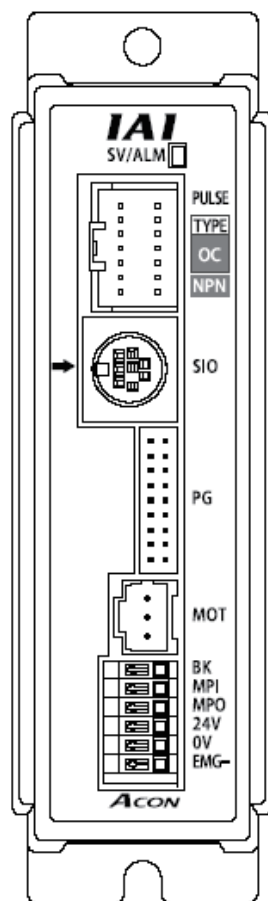




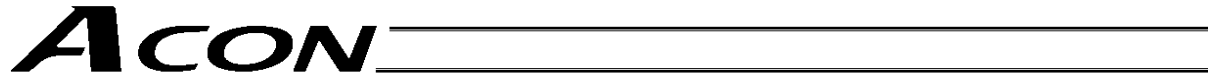
## ACON-PL/PO Controller Pulse-train Input Type

Operation Manual Fourteenth 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 DVD that comes with the product contains operation manuals for IAI products.

When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

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

### [Important]

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



## 1. Use Environment

The 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	RCM-101-***	All are compatible with existing RCS controllers.
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

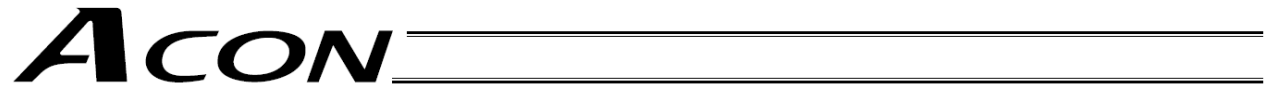
This controller uses nonvolatile memory to store parameters. Although data in the memory is retained even after the power is cut off, the stored data will be lost if the nonvolatile memory is damaged. It is therefore recommended that you regularly back up the latest parameters in case of accidental data loss. Regular backup will also let you restore data quickly if the controller must be replaced for other reasons.

Use one of the following methods to back up data:

[1] Use the PC software to save the data to a CD or DVD.

[2] Create a position table list or parameter list to keep a written record of parameter settings.

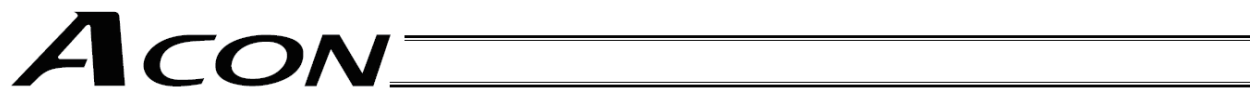




## **CE Marking**

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

***A*CON** \_\_\_\_\_



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## Safety Guide

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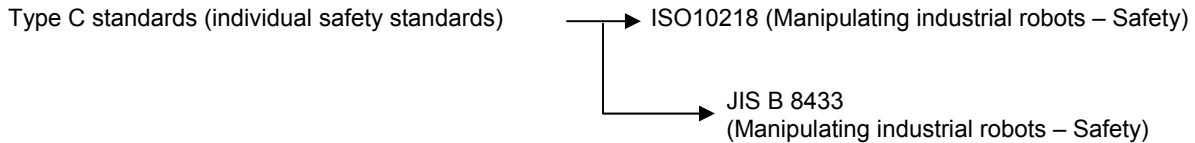
When designing and manufacturing a robot system, ensure safety by following the safety guides provided below and taking the necessary measures.

### 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:



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
			Preparation of work rules	Article 150-3
		Not cut off	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<sup>3</sup> 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	<ul style="list-style-type: none"> <li>● 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:               <ul style="list-style-type: none"> <li>[1] Medical devices relating to maintenance, management, etc., of life or health</li> <li>[2] Mechanisms or mechanical devices (vehicles, railway facilities, aircraft facilities, etc.) intended to move or transport people</li> <li>[3] Important safety parts in mechanical devices (safety devices, etc.)</li> </ul> </li> <li>● Do not use this product in the following environments:               <ul style="list-style-type: none"> <li>[1] Place subject to flammable gases, ignitable objects, flammables, explosives, etc.</li> <li>[2] Place that may be exposed to radiation</li> <li>[3] Place where the surrounding air temperature or relative humidity exceeds the specified range</li> <li>[4] Place subject to direct sunlight or radiated heat from large heat sources</li> <li>[5] Place subject to sudden temperature shift and bedewing</li> <li>[6] Place subject to corrosive gases (sulfuric acid, hydrochloric acid, etc.)</li> <li>[7] Place subject to excessive dust, salt or iron powder</li> <li>[8] Place where the product receives direct vibration or impact</li> </ul> </li> <li>● 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.</li> </ul>
2	Transportation	<ul style="list-style-type: none"> <li>● When transporting the product, exercise due caution not to bump or drop the product.</li> <li>● Use appropriate means for transportation.</li> <li>● Do not step on the package.</li> <li>● Do not place on the package any heavy article that may deform the package.</li> <li>● 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.</li> <li>● When using a crane or other equipment, never use it to hoist any article exceeding the rated load of the applicable crane, etc.</li> <li>● 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.</li> <li>● Do not climb onto the article being hoisted.</li> <li>● Do not keep the article hoisted.</li> <li>● Do not stand under the hoisted article.</li> </ul>
3	Storage/preservation	<ul style="list-style-type: none"> <li>● The storage/preservation environment should conform to the installation environment. Among others, be careful not to cause bedewing.</li> </ul>
4	Installation/startup	<p>(1) Installing the robot, controller, etc.</p> <ul style="list-style-type: none"> <li>● 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.</li> <li>● Do not step on the product or place any article on top. The product may tip over or the article may drop, resulting in injury, product damage, loss of/drop in product performance, shorter life, etc.</li> <li>● If the product is used in any of the following places, provide sufficient shielding measures:               <ul style="list-style-type: none"> <li>[1] Place subject to electrical noise</li> <li>[2] Place subject to a strong electric or magnetic field</li> <li>[3] Place where power lines or drive lines are wired nearby</li> <li>[4] Place subject to splashed water, oil or chemicals</li> </ul> </li> </ul>

4	Installation/ startup	<p>(2) Wiring the cables</p> <ul style="list-style-type: none"> <li>● Use IAI's genuine cables to connect the actuator and controller or connect a teaching tool, etc.</li> <li>● 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.</li> <li>● Wire the product correctly after turning off the power.</li> <li>● 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.</li> <li>● Be sure to connect the cable connectors without fail and firmly. Failing to do so may result in fire, electric shock or product malfunction.</li> <li>● 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.</li> </ul> <p>(3) Grounding</p> <ul style="list-style-type: none"> <li>● 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.</li> </ul> <p>(4) Safety measures</p> <ul style="list-style-type: none"> <li>● 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.</li> <li>● Be sure to provide an emergency stop circuit so that the product can be stopped immediately in case of emergency during operation.</li> <li>● 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.</li> <li>● 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.</li> <li>● Put up a sign saying "WORK IN PROGRESS. DO NOT TURN ON POWER," etc., during installation, adjustment, etc. If the power is accidentally turned on, electric shock or injury may result.</li> <li>● Implement measures to prevent the load, etc., from dropping due to a power outage or emergency stop.</li> <li>● Ensure safety by wearing protective gloves, protective goggles and/or safety shoes, as necessary.</li> <li>● Do not insert fingers and objects into openings in the product. Doing so may result in injury, electric shock, product damage, fire, etc.</li> <li>● 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.</li> </ul>
5	Teaching	<ul style="list-style-type: none"> <li>● 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.</li> <li>● 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.</li> <li>● 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.</li> <li>● Put up a sign saying "WORK IN PROGRESS" in a conspicuous location.</li> <li>● 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.</li> </ul> <p>* Safety fences --- Indicate the movement range if safety fences are not provided.</p>
6	Confirmation operation	<ul style="list-style-type: none"> <li>● After teaching or programming, carry out step-by-step confirmation operation before switching to automatic operation.</li> <li>● When carrying out confirmation operation inside the safety fences, follow the specified work procedure just like during teaching.</li> <li>● 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.</li> <li>● 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.</li> </ul>

7	Automatic operation	<ul style="list-style-type: none"> <li>● Before commencing automatic operation, make sure no one is inside the safety fences.</li> <li>● Before commencing automatic operation, make sure all related peripherals are ready to operate in the auto mode and no abnormalities are displayed or indicated.</li> <li>● Be sure to start automatic operation from outside the safety fences.</li> <li>● 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.</li> <li>● 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.</li> </ul>
8	Maintenance/ inspection	<ul style="list-style-type: none"> <li>● 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.</li> <li>● When working inside the safety fences, turn off the power switch, as a rule.</li> <li>● 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.</li> <li>● 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.</li> <li>● Put up a sign saying “WORK IN PROGRESS” in a conspicuous location.</li> <li>● Use appropriate grease for the guides and ball screws by checking the operation manual for each model.</li> <li>● Do not perform a withstand voltage test. Conducting this test may result in product damage.</li> <li>● 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.</li> </ul> <p>* Safety fences --- Indicate the movement range if safety fences are not provided.</p>
9	Modification	<ul style="list-style-type: none"> <li>● The customer must not modify or disassemble/assemble the product or use maintenance parts not specified in the manual without first consulting IAI.</li> <li>● Any damage or loss resulting from the above actions will be excluded from the scope of warranty.</li> </ul>
10	Disposal	<ul style="list-style-type: none"> <li>● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste.</li> <li>● When disposing of the product, do not throw it into fire. The product may explode or generate toxic gases.</li> </ul>

## 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

**Acon** \_\_\_\_\_

## 1. Overview

### 1.1 Introduction

This product is a pulse-train input controller used exclusively with RCA, RCA2 and RCL actuators. It can control actuators using the positioning control function of the host controller (PLC). The key features and functions of this controller are summarized below.

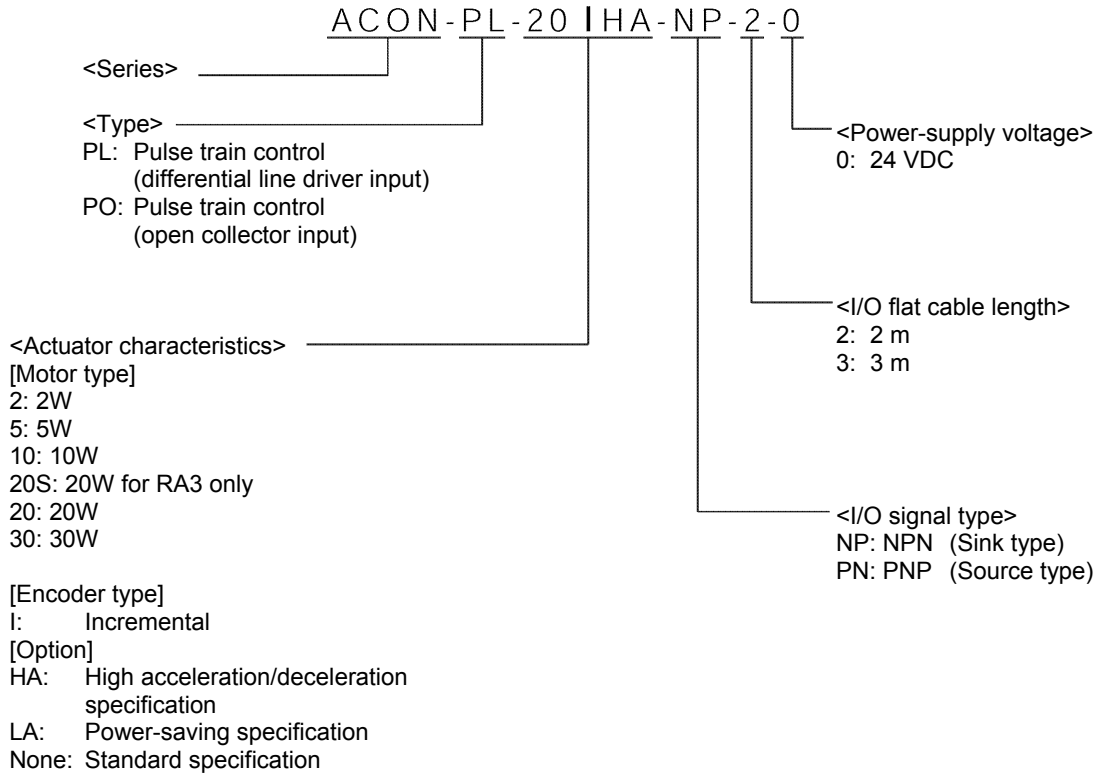
- **Dedicated Homing Signal**  
This signal supports IAI's original homing operation based on push motion at the stroke end. With this signal, homing can be performed automatically without having to program a complex sequence or using an external sensor, etc.
- **Brake Control Function**  
The electromagnetic brake power is supplied internally from the controller. However, 24 V must be supplied externally to forcibly release the brake when the servo is off.
- **Torque Limiting Function**  
This controller lets you limit torque using an external signal (set by a parameter). A signal is output when the specified torque is reached. This function enables push-motion operation, press-fit operation, etc.
- **Feed-forward Control Function**  
The response can be improved in certain situations such as when the load inertia ratio is high. Increasing the value set in the applicable parameter decreases the deviation (difference between the position command and the position feedback), thereby improving the response.
- **Primary Filter Function for Position Command**  
Soft start and stop can also be implemented in the command-pulse input mode where acceleration and deceleration settings are not considered.

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

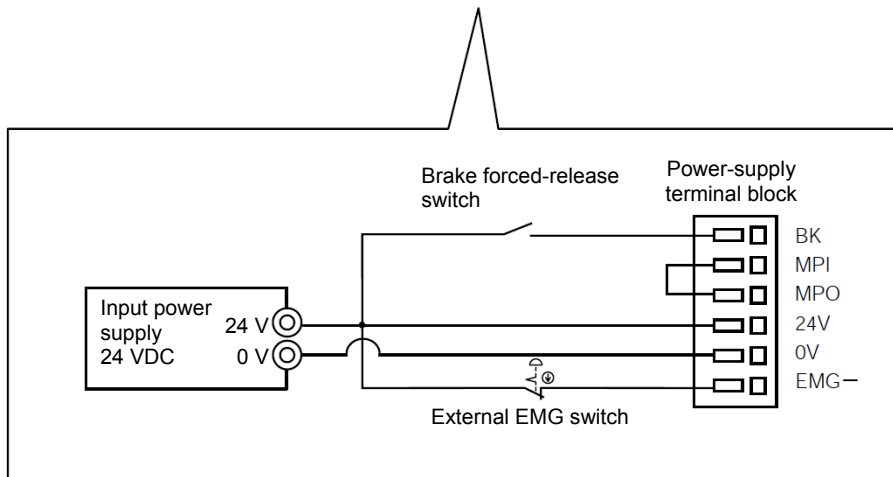
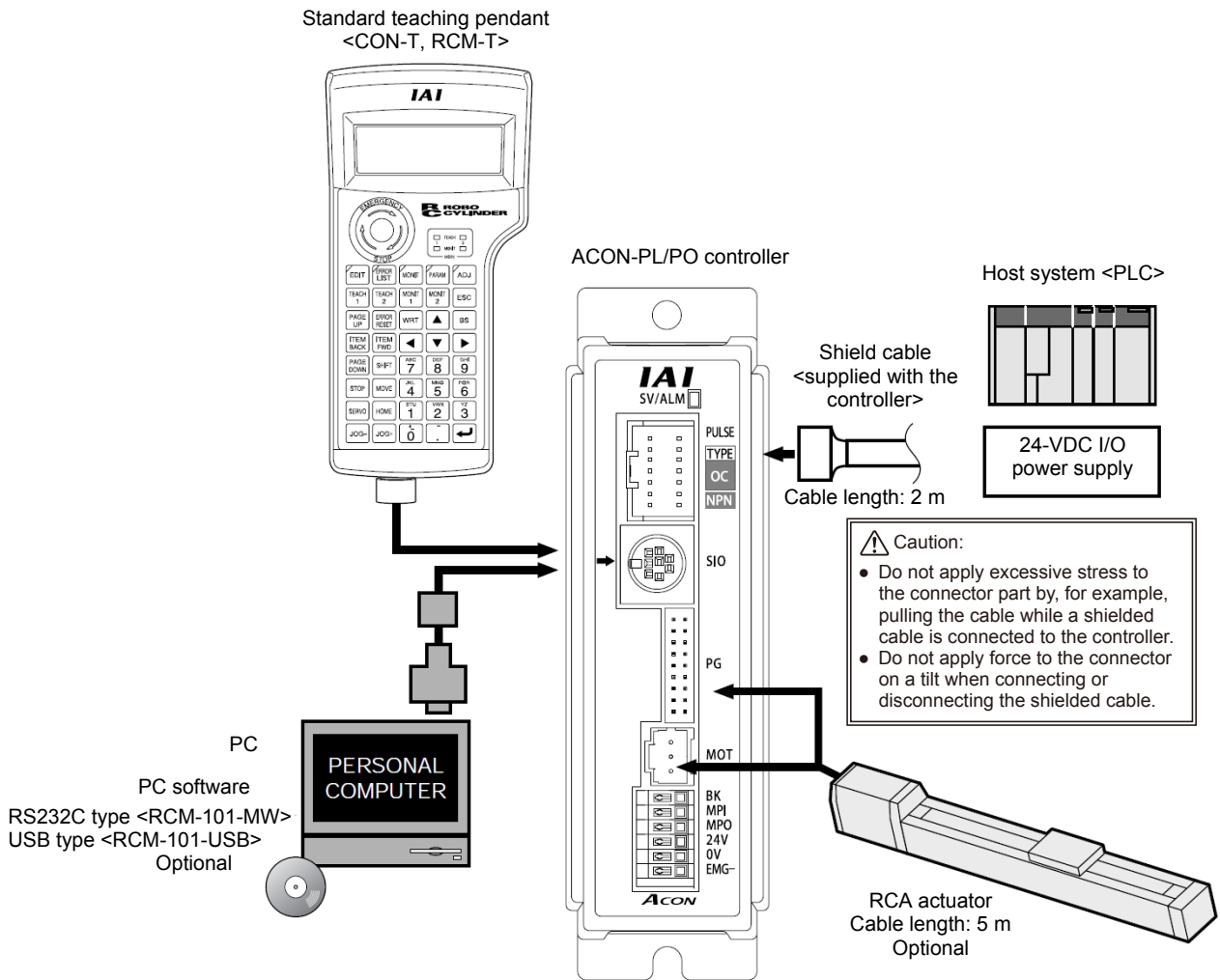
This manual does not cover all possible deviations from normal operations or unexpected phenomena such as complex signal changes resulting from critical timings. Therefore, the reader should assume that items not described in this manual are "not permitted," as a rule.

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

## 1.2 How to Read Model Name



## 1.3 System Configuration



Caution: The BK terminal need not be connected if the actuator has no brake.

## 1.4 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-PL/PO
- Actuator
- I/O shield cable  
CB-PACPU-PIO\*\*\*
- Motor cable  
CB-ACS-MA \*\*\*
- Encoder cable  
CB-ACS-PA \*\*\*
- Operation manual
- Teaching pendant <Options>  
RCM-T (standard)  
RCM-E (simple)  
RCM-P (data setting)  
CON-T (standard)
- PC software <Options>  
RS-232C type <RCM-101-MW>  
USB type <RCM-101-USB>  
(Cable is supplied)
- 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. → Chapter 3, "Installation and Wiring"
- Connect the motor cable and encoder cable.
- Connect the I/O shield 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. (The LED remains unlit when the servo is off.)

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 6, "Troubleshooting."

### 5. Checking the servo-on status

Confirm that the slider or rod is not contacting a mechanical end.

If the slider/rod is contacting a mechanical end, move the slider/rod in the opposite direction to provide a space in between.

If a brake is equipped, turn on the brake release switch to forcibly release the brake before moving the slider/rod. At this time, be careful not to pinch your hand or damage the robot hand by the slider/rod, as the slider/rod may drop unexpectedly by its dead weight.

Next, forcibly output a servo-on signal from the PLC.

The actuator enters a servo lock mode. If the monitor LED [SV/ALM] on the front face of the controller illuminates in green, the controller is functioning normally.

## 6. Setting a mode

If you want to use the “push mode” PIO pattern, change the value of Parameter No. 25 to “1.”

→ Chapter 4, “Operation Using I/Os”

\* The factory setting is to use the “standard mode.”

## 7. Setting an electronic gear

Determine the unit travel distance of the actuator per one pulse in input command pulse train.

→ Chapter 4, “Setting Parameters Required for

Operation”

## 8. Setting the command pulse-train input mode

Set a pulse-train input pattern for command pulse input (PP•/PP, NP•/NP).

→ Chapter 4, “Setting Parameters Required for

Operation”

## 9. Confirming the safety circuit operation

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

→ Chapter 3, “Installation and Wiring”

## 10. Adjustment by test operation

- Carry out operation check under the actual load using the host controller to check the operating characteristics. Adjust the parameters, if necessary.

→ Chapter 5, “Parameter Settings”

- Confirm that the entire system operates properly without presenting any abnormality.

## 1.5 Warranty

### 1.5.1 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

### 1.5.2 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.

### 1.5.3 Honoring Warranty

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

### 1.5.4 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.

## 1.5.5 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.

## 1.5.6 Other Items Excluded from Warranty

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

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

## 2. Specifications

### 2.1 Basic Specifications

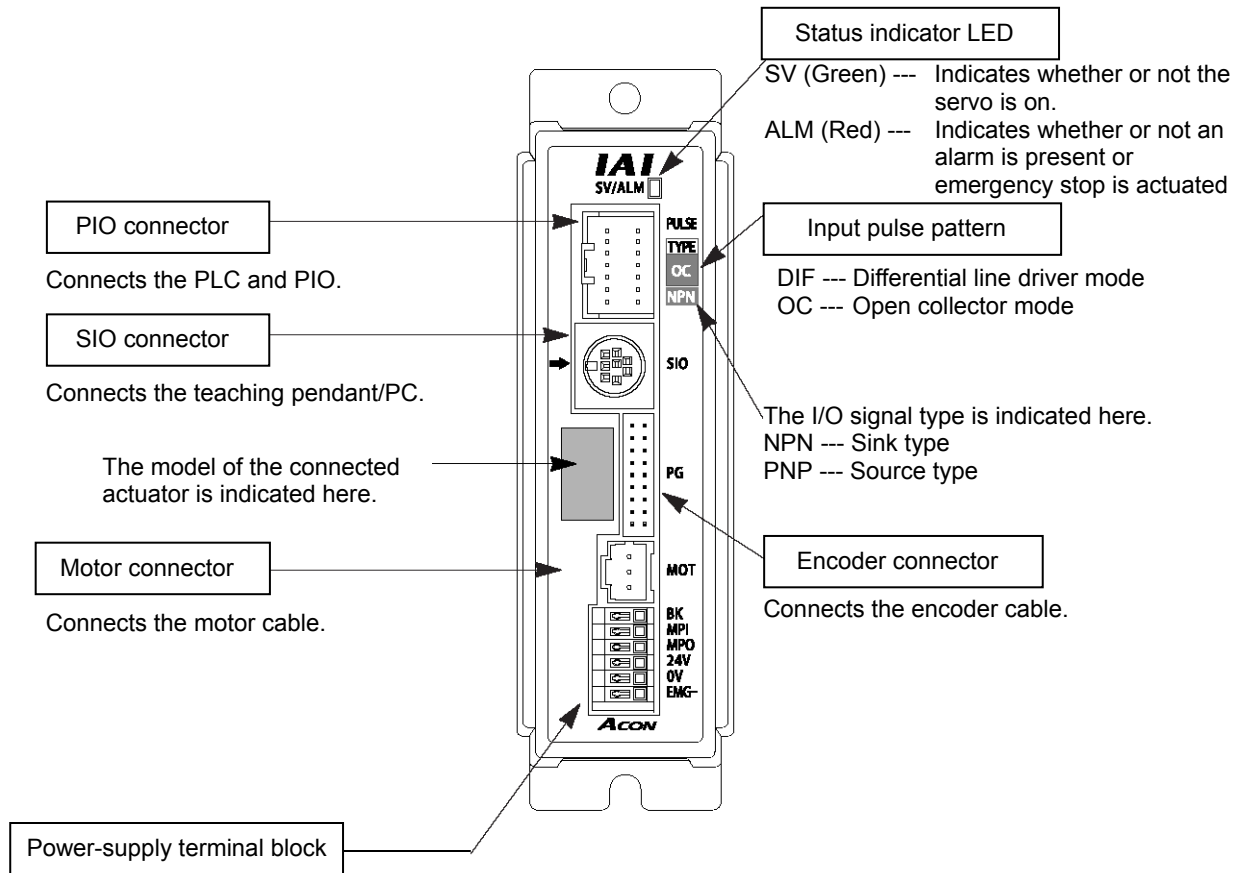
Specification item		Description				
Model		ACON-PL/PO				
Number of controlled axes		1 axis per unit				
Power-supply voltage		24 VDC $\pm$ 10%				
Motor power supply capacity (Note 1)	Actuator	Motor type	Standard specification/Support high acceleration/deceleration		Support power-saving	
			Rated [A]	Maximum (Note 2)	Rated [A]	Maximum (Note 2)
	RCA/ RCA2	10 W	1.3	4.4	1.3	2.5
		20 W [Model code: 20]	1.3	4.4	1.3	2.5
		30 W	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	2 W	0.8	4.6		
		5 W	1.0	6.4		
10 W		1.3	6.4			
Heat output		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			
RA3L/ SA3L/ SA6L/ SM6L		1145 Pulse/rev				
Function/performance	Control mode		Position control by pulse train input			
	Maximum input pulse frequency		60 kpps max. (open collector) / 200 kpps max. (differential)			
	Command pulse multiplier (Electronic gear: $\frac{A}{B}$ )		A, B = 1~4096 $\frac{1}{50} < \frac{A}{B} < \frac{50}{1}$ (set by parameters)			
	Positioning complete band		0.1 mm ~ 999.999 mm (set by parameters)			
Power supply for I/O signal I/F		24 VDC $\pm$ 10% Some open collectors have outputs that come with a built-in pull-up resistor. If any such open collector is used, remove the pull-up resistors or use ports without pull-up resistor.				
Backup memory		Parameters are saved in a non-volatile memory; serial EEPROM; rewritable approx. 100,000 times				
PIO interface		24 VDC, insulated; dedicated input/output				
PIO interface power supply		24 VDC $\pm$ 10% (supplied externally)				
LED indicator		SV (green) --- Whether or not the servo is on / ALM (red) --- Whether or not an alarm is present or emergency stop is actuated.				
Serial communication		RS485, 1 channel (for teaching pendant/dedicated PC software)				
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 shield cable: 2 m or shorter (open collector) or 10 m or shorter (differential)				
Dielectric strength		500 VDC 10 m $\Omega$				
Environment	Surrounding air temperature		0 to 40 °C			
	Surrounding humidity		85% RH or below (non-condensing)			
	Surrounding environment		Free from corrosive gases.			
	Ambient storage temperature		-10 to 65 °C			
	Ambient 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 power 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)

\* For the DC power supply of +24 V, select the "peak load" specification or a power supply having sufficient allowance. In particular, pay attention when the robot has a remote sensing function.

## 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 VDC.
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.)
24V	Positive side of the 24-VDC input power supply.
N	Negative side of the 24-VDC input power supply.
EMG	Connection terminal for the emergency stop circuit (for cutting of motor drive signals). A common ground is used, so connect the opposite side of the emergency stop switch (or contacts) to the positive side of the 24-VDC input power supply.

### ■ Model indication of the connected actuator type

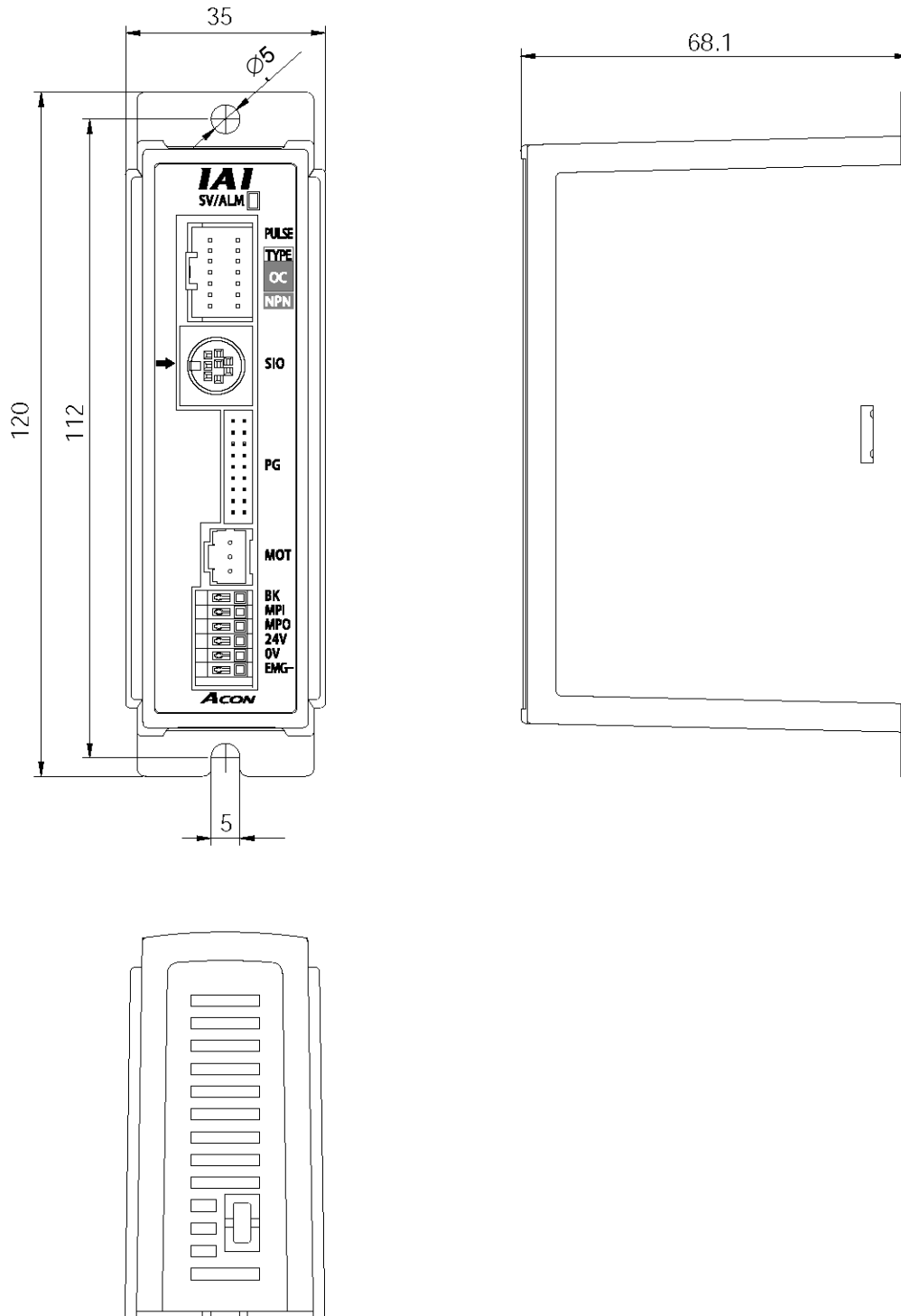
The type, ball screw lead and stroke of the actuator are indicated. When connecting the cables, confirm that the actuator is of the correct specifications.

Example of indication:

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

## 2.3 External Dimensions

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



## 3. Installation and Wiring

Pay due attention to the 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

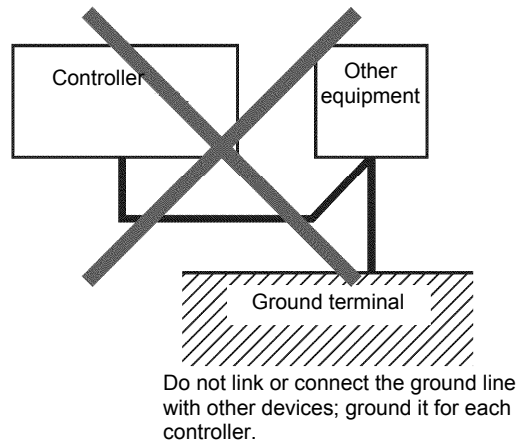
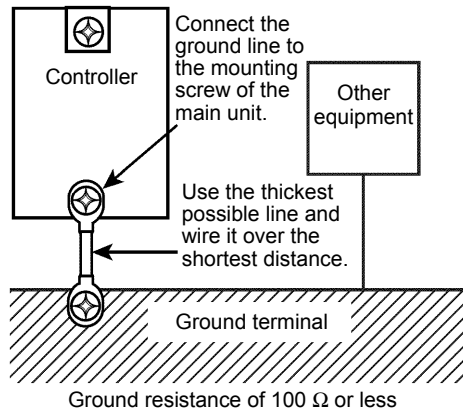
The controller takes a supplied voltage of 24 VDC  $\pm$  10%.  
For details refer to 2.1, "Base Specifications."

## 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  $100\ \Omega$  or less using a dedicated grounding. Moreover, the thickness of cable shall be  $1.6\ \text{mm}$  or thicker.



### [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 bey ond the length of the supplied cable, contact IAI.

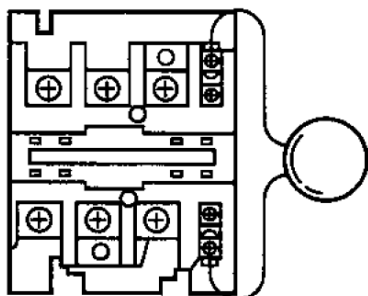
### (2) Noise sources and elimination

Noise generates from many sources, but the most comm on 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



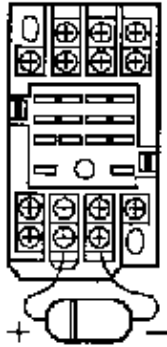
← Surge absorber

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

Measure --- Install a diode in parallel with the coil or use a built-in diode type.



If DC power is used, exercise due caution because the diode, internal controller parts and/or DC power supply may be damaged if the diode is installed in the wrong polarities.

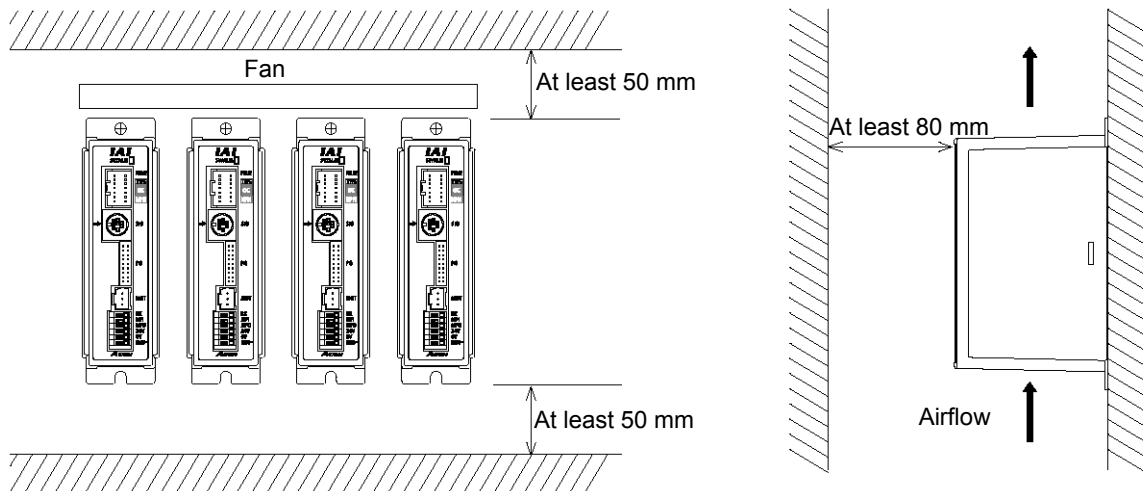
### 3.4 Heat Radiation and Installation

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).

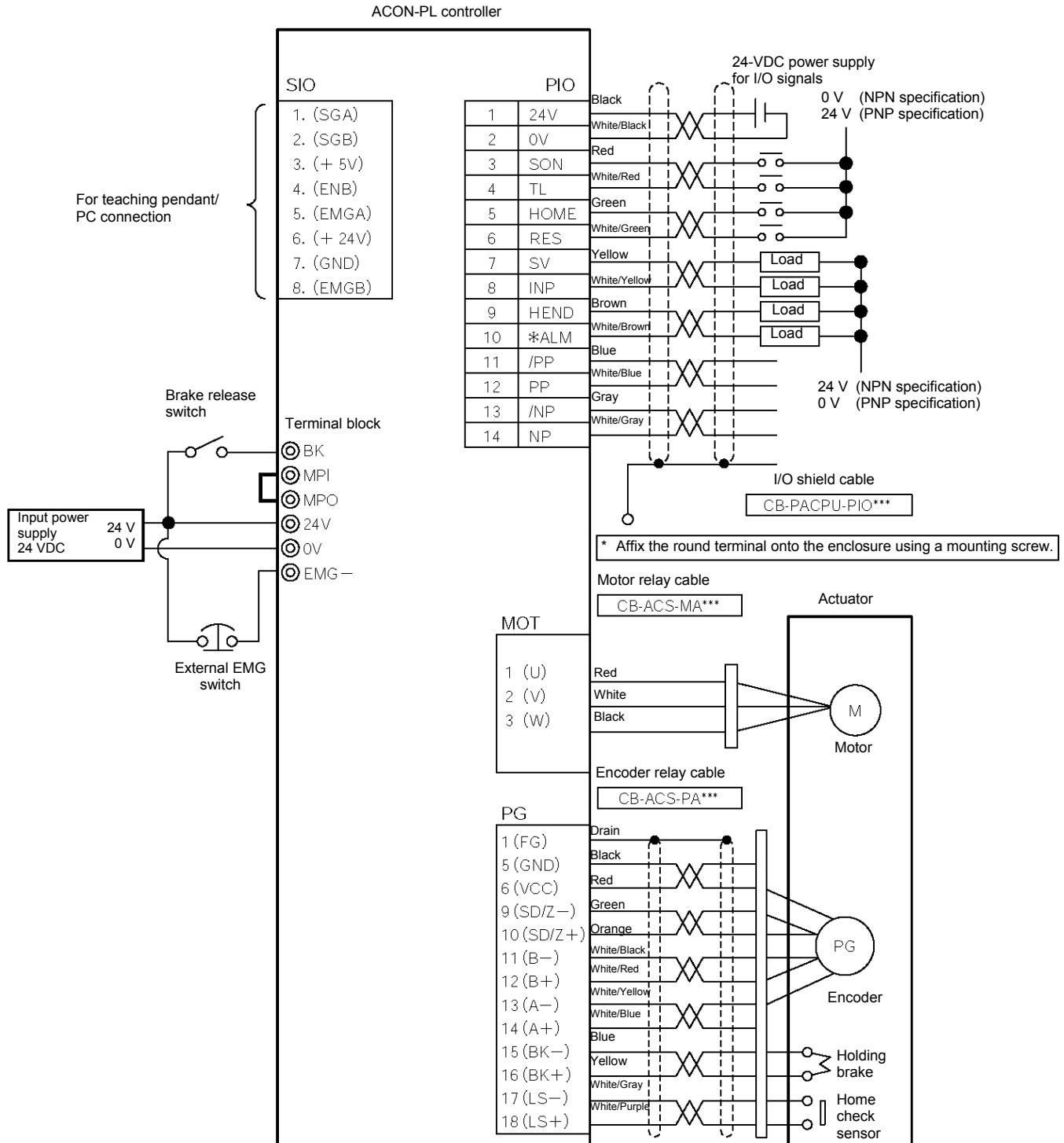


Regardless of whether you are installing one or more controllers, provide sufficient clearances around each controller to permit easy access for installation and removal of the controller.

## 3.5 External Connection Diagram

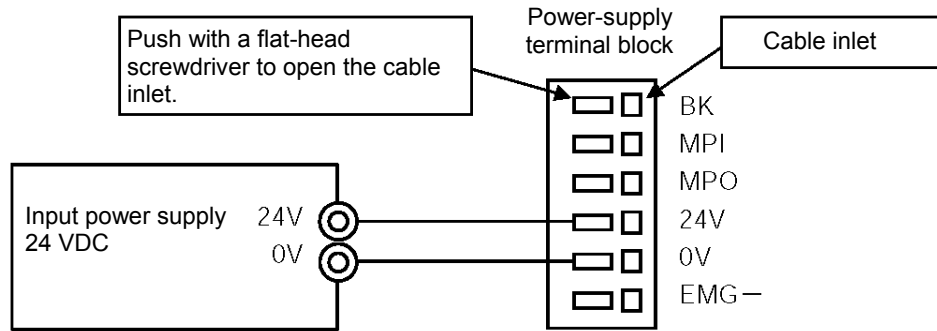
An example of standard wiring is shown below.

The wire colors of the robot encoder relay cable are different from those of the standard encoder relay cable. 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	<p>Twisted wire: AWG 22 (0.3 mm<sup>2</sup>) (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.</p>
Temperature rating of insulation sheath	60°C or above
Length of bare wire	

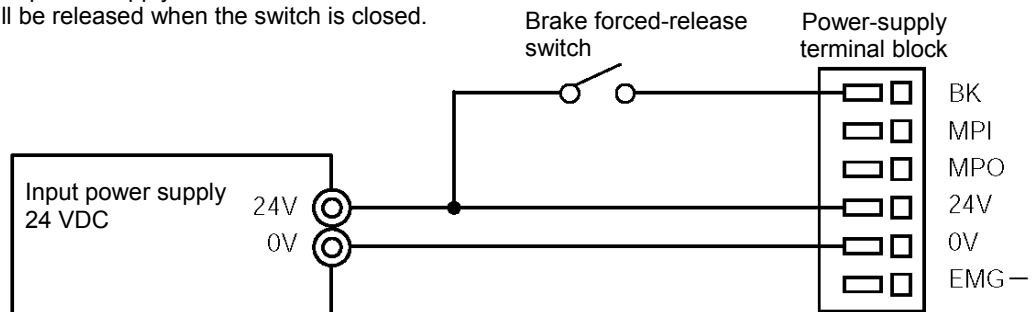
## 3.7 Wiring the Brake Forced-release Switch

If the actuator is equipped with a brake, provide a forced-release switch to permit a reset means during startup adjustment or in case of emergency.

The customer must provide the switch (24 VDC, with a minimum contact capacity of 0.2 A).

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

The brake will be released when the switch is closed.



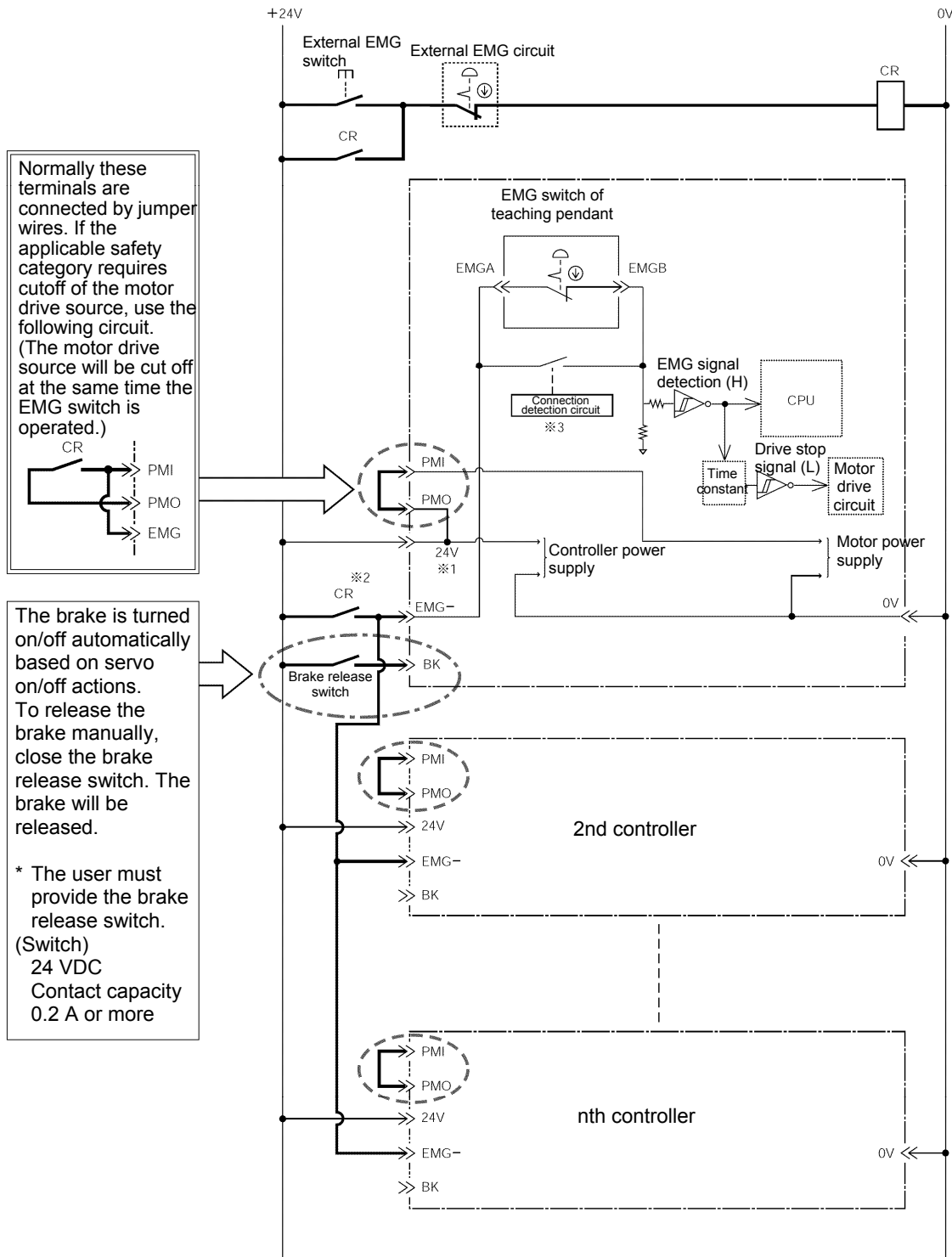
**Danger:** If the actuator is oriented vertically, exercise due caution when releasing the brake to prevent the slider/rod from dropping unexpectedly to pinch your hand or damage the robot hand or work.

## 3.8 Wiring the Emergency Stop Circuit

### 3.8.1 Cutting Off the Drive Signal (Standard)


Shown below is an example when the emergency stop circuit of the entire system is used to actuate an emergency stop on multiple controllers.

However, the emergency stop switch on the teaching pendant cannot actuate an emergency stop of the entire system.



Notes on power supply and emergency stop circuit

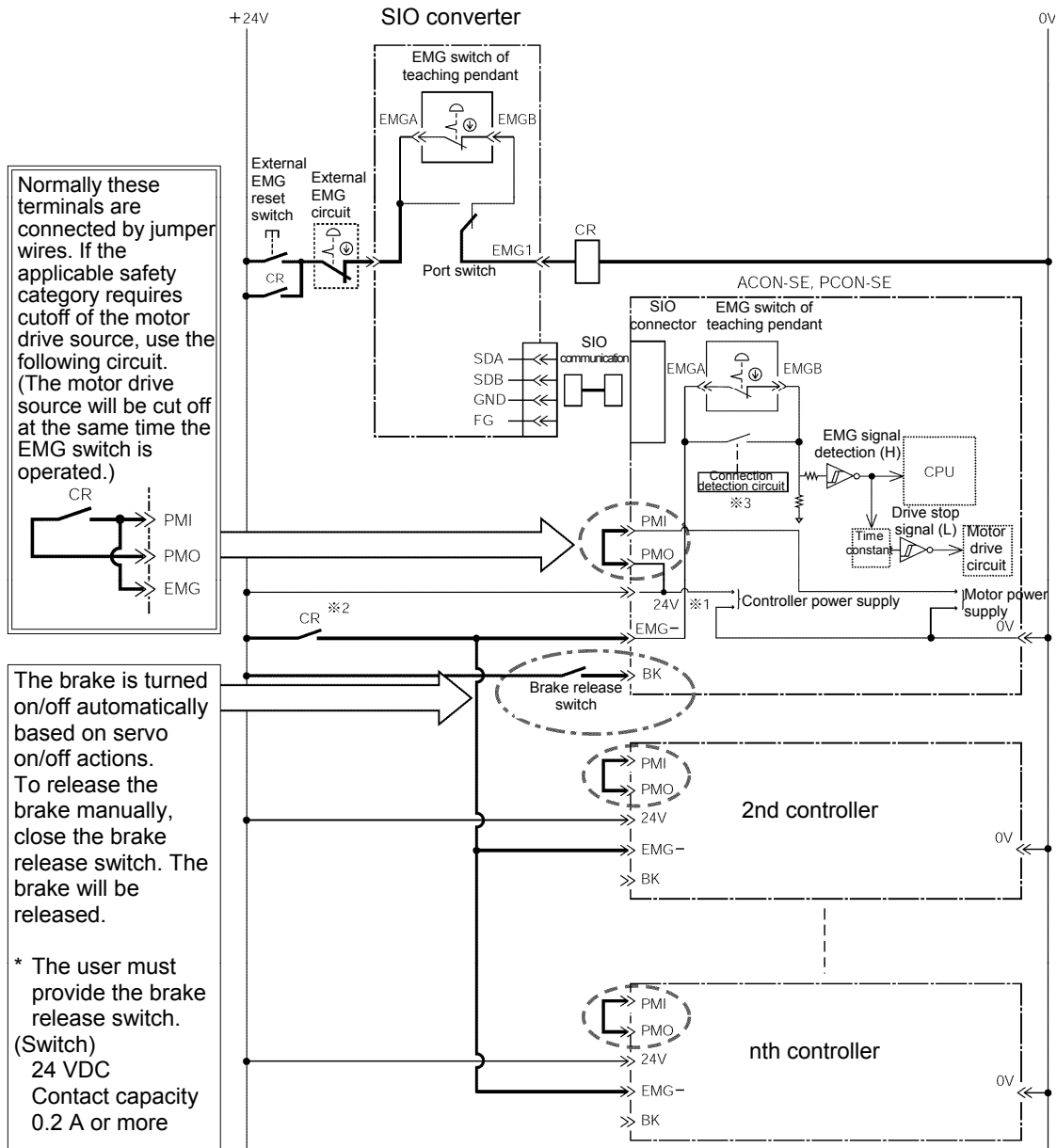
- \*1 Refer to the specification list for the load current of one controller.
- \*2 The input current at the EMG- terminal of each controller is 5 mA. If the relay contact CR is to be connected to the EMG- terminals of multiple controllers, check the contact capacity of the relay.
- \*3 When the teaching pendant is plugged into the controller, the controller automatically recognizes the connection.

 Caution:

- When cutting off the power circuit, do not cut off the 0-V side because it is connected to the internal ground line.
- If a SIO converter or gateway unit is used, use the same power supply or use a common 0-V line.

To actuate an emergency stop on the entire system using the emergency stop switch on the teaching pendant, use a SIO converter.

You can also reflect the operation of the teaching pendant's emergency stop switch when a gateway unit is used.



**Notes on power supply and emergency stop circuit**

- \*1 Refer to the specification list for the load current of one controller.
- \*2 The input current at the EMG- terminal of each controller is 5 mA. If the relay contact CR is to be connected to the EMG- terminals of multiple controllers, check the contact capacity of the relay.
- \*3 When the teaching pendant is plugged into the controller, the controller automatically recognizes the connection.

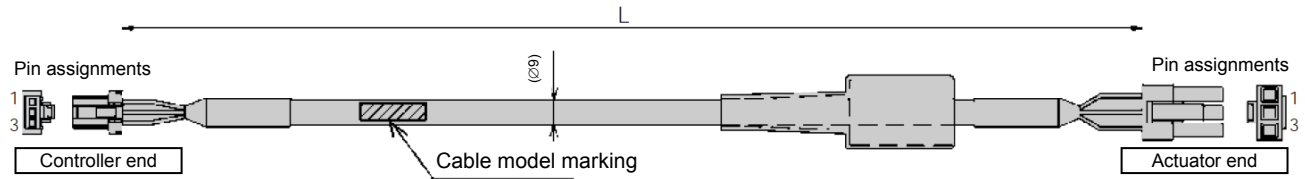
## 3.9 Connecting the Actuator

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	

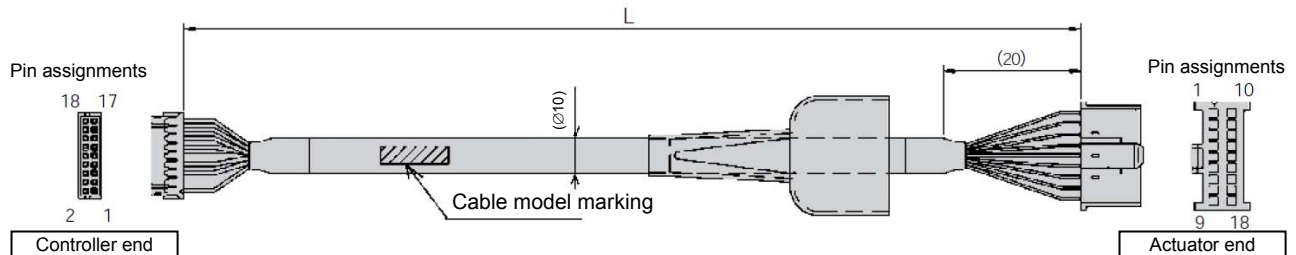
Housing: SLP-03V (J.S.T. Mfg.)  
Contact: BSF-21T-P1.4 (J.S.T. Mfg.)

### (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)

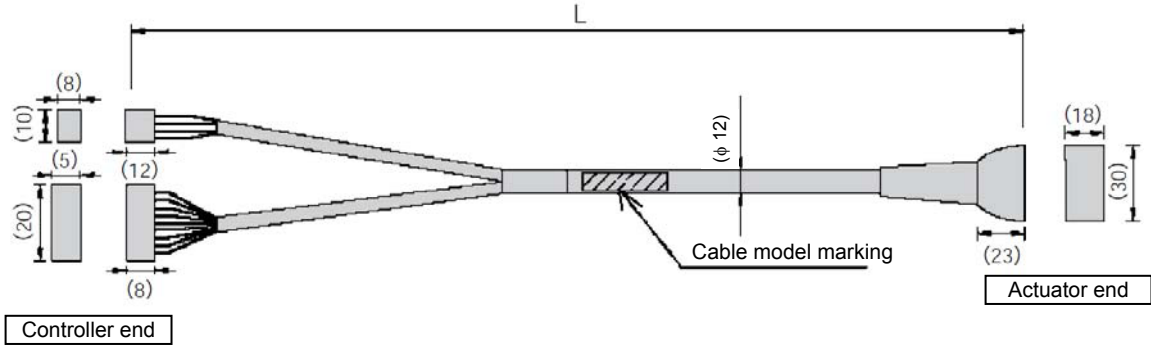


Pin No.	Signal name	Description	Cable color	
			Standard cable	Robot cable
18	LS+	Home check sensor	Blue	White/Purple
17	LS-		Orange	White/Gray
16	BK+	Brake power	Green	Yellow
15	BK-		Brown	Blue
14	ENA	Encoder phase A signal	Gray	White/Blue
13	EN $\bar{A}$		Red	White/Yellow
12	ENB	Encoder phase B signal	Black	White/red
11	EN $\bar{B}$		Yellow	White/Black
10	ENZ	Encoder phase Z signal	Pink	Orange
9	EN $\bar{Z}$		Purple	Green
8	—	Encoder control signal	White	Purple
7	VPS	Encoder power supply	Blue/Red	Gray
6	5V		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.)

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)



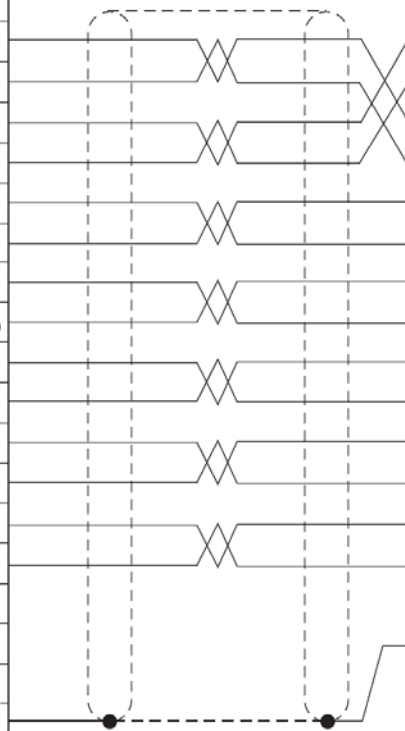
Housing : DF1E-3S-2.5C  
 Contact : DF1E-2022SCF

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



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

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	Gray (Red ●)
9	Z-		Gray (Blue ●)
8	-	-	Orange (Red ● continuous)
7	/PS	Encoder control signal	Orange (Blue ● continuous)
6	VCC	Encoder power supply	Gray (Red ● continuous)
5	GND		Grey (Blue ● continuous)
4	-	-	-
3	-	-	-
2	-	-	-
1	FG	Shield	Shield



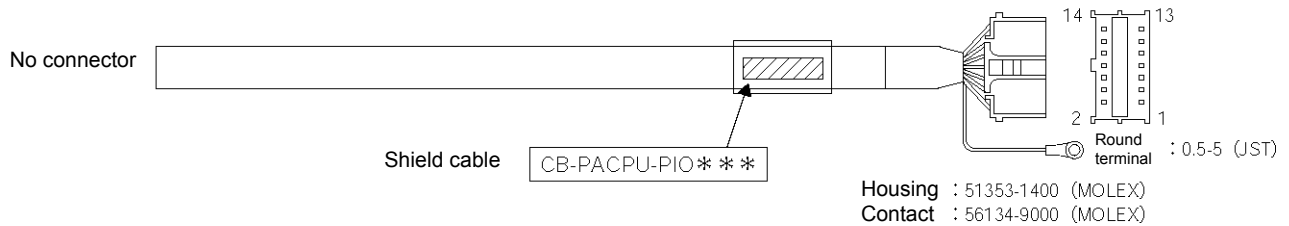
Housing: PHDR-18VR (J.S.T. Mfg.)  
 Contact: SPHD-001T-P0.5 (J.S.T. Mfg.)

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

## 3.10 Connecting the I/O Shield Cable

Cable model: CB-PACPU-PIO\*\*\*

(Note: \*\*\* indicates the cable length. (Example) 2 m: 020)

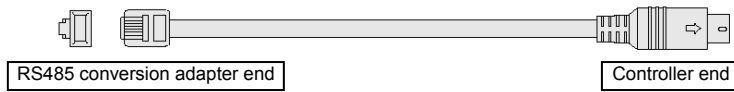


Pin No.	Color	Name	Remarks
1	Black	External 24 V	
2	White/Black	External ground	If the controller is used in the open collector mode, also use this pin for the COMMON signal for command pulses.
3	Red	SON	Servo-on signal
4	White/Red	TL	Torque-limit selection signal
5	Green	HOME	Homing signal
6	White/Green	RES/DCLR	Reset signal/deviation-counter clear signal
7	Yellow	SV	Servo-on output
8	White/Yellow	INP/TLR	Positioning complete signal/torque limit signal
9	Brown	HEND	Homing complete signal
10	White/Brown	*ALM	Alarm signal
11	Blue	Command pulse/PP	
12	White/Blue	Command pulse PP	Not connected if the controller is used in the open collector mode.
13	Gray	Command pulse/NP	
14	White/Gray	Command pulse NP	Not connected if the controller is used in the open collector mode.
-	-	FG	Shield (connected to the enclosure)

- ⚠ Caution:
- Do not apply excessive stress to the connector part by, for example, pulling the cable while a shielded cable is connected to the controller.
  - Do not apply force to the connector on a tilt when connecting or disconnecting the shielded cable.

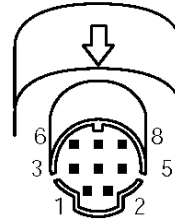
## 3.11 Connecting the Communication Cable

Connect the communication cable to the SIO connector.



CB-RCA-SIO\*\*\*

Pin layout of cable-end connector



Cable color	Signal abbreviation	Pin No.	Pin No.	Signal abbreviation	Cable color
Brown	5V	1	1	SGA	Yellow
Yellow	SGA	2	2	SGB	Orange
Red	GND	3	3	5V	Brown/Green
Orange	SGB	4	4	ENB	—
Blue	GND	5	5	EMGA	Black
Green	5V	6	6	24V	—
Shorting wire UL1004AWG28 (Black)			7	GND	Red/Blue
Not connected to the shield.			8	EMGB	Black
			FG	Shield	

## 4. Operation Using I/O Signals

This chapter explains the wire connections and operation timings you should know in order to perform positioning operation using a PLC with I/O signals. Two PIO patterns are available for you to choose from in accordance with your specific application.

PIO pattern	Setting (User Parameter No. 25)
Standard mode (factory setting)	0
Push mode	1

### 4.1 Interface Circuit

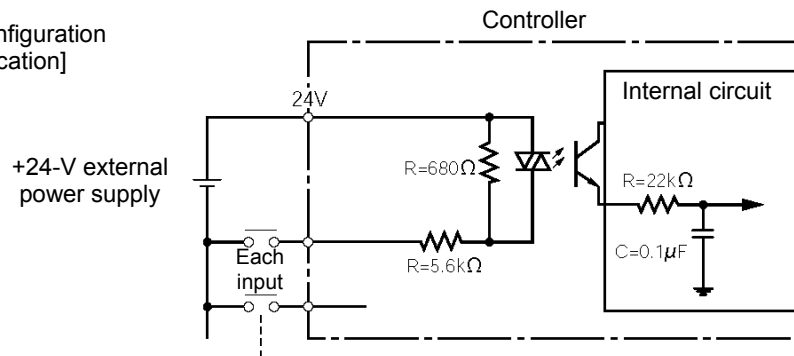
The standard interface circuit conforms to the NPN specification, but the PNP specification type is also available as an option.

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.

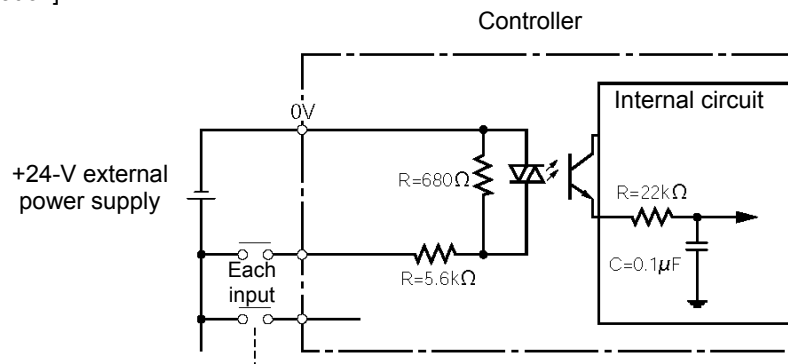
#### 4.1.1 External Input Specifications

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

Internal circuit configuration  
[NPN specification]



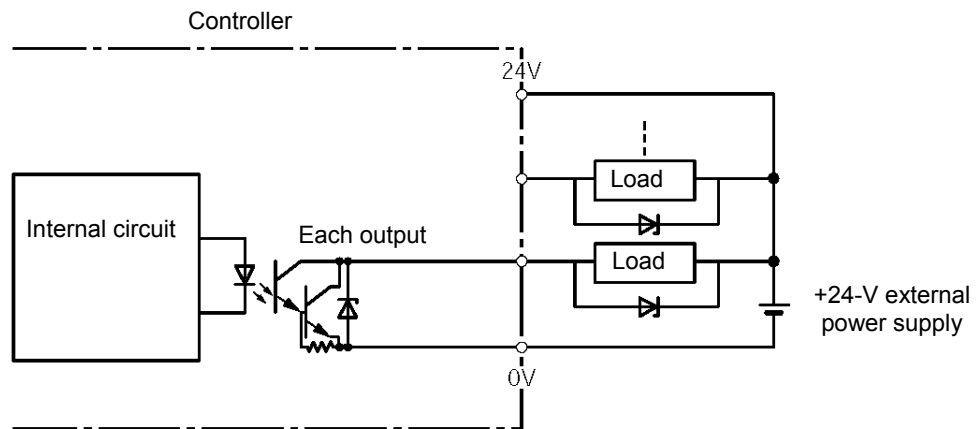
[PNP specification]



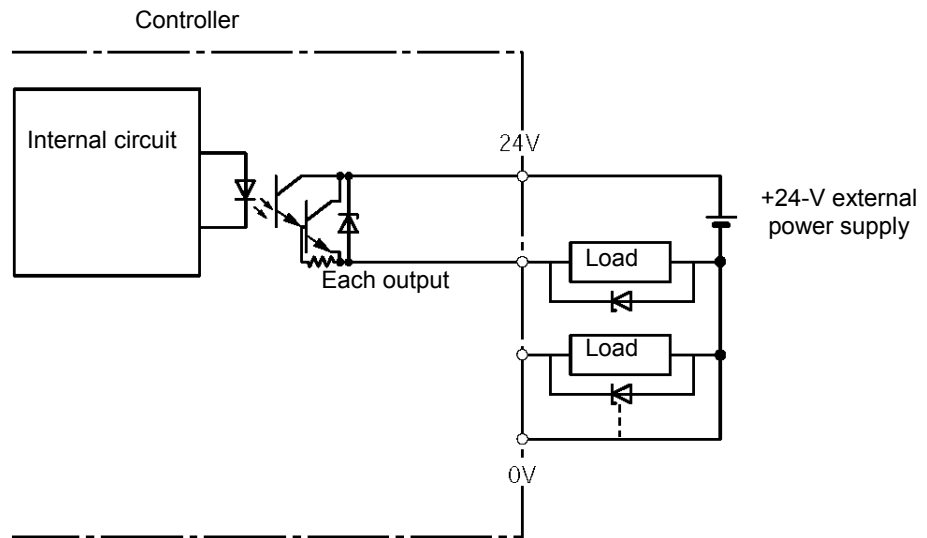
## 4.1.2 External Output Specifications

Item	Specification
Number of output points	4 points
Rated load voltage	24 VDC
Maximum current	50 mA per point
Residual voltage	Max. 2 V
Insulation method	Photocoupler

Internal circuit configuration  
[NPN specification]



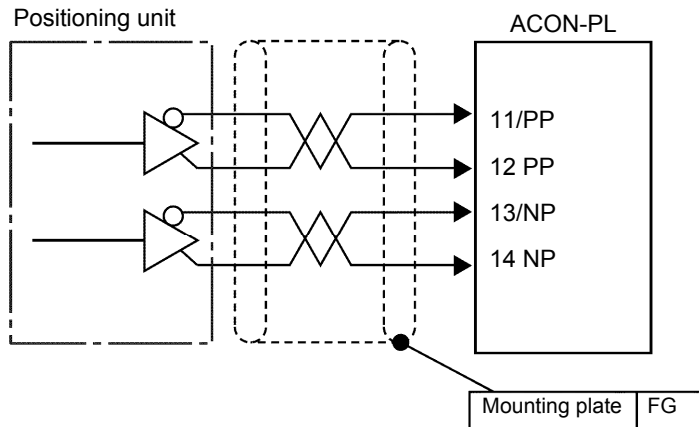
[PNP specification]



## 4.1.3 Command Pulse Train Input Specifications

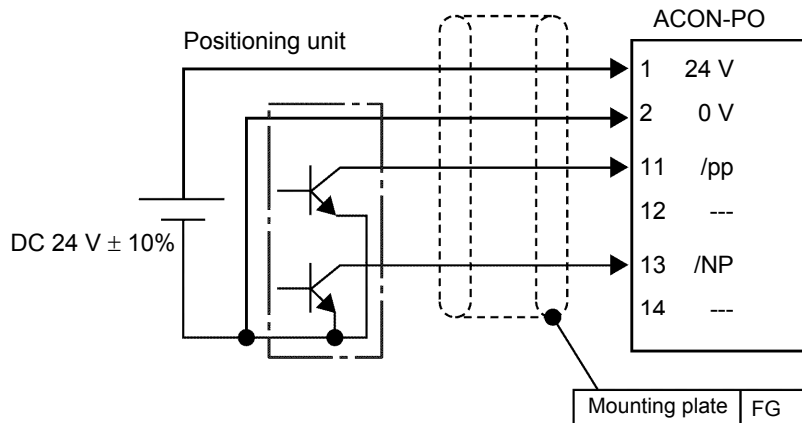
[Input using a differential line driver]

Applicable line driver: 26C31 or equivalent



Note: Always connect the shield of the twisted pair cable joined to the connector, to the mounting plate.

[Input using an open collector]



Note 1: Always connect the shield of the twisted pair cable joined to the connector, to the mounting plate.

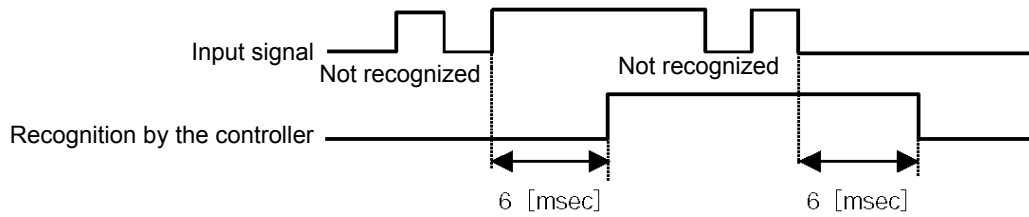
Note 2: Some open collector outputs have a built-in pull-up resistor. In this case, remove the pull-up resistor.

## 4.1.4 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.

\* Excluding command pulse input (PP•/PP, NP•/NP).



## 4.2 Standard Mode

Choose the PIO pattern of this mode if you wish to perform position control using pulse train input from a PLC. Set User Parameter No. 25 (PIO pattern selection) to "0." (This parameter has been set to the "standard type" prior to the shipment).

### 4.2.1 Explanation of I/O Signals

Pin No.	Signal	Name	Remarks
1	24 V	External 24 V	
2	0 V	External ground	If the controller is used in the open collector mode, also use this pin for the COMMON signal for command pulses as well as the 0V signal for the controller's control power.
3	IN0	SON	Servo-on signal
4	IN1	TL	Torque-limit selection signal
5	IN2	HOME	Homing signal
6	IN3	RES	Reset signal
7	OUT0	SV	Servo-on output
8	OUT1	INP	Positioning complete signal
9	OUT2	HEND	Homing complete signal
10	OUT3	*ALM	Alarm signal
11	/PP	Command pulse	
12	PP	Command pulse	Not connected if the controller is used in the open collector mode.
13	/NP	Command pulse	
14	NP	Command pulse	Not connected if the controller is used in the open collector mode.

#### ■ Servo-on Command Input (SON)

The servo remains on while this signal is ON.

The actuator can be operated while the SON signal is ON.

While this signal is OFF, the actuator does not operate even when the controller power is supplied.


If the SON signal is turned OFF while the actuator is operating, the actuator will decelerate at the forced-stop torque until it stops. After the actuator stops, the servo will turn off and the motor will enter a free-run state.

At this time, the function specified by the applicable parameter (electromagnetic brake) becomes.

#### ■ Reset Signal Input (RES)

This signal resets the alarms currently detected by the controller.

You can turn the RES signal ON to reset the alarms currently detected by the controller.

 **Caution:** This signal cannot reset cold-start level alarms. Identify the cause of each alarm and remove the cause before restarting the controller.

- Torque-limit Selection Signal (TL)  
This signal limits the motor torque.  
While this signal is ON, the actuator thrust (motor torque) is limited to the torque set in User Parameter No. 57 (Torque limit).

⚠ Caution: Excessive deviation (standing pulses) may generate while torque is limited (while the TL signal is ON) (for example, when the actuator receives load and is prevented from moving just like in push-motion operation).  
If the TL signal is turned OFF in this condition, the controller will instantly start controlling the actuator at the maximum torque and the actuator may move suddenly or run out of control.

This signal can be disabled using User Parameter No. 61 (Torque-limit command input). Disable the TL signal if it is not used.

- Homing Signal (HOME)  
This command signal is used to perform homing automatically.  
The homing command is processed at the leading edge (ON edge) of the HOME signal to cause the actuator to return to its home automatically.  
When the homing is completed, the HEND (homing complete) output signal turns ON.  
Program the host controller (PLC) so that its current-value register will be reset to the home ("0" will be input to the register) by the current-value preset function, etc., upon turning ON of the HOME signal.
  - \* This signal is always enabled as long as the servo is on.
  - \* Even after homing has been performed once, homing can be performed again by turning the HOME signal ON.

⚠ Caution:

- The HOME signal is given priority over pulse train commands. Even while the actuator is moving under a pulse train command, it will start moving to the home once the HOME signal is turned ON.
- The HOME signal is processed only at its leading edge (ON edge).
- If the SON signal turns OFF or an alarm is detected during homing, the homing operation will stop. If the servo turns off, the homing command will be cancelled even if the HOME signal is still ON. To perform homing again, turn the HOME signal OFF, and then turn it back ON.
- The actuator can be operated without using this function. If this function is not used, however, all management actions over position data will be left to the host controller.  
In this case, take necessary measures to prevent an over-stroke error, such as not sending pulse commands exceeding the effective stroke, or providing external limit switches or other devices for detecting stroke ends to forcibly stop the actuator upon detection of a stroke end.
- This controller has a command pulse counter. After homing, the controller increments/decrements command pulses and performs positioning based on command pulse data.  
However, the command pulse counter cannot be used if this function is not used. Without this function, the position where the actuator is currently stopped is used as the origin and the actuator will move from there by the number of pulses input (incremental movement). If incremental movement is repeated, positioning errors generating in individual positioning operations will accumulate and the actuator may end up not stopping at the final target position. To prevent this problem, periodically execute homing from the host controller or take other appropriate measures.

## Command Pulse Input

Command pulses can be input in the open collector mode (60 kpps max.) or differential line driver mode (200 kpps max.).

You can select a desired input pattern of command pulses from 90° phase-difference (phase-A/B x4) signal, pulse train + forward/reverse signal, and forward pulse/reverse pulse. The positive logic or negative logic can be selected for each of these patterns.

**⚠ Caution:**

- The actuator moves in the negative direction (the motor runs in the forward direction) when forward pulses are input, and moves in the positive direction (the motor runs in the reverse direction) when reverse pulses are input. (These directions are reversed if the actuator is of motor reversing type.)
- When determining the forward/reverse directions, pay attention to the host controller setting as well as the PP•/PP and NP•/NP connection.
- For actuator accelerations/decelerations, set values not exceeding the rated acceleration/deceleration of the actuator. (The rated acceleration/deceleration of each actuator is specified in the actuator's catalog.)

\* The motor direction is determined based on CCW representing the forward direction when viewed from the load-end of the shaft.

- You can set one of six command pulse patterns in the command-pulse input mode.

Command-pulse input pattern		Input terminal	Forward	Reverse
Negative logic	Forward pulse train	PP • /PP		
	Reverse pulse train	NP • /NP		
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.			
	Pulse train	PP • /PP		
	Sign	NP • /NP		
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.			
	Phase-A/B pulse train	PP • /PP		
		NP • /NP		
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.				
Positive logic	Forward pulse train	PP • /PP		
	Reverse pulse train	NP • /NP		
	Pulse train	PP • /PP		
	Sign	NP • /NP		
	Phase-A/B pulse train	PP • /PP		
NP • /NP				

(Note) The figures shown above are an image when a command pulse input is made on the differential line driver. The pulse waveform reverses as shown in the next page when the pulse is input on the open collector.

Shown below is an image when a command pulse input is made on the open collector.

Command-pulse input pattern		Input terminal	Forward	Reverse
Negative logic	Forward pulse train	/PP		
	Reverse pulse train	/NP		
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.			
	Pulse train	/PP		
	Sign	/NP	High	Low
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.			
	Phase-A/B pulse train	/PP		
		/NP		
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.				
Positive logic	Forward pulse train	/PP		
	Reverse pulse train	/NP		
	Pulse train	/PP		
	Sign	/NP	Low	High
	Phase-A/B pulse train	/PP		
	/NP			

- Positioning Complete Signal (INP)**  
 This signal turns ON when the deviation in the deviation counter (standing pulses) is within the positioning band. It remains OFF while the servo is off.

⚠ **Caution:**

- This signal turns ON when the servo is turned on (to perform positioning at the present position).
- This signal turns ON simply due to accumulation of deviation (standing pulses). Therefore, setting an excessively wide positioning band in the applicable position control parameter will cause this signal to turn ON once the actuator enters the positioning band during low-speed operation (before positioning is completed).
- The INP signal is recognized even when the TL signal is ON.

## ■ Homing Complete Signal (HEND)

This signal turns ON after homing has completed and the coordinate system has been established.

It turns ON upon completion of homing initiated by the HOME signal or a command from the teaching pendant or PC software.

This signal turns OFF once the servo turns off. Perform homing again after the servo has turned off.



Caution:

- The software stroke limits set by the corresponding actuator parameters are effective only while this signal is ON.
- The actuator can be operated without using this function. In this case, however, take necessary measures, such as not sending pulse commands exceeding the effective stroke, or providing external limit switches for detecting stroke ends to forcibly stop the actuator upon detection of a stroke end.

## ■ Servo-on Output Signal (SV)

When the SON (servo-on) signal turns ON, the servo turns on. As the controller subsequently enters a ready state, this signal turns ON.

This signal turns OFF when the servo is turned off upon turning OFF of the SON signal.

This signal is linked to the LED (green light) on the front panel of the controller.

## ■ Alarm Signal (\*ALM)

This signal turns OFF when the controller's protective circuit (function) has actuated following an alarm detection and the basic cutoff procedure has been implemented as a result.

The signal will turn ON if the RES (reset) signal is turned ON after the cause of the alarm has been removed (except when the alarm relates to a cold-start level error).

When an alarm is detected, a red LED light will illuminate on the front panel of the controller. A green LED remains on while the controller is operating normally.



Caution:

- Identify the cause of each alarm and remove the cause before restarting the controller.  
You can check alarm codes using the teaching pendant or PC software. The controller can store data of up to 16 most recent alarms. This alarm history data will be retained even after the power is cut off.  
Each alarm record is displayed with the time it was generated, so you can check which alarm occurred when.
- For details on alarm history, refer to 6.3, "Alarms, Causes and Actions."

## 4.2.2 Setting Parameters Required for Operation

The following parameters must always be set prior to every operation.  
(These parameters are all you need to set to perform operations that only involve positioning.)

### (1) Electronic gear

User Parameter Nos. 65 and 66 (Electronic gear numerator and denominator)

Name	Symbol	Unit	Input range	Default (reference)
Electronic gear numerator	CNUM	-	1 ~ 4096	200
Electronic gear denominator	CDEN	-	1 ~ 4096	15

These parameters are used to determine the unit travel distance of the actuator per one pulse in input command pulse train.

Unit travel distance of linear-motion axis = Minimum travel unit (1, 0.1, 0.01 mm, etc.)/pulse

Unit travel distance of rotational axis = Minimum travel unit (1, 0.1, 0.01 deg, etc.)/pulse

#### ■ Calculation Formula for Electronic Gear

Linear-motion axis

$$\frac{\text{Electronic gear numerator (CNUM)}}{\text{Electronic gear denominator (CDEN)}} = \frac{\text{Encoder pulses (pulses/rev)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Unit travel distance (mm/pulse)}$$

Rotational axis

$$\frac{\text{Electronic gear numerator (CNUM)}}{\text{Electronic gear denominator (CDEN)}} = \frac{\text{Encoder pulses (pulses/rev)}}{360 \text{ (deg/rev)} \times \text{Gear ratio of rotational axis}} \times \text{Unit travel distance (deg/pulse)}$$

#### Reference

The actuator speed is calculated as follows:

Speed = Unit travel distance x Input pulse frequency (Hz)

Take note that if the unit travel distance is too small, the actuator may not be able to reach the maximum speed.

#### List of encoder pulses and leads length by model

Actuator type	Encoder resolution	Lead length
RCA or RCA2 other than RCA2-□□□ N	800 (Pulse/rev)	Check the lead marking on the side panel of the controller.
RCA2-□□□ N	1048 (Pulse/rev)	Check the lead marking on the side panel of the controller.
RCL-SA1L/SA4L/SM4L/RA1L	715 (Pulse/rev)	30.03 mm
RCL-SA2L/SA5L/SM5L/RA2L	855 (Pulse/rev)	35.91 mm
RCL-SA3L/SA6L/SM6L/RA3L	1145 (Pulse/rev)	48.09 mm

■ Calculation Example

Operate an actuator with a ball screw lead of 6 mm equipped with an encoder of 800 pulses/rev, at a unit travel distance to 0.1 mm (1/10).

\* The encoder resolution is 800 (pulses/rev) for the RCA and RCA2, and as shown in the table on the previous page for the micro-slider and cylinder series.

$$\frac{\text{Electronic gear numerator (CNUM)}}{\text{Electronic gear denominator (CDEN)}} = \frac{\text{Encoder pulses (pulses/rev)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Unit travel distance (mm/pulse)}$$

$$= \frac{800}{6} \times \frac{1}{10} = \frac{40}{3}$$

The electronic gear numerator (CNUM) and electronic gear denominator (CDEN) are 40 and 3, respectively. Based on these settings, the travel distance per one pulse in input command pulse train is calculated as 0.1 mm.

⚠ Caution:

- Set both the electronic gear numerator (CNUM) and electronic gear denominator (CDEN) as integers not exceeding 4,096, by reducing them as much as possible with a common divisor. Also, CNUM and CDEN must satisfy the relational expression specified below.

$$2^{31} \geq \frac{\text{Stroke length (mm)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Encoder pulses (Pulse)} \times (\text{CNUM})$$

$$2^{31} \geq \frac{\text{Stroke length (mm)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Encoder pulses (Pulse)} \times (\text{CDEN})$$

- Do not set a minimum travel unit smaller than the encoder resolution.

$$\text{Encoder resolution for linear-motion axis (mm/pulse)} = \frac{\text{Ball screw lead length (mm/rev)}}{\text{Encoder pulses (pulses/rev)}}$$

$$\text{Encoder resolution for rotational axis (deg/pulse)} = \frac{360 \text{ (deg/rev)} \times \text{Gear ratio of rotational axis}}{\text{Encoder pulses (pulses/rev)}}$$

The actuator will not move unless enough command pulses accumulate to reach or exceed the encoder resolution.

## (2) Command Pulse Mode

User Parameter No. 63 (Command-pulse input mode)

Name	Symbol	Unit	Input range	Default (reference)
Command-pulse input mode	MOD	-	0 ~ 2	1

Set a pulse-train input pattern for command pulse input (PP•/PP, NP•/NP).

\* The setting of positive logic or negative logic is explained in (3), "Input Polarity in the Command Pulse Mode."

Command-pulse input pattern	Input terminal	Forward	Reverse	Setting	
Negative logic	Forward pulse train	PP • /PP			2
	Reverse pulse train	NP • /NP			
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.				
	Pulse train	PP • /PP			1
	Sign	NP • /NP			
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.				
	Phase-A/B pulse train	PP • /PP			0
NP • /NP					
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.					
Positive logic	Forward pulse train	PP • /PP			2
	Reverse pulse train	NP • /NP			
	Pulse train	PP • /PP			1
	Sign	NP • /NP			
	Phase-A/B pulse train	PP • /PP			0
NP • /NP					

(Note) The figures shown above are an image when a command pulse input is made on the differential line driver. The pulse waveform reverses when the pulse is input on the open collector.

[Refer to 4.2.1 Command Pulse Input]

### (3) Input Polarity in the Command Pulse Mode


User Parameter No. 64 (Polarity in command-pulse input mode)

Name	Symbol	Unit	Input range	Default (reference)
Polarity in command-pulse input mode	POLE	-	0 ~ 1	0

Setting

Positive logic: 0

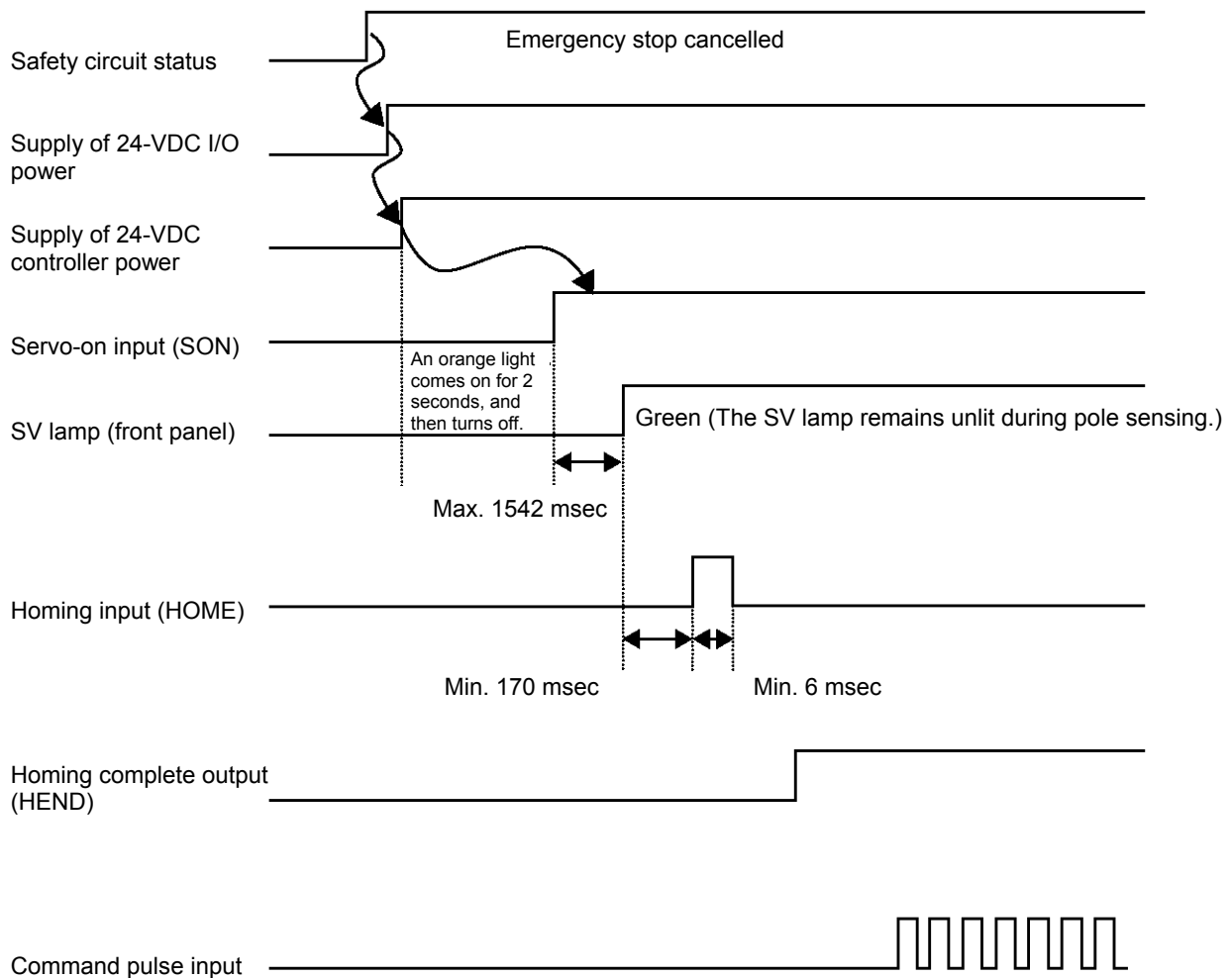
Negative logic: 1

 **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.


## 4.2.3 Timings after Power On

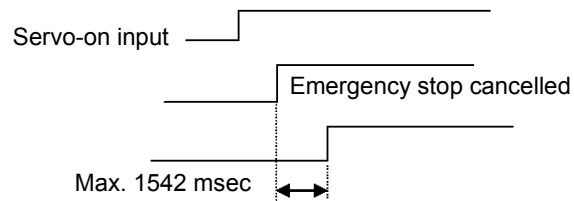
- Steps from Initial Startup to Actuator Adjustment

- [1] Confirm that the slider or rod is not contacting a mechanical end or that the work is not contacting any peripheral equipment.
- [2] Cancel the emergency stop or connect the motor drive power.
- [3] Supply the 24-VDC I/O power: PIO connector pins 1 and 2.
- [4] Supply the 24-VDC controller power: 24-V and 0-V terminals on the power-supply terminal block.
- [5] Set the minimum required parameters. Refer to 4.2.2, "Setting Parameters Required for Operation."  
Reference 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."
- [6] Input a servo-on signal from the PLC (if the servo-on input is enabled).
- [7] Input a homing signal from the PLC.
- [8] Input position command pulses from the PLC.



\* If Parameter No. 21 (Servo-on input disable selection) is set to "1," a servo-on signal need not be input.

 **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 1542 msec after the emergency stop is cancelled.



## 4.3 Push Mode

Use the PIO pattern of this mode if you wish to perform position control and push-motion operation using pulse train input from a PLC.

Set User Parameter No. 25 (PIO pattern selection) to "1."

### 4.3.1 Explanation of I/O Signals

Pin No.	Signal	Name	Remarks
1	24 V	External 24 V	
2	0 V	External ground	If the controller is used in the open collector mode, also use this pin for the COMMON signal for command pulses as well as the 0V signal for the controller's control power.
3	IN0	SON	Servo-on signal
4	IN1	TL	Torque-limit selection signal
5	IN2	HOME	Homing signal
6	IN3	RES/DCLR	Reset signal/deviation-counter clear signal
7	OUT0	SV	Servo-on output
8	OUT1	INP/TLR	Positioning complete signal/torque limit signal
9	OUT2	HEND	Homing complete signal
10	OUT3	*ALM	Alarm signal
11	/PP	Command pulse	
12	PP	Command pulse	Not connected if the controller is used in the open collector mode.
13	/NP	Command pulse	
14	NP	Command pulse	Not connected if the controller is used in the open collector mode.

#### ■ Servo-on Command Input (SON)

The servo remains on while this signal is ON.

The actuator can be operated while the SON signal is ON.

While this signal is OFF, the actuator does not operate even when the controller power is supplied.


If the SON signal is turned OFF while the actuator is operating, the actuator will decelerate at the forced-stop torque until it stops. After the actuator stops, the servo will turn off and the motor will enter a free-run state.

At this time, the function specified by the applicable parameter (electromagnetic brake) becomes active.

#### ■ Reset Signal Input (RES)

This signal resets the alarms currently detected by the controller.

You can turn the RES signal ON to reset the alarms currently detected by the controller.

 **Caution:** This signal cannot reset cold-start level alarms. Identify the cause of each alarm and remove the cause before restarting the controller.

#### ■ Deviation-counter Clear Signal (DCLR)

While the TL signal is ON, the RES signal functions as the deviation-counter clear signal (DCLR).

The deviation counter is cleared continuously while this signal is ON.

Upon completion of push-motion operation, you can clear the deviation counter by inputting this signal.

## ■ Torque-limit Selection Signal (TL)

This signal limits the motor torque.

While this signal is ON, the actuator thrust (motor torque) is limited to the torque set in User Parameter No. 57 (Torque limit).

- ⚠ Caution:
- Do not turn the TL signal OFF while it is ON.
  - Excessive deviation (standing pulses) may generate while torque is limited (while the TL signal is ON) (for example, when the actuator receives load and is prevented from moving just like in push-motion operation).  
If the TL signal is turned OFF in this condition, the controller will instantly start controlling the actuator at the maximum torque and the actuator may move suddenly or run out of control.

This signal can be disabled using User Parameter No. 61 (Torque-limit command input). Disable the TL signal if it is not used.

## ■ Homing Signal (HOME)

This command signal is used to perform homing automatically.

The homing command is processed at the leading edge (ON edge) of the HOME signal to cause the actuator to return to its home automatically.

When the homing is completed, the HEND (homing complete) output signal turns ON.

Program the host controller (PLC) so that its current-value register will be reset to the home ("0" will be input to the register) by the current-value preset function, etc., upon turning ON of the HOME signal.

\* This signal is always enabled as long as the servo is on.

\* Even after homing has been performed once, homing can be performed again by turning the HOME signal ON.

- ⚠ Caution:
- The HOME signal is given priority over pulse train commands. Even while the actuator is moving under a pulse train command, it will start moving to the home once the HOME signal is turned ON.
  - The HOME signal is processed only at its leading edge (ON edge).
  - If the SON signal turns OFF or an alarm is detected during homing, the homing operation will stop. If the servo turns off, the homing command will be cancelled even if the HOME signal is still ON. To perform homing again, turn the HOME signal OFF, and then turn it back ON.
  - The actuator can be operated without using this function. If this function is not used, however, all management actions over position data will be left to the host controller.  
In this case, take necessary measures to prevent an over-stroke error, such as not sending pulse commands exceeding the effective stroke, or providing external limit switches or other devices for detecting stroke ends to forcibly stop the actuator upon detection of a stroke end.
  - This controller has a command pulse counter. After homing, the controller increments/decrements command pulses and performs positioning based on command pulse data.  
However, the command pulse counter cannot be used if this function is not used. Without this function, the position where the actuator is currently stopped is used as the origin and the actuator will move from there by the number of pulses input (incremental movement). If incremental movement is repeated, positioning errors generating in individual positioning operations will accumulate and the actuator may end up not stopping at the final target position. To prevent this problem, periodically execute homing from the host controller or take other appropriate measures.

## ■ Command Pulse Input

Command pulses can be input in the open collector mode (60 kpps) or differential line driver mode (200 kpps). You can select a desired input pattern of command pulses from 90° phase-difference (phase-A/B x4) signal, pulse train + forward/reverse signal, and forward pulse/reverse pulse. The positive logic or negative logic can be selected for each of these patterns.

**⚠ Caution:**

- The actuator moves in the negative direction (the motor runs in the forward direction) when forward pulses are input, and moves in the positive direction (the motor runs in the reverse direction) when reverse pulses are input. (These directions are reversed if the actuator is of motor reversing type.)
- When determining the forward/reverse directions, pay attention to the host controller setting as well as the PP•/PP and NP•/NP connection.
- For actuator accelerations/decelerations, set values not exceeding the rated acceleration/deceleration of the actuator. (The rated acceleration/deceleration of each actuator is specified in the actuator's catalog.)

\* The motor direction is determined based on CCW representing the forward direction when viewed from the load-end of the shaft.

- You can set one of six command pulse patterns in the command-pulse input mode.

Command-pulse input pattern		Input terminal	Forward	Reverse	
Negative logic	Forward pulse train	PP • /PP			
	Reverse pulse train	NP • /NP			
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.				
	Pulse train	PP • /PP			
	Sign	NP • /NP			
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.				
	Phase-A/B pulse train	PP • /PP			
		NP • /NP			
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.					
Positive logic	Forward pulse train	PP • /PP			
	Reverse pulse train	NP • /NP			
	Pulse train	PP • /PP			
	Sign	NP • /NP			
	Phase-A/B pulse train	PP • /PP			
NP • /NP					

(Note) The figures shown above are an image when a command pulse input is made on the differential line driver. The pulse waveform reverses as shown in the next page when the pulse is input on the open collector.

Shown below is an image when a command pulse input is made on the open collector.

Command-pulse input pattern		Input terminal	Forward	Reverse
Negative logic	Forward pulse train	/PP		
	Reverse pulse train	/NP		
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.			
	Pulse train	/PP		
	Sign	/NP	High	Low
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.			
	Phase-A/B pulse train	/PP		
		/NP		
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.				
Positive logic	Forward pulse train	/PP		
	Reverse pulse train	/NP		
	Pulse train	/PP		
	Sign	/NP	Low	High
	Phase-A/B pulse train	/PP		
		/NP		

■ Positioning Complete Signal (INP)

This signal turns ON when the deviation in the deviation counter (standing pulses) is within the positioning band. It remains OFF while the servo is off.

- ⚠ Caution:
- This signal turns ON when the servo is turned on (to perform positioning at the present position).
  - This signal turns ON simply due to accumulation of deviation (standing pulses). Therefore, setting an excessively wide positioning band in the applicable position control parameter will cause the INP signal to turn ON once the actuator enters the positioning band during low-speed operation (before positioning is completed).

## ■ Torque Limiting Signal (TLR)

This signal turns ON when the specified torque limit is reached in the torque limiting mode.

While the TL (torque-limit selection) signal is ON, this signal will turn ON if the actuator thrust (motor torque) reaches the torque limit set by the torque limit parameter.

This signal will turn OFF once the motor torque drops to below the specified limit.

## ■ Homing Complete Signal (HEND)

This signal turns ON after homing has completed and the coordinate system has been established.

It turns ON upon completion of homing initiated by the HOME signal or a command from the teaching pendant or PC software.

This signal turns OFF once the servo turns off. Perform homing again after the servo has turned off.



Caution:

- The software stroke limits set by the corresponding actuator parameters are effective only while this signal is ON.
- The actuator can be operated without using this function. In this case, however, take necessary measures, such as not sending pulse commands exceeding the effective stroke, or providing external limit switches for detecting stroke ends to forcibly stop the actuator upon detection of a stroke end.

## ■ Servo-on Output Signal (SV)

When the SON (servo-on) signal turns ON, the servo turns on. As the controller subsequently enters a ready state, this signal turns ON.

This signal turns OFF when the servo is turned off upon turning OFF of the SON signal.

This signal is linked to the LED (green light) on the front panel of the controller.

## ■ Alarm Signal (ALM)

This signal turns OFF when the controller's protective circuit (function) has actuated following an alarm detection and the basic cutoff procedure has been implemented as a result.

The signal will turn ON if the RES (reset) signal is turned ON after the cause of the alarm has been removed (except when the alarm relates to a cold-start level error).

When an alarm is detected, a red LED light will illuminate on the front panel of the controller. A green LED remains on while the controller is operating normally.



Caution:

- Identify the cause of each alarm and remove the cause before restarting the controller. You can check alarm codes using the teaching pendant or PC software. The controller can store data of up to 16 most recent alarms. This alarm history data will be retained even after the power is cut off. Each alarm record is displayed with the time it was generated, so you can check which alarm occurred when.
- For details on alarm history, refer to 6.3, "Alarms, Causes and Actions."

## 4.3.2 Setting Parameters Required for Operation

The following parameters must always be set prior to every operation.  
(These parameters are all you need to set to perform operations that only involve positioning.)

### (1) Electronic gear

User Parameter Nos. 65 and 66 (Electronic gear numerator and denominator)

Name	Symbol	Unit	Input range	Default (reference)
Electronic gear numerator	CNUM	-	1 ~ 4096	200
Electronic gear denominator	CDEN	-	1 ~ 4096	15

These parameters are used to determine the unit travel distance of the actuator per one pulse in input command pulse train.

Unit travel distance of linear-motion axis = Minimum travel unit (1, 0.1, 0.01 mm, etc.)/pulse

Unit travel distance of rotational axis = Minimum travel unit (1, 0.1, 0.01 deg, etc.)/pulse

#### ■ Calculation Formula for Electronic Gear

Linear-motion axis

$$\frac{\text{Electronic gear numerator (CNUM)}}{\text{Electronic gear denominator (CDEN)}} = \frac{\text{Encoder pulses (pulses/rev)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Unit travel distance (mm/pulse)}$$

Rotational axis

$$\frac{\text{Electronic gear numerator (CNUM)}}{\text{Electronic gear denominator (CDEN)}} = \frac{\text{Encoder pulses (pulses/rev)}}{360 \text{ (deg/rev)} \times \text{Gear ratio of rotational axis}} \times \text{Unit travel distance (deg/pulse)}$$

#### Reference

The actuator speed is calculated as follows:

Speed = Unit travel distance x Input pulse frequency (Hz)

Take note that if the unit travel distance is too small, the actuator may not be able to reach the maximum speed.

#### List of encoder pulses and leads length by model

Actuator type	Encoder resolution	Lead length
RCA or RCA2 other than RCA2-□□□N	800 (Pulse/rev)	Check the lead indicated on the front panel of the controller.
RCA2-□□□N	1048 (Pulse/rev)	Check the lead indicated on the front panel of the controller.
RCL-SA1L/SA4L/SM4L/RA1L	715 (Pulse/rev)	30.03 mm
RCL-SA2L/SA5L/SM5L/RA2L	855 (Pulse/rev)	35.91 mm
RCL-SA3L/SA6L/SM6L/RA3L	1145 (Pulse/rev)	48.09 mm

■ Calculation Example

Operate an actuator with a ball screw lead of 6 mm equipped with an encoder of 800 pulses/rev, at a unit travel distance to 0.1 mm (1/10).

\* The encoder resolution is 800 (pulses/rev) for the RCA and RCA2, and as shown in the table on the previous page for the micro-slider and cylinder series.

$$\frac{\text{Electronic gear numerator (CNUM)}}{\text{Electronic gear denominator (CDEN)}} = \frac{\text{Encoder pulses (pulses/rev)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Unit travel distance (mm/pulse)}$$

$$= \frac{800}{6} \times \frac{1}{10} = \frac{40}{3}$$

The electronic gear numerator (CNUM) and electronic gear denominator (CDEN) are 40 and 3, respectively. Based on these settings, the travel distance per one pulse in input command pulse train is calculated as 0.1 mm.

⚠ Caution:

- Set both the electronic gear numerator (CNUM) and electronic gear denominator (CDEN) as integers not exceeding 4,096, by reducing them as much as possible with a common divisor. Also, CNUM and CDEN must satisfy the relational expression specified below.

$$2^{31} \geq \frac{\text{Stroke length (mm)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Encoder pulses (Pulse)} \times (\text{CNUM})$$

$$2^{31} \geq \frac{\text{Stroke length (mm)}}{\text{Ball screw lead length (mm/rev)}} \times \text{Encoder pulses (Pulse)} \times (\text{CDEM})$$

- Do not set a minimum travel unit smaller than the encoder resolution.

$$\text{Encoder resolution for linear-motion axis (mm/pulse)} = \frac{\text{Ball screw lead length (mm/rev)}}{\text{Encoder pulses (pulses/rev)}}$$

$$\text{Encoder resolution for rotational axis (deg/pulse)} = \frac{360 (\text{deg/rev}) \times \text{Gear ratio of rotational axis}}{\text{Encoder pulses (pulses/rev)}}$$

The actuator will not move unless enough command pulses accumulate to reach or exceed the encoder resolution.

## (2) Command Pulse Mode

User Parameter No. 63 (Command-pulse input mode)

Name	Symbol	Unit	Input range	Default (reference)
Command-pulse input mode	MOD	-	0 ~ 2	1

Set a pulse-train input pattern for command pulse input (PP•/PP, NP•/NP).

\* The setting of positive logic or negative logic is explained in (3), "Input Polarity in the Command Pulse Mode."

Command-pulse input pattern	Input terminal	Forward	Reverse	Setting
Negative logic	Forward pulse train	PP • /PP		2
	Reverse pulse train	NP • /NP		
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.			
	Pulse train	PP • /PP		1
	Sign	NP • /NP		
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.			
	Phase-A/B pulse train	PP • /PP		
NP • /NP				
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.				
Positive logic	Forward pulse train	PP • /PP		2
	Reverse pulse train	NP • /NP		
	Pulse train	PP • /PP		1
	Sign	NP • /NP		
	Phase-A/B pulse train	PP • /PP		
NP • /NP				

(Note) The figures shown above are an image when a command pulse input is made on the differential line driver. The pulse waveform reverses when the pulse is input on the open collector.  
[Refer to 4.3.1 Command Pulse Input]

### (3) Input Polarity in the Command Pulse Mode


User Parameter No. 64 (Polarity in command-pulse input mode)

Name	Symbol	Unit	Input range	Default (reference)
Polarity in command-pulse input mode	POLE	-	0 ~ 1	0

Setting

Positive logic: 0

Negative logic: 1

 **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. The actuator normally moves by approx. 0.5 to 2 mm due to this detection operation, although the specific distance will vary depending on the ball screw lead.

(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.)

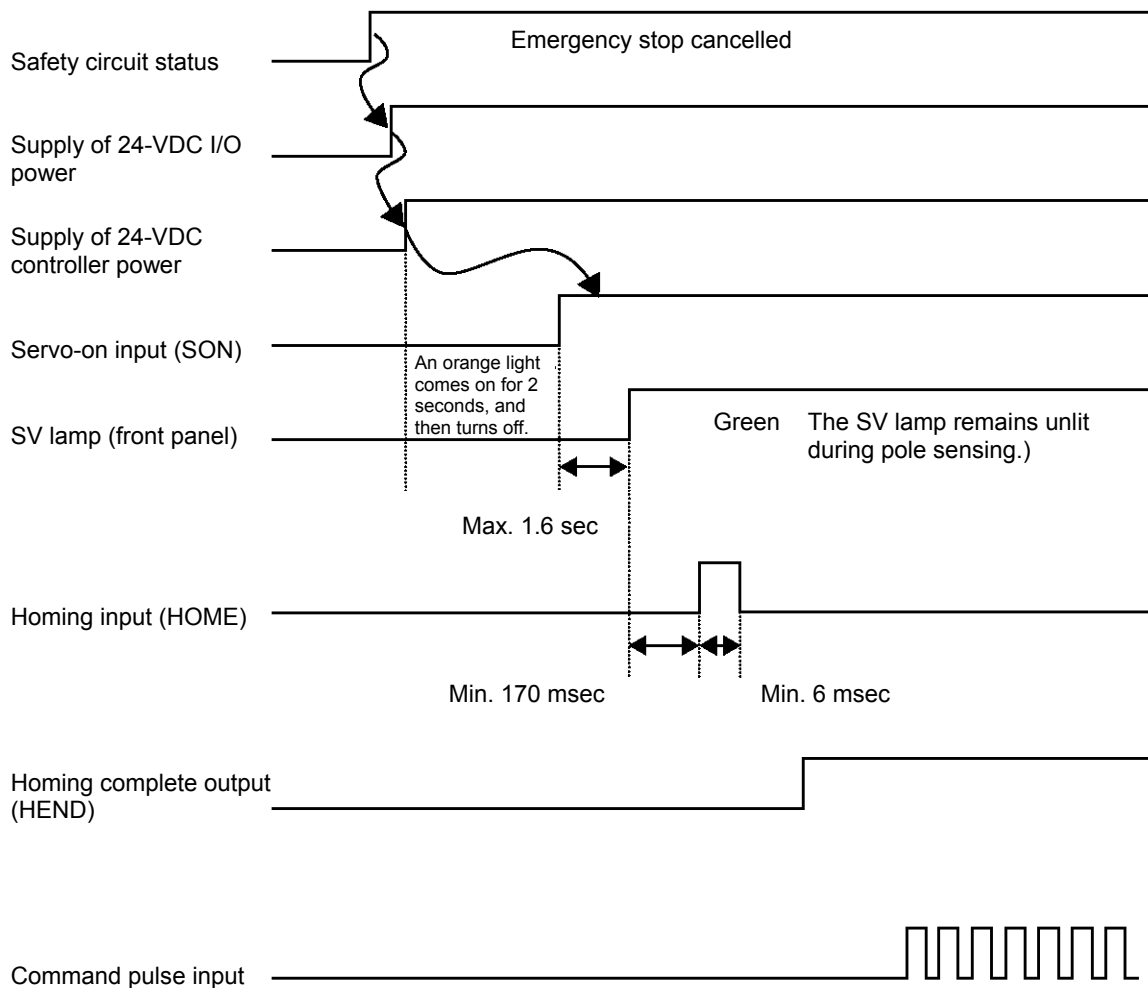
If the power is turned on when the actuator is positioned near a mechanical end, the detection operation may cause the actuator to contact the mechanical end and reverse.

Pay due attention not to cause the work or hand to contact any surrounding object and sustain damage as a result.


## 4.3.3 Timings after Power On

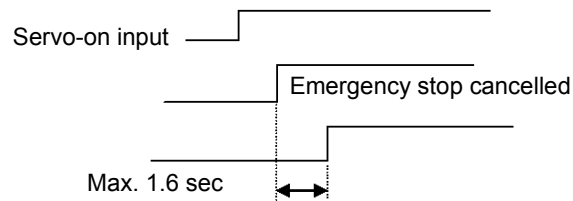
- Steps from Initial Startup to Actuator Adjustment

- [1] Confirm that the slider or rod is not contacting a mechanical end or that the work is not contacting any peripheral equipment.
- [2] Cancel the emergency stop or connect the motor drive power.
- [3] Supply the 24-VDC I/O power: PIO connector pins 1 and 2.
- [4] Supply the 24-VDC controller power: 24-V and N terminals on the power-supply terminal block.
- [5] Set the minimum required parameters. Refer to 4.2.2, "Setting Parameters Required for Operation."  
Reference 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."
- [6] Input a servo-on signal from the PLC (if the servo-on input is enabled).
- [7] Input a homing signal from the PLC.
- [8] Input position command pulses from the PLC.




\* If Parameter No. 21 (Servo-on input disable selection) is set to "1," a servo-on signal need not be input.

 **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 1542 msec after the emergency stop is cancelled.



## 5. Parameter Settings

### 5.1 Parameter List

 **Caution:** This product uses a non-volatile memory (EEPROM) as the storage medium. If the power is cut off while data is still being written, the data may not be written correctly. Exercise due caution to prevent cutoff of power while rewriting parameters. 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
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)
7	d	PLGO	Servo gain number	-	6
9	b	ACMD	Default acceleration/deceleration	G	Set individually in accordance with the actuator characteristics.
10	b	INP	Default positioning band (in-position)	mm	Set individually in accordance with the actuator characteristics.
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	c	LS	Home sensor input polarity [0: None / 1: Contact a / 2: Contact b]	-	0
21	c	SON	Servo-on input [0: Enable / 1: Disable]	-	0
22	a	OFST	Home offset	mm	Set individually in accordance with the actuator characteristics.
25	c	IOPN	PIO pattern selection	-	0 [Standard type]
28	b	PHSP	Default direction of excited phase signal detection [0: Reverse / 1: Forward]	-	0
29	b	PHSP	Excited phase signal detection time	msec	128
30	b	PHSP	Pole sensing type [0: Current suppression / 1: Distance suppression]	-	1
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.
35	b	SAFV	Safety speed	mm/sec	100
40	c	HOME	Homing input [0: Enable / 1: Disable]	-	0 [Enable]
42	b	ENBL	Enable function [0: Enable / 1: Disable]	-	1 [Disable]
43	b	HMC	Home check sensor input polarity [1: Contact a / 2: Contact b]	-	Set individually in accordance with the actuator characteristics.
45	c	SIVM	Silent interval multiplication factor	-	0 [Multiplication factor disabled]
52	c	HSTP	Default acceleration/deceleration mode	-	0 [Trapezoid]
54	d	CLPF	Current control band number	-	Set individually in accordance with the actuator characteristics.

No.	Type	Symbol	Name	Unit	Factory default
55	b	PLPF	Primary filter time constant for position command	msec	0
57	b	TQLM	Torque limit	%	70
58	c	SDCR	Clear deviation at servo off/alarm stop [0: Disable / 1: Enable]	-	1 [Enable]
59	b	FSTP	Monitor error while limiting torque [0: Disable / 1: Enable]	-	1 [Enable]
60	c	DCLR	Deviation-counter clear input [0: Enable / 1: Disable]	-	0 [Enable]
61	c	TL	Torque-limit command input [0: Enable / 1: Disable]	-	0 [Enable]
62	b	CPR	Pulse count direction [0: Forward / 1: Reverse]	-	Set individually in accordance with the actuator characteristics.
63	c	MOD	Command-pulse input mode	-	1 [Pulse train + Sign]
64	c	POLE	Polarity in command-pulse input mode [0: Positive / 1: Negative]	-	0 [Positive logic]
65	b	CNUM	Electronic gear numerator	-	200 [Numerator of command pulse multiplier]
66	b	CDEN	Electronic gear denominator	-	15 [Denominator of command pulse multiplier]
71	d	PLFG	Position feed-forward gain	-	0
77	b	LEAD	Ball screw lead [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	Rotation axis mode selection	-	Set individually in accordance with the actuator characteristics.
80	b	ATYP	Rotation axis shortcut selection	-	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 during movement]

\* The numbers are displayed on the PC software screen but not on the teaching pendant.  
 The missing numbers are not used and omitted.  
 The category codes are provided only for convenience and not displayed on either the PC software screen or teaching pendant.

## 5.2 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.

### 5.2.1 Parameters Relating to Actuator Stroke Range

- Soft Limits (No. 3 L IMM) (No. 4 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.

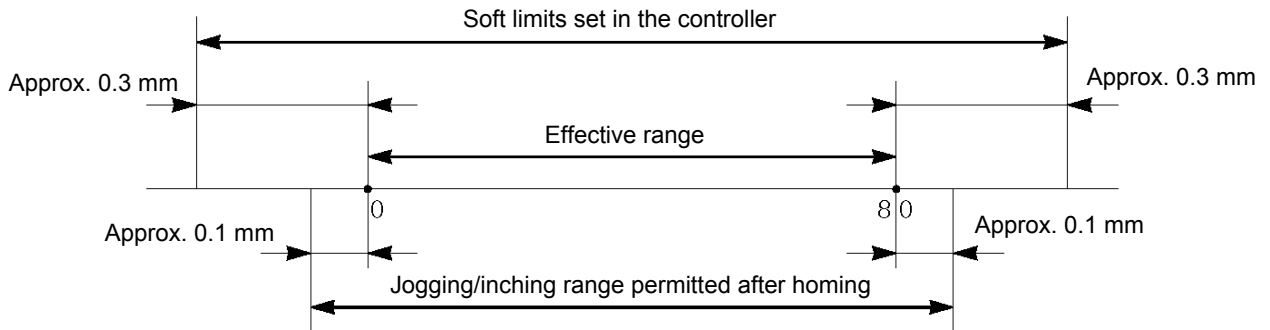
Exercise due caution when setting these parameters, as wrong settings will cause collision with the mechanical end. The minimum setting unit is 0.01 mm.

(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

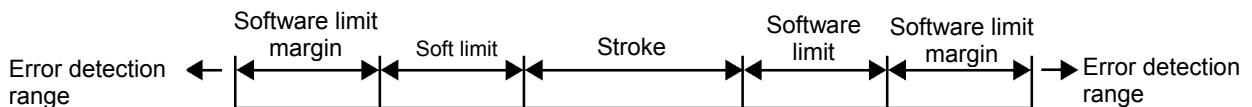


- Software limit margin (No. 88 SWLM)

If the actuator goes outside the range defined by the soft limits, a “Software limit over error” occurs.

By setting parameter No. 88, you can disable the detection of this error for the dimension corresponding to the value set in parameter No. 88 from each soft limit.

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.  
Note that if the home direction is reversed, all the entered position data will be cleared.

- 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.

## 5.2.2 Parameters Relating to Actuator Operating Characteristics

- **Default Acceleration/Deceleration (No. 9 ACMD)**

The factory setting is the rated acceleration/deceleration of the actuator.

The value of this parameter sets the acceleration/deceleration to be applied in jogging operation performed on the teaching pendant or using the PC software.

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 "0.01" mm, which is set in Parameter No. 10.

This value is used to determine if positioning has completed. With a controller of pulse-train input type, the positioning complete signal (INP) will turn ON when the deviation in the deviation counter (standing pulses) is within the range set in this parameter.

Increasing the value of this parameter excessively may cause the positioning complete signal (INP) to be output before positioning is completed.

- **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.

- **Default Direction of Excited Phase Signal Detection**

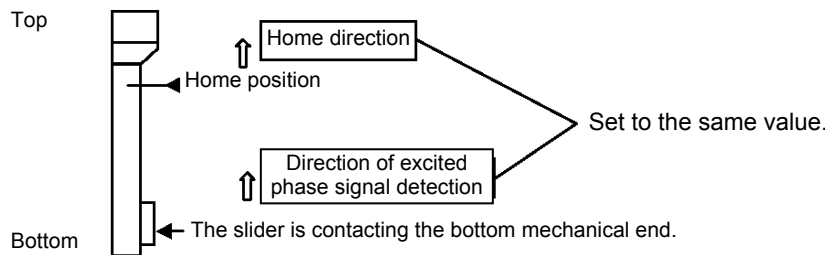
The excited phase is detected when the servo is turned on for the first time after turning on the power. This parameter defines the direction of this detection.

This parameter need not be changed in normal conditions of use. However, if the actuator is contacting a mechanical end or any obstacle when the power is turned on and cannot be moved by hand, change the direction of detection to one in which the motor can be driven easily.

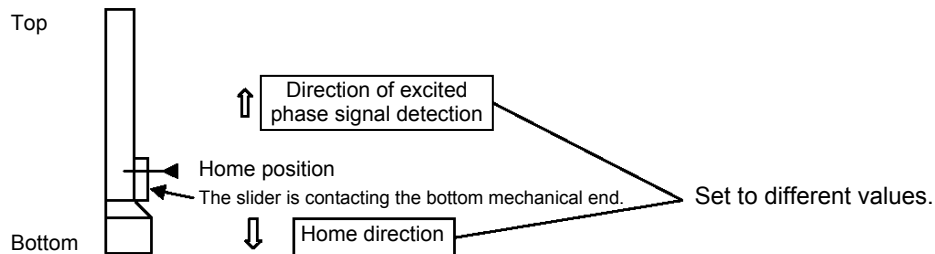
To do this, set the value of Parameter No. 28 to either "0" or "1." If the direction of detection is to be the same as the home direction, specify the same value currently set in Parameter No. 5, "Home direction."

To set the direction opposite to the home direction, specify the value different from the one currently set in Parameter No. 5, "Home direction."

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



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



- **Excited Phase Signal Detection Time**

The excited phase is detected when the servo is turned on for the first time after turning on the power. This parameter defines the time of this detection.

Before shipment, this parameter is set to a detection time appropriate for the standard specification of the actuator, and thus the setting need not be changed in normal conditions of use.

Should an excitation detection error or abnormal operation occur when the servo is turned on for the first time after turning on the power, you can try changing the detection time set in Parameter No. 29 as a possible countermeasure. Before changing this parameter, contact IAI.

- **Pole Sensing Type**

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.

Since the default setting need not be changed in normal conditions of use, the customer is advised not to change the parameter.

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 to be applied in jogging operation performed on the teaching pendant or using the PC software.

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.

\* This parameter is invalid during pulse train control.

- **Torque Limit (No. 57 TQLM)**

The torque limit to be applied when the torque-limit selection signal (TL) is input is set in Parameter No. 57.

Setting unit: %

The maximum limit is 70% of the rating.

- **Error Monitor while Limiting Torque (No. 59 TRER)**

Whether to disable or enable error monitor when deviation pulses exceed the value set in the applicable internal parameter while torque is limited (the TL signal is ON), is set in Parameter No. 59.

	Setting
Disable (Do not monitor)	0
Enable (Monitor)	1

The factory setting is “1” [Enable].

- **Pulse Count Direction (No. 62 CPR)**

The motor direction with respect to the command pulse is set in Parameter No. 62.

	Setting
Count pulses in forward direction	0
Count pulses in reverse direction	1

The factory setting is different for each actuator.

- **Electronic Gear (No. 65 CNUM) (No. 66 CDEN)**

The electronic gear numerator and denominator are set in Parameter Nos. 65 and 66.

	Setting
Electronic gear numerator	200
Electronic gear denominator	15

These parameters are used to determine the unit travel distance of the actuator per one pulse in input command pulse train.

Unit travel distance of linear-motion axis = Minimum travel unit (1, 0.1, 0.01 mm, etc.)/pulse

Unit travel distance of rotational axis = Minimum travel unit (1, 0.1, 0.01 deg, etc.)/pulse

- **Enable Function (No. 42 ENBL)**

Whether to enable or disable the deadman switch function of an ANSI teaching pendant is defined in Parameter No. 42.

\* An ANSI teaching pendant is still to be developed.

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

The factory setting is “1” [Disable].

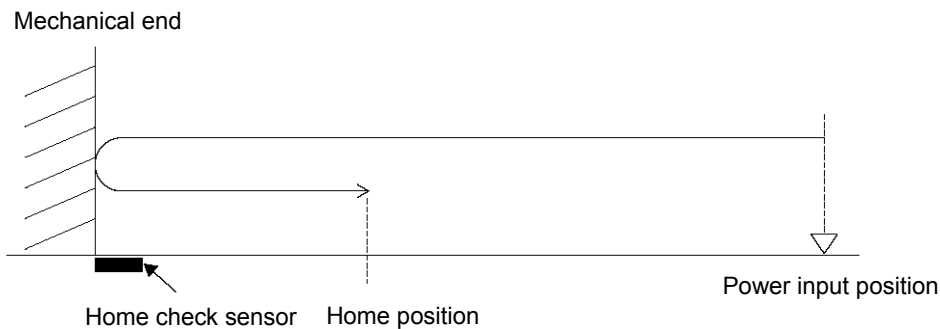
- Home Check Sensor Input Polarity [No. 43 HMC]

Although standard actuators do not come with a home check sensor, this sensor can be installed as an option. This parameter need not be changed in normal conditions of use. If the customer wishes to change the home check mode after shipment, change the value set in Parameter No. 43.

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

[Explanation of operation]

- [1] When a homing command is issued, the actuator moves until contacting the mechanical end, after which it reverses the direction and stops at the home position.
- [2] If a home check sensor signal has been detected by the time the actuator is stopped, the controller determines that the homing was completed successfully. If a home check sensor signal is not detected before the actuator stops, the controller recognizes “position deviation.” Accordingly, the controller generates a “home sensor not yet detected” error and outputs 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)

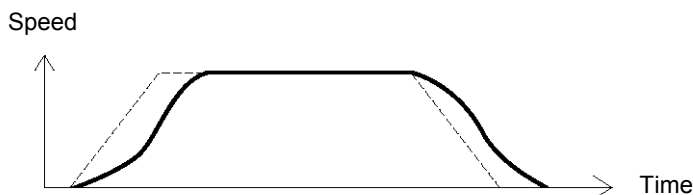
Parameter No.	Unit	Input range	Default
55	msec	0 ~ 100	0

This parameter sets the time constant to be applied when the primary filter for position command is enabled by the acceleration/deceleration mode setting.

The setting unit for travel is “0.1” msec.

The greater the value set in this parameter, the longer the primary delay becomes.

\* If “0” is set, acceleration and deceleration do not reflect any primary delay.



- **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.

\* Do not change the setting.

- **Axis Operation Type (No. 78 ATYP)**

This parameter defines the type of the actuator used.

Definition of settings : 0 (Linear axis)  
: 1 (Rotational axis)

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

If the axis operation type (No. 78) is set to "Rotational axis," selecting the index mode fixes the expression range of current values to between 0 and 359.99. If the index mode is selected, shortcut control is possible.

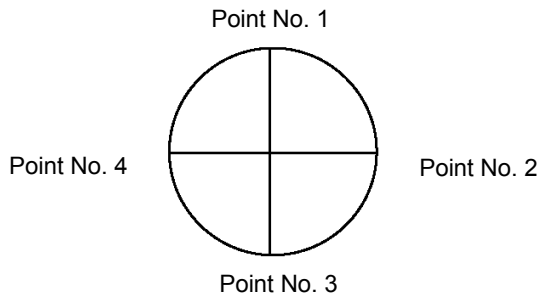
Definition of settings : 0 (Normal mode)  
: 1 (Index mode)

Note: 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.

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

Shortcut refers to an operation whereby the actuator moves to the next point by rotating in the direction requiring the shorter travel.

	Setting
Do not select	0
Select	1



Positions

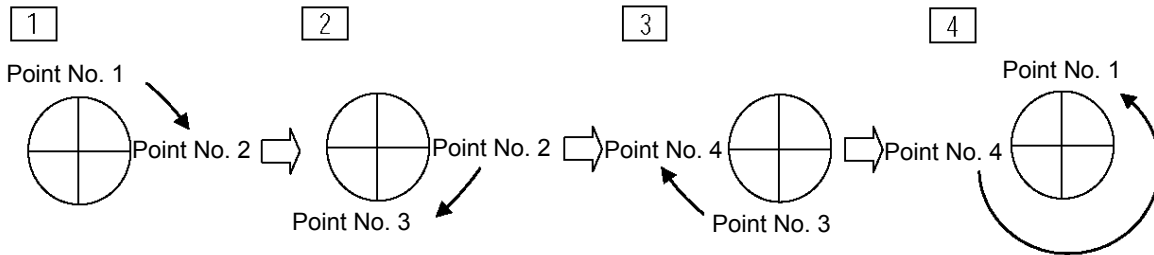
Point number	Position data
1	0
2	90
3	180
4	270

One degree of position data corresponds to 1 mm.

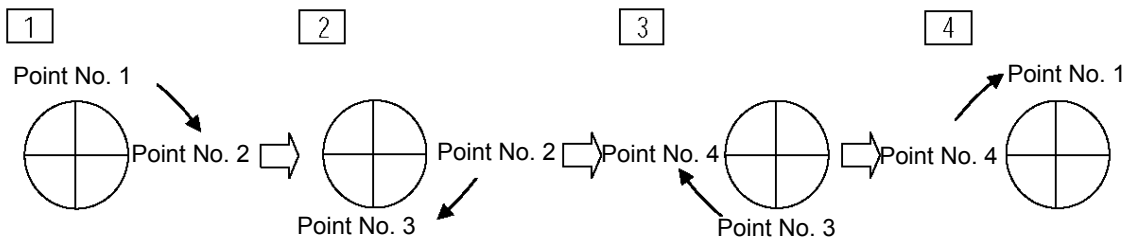
If the actuator is moved in the order to positions 1 → 2 → 3 → 4, the actuator will operate differently depending on whether or not shortcut is selected.

When shortcut is not selected

Current-limiting value during movement  
(2.8 to 4 times depending on the characteristics of the actuator)



When shortcut is selected



- 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 during movement (2.8 to 4 times depending on the characteristics of the actuator)
1	Current-limiting value during push & hold operation

## 5.2.3 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	Standard mode Use the PIO pattern of this type if you wish to perform position control using pulse train input from a PLC.
1	Push mode Use the PIO pattern of this type if you wish to perform position control and push-motion control using pulse train input from a PLC.

The factory setting is "0" [Standard type].

- **Servo-on Input Disable Selection (No. 21 SON)**

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

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

The factory setting is "0" [Enable].

- **SIO Communication Speed (No. 16 BRSL)**

This parameter is not used with this controller. It applies to controllers of serial communication type.

If this parameter is set, it sets the communication speed to be used when the controller implements serial communication control via the PLC's communication module.

Set Parameter No. 16 to a value appropriate for the specification of the communication module.

9600, 19200, 38400 or 115200 bps can be selected as the communication speed.

The factory setting is "38400" bps.

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

This parameter is not used with this controller. It applies to controllers of serial communication type.

If this parameter is set, it defines the minimum delay before the controller's transmitter is activated following the completion of command reception, when the controller implements serial communication control via the PLC's communication module.

The factory setting is "5" msec. If the communication module specification exceeds 5 msec, set the required time in Parameter No. 17.

- **Silent Interval Multiplication Factor (No. 45 SIVM)**

This parameter is not used with this controller. It applies to RS485 serial communication commands.

If this parameter is set, it defines the multiplication factor of silent interval time to be used for delimiter judgment in the RTU mode.

The factory setting is the communication time corresponding to 3.5 characters in accordance with the Modbus specification.

This parameter need not be changed in normal conditions of use where the actuator is operated using a PC or teaching pendant.

If the character sending interval exceeds the silent interval because the scan time of the PLC is not ideal, however, you can extend the silent interval time through Parameter No. 45.

The minimum setting unit is 1 (times), and the input range is 0 to 10. If "0" is set, it means that the silent interval multiplication factor is disabled.

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

Parameter No.	Unit	Input range	Default
52	-	0 ~ 2	0

This parameter sets the acceleration/deceleration mode.

When "0" is set: Trapezoid

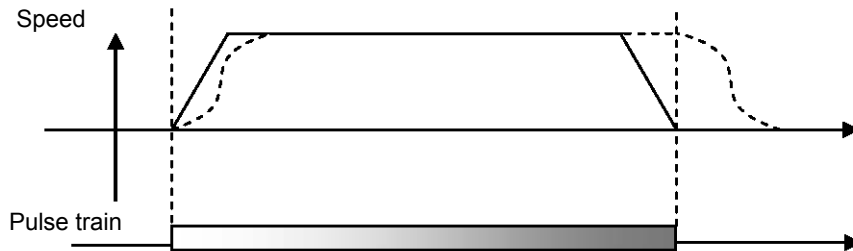
When "2" is set: Primary filter for position command

A primary delay is always reflected during movement. The travel corresponds to the specified pulses. Smooth acceleration and deceleration can be implemented even when the host controller has no acceleration/deceleration function or the number of command pulses changes suddenly.

The time constant is set in Parameter No. 55 (Filter time constant for position command).

If "0" is set, acceleration and deceleration do not reflect any primary delay.

Image diagram



- Homing Input (No. 40 HOME)

Whether to disable or enable the homing input signal is set in Parameter No. 40.

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

The factory setting is "0" [Enable].

- Clear Deviation at Servo Off/Alarm Stop (No. 58 SDCR)

Whether to disable or enable the deviation clear function when the servo is turned off or an alarm generates is set in Parameter No. 58.

	Setting
Disable (Do not clear)	0
Enable (Clear)	1

The factory setting is "1" [Enable].

- Deviation-counter Clear Input (No. 60 DCLR)

Whether to disable or enable the deviation-counter clear input is set in Parameter No. 60.

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

The factory setting is "0" [Enable].

- Torque-limit Command Input (No. 61 TL)

Whether to disable or enable the torque-limit command input is set in Parameter No. 61.

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

The factory setting is "0" [Enable].

- Command-pulse Input Mode (No. 63 MOD)

The command pulse pattern, selectable from six types, is set in Parameter No. 63.

Command-pulse input pattern		Input terminal	Forward	Reverse	Setting
Negative logic	Forward pulse train	PP • /PP			2
	Reverse pulse train	NP • /NP			
	Forward pulse trains indicate motor revolutions in the positive direction, while reverse pulse trains indicate motor revolutions in the reverse direction.				
	Pulse train	PP • /PP			1
	Sign	NP • /NP	Low	High	
	Command pulses indicate motor revolutions, while the sign of the command indicates the rotating direction.				
	Phase-A/B pulse train	PP • /PP			
NP • /NP					
Phase-A/B x4 pulses of 90° phase difference indicate both revolutions and rotating direction.					
Positive logic	Forward pulse train	PP • /PP			2
	Reverse pulse train	NP • /NP			
	Pulse train	PP • /PP			1
	Sign	NP • /NP	High	Low	
	Phase-A/B pulse train	PP • /PP			
NP • /NP					

(Note) The figures shown above are an image when a command pulse input is made on the differential line driver. The pulse waveform reverses when the pulse is input on the open collector.

[Refer to 4.2.1 Command Pulse Input]

The factory setting is "1" [Pulse train + Sign].

- Polarity in Command-pulse Input Mode (No. 64 POLE)

The input polarity of command pulses is set in Parameter No. 64.

	Setting
Positive logic	0
Negative logic	1

The factory setting is "0" [Positive logic].

## 5.2.4 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 PLGO)

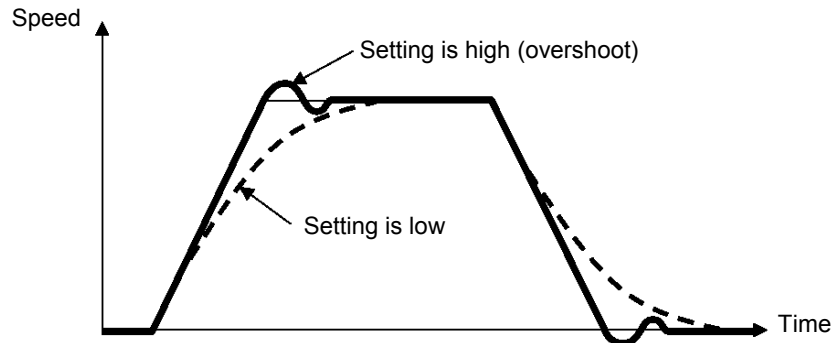
Parameter number	Unit	Input range	Default
7	5 rad/sec	0 ~ 15	6

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)

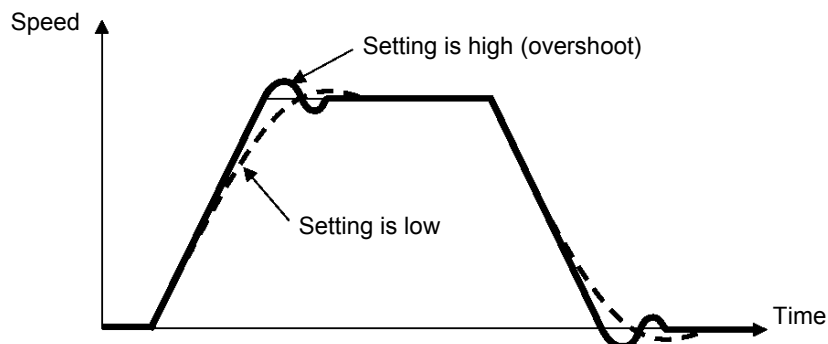
Parameter number	Unit	Input range	Default
31	---	1 ~ 27661	Set individually in accordance with the actuator characteristics.

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.

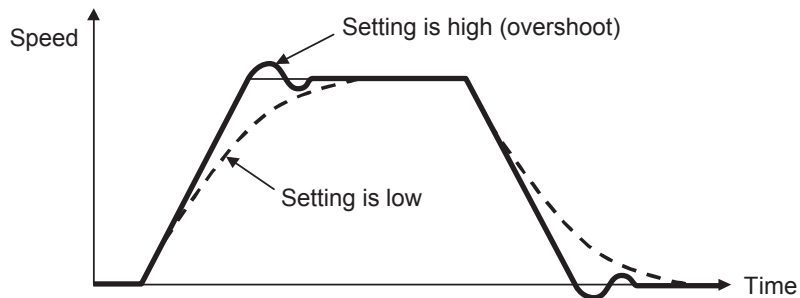
However, increasing the setting too much increases the tendency of the actuator to overshoot or oscillate, resulting in increased mechanical vibration.



- 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 ~ 4	Set individually in accordance with the actuator characteristics.

This parameter is used to change the current control band. A value corresponding to the applicable actuator is set at the factory. Never change this parameter. If the parameter is changed, stability of the control system may be affected and a very dangerous situation may occur.

- 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 "80." 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.

## 6. Troubleshooting

### 6.1 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.

## 6.2 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.

## 6.3 Alarms, Causes and Actions

### (1) Operation Cancellation Alarms

Code	Error	Cause/action
0A4	Command counter overflow	<p>Cause: This alarm generates when the value in the command pulse counter deviates from the range of -134217728 to 134217728.</p> <p>Action: Check the setting of command pulses.</p>
0B5	Phase-Z position error	<p>The position at which phase Z was detected during home return was outside the specified range or phase Z could not be detected.</p> <p>Cause: Faulty encoder</p> <p>Action: Contact IAI.</p>
0BA	Home sensor not yet detected	<p>This alarm indicates that the actuator equipped with a home sensor reached the mechanical end before a home sensor detection signal was output. (This alarm also generates when the actuator cannot move because the load is too heavy.)</p> <p>Cause: [1] The home sensor is not installed in an appropriate position and thus cannot be detected. [2] Open cable or inappropriately installed connector [3] The work is receiving an external force.</p> <p>Action: [1] Readjust the sensor installation position. [2] Perform electrical continuity check to see if the cable is open. Also check if the connector is installed properly. [3] Check the mechanisms around the work and make sure the work does not receive any strong external force. If the cause cannot be identified, contact IAI.</p>
0BE	Homing timeout	<p>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.)</p> <p>Action: As one possible cause, the controller and actuator combination may be incorrect. Contact IAI.</p>
0C0	Excessive actual speed	<p>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.</p> <p>Action: Check the assembly condition of mechanical parts for any abnormality. If the actuator itself is suspected as the cause, contact IAI.</p>
0CC	Abnormal control power-supply voltage	<p>The voltage of the 24-V input power supply is excessive (24 V + 20%: 28.8 V or below).</p> <p>Cause: [1] The voltage of the 24-V input power supply is high. [2] Faulty part in the controller</p> <p>Action: Check the input power-supply voltage. If the voltage is normal, contact IAI.</p>
0CE	Drop in control supply voltage	<p>This alarm indicates that the voltage of the 24-V input power supply has dropped (24 V-20%: 19.2 V or less).</p> <p>Cause: [1] Low voltage of the 24V input power supply [2] Faulty part inside the controller</p> <p>Action: Check the voltage of the input power supply. If the voltage is normal, please contact IAI.</p>

Code	Error	Cause/action
0D2	Excessive motor power-supply voltage	<p>Cause: This error occurs when overvoltage of motor power has been detected (38V or more)</p> <p>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.</p>
0D8	Deviation overflow	<p>The position deviation counter has overflowed.</p> <p>Cause: [1] The work hit a surrounding object during movement and the impact caused the speed to drop. [2] The specified acceleration is too high for the transferred mass. [3] The brake is improperly engaged and cannot be released correctly.</p> <p>Action: [1] Check the mechanisms around the work and make sure the work does not receive any strong external force. If [3] is suspected as the cause, contact IAI.</p>
0D9	Software limit over	This alarm indicates that a soft limit was reached.
0ED	Absolute encoder error (1)	<p>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.</p> <p>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.</p>
0EE	Absolute encoder error (2)	<p>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.</p> <p>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.</p>
0EF	Absolute encoder error (3)	<p>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.</p> <p>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.</p> <p>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").</p>

## (2) Cold Start Alarms

Code	Error	Cause/action
0A1	Parameter data error	<p>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.</p> <p>Action: Change the settings to appropriate values.</p>
0A8	Motor/encoder type not supported	<p>Cause: The monitor type or encoder type set in the applicable parameter is not supported.</p> <p>Action: If this error persists after reconnecting the power, contact IAI.</p>
0B4	Electrical angle mismatch	<p>Cause: The position deviation counter has overflowed.</p> <p>Action: Check the load condition, such as whether the work is not contacting any nearby object or if the brake is released. If the electrical angle is not yet confirmed (phase Z is not yet detected), deviation overflow may be a cause. In this case, check the cable connection because deviation overflow can be caused by a broken motor wire or encoder line output error.</p>
0B7	Indeterminate magnetic pole	<p>This controller will conduct magnetic pole phase detection when the servo is first turned ON after the power is input. This alarm indicates that the magnetic pole phase cannot be detected even with a lapse of a specified period of time.</p> <p>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 has not been released. [3] The motor load increased due to application of external force. [4] The slide resistance of the actuator itself is high.</p> <p>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 is suspected to be the cause, please contact IAI.</p>
0C8	Overcurrent	<p>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 insulation of motor coil may have deteriorated.</p> <p>Action: Measure the inter-phase resistances among motor connection wires U, V and W, as well as the insulation resistance between the motor connection wires and ground, to check for deterioration of insulation. Before executing measurement, please contact IAI.</p>
0CA	Overheat	<p>Cause: [1] The temperature around the power transistor in the controller is excessively high (95°C or above). [2] When the actuator is installed vertically, regenerative resistance energy is insufficient during downward movement because of a high deceleration setting. [3] Defective part in the controller</p> <p>Action: [1] Lower the temperature around the controller. [2] Revise the specified conditions to make the deceleration curve more gradual. If neither action [1] nor [2] improves the situation, contact IAI.</p>

Code	Error	Cause/action
0CB	Current-sensor offset adjustment error	<p>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.</p> <p>Cause: [1] Faulty current detection sensor or peripheral component</p> <p>Action: The board must be replaced. Contact IAI.</p>
0E0	Overload	<p>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.</p> <p>Action: [1] Check the work and its surroundings. If the work 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 work 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.</p> <p>Note: Before restarting operation, be sure to remove the cause. If the power is cut off once, input the power again after 30 min or more have elapsed to prevent the motor coil from burnout.</p>
0E8	Phase-A/B disconnection detection	<p>Encoder signals cannot be detected correctly.</p> <p>Cause: [1] Loose or disconnected encoder-relay cable connector [2] Loose or disconnected actuator-end connector of the supplied cable</p> <p>Action: Check the connection condition of the encoder relay cable and conduct a continuity check. If the results are normal, please contact IAI.</p>
0F4	Mismatched PCB	<p>This controller has a different motor drive circuit in accordance with the motor capacity. Therefore, a mounted motor is determined based on the printed circuit board (PCB).</p> <p>To this end, it is checked in the initialization process after starting whether the motor type set in the applicable system parameter matches the board.</p> <p>The alarm indicates that the motor type does not match the board.</p> <p>Cause: A parameter input error or board assembling error is suspected.</p> <p>Action: Should this error occur, please contact IAI.</p>

Code	Error name	Cause/Action
0F5	Nonvolatile memory write verify error	When data is written in the nonvolatile memory, the written data is read once for a check to verify the data matching. This alarm indicates that the written data is not matching. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm is generated again after reconnecting the power, please contact IAI.
0F6	Nonvolatile memory write timeout	This alarm indicates that no response was made when data was written in the nonvolatile memory. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm is generated again after reconnecting the power, please contact IAI.
0F8	Damaged nonvolatile memory	Abnormal data was detected during the nonvolatile memory check after starting. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm is generated again after reconnecting the power, please contact IAI.
0FA	CPU error	The CPU was not operating properly. Cause: [1] Faulty CPU [2] Malfunction due to noise Action: If the alarm is generated again after reconnecting the power, please contact IAI.

### (3) Non-alarm Message

Code	Error	Cause/action
FFF	Power on log	This is not an error. (It simply means that a rise of controller power has been detected.)

## 6.4 Messages Displayed during Teaching Pendant Operation


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

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.
116	Last position data available	Data was stored in the last position fields when an attempt was made to add data to the position table. Clear or delete the data for the last position.
117	No movement data	No target position is set under the selected position number. Input a target position first.
11E	Inconsistent data pair	The magnitude relationship of a pair of data is inappropriate. (Example) The same value is set in both the + and – soft limit parameters. Input appropriate values again.
11F	Absolute value too small	The minimum travel toward a target position is determined by the lead of the drive system and encoder resolution. This message indicates that the input target position is less than this minimum travel. (Example) If the lead is 20 mm, the encoder resolution is 800 pulses and therefore the minimum travel is calculated as 0.025 mm/pulse (20 ÷ 800). If 0.02 mm is input as the target position, this message will be displayed.
121	Push search end over	The final position in push-motion operation exceeds a soft limit. No harm is done as long as the actuator contacts the work. If it misses the work, however, the actuator will reach the soft limit and this message will be displayed. Change either the target position or positioning band.
122	Multiple axes connected at assignment	An axis number was assigned when multiple axes were connected. Always assign an axis number when only one axis is connected.
180 181 182	Axis number change OK Controller initialization OK Home change all clear	This is an operation check message. (It does not indicate misoperation or error.)
201	Emergency stop	An emergency stop status was detected. (This is not an error.)
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 movement	The start signal (CSTR) was turned ON from the PLC while the actuator was moving, resulting in redundant move commands.
20D	STOP-OFF during movement	The pause signal (*STP) was turned OFF from the PLC while the actuator was moving, disabling the actuator movement.
20E	Soft limit over	A soft limit was reached.
20F	Missed work detected	The actuator passed the work without contacting it in push-motion operation. Review the work condition as well as the target position/positioning band settings.
210	HOME-ON during movement	The homing signal (HOME) was turned ON from the PLC while the actuator was moving, resulting in redundant move commands.
211	JOG-ON during movement	The jog signal (JOG) was turned ON from the PLC while the actuator was moving, resulting in redundant move commands.
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.
307 309	Memory command denied Write address error	A command was denied in serial communication with the controller. 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.


## 6.5 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.

 **Caution:** When checking the continuity of the shield 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] Inappropriate contact of the shield 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] Check if parameter No. 42 [Enable function] is set to "Enable" by mistake by connecting a teaching pendant not supporting the enable switch.

- The Actuator does not Operate when a Pulse Train is Input.  
Cause: [1] The I/O I/F signal issued with the pulse train is invalid.  
[2] The command-pulse train pattern is not set properly in the parameters.  
Action: [1] Check the input signal.  
[2] Check User Parameter No. 63 (Command-pulse input mode) and No. 64 (Polarity in command-pulse input mode).

 **Caution:** With certain third-party host controllers, the positive and negative logic settings of pulse train patterns are opposite to those of IAI's controllers. Reverse the positive and negative logic settings to see if the problem is resolved.

- With an Actuator Installed in Vertical Orientation, Noise Generates during Downward Movement.  
Cause: The load exceeds the rated load capacity.  
Action: [1] Decrease the speed.  
[2] Decrease the value set in User Parameter No. 7 (Servo gain number). As a guide, do not decrease the setting to below 3.
- 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.  
[2] 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.  
[3] Wrong electronic gear setting  
[4] 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] Recalculate for electronic gear.  
[3] Contact IAI.
- The Actuator Installed in the Vertical Orientation Completes Homing before the Home Is Reached.  
Cause: [1] The ball screw is receiving torsional stress due to the affixing method of the actuator, unevenly tightened 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] Loosen the affixing bolts to check if the slider moves smoothly.  
[2] If the slide resistance of the actuator itself is high, contact IAI.

- The Actuator Malfunctions when the Servo Is Turned On after Turning On the Power.
  - Cause: Excited phase detection is not performed properly when the servo is turned on, because one of the following conditions exists when the power was turned on:
    - [1] The slider or rod was contacting a mechanical end.
    - [2] The work was pushed by a strong external force.
  - Action: [1] Check if the slider or rod is not contacting a mechanical end. If the slider/rod is contacting a mechanical end, separate the slider/rod from the mechanical end.
    - If the actuator is equipped with a brake, turn on the brake release switch to forcibly release the brake before moving the actuator. At this time, be careful not to pinch your hand or damage the robot hand or work by the slider/rod, as the slider/rod may drop unexpectedly by its dead weight.
    - If the actuator cannot be moved by hand, one measure is to check the direction of excited phase signal detection and change the direction of detection as necessary. If you wish to change the direction, contact IAI beforehand.
    - For details, refer to the applicable parameter explained in 6.2.2, "Parameters Relating to Actuator Operating Characteristics."
  - [2] Check if the work is not contacting any peripheral equipment.
    - If the work is contacting peripheral equipment, separate the work from the equipment by providing a minimum clearance of 1 mm in between.
- If neither [1] nor [2] applies, contact IAI.

## \* 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	-	-	-
					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	-	-	-
					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	-	-	-
	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	-	-	-
					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	-	-	-	
				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	-	-	-	
				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	-	-	-
			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	-	-	-
			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	-	-	-
			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	-	-	-
			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	-	-	-
					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	-	-	-
					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	-	-	-
	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	-	-	-
					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	-	-	-
					20	Horizontal/Vertical	25	1300 800	Energy-saving spec.: 0.3 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	-	-	-
	SA5C	Ball screw	20	800	3	Horizontal/vertical	3.75	200 (at 50 to 450st) 190 (at 500st)	Energy-saving spec.: 0.2 High acc/dec spec.: 0.2	-	-	-
					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	-	-	-	
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	-	-	-	
SA5D	Ball screw	20	800	3	Horizontal/vertical	3.75	200 (at 50 to 450st) 190 (at 500st)	0.2	-	-	-	
				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	-	-	-	
				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	-	-	-	
SA5R	Ball screw	20	800	3	Horizontal/vertical	3.75	200 (at 50 to 450st) 190 (at 500st)	0.2	-	-	-	
				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	-	-	-	
				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	-	-	-	

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 (at 50 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							
									Energy-saving spec.: 0.3							
					6	Horizontal/vertical	7.5	400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	High acc/dec spec.: 1.0		-	-	-			
									Energy-saving spec.: 0.2							
					3	Horizontal/vertical	3.75	200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	High acc/dec spec.: 0.2		-	-	-			
									Energy-saving 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)
	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)
	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
	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)

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		200	0.2	-	-	-
						2	Horizontal	1.90	100	0.2	-	-	-
							Vertical		100	0.2	-	-	-
		Lead screw			6	Horizontal	5.72	220	0.2	-	-	-	
						Vertical		220	0.2	-	-	-	
					4	Horizontal	3.81	200	0.2	-	-	-	
Vertical						200		0.2	-	-	-		
2					Horizontal	1.90	100	0.2	-	-	-		
					Vertical		100	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)				
					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		370 (at 750st) 330 (at 800st)	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		185 (at 750st) 165 (at 800st)	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		90 (at 750st) 80 (at 800st)	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		370 (at 750st) 330 (at 800st)	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		185 (at 750st) 165 (at 800st)	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		90 (at 750st) 80 (at 800st)	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)				
					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		370 (at 750st) 330 (at 800st)	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		185 (at 750st) 165 (at 800st)	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		90 (at 750st) 80 (at 800st)	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		370 (at 750st) 330 (at 800st)	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		185 (at 750st) 165 (at 800st)	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		90 (at 750st) 80 (at 800st)	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		200	0.2	-	-	-
					2	Horizontal	1.90	100	0.2	-	-	-
						Vertical		100	0.2	-	-	-
		Lead screw	6	Horizontal	5.72	220	0.2	-	-	-		
				Vertical		220	0.2	-	-	-		
			4	Horizontal	3.81	200	0.2	-	-	-		
				Vertical		200	0.2	-	-	-		
			2	Horizontal	1.90	100	0.2	-	-	-		
				Vertical		100	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		200	0.2	-	-	-
					2	Horizontal	1.90	100	0.2	-	-	-
						Vertical		100	0.2	-	-	-
		Lead screw	6	Horizontal	5.72	220	0.2	-	-	-		
				Vertical		220	0.2	-	-	-		
			4	Horizontal	3.81	200	0.2	-	-	-		
				Vertical		200	0.2	-	-	-		
			2	Horizontal	1.90	100	0.2	-	-	-		
				Vertical		100	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		200	0.2	-	-	-
					2	Horizontal	1.90	100	0.2	-	-	-
						Vertical		100	0.2	-	-	-
		Lead screw	6	Horizontal	5.72	220	0.2	-	-	-		
				Vertical		220	0.2	-	-	-		
			4	Horizontal	3.81	200	0.2	-	-	-		
Vertical				200		0.2	-	-	-			
2			Horizontal	1.90	100	0.2	-	-	-			
			Vertical		100	0.2	-	-	-			
TA4C	Ball screw	10	800	6	Horizontal	7.5	300	0.3	-	-	-	
					Vertical		300	0.2	-	-	-	
				4	Horizontal	5	200	0.3	-	-	-	
					Vertical		200	0.2	-	-	-	
				2	Horizontal	2.5	100	0.2	-	-	-	
					Vertical		100	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	30.03	Horizontal/vertical	42	300	2	0.75	2	2
	RA2L			855	35.91	Horizontal/vertical	42	340	2	1.5	4	4
	RA3L			1145	48.09	Horizontal/vertical	42	450	2	3	8	8
	SA1L			715	30.03	Horizontal	42	420	2	-	-	-
	SA2L			855	35.91	Horizontal	42	460	2	-	-	-
	SA3L			1145	48.09	Horizontal	42	600	2	-	-	-
	SA4L			715	30.03	Horizontal	42	1200	2	-	-	-
	SM4L			715	30.03	Horizontal	42	1200	2	-	-	-
	SA5L			855	35.91	Horizontal	42	1400	2	-	-	-
	SM5L			855	35.91	Horizontal	42	1400	2	-	-	-
	SA6L			1145	48.09	Horizontal	42	1600	2	-	-	-
	SM6L			1145	48.09	Horizontal	42	1600	2	-	-	-

## Parameter Record

Recorded date: \_\_\_\_\_

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

No.	Type	Symbol	Name	Unit	Recorded data
3	a	LIMM	Soft limit + side	mm	
4	a	LIML	Soft limit – side	mm	
5	a	ORG	Home direction [0: Reverse / 1: Forward]	-	
7	d	PLGO	Servo gain number	-	
9	b	ACMD	Default acceleration/deceleration	G	
10	b	INP	Default positioning band (in-position)	mm	
13	b	ODPW	Current-limiting value during homing	%	
16	c	BRSL	SIO communication speed	bps	
17	c	RTIM	Minimum delay time for slave transmitter activation	msec	
18	c	LS	Home sensor input polarity [0: None / 1: Contact a / 2: Contact b]	-	
21	c	SON	Servo-on input [0: Enable / 1: Disable]		
22	a	OFST	Home offset	mm	
25	c	IOPN	PIO pattern selection	-	
28	b	PHSP	Default direction of excited phase signal detection [0: Reverse / 1: Forward]		
29	b	PHSP	Excited phase signal detection time	msec	
30	b	PHSP	Pole sensing type [0: Current suppression / 1: Distance suppression]	-	
31	d	VLPG	Speed loop proportional gain	-	
32	d	VLPT	Speed loop integral gain	-	
33	d	TRQF	Torque filter time constant	-	
35	b	SAFV	Safety speed	mm/sec	
40	c	HOME	Homing input [0: Enable / 1: Disable]	-	
42	b	ENBL	Enable function [0: Enable / 1: Disable]	-	
43	b	HMC	Home check sensor input polarity [1: Contact a / 2: Contact b]	-	
45	c	SIVM	Silent interval multiplication factor	-	
52	c	HSTP	Default acceleration/deceleration mode	-	
54	d	CLPF	Current control band number	-	
55	b	PLPF	Primary filter time constant for position command	msec	
57	b	TQLM	Torque limit	%	
58	c	SDCR	Clear deviation at servo off/alarm stop [0: Disable / 1: Enable]	-	
59	b	FSTP	Monitor error while limiting torque [0: Disable / 1: Enable]	-	
60	c	DCLR	Deviation-counter clear input [0: Enable / 1: Disable]	-	

No.	Type	Symbol	Name	Unit	Recorded data
61	c	TL	Torque-limit command input [0: Enable / 1: Disable]	-	
62	b	CPR	Pulse count direction [0: Forward / 1: Reverse]	-	
63	c	MOD	Command-pulse input mode	-	
64	c	POLE	Polarity in command-pulse input mode [0: Positive / 1: Negative]	-	
65	b	CNUM	Electronic gear numerator	-	
66	b	CDEN	Electronic gear denominator	-	
71	d	PLFG	Position feed-forward gain	-	
77	b	LEAD	Ball screw lead [mm]	mm	
78	b	ATYP	Axis operation type	-	
79	b	ATYP	Rotation axis mode selection	-	
80	b	ATYP	Rotation axis shortcut selection	-	
88	a	SWLM	Software limit margin	mm	
91	b	PSFC	Current-limiting value at stopping due to missed push-motion	-	

\* The numbers are displayed on the PC software screen but not on the teaching pendant.  
 The missing numbers are not used and omitted.  
 The category codes are provided only for convenience and not displayed on either the PC software screen or teaching pendant.

## Change History

Revision Date	Description of Revision
	First edition Second edition Third edition Fourth edition <ul style="list-style-type: none"> <li>• Added the additional models on P.2.</li> <li>• Changed the teaching drawing to CON-T on P.3.</li> <li>• Corrected the specifications on P.7. (Added current value of the additional models and encoder resolutions.)</li> <li>• Changed the part about supplied voltage on P.10 (for the additional models).</li> <li>• Unified the notation of the part about noise elimination measures to ones for other models on P.11 and 12.</li> <li>• Reviewed the emergency stop circuit on P.15 to 17.</li> <li>• Change made to caution note regarding the pull-up resistor in P.24</li> <li>• Encoder resolutions added for the additional models in P.31, 32, 42 and 43</li> <li>• Notes added regarding the items related to the additional parameter No.78 in P.49, 50, 56 and 57</li> <li>• Added the error code: 0B5, 0CE, 0A8, 0B4, 0D2, 0F4 to 0F6 and 0F8 on P.66 to 70.</li> <li>• Edited the added models on P.77 to 79.</li> <li>• PIO pattern names changed to those shown in the catalog for all the related pages</li> </ul>
2009.11	Fifth edition <ul style="list-style-type: none"> <li>• Encoder resolutions added for the additional models in P.7. Current values added</li> <li>• Updated the cable drawing on pages 18 and 19.</li> <li>• Encoder resolutions added for the additional models in P.31</li> <li>• Correction made to warning note in P.34</li> <li>• Encoder resolutions added for the additional models in P.42</li> <li>• Correction made to warning note in P.45</li> <li>• Absolute error added in P.67</li> </ul>
2010.02	Sixth edition <ul style="list-style-type: none"> <li>• Added "About CE Marking."</li> </ul>
2010.04	Seventh edition <ul style="list-style-type: none"> <li>• Added "Please Read Before Use" on the first page after the cover.</li> <li>• Added "Safety Guide" on the first page after the Table of Contents.</li> <li>• Added "Change History" on the last page.</li> </ul>

Revision Date	Description of Revision
2010.07	Eighth edition • Replaced the warning on P.42
2011.01	Ninth edition • Correction made in "Speed loop integral gain" in P.70
2011.04	Tenth edition • Swapped over the page for CE Marking
2011.07	Eleventh edition • Contents changed in 1.5 Warranty in P.14 to P.15 • Contents changed and added in Appendix: List of Specifications of Connectable Actuators.
2012.12	Twelfth edition • List of encoder pulses and leads length by model added a model to a table in P.40 to P.51 • The lead of the actuator was indicated in the clause linear type in P.98
2012.12	Thirteenth edition • Explanation changed for home return current (Parameter No. 13) in P. 61 and 84 • Added "D2 Error" in P. 76
2014.05	Fourteenth edition • Image added for input pulse image on open collector • Note added in P. 11 and P. 29
2015.03	14B edition • Correction made to moto maximum current at 30 watts (4.0 to 4.4A) in P. 17





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