
					Vertical		380 (at 50st) 540 (at 100st) 660 (at 150st) 770 (at 200st) 800 (at 250 to 650st) 790 (at 700st) 690 (at 750st) 610 (at 800st)	0.2			
				12	Horizontal	15	380 (at 50st) 540 (at 100st) 600 (at 150st to 550st) 570 (at 600st) 490 (at 650st) 425 (at 700st) 370 (at 750st) 330 (at 800st)	0.7	28	47	
					Vertical			0.3			
				6	Horizontal	7.5	300 (at 50st to 550st) 285 (at 600st) 245 (at 650st) 210 (at 700st) 185 (at 750st) 165 (at 800st)	0.7	57	95	
					Vertical			0.3			
				3	Horizontal	3.75	150 (at 50st to 550st) 140 (at 600st) 120 (at 650st) 105 (at 700st) 90 (at 750st) 80 (at 800st)	0.7	113	189	
					Vertical			0.3			

Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (slider type)	SA6R	Ball screw	800	12	Horizontal	15	380 (at 50st) 540 (at 100st) 600 (at 150st to 550st) 570 (at 600st) 490 (at 650st) 425 (at 700st) 370 (at 750st) 330 (at 800st)	0.3	30	47	20
					Vertical			0.2			
				6	Horizontal	7.5	300 (at 50st to 550st) 285 (at 600st) 245 (at 650st) 210 (at 700st) 185 (at 750st) 165 (at 800st)	0.3	58	95	
					Vertical			0.2			
				3	Horizontal	3.75	150 (at 50st to 550st) 140 (at 600st) 120 (at 650st) 105 (at 700st) 90 (at 750st) 80 (at 800st)	0.2	112	189	
					Vertical			0.2			
RCP3 (table type)	TA3C	Ball screw	800	6	Horizontal	7.5	300	0.3	5.4	9	20
					Vertical		200	0.2			
				4	Horizontal	5	200	0.3	8.4	14	
					Vertical		133	0.2			
				2	Horizontal	2.5	100	0.2	16.8	28	
					Vertical		67	0.2			
	TA3R	Ball screw	800	6	Horizontal	7.5	300	0.3	5.4	9	20
					Vertical		200	0.2			
				4	Horizontal	5	200	0.3	8.4	14	
					Vertical		133	0.2			
				2	Horizontal	2.5	100	0.2	16.8	28	
					Vertical		67	0.2			
	TA4C	Ball screw	800	6	Horizontal	7.5	300	0.3	9	15	20
					Vertical			0.2			
				4	Horizontal	5	200	0.3	13.2	22	
					Vertical			0.2			
				2	Horizontal	2.5	100	0.2	26.4	44	
					Vertical			0.2			
	TA4R	Ball screw	800	6	Horizontal	7.5	300	0.3	9	15	20
					Vertical			0.2			
				4	Horizontal	5	200	0.3	13.2	22	
					Vertical			0.2			
				2	Horizontal	2.5	100	0.2	26.4	44	
					Vertical			0.2			
	TA5C	Ball screw	800	10	Horizontal	12.5	465	0.3	20	34	20
					Vertical		400	0.2			
				5	Horizontal	6.25	250	0.3	40	68	
					Vertical			0.2			
				2.5	Horizontal	3.12	125	0.2	82	136	
					Vertical			0.2			
	TA5R	Ball screw	800	10	Horizontal	12.5	465	0.3	20	34	20
					Vertical		400	0.2			
				5	Horizontal	6.25	250	0.3	40	68	
					Vertical			0.2			
				2.5	Horizontal	3.12	125	0.2	82	136	
					Vertical			0.2			

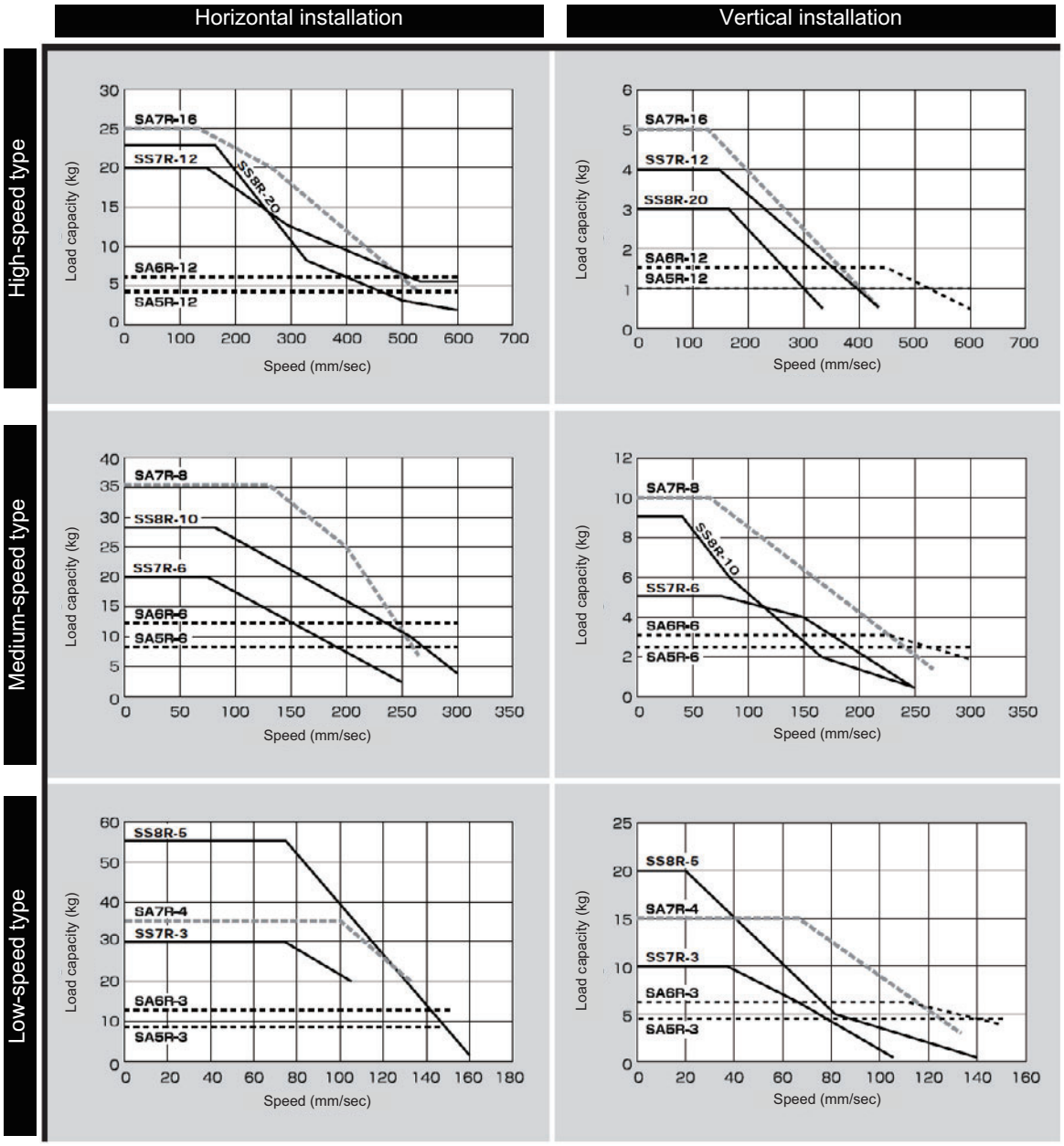
Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (table type)	TA6C	Ball screw	800	12	Horizontal	15	560	0.3	30	47	20
					Vertical		500	0.2			
				6	Horizontal	7.5	300	0.3	58	95	
					Vertical			0.2			
				3	Horizontal	3.75	150	0.2	112	189	
					Vertical			0.2			
	TA6R	Ball screw	800	12	Horizontal	15	560	0.3	30	47	20
					Vertical		500	0.2			
				6	Horizontal	7.5	300	0.3	58	95	
					Vertical			0.2			
				3	Horizontal	3.75	150	0.2	112	189	
					Vertical			0.2			
	TA7C	Ball screw	800	12	Horizontal	15	600	0.3	30	47	20
					Vertical		580	0.2			
				6	Horizontal	7.5	300	0.3	58	95	
					Vertical			0.2			
				3	Horizontal	3.75	150	0.2	112	189	
					Vertical			0.2			
	TA7R	Ball screw	800	12	Horizontal	15	600	0.3	30	47	20
					Vertical		580	0.2			
				6	Horizontal	7.5	300	0.3	58	95	
					Vertical			0.2			
				3	Horizontal	3.75	150	0.2	112	189	
					Vertical			0.2			

Correlation diagram of speed and load capacity for the slider type (motor-straight type)

	Horizontal installation	Vertical installation
High-speed type		
Medium-speed type		
Low-speed type		

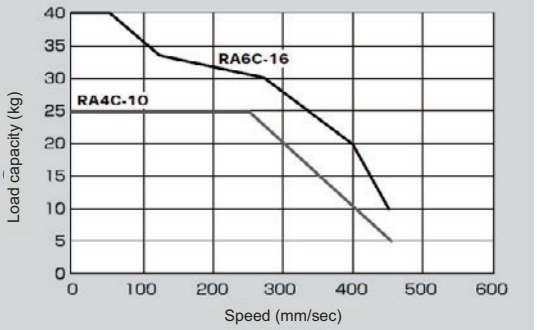
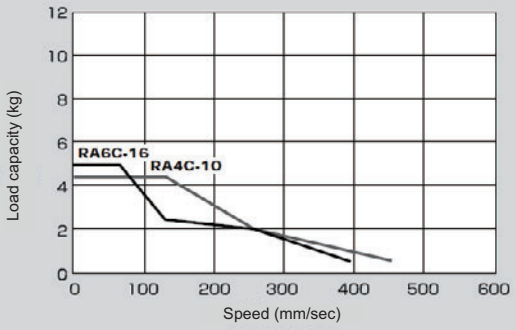
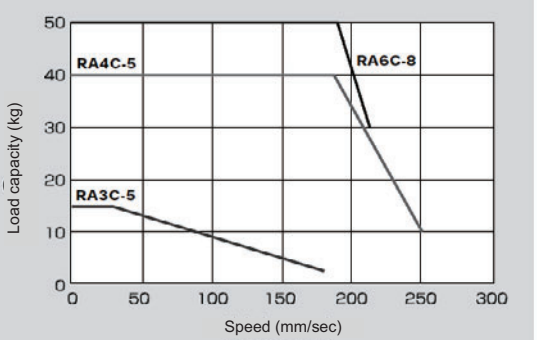
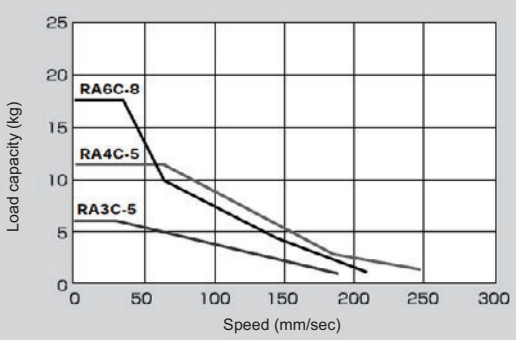
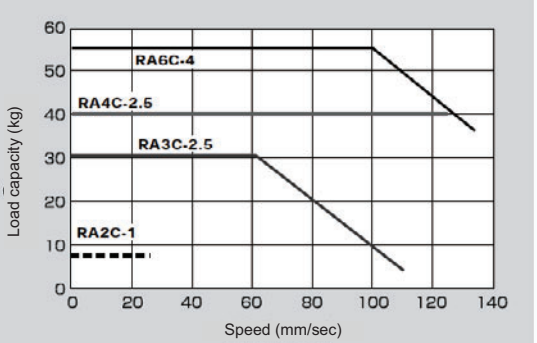
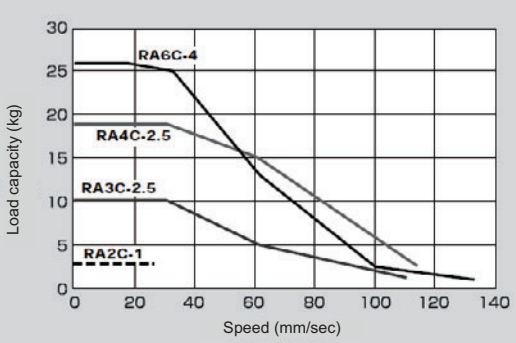
(Note) In the above graphs, the number after the type code indicates the lead.

Correlation diagram of speed and load capacity for the slider type (motor-reversing type)



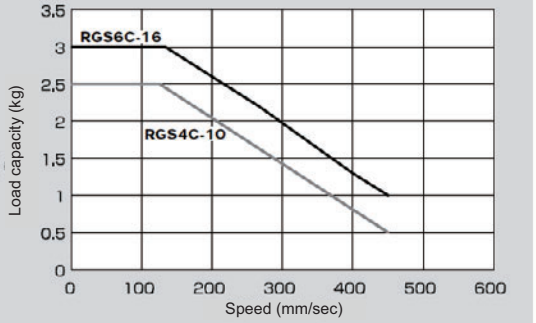
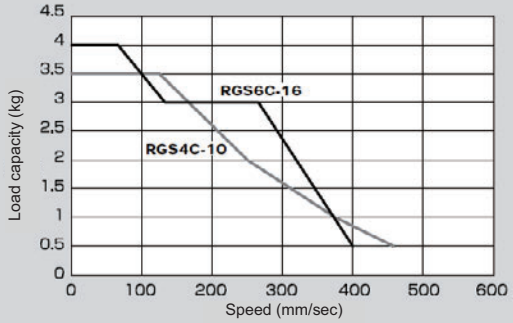
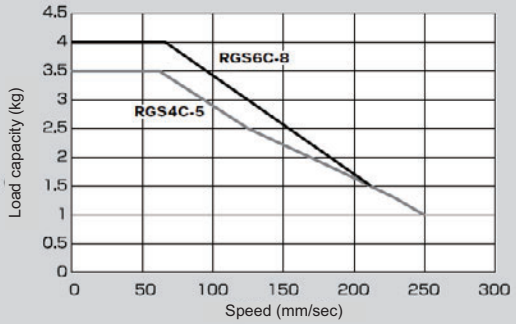
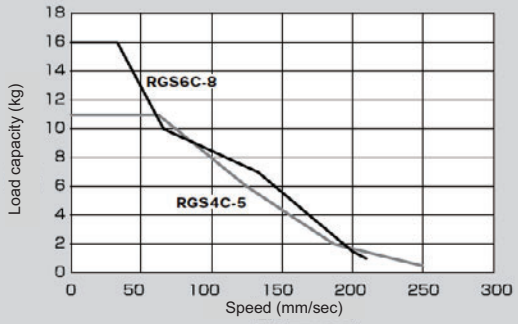
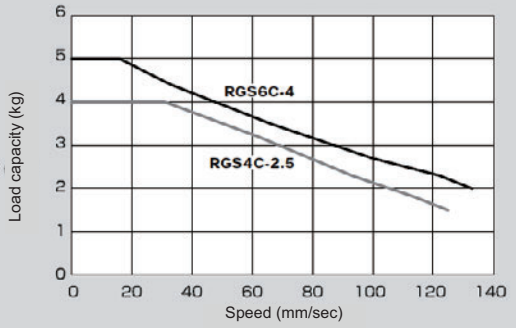
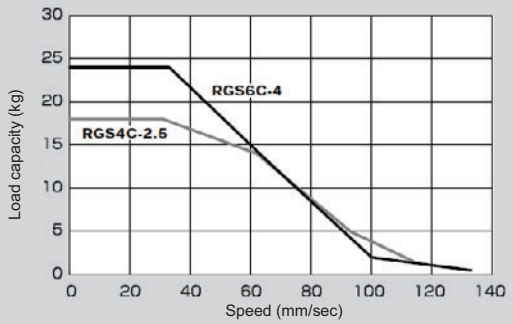
(Note) In the above graphs, the number after the type code indicates the lead.

Correlation diagram of speed and load capacity for the standard rod type

	Horizontal installation (Note 1)	Vertical installation
High-speed type		
Medium-speed type		
Low-speed type		

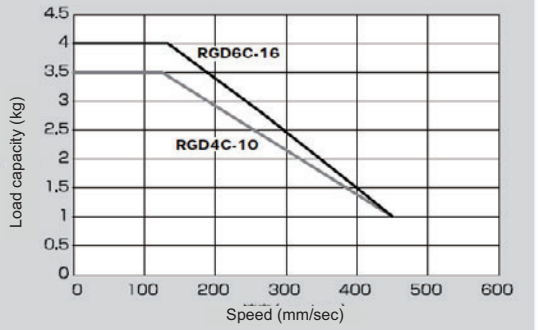
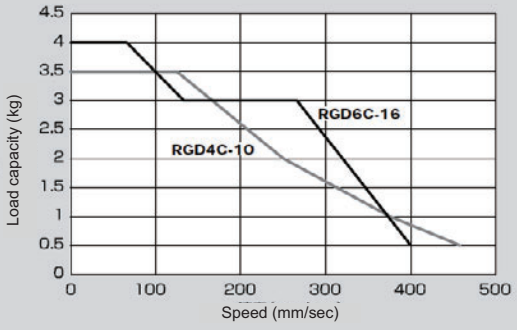
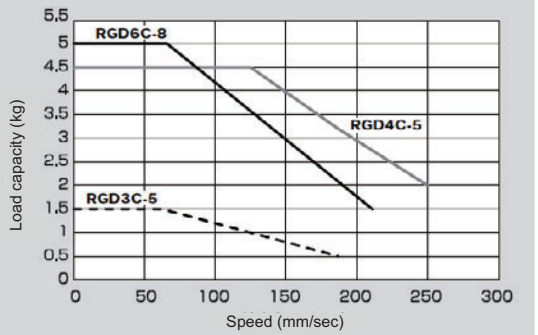
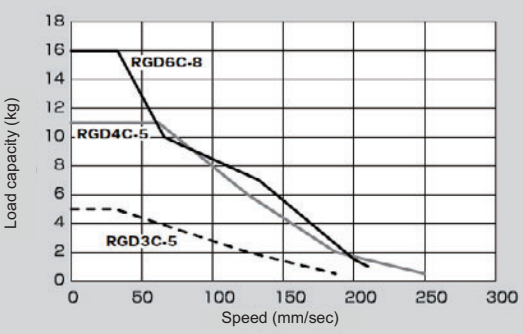
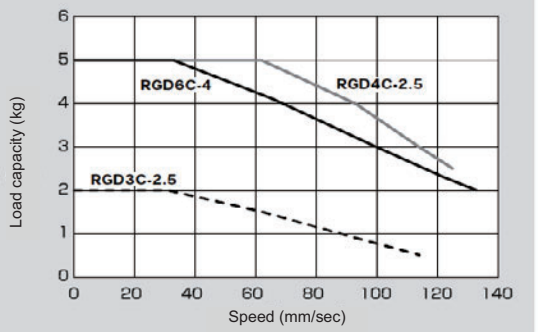
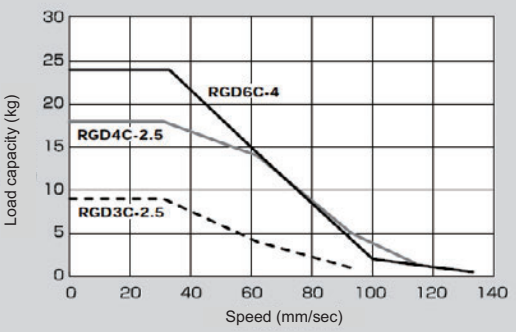
(Note) In the above graphs, the number after the type code indicates the lead.
(Note 1) The figures for horizontal installation assume use of an external guide.

Correlation diagram of speed and load capacity for the single-guide type

	Horizontal installation	Vertical installation
High-speed type		
Medium-speed type		
Low-speed type		

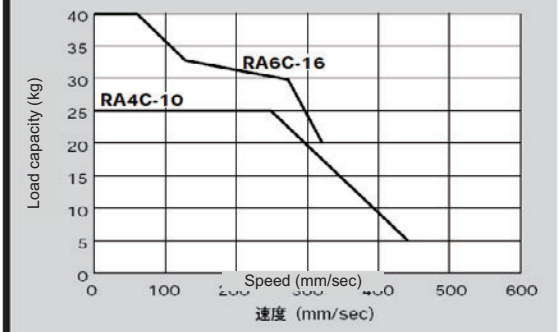
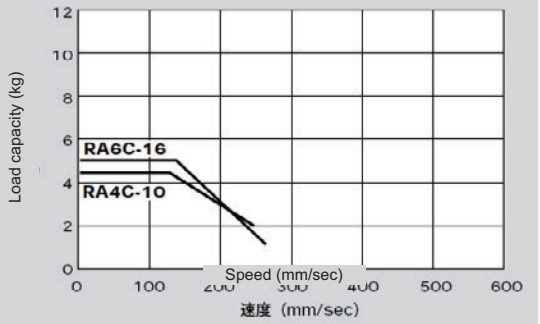
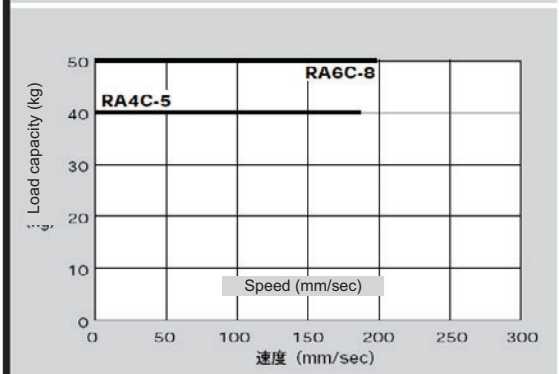
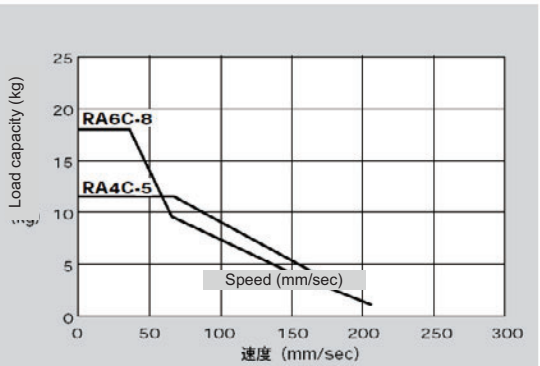
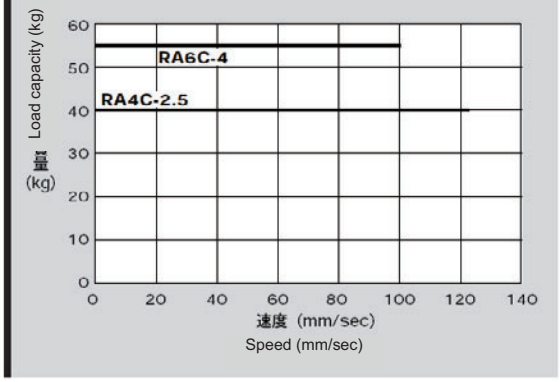
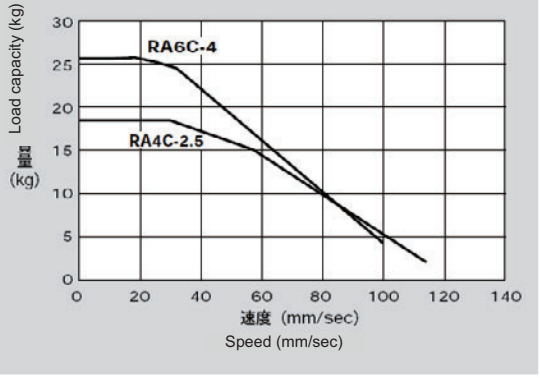
(Note) In the above graphs, the number after the type code indicates the lead.

Correlation diagram of speed and load capacity for the double-guide type

	Horizontal installation	Vertical installation
High-speed type		
Medium-speed type		
Low-speed type		

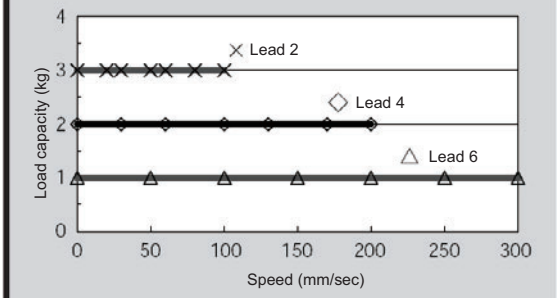
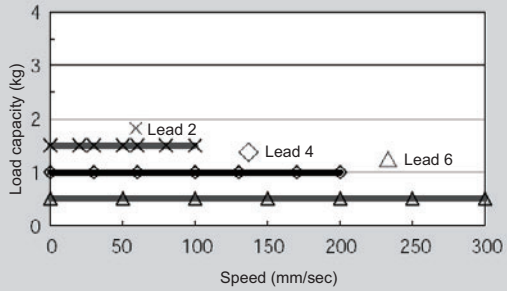
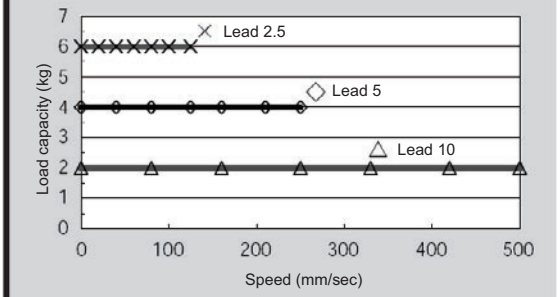
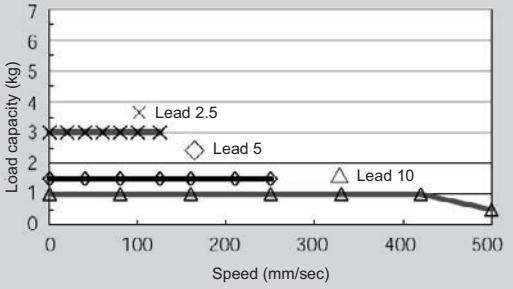
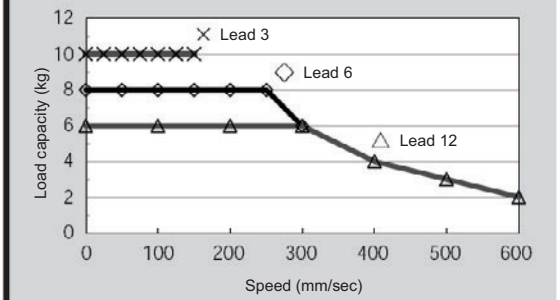
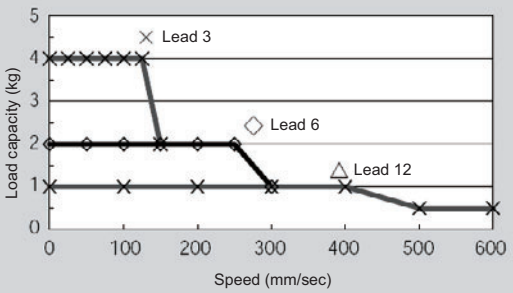
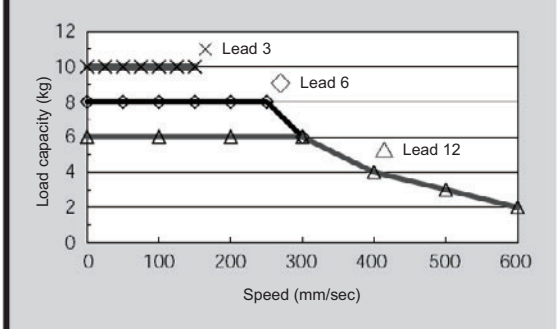
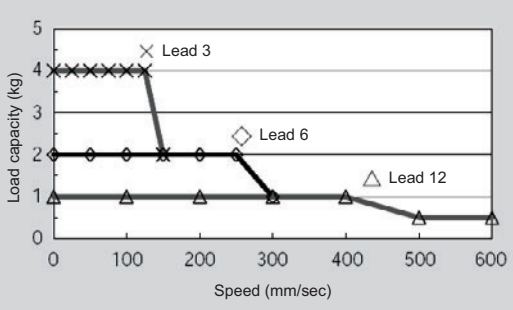
(Note) In the above graphs, the number after the type code indicates the lead.

Correlation diagram of speed and load capacity for the dustproof/splash-proof type

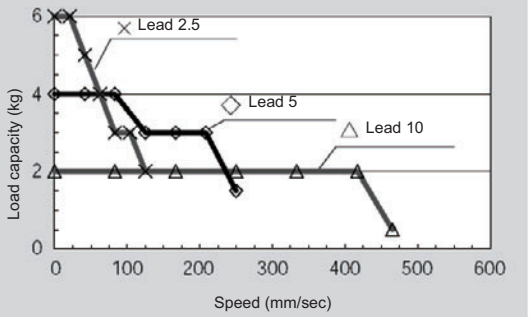
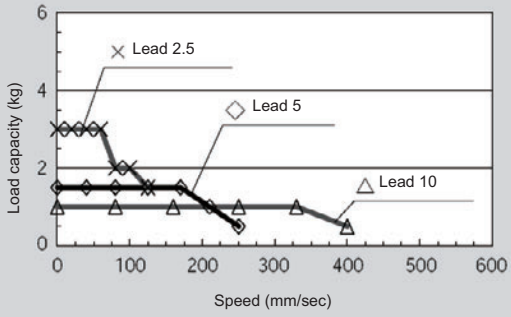
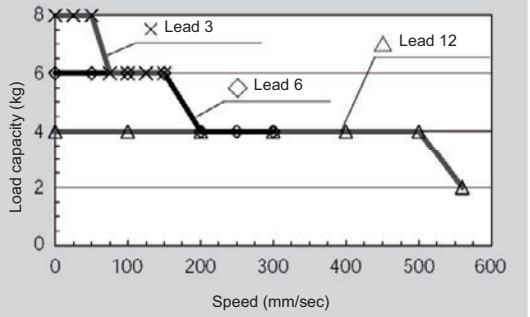
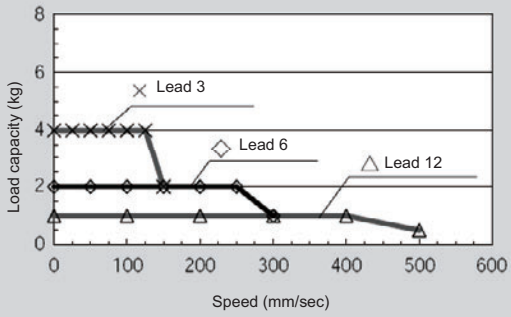
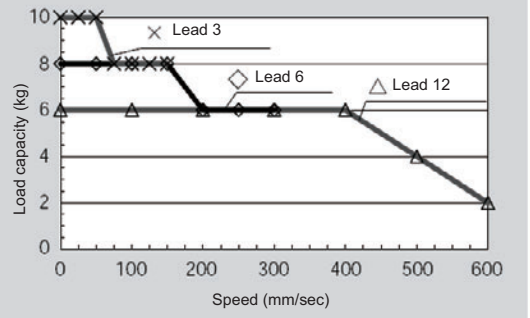
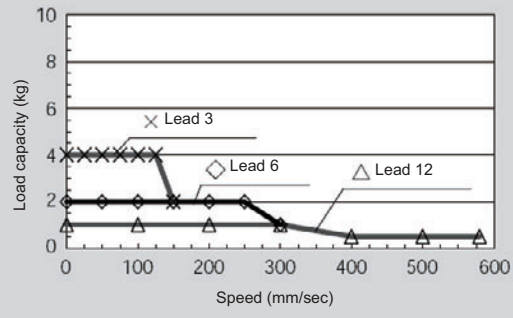
	Horizontal installation (Note 1)	Vertical installation (Note 2)
High-speed type		
Medium-speed type		
Low-speed type		

(Note) In the above graphs, the number after the type code indicates the lead.
(Note 1) The figures for horizontal installation assume use of an external guide.
(Note 2) Use of the actuator at the maximum load capacity corresponding to the applicable speed may cause vibration/overshooting. Select an appropriate model that provides an allowance of approx. 70%.

Correlation diagram of speed and load capacity for the RCP3 slider type

	Horizontal installation	Vertical installation
SA3C		
SA4C		
SA5C		
SA6C		

Correlation diagram of speed and load capacity for the RCP3 table type

	Horizontal installation	Vertical installation
TA5C		
TA6C		
TA7C		

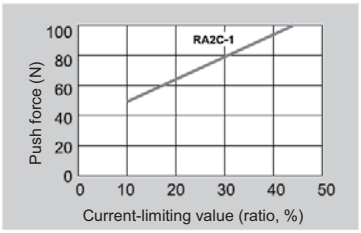
Push Force and Current-limiting Value

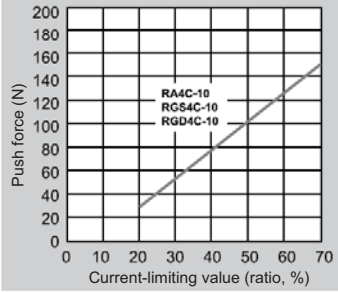
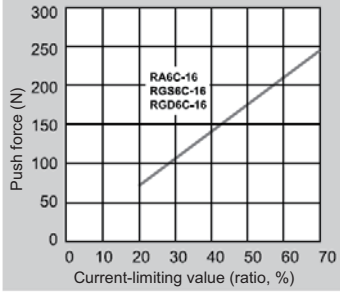
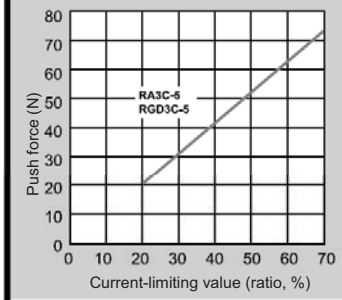
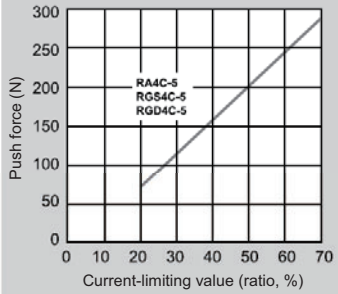
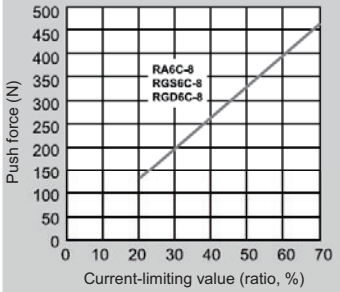
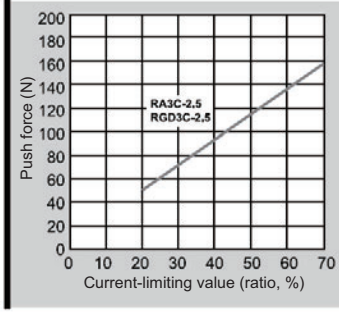
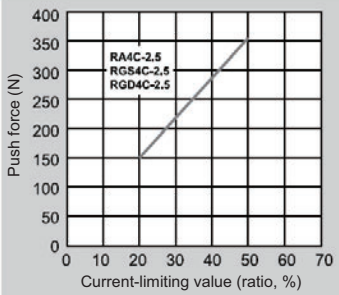
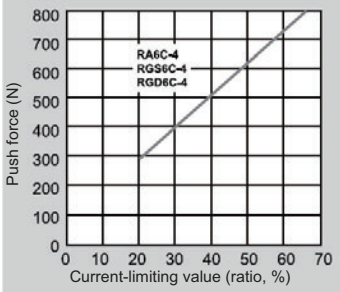
Caution

- The relationship of push force and current-limiting value is based on the rated push speed (factory setting) and provides only a guideline.
- Make sure the actual push force is equal to or greater than the minimum push force. If not, the push force will not stabilize.
- Do not change the setting of push speed (parameter No. 7). If you must change the push speed, consult IAI.
- If, among the operating conditions, the positioning speed is set to a value equal to or smaller than the push speed, the push speed will become the set speed and the specified push force will not generate.

RCP2 Series — Rod Type

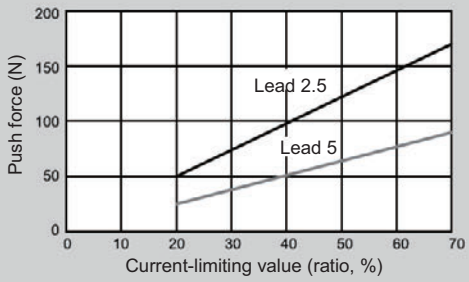
RA2C Type



	RA3C/RGD3C	RA4C/RGS4C/RGD4C	RA6C/RGS6C/RGD6C
High-speed type			
Medium-speed type			
Low-speed type			

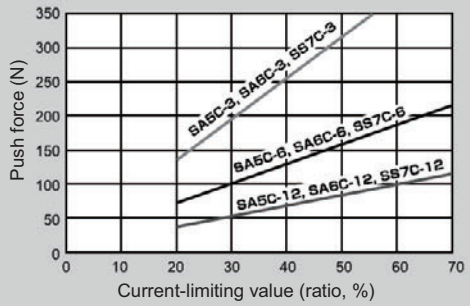
RCP2 Series Short Type

SRA4R/SRGS4R/SRGD4R

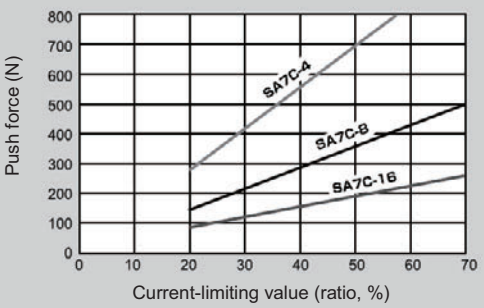


RCP2 Series Slider Type

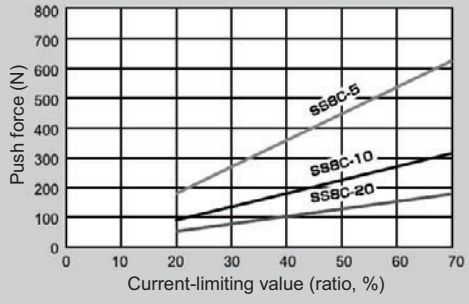
SA5C/SA6C/SS7C Type



SA7C Type

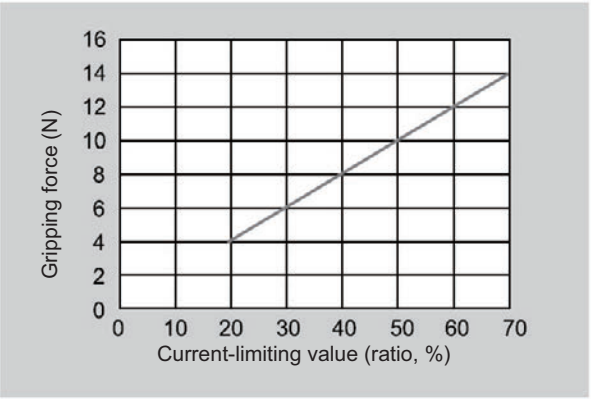


SS8C Type

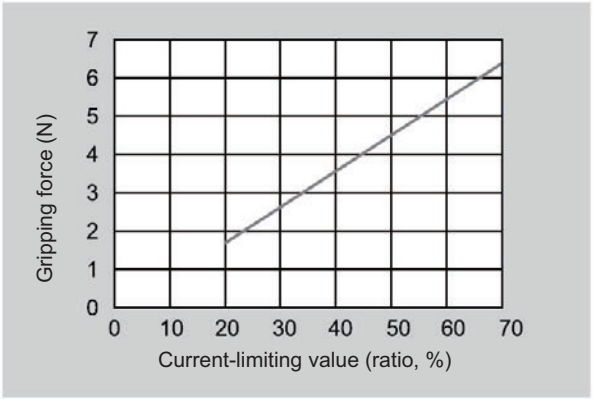


RCP2 Series **Gripper**

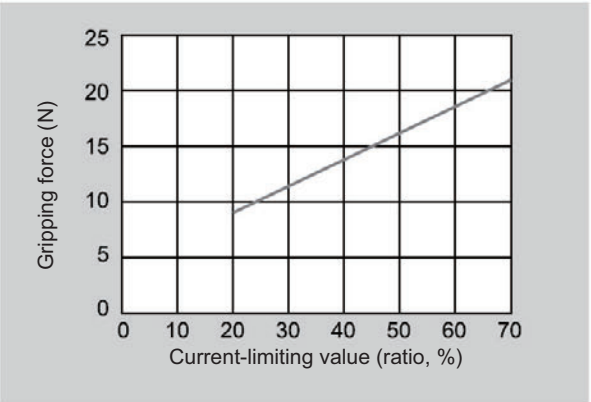
GRSS



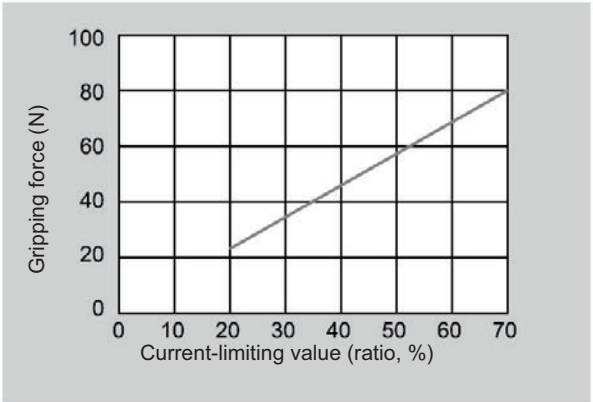
GRLS



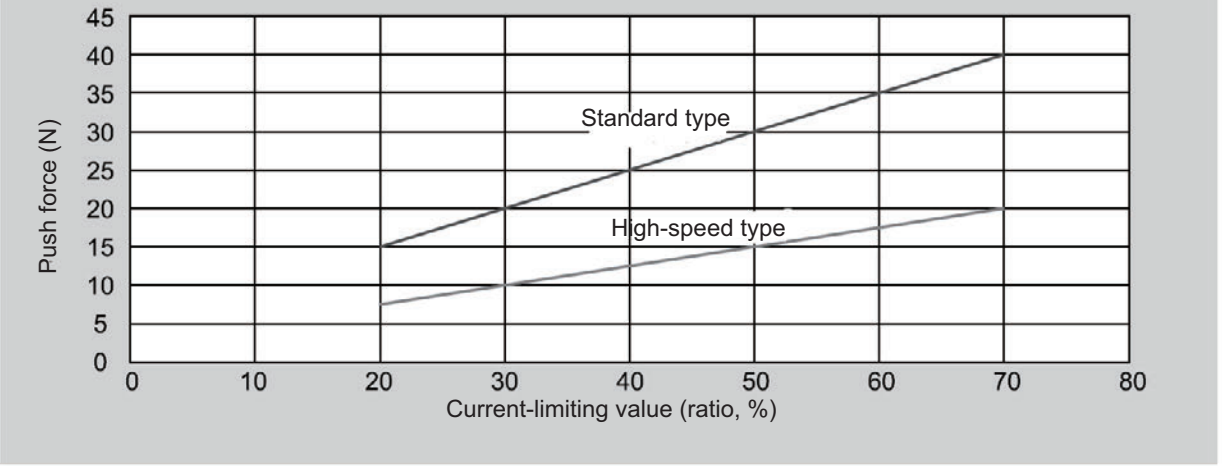
GRS



GRM

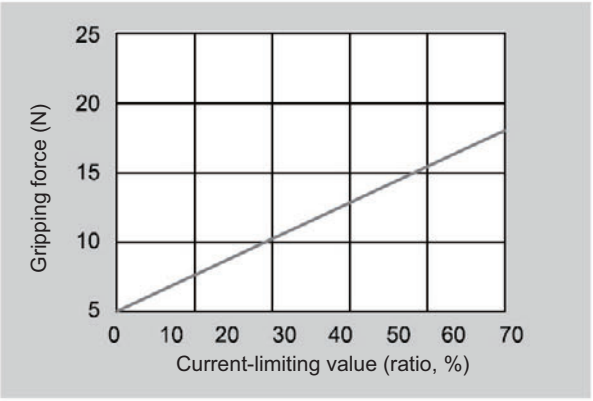


GRST

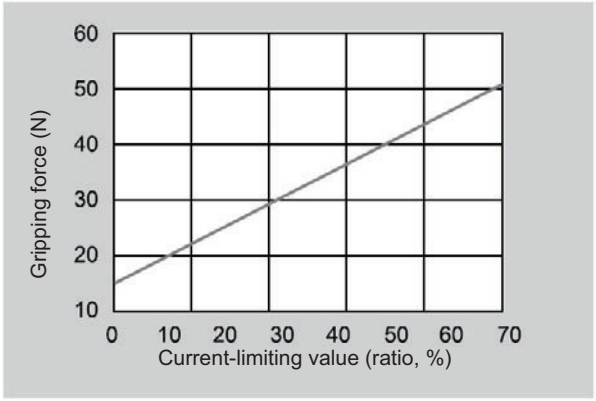


RCP2 Series **3-finger Gripper**

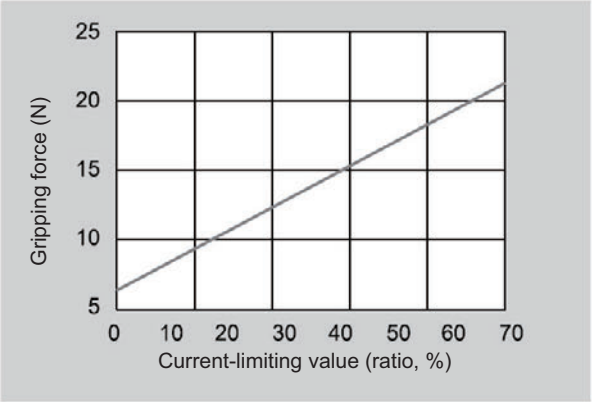
GR3LS



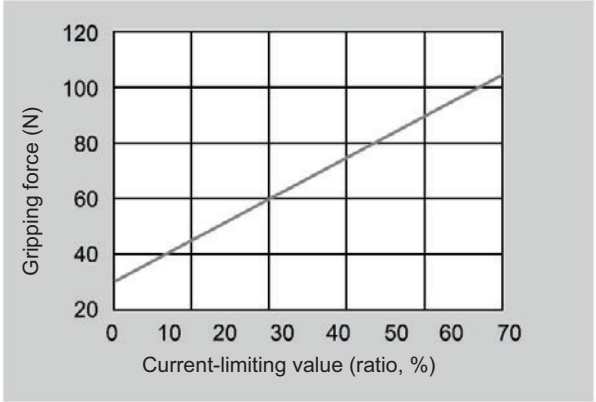
GR3LM



GR3SS

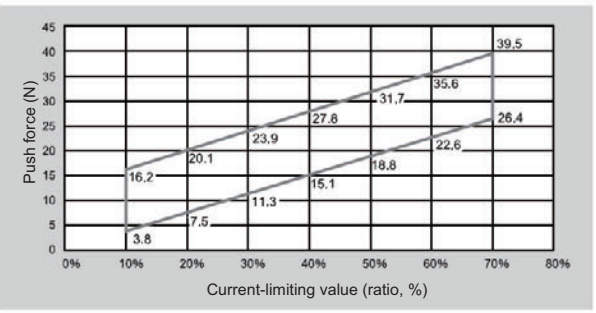


GR3SM

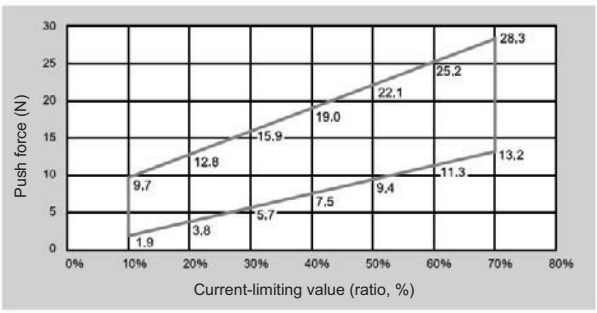


RCP3 Series **Slim, Compact Rod Type**

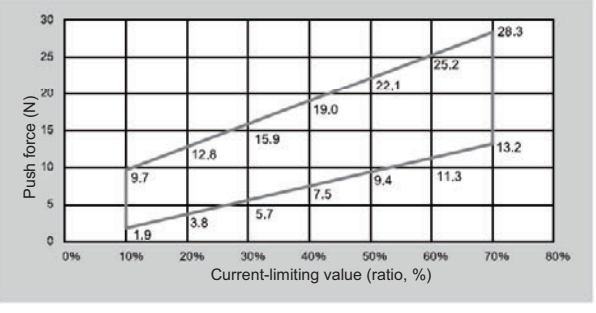
RA2AC/RA2AR Lead 1



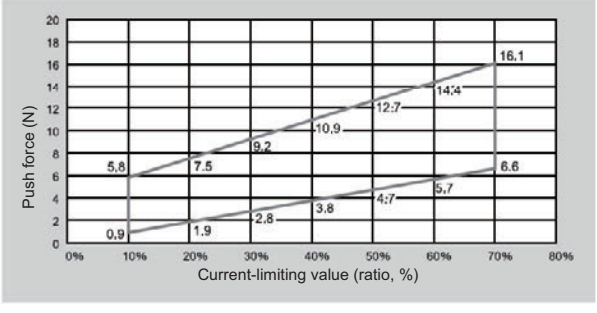
RA2BC/RA2BR Lead 2



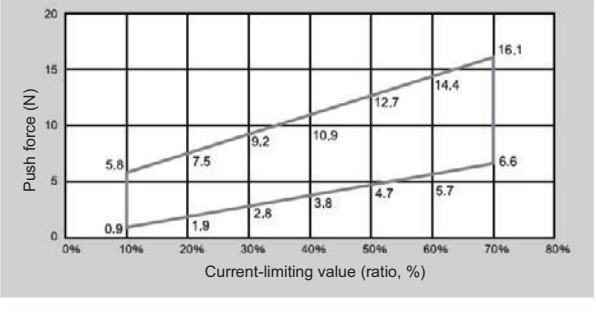
RA2AC/RA2AR Lead 2



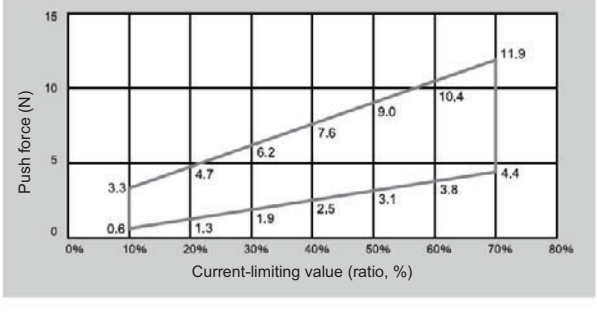
RA2BC/RA2BR Lead 4



RA2AC/RA2AR Lead 4

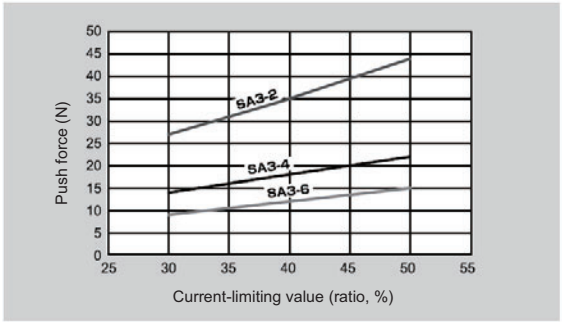


RA2BC/RA2BR Lead 6

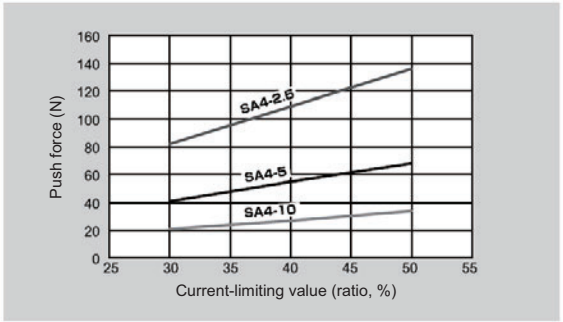


RCP3 Series Slider Type

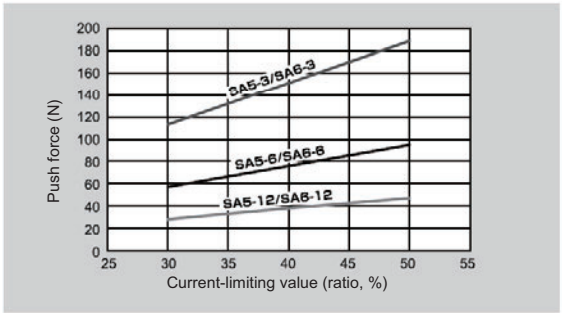
SA3C Type



SA4C Type

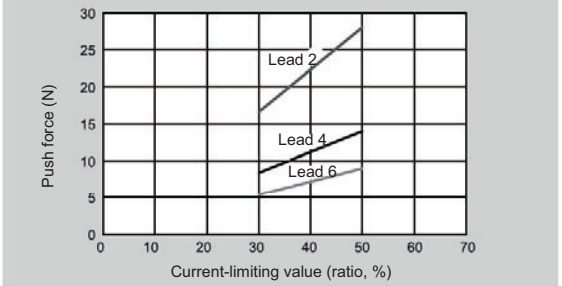


SA5C/SA6C Type

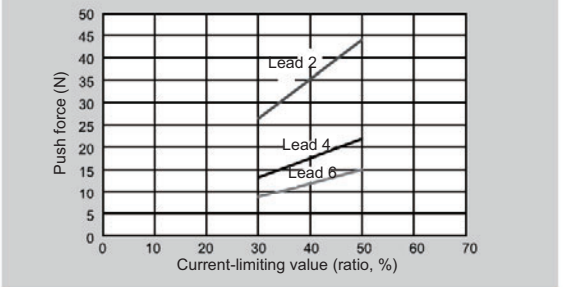


RCP3 Series Slim, Compact Table Type

TA3C/TA3R Type

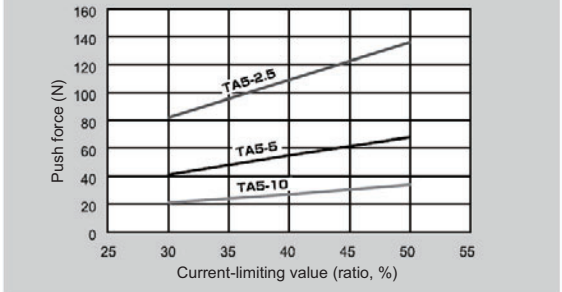


TA4C/TA4R Type

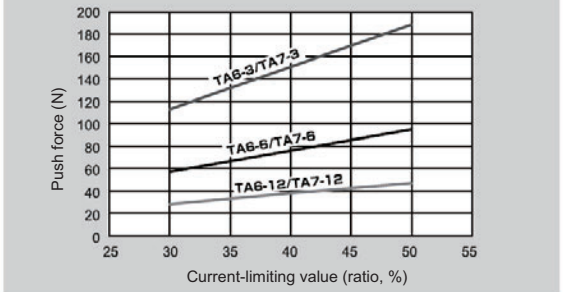


RCP3 Series Table Type

TA5C Type



TA6C/TA7C Type



Position Table Record

Date Recorded: _____

No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Threshold [%]	Positioning band [mm]	Zone + [mm]	Zone – [mm]	Acceleration/ deceleration mode	Incremental	Command mode	Standstill mode
0													
1													
2													

Parameter Record

Recorded date: _____

Types: a: Parameter relating to actuator stroke range
b: Parameter relating to actuator operating characteristics
c: Parameter relating to external interface
d: Servo gain adjustment

No.	Type	Name	Unit	Data
1	a	Zone limit 1 + side	mm	
2	a	Zone limit 1 – side	mm	
3	a	Soft limit + side	mm	
4	a	Soft limit – side	mm	
5	a	Home direction [0: Reverse / 1: Forward]	-	
6	b	Push-motion completion judgment time	msec	
7	d	Servo gain number	-	
8	b	Default speed	mm/sec	
9	b	Default acceleration/deceleration	G	
10	b	Default positioning band (in-position)	mm	
12	b	Current-limiting value at standstill after positioning	%	
13	b	Current-limiting value during homing	%	
16	c	SIO communication speed	bps	
17	c	Minimum delay time for slave transmitter activation	msec	
18	b	Home sensor input polarity	-	
21	c	Servo-on input disable selection [0: Enable / 1: Disable]	-	
22	a	Home offset	mm	
23	a	Zone limit 2 + side	mm	
24	a	Zone limit 2 – side	mm	
25	c	PIO pattern selection	-	
28	b	Default direction of excited phase signal detection [0: Reverse / 1: Forward]	-	
29	b	Excited phase signal detection time	msec	
31	d	Speed loop proportional gain	-	
32	d	Speed loop integral gain	-	
33	d	Torque filter time constant	-	
34	b	Push speed	mm/sec	
35	b	Safety speed	mm/sec	
36	b	Automatic servo-off delay time 1	sec	
37	b	Automatic servo-off delay time 2	sec	
38	b	Automatic servo-off delay time 3	sec	
39	c	Positioning complete signal output mode [0: PEND / 1: INP]	-	
42	b	Enable function [0: Enable / 1: Disable]	-	
43	b	Home check sensor input polarity	-	
45	c	Silent interval multiplication factor	times	
46	b	Speed override	%	
53	b	Default standstill mode	-	
77	b	Ball screw lead	mm	
78	b	Axis operation type	-	
79	b	Rotational axis mode selection	-	
80	b	Shortcut selection for rotational axis	-	
83	b	Absolute unit [0: Do not use / 1: Use]	-	

Change History

Revision Date	Description of Revision
	First edition
2007.03	Second edition
	Third edition
2009.12	Third B edition
	• Note added regarding CE Marking at the beginning
2010.02	Fourth edition
	• Operation Manual Catalog No. changed
2010.03	Fifth edition
	• “Please Read Before Use” added after top page
	• “H: High-acceleration loading specification” added to model name in P.4
2010.04	Sixth edition
	• “Precautions for Safety” in P.1 to 7, before Table of Contents, deleted and swapped to “Safety Guide” after Table of Contents
	• “List of Specifications of Applicable Actuators” in Appendix in P.110 swapped with “List of Specifications of Connectable Actuators”
	• “Push Force and Current-limiting Value” added to Appendix in P.126
	Seventh edition
	• Skipped
2010.09	Eighth edition
	• Note added regarding CE Marking at the beginning
	• Correction made to explanations of excited phase signal detection time in P.45 and 46
	• Notes related to “Push Force and Current-limiting Value” in P.72 to 75 moved to last pages
	• Cautions for push-motion operation added to P.70
	• 0C8 error added in P.97
	• Correction made to referable parameter numbers in caution note in P.106 and 122
2011.01	Ninth edition
	• Correction made in “Speed loop integral gain” in P.95
2011.04	Tenth edition
	• Swapped over the page for CE Marking
2011.07	Eleventh edition
	• Contents changed in 1.6 Warranty in P. 16 to P. 17 • Caution note added regarding positioning band setting in P. 85 and P. 99 • Contents changed and added in Appendix: List of Specifications of Connectable Actuators.

Revision Date	Description of Revision
2012.05	Twelfth edition • “Explanation for UL Compliance” added before Contents • Contents added and changed in Safety Guide • 3.1 Installation Environment revised
2012.07	Thirteenth edition • Contents changed in UL
2013.01	Fourteenth edition • Contents deleted in UL
2013.11	Fifteenth edition • 5.4 Power-saving Modes at Standby Positions revised
2019.04	Fifteenth C edition • Correction made to I/O Flat Cable Type in P. 24

Manual No.: ME0156--15C (April 2019)

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