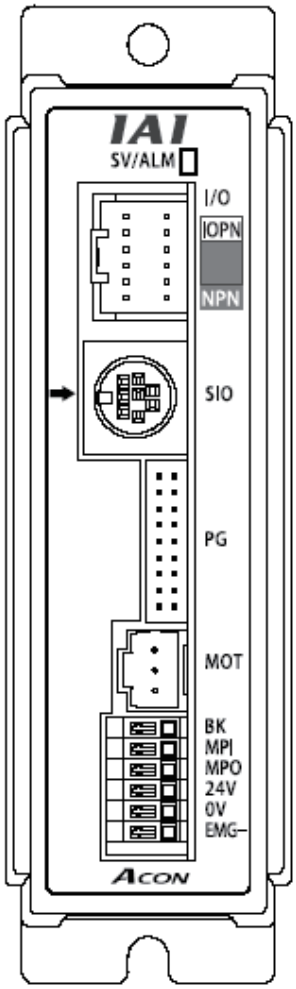
ACON

ACON-CY Controller
Solenoid Valve Type

Operation Manual Thirteen Edition



IAI America, Inc.

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 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.
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- The company names, names of products and trademarks of each company shown in the sentences are registered trademarks.

ACON	CAUTION

1. Use Environment

ACON controllers can be used in an environment of pollution degree 2 or equivalent.

2. PC Software and Teaching Pendant Models

New functions have been added to the entire ACON 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 RCS 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 RCS controllers.
PC software (with USB communication cable)	RCM-101-USB	
Teaching pendant	RCM-T, CON-T	
Simple teaching pendant	RCM-E	
Data setting unit	RCM-P	
Touch panel display	RCM-PM-01	It is not compatible with RCS controller.

3. Recommendation for Backing Up Latest Data

This controller uses nonvolatile memory to store position table data and parameters. Although data in the memory is retained even after the power is cut off, the stored data will be lost if the nonvolatile memory is damaged.

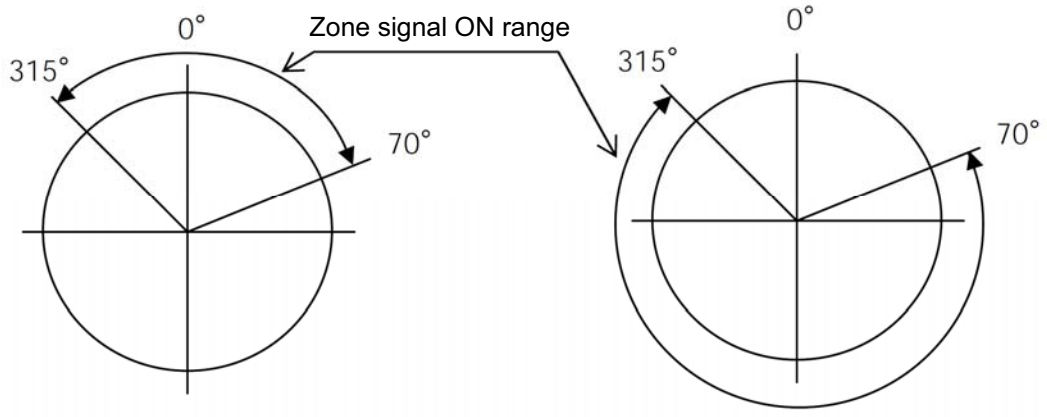
It is therefore recommended that you regularly back up the latest position table data and parameters in case of accidental data loss. Regular backup will also let you restore data quickly if the controller must be replaced for other reasons.

Use the following methods to back up data:
[1] Use the PC software to save the data to a CD or FD.
[2] Create a position table sheet or parameter sheet and keep a written record of backup.

- Changes to Zone Function

Applicable application versions: V0015 and later
Among the zone signal settings, those that result in “Zone setting+ < Zone setting-” are now effective.
V0014 and earlier: “Zone setting+ ≤ Zone setting-” → A zone signal is not output.
V0015 and later: “Zone setting+ = Zone setting-” → This is the only condition in which a zone signal is not output.
Accordingly, you can now output a zone signal even when a rotary actuator is operated over the 0° position in the index mode.
An example is given below.

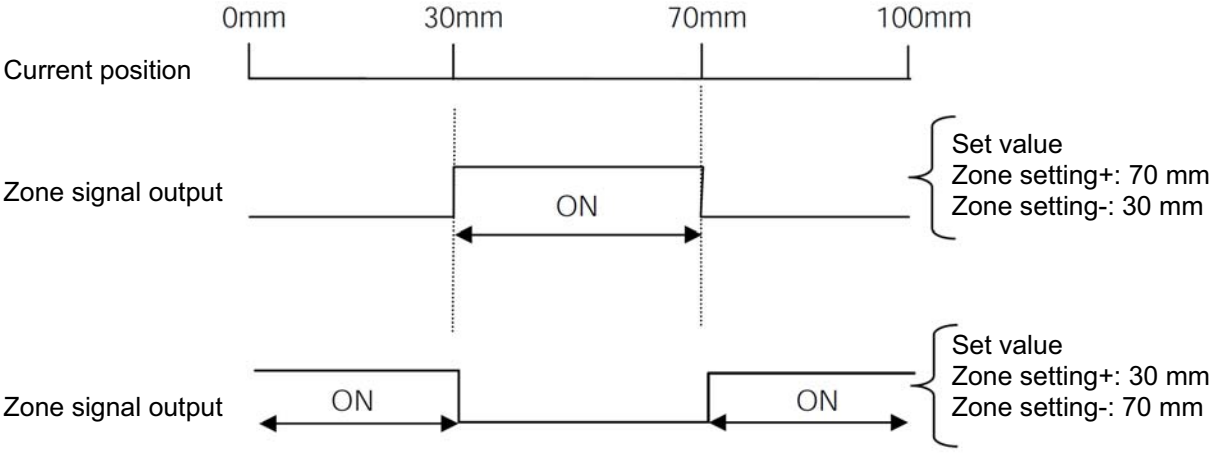
[Rotary actuator in index mode]



Set value
Zone setting+: 70°
Zone setting-: 315°

Set value
Zone setting+: 315°
Zone setting-: 70°

[Linear axis]



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

When designing and manufacturing a robot system, ensure safety by following the safety guides provided below and taking the necessary measures.

Regulations and Standards Governing Industrial Robots

Safety measures on mechanical devices are generally classified into four categories under the International Industrial Standard ISO/DIS 12100, “Safety of machinery,” as follows:

Safety measures
- Inherent safety design
- Protective guards --- Safety fence, etc.
- Additional safety measures --- Emergency stop device, etc.
- Information on use --- Danger sign, warnings, operation manual

Based on this classification, various standards are established in a hierarchical manner under the International Standards ISO/IEC. The safety standards that apply to industrial robots are as follows:

Type C standards (individual safety standards) → ISO10218 (Manipulating industrial robots – Safety)

→ JIS B 8433
(Manipulating industrial robots – Safety)

Also, Japanese laws regulate the safety of industrial robots, as follows:

Industrial Safety and Health Law Article 59
Workers engaged in dangerous or harmful operations must receive special education.

Ordinance on Industrial Safety and Health
Article 36 --- Operations requiring special education
- No. 31 (Teaching, etc.) --- Teaching and other similar work involving industrial robots (exceptions apply)
- No. 32 (Inspection, etc.) --- Inspection, repair, adjustment and similar work involving industrial robots (exceptions apply)

Article 150 --- Measures to be taken by the user of an industrial robot

Requirements for Industrial Robots under Ordinance on Industrial Safety and Health

Work area	Work condition	Cutoff of drive source	Measure	Article
Outside movement range	During automatic operation	Not cut off	Signs for starting operation	Article 104
			Installation of railings, enclosures, etc.	Article 150-4
Inside movement range	During teaching, etc.	Cut off (including stopping of operation)	Sign, etc., indicating that work is in progress	Article 150-3
		Not cut off	Preparation of work rules	Article 150-3
			Measures to enable immediate stopping of operation	Article 150-3
			Sign, etc., indicating that work is in progress	Article 150-3
			Provision of special education	Article 36-31
			Checkup, etc., before commencement of work	Article 151
	During inspection, etc.	Cut off	To be performed after stopping the operation	Article 150-5
			Sign, etc., indicating that work is in progress	Article 150-5
		Not cut off (when inspection, etc., must be performed during operation)	Preparation of work rules	Article 150-5
			Measures to enable immediate stopping of operation	Article 150-5
			Sign, etc., indicating that work is in progress	Article 150-5
			Provision of special education (excluding cleaning and lubrication)	Article 36-32

Applicable Models of IAI's Industrial Robots

Machines meeting the following conditions are not classified as industrial robots according to Notice of Ministry of Labor No. 51 and Notice of Ministry of Labor/Labor Standards Office Director (Ki-Hatsu No. 340):

(1) Single-axis robot with a motor wattage of 80 W or less
(2) Combined multi-axis robot whose X, Y and Z-axes are 300 mm or shorter and whose rotating part, if any, has the maximum movement range of within 300 mm^3 including the tip of the rotating part
(3) Multi-joint robot whose movable radius and Z-axis are within 300 mm

Among the products featured in our catalogs, the following models are classified as industrial robots:

1. Single-axis ROBO Cylinders
   RCS2/RCS2CR-SS8□ whose stroke exceeds 300 mm
2. Single-axis robots
   The following models whose stroke exceeds 300 mm and whose motor capacity also exceeds 80 W:
   ISA/ISPA, ISDA/ISPDA, ISWA/ISPWA, IF, FS, NS
3. Linear servo actuators
   All models whose stroke exceeds 300 mm
4. Cartesian robots
   Any robot that uses at least one axis corresponding to one of the models specified in Sections 1 to 3 and also CT4
5. IX SCARA robots
   All models whose arm length exceeds 300 mm
   (All models excluding IX-NNN1205/1505/1805/2515, NNW2515 and NNC1205/1505/1805/2515)

Notes on Safety of Our Products

Common items you should note when performing each task on any IAI robot are explained below.

No.	Task	Note
1	Model selection	● This product is not planned or designed for uses requiring high degrees of safety. Accordingly, it cannot be used to sustain or support life and must not be used in the following applications: [1] Medical devices relating to maintenance, management, etc., of life or health [2] Mechanisms or mechanical devices (vehicles, railway facilities, aircraft facilities, etc.) intended to move or transport people [3] Important safety parts in mechanical devices (safety devices, etc.) ● Do not use this product in the following environments: [1] Place subject to flammable gases, ignitable objects, flammables, explosives, etc. [2] Place that may be exposed to radiation [3] Place where the surrounding air temperature or relative humidity exceeds the specified range [4] Place subject to direct sunlight or radiated heat from large heat sources [5] Place subject to sudden temperature shift and bedewing [6] Place subject to corrosive gases (sulfuric acid, hydrochloric acid, etc.) [7] Place subject to excessive dust, salt or iron powder [8] Place where the product receives direct vibration or impact ● Do not use this product outside the specified ranges. Doing so may significantly shorten the life of the product or result in product failure or facility stoppage.
2	Transportation	● When transporting the product, exercise due caution not to bump or drop the product. ● Use appropriate means for transportation. ● Do not step on the package. ● Do not place on the package any heavy article that may deform the package. ● When using a crane with a capacity of 1 ton or more, the crane must be operated by personnel qualified to operate cranes and perform slinging operations. ● When using a crane or other equipment, never use it to hoist any article exceeding the rated load of the applicable crane, etc. ● Use hoisting accessories suitable for the article to be hoisted. Select appropriate hoisting accessories by making sure there is an ample allowance for safety in their cutting load, etc. ● Do not climb onto the article being hoisted. ● Do not keep the article hoisted. ● Do not stand under the hoisted article.
3	Storage/ preservation	● The storage/preservation environment should conform to the installation environment. Among others, be careful not to cause bedewing.
4	Installation/ startup	(1) Installing the robot, controller, etc. ● Be sure to firmly secure and affix the product (including its load). If the product tips over, drops, malfunctions, etc., damage or injury may result. ● Do not step on the product or place any article on top. The product may tips over or the article may drop, resulting in injury, product damage, loss of/drop in product performance, shorter life, etc. ● If the product is used in any of the following places, provide sufficient shielding measures: [1] Place subject to electrical noise [2] Place subject to a strong electric or magnetic field [3] Place where power lines or drive lines are wired nearby [4] Place subject to splashed water, oil or chemicals

No.	Task	Note
4	Installation/ startup	(2) Wiring the cables ● Use IAI's genuine cables to connect the actuator and controller or connect a teaching tool, etc. ● Do not damage, forcibly bend, pull, loop round an object or pinch the cables or place heavy articles on top. Current leak or poor electrical continuity may occur, resulting in fire, electric shock or malfunction. ● Wire the product correctly after turning off the power. ● When wiring a DC power supply (+24 V), pay attention to the positive and negative polarities. Connecting the wires in wrong polarities may result in fire, product failure or malfunction. ● Be sure to connect the cable connectors without fail and firmly. Failing to do so may result in fire, electric shock or product malfunction. ● Do not cut and reconnect the cables of the product to extend or shorten the cables. Doing so may result in fire or product malfunction.
		(3) Grounding ● Be sure to provide class D (former class 3) grounding for the controller. Grounding is required to prevent electric shock and electrostatic charges, improve noise resistance and suppress unnecessary electromagnetic radiation.
		(4) Safety measures ● Implement safety measures (such as installing safety fences, etc.) to prevent entry into the movement range of the robot when the product is moving or can be moved. Contacting the moving robot may result in death or serious injury. ● Be sure to provide an emergency stop circuit so that the product can be stopped immediately in case of emergency during operation. ● Implement safety measures so that the product cannot be started only by turning on the power. If the product starts suddenly, injury or product damage may result. ● Implement safety measures so that the product will not start upon cancellation of an emergency stop or recovery of power following a power outage. Failure to do so may result in injury, equipment damage, etc. ● Put up a sign saying "WORK IN PROGRESS. DO NOT TURN ON POWER," etc., during installation, adjustment, etc. If the power is accidently turned on, electric shock or injury may result. ● Implement measures to prevent the load, etc., from dropping due to a power outage or emergency stop. ● Ensure safety by wearing protective gloves, protective goggles and/or safety shoes, as necessary. ● Do not insert fingers and objects into openings in the product. Doing so may result in injury, electric shock, product damage, fire, etc. ● When releasing the brake of a vertically installed actuator, be careful not to pinch your hand or damage the load, etc., due to the slider dropping by its dead weight.
5	Teaching	● Whenever possible, perform teaching from outside the safety fences. If teaching must be performed inside the safety fences, prepare "work rules" and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying "WORK IN PROGRESS" in a conspicuous location. ● When releasing the brake of a vertically installed actuator, be careful not to pinch your hand or damage the load, etc., due to the slider dropping by its dead weight. * Safety fences --- Indicate the movement range if safety fences are not provided.

No.	Task	Note
6	Confirmation operation	● After teaching or programming, carry out step-by-step confirmation operation before switching to automatic operation. ● When carrying out confirmation operation inside the safety fences, follow the specified work procedure just like during teaching. ● When confirming the program operation, use the safety speed. Failure to do so may result in an unexpected movement due to programming errors, etc., causing injury. ● Do not touch the terminal blocks and various setting switches while the power is supplied. Touching these parts may result in electric shock or malfunction.
7	Automatic operation	● Before commencing automatic operation, make sure no one is inside the safety fences. ● Before commencing automatic operation, make sure all related peripherals are ready to operate in the auto mode and no abnormalities are displayed or indicated. ● Be sure to start automatic operation from outside the safety fences. ● If the product generated abnormal heat, smoke, odor or noise, stop the product immediately and turn off the power switch. Failure to do so may result in fire or product damage. ● If a power outage occurred, turn off the power switch. Otherwise, the product may move suddenly when the power is restored, resulting in injury or product damage.
8	Maintenance/ inspection	● Whenever possible, work from outside the safety fences. If work must be performed inside the safety fences, prepare “work rules” and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, turn off the power switch, as a rule. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying “WORK IN PROGRESS” in a conspicuous location. ● Use appropriate grease for the guides and ball screws by checking the operation manual for each model. ● Do not perform a withstand voltage test. Conducting this test may result in product damage. ● When releasing the brake of a vertically installed actuator, be careful not to pinch your hand or damage the load, etc., due to the slider dropping by its dead weight. * Safety fences --- Indicate the movement range if safety fences are not provided.
9	Modification	● The customer must not modify or disassemble/assemble the product or use maintenance parts not specified in the manual without first consulting IAI. ● Any damage or loss resulting from the above actions will be excluded from the scope of warranty.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When disposing of the product, do not throw it into fire. The product may explode or generate toxic gases.

Indication of Cautionary Information

The operation manual for each model denotes safety guides under “Danger,” “Warning,” “Caution” and “Note,” as specified below.

Level	Degree of danger/loss	Symbol
Danger	Failure to observe the instruction will result in an imminent danger leading to death or serious injury.	 Danger
Warning	Failure to observe the instruction may result in death or serious injury.	 Warning
Caution	Failure to observe the instruction may result in injury or property damage.	 Caution
Note	The user should take heed of this information to ensure the proper use of the product, although failure to do so will not result in injury.	 Note

1. Overview

1.1 Introduction

As a dedicated controller for our RCS 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 RCA, RCA2 and RCL controller.
This controller also provides a power-saving function 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.
  - Solenoid valve mode 0--- 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.
  - Solenoid valve mode 1--- A movement complete signal is output only when positioning operation has completed following a move command.

  * It is set to solenoid valve mode 0 at the time of 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 loads 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 measure
  An automatic servo-off function is provided by assuming situations where the motor is used in applications requiring a long standby time.

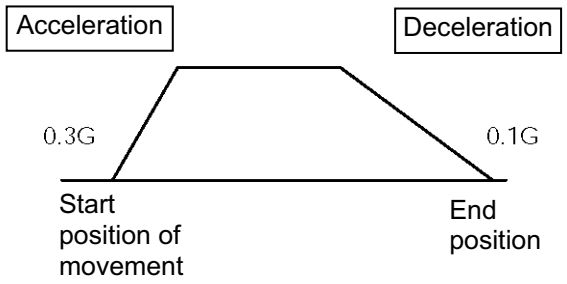
When actually starting your system or if you have encountered any problem, also refer to the manuals for the actuator, teaching pendant, PC software and/or any other component you are using, in addition to this manual.

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.

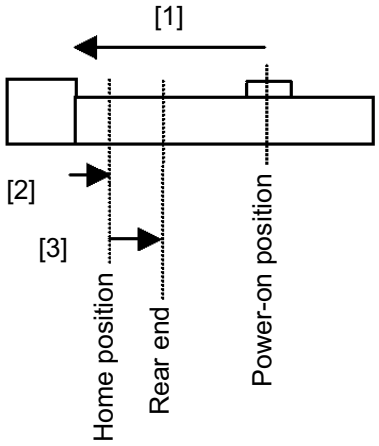
* This manual has been prepared with the utmost attention to ensure precision and completeness. However, there may still be inaccuracies and omissions. Should you find any inaccurate description or if you have any comment, please contact IAI.
Keep this manual in a convenient place so that you can easily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

1.2 Differences from Air Cylinders in Control Functions

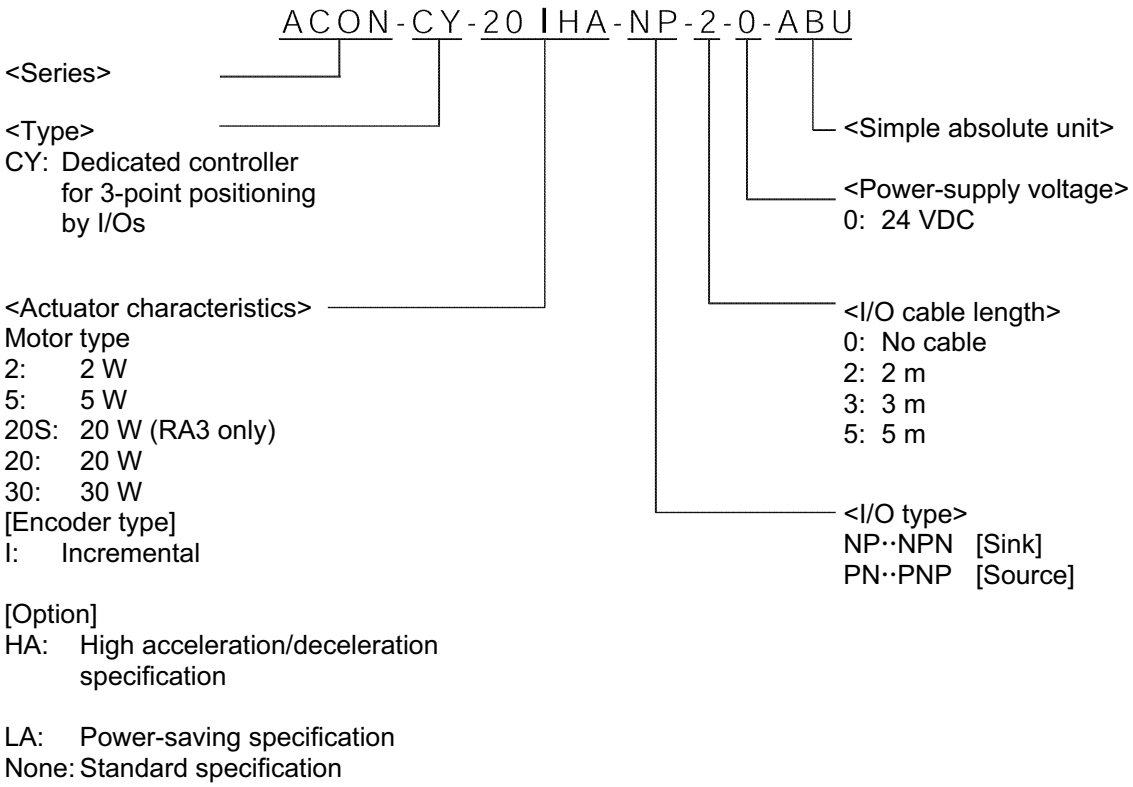
For those of you who have been using air cylinders and have never used motorized cylinders before, this section gives a brief explanation of how this controller is different from air cylinders.
Read the following information and implement controls appropriate for your system.

<table>
<tr><th>Item</th><th>Air cylinder</th><th>ACON</th></tr>
<tr><td>Drive method</td><td>Air pressure by solenoid valve control.</td><td>Ball screw drive using an AC servo 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>

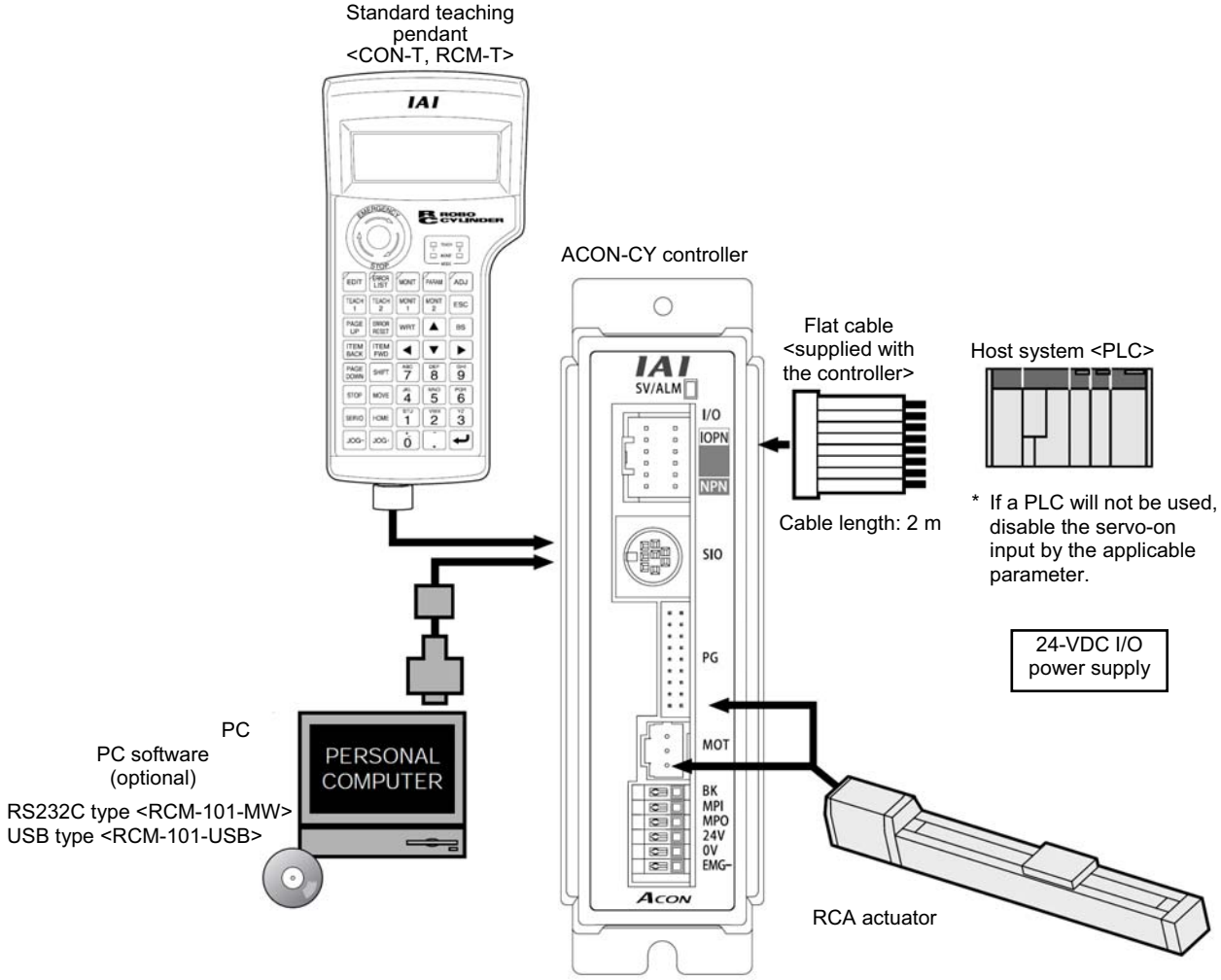
Item	Air cylinder	ACON
Position check upon power on	Judgment using a reed switch or other external detection sensor.	When the power is turned on, mechanical coordinates are not stored in the controller and thus the current position is not yet determined. For this reason, a rear end move command must 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.

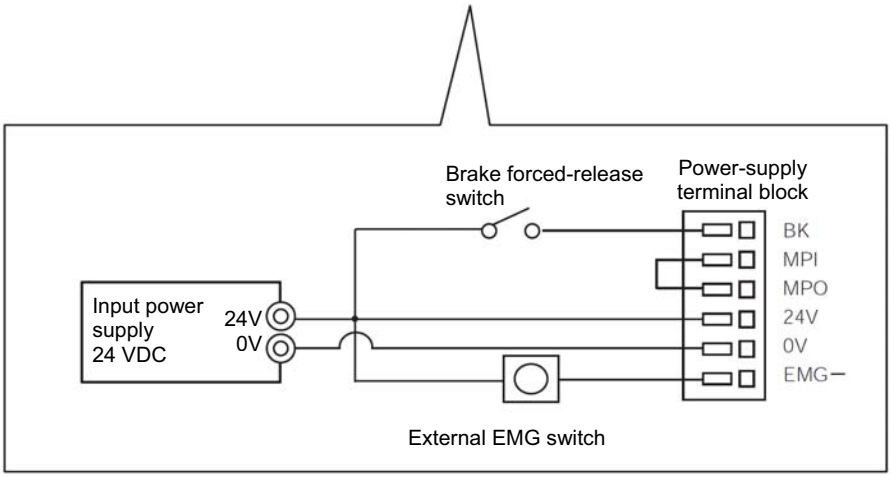
1.3 How to Read Model Name



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 ACON-CY
- Actuator
- I/O flat cable CB-PAC-PIO ***
- Motor cable CB-ACS-MA ***
- Encoder cable CB-ACS-PA ***
- Operation manual

<Options>

- Teaching pendant
  RCM-T (standard)
  RCM-E (simple)
  RCM-P (data setting)
  CON-T (standard)
- PC software
  RS232C type <RCM-101-MW>
  USB type <RCM-101-USB>
  (Each software program comes with a cable.)
- Simple absolute unit
- Touch panel display <RCM-PM-01>

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 Set the PIO pattern/safety speed

On the PC screen or teaching pendant, set the MANU operating mode to [Teaching mode: Enable safety speed/Inhibit PIOs].
In this condition, set appropriate values in parameter No. 25 (PIO pattern selection) and parameter No. 35 (Safety speed).

* The factory-set PIO pattern and safety speed are “Solenoid valve mode 0” and “100 mm/s or less,” respectively. → Chapter 6, “Parameter Settings”

6 Turn on the servo

Confirm that the slider or rod is not contacting a mechanical end.
If the slider/rod is contacting a mechanical end, move it away from the mechanical end.
If the actuator is equipped with a brake, turn on the brake forced-release switch to forcibly release the brake before moving the actuator.
The load may suddenly drop when the brake is released, so exercise due caution not to pinch your hand or damage the robot hand by the falling load.

Turn on the servo from the PC or teaching pendant.
If the actuator enters a servo lock mode and the monitor LED [SV/ALM] on the front face of the controller illuminates in green, the controller is functioning properly.

7 Check the operation of the safety circuit

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

→ 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 load 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 load, 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.

→ 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 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 Limited Liability

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

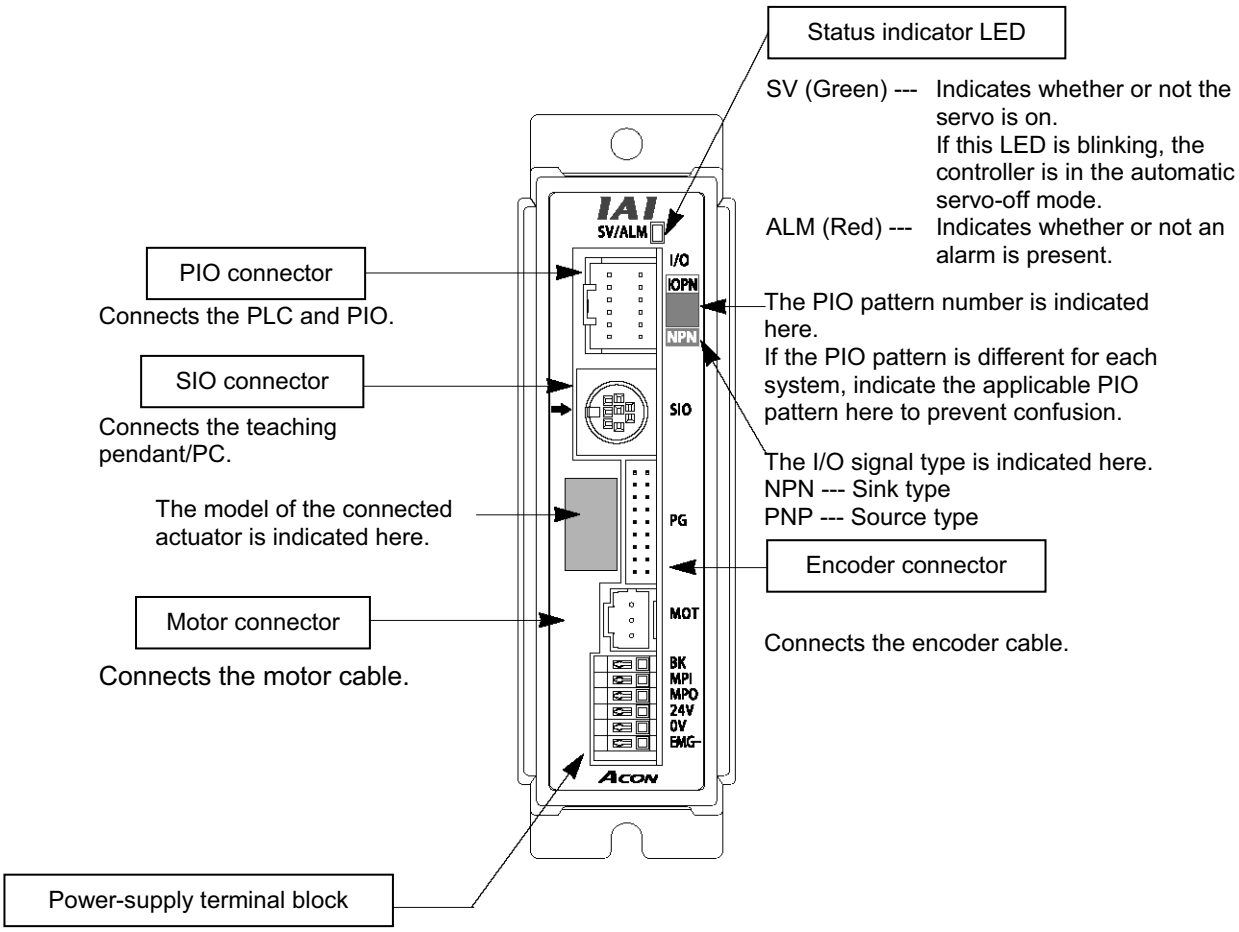
Specification item			Description			
Model			ACON-CY			
Number of controlled axes			1 axis per unit			
Power-supply voltage			24 VDC +10%/-10%			
Motor power supply capacity (Note 1)	Actuator	Motor type	Standard specification/Support high acceleration/deceleration		Support power-saving	
			Rated [A]	Maximum (Note 2)	Rated [A]	Maximum (Note 2)
	RCA/ RCA2	10W	1.3	4.4	1.3	2.5
		20W [Model code: 20]	1.3	4.4	1.3	2.2
		30W	1.3	4.4	1.3	2.2
		20 W [Model code: 20S] For RA3, RA4 and TA5 types only	1.7	5.1	1.7	3.4
	RCL	2W	0.8	4.6		
		5W	1.0	6.4		
		10W	1.3	6.4		
Heat release			8.4 W			
Encoder resolution	RCA,		800 Pulse/rev			
	RCA2	RCA2-□□□N	1048 Pulse/rev			
		Other than RCA2-□□□N	800 Pulse/rev			
	RCL	RA1L•SA1L ?SA4L•SM4L	715 Pulse/rev			
		RA2L•SA2L ?SA5L•SM5L	855 Pulse/rev			
		RA2L•SA2L ?SA6L•SM6L	1145 Pulse/rev			
Positioning command			3 positioning points (backward edge, forward edge, middle 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 isolation, dedicated 4-point inputs/6-point outputs			
PIO interface power supply			24 VDC ±10% (external supply)			
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		Free from corrosive gases.			
	Surrounding storage temperature		-10 to 65°C			
	Surrounding 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			

(Note 1) Rush current of 5 to 12 times the rated current is conducted for approximately 1 to 2 msec after turning the supply on. Note that the rush current value varies depending on the impedance of the power line.

(Note 2) The maximum current is conducted at the servo motor exciting phase detection performed in the first servo on processing after turning the power on (normally: approximately 1 to 2 seconds, maximum: 10 seconds).

* Select power supply of +24 VDC power supply of the “peak load support" specification or with sufficient capacity.

2.2 Name and Function of Each Part of the Controller



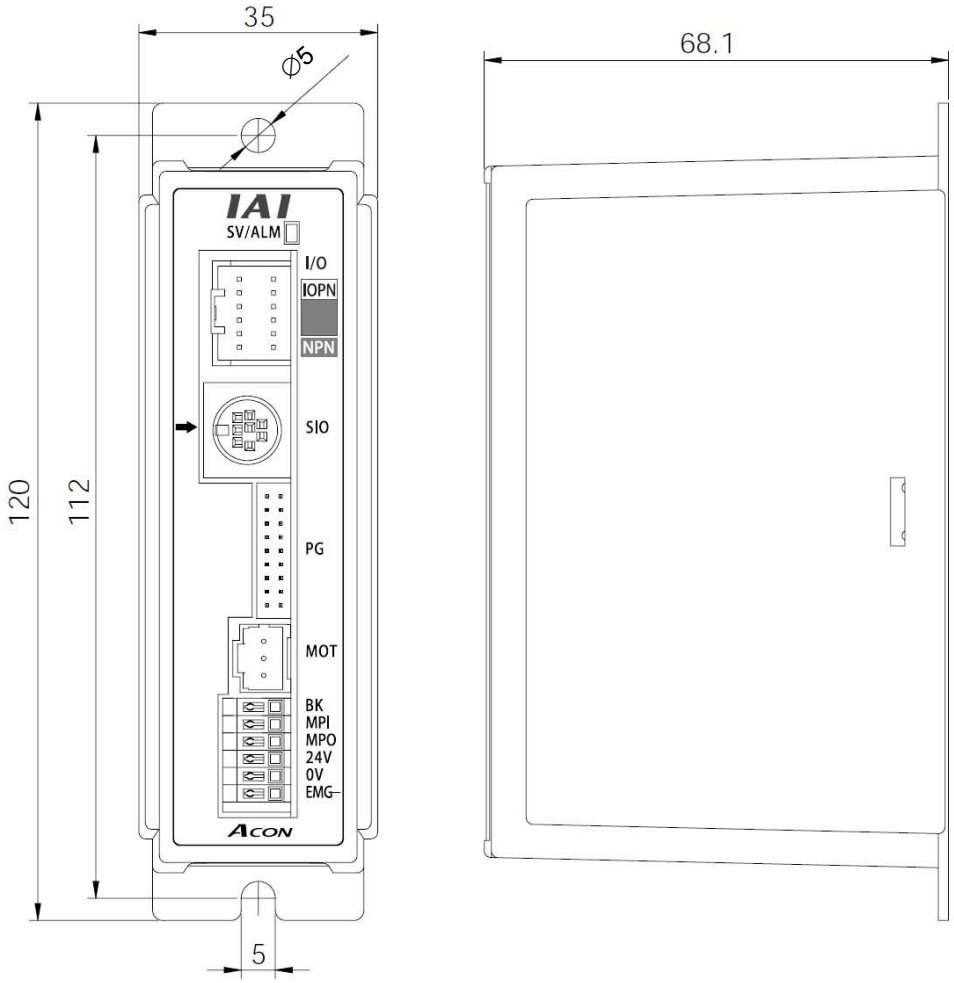
BK	Connection terminal for the brake forced-release switch to be used when the actuator is equipped with a brake. Connect the opposite side of the switch to 24 V.
MPI, MPO	Contacts for cutting off the motor drive power to achieve a safety level of safety category 1. MPI and MPO connect to the input side 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.

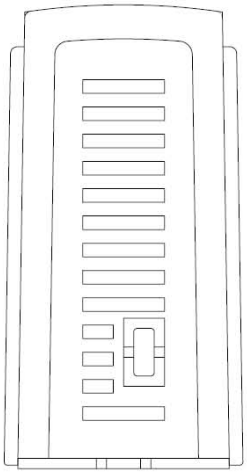
■ Model indication of the connected actuator type
The type, ball screw lead and stroke of the actuator are indicated. When connecting the cables, confirm that the actuator is of the correct specifications.
Example of indication:

SA4C ← The actuator type is SA4C.
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 installation environment of the controller.

3.1 Installation Environment

(1) When installing and wiring the controller, do not block the cooling ventilation holes. (Insufficient ventilation will not only prevent the controller from demonstrating its full performance, but it may also cause breakdown.)
(2) Prevent foreign matter from entering the controller through the ventilation holes. Since the enclosure of the controller is not dustproof or waterproof (oilproof), avoid using the controller in a place subject to significant dust, oil mist or splashes of cutting fluid.
(3) Do not expose the controller to direct sunlight or radiating heat from a large heat source such as a heat treatment furnace.
(4) Use the controller in an environment free from corrosive or inflammable gases, under a temperature of 0 to 40°C and humidity of 85% or less (non-condensing).
(5) Use the controller in an environment where it will not receive any external vibration or shock.
(6) Prevent electrical noise from entering the controller or its cables.
(7) The product can be used in an environment with Pollution Degree 2.

3.2 Supplied Voltage

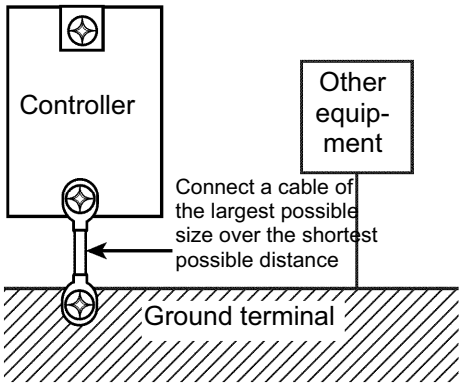
The controller takes a supplied voltage of 24 VDC ±10%.
For the load current of the actuator, refer to 2.1, “Basic Specifications.”

3.3 Noise Elimination Measures and Grounding

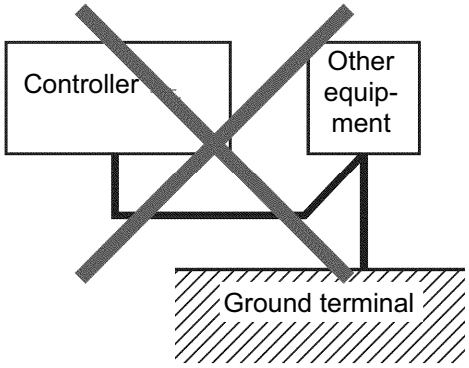
The following explains the noise elimination measures that should be taken when using this controller.

(1) Wiring and power supply connection

[1] Grounding must be made by ground resistance of 100 Ω or less using a dedicated grounding. Moreover, the thickness of cable shall be 1.6 mm^2 or thicker.



Ground resistance of 100 Ω or less



Do not link or connect the ground line with other devices; ground it for each controller.

[2] Precautions regarding wiring method

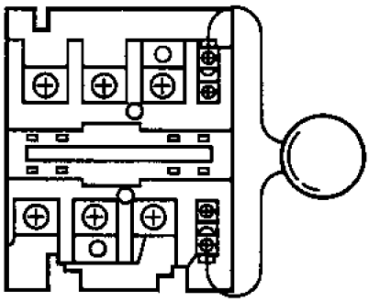
Use a twisted cable to connection the 24 VDC external power supply.
Separate wiring of signal lines and encoders from power supply lines and power lines.
(Do not tie them together or place in the same cable duct.)
If you want to extend the motor or encoder cable beyond the length of the supplied cable, 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 from these sources can be eliminated by implementing the measures specified below.

AC solenoid valves, magnet switches, relays

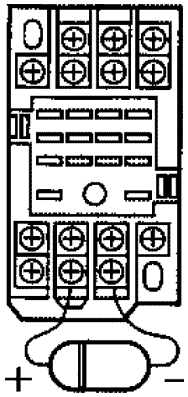
Measure: Install a surge absorber in parallel with the coil



← Surge absorber
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.

[2] DC solenoid valves, magnet switches and relays

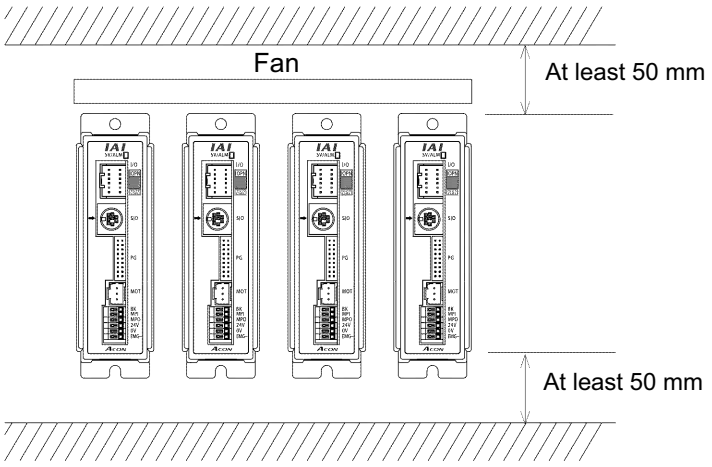
Method: Mount diodes in parallel with the coil or use types with built-in diodes.

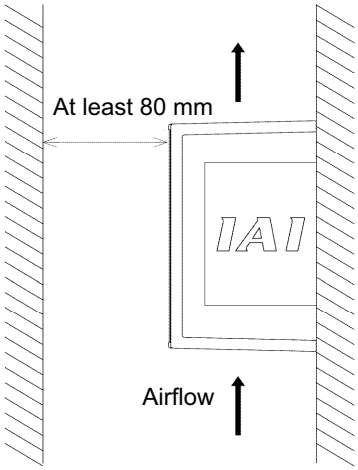


In a DC circuit, connecting a diode in reverse polarity will damage the diode, internal parts of the controller and/or DC power supply, so exercise due caution.

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).



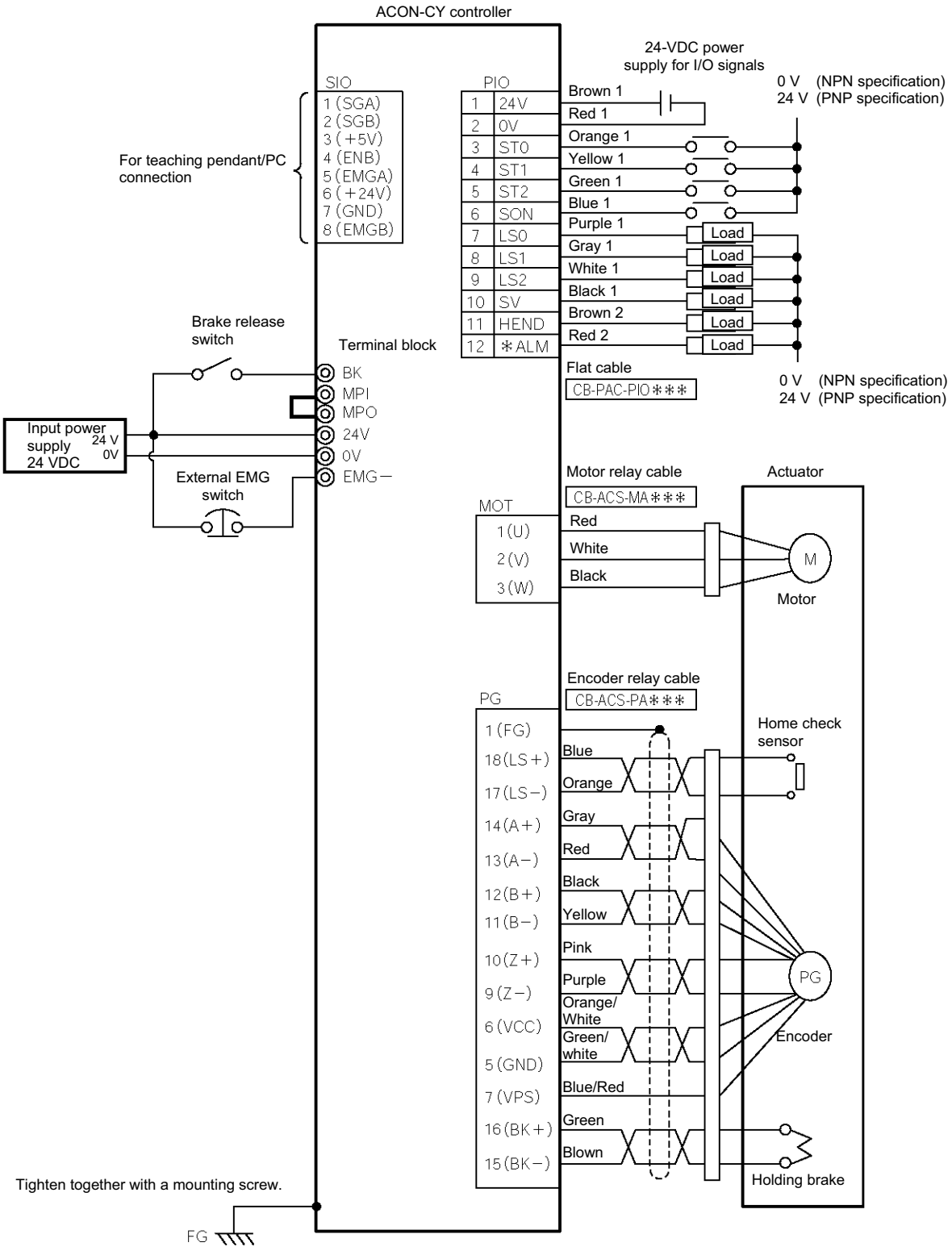


Regardless of whether you are installing one or more controllers, provide sufficient clearances around each controller to permit easy access for installation and removal of the controller.

3.5 External Connection Diagram

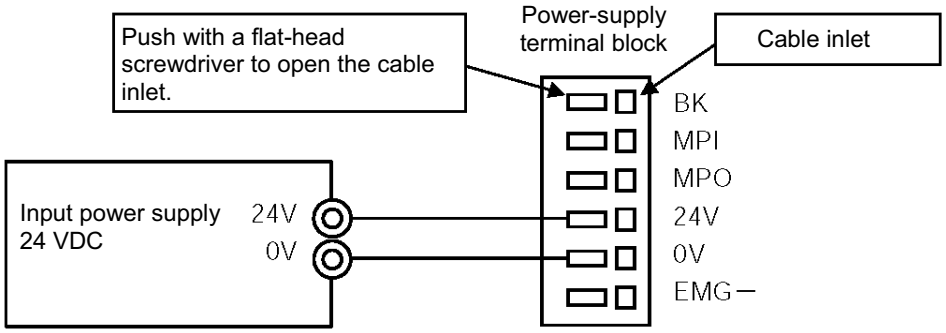
An example of standard wiring is shown below.

(Note) The PIO signal names when solenoid valve mode 0 is selected are shown below.
The color of the encoder relay cable is different for the robot cable specification. Refer to 3.9.2, “Encoder Relay Cable.”

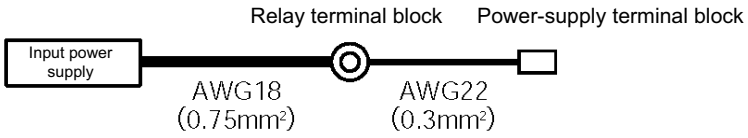
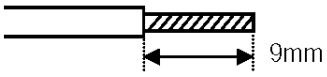


3.6 Wiring the Power Supply

Connect the positive side and negative side of the 24-VDC power supply to the 24-V terminal and 0-V terminal on the power-supply terminal block, respectively.

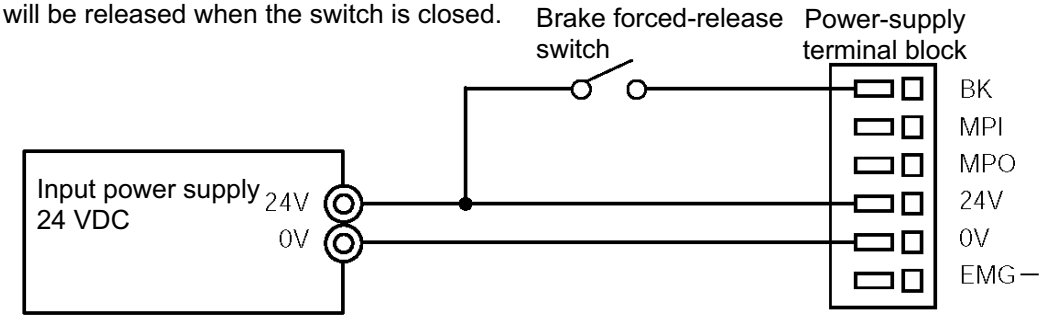


Use a wire satisfying the following specifications.

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 isolation 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.

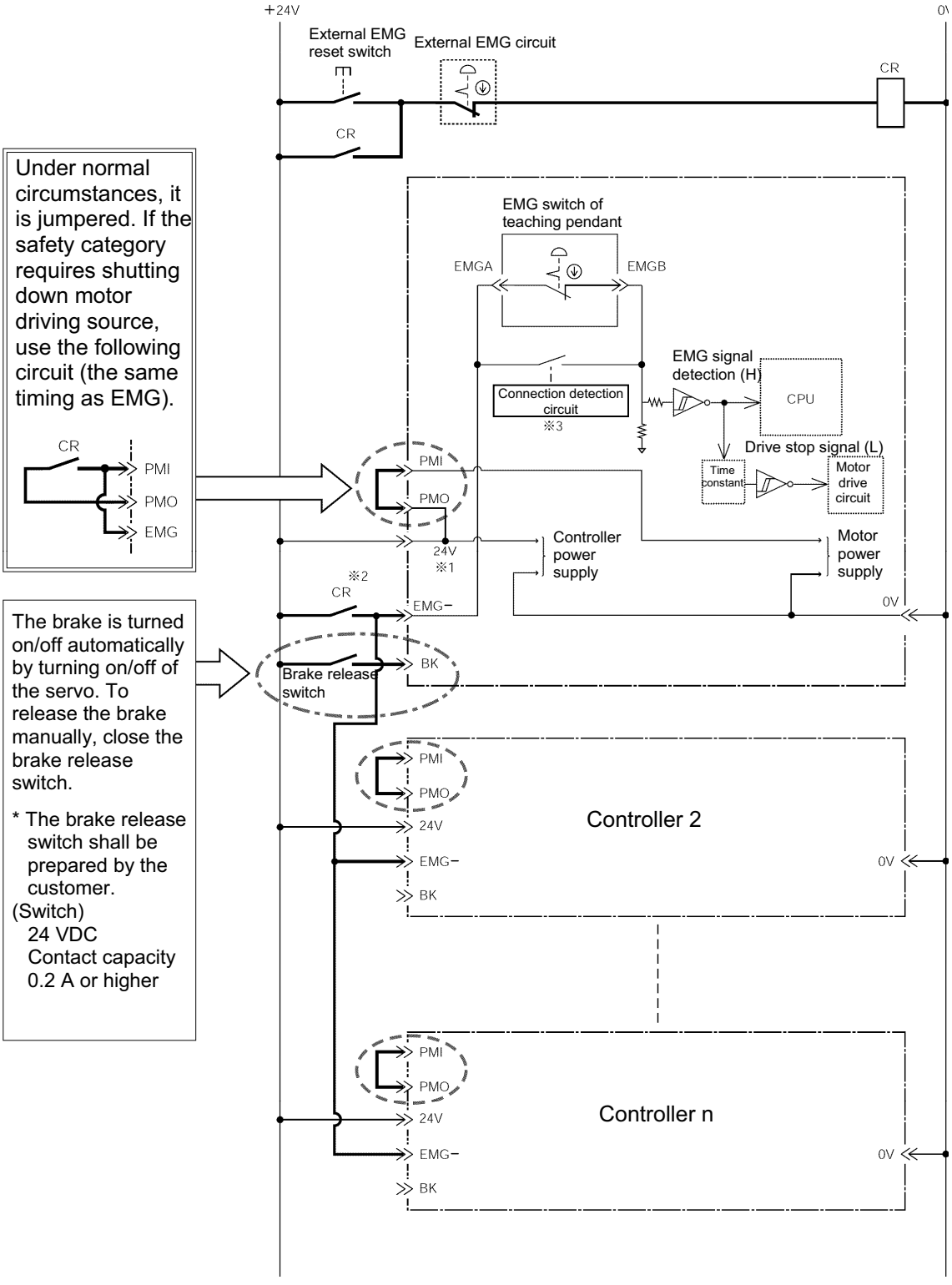


Danger:	If the actuator is oriented vertically, exercise due caution when releasing the brake to prevent the slider/rod from dropping unexpectedly to pinch your hand or damage the robot hand or load.

3.8 Wiring the Emergency Stop Circuit

3.8.1 Cutting off the Drive Signal (Standard)

The example below shows an emergency stop circuit for the entire system that urgently stops multiple controllers. Note that the entire system cannot be stopped urgently even if emergency stop is applied from the teaching pendant.



Precautions on power supply and emergency stop circuit

*1 Refer to the specification list for the load current conducted per controller.

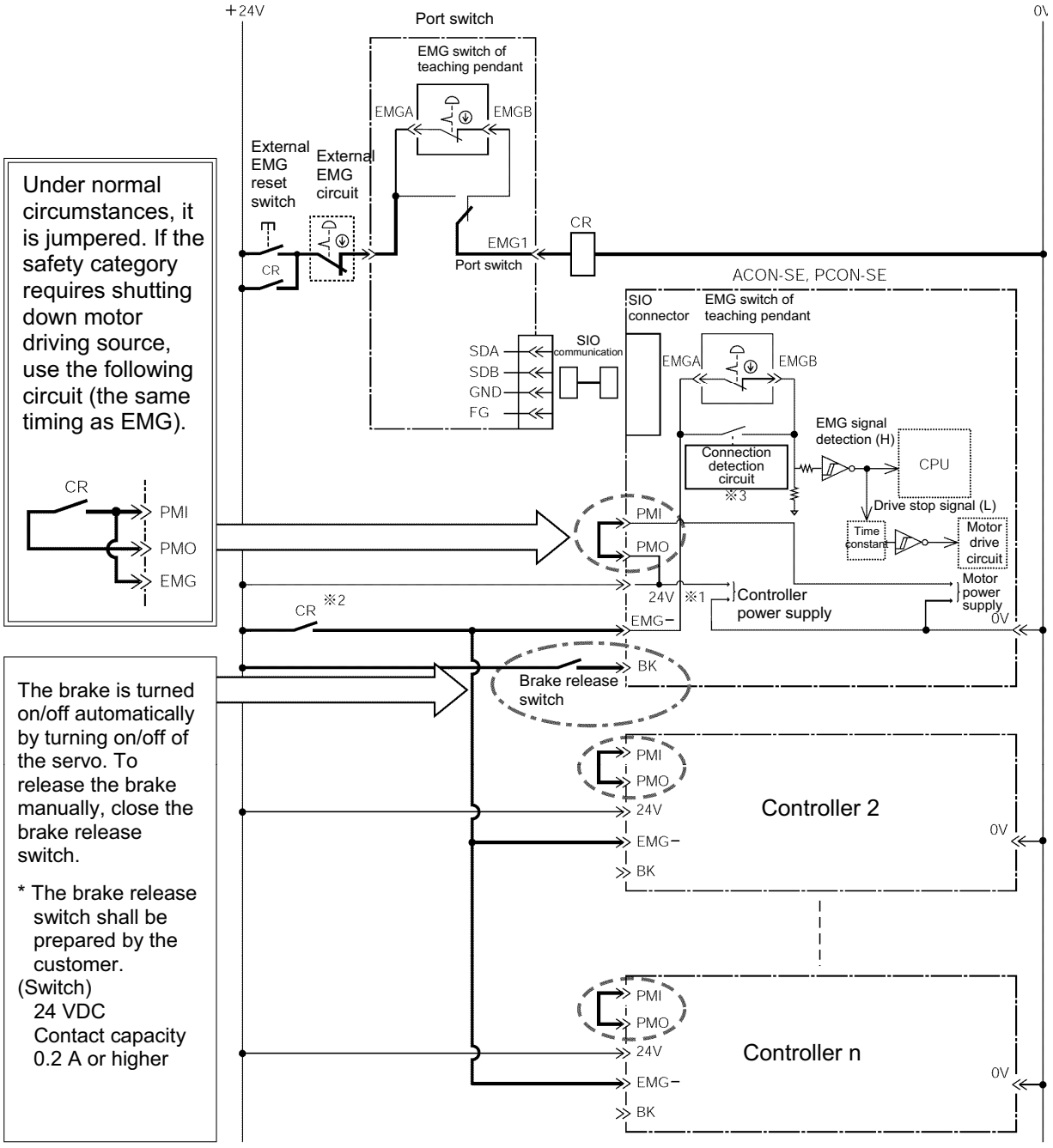
*2 The input current to the EMG- terminal per controller is 5 mA. When connecting a relay contact CR to EMG- terminals of several controllers, make sure to check the capacity of the relay contact.

*3 When the teaching pendant is inserted to a controller, the controller automatically recognizes that it is connected.

⚠ Caution:

- When shutting down the power supply circuit, do not shut down the 0 V side because it is connected to the internal ground line.
- To use an SIO converter and/or gateway unit, use the same power supply or share the 0 V side.

Use an SIO converter if it is desired to stop the entire system urgently by emergent stop via the teaching pendant. The operation on the emergency stop switch of the teaching pendant can also be reflected when a gateway unit is used as well.



Precautions on power supply and emergency stop circuit

*1 Refer to the specification list for the load current conducted per controller.

*2 The input current to the EMG- terminal per controller is 5 mA. When connecting a relay contact CR to EMG- terminals of several controllers, make sure to check the capacity of the relay contact.

*3 When the teaching pendant is inserted to a controller, the controller automatically recognizes that it is connected.

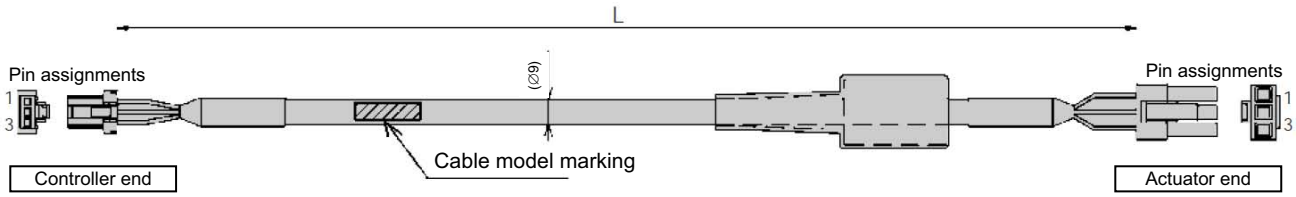
3.9 Connecting the Actuator

Dedicated relay cables are used to wire between the controller and actuator.

(1) RCA motor cable

Model: CB-ACS-MA□□□CB

(□□□ indicates the cable length L. Example: 080 = 8 m)



Pin No.	Signal name	Cable color
1	U	Red
2	V	White
3	W	Black

Housing: DF1E-3S-2.5C (Hirose)
Contact: DF1E-2022SC (Hirose)
(or DF1B-2022SC)

Pin No.	Wire size
1	AWG22
2	
3	

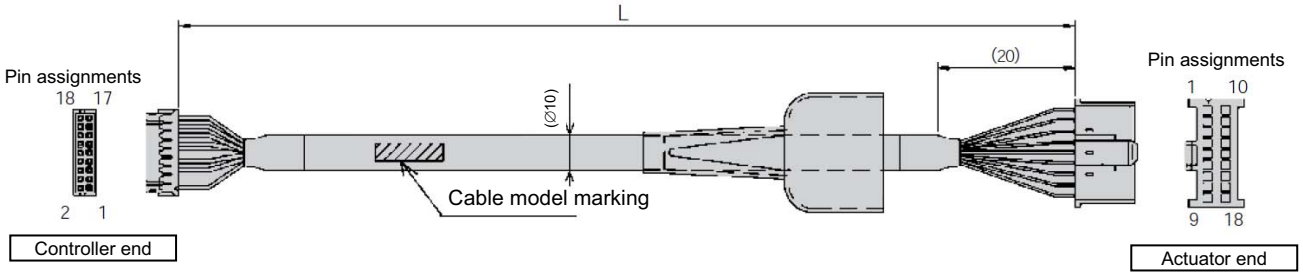
Housing: SLP-03V (J.S.T. Mfg.)
Contact: BSF-21T-P1.4 (J.S.T. Mfg.)

(2) RCA encoder cable/encoder robot cable

Standard cable model: CB-ACS-PA□□□

Robot cable model: CB-ACS-PA-□□□-RB (optional)

(□□□ indicates the cable length L. Example: 080 = 8 m)



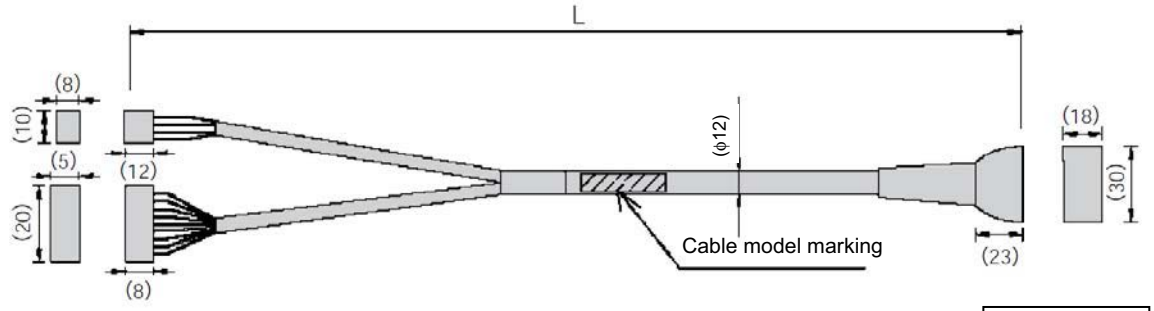
Pin No.	Signal name	Description	Cable color	
			Standard cable	Robot cable
18	LS+	Home check sensor	Blue	White/Purple
17	LS−		Orange	White/Grey
16	BK+	Brake power	Green	Yellow
15	BK−		Brown	Blue
14	ENA	Encoder phase A signal	Grey	White/Blue
13	$\overline{\text{ENA}}$		Red	White/Yellow
12	ENB	Encoder phase B signal	Black	White/red
11	$\overline{\text{ENB}}$		Yellow	White/Black
10	ENZ	Encoder phase Z signal	Pink	Orange
9	$\overline{\text{ENZ}}$		Purple	Green
8	—	—	White	Purple
7	VPS	Encoder control signal	Blue/Red	Grey
6	5V	Encoder power supply	Orange/White	Red
5	GND		Green/White	Black
4	—	—	—	—
3	—	—	—	—
2	—	—	—	—
1	FG	Shield	Drain	Drain

Housing: PHDR-18VR (J.S.T. Mfg.)
Contact: SPHD-001T-P0.5 (J.S.T. Mfg.)

Pin No.	Signal name
1	ENA
2	$\overline{\text{ENA}}$
3	ENB
4	$\overline{\text{ENB}}$
5	—
6	—
7	LS+
8	—
9	FG
10	ENZ
11	$\overline{\text{ENZ}}$
12	—
13	VPS
14	5V
15	GND
16	LS−
17	BK−
18	BK+

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

(3) RCA2 monitor/encoder integrated cable
Model: CB-ACS-MPA□□□
(□□□ indicates the cable length L. Example: 080 = 8 m)



Housing : DF1E-3S-2.5C
Contact : DF1E-2022SCF

Pin No.	Signal name	Cable name
1	U	Red
2	V	Yellow
3	W	Black

Pin No.	Signal name	Description	Cable name
18	LS+	Home check sensor	Pink (Red ●)
17	LS−		Pink (Blue ●)
16	BK+	Brake power	Yellow (Red ●)
15	BK−		Yellow (Blue ●)
14	A+	Encoder phase A signal	White (Red ●)
13	A−		White (Blue ●)
12	B+	Encoder phase B signal	Orange (Red ●)
11	B−		Orange (Blue ●)
10	Z+	Encoder phase Z signal	Grey (Red ●)
9	Z−		Grey (Blue ●)
8	−	———	Orange (Red ● continuous)
7	/PS	Encoder control signal	Orange (Blue ● continuous)
6	VCC	Encoder power supply	Grey (Red ● continuous)
5	GND		Grey (Blue ● continuous)
4	−	———	−
3	−	———	−
2	−	———	−
1	FG	Shield	Shield

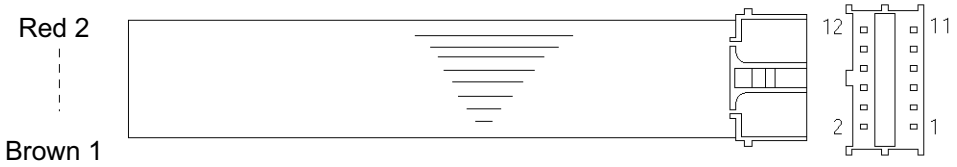
Pin No.
A1
B1
A2
B2
A3
B3
A4
B4
A5
B5
A6
B6
A7
B7
A8
B8
A9
B9
A10
B10
A11
B11

Housing: PHDR-18VR (J.S.T. Mfg.)
Contact: SPHD-001T-P0.5 (J.S.T. Mfg.)

Housing: D-1100D1-1827863-1 (AMP)
Contact: D-1 1827570-2

3.10 Connecting the I/O Flat Cable

Cable type: : CB-PAC-PIO***



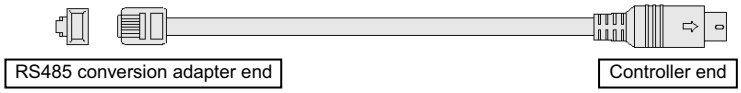
Housing: 51353-1200 (MOLEX)
Contact: 56134-9000 (MOLEX)

No.	Signal name		Color	Wiring
	In case of solenoid valve mode 0	In case of solenoid valve mode 1		
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.

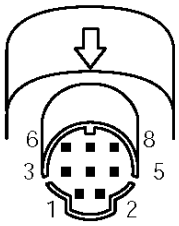
3.11 Connecting the Communication Cable

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.

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	1	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 (mm)
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.

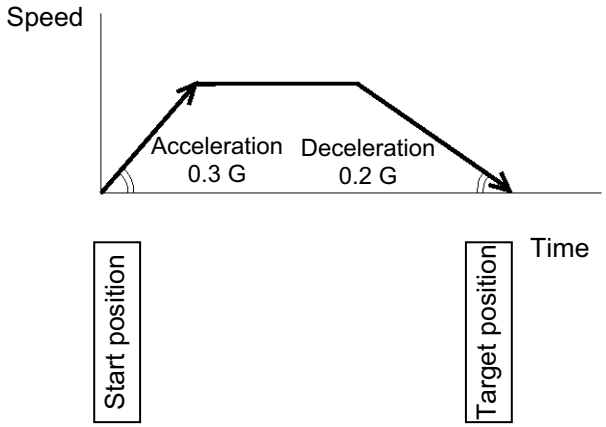
* On the teaching pendant, an equal sign indicates that the applicable position is set in the incremental mode.

(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 load is substantially lighter than the rated load capacity.”
  If the load 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

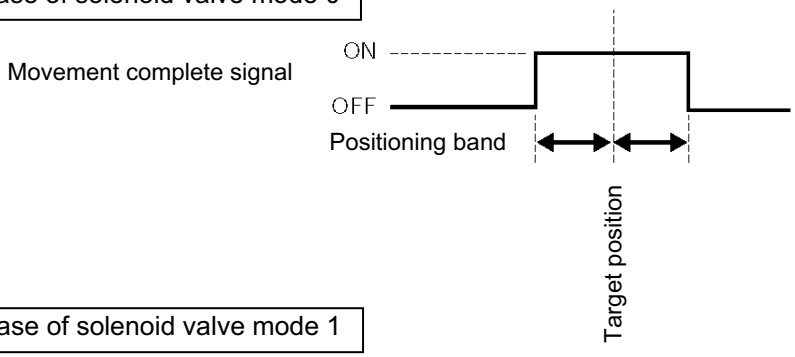
- This field is not used with this controller.
  The factory setting is “0.”

(7) Positioning band

- What this field means is different in “positioning operation” and “push-motion operation.”

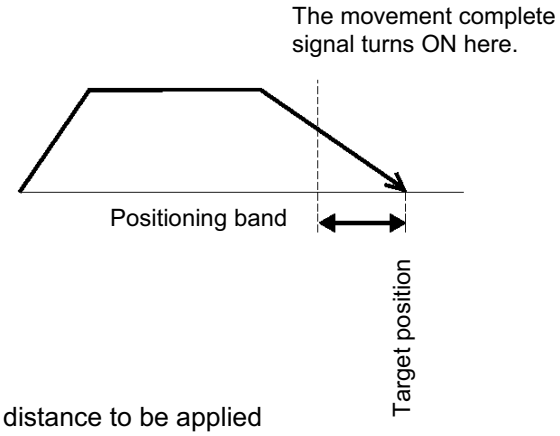
“Positioning operation”:
In the proximity switch type, this field defines the width within which the movement complete signal turns ON.
In the standard type, this field defines how far before the target position the movement complete signal turns ON.
The factory setting is “0.1” mm.

In case of solenoid valve mode 0

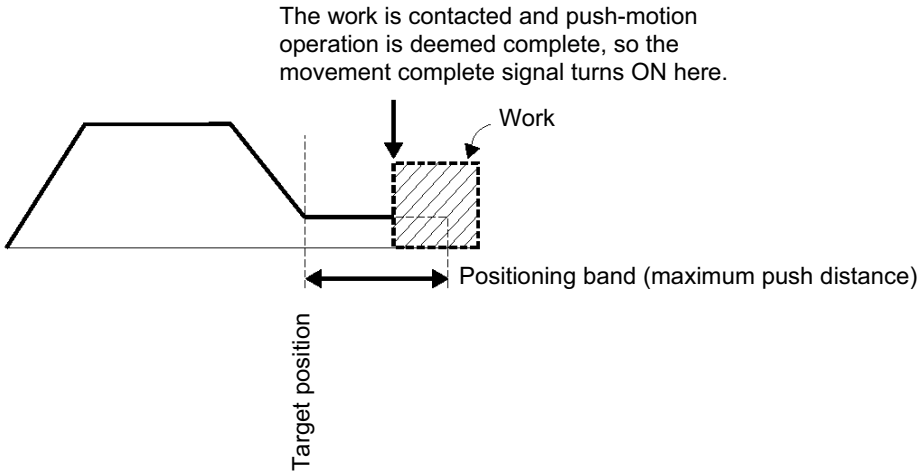


In case of solenoid valve mode 1

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 +/–

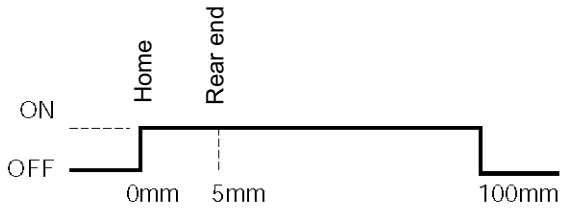
- This field defines the range within which the zone output signal turns ON during operation of solenoid valve mode 1.
  To increase flexibility, a different range can be set for each target position.

[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

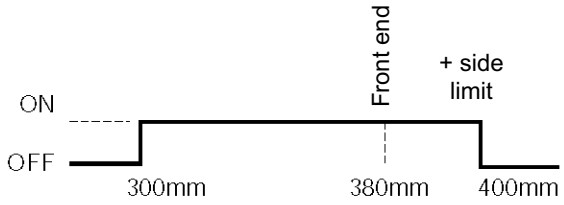
Move command to the rear end

Zone output signal



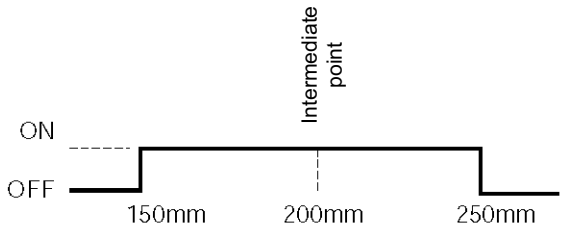
Move command to the front end

Zone output signal



Move command to the intermediate point

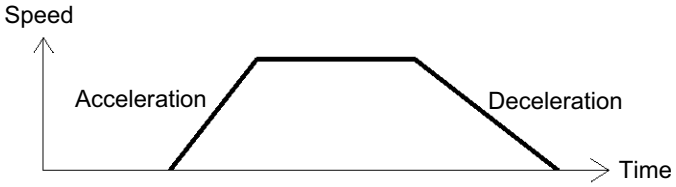
Zone output signal



(9) Acceleration/ deceleration mode

• This field defines the acceleration/deceleration pattern characteristics.
The factory setting is “0.”
0: Trapezoid pattern
1: S-motion
2: Primary delay filter

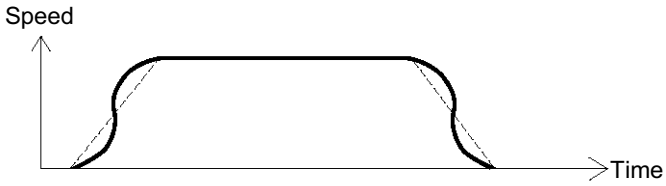
Trapezoid pattern



* Set the acceleration and deceleration in the “Acceleration” and “Deceleration” fields of the position table.

S-motion

When this pattern is selected, the motor accelerates along a curve that rises gradually to a certain point and then climbs quickly.
Use this pattern when you want to set high acceleration/deceleration to meet the required tact time while still allowing the motor to accelerate and decelerate gradually at the start of movement and immediately before stopping.

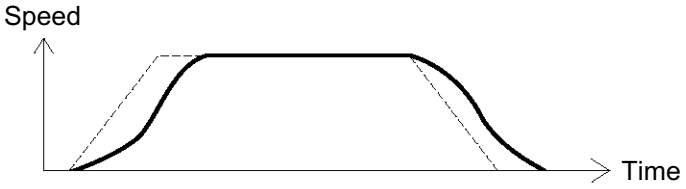


* The level of S-motion is set in Parameter No. 56 (S-motion ratio setting). The setting unit is “%,” and the setting range is “0” to “100.”
(The above graph is based on a setting of 100%.)
If “0” is set, the S-motion function is disabled.
Take note that this setting is not reflected in jogging or inching performed from a PC or teaching pendant.

⚠Caution: [1] Even if you issue a position command or high-value command with specified S-motion acceleration/deceleration in order to change moving speed while the actuator is operating, trapezoid control, rather than S-motion acceleration/deceleration control, is performed. Make sure to issue a command when the actuator is stopped.
[2] S-motion acceleration/deceleration is disabled in the index mode of the rotary actuator. Trapezoid control is performed even if S-motion acceleration/deceleration control is specified.
[3] If acceleration or deceleration time exceeding 2 seconds is set, do not command S-motion acceleration/deceleration control. Normal operation cannot be performed.
[4] Do not suspend the operation during acceleration or deceleration. The speed changes (accelerates), which may be dangerous.

Primary delay filter

When this pattern is selected, the motor operates along a more gradual acceleration/deceleration curve than during linear acceleration/deceleration operation (trapezoid pattern). Use this pattern when you want to prevent the work from receiving microvibration during acceleration or deceleration.



* The level of primary delay is set in Parameter No. 55 (Primary filter time constant for position command). The minimum input unit is 0.1 msec and the setting range is from 0.0 to 100.0. If “0” is set, the primary delay filter is disabled.
Take note that this setting is not reflected in jogging or inching performed from a PC or teaching pendant.

(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 solenoid valve mode 0, make sure to specify the absolute coordinate. If the relative coordinate is specified, a position data error will occur.

(11) Command mode

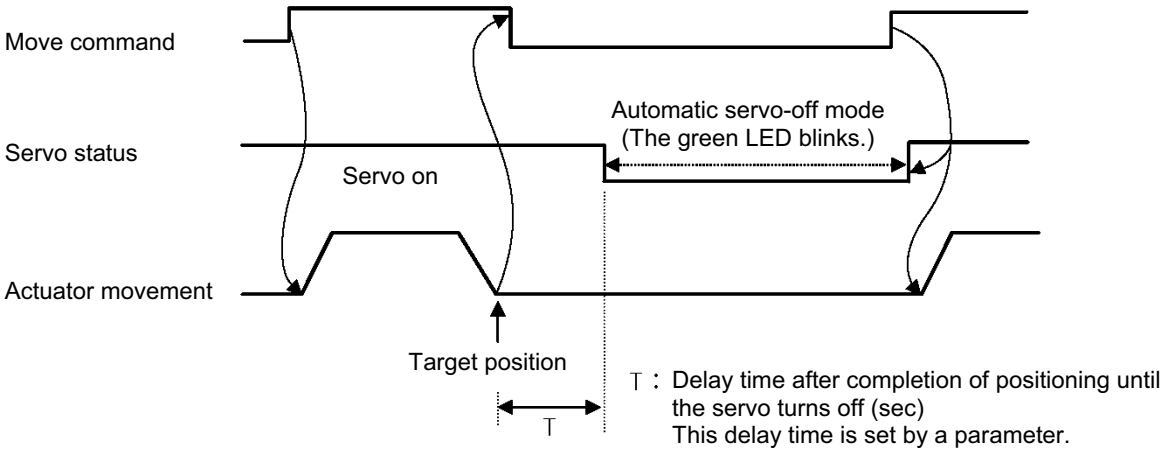
- This field is not used with this controller. The factory setting is “0.”

(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: Power-saving mode is disabled. * The factory setting is “0” [Disable].
  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.

Automatic servo-off mode

The servo automatically turns off after elapse of a specified time following the completion of positioning. (Since no holding current is required, power consumption decreases.)
When the PLC issues the next move command, the servo will turn on again and the actuator will start moving.



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.
* Solenoid valve mode 0 is set at the shipment.

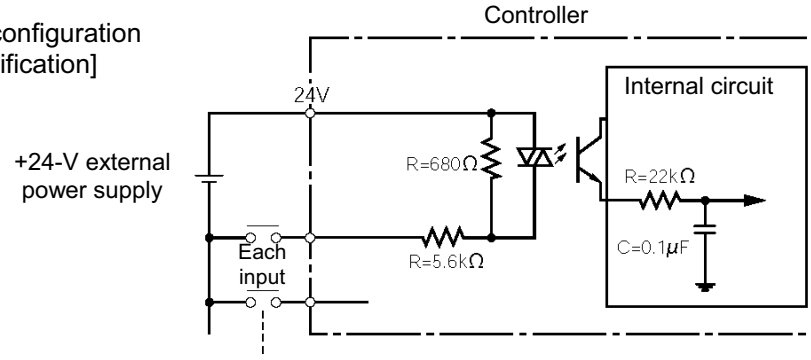
5.1 Interface Circuit

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.

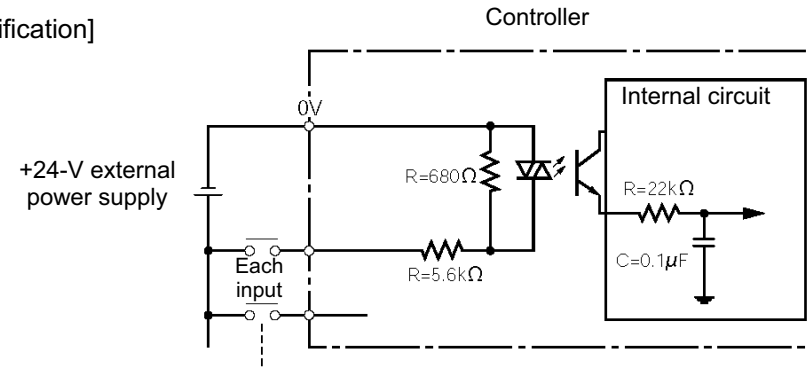
5.1.1 External Input Specifications

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
Isolation method	Photocoupler

Internal circuit configuration
[NPN specification]



[PNP specification]

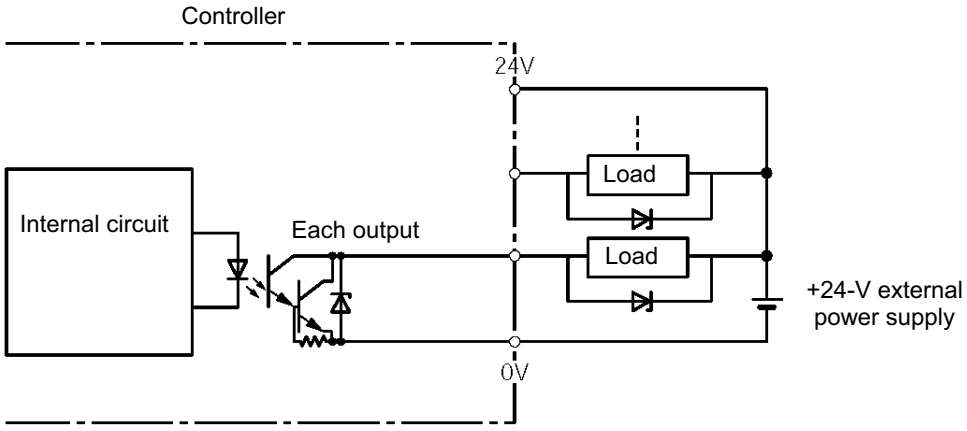


5.1.2 External Output Specifications

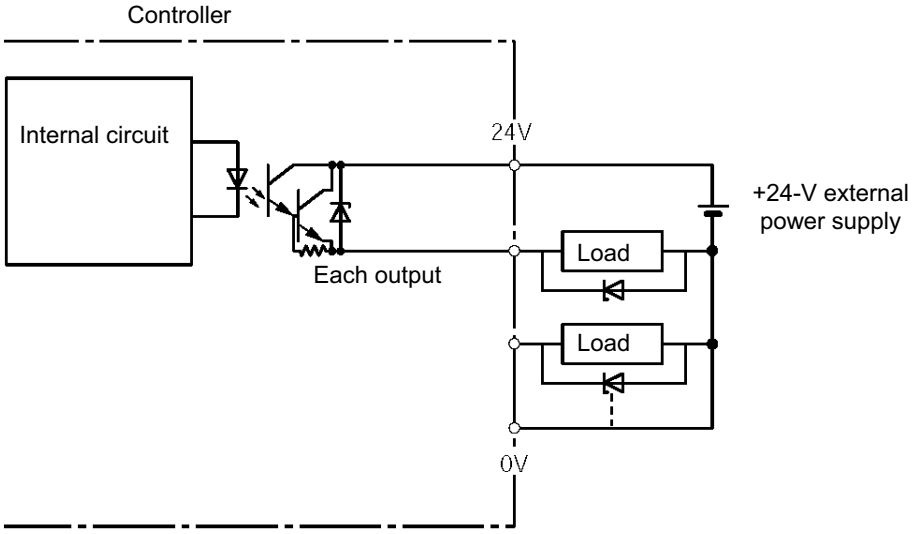
Item	Specification
Number of output points	6 points
Rated load voltage	24 VDC
Maximum current	50 mA per point
Residual voltage	Max. 2 V
Insolation method	Photocoupler

Internal circuit configuration

[NPN specification]

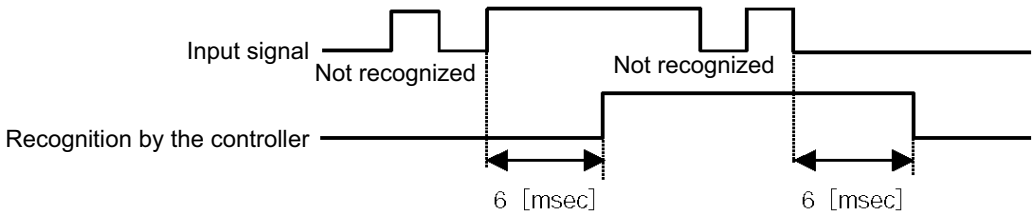


[PNP specification]



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 Solenoid Valve Mode 0

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 load, etc., the servo is turned off to apply brake force to supplement the built-in brake.

* Do not use push-motion operations.

⚠ 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	0 V	
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 automatic 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.

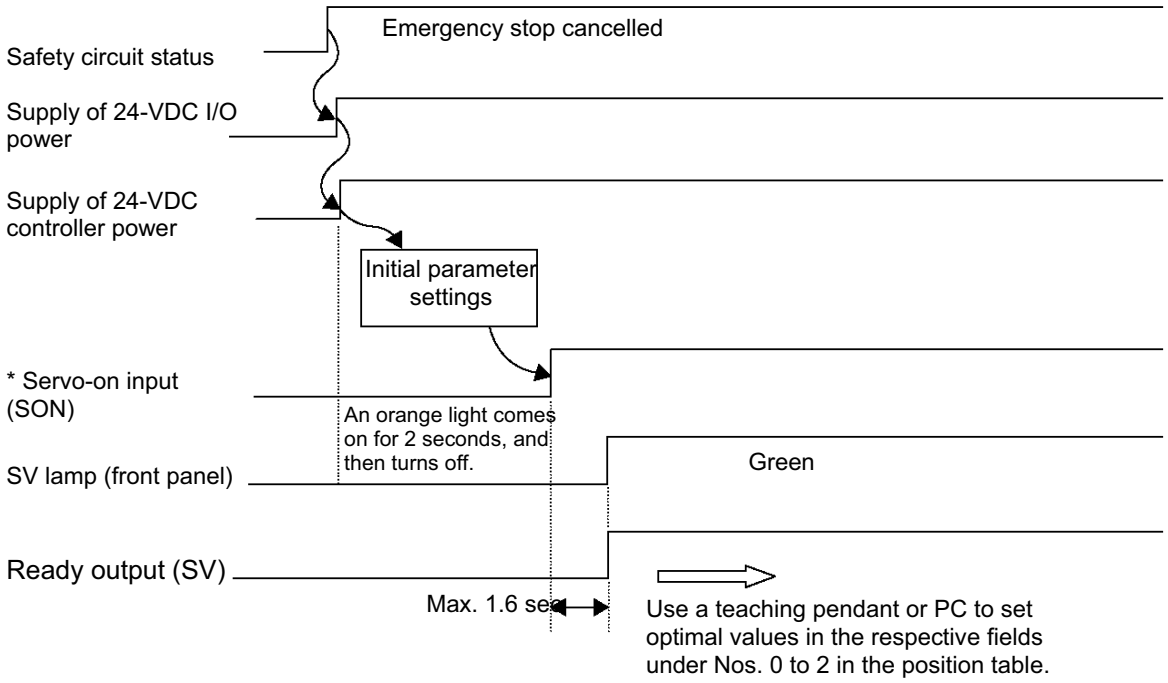
(Reference) Acceptance of each move command before homing is explained below:
[1] A rear end move command is accepted.
[2] An intermediate point move command is not accepted.
[3] A front end move command is accepted, but once the actuator moves forward at the homing speed and contacts the mechanical 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

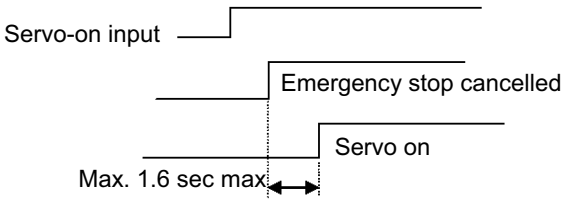
- Steps from Initial Startup to Actuator Adjustment
  [1] Cancel the emergency stop or connect the motor drive power.
  [2] Supply the 24-VDC I/O power (PIO connector pins 1 and 2).
  [3] Supply the 24-VDC controller power (24-V and 0-V terminals on the power-supply terminal block).
  [4] Set the minimum 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).

  [5] Input a servo-on signal from the PLC (if the servo-on input is enabled).
  [6] 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.

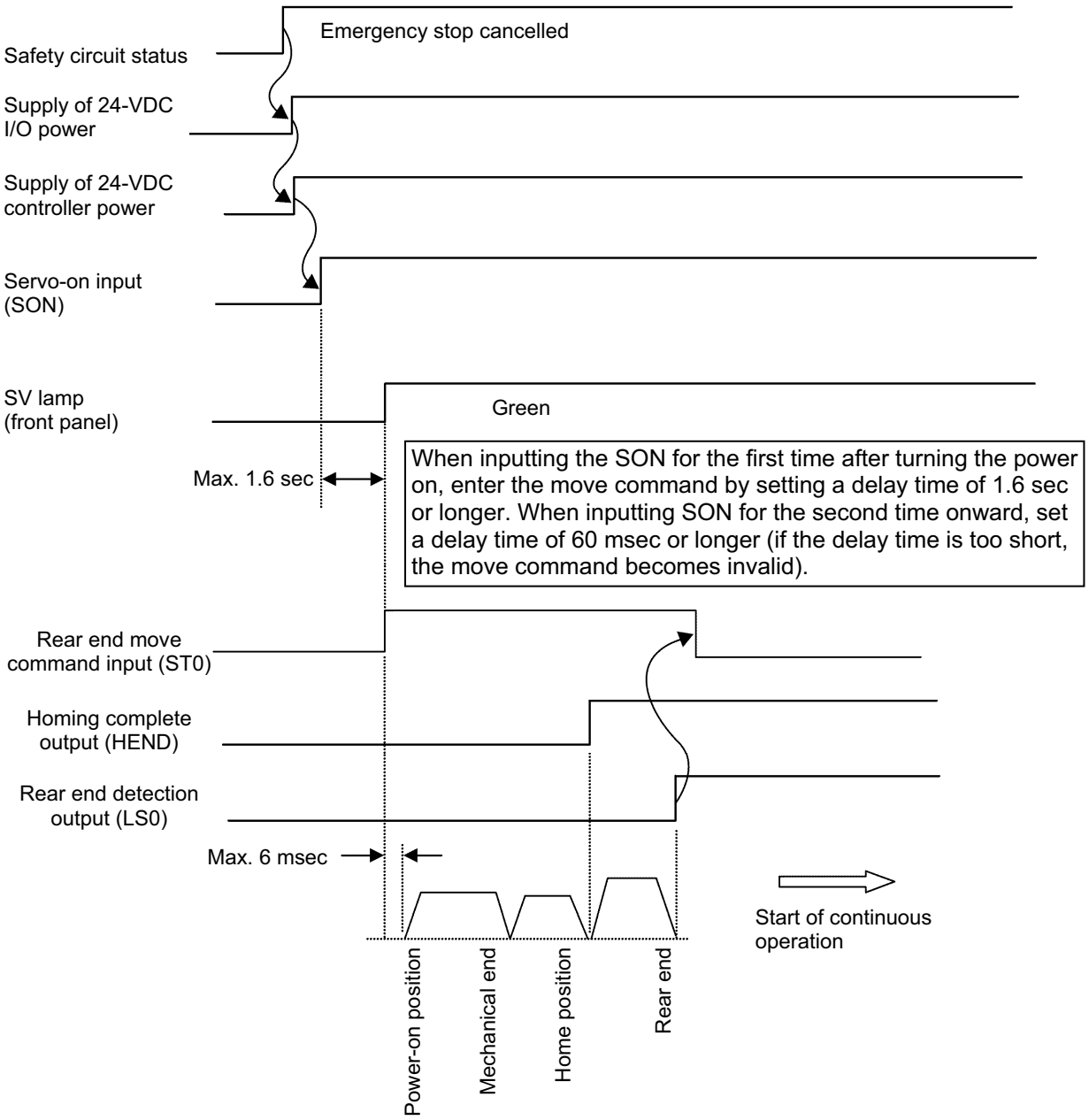


* If you have changed the value of Parameter No. 21 (Servo-on input disable selection) to "1," the servo-on input signal is not required.

⚠ 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 1.6 seconds after the emergency stop is cancelled.



- Normal Operating Procedure
  The operating procedure in a normal condition is explained below.
  [1] Cancel the emergency stop or connect the motor drive power.
  [2] Supply the 24-VDC I/O power.
  [3] Supply the 24-VDC controller power.
  [4] Input a servo-on signal from the PLC
  [5] First, input a rear end move command signal from the PLC (to cause the actuator to stand by at the rear end).
  [6] Start automatic operation.



⚠ Warning: Since a servo motor is applied as the driving motor, the system performs the excitation phase detection in the first servo ON process after the power is turned ON.
Therefore, it is necessary that the actuator is free for operation when the servo is turned ON. It may disturb the excitation pole detection work properly and may cause such problems as an abnormal operation or the excitation detection error if the slider or the rod is touching the mechanical end or the work piece is interfering with the surrounding devices.
In such a case, move the actuator by hand to a position where it can be operated freely.
If the unit is equipped with a brake, it is necessary to release the brake manually by putting the brake release switch ON. Be careful, the slide or rod may drop due to the payload on the actuator. Be sure to avoid any damage or injuries from the load moving.
If the actuator cannot be moved by hand, there is an option to change Parameter No.28 (Excitation Pole Signal Detection Direction) setting. However, please contact us in advance if you desire to do so.

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 a mode to reduce power consumption in such standstill state as part of the controller’s energy-saving function. Use this mode after confirming that it will not cause problems in any part of the system.

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

In this case, you can select the desired mode based on the value set in the “Standstill mode” field of the position table.
(The setting of Parameter No. 53 is ignored.)

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

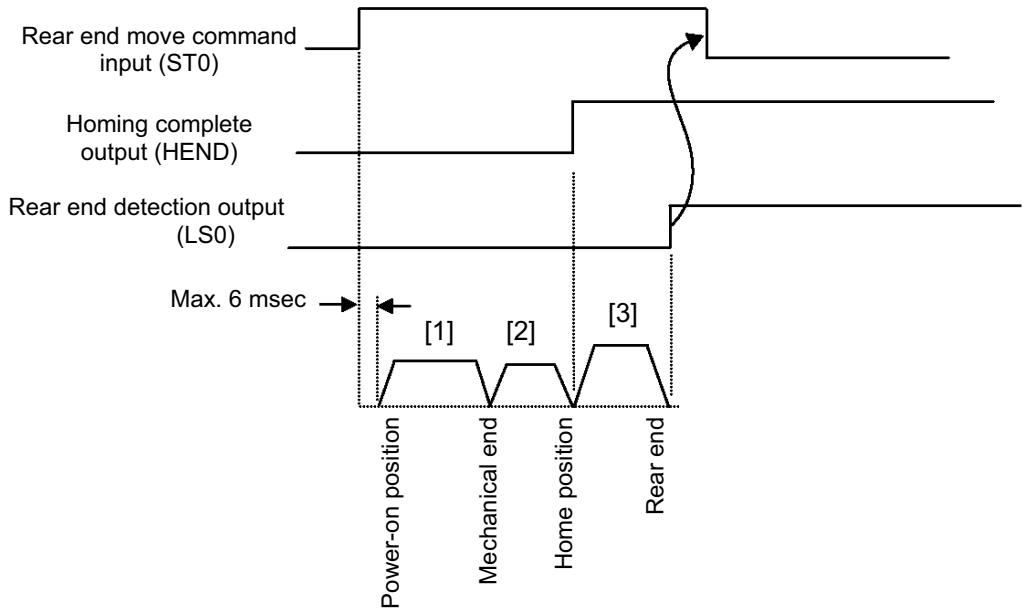
MEMO

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

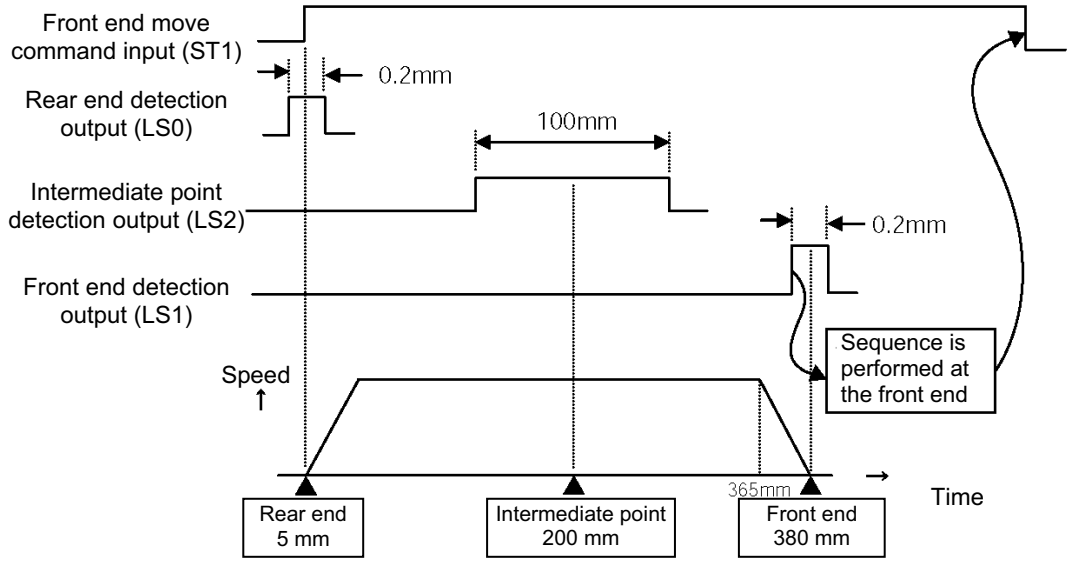
Operation timings

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

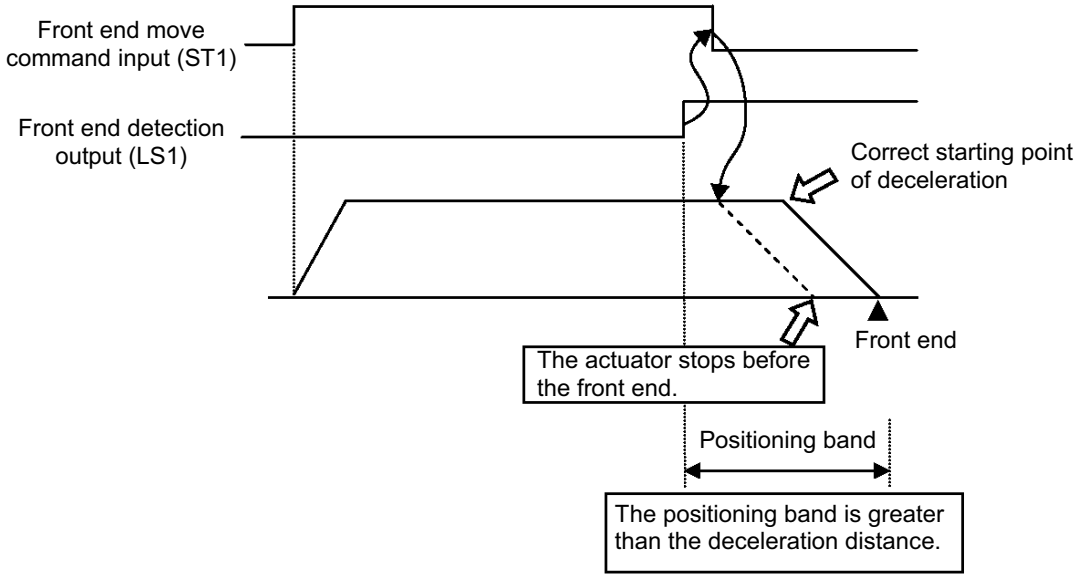
- Meaning of Position Detection Output Signals (LS0, LS1, LS2)
  These signals are handled in the same way as limit switches (LSs). They turn ON when the following conditions are met:
  [1] The homing complete output signal (HEND) is ON.
  [2] The current position is within the allowable distance before 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 load 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 load 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

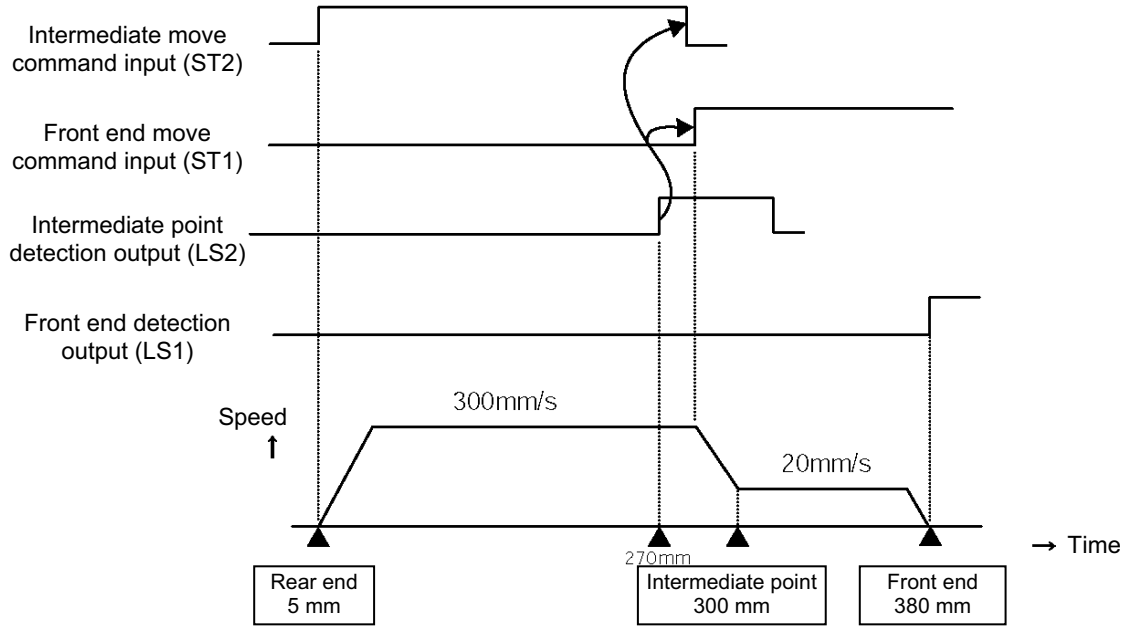
No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Comment
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	20.00	0.30	0.30	0	0.10	Front end
2	300.00	300.00	0.30	0.30	0	30.00	Intermediate point

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.

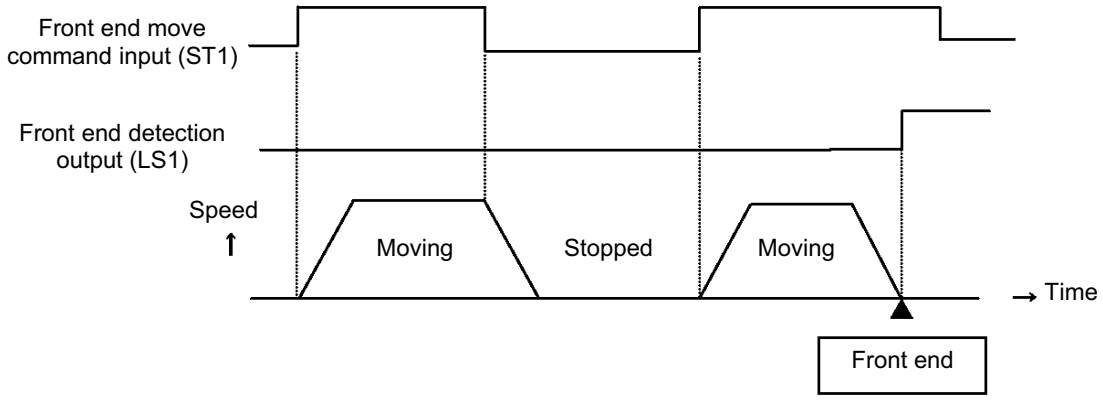
PLC processing 2: The intermediate point move command signal (ST2) turns OFF, and the front end move command signal (ST1) turns ON.
[3] The actuator decelerates from 300 mm/s to 20 mm/s, and stops at the front end.



⚠ 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.

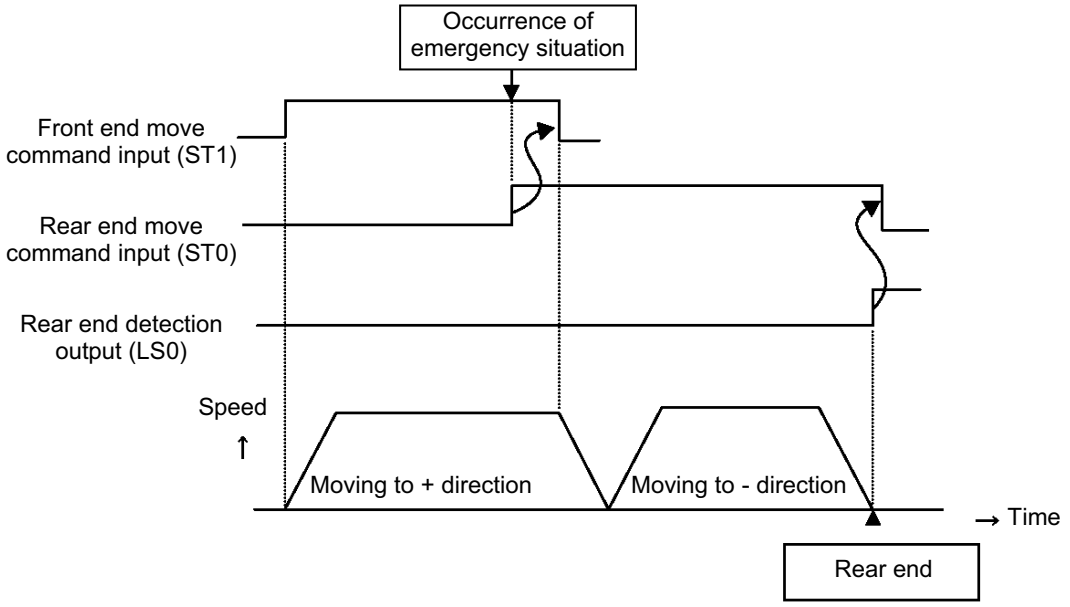
  (Example) Return the actuator to the standby position (rear end) after an emergency situation occurred while the actuator was moving toward the front end

  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 Solenoid Valve Mode 1

This type assumes situations where the system must achieve high productivity. Use this type if your application meets the following conditions, among others:

[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.

> ⚠ Caution: The controller is shipped with solenoid valve mode 0 pre-selected. If you want to use solenoid valve mode 1, 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	0 V	
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.

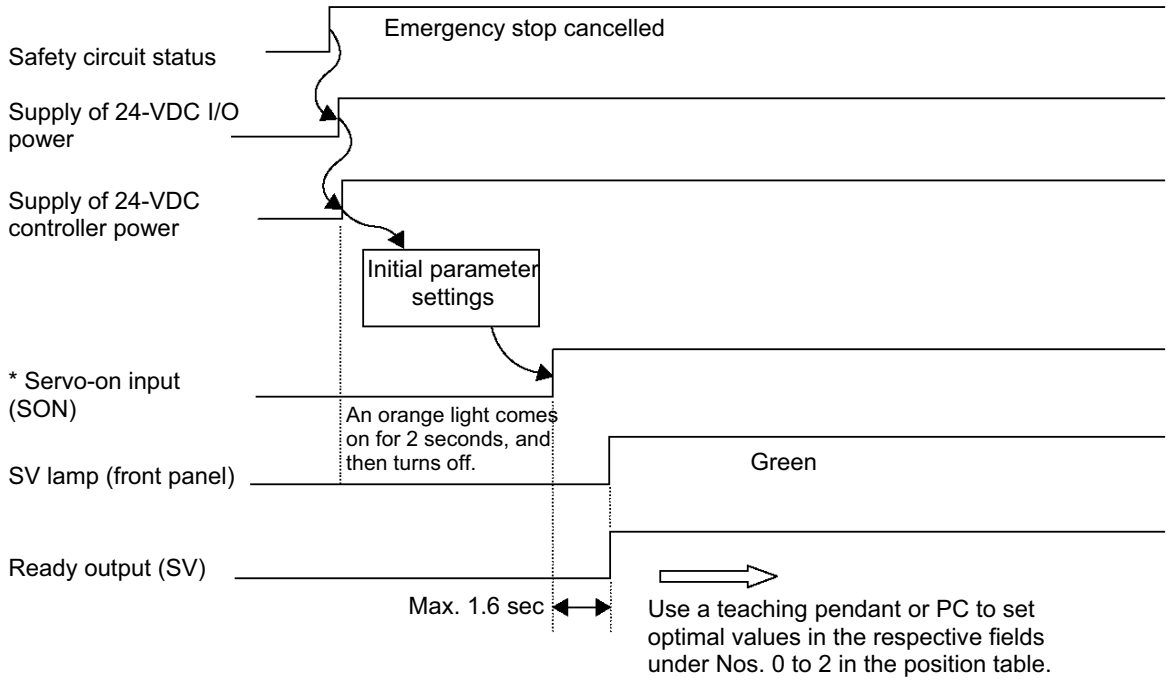
■ Homing Complete Output (HEND)
This signal is OFF immediately after the power is turned on.
To establish the initial coordinate, only a rear end move command is accepted after power on. Once a rear end move command has been input, the actuator performs homing and then moves to the rear end.
This signal 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

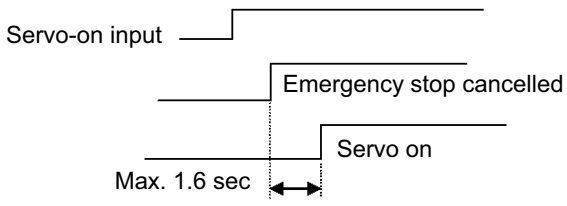
- Steps from Initial Startup to Actuator Adjustment
  [1] Cancel the emergency stop or connect the motor drive power.
  [2] Supply the 24-VDC I/O power (PIO connector pins 1 and 2).
  [3] Supply the 24-VDC controller power (24-V and 0-V terminals on the power-supply terminal block).
  [4] Set the minimum required parameters.
  (Example)
  - To switch to solenoid valve mode 1, 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).

  [5] Input a servo-on signal from the PLC.
  [6] 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.

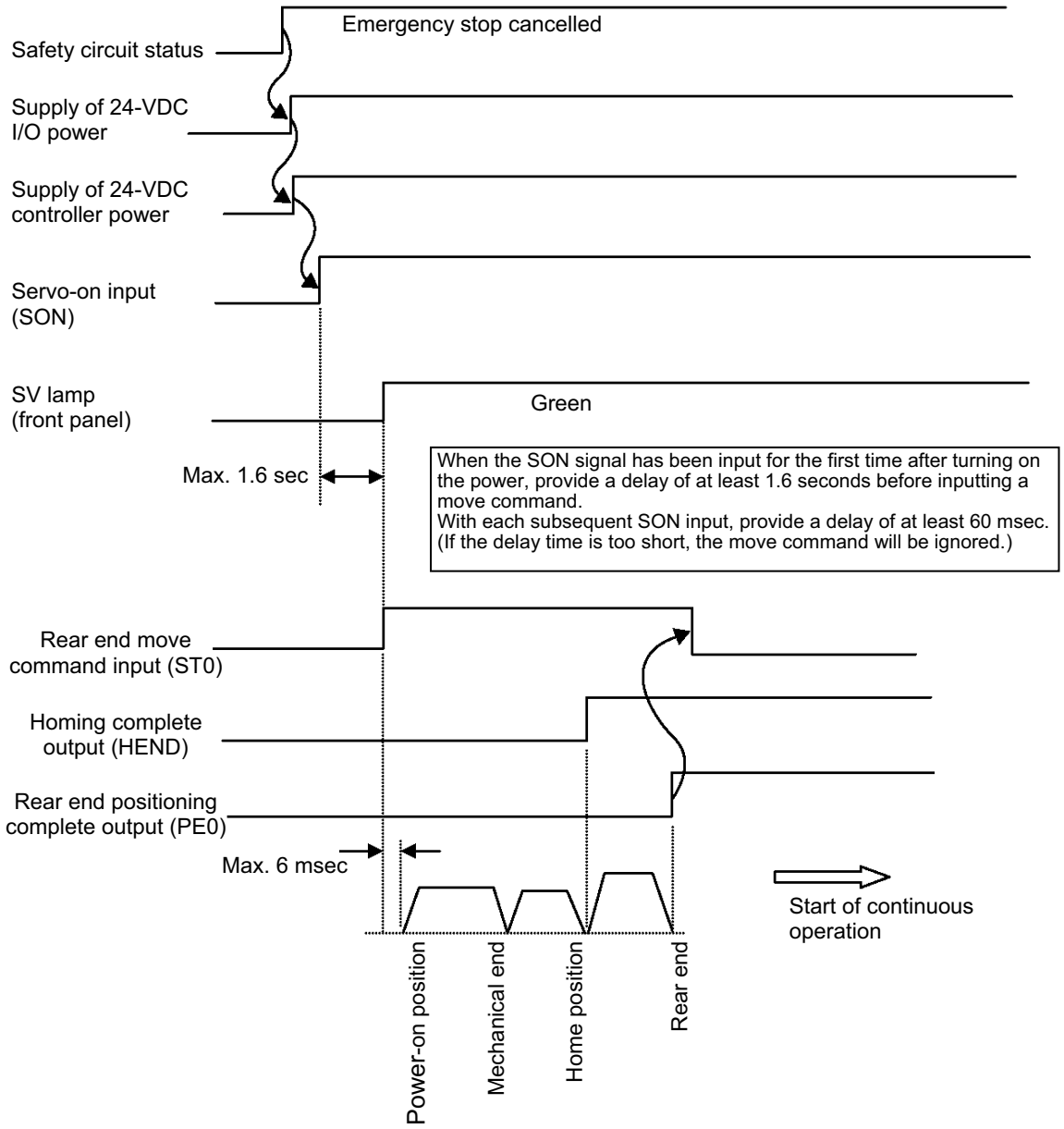


* If you have changed the value of Parameter No. 21 (Servo-on input disable selection) to "1," the servo-on input signal is not required.

⚠ 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 1.6 seconds after the emergency stop is cancelled.



- Normal Operating Procedure
  The operating procedure in a normal condition is explained below.
  [1] Cancel the emergency stop or connect the motor drive power.
  [2] Supply the 24-VDC I/O power.
  [3] Supply the 24-VDC controller power.
  [4] Input a servo-on signal from the PLC.
  [5] First, input a rear end move command signal from the PLC (to cause the actuator to stand by at the rear end).
  [6] Start automatic operation.



⚠ Warning: The excited pole phase is detected when the servo is turned on for the first time after the power has been turned on, or before an absolute reset is performed following the connection of a simple absolute unit. For this reason, the actuator moves 0.5 to 2 mm under the normal circumstances, although it depends on the lead length of ball screws.

(On rare occasions where the actuator position at which the power is turned on is not ideal, the actuator may move by around one half the ball screw lead.)

If the power is turned on when the actuator is positioned near a mechanical end, the detection operation may cause the actuator to contact the mechanical end and reverse.

Pay sufficient care so that the load and hand do not interfere with peripheral objects and get damaged with this operation

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 a mode 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 at the target position is long

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

→ For details, refer to 5.4, "Power-saving Mode 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.

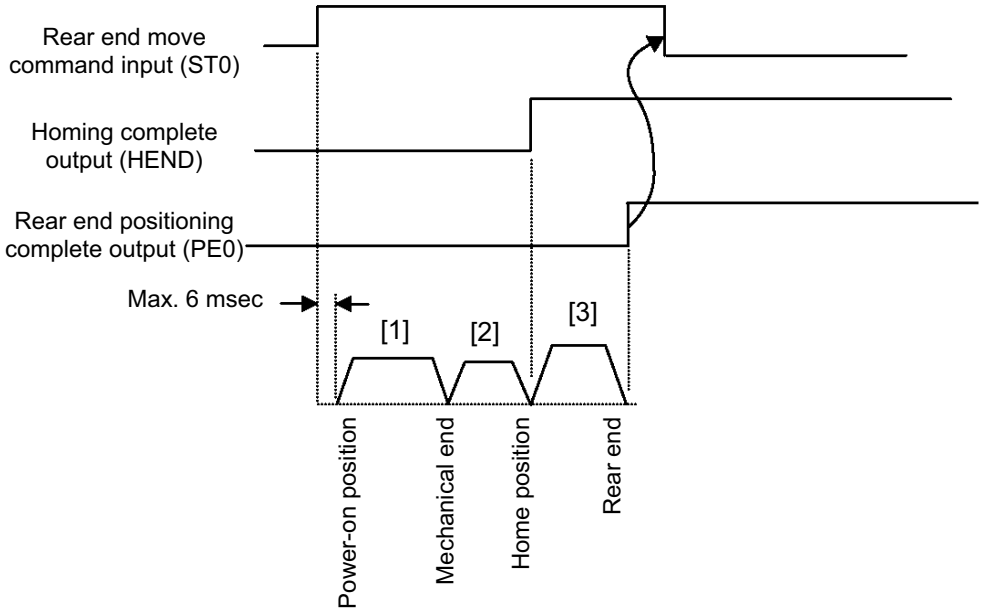
→ For details, refer to 6.2.3, "Parameters Relating to External Interface."

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

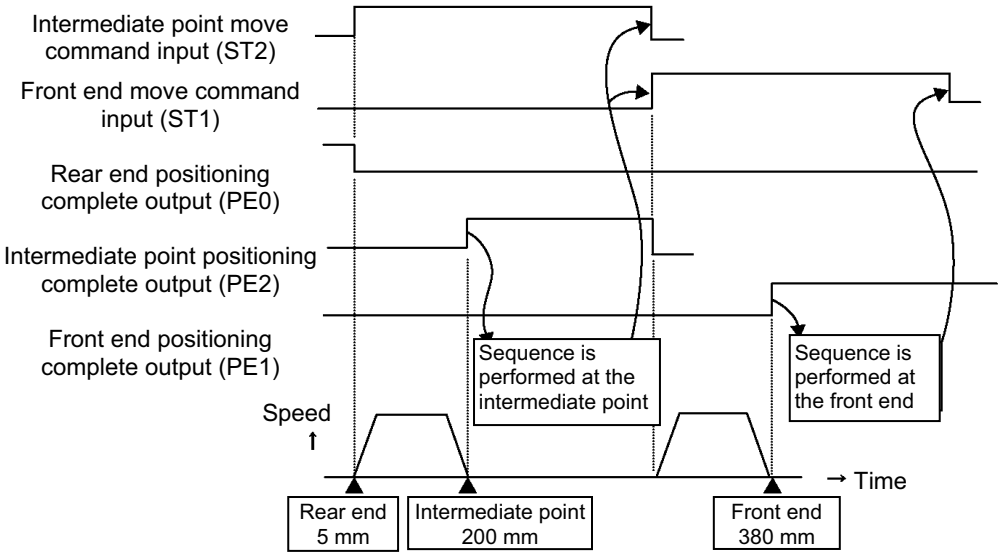
Operation timings

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.

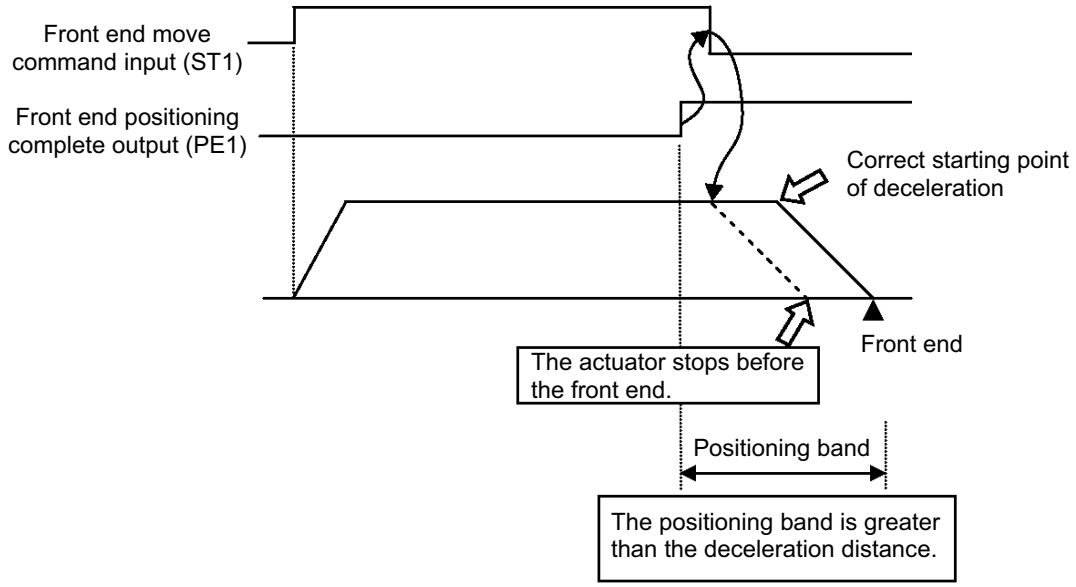
⚠ Caution: All position detection outputs will turn OFF once a phase A/B open detection alarm generates.

- 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 load 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 load 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

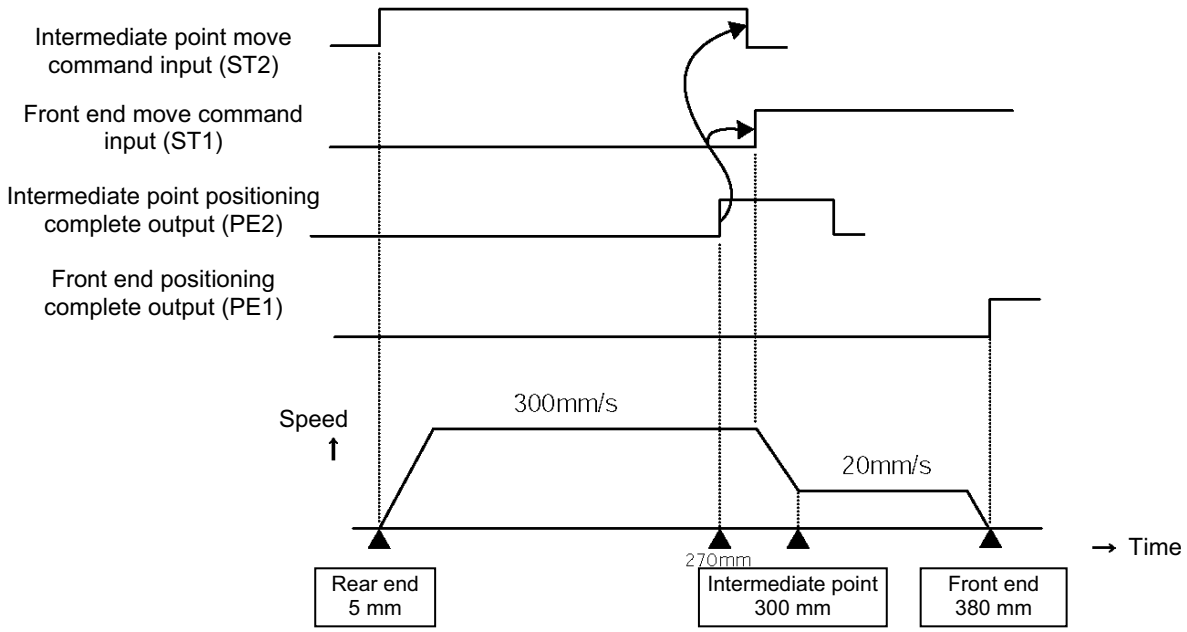
No	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Comment
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	20.00	0.30	0.30	0	0.10	Front end
2	300.00	300.00	0.30	0.30	0	30.00	Intermediate point

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.

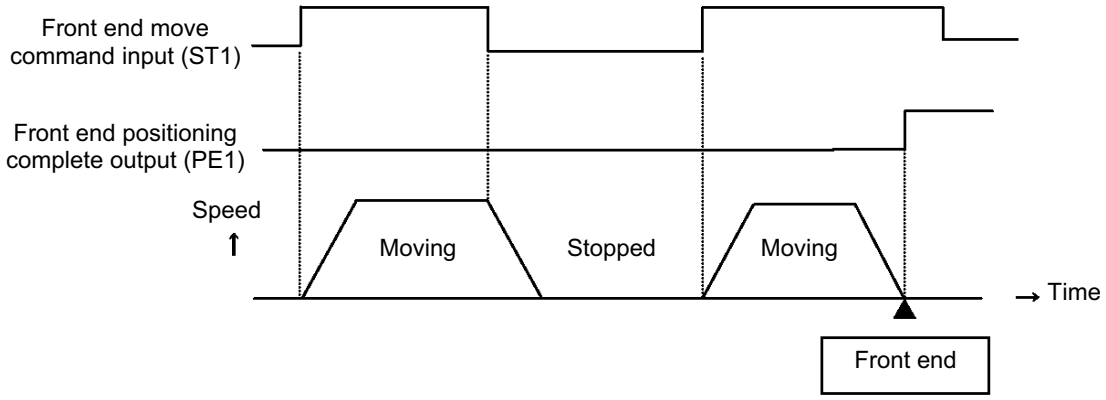
PLC processing 2: The intermediate point move command signal (ST2) turns OFF, and the front end move command signal (ST1) turns ON.
[3] The actuator decelerates from 300 mm/s to 20 mm/s, and stops at the front end.



⚠ 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.

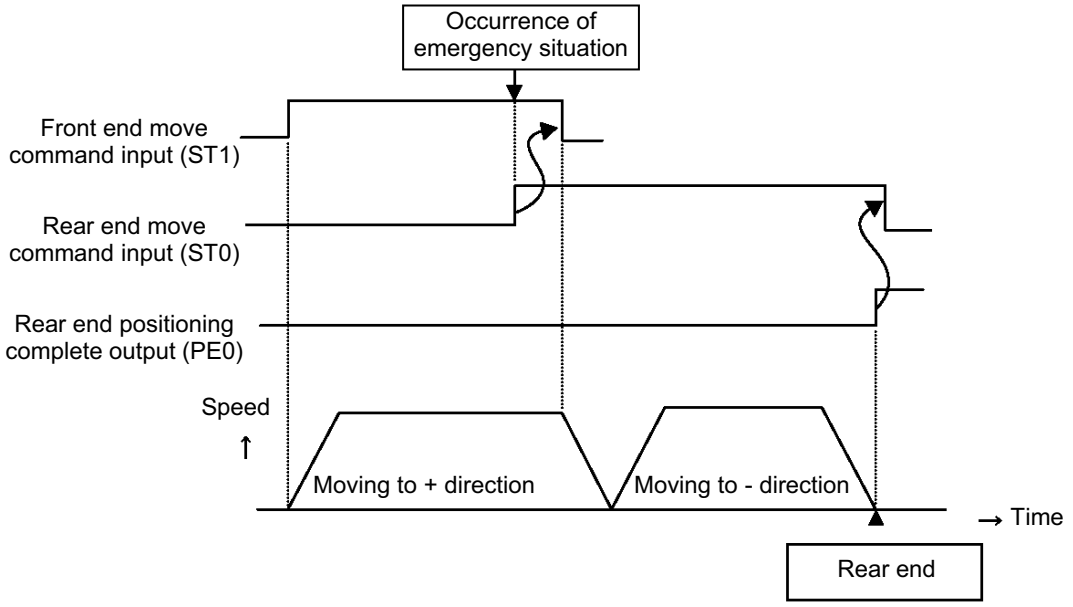
  (Example) Return the actuator to the standby position (rear end) after an emergency situation occurred while the actuator was moving toward the front end

  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.

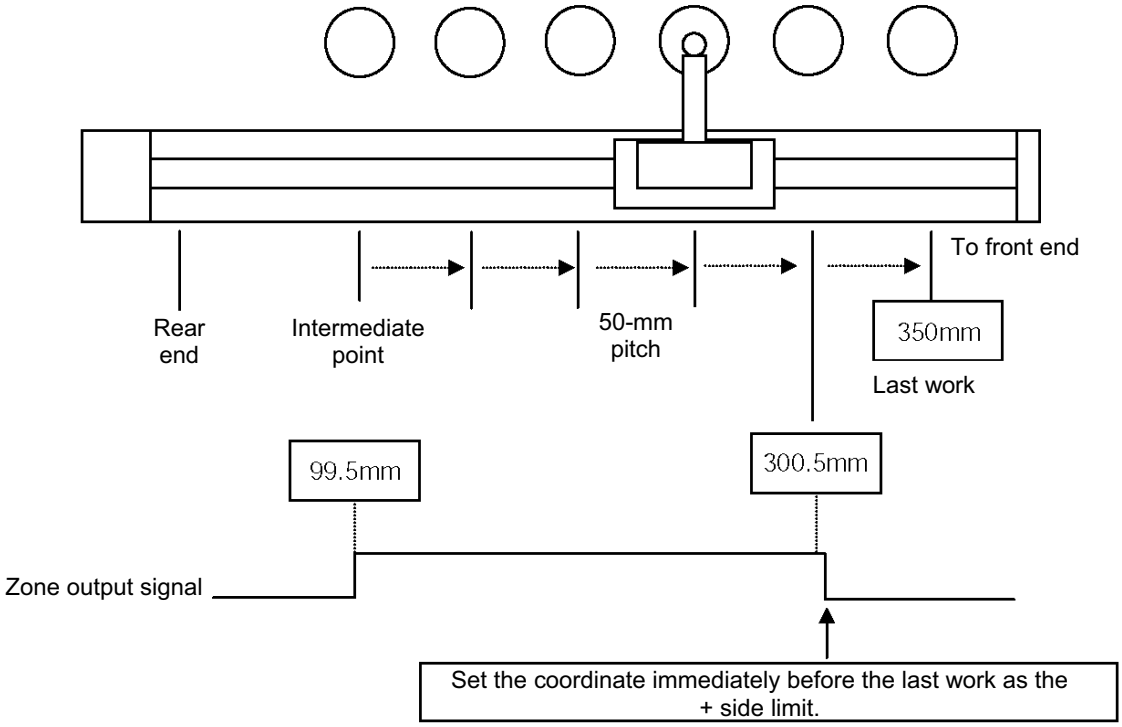
  Operation:
  [1] After the front end move command signal (ST1) turns OFF, the actuator decelerates to a stop.
  [2] The actuator reverses its direction and starts moving toward the rear end.
  [3] When the actuator reaches the rear end, the rear end positioning complete output (PE0) turns ON.

  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 loads 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.

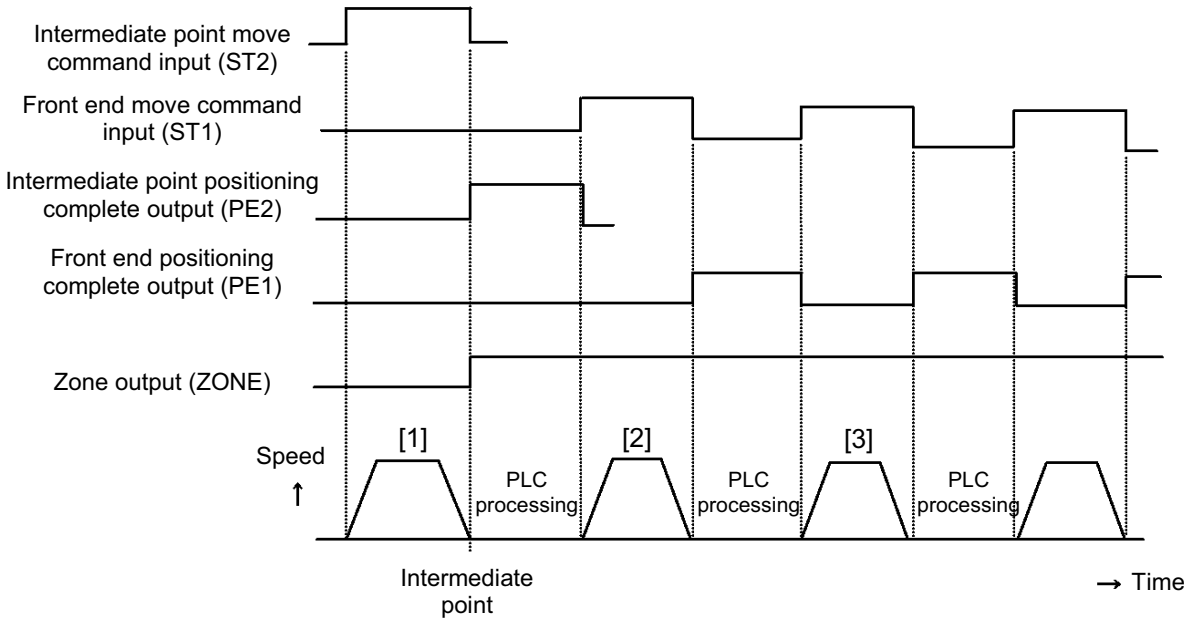
PLC processing 2: The intermediate point move command signal (ST2) turns OFF and the sequence processing is performed.
Once the sequence processing is completed, the front end move command signal (ST1) turns ON.

[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 loads.
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 load is the last load.
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.

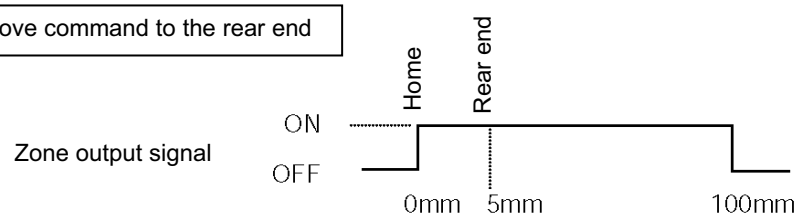
[1] Set an interlock signal to prevent contact with peripheral equipment.
[2] Set a trigger signal for peripheral equipment to reduce the tact time.
[3] Detect missed load during push-motion operation.
[4] Determine the end point when positioning to a series of aligned loads via constant pitch feed.

(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.

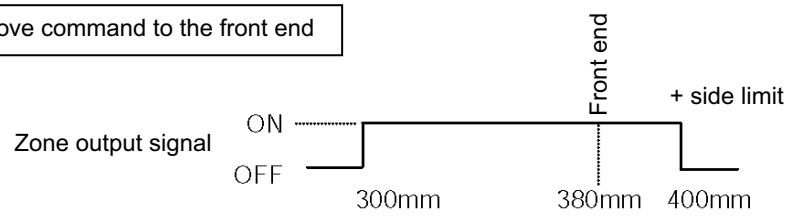
[Setting example]

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

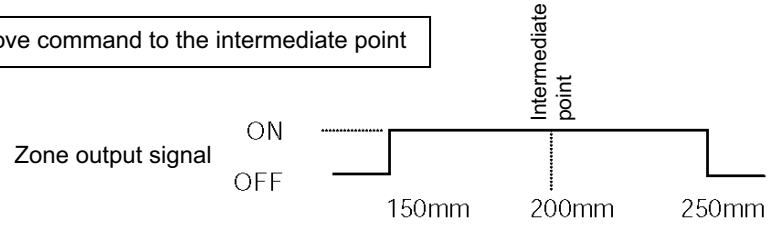
Move command to the rear end



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 load.
Accordingly, the actuator can be used with systems that clamp, press-fit or otherwise push loads.
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.

For the relationship of push torque and current-limiting value, contact IAI.

[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.
[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 load is installed, as well as a possible depression if the load is made of elastic material.)
[3] If it is possible for the system to miss the load, use the zone output signal to detect missed load. To do this, enter appropriate values in the “Zone +” and “Zone –” fields to specify a range within which the load is deemed to have been contacted successfully.
[4] Change the value of Parameter No. 6 (Push-motion completion judgment time), if necessary.
[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

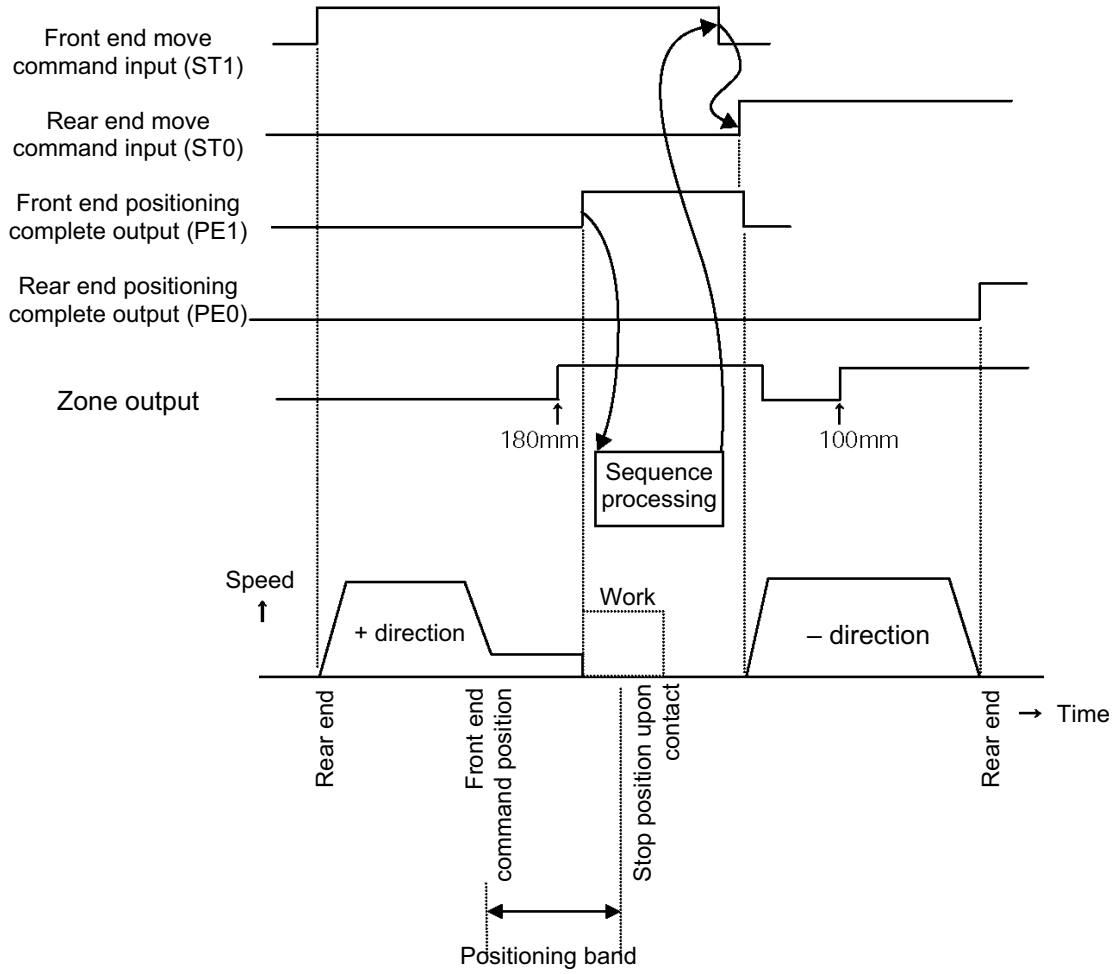
PLC processing 1: The rear end move command signal (ST0) and intermediate point move command signal (ST2) turn OFF, and the front end move command signal (ST1) turns ON.

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 load 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 load has been successfully contacted, the sequence processing is performed in a “condition where the load 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).

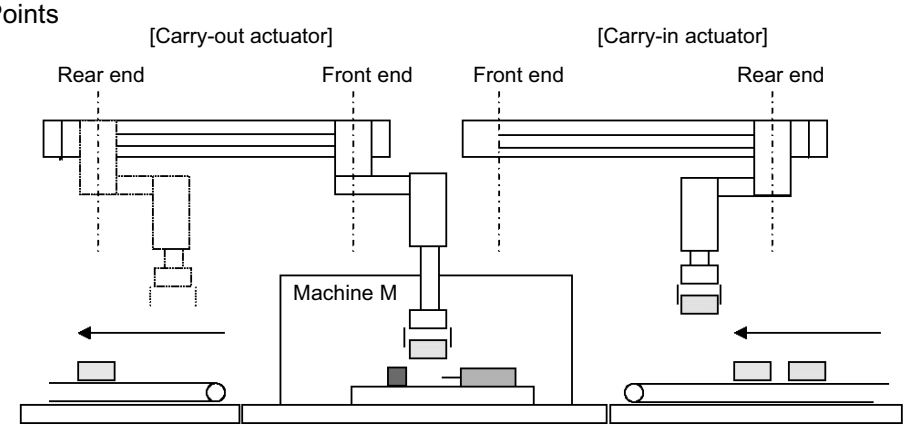
* If the zone output signal dose not turn ON when the front end positioning complete output (PE1) is ON, the condition should be interpreted as “missed load” or “abnormal load installation position.”



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

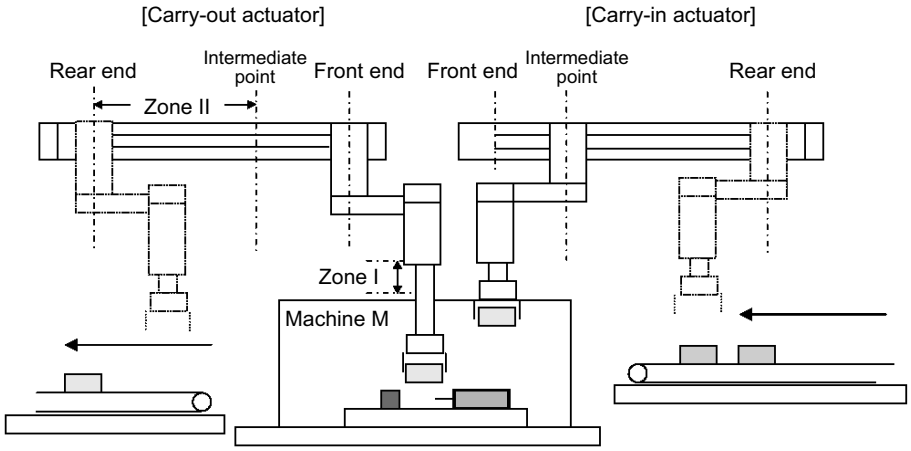
This section explains how the tact time is reduced differently between an application with two stop points only, and an application with three stop points where zone output signals are also used.

- 2 Stop Points



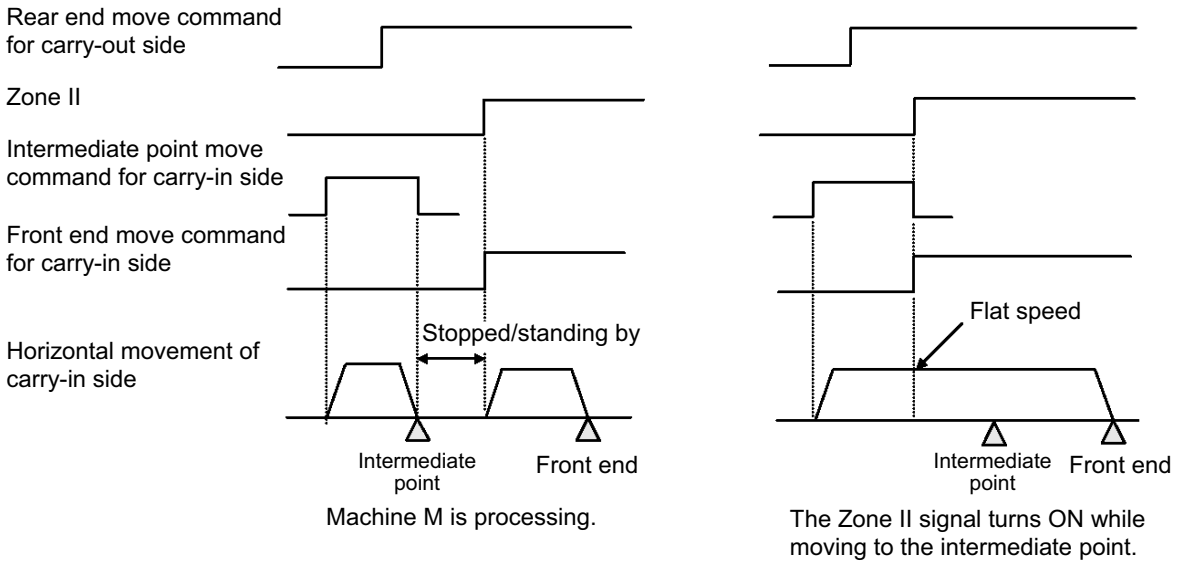
Assume that Machine M has completed processing. If there are two stop points, the vertical axis rises from the condition shown above, and thereafter the carry-in side cannot move toward the front end unless it is confirmed that the carry-out side is at the rear end.
Machine M stands by during the sequence 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.

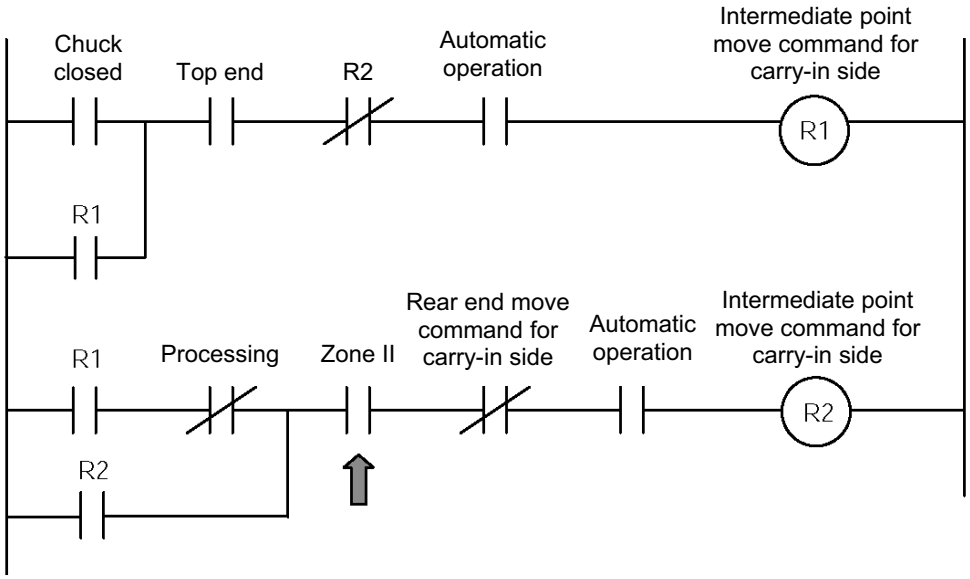
- 3 Stop Points Combined with Zone Output Signals



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





5.4 Power-saving Mode at Standby Positions

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

The actuator is standing by upon completion of positioning to the target position set in the "Position" field under each position number

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

Meaning of the setting in the "Standstill mode" field of the position table

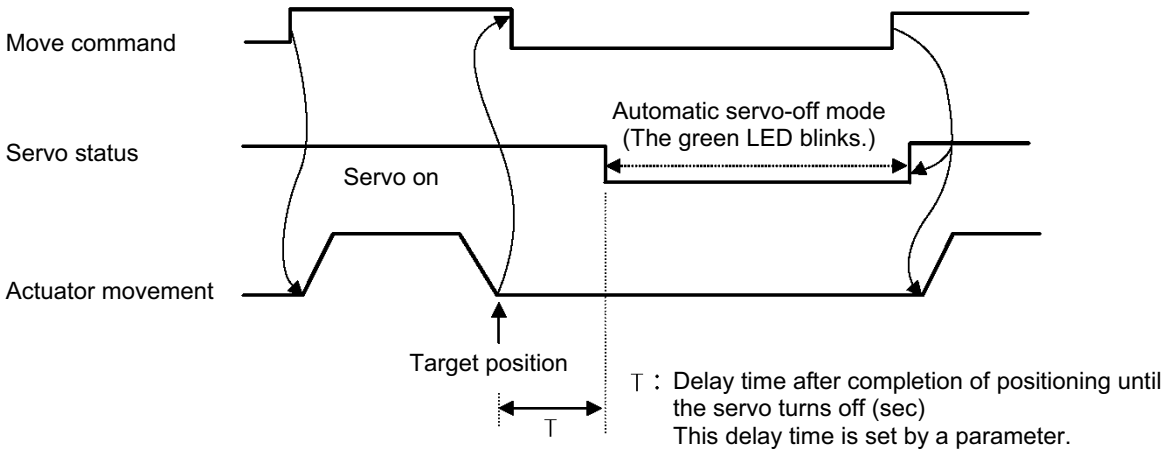
	Setting
Power-saving mode is disabled. (The actuator is completely stopped.)	0
Automatic servo-off mode. The delay time is defined by Parameter No. 36.	1
Automatic servo-off mode. The delay time is defined by Parameter No. 37.	2
Automatic servo-off mode. The delay time is defined by Parameter No. 38.	3

■ Automatic Servo-off Mode

The servo automatically turns off after elapse of a specified time following the completion of positioning. (Since no holding current is required, power consumption decreases.)

When the PLC issues the next move command, the servo will turn on again and the actuator will start moving.

* Since the servo turns off temporarily, slight position deviation may occur.
Do not use this mode at a standby position where such position deviation may be detrimental.



In solenoid valve mode 1, the positioning complete signals (PE0, PE1, PE2) turn OFF.
However, you can set the applicable parameter to keep these signals ON taking the situation where allowing the positioning complete signals to turn OFF will cause problems depending on the sequence circuit of the PLC into consideration.

Setting of Parameter No. 39 (Positioning complete signal output mode)	Positioning complete signal (PE0, PE1, PE2) state
0 [PEND]	When the servo is off, the positioning complete signal turns OFF unconditionally. Even when the next move command is issued and the servo turns on again, the signal will remain OFF because the actuator has already started moving to the next target position.
1 [INP]	Even when the servo is off, the positioning complete signal turns ON if the current position is close enough to the target position, or specifically inside the range corresponding to the value set in the “Positioning band” field of the position table. The signal turns OFF if the current position is outside this range.

(Note) The factory setting is “0” [PEND].

⚠ Warning: If the next move command is an incremental move command (via constant pitch feed), never use automatic servo-off.
The current position may deviate slightly as the servo turns on.

⚠ Caution: In push-motion operation, automatic servo-off is invalid if push-motion is normally completed. It becomes valid if the actuator misses the load and completed. Do not use the automatic servo-off mode during push-motion operation, as a rule.

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	25.5
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
13	b	ODPW	Current-limiting value during home return	%	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	AIOF	Home sensor input polarity	-	(As specified at the time of order)
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 [Solenoid valve mode 0]
28	b	PHSP	Default direction of excited phase signal detection [0: Reverse / 1: Forward]	-	Set individually in accordance with the actuator characteristics.
29	b	PHSP	Excited phase signal detection time	msec	128
30	b	PHSP	Pole sensing type [0: Current suppression / 1: Distance suppression]	-	1 [Distance suppression]
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

No.	Type		Name	Unit	Factory default
52	b	CTLF	Default acceleration/deceleration mode	-	0 [Trapezoid]
53	b	CTLF	Default standstill mode	-	0
54	d	CLPF	Current control band number	-	4
55	b	PLPF	Primary filter time constant for position command	msec	0
56	b	SCRV	S-motion ratio setting	%	0
71	d	PLFG	Feed-forward gain	-	0
77	b	LEAD	Ball screw lead length	mm	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	ABS unit [0: Do not used/1: Use]	-	Set individually in accordance with the actuator characteristics.
88	a	SWLM	Software limit margin	mm	Set individually in accordance with the actuator characteristics.
91	b	PSFC	Current-limiting value at stopping due to missed push-motion	-	0 [Current-limiting value at movement]

(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.

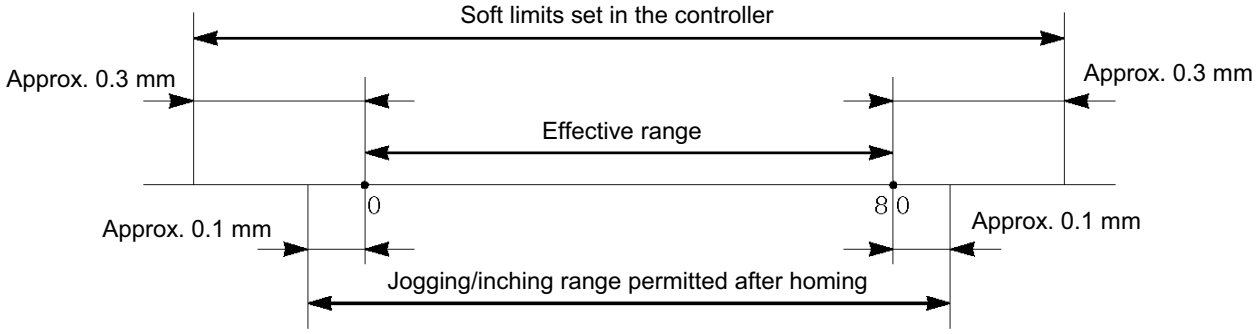
6.2 Detail Explanation of Parameters

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

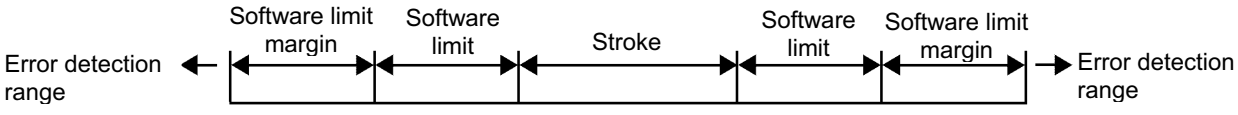
- Soft Limits (No. 3/4 LIMM/LIML)

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



- Software limit margin (No. 88 SWLM)

A “software limit over error” occurs if the actuator exceeds the software limit.
By setting parameter No. 88, it is possible to suppress detection of errors for the range from the software limit to the setting value of parameter No. 88.
The minimum setting range is 0.01 mm.



- 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)

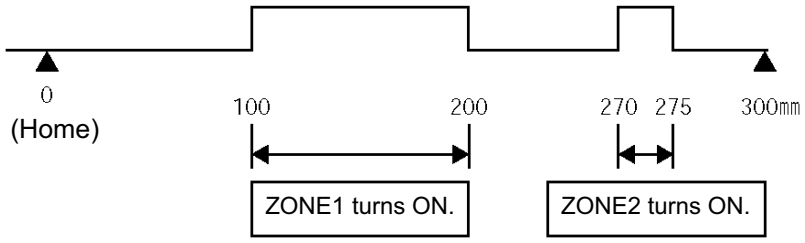
Parameter No. 22 has been set to an optimal value at the factory so that the distance from the mechanical end to home will remain constant.
The minimum setting unit is 0.01 mm.
This parameter can be adjusted in the following conditions:
[1] Align the actuator's home with the mechanical home on the equipment 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.

- Default Acceleration/Deceleration Mode (No. 52 CTLF)

This value is recognized as data in the “Acceleration/deceleration mode” field corresponding to each position number when a target position is entered for that position in the position table where acceleration/deceleration mode is not yet entered.
The factory setting is “0” [Trapezoid pattern].
To change the default acceleration/deceleration pattern, change the value set in Parameter No. 52 as follows.

	Setting
Trapezoid pattern	0
S-motion	1
Primary delay filter	2

- Current-limiting value during home return (No. 13 ODPW)

The factory setting conforms to the standard specification of the actuator.
This parameter does not require changing under normal circumstances. Do not change the parameter value.

- 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 magnetic-pole 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. If an error generates because the controller is unable to determine the magnetic pole, you can try changing the direction set in Parameter No. 28 as a possible countermeasure.
Before changing this parameter, contact IAI.

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

The magnetic-pole phase is detected when the servo is turned on for the first time after turning on the power. This parameter defines the time corresponding to one step of this detection operation.
The factory setting is “128” [msec].
This parameter need not be changed in normal conditions of use. If an error generates because the controller is unable to determine the magnetic pole, you can try changing the detection time set in Parameter No. 29 as a possible countermeasure.
Before changing this parameter, contact IAI.

- Pole Sensing Type (No. 30 PHSP)

The magnetic-pole phase is detected when the servo is turned on for the first time after turning on the power. The mode of this detection operation is defined in Parameter No. 30.
This parameter need not be changed in normal conditions of use. The customer is advised not to change the setting.
Definition of settings: 0 (Current suppression mode)
1 (Distance suppression mode)
The factory setting is “1” [Distance suppression mode].

- Safety Speed (No. 35 SAFV)

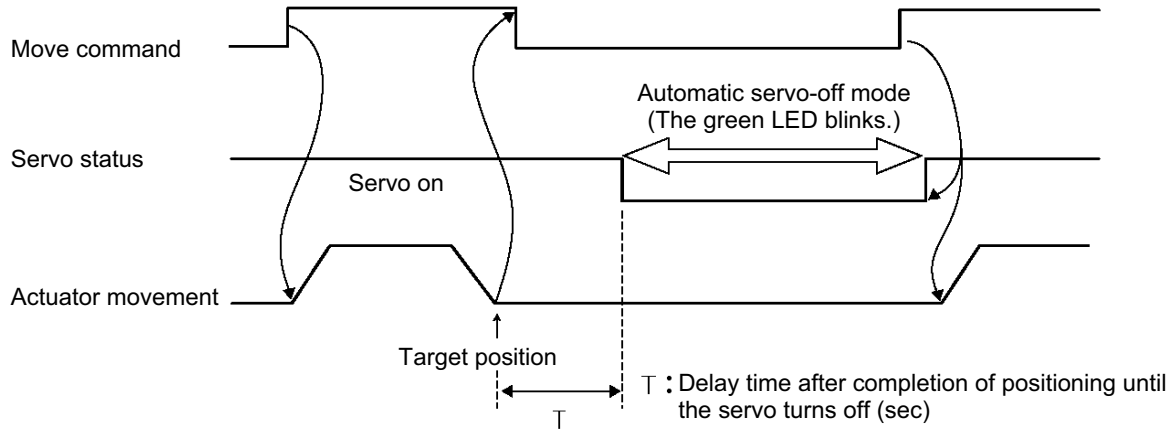
This parameter defines the feed speed during manual operation.
The factory setting is “100” [mm/sec].
To change the speed, set an optimal value in Parameter No. 35.
Since the maximum speed is limited to 250 mm/sec, set the safety speed to below this level.

- 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).

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)

The factory setting is “0” [Disable].

This value is recognized as data in the “Standstill mode” field corresponding to each position number when a target position is entered for that position in the position table where standstill mode is not yet entered.

To enable the automatic servo-off function when the actuator stands by for a long time after positioning is completed, set a desired value between “1” and “3” in Parameter No. 53.

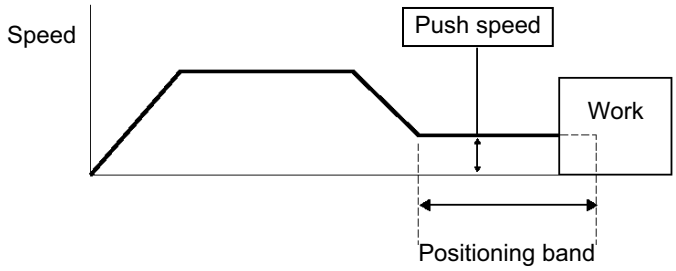
	Setting
Power-saving mode is disabled.	0
Automatic servo-off mode. The delay time is defined by Parameter No. 36.	1
Automatic servo-off mode. The delay time is defined by Parameter No. 37.	2
Automatic servo-off mode. The delay time is defined by Parameter No. 38.	3

Automatic servo-off mode

The servo automatically turns off after elapse of a specified time following the completion of positioning. (Since no holding current is required, power consumption decreases.)
When the PLC issues the next move command, the servo will turn on again and the actuator will start moving.
Refer to the timing chart above.

● Push Speed (No. 34 PSHV)

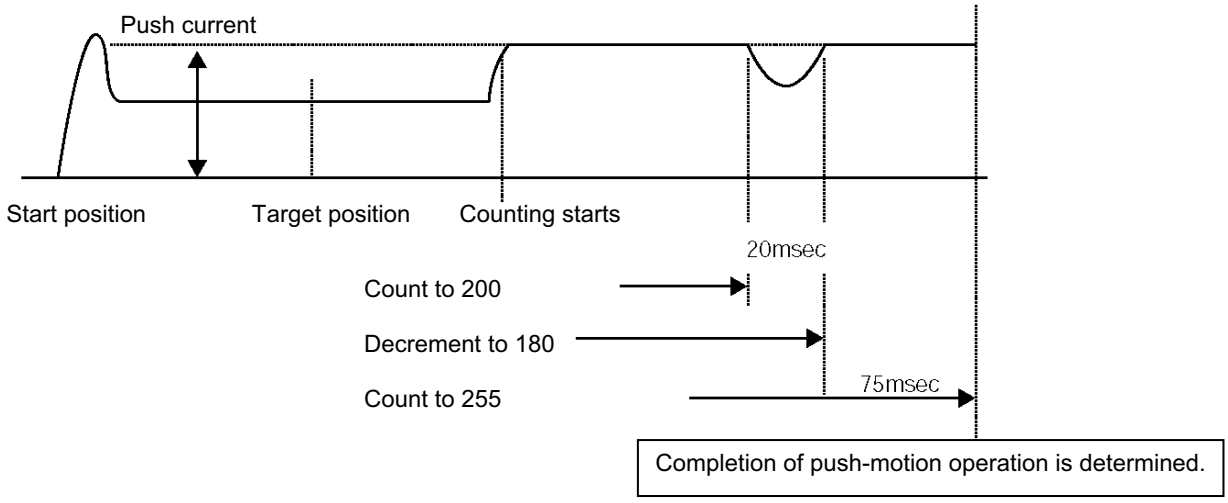
This parameter defines the push speed that applies after the target position has been reached in push-motion operation.
Before shipment, a default speed appropriate for the actuator characteristics is set.
Depending on the material and shape of the load, etc., set an appropriate speed in Parameter No. 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 load 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 load, 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 load 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].

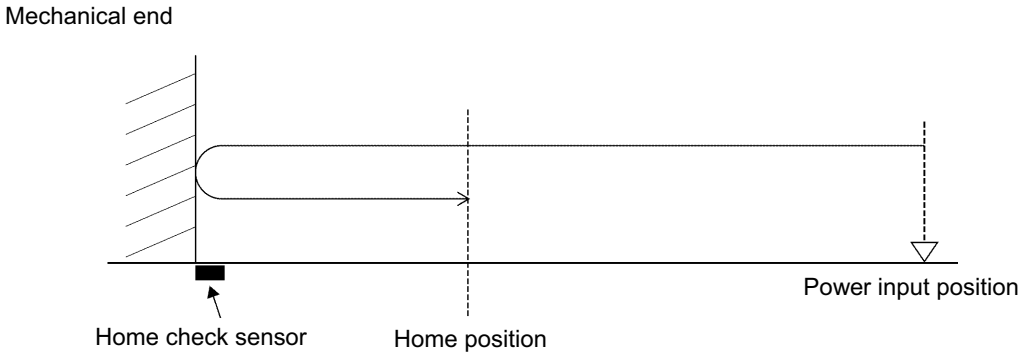
● Home Check Sensor Input Polarity (No. 43 AIOF)

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 home return command is issued, the actuator moves until contacting the mechanical end. Upon contact with the mechanical end, the home check sensor signal is detected.
[2] Next, the actuator reverses its direction and stops at the home position.
[3] The controller determines that the movement has completed successfully if the home check sensor signal had changed when the actuator stopped. If the sensor signal remains the same, the controller recognizes that “position deviation” has occurred, in which case the controller will generate a “Home sensor not detected” error and output an alarm signal.



● Home Sensor Input Polarity (No. 18 AIOF)

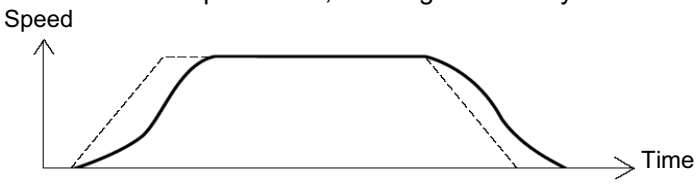
The input polarity of the home sensor is defined in Parameter No. 18.
Since the current RCA actuators do not adopt the home sensor mode, the factory setting is “0” [No sensor].
This parameter is provided to support future extension of actuator function. The customer is advised not to change the setting.

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

● Primary Filter Time Constant for Position Command (No. 55 PLPF)

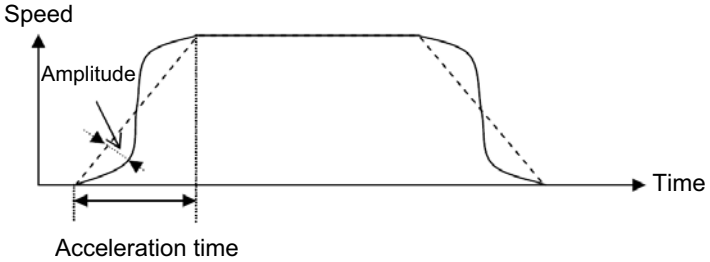
The delay to be applied when “1” [Primary delay filter] is set in the “Acceleration/deceleration mode” field of the position table is defined in Parameter No. 55.
The minimum input unit is 0.1 msec and the setting range is from 0.0 to 100.0.
The factory setting is “0” [msec].

* If the parameter is set to “0,” the primary delay filter is disabled.
The greater the value set in this parameter, the longer the delay becomes.



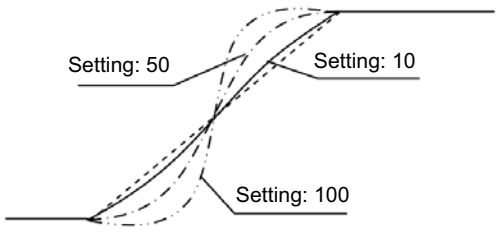
● S-motion Ratio Setting

The level of S-motion to be applied when “2” [S-motion] is set in the “Acceleration/deceleration mode” field of the position table is defined in Parameter No. 56.
The setting unit is “%”, and the setting range is “0” to “100.”
The factory setting is 0% (= S-motion mode is disabled).



In the S-motion mode, a sine wave pattern is applied where the acceleration time corresponds to one period.
Use parameter No. 56 to specify a desired amplitude level.

Setting of parameter No. 56 [%]	Amplitude level
0 [factory setting]	S-motion mode is disabled (dotted line in the figure below)
100	Sine wave amplitude x 1 (two-dot chain line in the figure below)
50	Sine wave amplitude x 0.5 (one-dot chain line in the figure below)
10	Sine wave amplitude x 0.1 (solid line in the figure below)



⚠Caution: [1] Even if you issue a position command or high-value command with specified S-motion acceleration/deceleration in order to change moving speed while the actuator is operating, trapezoid control, rather than S-motion acceleration/deceleration control, is performed. Make sure to issue a command when the actuator is stopped.
[2] S-motion acceleration/deceleration is disabled in the index mode of the rotary actuator. Trapezoid control is performed even if S-motion acceleration/deceleration control is specified.
[3] If acceleration or deceleration time exceeding 2 seconds is set, do not command S-motion acceleration/deceleration control. Normal operation cannot be performed.
[4] Do not suspend the operation during acceleration or deceleration. The speed changes (accelerates), which may be dangerous.

- Ball Screw Lead Length (No. 77 LEAD)

This parameter defines the ball screw lead length.
A default value appropriate for the characteristics of the actuator is set at the factory.

- 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)

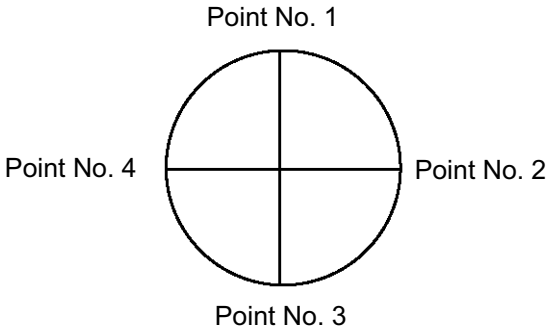
If the axis operation type (No. 78) is set to “rotational axis,” selecting the index mode will fix the current value to a range of 0 to 359.99. If the index mode is selected, shortcut control can be used.
Definition of settings : 0 (Normal mode)
: 1 (Index mode)

Caution:	Push & hold operation cannot be performed in the index mode. If push action data is entered in the position data, the data will be disabled and the actuator will perform normal movement. The positioning band will correspond to the default positioning band set by the applicable parameter.

- Shortcut Selection For Rotational Axis (No. 80 ATYP)

Shortcut means to move in the rotation direction requiring smaller movement to the next point.

	Setting
Do not select	0
Select	1



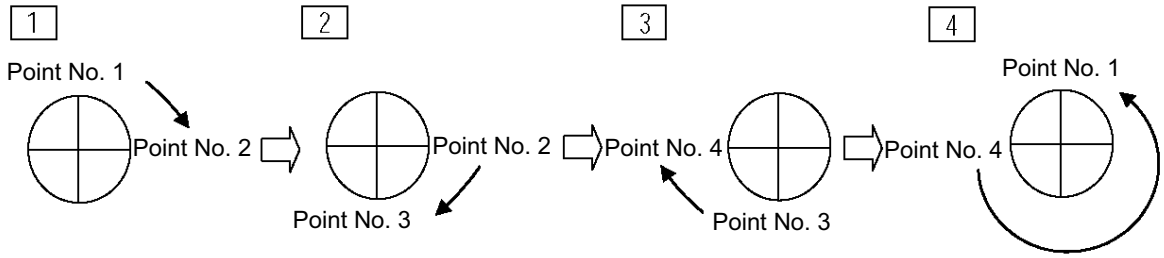
Positions

Point number	Position data
1	0
2	90
3	180
4	270

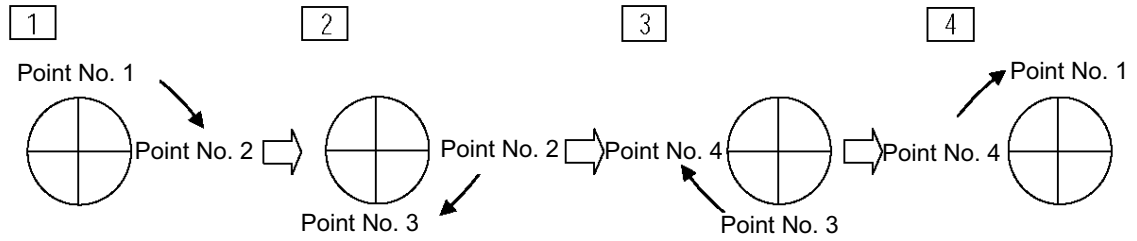
One degree of position data corresponds to 1 mm.

If the actuator is moved in the order to positions 1 → 2 → 3 → 4, the actuator will operate differently depending on whether or not shortcut is selected, as explained below.

When shortcut is not selected



When shortcut is selected



- Absolute Unit (No. 83 ETYP)

Parameter No. 83 sets whether or not an optional simple absolute unit is used.

	Setting
Not used	0
Used	1

- Current-Limiting Value At Stopping due to Missed Push-Motion (No. 91 PSFC)

The current-limiting value at stopping when the actuator misses the push-motion is defined.

Parameter No. 91	Description
0	Current-limiting value at movement (2.8 to 4 times higher due to the actuator characteristics)
1	Current-limiting value at push-motion

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	Solenoid valve mode 0 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	Solenoid valve mode 1 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” [Solenoid valve mode 0].

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

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 solenoid valve mode 1.
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)
It is not necessary to change the setting.
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)
It is not necessary to change the setting.
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)
It is not necessary to change the setting.
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.

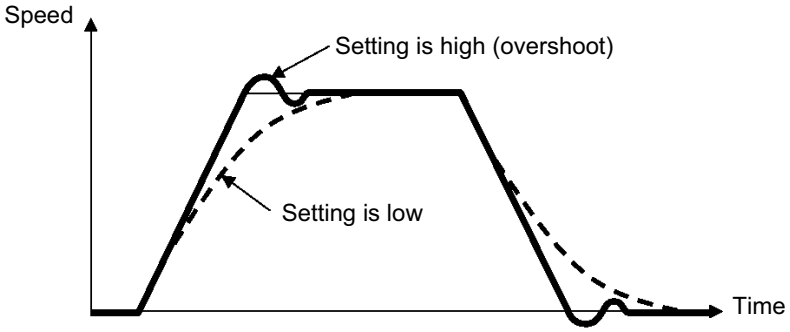
6.2.4 Servo Gain Adjustment

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 ~ 15	6

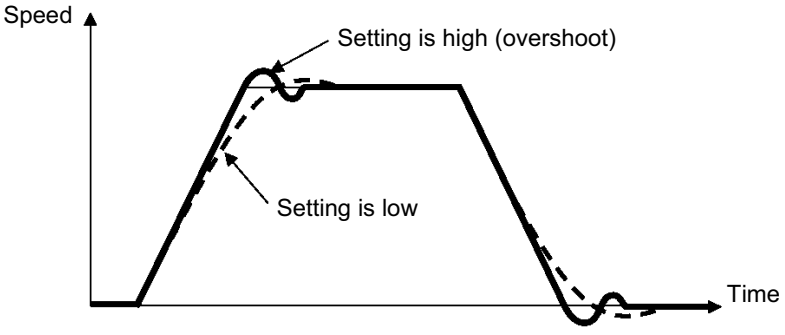
This parameter determines the level of response with respect to a position control loop.
Increasing the setting improves compliance with the position command.
However, increasing the setting too much increases the tendency of the actuator to overshoot.
If the setting is low, compliance with the position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

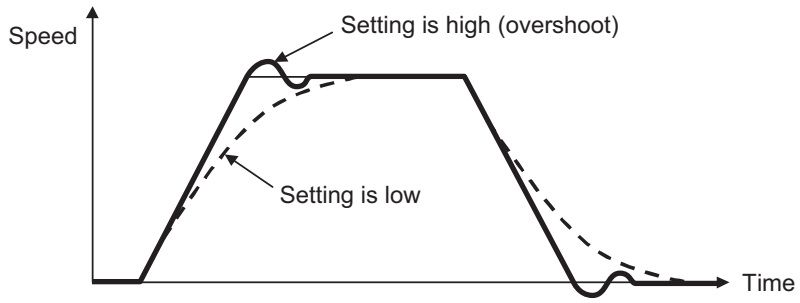
This parameter determines the level of response with respect to a speed control loop.
Increasing the setting improves compliance with the speed command (i.e., servo rigidity increases).
The greater the load inertia, the higher the setting should be.
However, increasing the setting too much increases 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.

- Current Control Band Number (No. 54 CLPF)

Parameter number	Unit	Input range	Default
54	---	0 ~ 7	Set individually in accordance with the actuator characteristics.

Set the control band of the PI current control system.
This parameter need not be changed in normal conditions of use. The customer is advised not to change the setting.
If the parameter is changed carelessly, stability of the control system may be affected and a very dangerous situation may occur.
This parameter may be useful in certain situations such as when resonance noise generates, in which case changing the parameter can suppress the noise.
If you wish to change the parameter, always contact IAI first and follow the instruction.

- Feed-forward Gain (No. 71 PLFG)

Parameter number	Unit	Input range	Default
71	---	0 ~ 100	Set individually in accordance with the actuator characteristics.

Set the amount of feed-forward gain of the position control system.
Setting this parameter increases the servo gain and improves the response of operation that uses a position control loop.
Use this parameter to improve the response of a mechanical system whose rigidity is low or load inertia ratio is high.
As a rough guide, set a value between “10” and “50.” Increasing the value set in this parameter reduces the deviation and improves the response.
Take note, however, that setting an excessively large value may generate vibration or noise.

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
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 in solenoid valve mode 0. 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.
0A3	Position command information data error	Cause: The speed or acceleration/deceleration at the value command exceeded the maximum setting value. Action: Change to the appropriate value.
0B5	Phase-Z position error	The position at which the phase-Z was detected at homing was outside the specified range. Cause: Encoder error Action: Contact IAI.
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 load 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 load 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.
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.
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.

Code	Error	Cause/action
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.
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.
0D2	Excessive motor power-supply voltage	Cause: This error occurs when overvoltage of motor power has been detected (38V or more) Action: Check the motor power input voltage (MPI terminal). In case there is no fault found in voltage, malfunction of controller can be considered. Please contact us.
0D8	Deviation overflow	The position deviation counter has overflowed. Cause: The speed dropped during movement due to the effect of an external force, etc. Action: Check the load conditions—such as whether the load is contacting a surrounding object or the brake is disengaged—and then correct the abnormality, if any
0D9	Software stroke limit overtravel error	Cause: [1] The actuator installed vertically overshot and exceeded a software stroke limit due to a large load or high deceleration setting when the target position was set to a point near the software stroke limit. [2] The actuator was moved to outside the software stroke limits with the servo turned off, and then the servo was turned on. Action: [1] Set the deceleration curve properly so that the actuator will not overshoot when stopping. [2] Return the actuator to inside the software stroke limits, and then turn on the servo.
0DC	Out of push & hold operation range error	This error occurs when the actuator was pushed back to the target position due to an excessive push force after completion of push & hold operation. Review the entire system.
0ED	Absolute encoder error (1)	Cause: [1] When the power was reconnected following the completion of an absolute reset, the current position changed due to an external factor, etc., while the ABS unit was communicating. [2] When an absolute reset was performed, the current position changed due to an external factor, etc., while the controller was communicating with the simple absolute unit. Action: [1] Detail code = H'0001 Turn on the power and then turn it back on in a condition where the actuator does not receive vibration, etc. [2] Detail code = H'0002 Perform an origin return operation again in a condition where the actuator does not receive vibration, etc.

Code	Error	Cause/action
0EE	Absolute encoder error (2)	Cause: [1] The power was turned on for the first time after connecting the battery of the simple absolute unit. [2] Detail code = H'0001 The battery voltage dropped to a level at which the encoder counter in the simple absolute unit could no longer retain the count. [3] Detail code = H'0002 The encoder connector was unplugged or encoder cable suffered a broken wire during power outage. [4] Detail code = H'0003 The parameter was changed. Action: If [1], [2] or [4] is the case, perform an absolute reset according to the specified procedure by referring to the operation manual for your simple absolute unit (5.2, "How to Perform Absolute Reset"). [2] Supply the power for at least 48 hours to fully charge the battery and then perform an absolute reset.
0EF	Absolute encoder error (3)	Cause: When the power was cut off, the current value changed at a speed equal to or above the set value of rotational speed due to an external factor, etc. Action: Change the value set in the simple absolute unit and take an appropriate action to prevent the actuator from moving at a speed equal to or above the set speed. If the battery backup time has enough allowance to do so, increase the setting of motor speed. Refer to: 5.1.1, "Piano Switch Settings" in the operation manual for your simple absolute unit. If this error has generated, perform an absolute reset according to the specified procedure (5.2, "How to Perform Absolute Reset").

(2) Cold Start 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.
0A8	Unsupported motor/encoder type	Cause: Motor type and/or encoder type set in parameters are not supported. Action: Contact IAI if the error persists even after turning the power on again.
0B4	Electric angle mismatch	Cause: The position deviation counter has overflowed. Action: Check if loads interfere with peripheral objects, the brake is released or other load conditions exit. Moreover, occurrence of deviation overflow (when phase-Z is undetected) can be considered as a cause before the electric angle is determined. In this case, disconnection of the motor cable and/or output error of the encoder cable can be considered; check the connection of the cables.
0B7	Indeterminable magnetic pole	This controller detects the magnetic-pole phase when the servo is turned on for the first time after turning on the power. This alarm indicates that the magnetic-pole phase cannot be detected after a specified 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 slide 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] 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.
0C8	Overcurrent	Cause: The output current of the power-supply circuit became abnormally high. This alarm should not generate in normal conditions of use. If it generates, the isolation of motor coil may have deteriorated. Action: Measure the inter-phase resistances among motor connection wires U, V and W, as well as the isolation resistance between the motor connection wires and ground, to check for deterioration of isolation. If you wish to measure the above resistances, contact IAI.
0CA	Overheating	Cause: [1] The temperature around the power transistor inside the controller is too high (= 95 °C or higher). [2] Lack of regeneration resistant energy because deceleration is set too high at moving downward in case of vertically installed controller. [3] Default parts inside the controller Action: [1] Lower the surrounding temperature of the controller. [2] Review the setting conditions such that the deceleration speed shows gradual curve. If [1] or [2] is not the case, contact IAI.

Code	Error	Cause/action
0CB	Current-sensor offset adjustment error	The status of the current detection sensor in the controller is checked during the initialization process. This alarm indicates that the sensor was found abnormal as a result of this check. Cause: [1] Faulty current detection sensor or peripheral component [2] Inappropriate offset adjustment Action: The board must be replaced or offset must be adjusted. Contact IAI.
0E0	Overload	Cause: [1] The load increased due to application of external force. [2] If the actuator is equipped with a brake, the brake cannot be released. [3] The slide resistance of the actuator is large in some areas. Action: [1] Check the load and its surroundings. If the load is receiving any abnormal external force, make the necessary corrections to remove the force. [2] Turn on the brake release switch to see if the brake is released. If the brake is not released, the brake itself may be faulty, or an open cable or faulty brake circuit component in the controller is suspected, among others. [3] If the load can be moved by hand, do so to check for any area where the slide resistance increases. If [2] or [3] is the case, contact IAI. Note: Be sure to remove the cause of the alarm before resuming the operation. If the power has been cut off, wait for at least 30 minutes before reconnecting the power to prevent the motor coil from being burned.
0E8	Open phase A/B detected	Encoder signals cannot be detected correctly. 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.
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.

Code	Error	Cause/action
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 load. If it misses the load, 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] 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.
  [3] Is Parameter No. 42 (Enable function) enabled by mistake when a teaching pendant is connected that does not support the enable switch?

- With an Actuator Installed in Vertical Orientation, Positioning Completes Prematurely.
  Cause: [1] The ball screw is receiving torsional stress due to the actuator affixing method, uneven tightening of bolts, etc.
  [2] The slide resistance of the actuator itself is high.
  Action: Check / Change the parameters set in User Parameter No. 13 (Current Limit at Home Return). Reference for setting is from 120% (when direction of home return is upwards) to the initial setting or 80% (when direction of home return is downwards).
  [1] To check if the condition in [1] 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.
  [2] If the slide resistance of the actuator itself is high, contact IAI.

- 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 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.

- 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	Motor output [W]	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]
RCA (rod type)	RA3C	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					5	Horizontal/ vertical	6.25	250	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					2.5	Horizontal/ vertical	3.12	125	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
	RGS3C	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					5	Horizontal/ vertical	6.25	250	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					2.5	Horizontal/ vertical	3.12	125	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
	RGD3C	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					5	Horizontal/ vertical	6.25	250	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					2.5	Horizontal/ vertical	3.12	125	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
	RA3D	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	0.3	–	–	–
										–	–	–
					5	Horizontal/ vertical	6.25	250	0.3	–	–	–
										–	–	–
					2.5	Horizontal/ vertical	3.12	125	0.2	–	–	–
										–	–	–
	RGS3D	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	0.3	–	–	–
										–	–	–
					5	Horizontal/ vertical	6.25	250	0.3	–	–	–
										–	–	–
					2.5	Horizontal/ vertical	3.12	125	0.2	–	–	–
										–	–	–
	RGD3D	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	0.3	–	–	–
										–	–	–
					5	Horizontal/ vertical	6.25	250	0.3	–	–	–
										–	–	–
					2.5	Horizontal/ vertical	3.12	125	0.2	–	–	–
										–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA (rod type)	RA3R	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	0.3	–	–	–
										–	–	–
					5	Horizontal/ vertical	6.25	250	0.3	–	–	–
										–	–	–
					2.5	Horizontal/ vertical	3.12	125	0.2	–	–	–
										–	–	–
	RGD3R	Ball screw	20	800	10	Horizontal/ vertical	12.5	500	0.3	–	–	–
										–	–	–
					5	Horizontal/ vertical	6.25	250	0.3	–	–	–
										–	–	–
					2.5	Horizontal/ vertical	3.12	125	0.2	–	–	–
										–	–	–
	RA4C	Ball screw	20	800	12	Horizontal/ vertical	15	600	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					6	Horizontal/ vertical	7.5	300	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					3	Horizontal/ vertical	3.75	150	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
			30		12	Horizontal/ vertical	15	600	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					6	Horizontal/ vertical	7.5	300	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					3	Horizontal/ vertical	3.75	150	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
	RGS4C	Ball screw	20	800	12	Horizontal/ vertical	15	600	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					6	Horizontal/ vertical	7.5	300	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					3	Horizontal/ vertical	3.75	150	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
			30		12	Horizontal/ vertical	15	600	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					6	Horizontal/ vertical	7.5	300	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					3	Horizontal/ vertical	3.75	150	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
	RGD4C	Ball screw	20	800	12	Horizontal/ vertical	15	600	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					6	Horizontal/ vertical	7.5	300	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					3	Horizontal/ vertical	3.75	150	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–
			30		12	Horizontal/ vertical	15	600	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					6	Horizontal/ vertical	7.5	300	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0	–	–	–
					3	Horizontal/ vertical	3.75	150	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA (rod type)	RA4D	Ball screw	20	800	12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
			30		12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
	RGS4D	Ball screw	20	800	12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
			30		12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
	RGD4D	Ball screw	20	800	12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
			30		12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
	RA4R	Ball screw	20	800	12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
			30		12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA (rod type)	RGD4R	Ball screw	20	800	12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
			30		12	Horizontal/ vertical	15	600	0.3	–	–	–
										–	–	–
					6	Horizontal/ vertical	7.5	300	0.3	–	–	–
										–	–	–
					3	Horizontal/ vertical	3.75	150	0.2	–	–	–
										–	–	–
	SRA4R	Ball screw	20	800	5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–
	SRGS4R	Ball screw	20	800	5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–
	SRGD4R	Ball screw	20	800	5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA (slider type)	SA4C	Ball screw	20	800	10	Horizontal/ vertical	12.5	665	Energy-saving spec.: 0.3 High acc/dec spec.: 1.0	–	–	–
					5	Horizontal/ vertical	6.25	330	Energy-saving spec.: 0.3 High acc/dec spec.: 1.0	–	–	–
					2.5	Horizontal/ vertical	3.12	165	Energy-saving spec.: 0.2 High acc/dec spec.: 0.2	–	–	–
	SA4D	Ball screw	20	800	10	Horizontal/ vertical	12.5	665	0.3	–	–	–
					5	Horizontal/ vertical	6.25	330	0.3	–	–	–
					2.5	Horizontal/ vertical	3.12	165	0.2	–	–	–
	SA4R	Ball screw	20	800	10	Horizontal/ vertical	12.5	665	0.3	–	–	–
					5	Horizontal/ vertical	6.25	330	0.3	–	–	–
					2.5	Horizontal/ vertical	3.12	165	0.2	–	–	–
	SA5C	Ball screw	20	800	20	Horizontal	25	1300	Energy-saving spec.: 0.3	–	–	–
						Vertical		800	High acc/dec spec.: 0.8	–	–	–
					12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st)	Energy-saving spec.: 0.3 High acc/dec spec.: 0.8	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st)	Energy-saving spec.: 0.3 High acc/dec spec.: 0.8	–	–	–
					3	Horizontal/ vertical	3.75	200 (at 50 to 450st) 190 (at 500st)	Energy-saving spec.: 0.2 High acc/dec spec.: 0.2	–	–	–
	SA5D	Ball screw	20	800	12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st)	0.3	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st)	0.3	–	–	–
					3	Horizontal/ vertical	3.75	200 (at 50 to 450st) 190 (at 500st)	0.2	–	–	–
	SA5R	Ball screw	20	800	12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st)	0.3	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st)	0.3	–	–	–
					3	Horizontal/ vertical	3.75	200 (at 50 to 450st) 190 (at 500st)	0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA (slider type)	SA6C	Ball screw	30	800	20	Horizontal	25	1300 (at50 to 500st) 1160 (at 550st) 990 (at 600st)	Energy-saving spec.: 0.3	–	–	–
						Vertical		800	High acc/dec spec.: 0.8	–	–	–
					12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0			
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	Energy-saving spec.: 0.3	–	–	–
									High acc/dec spec.: 1.0			
					3	Horizontal/ vertical	3.75	200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	Energy-saving spec.: 0.2	–	–	–
									High acc/dec spec.: 0.2			
	SA6D	Ball screw	30	800	12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	0.3	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380(at 500st) 320(at 550st) 270(at 600st)	0.3	–	–	–
					3	Horizontal/ vertical	3.75	200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	0.2	–	–	–
	SA6R	Ball screw	30	800	12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	0.3	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	0.3	–	–	–
					3	Horizontal/ vertical	3.75	200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	0.2	–	–	–
	SS4D	Ball screw	20	800	10	Horizontal/ vertical	12.5	665	0.3	–	–	–
					5	Horizontal/ vertical	6.25	330	0.3	–	–	–
					2.5	Horizontal/ vertical	3.12	165	0.2	–	–	–
	SS5D	Ball screw	20	800	12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st)	0.3	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st)	0.3	–	–	–
					3	Horizontal/ vertical	3.25	200 (at 50 to 450st) 190 (at 500st)	0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA (slider type)	SS6D	Ball screw	30	800	12	Horizontal/ vertical	15	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	0.3	–	–	–
					6	Horizontal/ vertical	7.5	400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	0.3	–	–	–
					3	Horizontal/ vertical	3.25	200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	0.2	–	–	–
RCA (arm type)	A4R	Ball screw	20	800	10	Horizontal/ vertical	12.5	330	0.2	–	–	–
					5		6.25	165	0.2	–	–	–
	A5R	Ball screw	20	800	12	Horizontal/ vertical	15	400	0.2	–	–	–
					6		7.5	200	0.2	–	–	–
	A6R	Ball screw	30	800	12	Horizontal/ vertical	15	400	0.2	–	–	–
					6		7.5	200	0.2	–	–	–
RCA2 (rod type)	RN3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	RP3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	GS3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	GD3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	SD3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	RN4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA2 (rod type)	RP4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	GS4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	GD4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	SD4N	Ball screw	20	1048	6	Horizontal	5.72	240 (at 25st) 300 (at 50 to 75st)	0.3	–	–	–
						Vertical		200 (at 25st) 300 (at 50 to 75st)	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	200 (at 25st) 300 (at 50 to 75st)	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA2 (slider type)	SA3C	Ball screw	10	800	6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	5	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	2.5	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	SA3R	Ball screw	10	800	6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	5	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	2.5	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	SA4C	Ball screw	20	800	10	Horizontal	12.5	380 (at 50st) 500 (at 100 to 500st)	0.3	–	–	–
						Vertical			0.2	–	–	–
					5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–
	SA4R	Ball screw	20	800	10	Horizontal	12.5	380 (at 50st) 500 (at 100 to 500st)	0.3	–	–	–
						Vertical			0.2	–	–	–
					5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA2 (slider type)	SA5C	Ball screw	20	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)	0.3	–	–	–
						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)	0.3	–	–	–
						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	–	–	–
						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	–	–	–
						Vertical			0.2	–	–	–
	SA5R	Ball screw	20	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	–	–	–
						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	–	–	–
						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	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA2 (slider type)	SA6C	Ball screw	30	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)	0.3	–	–	–
						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)	0.3	–	–	–
						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	–	–	–
						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	–	–	–
						Vertical			0.2	–	–	–
	SA6R	Ball screw	30	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	–	–	–
						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	–	–	–
						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	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA2 (table type)	TC3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	TW3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	TF3N	Lead screw	10	1048	4	Horizontal/ vertical	3.81	200	0.2	–	–	–
					2		1.90	100				
					1		0.95	50				
	TC4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	TW4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	TF4N	Ball screw	20	1048	6	Horizontal	5.72	270	0.3	–	–	–
						Vertical		220	0.2	–	–	–
					4	Horizontal	3.81	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
		Lead screw			6	Horizontal	5.72	220	0.2	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	3.81	200	0.2	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	1.90	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA4C	Ball screw	10	800	6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	5	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	2.5	100	0.2	–	–	–
						Vertical			0.2	–	–	–

Actuator series	Type	Feed screw	Motor output [W]	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]
RCA2 (table type)	TA4R	Ball screw	10	800	6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					4	Horizontal	5	200	0.3	–	–	–
						Vertical			0.2	–	–	–
					2	Horizontal	2.5	100	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA5C	Ball screw	20	800	10	Horizontal	12.5	465	0.3	–	–	–
						Vertical		400	0.2	–	–	–
					5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA5R	Ball screw	20	800	10	Horizontal	12.5	465	0.3	–	–	–
						Vertical		400	0.2	–	–	–
					5	Horizontal	6.25	250	0.3	–	–	–
						Vertical			0.2	–	–	–
					2.5	Horizontal	3.12	125	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA6C	Ball screw	20	800	12	Horizontal	15	560	0.3	–	–	–
						Vertical		500	0.2	–	–	–
					6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					3	Horizontal	3.75	150	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA6R	Ball screw	20	800	12	Horizontal	15	560	0.3	–	–	–
						Vertical		500	0.2	–	–	–
					6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					3	Horizontal	3.75	150	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA7C	Ball screw	30	800	12	Horizontal	15	600	0.3	–	–	–
						Vertical		580	0.2	–	–	–
					6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					3	Horizontal	3.75	150	0.2	–	–	–
						Vertical			0.2	–	–	–
	TA7R	Ball screw	30	800	12	Horizontal	15	600	0.3	–	–	–
						Vertical		580	0.2	–	–	–
					6	Horizontal	7.5	300	0.3	–	–	–
						Vertical			0.2	–	–	–
					3	Horizontal	3.75	150	0.2	–	–	–
						Vertical			0.2	–	–	–
RCL	RA1L	Linear	–	715	–	Horizontal/ vertical	42	300	2	0.75	2	2
	RA2L			855		Horizontal/ vertical	42	340	2	1.5	4	4
	RA3L			1145		Horizontal/ vertical	42	450	2	3	8	8
	SA1L			715		Horizontal	42	420	2	–	–	–
	SA2L			855		Horizontal	42	460	2	–	–	–
	SA3L			1145		Horizontal	42	600	2	–	–	–
	SA4L			715		Horizontal	42	1200	2	–	–	–
	SM4L			715		Horizontal	42	1200	2	–	–	–
	SA5L			855		Horizontal	42	1400	2	–	–	–
	SM5L			855		Horizontal	42	1400	2	–	–	–
	SA6L			1145		Horizontal	42	1600	2	–	–	–
	SM6L			1145		Horizontal	42	1600	2	–	–	–

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 specification	Incremental	Command mode	Standstill mode
0													
1													
2													

Parameter Record

Recorded date: _____

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	
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	
30	b	Pole sensing type [0: Current suppression / 1: Distance suppression]	-	
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	%	
52	**b**	Default acceleration/deceleration mode	-	
53	b	Default standstill mode	-	
54	**d**	Current control band number	-	
55	**b**	Primary filter time constant for position command	msec	
56	**b**	S-motion ratio setting	%	
71	d	Feed-forward gain	-	
77	b	Ball screw lead length	mm	

No.	Type	Name	Unit	Data
78	b	Axis operation type	-	`
79	b	Rotational axis mode selection	-	
80	b	Shortcut selection for rotation	-	`
83	b	Absolute unit [0: Not used / 1: Used]	-	
88	a	Software limit margin	mm	`
91	b	Current-limiting value at stopping due to missed push-motion	-	

Change History

Revision Date	Description of Revision
	First edition
March 2007	Second edition
	Third edition • Changed the cautions at the front.
January 2009	Fourth edition • Added the additional models on p. 4. • Changed the teaching drawing to CON-T on p. 5. • Corrected the specifications on p. 10. (Added current value of the additional models and encoder resolutions.) • Changed the part about supplied voltage on p. 13 (for the additional models). • Unified the notation of the part about noise elimination measures to ones for other models on p. 14 and 15. • Reviewed the emergency stop circuit on p. 18 to 20. • Corrected the timing chart on p. 38. • Corrected the explanation on SV lamp on p. 50. • Edited the additional parameters for No. 77 or later on p. 66 to 84. • Edited the added error codes on p. 87 to 90. • Edited the added models on p. 96 to 98. • Unified the PIO pattern names to catalogue names in all of the overview areas.
February, 2010	Fifth edition • Added "About CE Marking."
April, 2010	Sixth edition • Added "Please Read Before Use" on the first page after the cover. • Added "Safety Guide" on the first page after the Table of Contents. • Added "Change History" on the last page.
July, 2010	Seventh edition • Replaced the warning on p. 47
September, 2010	Eighth edition • Added the caution on S-motion acceleration/deceleration.
November, 2010	Ninth edition • Replaced the warning on P.47
January, 2011	Tenth edition • Correction made in "Speed loop integral gain" in P.91
April, 2011	Eleventh edition • Swapped over the page for CE Marking
July, 2011	Twelfth edition • Contents changed in 1.6 Warranty in P.16 to P.17 • Contents changed and added in Appendix: List of Specifications of Connectable Actuators.

Revision Date	Description of Revision
December, 2012	Thirteenth edition • Explanation changed for home return current (Parameter No. 13) in P. 80 and 104 • Added "D2 Errer" in P. 96
March, 2015	13C edition • Correction made to moto maximum current at 30 watts (4.0 to 4.4A) in P. 18

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