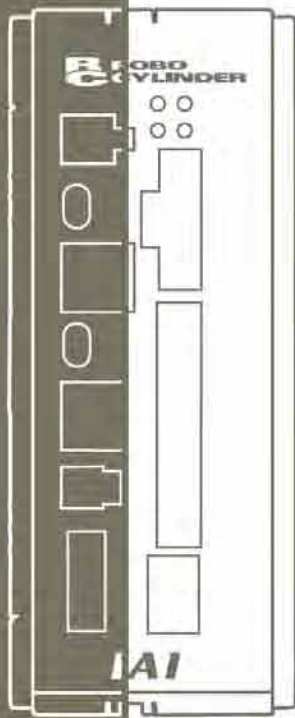




**RCS Series  
ROBO Cylinder Controller  
RCS-E Type**

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**Operation Manual    Seventh Edition**



***IAI America, Inc.***



## **Please Read Before Use**

Thank you for purchasing our product.

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

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.

The CD that comes with the product contains operation manuals for IAI products.

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

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

### **[Important]**

- This Operation Manual is original.
- The product cannot be operated in any way unless expressly specified in this Operation Manual. IAI shall assume no responsibility for the outcome of any operation not specified herein.
- Information contained in this Operation Manual is subject to change without notice for the purpose of product improvement.
- If you have any question or comment regarding the content of this manual, please contact the IAI sales office near you.
- 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) Hold · Servo ON Signal

When operating the RCS (ROBO cylinder) controller, you will need to turn ON the Hold & Servo ON signal Input Signal of PIO.



In case the Hold Stop Input Signal of PIO remains OFF, RCS controller will not move due to hold status. Therefore, please be careful.

(2) Position 0 may be output regardless of the actual position. At the timings specified below, the positioning completion signal turns ON no matter where the actual position is. As a result, the output status becomes "Position 0."

1. When the power is turned on
2. When the emergency stop is reset
3. When the alarm is reset
4. When a reset is performed after hold

Be extra careful when using Position 0.

(3) With the absolute type, 0E5 (Encoder Reception Error) will be displayed under certain conditions, such as when the power is first turned on after disconnecting the battery or PG cable. This display does not indicate fault. Perform an absolute reset in accordance with the specified procedure.

(4) Recommendation for backing up latest data

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

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

Use the following methods to back up data:

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

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## Requirements for Industrial Robots under Ordinance on Industrial Safety and Health

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



## Applicable Modes of IAI's Industrial Robot

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 robo 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 end 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 robos  
Any robot that uses at least one axis corresponding to one of the models specified in 1 to 3
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 condensation</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 of 1 ton or more in capacity, make sure the crane operators are qualified to operate cranes and perform slinging work.</li> <li>● When using a crane, etc., never hoist articles exceeding the rated load of the crane, etc.</li> <li>● Use hoisting equipment suitable for the article to be hoisted. Calculate the load needed to cut off the hoisting equipment and other loads incidental to equipment operation by considering a safety factor. Also check the hoisting equipment for damage.</li> <li>● Do not climb onto the article while it is being hoisted.</li> <li>● Do not keep the article hoisted for an extended period of time.</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 condensation.</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 work part). 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>

No.	Task	Note
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>● Securely connect the cables and connectors so that they will not be disconnected or come loose. 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 work part, 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 the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc.</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> </ul>

No.	Task	Note
		<ul style="list-style-type: none"> <li>● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged load, etc.</li> <li>* Safety fences --- Indicate the movement range if safety fences are not provided.</li> </ul>
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 the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc.</li> <li>* Safety fences --- Indicate the movement range if safety fences are not provided.</li> </ul>
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 precautions 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.	 <b>Danger</b>
Warning	Failure to observe the instruction may result in death or serious injury.	 <b>Warning</b>
Caution	Failure to observe the instruction may result in injury or property damage.	 <b>Caution</b>
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.	 <b>Note</b>









## 1. Overview

### 1.1 Forward

Thank you very much for purchasing the RCS controller. This manual explains the features of this machine and its operating procedures.

Without knowing beforehand how to correctly use or operate the controller, not only will the user be unable to take full advantage of all the functions built into this product but the user might also, inadvertently cause damage to the robot or shorten its life. Please read this manual as well as other manuals carefully pertaining to the product to acquire an understanding of the proper method of handling and operating the controller. Keep this manual handy so that you can refer to the appropriate sections as the need arises.

Also refer to the operation manuals for the various actuators you are using, as well as the operation manual(s) for the optional PC software and/or teaching pendant if applicable.

#### Absolute Specifications:

- With the absolute home controller, once power is applied, and absolute reset is executed, you can execute positioning without the need to home after reapplying the power. Other basic functions are the same as the standard RCS controller.
- Absolute reset is not set at time of shipment. Please execute absolute reset by yourself.  
Only RCS actuators of absolute specification can be used with the absolute RCS controller. The standard RCS actuator cannot be used.

- Actuator duty

It is recommended that IAI's actuators be used at a duty of 50% or below as a guideline in view of the relationship of service life and accuracy.

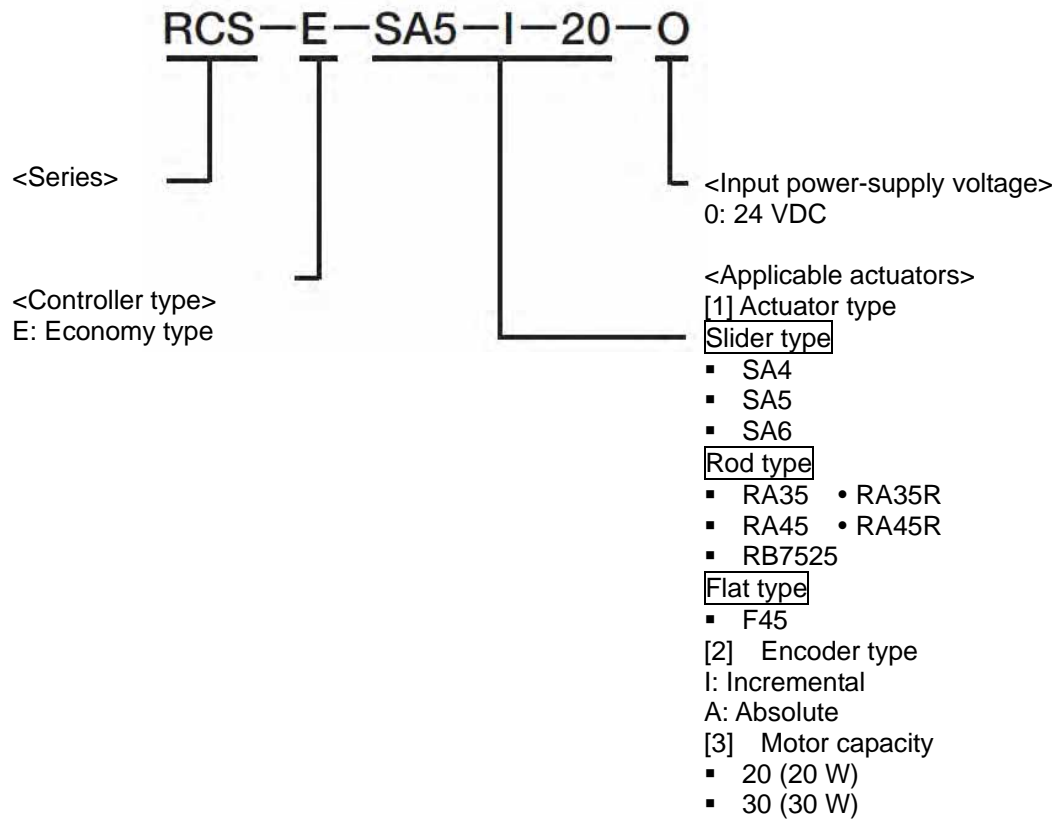
Duty is calculated by the formula below:

$$\text{Duty (\%)} = \frac{\text{Operating hours}}{\text{Operating hours} + \text{Non - operating hours}} \times 100$$

- \* We have paid utmost attention to ensure accuracy of this manual. Should you find any error, however, or if you have any input, please contact IAI.

We recommend that you keep this manual in a convenient place so that you can reference it readily when needed.

## 1.2 How to Read Model Number



### 1.3 Safety Precautions

Please read the following information carefully in order to gain an understanding of safety precautions.

This product was developed as components for driving automated equipment and is designed not to produce greater torque or speed than is necessary. However, strictly observe the following items to prevent any accidents from occurring.

1. As a rule, any handling or operating methods not described in this manual should be viewed as things that should not be attempted. Please contact IAI if any portion of the contents of this manual are unclear.
2. Use only the products specified for wiring between the actuator and controller.
3. Stand clear of the operating range of the machine when it is in motion or is ready to operate (when the control power is on). Surround the system with safety partitions if there is a possibility that people can enter the area where the machine is being used.
4. When assembling, adjusting, or performing maintenance on the machine, always disengage the power supply to the controller. During work, display a sign stating work in progress where it is readily visible. Also, keep the power cable close to the operator so that another person cannot inadvertently switch on the power.
5. When more than one person is working on the system, agree on signals beforehand to ensure everyone's safety before beginning work. In particular, when doing work involving axis movement, always call out for everyone's safety regardless of whether power is ON or OFF, or the axis is to be mechanically driven or manually moved.
6. When the user needs to lengthen the cables, check the wiring carefully to make sure it is correct before turning the power ON since miswiring can lead to malfunction.

## 1.4 Warranty Period and Scope of Warranty

The RCS controller undergoes stringent testing before it is shipped from our factory. IAI provides the following warranty:

### 1. Warranty Period

The warranty period expires upon elapse of one of the following periods, whichever occurs first.

- 18 months after the shipment from IAI
- 12 months after delivery to the location specified by the user.

### 2. Scope of Warranty

If within the period specified above, a breakdown occurs while operating the controller under normal conditions and is clearly the responsibility of the manufacturer, IAI will repair the unit at no cost. However, the following items are not covered by this warranty:

- Faded paint or other changes that occur naturally over time.
- Consumable components that wear out with use (battery, etc.).
- Unit seems to be noisy or similar impressions that do not affect machinery performance.
- Damage resulting from improper handling or use.
- Damage resulting from user error or failure to perform proper maintenance.
- Use of any part which is not a genuine part of IAI
- Any alterations not authorized by IAI or its representatives, including parameters.
- Damage caused by fire and other natural disasters or accidents.

The warranty pertains to the purchased product itself and does not cover any loss that might arise from a breakdown of the product. Any repairs will be done at our factory.

Make sure you understand the foregoing terms of warranty.
---

## 1.5 Setting Environment and Noise Measures

Please be careful for controller setting environment

### 1.5.1 Installation Environment

This controller can be used in an environment of pollution degree 2\*<sup>1</sup> or equivalent.

\*1 Pollution degree 2: Normally only nonconductive pollution occurs. Temporary conductivity caused by condensation is to be expected.  
(EN60947-5-1)

- (1) Do NOT block the air vents of your controller when installing your IA system.  
(Unavailability of sufficient ventilation not only prevents the controller from demonstrating its designed performance, but it may also lead to a controller failure.)
- (2) Prevent foreign matters from entering the controller through the vent holes. Your controller is NOT dust, water, or oil proof. Avoid using your IA system in environments subject to contamination by dust, oil, mist, or cutting oil.
- (3) Do not expose your IA system to direct sunlight or radiation heat from a large heat source such as heat treat furnace, etc.
- (4) Avoid placing your IA system under conditions of extreme temperatures above 40°C or below 0°C. The level of humidity should not be exceed 85%. Do NOT expose to corrosive or inflammable gas.
- (5) Avoid external vibration, unnecessary impact, or excessive shocks to your controller.
- (6) Take steps to shield controllers and wiring cables from electromagnetic noise.

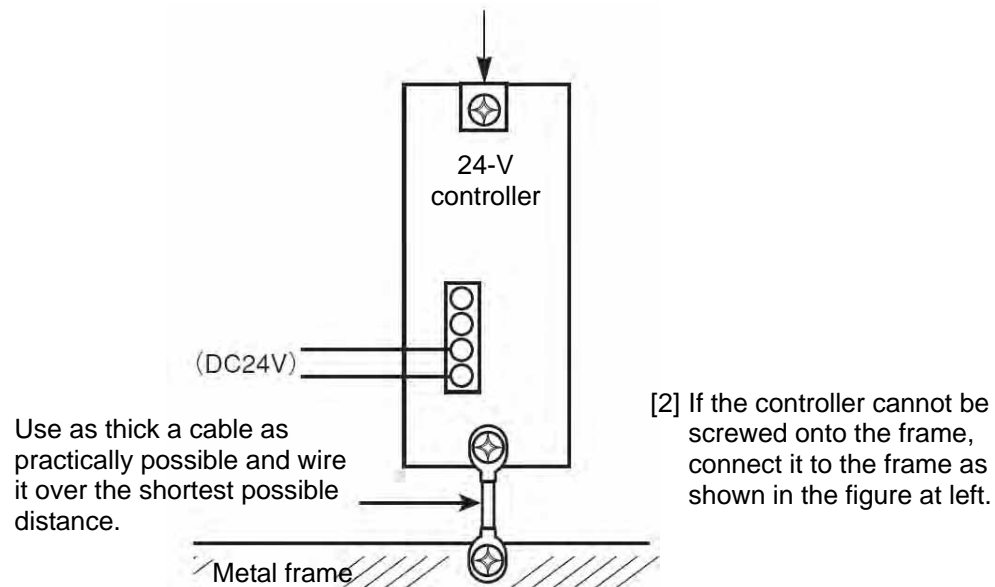
### 1.5.2 Power Source

The supplied voltage is 24 VDC  $\pm$  10%.

## 1.5.3 Noise Elimination Measures and Grounding

### (1) Noise Elimination Grounding

1. Directly screw the main body to the metal box.



### [3] Precautions regarding wiring method

Use a twisted cable for connection to the 24-VDC external power supply.

Separate the controller cables from high-power lines such as a cable connecting to a power circuit. (Do not bundle together the controller cables with high-power lines or place them in the same cable duct.)

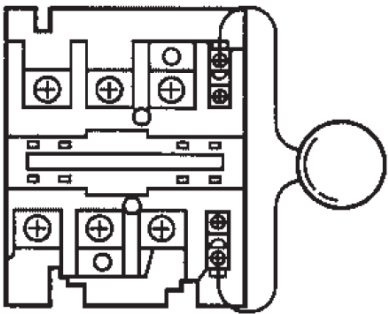
When extending the supplied motor cable or encoder cable, consult IAI's Technical Support or Sales Engineering Section.

## (2) Noise sources and elimination

Among the numerous noise sources, solenoid valves, magnet switches and relays are of particular concern when building a system. Noise from these sources can be eliminated by implementing the measures specified below.

### [1] AC solenoid valves, magnet switches and relays

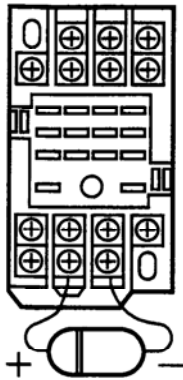
Measure: Install a surge absorber in parallel with the coil.



← Point  
Install a surge absorber to each coil over a minimum wiring length.  
Installing a surge absorber to the terminal block or other part will be less effective because of a longer distance from the coil.

### [2] DC solenoid valves, magnet switches and relays

Measure: Install a diode in parallel with the coil. Determine the diode capacity in accordance with the load capacity.



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

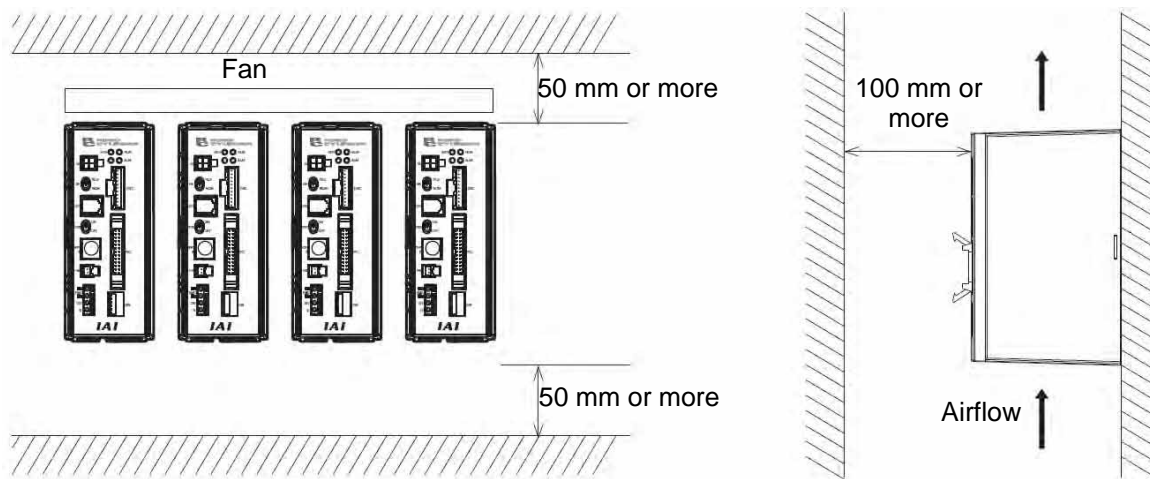
## 1.6 Heat Radiation and Installation

Design the control panel size, controller layout and cooling method in such a way that the temperature around the controller will not exceed 40°C.

Install the controller vertically on a wall, as shown below. Since cooling is provided by way of natural convection, always observe this installation direction and provide a minimum clearance of 50 mm above and below the controller to ensure sufficient natural airflows.

When installing multiple controllers side by side, providing a ventilation fan or fans above the controllers will help maintain a uniform temperature around the controllers.

Keep the front panel of the controller away from the wall (enclosure) by at least 100 mm.



Regardless of whether your system consists of a single controller or multiple controllers, provide sufficient clearances around each controller so that it can be installed/removed easily.



## 2. Specification

### 2.1 Base Specifications

Item		Specification											
Supply voltage		24 VDC ± 10%											
Supply current [A]		Type		RA35		RA45, F45		RB75 (60 W)		SA4, SA5		SA6	
		Rating	Peak	1.8	4.3	2.4	6.0	3.9	7.5	1.2	3.7	1.4	3.9
Maximum motor output		60 W (Torque limit x 2) / Other (x 3)											
Surrounding air temperature/humidity		0 to 40°C, 85%RH or less											
Surrrounding environment		IP10, free from corrosive gases											
Weight		540 g											
Protective functions		Regenerative voltage error, motor overcurrent, power-stage overheat, encoder error, motor overload, overspeed											
LED indicators		RDY (green), RUN (green), ALM (red), ENC (orange)											
DI/DO interface		24 VDC, isolated											
Input/output	8 dedicated input ports	Start Command position number (4-bit binary) * Pause Reset Servo-ON											
	10 dedicated output ports	Completed position number (4-bit binary) Position complete Home return completion Zone * Alarm * Emergency stop Moving											
		Serial interface input/output											
Number of positions		16											
Data entry method		Teaching pendant, PC software											
Storage device		EEPROM 8 kbytes, S-RAM 128 kbytes											

Note: Supplying the power-supply port or any I/O port with a voltage beyond the specified level may result in controller failure.  
\* indicates a b-contact signal.

## 2.1.1 Backup Battery (Absolute Specification)

### (1) Battery Specification

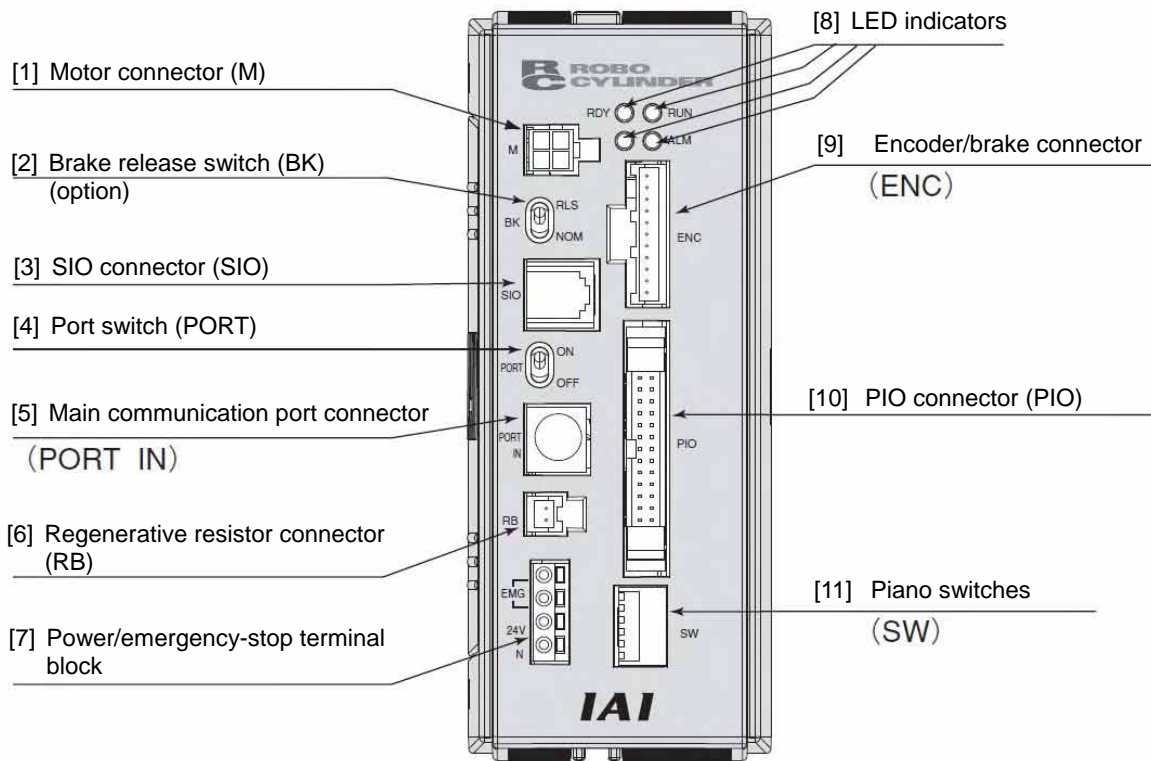
Item	Description
Type	Lithium battery
Manufacturer	Toshiba Battery Co., Ltd.
Model number	ER3VP
Nominal voltage	3.6 V
Rated capacity	2000 mAh
Weight	Approx. 8.5 g
Battery retention time Note 1)	Approx. 20,000 hours (at a surrounding air temperature of 20°C).

Note 1) Approx. 100  $\mu$ A of current is consumed while data is backed up by the absolute data backup battery (as opposed to approx. 4  $\mu$ A consumed while the main controller power is on).

- \* Do not modify or extend the wires. It may cause failure.
- \* The battery is replaced together with the board. Since what you will replace is not the battery alone, always use the product specified by IAI.  
An absolute reset must be performed after the battery has been replaced.

## 2.2 Names and Functions of Parts

### 2.2.1 Names



### 2.2.2 Functions

- [1] **Motor connector** (M•BK)  
A connector for the actuator's motor power cable.
- [2] **Brake release switch** (BK) This switch is available only when the brake option is selected.  
RLS: Brake is forcibly released  
NOM: Brake is in use (Normal setting)
- [3] **SIO connector** (SIO)  
A connector for linking another controller when two or more controllers are connected.
- [4] **Port switch** (PORT)  
ON: The PORT IN port (teaching pendant/PC software) becomes active. If a dedicated teaching pendant or cable is not connected to this port, the controller will recognize an emergency-stop condition.  
OFF: The PORT IN port (teaching pendant/PC software) becomes inactive. (Controller-to-controller communication is possible.)

[5] **Main communication port connector** (PORT IN)

A connector for receiving the communication cable from a dedicated teaching pendant or external equipment. It also receives a controller link cable when two or more axes are connected.

[6] **Regenerative resistor connector** (RB)

A connector for regenerative discharge resistor.

The controller will come with a regenerative resistor if the specified actuator capacity is 30 W or above. However, connection is basically optional, and it should be connected when a regenerative discharge error occurs. The error code of the regenerative discharge error is "0C9."

[7] **Power/emergency-stop terminal block**

EMG: Both terminals are used to connect an emergency-stop switch.

(EMG terminals are short-circuited at default.)

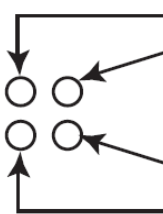
24V: Connect the positive side of the 24-VDC power supply.

This becomes the common terminal for the PIO input circuit

N: Connect the negative side of the 24-VDC power supply.

This becomes the common terminal for the PIO output circuit.

[8] **LEDs**



RDY (green): Indicate that the CPU is operating normally.

RUN (green): This LED turns on while the actuator is moving.

The LED also turns on when the voltage of the absolute-data backup battery drops.

ALM (red): This LED remains lit while an alarm is present.

ENC (orange): This LED turns on when the encoder cable is open or otherwise the encoder cannot be recognized.

[9] **Encoder/brake connector** (ENC)

An encoder/brake (optional) cable connector.

[10] **PIO connector** (PIO)

A PIO cable connector.

[11] **Piano switches** (SW)

There are six piano switches. The role of each switch is shown below.

Piano switch number	Role
6	FWP: Write protect switch
5	ABS-CLR: Absolute data clear switch (absolute specification)
4	Actuator address setting switches
3	
2	
1	

**Note:** All piano switches are designated as Nos. 1, 2, etc., from the bottom.  
With the piano switch in front of you, tilt it to the right side to turn on the switch, or tilt it to the left side to turn off the switch.

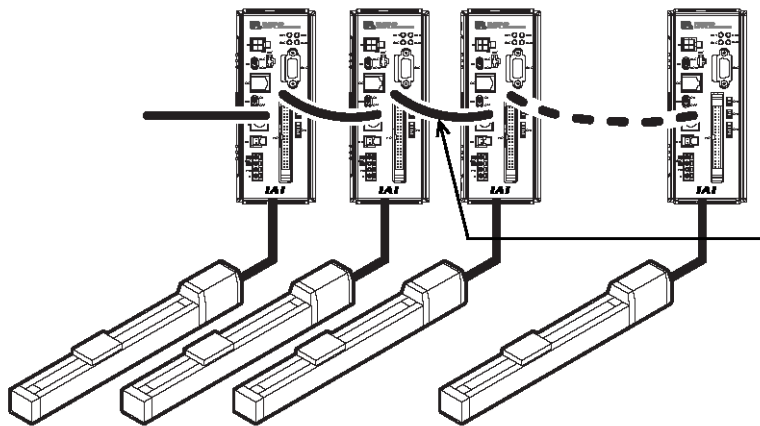
## Piano switches 1 to 4 --- Address switches

Use these switches to set the address of the applicable actuator if two or more axes are connected to the SIO connector. A desired address between 0 to 15 can be set.

(The factory setting is OFF for all of switch Nos. 1 to 4. This setting represents a condition where only one axis is used.)

Use these switches to set a desired address for each controller. Make sure no address is duplicated among the controllers. As long as they are unique, the addresses may not be contiguous and missing numbers are allowed.

Address	Piano switch numbers			
	1	2	3	4
0	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON
11	ON	ON	OFF	ON
12	OFF	OFF	ON	ON
13	ON	OFF	ON	ON
14	OFF	ON	ON	ON
15	ON	ON	ON	ON



The controller link cable is 200 mm long.

A maximum of 16 controllers can be connected.

## Piano switch 5 ABS-CLR (absolute specification) (Second from the top)

This switch clears the data of the absolute encoder. Use it to perform an absolute reset.  
This switch should be in the OFF position.

Normally this switch

## Piano switch 6 (First from the top)

Write protect switch. This switch is used for remote update. ... This switch should be in the OFF position.

### 2.2.3 Pin Assignments of the Communication Ports

- Pin assignments of the SIO connector

Pin No.	Signal name	Function
1	(+5V)	(5-VDC power output) or (preliminary signal terminal)
2	SGA	Positive logic side of the line transceiver I/O
3	GND	Communication ground
4	SGB	Negative logic side of the line transceiver I/O
5	GND	Communication ground
6	(+5V)	5-VDC power output

- Pin assignments of the main communication port

Pin No.	Signal name	Function
1	SGA	Serial communication
2	SGB	Serial communication
3	5V	5-V power output
4	EMGS	Emergency-stop status
5	EMGA	*1
6	24V	24-V power output
7	GND	Ground
8	ENGB	*1

\*1 Used to actuate an emergency stop (contact b).  
Short these pins to cancel an emergency stop.

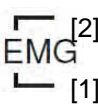
- Motor connector [Molex 5569-04A1]

Pin No.	Signal name	Connected wire
1	U	Motor phase U
2	V	Motor phase V
3	W	Motor phase W
4	(-)	

- Encoder/brake connector [JST S11B-XASK-1]

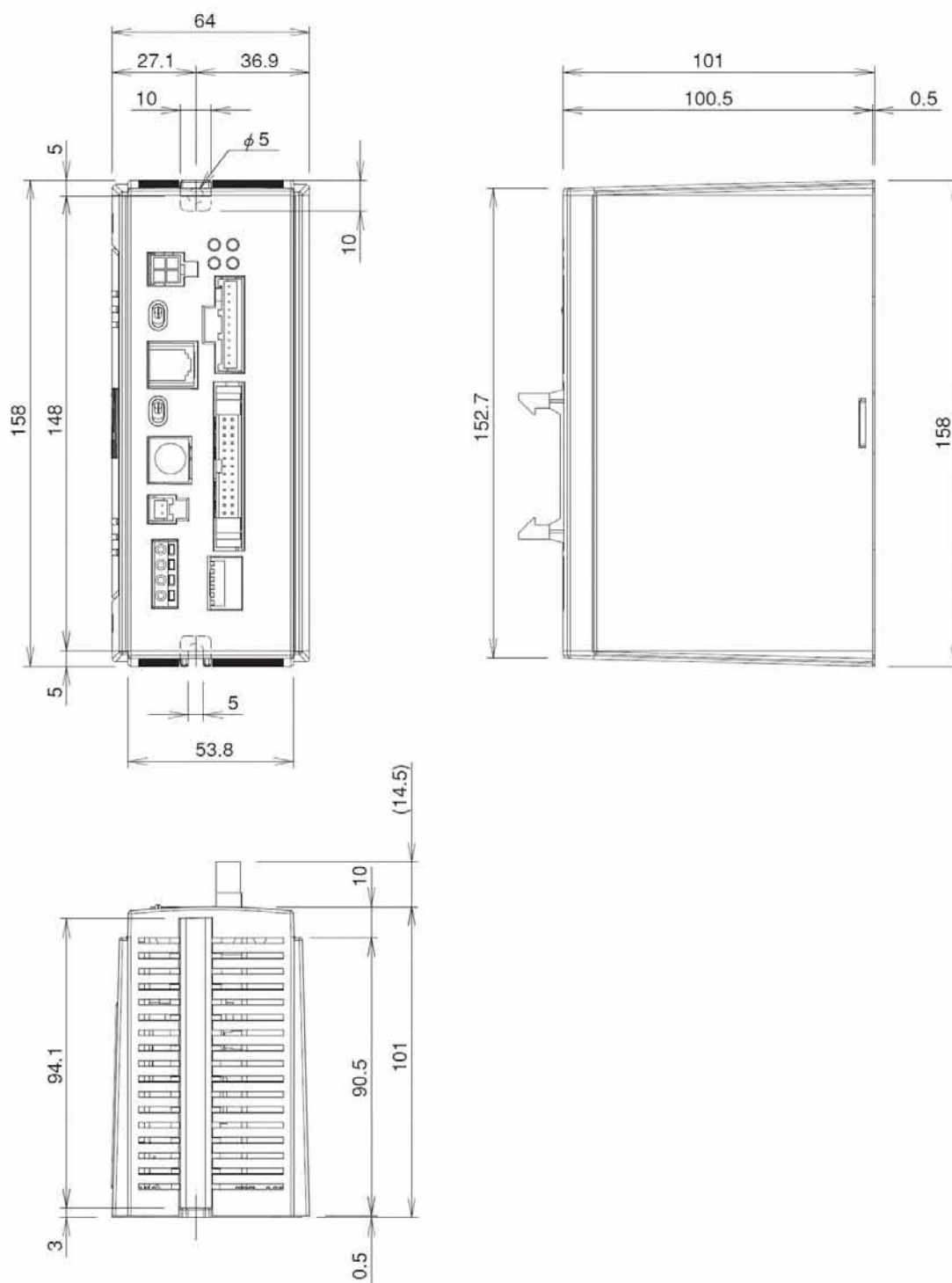
Pin No.	Signal name	Connected wire
1	EN A+	Encoder A+
2	EN B+	Encoder B+
3	EN Z+	Encoder Z+
4	EN Z-	Encoder Z-
5	SD+	Encoder SD+
6	SD-	Encoder SD-
7	EN 5V	Encoder 5V+
8	EN GND	Encoder COM-
9	BK N	Brake-
10	BK P	Brake+
11	FG	Shield

- Power/emergency-stop terminal block [Sato ML-800S IH (4P)]

Signal name	Connected wire
	These terminals are connected to the emergency stop circuit. 24 V is output to [1]. (These terminals have been shorted prior to shipment.)
24 V	Positive side of the 24-V power supply
N	Negative side of the 24-V power supply

24 V and ENG [1] are connected internally.

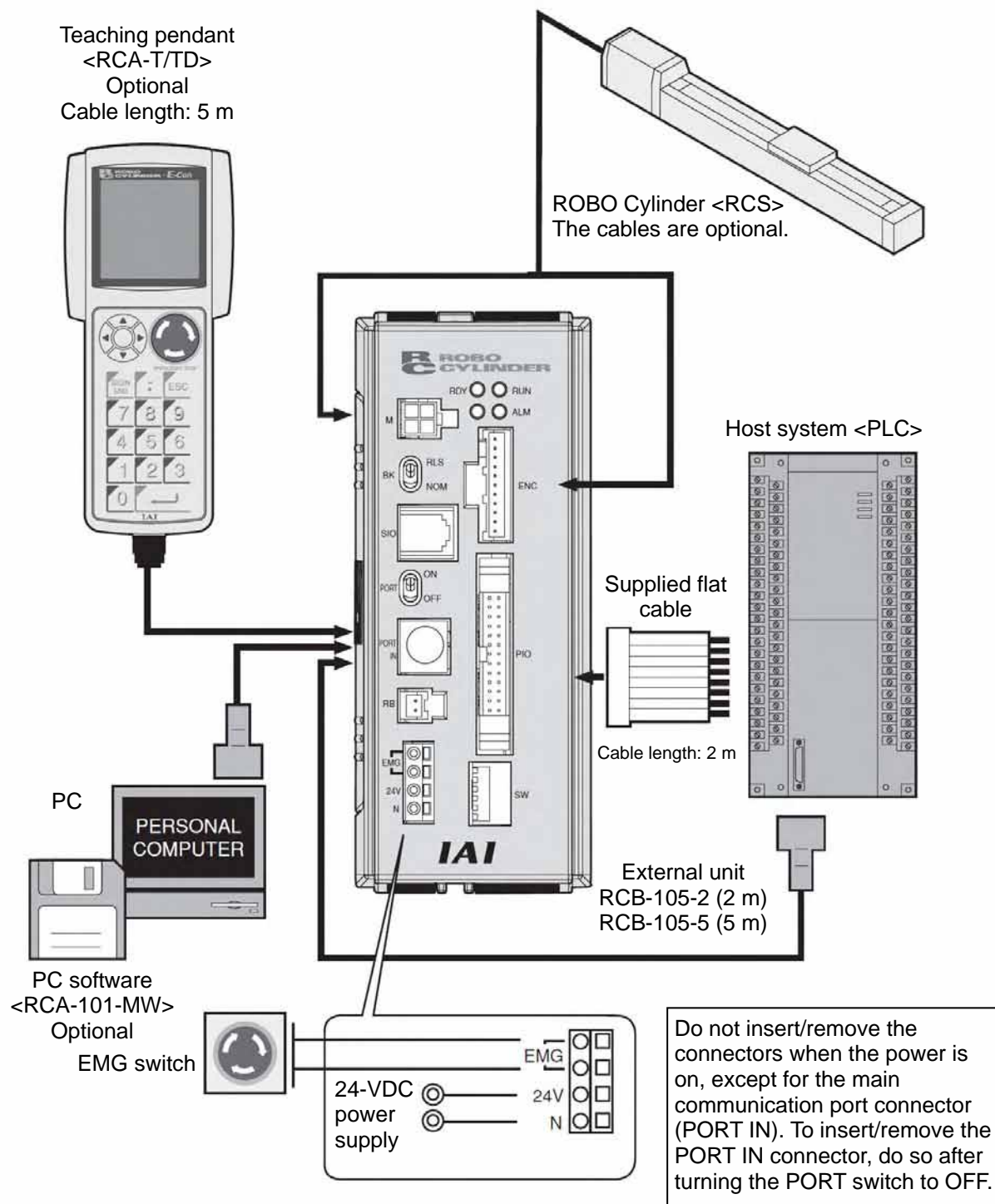
## 2.3 External Dimensions



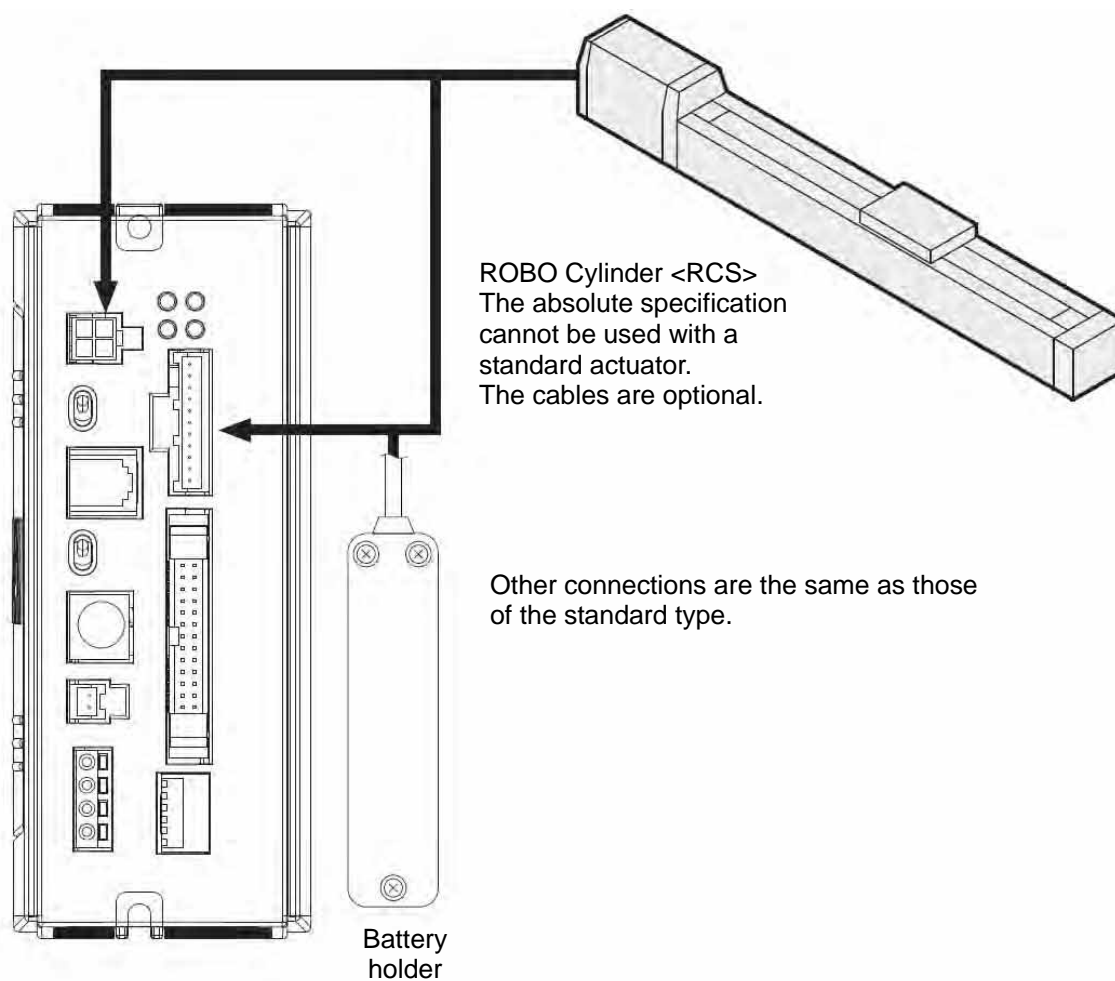


## 2.4 Connection Method

### 2.4.1 Standard Type

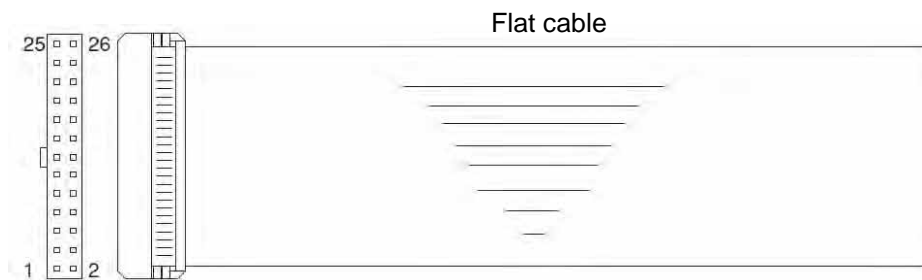


## 2.4.2 Absolute Specification



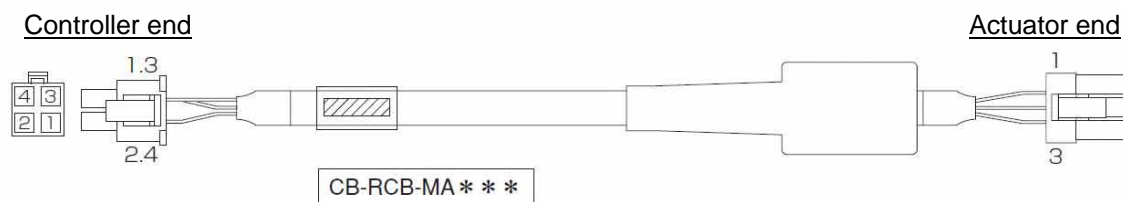
## 2.5 Supplied Cable

### 2.5.1 I/O Flat Cable



NO.	Signal	Color	NO.	Signal	Color
1	-	Brown-1	14	-	Yellow-2
2	-	Red-1	15	-	Green-2
3	Start	Orange-1	16	Completed position 1	Blue-2
4	Command position 1	Yellow-1	17	Completed position 2	Purple-2
5	Command position 2	Green-1	18	Completed position 4	Gray-2
6	Command position 4	Blue-1	19	Completed position 8	White-2
7	Command position 8	Purple-1	20	Position complete	Black-2
8	-	Gray-1	21	Home return completion	Brown-3
9	-	White-1	22	Zone	Red-3
10	*Pause	Black-1	23	* Alarm	Orang-3
11	Reset	Brown-2	24	*Emergency stop	Yellow-3
12	Servo ON	Red-2	25	Moving	Green-3
13	-	Orange-2	26	-	Blue-3

### 2.5.2 Motor Extension Cable



Cable color	Signal abbreviation	Pin No.
Red	U	1
White	V	2
Black	W	3
—	—	4

Receptacle: 5557-04R (Molex)  
Female terminal: 5556-TL (Molex)

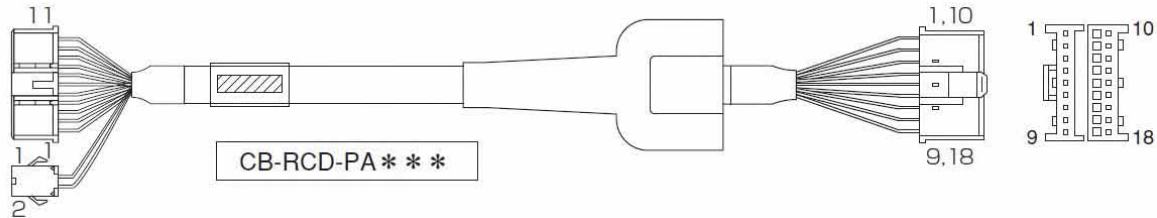
Pin No.	Signal abbreviation	Cable color
1	U	Red
2	V	White
3	W	Black

Plug housing: SLP-03V (JST)  
Socket contact: BSF-21T-P1.4 (JST)

## 2.5.3 Encoder Extension Cable

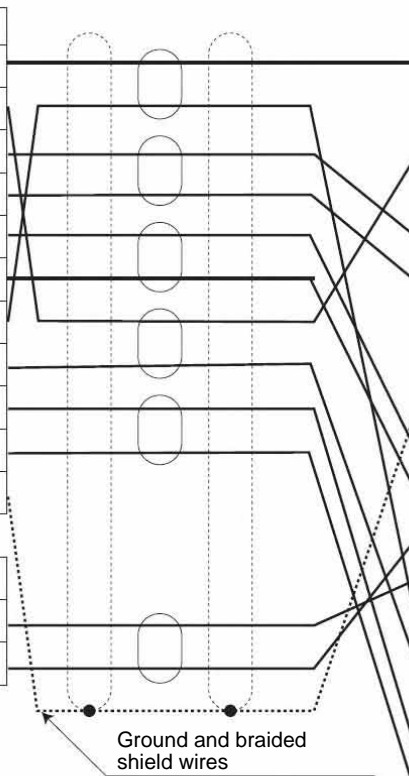
Controller end

Actuator end



Cable color	Signal abbreviation	Pin No.
Pink	A/U	1
White	B/V	2
Orange/white	Z/W	3
Green/white	$\bar{Z}/\bar{W}$	4
Blue	SD	5
Orange	$\bar{S}\bar{D}$	6
Purple	VCC	7
Blue/red	GND	8
Gray	BK—	9
Red	BK+	10
Ground	FG	11

Cable color	Signal abbreviation	Pin No.
	BAT—	1
	BAT+	2



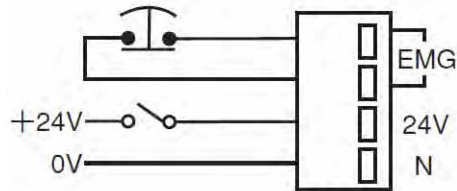
Pin No.	Signal abbreviation	Cable color
1	A/U	Pink
2	$\bar{A}/\bar{U}$	—
3	B/V	White
4	$\bar{B}/\bar{V}$	—
5	Z/W	Orange/white
6	$\bar{Z}/\bar{W}$	Green/white
7	—	—
8	—	—
9	FG	Ground
10	SD	Blue
11	$\bar{S}\bar{D}$	Orange
12	BAT+	Black
13	BAT—	Yellow
14	VCC	Purple
15	GND	Blue/red
16	—	—
17	BK—	Gray
18	BK+	Red

Plug housing: SMP-02V-BC (JST)  
Socket contact (gold plated): SHF-001T-0.8BS (JST)

Plug housing: XMP-18V (JST)  
Socket contact: BXA-001T-P0.6 (JST)  
Retainer: XMS-09V (JST)

## 2.6 Wiring

### 2.6.1 Wiring for Power Supply/Emergency Stop



Power/emergency-stop terminal block

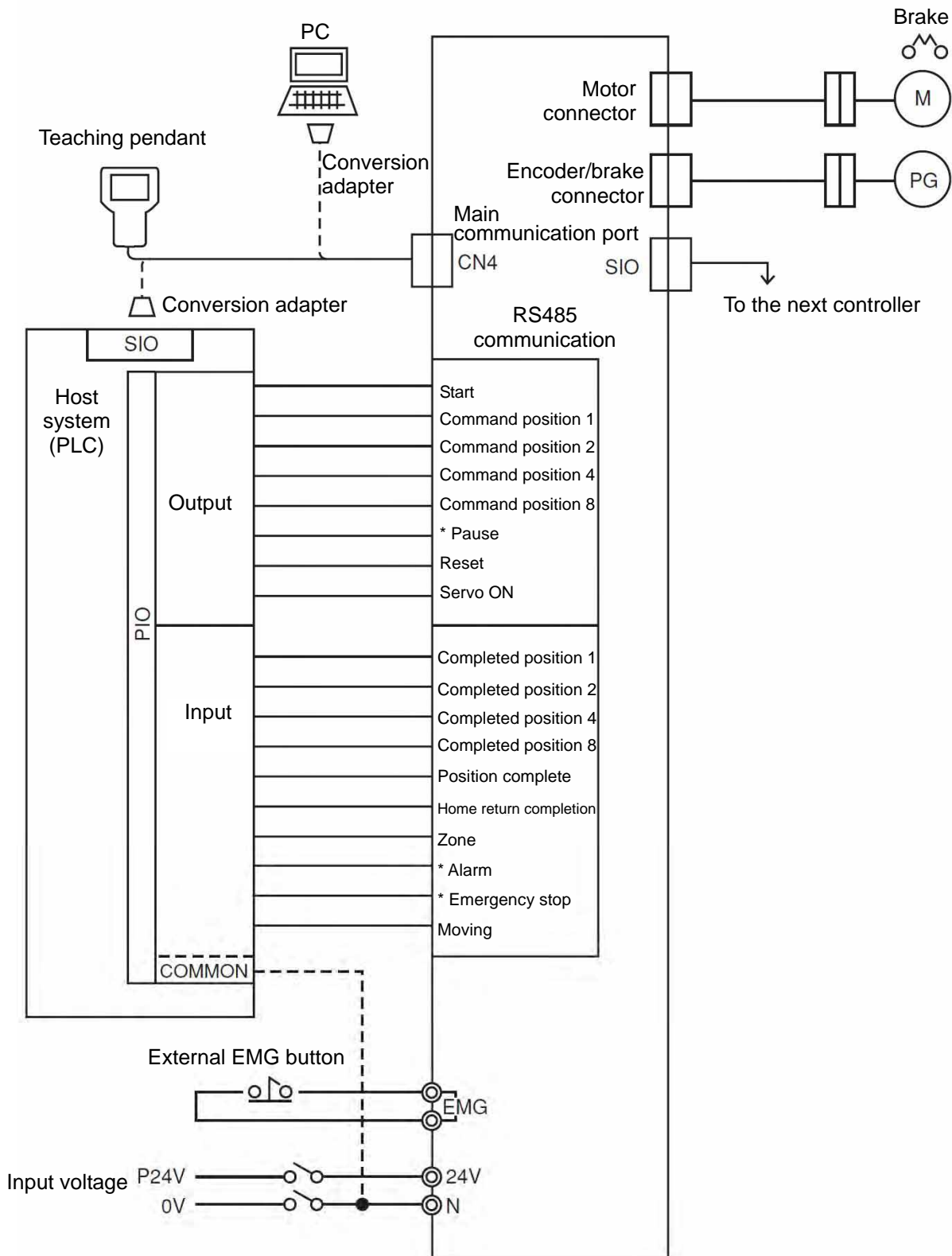
- \* The two EMG terminals are contact-b inputs used for connecting an emergency-stop switch. The controller is shipped with these terminals shorted, so that an emergency stop will not be actuated.

Note: When performing power connection, make sure the following specifications for power cable, etc., are satisfied.

Applicable cable	Single wire --- $\varnothing$ 1.0 (AWG18) Stranded wire --- 0.75 mm <sup>2</sup> (AWG18)
Allowable wire size	Single wire --- $\varnothing$ 0.4 (AWG26) to $\varnothing$ 1.2 (AWG16) Stranded wire --- 0.3 mm <sup>2</sup> (AWG22) to 1.25 mm <sup>2</sup> (AWG16) Element wire diameter --- $\varnothing$ 0.18 or larger
Standard stripped-wire length	11 mm
Button operation tool	Flathead screwdriver (shaft diameter $\varnothing$ 3, blade tip width 2.6)

Note: This controller has no power switch.

## 2.6.2 External Connection Diagram



(Note) \*Pause, \*Alarm and \*Emergency stop are contact-b signals.

### 2.6.3 PIO Interface

A PIO interface list is given below.

The PIO cable is a flat cable with no connector attached on the end connected to the external equipment.

PIO connector (26 pins)

Pin No.	Category	Signal name		Cable color
1	Input	Not used	Do not connect anything to this terminal.	Brown-1
2				Red-1
3		Start	Input for movement start signal	Orange-1
4		Command position 1	Input the position number you want to select. [1]	Yellow-1
5		Command position 2		Green-1
6		Command position 4		Blue-1
7		Command position 8		Purple-1
8		Not used	Do not connect anything to this terminal.	Gray-1
9				White-1
10		[2] * Pause	The moving actuator is paused.	Black-1
11		[3] Reset	Alarms are set.	Brown-2
12		[4] Servo ON	The servo is turned on.	Red-2
13		Not used		Orange-2
14	Output	Not used	Do not connect anything to this terminal.	Yellow-2
15			Do not connect anything to this terminal.	Green-2
16		Completed position 1	The position number to which the positioning has completed is output. [5]	Blue-2
17		Completed position 2		Purple-2
18		Completed position 4		Gray-2
19		Completed position 8		White-2
20		[6] Position complete	This signal is output upon completion of movement.	Black-1
21		[7] Home return completion	This signal is output upon completion of home return.	Brown-3
22		Zone	This signal is output within the range set by parameters.	Red-3
23		[8] * Alarm	This signal is output when a controller error is detected.	Orange-3
24		[9] *Emergency stop	This signal is output when an emergency stop is actuated.	Yellow-3
25		[10] Moving	This signal is output while the motor is running.	Green-3
26	Not used		Do not connect anything to this terminal.	Blue-3

Model number of controller-end connector: Hirose HIF6-26 PA-1.27DS

Note: Note: The ports denoted by \* operate on the negative (contact-b) logic. Never connect the signal of any of these ports to an unused port.

- [1] Command position  
Relationship of input pin numbers and selected position numbers (4-bit binary)

One of 16 positions from 0 to 15 can be input/selected.

1: ON    0: OFF

Pin No.	4	Command position 1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	5	Command position 2	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	6	Command position 4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	7	Command position 8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Selected position No.			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

**Note:** The actuator will not operate if the start input is turned ON after selecting a position number for which no position data is entered. (A bank 31 error (alarm code: 0B1) will occur.)

- [2] Pause  
This is a contact-b input. Keep the signal ON while the actuator is moving, and cause it to turn OFF when the movement pauses.
- [3] Reset  
An alarm will be reset once a rise of this signal is detected. If the cause of the alarm is not yet removed, the alarm will come back after the reset action. (Only the overcurrent alarm)  
When this signal is input while the actuator is in pause, the remaining travel will be cancelled.
- [4] Servo ON  
The servo is ON while this signal is ON.
- [5] Completed position  
All completed position signals will turn OFF the moment the position complete signal turns OFF.  
All completed position signals remain OFF while an emergency stop is actuated or during the direct teaching mode.  
When the controller returns to the ready mode thereafter, the completed position signal corresponding to the current actuator position will be output if the current actuator position is within the positioning band from the last position complete position. If the current actuator position is outside the positioning band, all completed position signals will remain OFF.  
In the push & hold mode, all completed position signals will remain OFF when the controller returns to the ready mode from an emergency-stop status or the direct teaching mode, regardless of the current actuator position.  
When an alarm occurs, a corresponding alarm code (short form) is output by the four bits of completed positions 1, 2, 4 and 8. The meanings of these signals vary in a normal state and when an alarm is present, so exercise caution when writing a sequence program. (Refer to 6.3, "PIO Alarm Outputs.")
- [6] Position complete  
This signal will turn ON when the controller becomes ready following a power connection. It will turn OFF when a start signal is input, and turn ON when a movement is completed



[7] Home return completion

This signal will turn ON when the initial home return is completed after a power connection. Thereafter, an alarm generated and this signal will remain ON until the power is turned off. It will not turn OFF following an emergency-stop signal input.

If the home return completion signal is OFF, it means home return will be performed before the next movement operation.

<p>Note: With the absolute specification, once the home position has been taught the home return complete signal will turn ON every time the power is turned on. If the home return complete signal turns OFF due to an alarm, the home position must be taught again.</p>
--

[8] Alarm

This signal will turn OFF when an alarm occurs. It remains ON as long as the controller is operating properly. To reset an alarm, remove the cause of the alarm, and then input a reset signal or reconnect the power.

[9] Emergency stop

This signal will turn OFF when an emergency stop is actuated. It remains ON as long as the controller is operating properly.

When the emergency stop is cancelled, the signal will turn ON.

[10] Moving

After the actuator starts moving, the start signal will turn OFF once this signal turns ON.

Use this signal if you want to detect stopping of the motor during pause.

## 2.6.4 Non-isolated External I/O Specification

### Input Part

Item	Specification
Number of inputs	8 points
Input voltage	24 VDC $\pm$ 10%
Input current	7 mA/1 circuit
Operation voltage	ON voltage --- 18 V min. OFF voltage --- 6 V max.
Isolation method	Not isolated

### Output Part

There are two specifications for the output part, namely Group 1 and Group 2.

Group 1: Output circuit based on TD62084 (or equivalent) (8 points)

Item	Specification
Signal name	Complete positions 1, 2, 4, 8, positioning complete, home return complete, zone, alarm
Rated load voltage	24 VDC (built-in flywheel diode)
Rated load current	40 mA/1 point
Recommended load current	20 mA/1 point
Leak current	0.1 mA (max.)
Residual voltage	3.1 V/40 mA (max.)
Isolation method	Not isolated
Overcurrent protection	47- $\Omega$ , 0.1-W fuse resistance

Group 2: 100-mA output circuit based on MOSFET (2 points)

Item	Specification
Signal name	Emergency stop, moving
Maximum output voltage	60 V (peak) (Open drain, no flywheel diode)
Maximum load current	100 mA/1 point
Residual voltage	1.1 V/100 mA
Isolation method	Not isolated
Overcurrent protection	10- $\Omega$ , 0.1-W fuse resistance



### 3. Data Entry <Basics>

This controller doesn't use command words, so there is no need to create a program.

All you need is to enter position data in the position-data table, and the actuator will move to the specified position.

Position data consists of number (No.), position (Position), speed (Speed), acceleration/deceleration (ACC), push (Push), positioning band (Pos. band), and acceleration only MAX (ACC MAX). The description in parentheses is as displayed on the teaching pendant.

Position data can be specified in two different modes: by absolute coordinate specification (absolute mode) in which the distance from the home is entered, or by relative coordinate specification (incremental mode) in which the incremental movement from the current position is entered.

Position-data table

No.	Position <small>Note</small>	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	0	100	0.3	0	0.1	0
1	30	100	0.3	0	0.1	0
2	10	100	0.3	0	0.1	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
15	100	100	0.3	0	0.1	0

When data is entered in the position column of the position-data table, the default values will be automatically entered in the remaining columns. Change the default values as necessary.

To change a default value, change the corresponding parameters starting with "Default."

The default values vary depending on the actuator type.

This indicates that the incremental mode is active. (This symbol is displayed only on the teaching pendant. Separate columns for incremental specification are provided in the PC software.)

**Note:** Enter position data first. Any attempt to enter other data before position data will be rejected. You can enter position data containing two decimal places. However, the controller only recognizes position data as a multiple of its minimum resolution. The minimum resolution of the controller varies depending on the actuator lead. For the above reason, the second decimal place in the entered position data may be rewritten in accordance with the actuator lead.  
Example: Entered value      Stored value  
                 50.01      →      50.03

## 3.1 Description of Position-Data Table

(1) No.

- Indicate the position data number.  
To enter an incremental movement, press the minus key in this column.  
On the teaching pendant, a “=” will be displayed between the number and position columns.  
The minus key need not be pressed in the absolute mode.

(2) Position (Position)

- Enter the target position to move the actuator to, in [mm].  
Absolute mode: Enter the distance to the target actuator position from the home. Negative values cannot be entered.  
Incremental mode: Enter the distance to the target actuator position from the current position. A negative value can also be entered (for movement in the negative direction along the displayed coordinate axis).

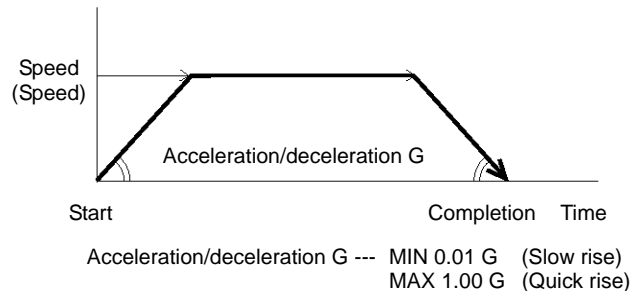
No.	Position		
0	30	Absolute mode	30 mm from the home
1	= 10	Incremental mode	+10 mm from the current position
2	= -10	Incremental mode	-10 mm from the current position
3	100	Absolute mode	100 mm from the home

(3) Speed (Speed)

- Enter the speed at which the actuator will be moved, in [mm/sec].  
The default value varies depending on the actuator type.

(4) Acceleration/deceleration (ACC)

- Enter the acceleration/deceleration at which the actuator will be moved, in [G].  
The acceleration should basically conform to the rating specified in the catalog.  
With RCS controllers, an acceleration level above the rating can be used to shorten the tact time only if the actuator is used in a condition where “the payload is significantly smaller than the rated loading capacity.”  
To deal with this situation, the “Acc” field in the position table allows for input of values greater than the rated acceleration.



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

## (5) Push (Push)

- Select the positioning mode or push & hold mode.  
The default value is "0."  
0: Positioning mode (= Normal operation)  
Other than 0: Push & hold mode [%]
- In the push & hold mode, enter the current-limiting value to be applied to the servo motor while the load is being pushed. With the RCS, set the current-limiting value to approx. 70%. The controller will not operate properly if this value is 30% or below.

The table on page 33 lists the push force at standstill for each controller type when the current-limiting value is set to 70%. Be sure to reference this table to set an appropriate value for your controller.

Note: If the push force is too small, a false detection of push & hold condition may occur due to slide resistance, etc., so exercise caution.

## (6) Positioning band (Pos. band)

- The function of the positioning band varies depending on whether the push & hold setting in (5) is "0" or "other than 0."  
[A] Push = 0 (Positioning mode)
- In the positioning mode, enter the position-complete detection width (distance to the target position), in [mm].
- The distance to the target position indicates the range prior to the target position, upon entry of the actuator in which range a position complete signal will be output.  
The default value is "0.1 [mm]" (Fig. A).  
[B] Push = Other than 0 (Push & hold mode)
- Enter the maximum push amount (distance from the target) in the push & hold mode, in [mm] (Fig. B).
- If the push direction corresponds to the negative direction along the displayed coordinate axis, add a – (minus) sign to the entered value.

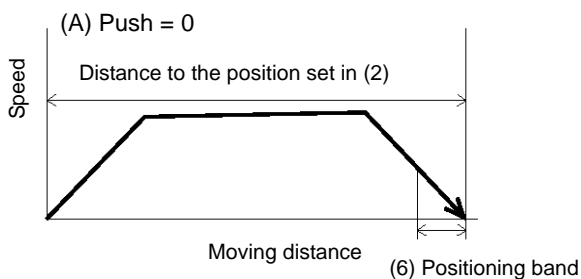


Fig. A

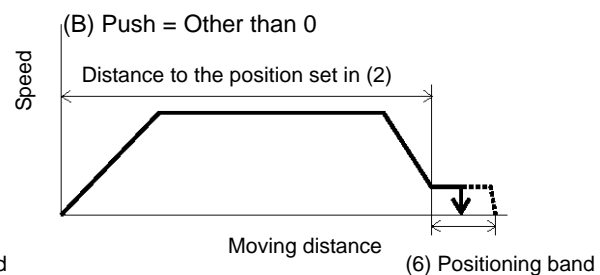


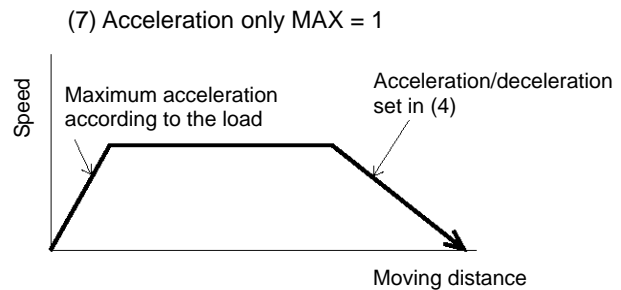
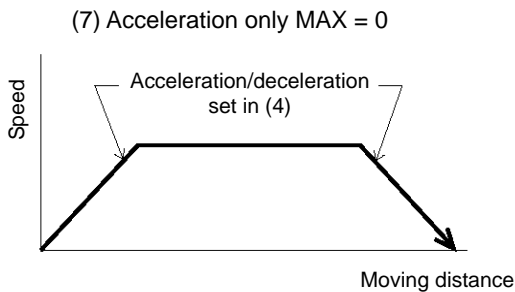
Fig. B

## (7) Acceleration only MAX (ACC MAX)

- Select the specified acceleration or maximum acceleration by entering "0" or "1."

The default value is "0."

- 0: Specified acceleration --- The value entered in (4) becomes the actual acceleration/deceleration.
- 1: Maximum acceleration --- The maximum acceleration set according to the load is used.  
The deceleration conforms to the value entered in (4).



**Caution:** As a rough guide, enable the acceleration only MAX setting when the actual payload is no more than one-third of the rated loading capacity. Check the rated loading capacity of your actuator by referring to the supplied specification list of supported actuators.

### 3.1.1 Push Force at Standstill

In the push & hold mode, enter a current-limiting value (%) in the position-data table under “Push.”  
 With the RCS, use a push force at standstill corresponding to a current-limiting value of approx. 70%.  
 The push force at standstill can be increased or decreased by increasing or decreasing the current-limiting value.  
 However, take note that the controller will not operate properly if the current-limiting value is 30% or below.  
 The table below lists the push force at standstill for each controller type when the current-limiting value is set to 70%.

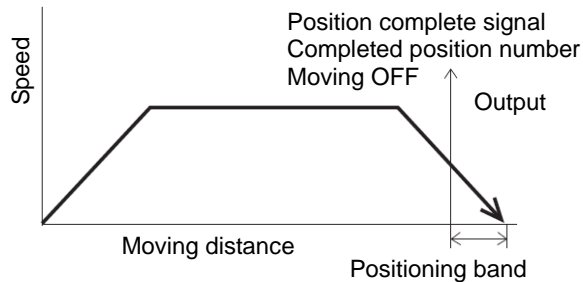
	Type	Motor (W)	Speed type	Push force (N (kgf))
Rod type	RA35	20	L	95 (9.7)
			M	47 (4.8)
			H	23 (2.4)
	RA45	30	L	142 (14.5)
			M	70 (7.2)
			H	35 (3.6)
	RB7525	60	M	143 (14.6)
			H	71 (7.3)
	RB7530	60	L	238 (24.3)
			M	118 (12.1)
			H	59 (6.1)
Flat type	F45	30	M	198 (20.2)
			H	99 (10.1)
			L	142 (14.5)
			M	70 (7.2)
			H	35 (3.6)

Note: The accuracy of push force at standstill is not guaranteed. The values are provided for reference purposes only.



## 3.2 Explanation of Modes

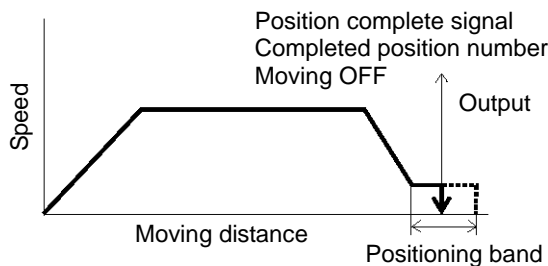
### 3.2.1 Positioning Mode Push = 0



- (1) The position complete output will turn ON and moving output will turn OFF at a position preceding the target position by the positioning band. A completed position number signal will be output at the same time.

### 3.2.2 Push & Hold Mode Push = Other than 0

- (1) Load was contacted successfully



- (1) After reaching the target position, the actuator will move at low speed. When the Pos. band set in the data table (see Note) is reached after the actuator contacts the load and the servo motor current has reached the current-limiting value, the position complete output will turn ON. A completed position number signal will be output at the same time. The moving output will turn OFF.

Note: The time set in the parameter “Push & hold stop judgment period.” The default value of “255 msec” is already entered.

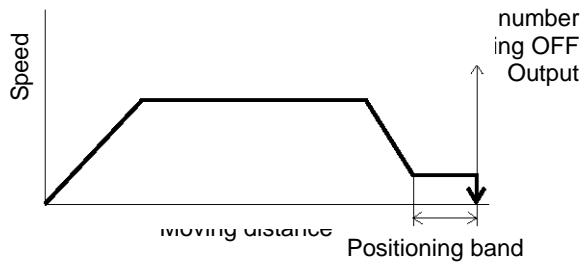
The actuator is holding the load in position while pushing it.

The actuator continues to push the load at the push force at standstill determined by the current-limiting value. Since the actuator is not inactive, exercise due caution when handling the machine in this condition.

The push speed is set as follows in accordance with the speed set in the position-data table:

	Set speed	
	20 mm/sec or more	Less than 20 mm/sec
Push speed	20 mm/sec	Set speed

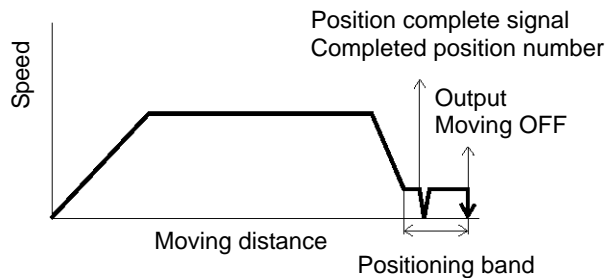
## (2) Load was not contacted (missed)



- (1) After reaching the target position, the actuator will move at low speed. Even after contacting the load, the actuator will move to the end of the positioning band if the servo motor current is yet to reach the current-limiting value. The position complete output will not turn ON even when the end of the positioning band is reached. In this case, only the completed position number will be output. The moving output will turn OFF. Check if the load has stopped moving based on whether the moving output has turned OFF.

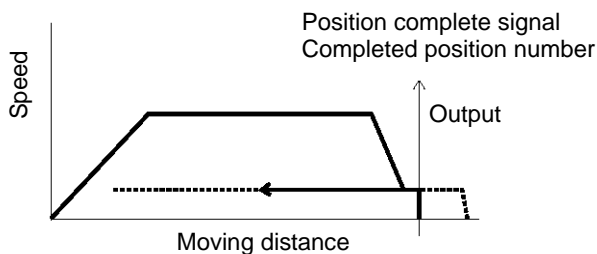
## (3) Load moves during push & hold operation

### [1] Load moves in the pushed direction



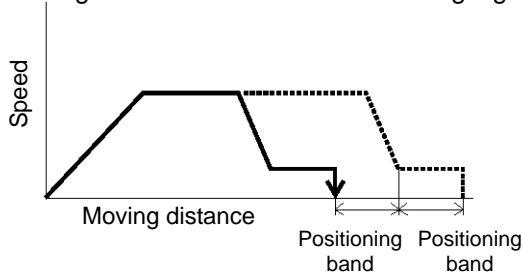
If the load moves in the pushed direction after the position complete output has turned ON (moving has turned OFF), the actuator will push the load within the positioning band. The moving output will turn ON. The position complete output will remain ON and the completed position number will be output continuously. Once the load stops moving, the moving output will turn OFF.

### [2] Load moves in the opposite direction from the push force (Actuator is pushed back by the reactive force of the load)



If the actuator is pushed back after the position complete output has turned ON because the actuator thrust is smaller than the reactive force of the load, the actuator will be pushed back all the way until its thrust balances out with the reactive force of the load. The position complete output will remain ON and the completed position number will be output continuously. The moving output will remain ON until the load stops moving.

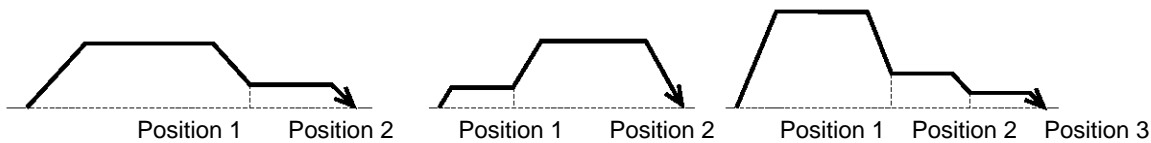
(4) Positioning band was entered with a wrong sign



If the positioning band is entered with a wrong sign, the position will deviate by twice the positioning band, as shown to the left, so exercise due caution.

### 3.2.3 Speed Change during Movement

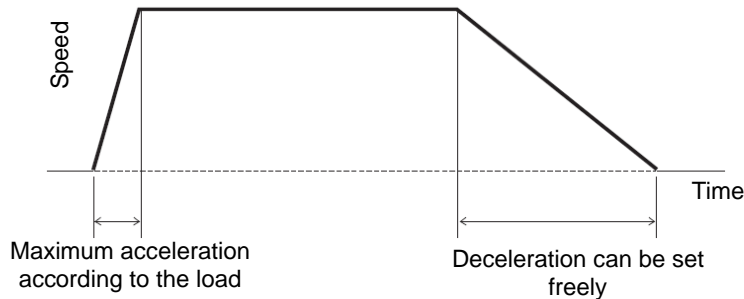
Speed control involving multiple speed levels is possible in a single operation. The actuator speed can be decreased or increased at a certain point during movement. However, the position at which to implement each speed change must be set.



### 3.2.4 Operation at Different Acceleration and Deceleration Settings

The actuator will accelerate and decelerate at different speeds if “1” is entered under “Acceleration only MAX” in the position data.

The acceleration corresponds to the maximum acceleration. The deceleration is the value input in the “Acc/Dec” field of the position data table.



**Caution:** Although the specific value differs depending on the actuator, the maximum acceleration cannot be more than three times the rated acceleration. Accordingly, this function should be enabled only when the payload is no more than one-third of the rated loading capacity and the actuator needs to be stopped gradually at slow deceleration. If this function is enabled when the payload is equivalent to the rated loading capacity, an overload error may occur. Even if an overload error does not occur, the actuator will still receive excessive impact loads that may negatively affect the life of the actuator. Therefore, exercise due caution when enabling this function. Check the rated loading capacity of your actuator by referring to the supplied specification list of supported actuators.

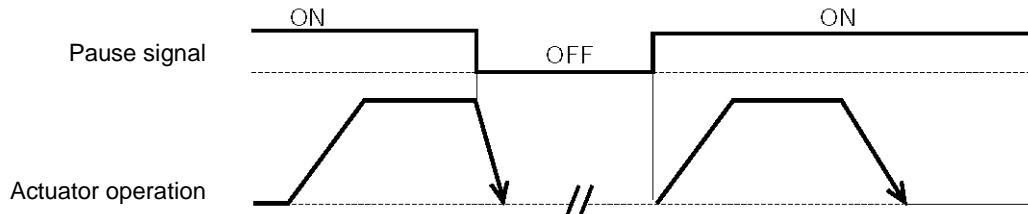
## 3.2.5 Pause

This signal can be used to stop the actuator in case of emergency.

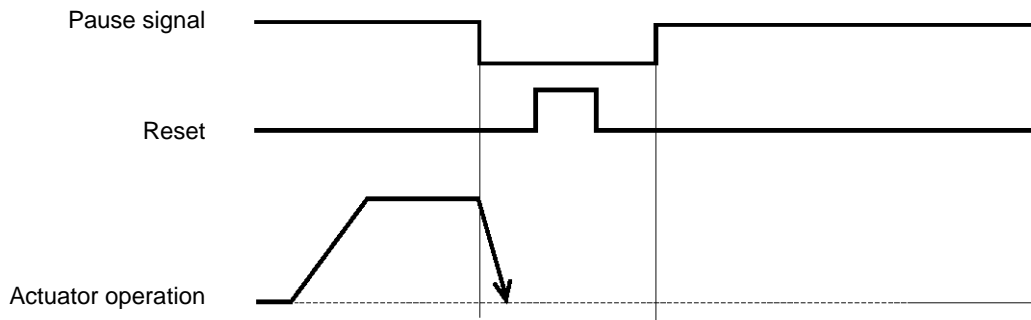
The movement of the actuator can be paused via an external input signal (pause).

For safety reasons, this signal is provided as a contact-b input (based on the negative logic).

The actuator will decelerate to a stop when the pause input is turned OFF, and resume movement when the pause input is turned ON.



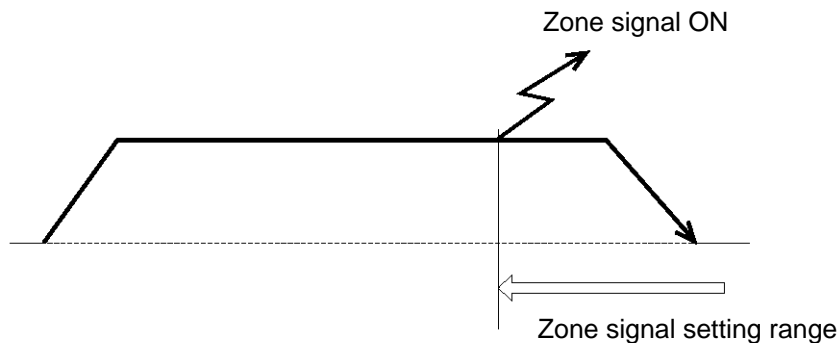
The remaining movement of the actuator can be cancelled by turning ON the reset input during pause (the movement will be cancelled upon rise of the reset input signal).



## 3.2.6 Zone Signal Output

This signal is output while the actuator is moving inside a specified zone (the zone can be set in a desired position).

By setting a zone signal in the applicable parameter beforehand, you can cause the zone signal to turn ON when the actuator enters the specified zone (the zone can be set in any position, even at the center of the stroke).



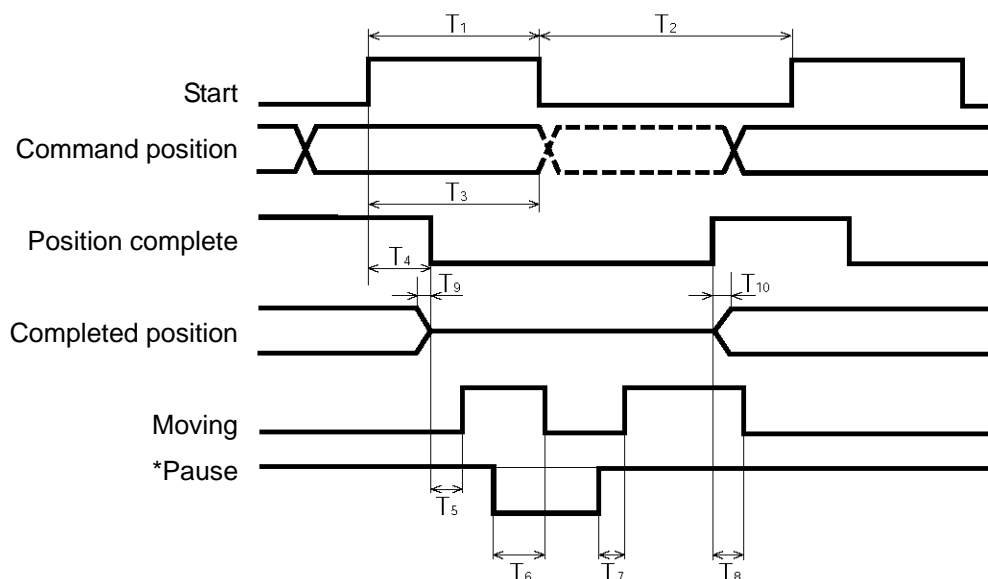
## 3.2.7 Home Return

With the standard specification, home return must be performed after the power has been input or an encoder open or CPU error alarm has been reset. Selecting a position number and then initiating a start will cause the controller to automatically perform home return before commencing the subsequent operation. Once home return is complete, the home return completion output will turn ON (standard specification).

Home return alone cannot be performed using PIO. To move the actuator to the home position in a normal condition, set a position number for which "0" is set in the position-data table under "Position," and then issue a movement command to that position.

With the absolute specification, home return is not necessary after the power has been input, as long as an absolute reset was performed once.

## 3.3 Timing Chart



Acc/dec	Description	Minimum	Maximum
T1	Start ON minimum duration	4 msec	–
T2	Start OFF minimum duration	4 msec	–
T3	Start ON → Command position hold time	6 msec	–
T4	Start ON → Position complete OFF delay	–	7 msec
T5	Position complete OFF → Moving ON delay	–	1 msec
T6	Pause OFF → Moving OFF delay	–	*1
T7	Pause ON → Moving ON delay	–	6 msec
T8	Position complete ON → Moving OFF delay	–	2 msec
T9	Completed position OFF → Position complete OFF delay	0.1 msec	1 msec
T10	Position complete ON → Completed position output delay	0.1 msec	1 msec

\*2

\*1: The maximum value will vary depending on the acceleration/deceleration.

\*2: After the position complete signal turned ON, wait for at least the sequencer's scan time before checking the completed position.

## 4. Using the Controller <Practical Steps>

### 4.1 How to Start (Standard Type)

(Refer to 4.2, "How to Execute An Absolute Reset," for the absolute specification.)

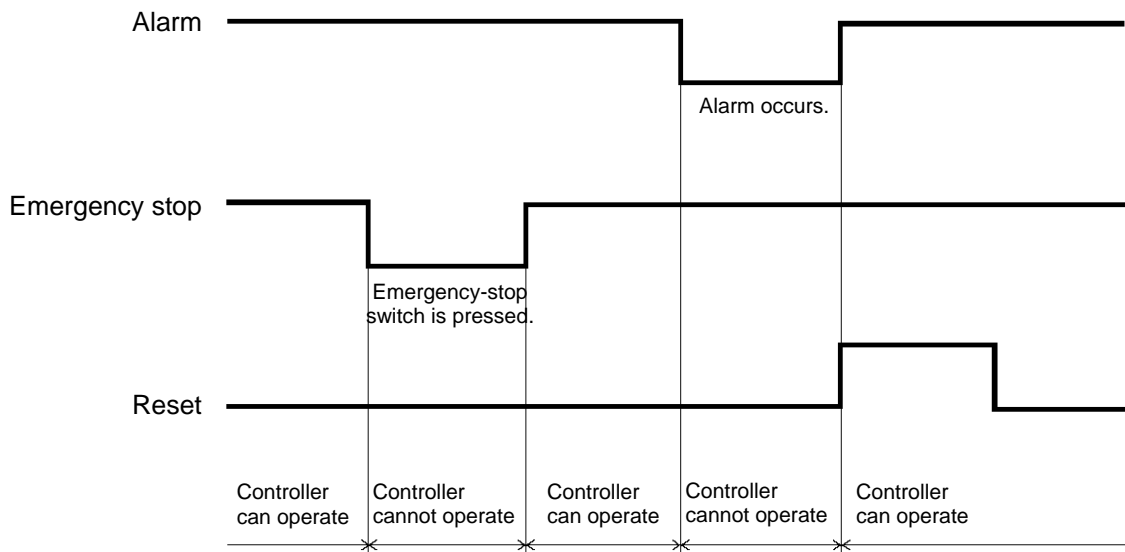
- (1) Confirm that both Nos. 5 and 6 of piano switch are set to OFF. If these switches are set to ON, tilt them back to the OFF positions.
- (2) Connect the motor/brake cables and encoder cable to the controller.
- (3) Connect the host PLC to the PIO connector using the supplied flat cable.
- (4) If two or more axes are connected, set the necessary items using the piano switches. For details, refer to "Names and Functions of Parts."
- (5) Supply the main power to the controller's terminal block.
- (6) Turn ON the pause and servo ON inputs at the PIO connector.
- (7) The controller is working properly if the RDY LED is lit. If the ALM LED is lit, there is an error. Refer to the alarm table and take an appropriate action.

Note: PIO inputs/outputs must be issued after the position complete signal turns ON following the power ON.

The controller is ready once the above operation is completed.

#### 4.1.1 When the Controller Can/Cannot Operate

- (1) The moment the power is turned on, the servo turns on. When the controller becomes ready, the PIO position complete output will turn ON.
- (2) The following chart shows the timing relationships of the PIO alarm/emergency-stop outputs and controller's operating status.



## 4.2 How to Execute Absolute Reset (Absolute Specification)

Note) With the absolute specification, 0E5 (an encoder receive error) will occur when the power is turned on for the first time after the battery or PG cable was disconnected. This does not indicate fault. If this error occurs, execute an absolute reset by following the specified procedure.

The specific method to execute an absolute reset will vary depending on the controller version.

A label on which a serial number is printed is attached on the right side of the controller.

In the serial number, check the alphabet in the second digit from the last.

Example) SERIAL No. AD251031 J3

In this example, the controller version is "J."

An absolute reset is executed in different ways on controllers of version J\* or earlier (A\* to J\*) and controllers of version K\* or later (K\*, L\*, etc.) (\* indicates a number).

(If the controller version is K\* or later, perform home return from the teaching pendant or PC software when executing an absolute reset.)

### How to Execute an Absolute Reset on a SERIAL No. K\* or Later

- [1] Connect the motor cable and encoder/brake cables to the controller.
- [2] Connect the host PLC to the PIO connector using the supplied flat cable.
- [3] If two or more axes are connected using a controller link cable, set the address using the piano switches (SW) on the controller. For details, refer to 2.2, "Names and Functions of Parts," in this manual.
- [4] Connect the battery to the controller.
- [5] Turn ON piano switch (SW) No. 5 (fifth from the bottom) on the controller (by tilting it to the right).
- [6] Turn on the main controller power.
- [7] The ALM LED will illuminate.
- [8] Turn ON the pause and servo ON input signals at the PIO connector.
- [9] Input a reset signal via the PIO connector to reset the alarm.
- [10] Perform home return from the teaching pendant or PC software.
- [11] Turn switch No. 1 of the controller's piano switches 2 (SW2) to OFF (tilt to the left).

An absolute reset has been executed.

## How to Execute an Absolute Reset on a a SERIAL No. J\* or Earlier

- [1] Connect the motor and encoder/brake cables to the controller.
- [2] Connect the host PLC to the PIO connector using the supplied flat cable.
- [3] If two or more axes are connected, set the address using SW1 on the controller. For details, refer to "Names and Functions of Parts."
- [4] Move the actuator slider or rod to a position where it is in contact with the mechanical end on the home side.
- [5] Turn ON piano switch (SW) No. 5 on the controller (by tilting it to the right).
- [6] Turn on the main controller power.
- [7] The RDY LED will illuminate.
- [8] Turn OFF piano switch No. 5 on the controller.
- [9] Turn switch No. 1 of the controller's SW2 to OFF (tilt to the left). Note 1)  
An absolute reset has been executed. The home has been set several millimeters ahead of the current position (mechanical end) (the specific distance from the mechanical end will vary depending on the actuator model).
- [10] To operate the actuator right away, turn ON the PIO pause/servo ON inputs.

Note 1) If switch No. 5 of piano switch remains ON, the next time the power is turned on an absolute reset will be executed based on the actuator position at that time.

Note 1) The absolute RCS controller can be used only with absolute RCS actuators. It cannot be used with standard RCS actuators.

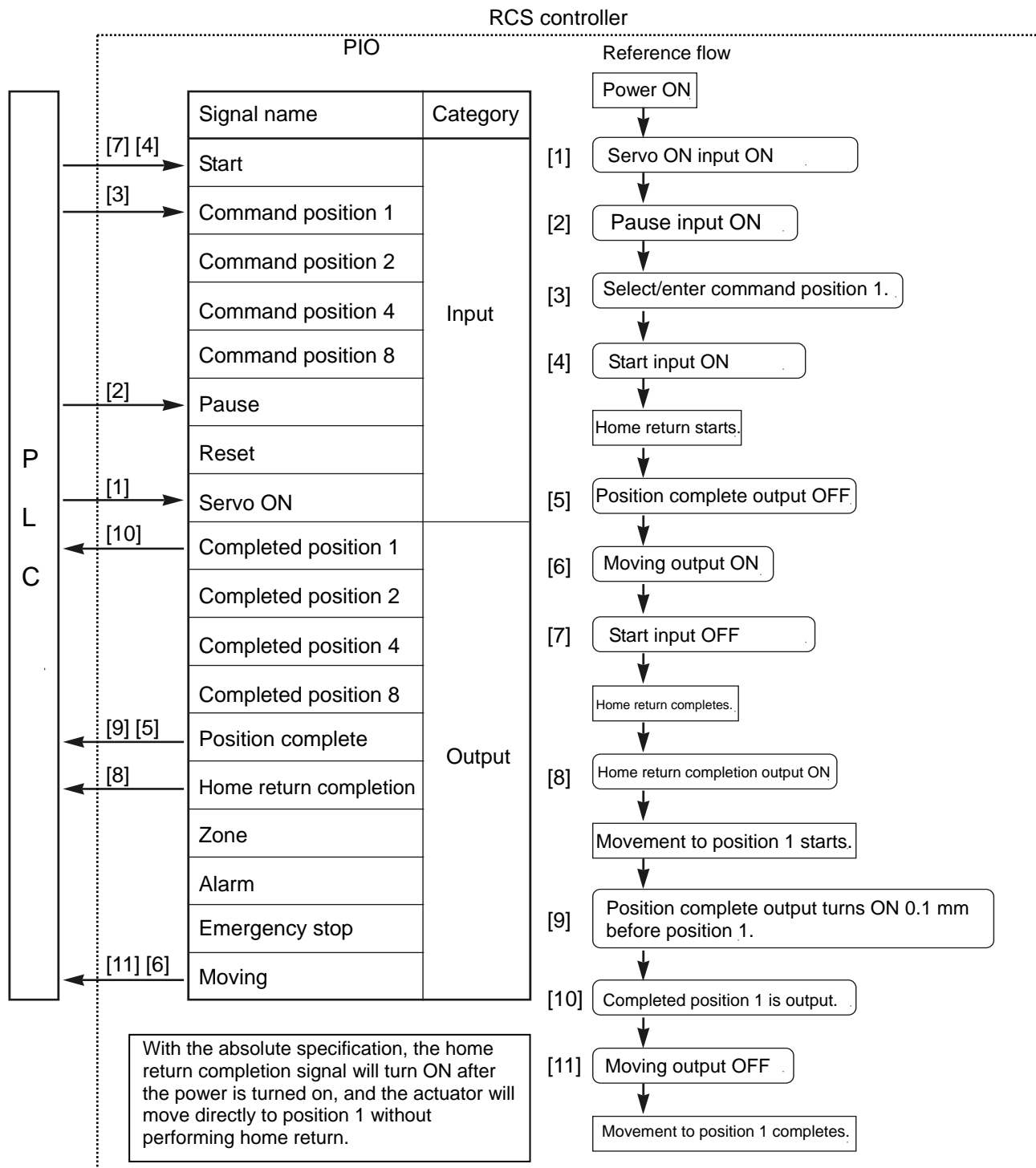


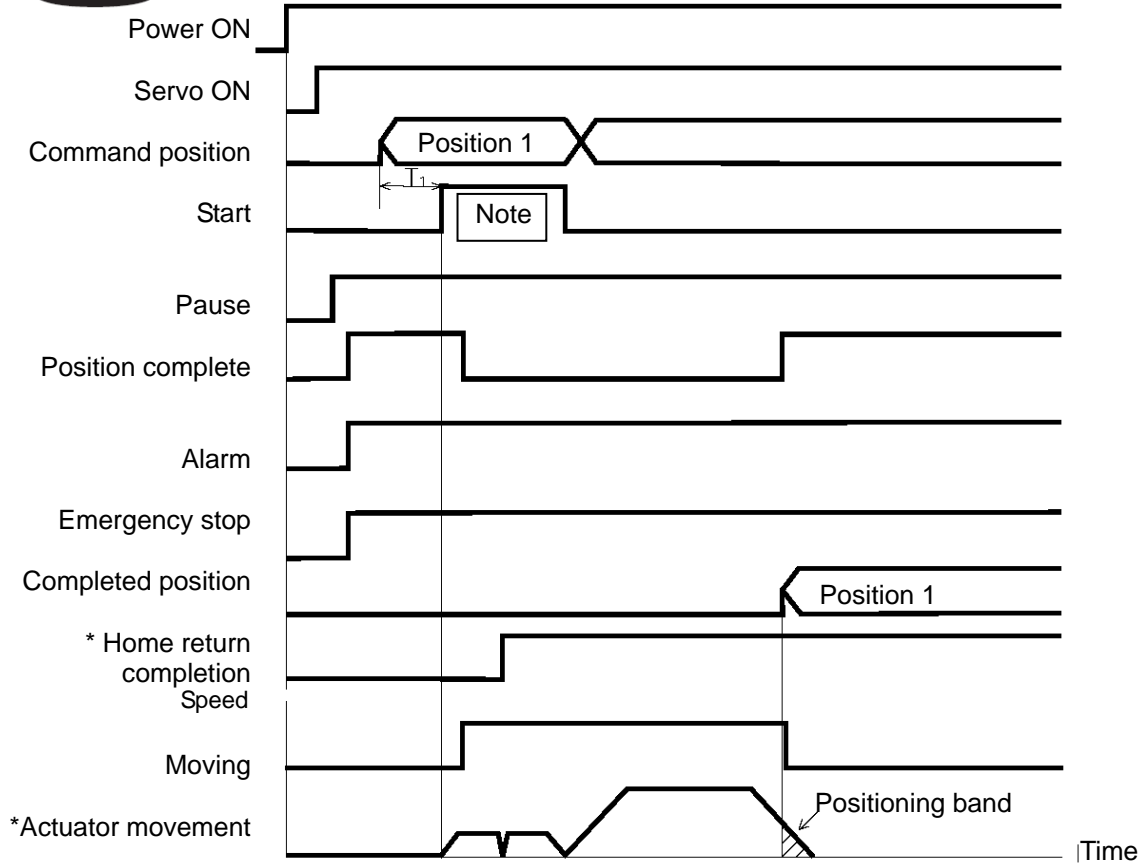
## 4.3 Movement after Power On (Standard Type)

Example of use in operation) After the power is turned on, move the actuator to the position 150 mm from the home at a speed of 200 mm/sec.

Position-data table (Field(s) within thick line must be entered.)

No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	0	100	0.3	0	0.1	0
1	150	200	0.3	0	0.1	0
...						





The position complete output will turn ON when the controller becomes ready following the power ON. (The position complete output will not turn ON if the servo ON input is OFF.)

To check if the controller is ready, always check if the position complete output is ON.

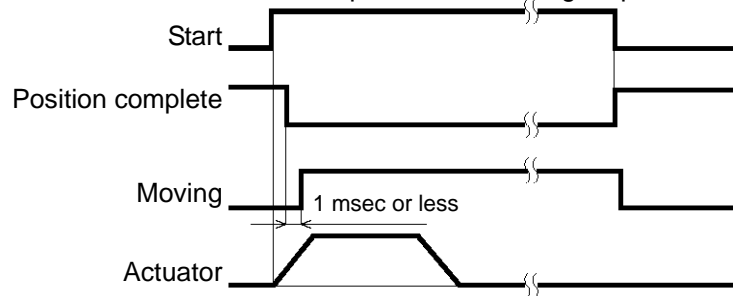
All completed position outputs are OFF immediately after the power is turned on. When the commanded movement is complete, the completed position will be output. If the movement command was to position No. 0, all of the completed positions will remain OFF.

The actuator will not operate unless the pause input is turned ON.

T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

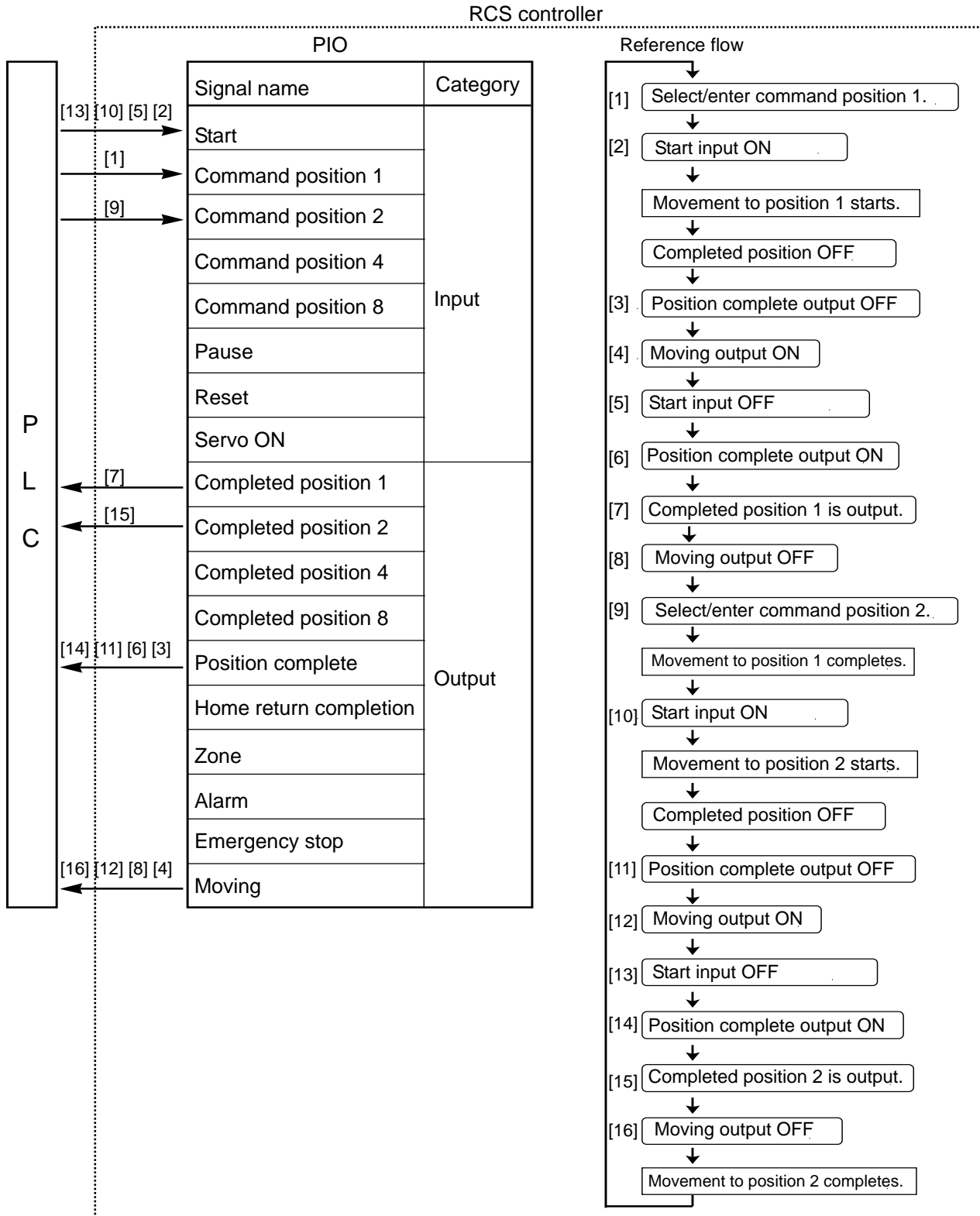
\* With the absolute specification, the home return completion signal will turn ON after the power is turned on, and home return will not be performed.

**Note:** When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.  
If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed. The moving output will not turn OFF, either.



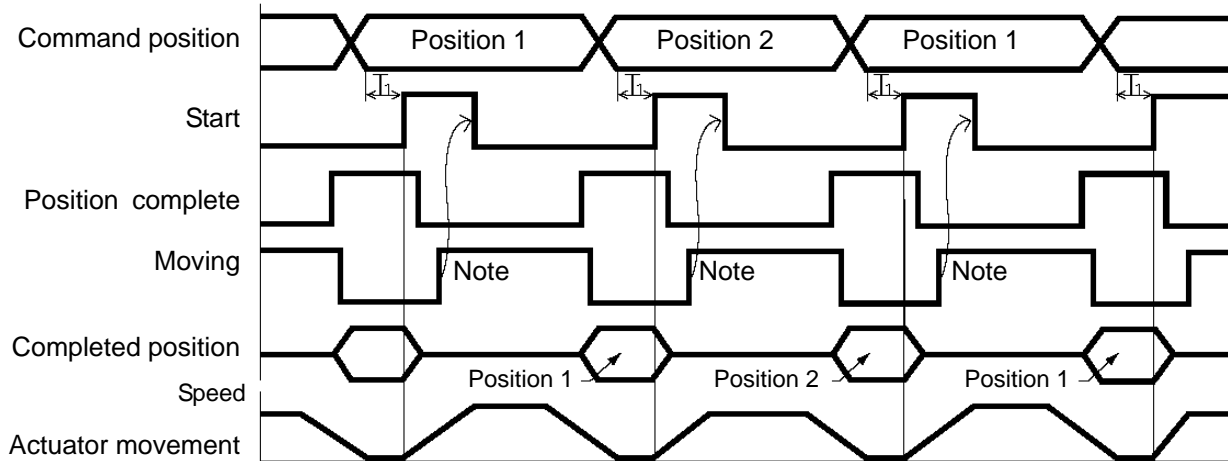
## 4.4 Positioning Mode (Back and Forth Movement between Two Points)

Example of use in operation) The actuator moves back and forth between two positions. The position 250 mm from the home is set as position 1, and the position 100 mm from the home is set as position 2. The travel speed to position 1 is set as 200 mm/sec, and to position 2 is set as 100 mm/sec.



Position-data table (Field(s) within thick line must be entered.)

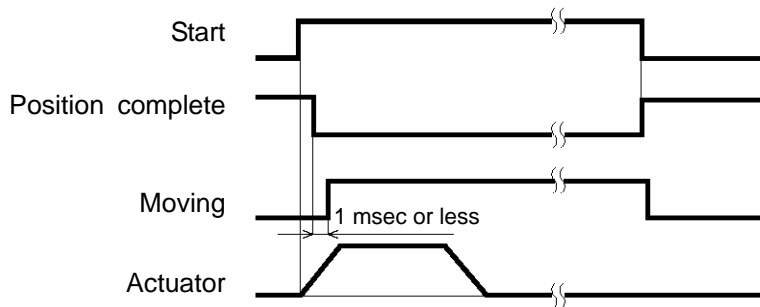
No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	250	200	0.3	0	0.1	0
2	100	100	0.3	0	0.1	0
⋮						



T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

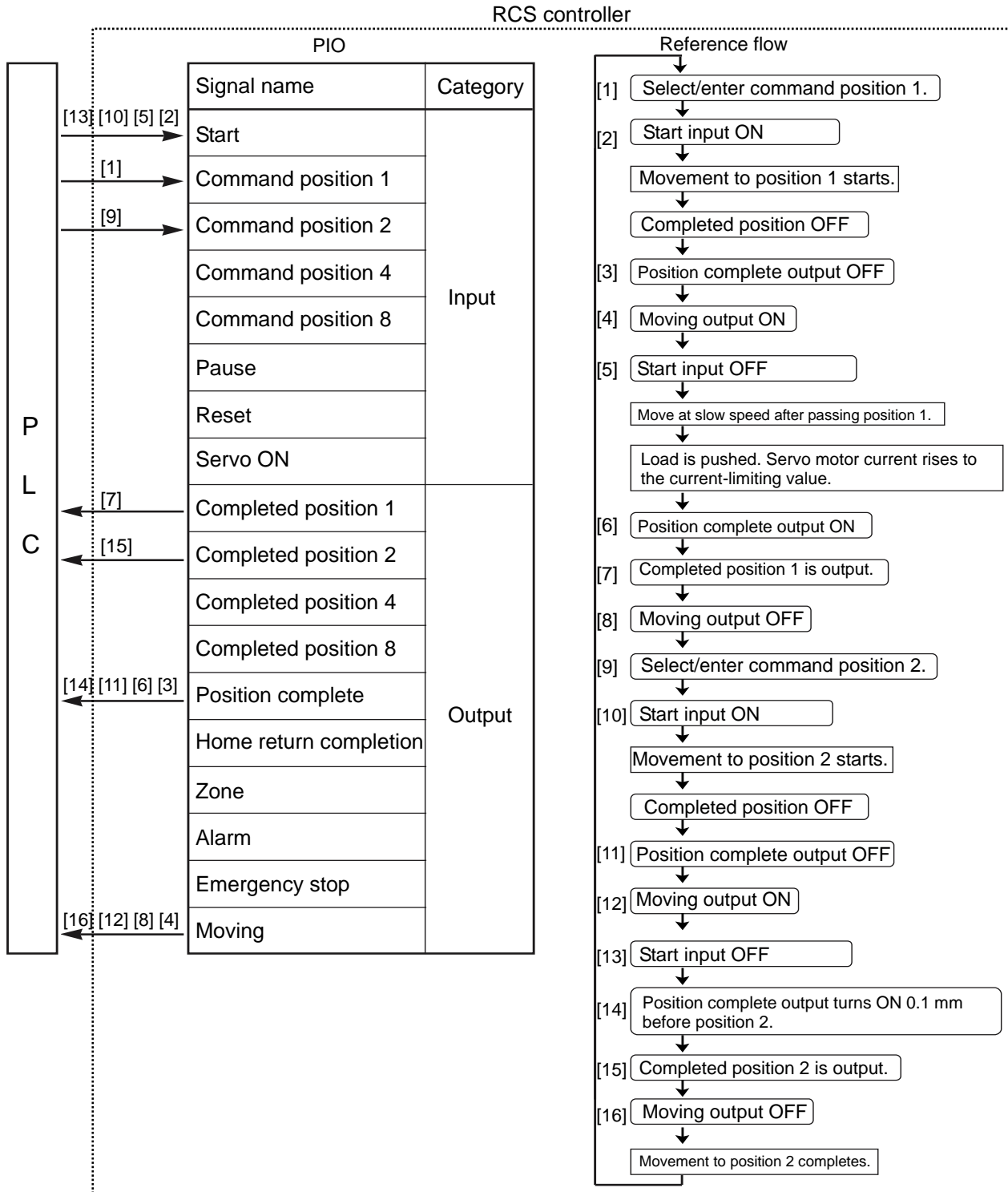
Each command position must be input after the position complete output has turned ON for the movement to the previous position.

Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.  
If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed. The moving output will not turn OFF, either.



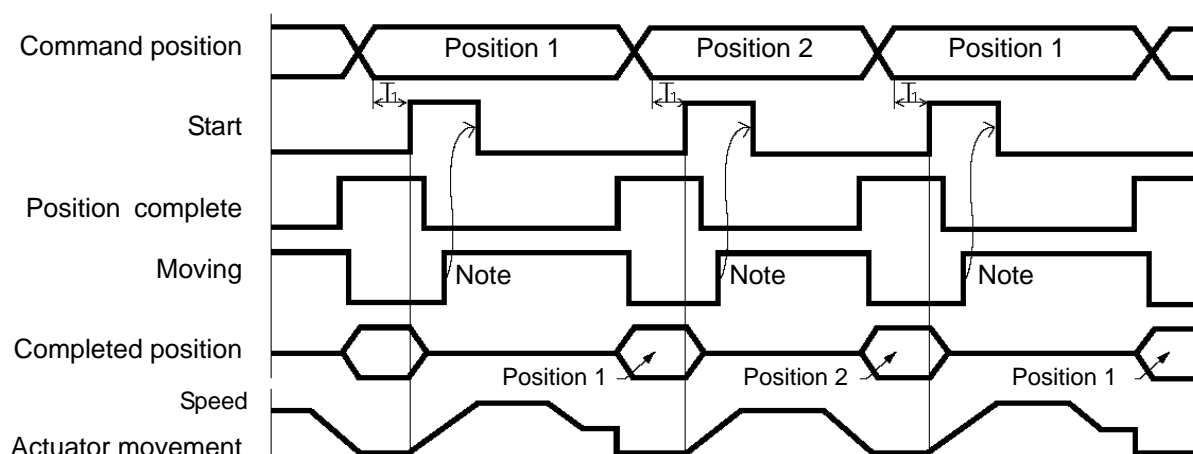
## 4.5 Push & Hold Mode

Example of use in operation) The actuator is caused to move back and forth in the push & hold mode and positioning mode. The position 280 mm from the home is set as position 1, and the position 40 mm from the home is set as position 2. Movement to position 1 is performed in the push & hold mode (the actuator is caused to contact the load and push it in the counter-motor direction). The maximum push amount at position 1 is set as 15 mm, and the current-limiting value during the push & hold operation by the servo motor is set as 50%. Movement to position 2 is performed in the positioning mode. The travel speed to position 1 is set as 200 mm/sec, and that to position 2 is set as 100 mm/sec.



Position-data table (Field(s) within thick line must be entered.)

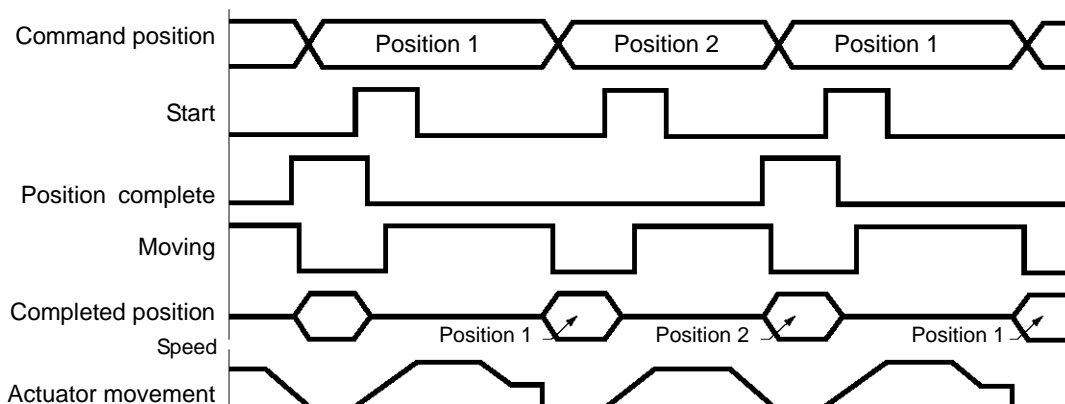
No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	280	200	0.3	50	15	0
2	40	100	0.3	0	0.1	0
⋮						



T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

Each command position must be input after the position complete output has turned ON for the movement to the previous position.

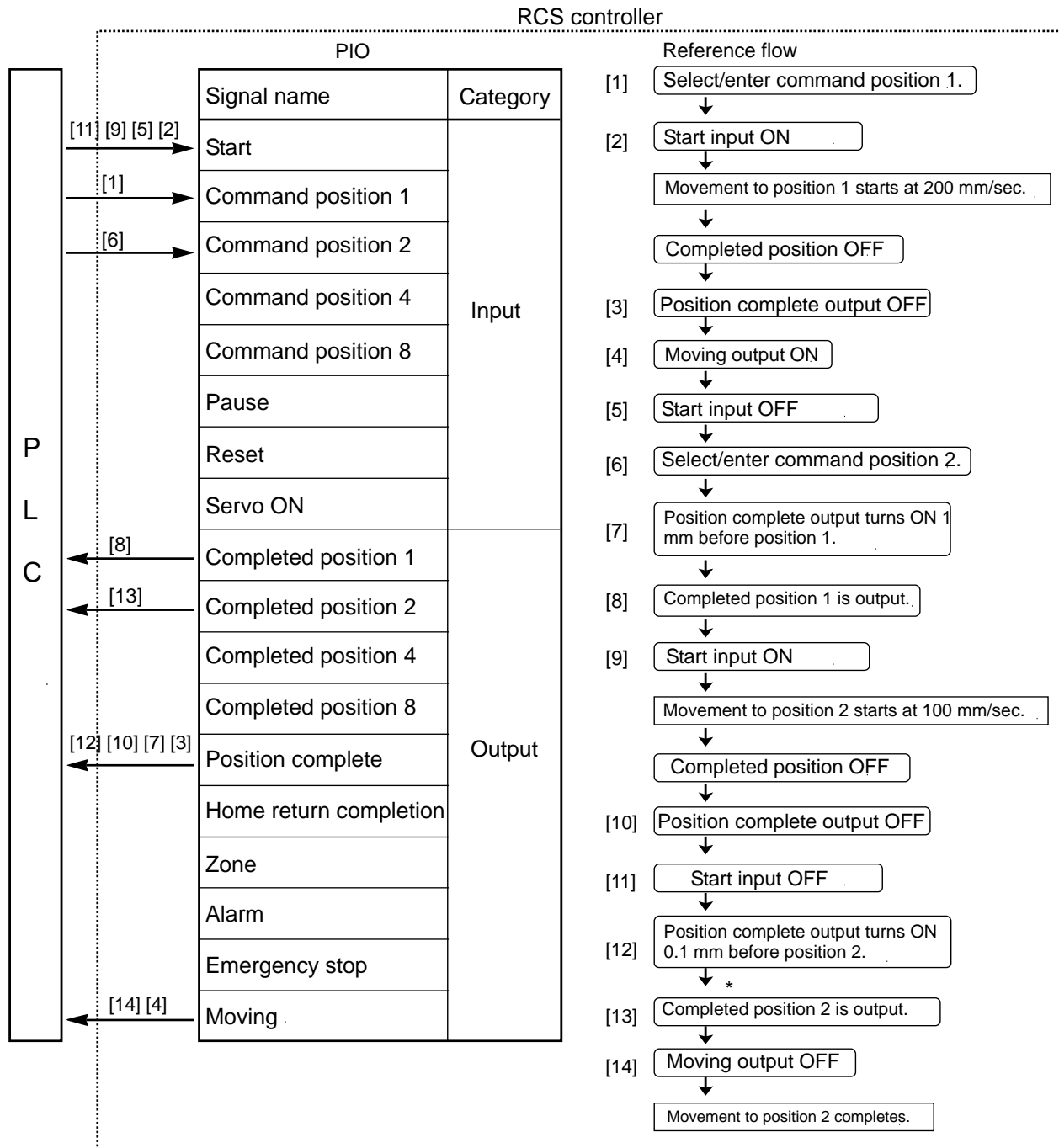
**Note:** When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.  
If the actuator has missed the load, the position complete output will not turn ON as shown below. The completed position will be output and the moving output will turn OFF.



## 4.6 Speed Change during Movement

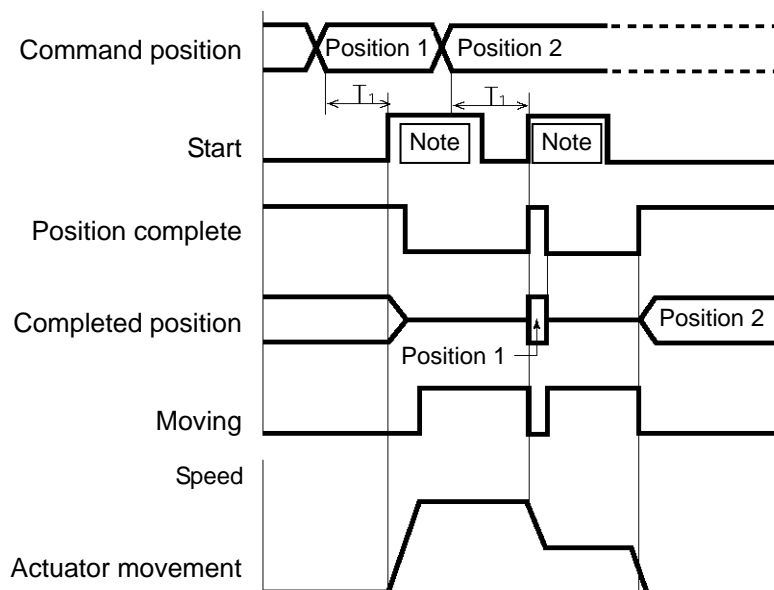
Example of use in operation) The actuator speed is reduced at a certain point during movement.  
 The position 150 mm from the home is set as position 1, and the position 200 mm from the home is set as position 2. The actuator is initially located between the home and position 1. The actuator is moved to position 2 being the target position, at a travel speed of 200 mm/sec to position 1 and that of 100 mm/sec from position 1 to position 2. In this example, the actuator is caused to move to position 1 and to position 2 successively. Before the actuator is stopped at position 1, command position 2 must be selected/entered and the start signal must be input. To do this, set a wide positioning band at position 1 and cause the start signal for movement to position 2 to be input immediately after the completion signal for movement to position 1 is output. (Command position 2 should be entered while the actuator is moving to position 1.)

Method)



Position-data table (Field(s) within thick line must be entered.)

No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	150	200	0.3	0	1	0
2	200	100	0.3	0	0.1	0
⋮						
⋮						



T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

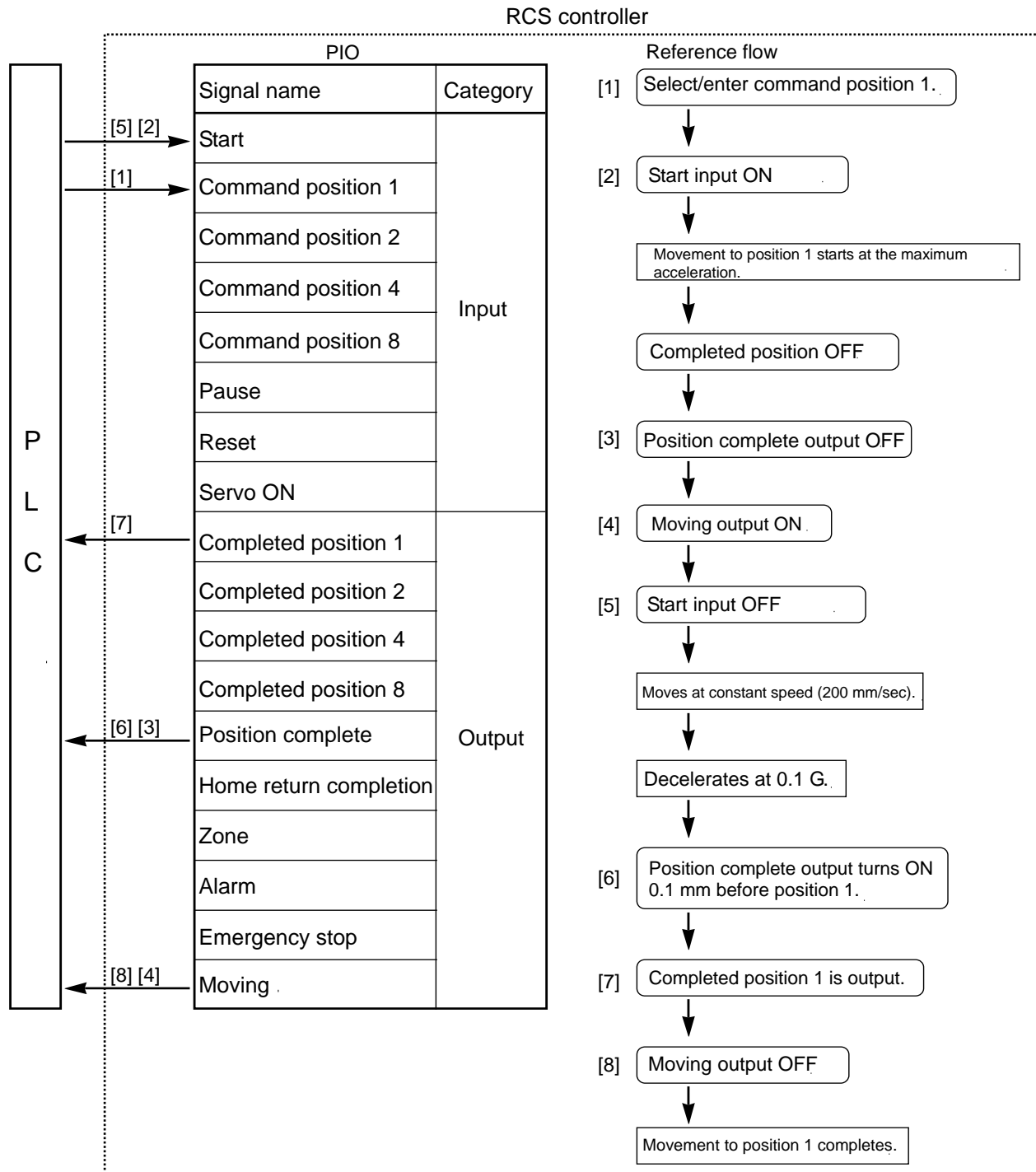
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.



## 4.7 Operation at Different Acceleration and Deceleration Settings

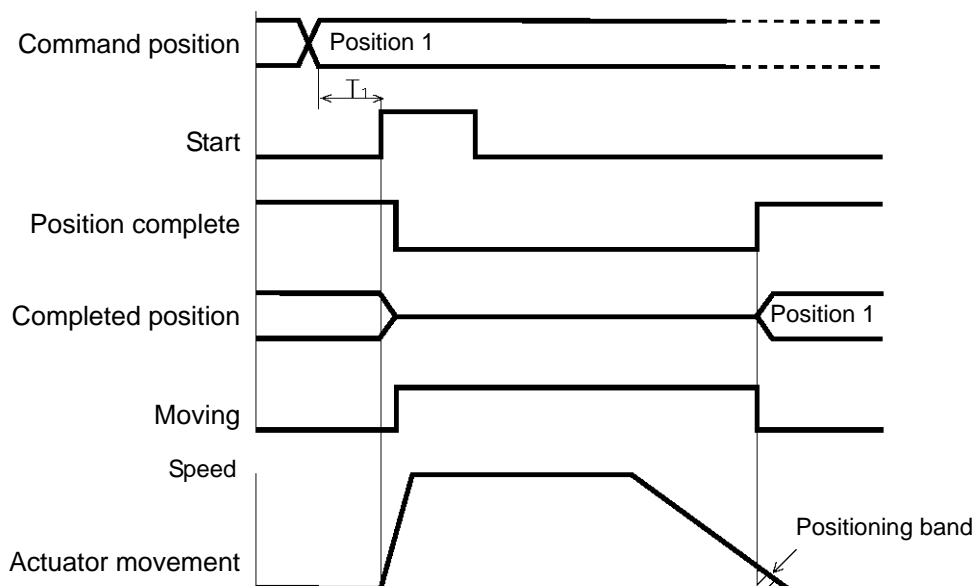
Example of use in operation) Positioning is performed to the position 150 mm from the home (position 1) at a speed of 200 mm/sec. The actuator will accelerate at the maximum acceleration set according to the load, and decelerate at 0.1 G.

Method) Entering "1" under "Acceleration only MAX" in the position data will automatically adjust the acceleration to the maximum acceleration set according to the load. Entering "0.1" under "Acceleration/deceleration" in the position data will set the deceleration to 0.1 G.



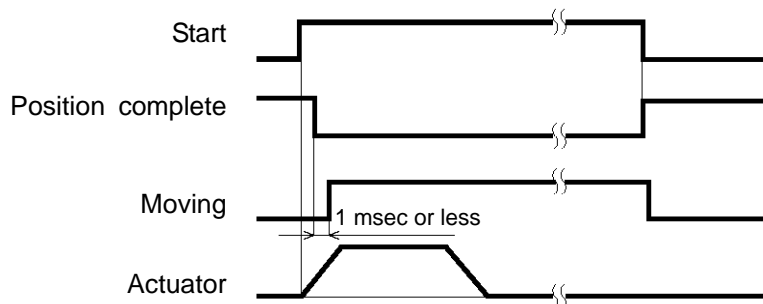
Position-data table (Field(s) within thick line must be entered.)

No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	150	200	0.1	0	0.1	1
⋮						



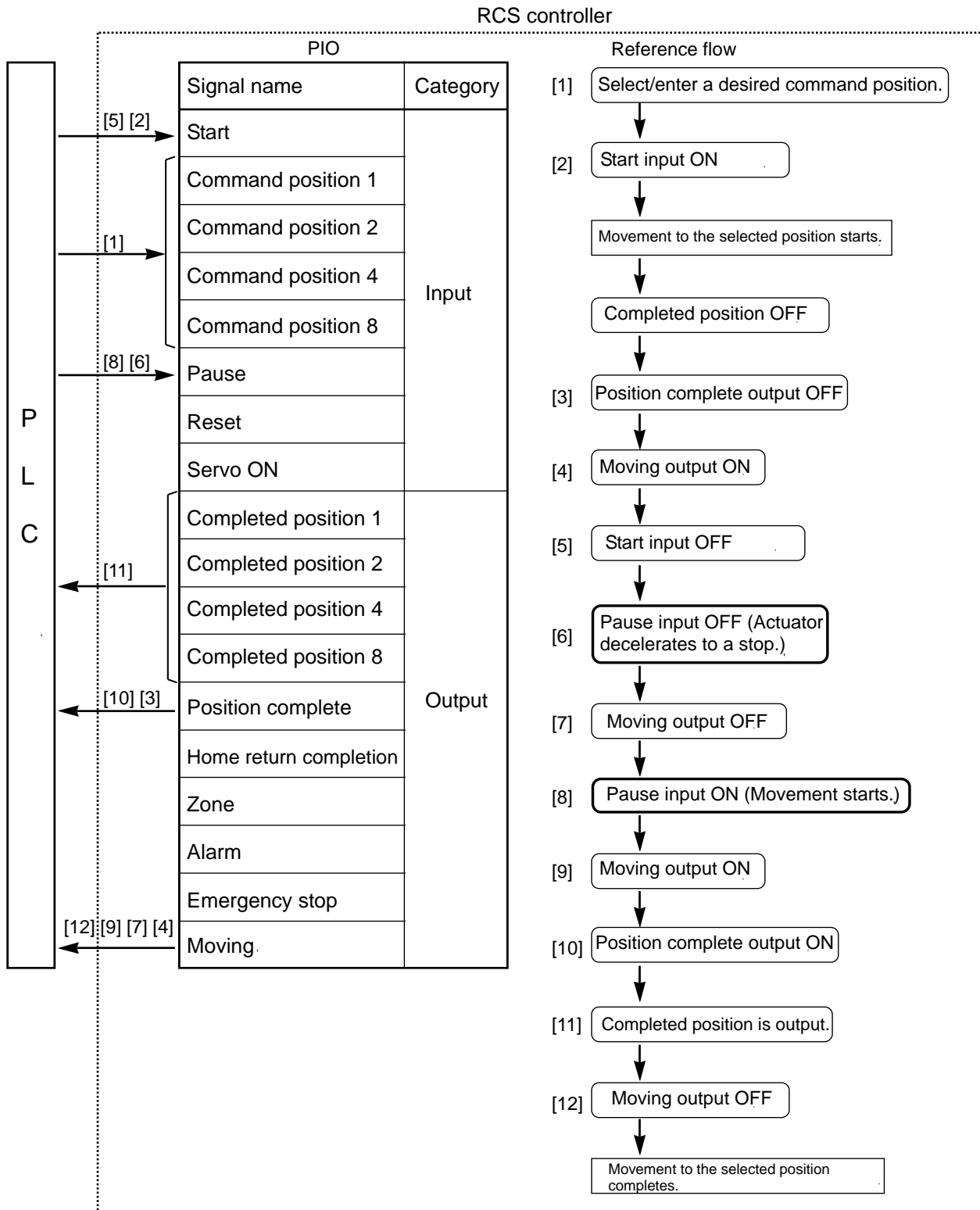
T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

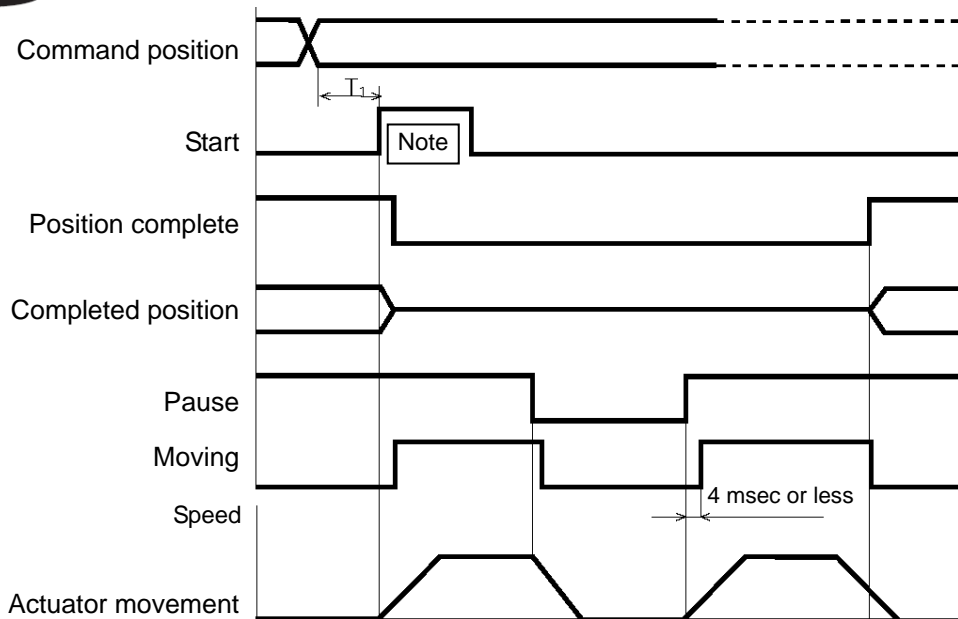
**Note:** When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.  
If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed. The moving output will not turn OFF, either.



## 4.8 Pause

Example of use in operation) The actuator is paused during movement.  
 Method) Use the pause input.

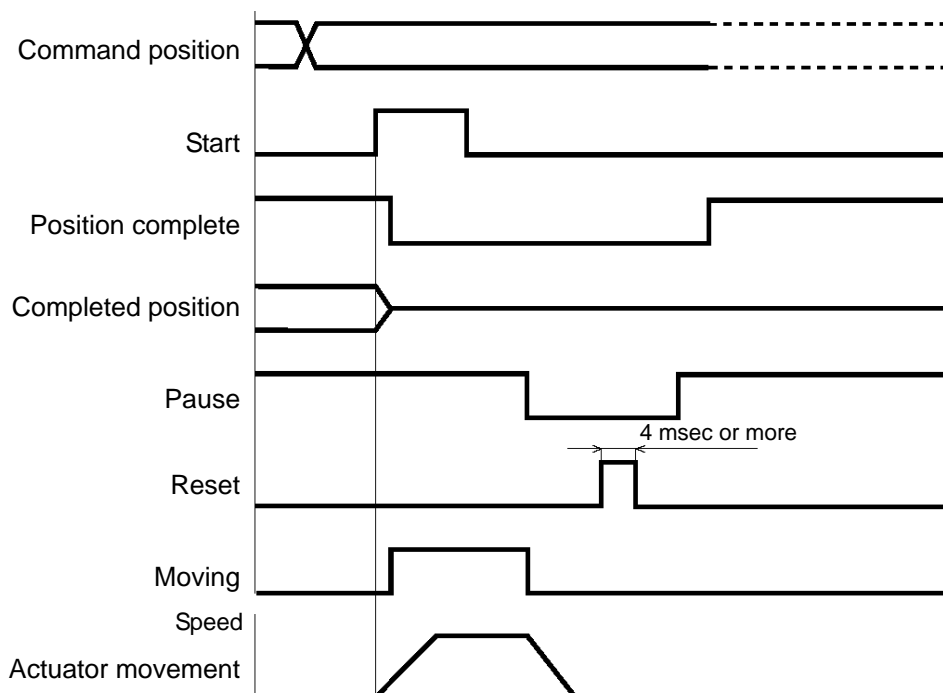




T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.

The remaining movement can be cancelled by turning ON the reset input during pause.  
(The controller will detect a rise of the reset signal and cancel the remaining movement.)

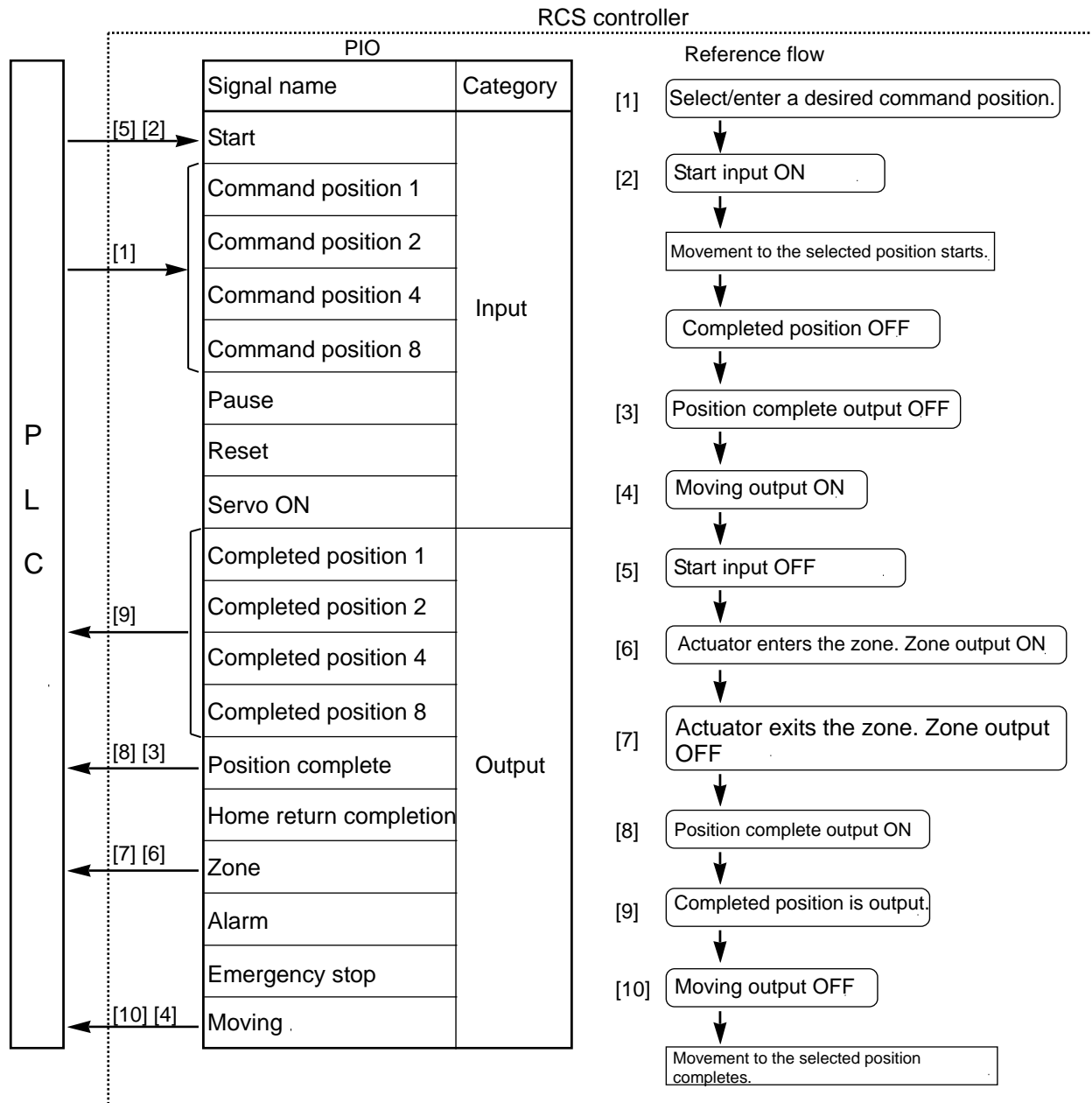


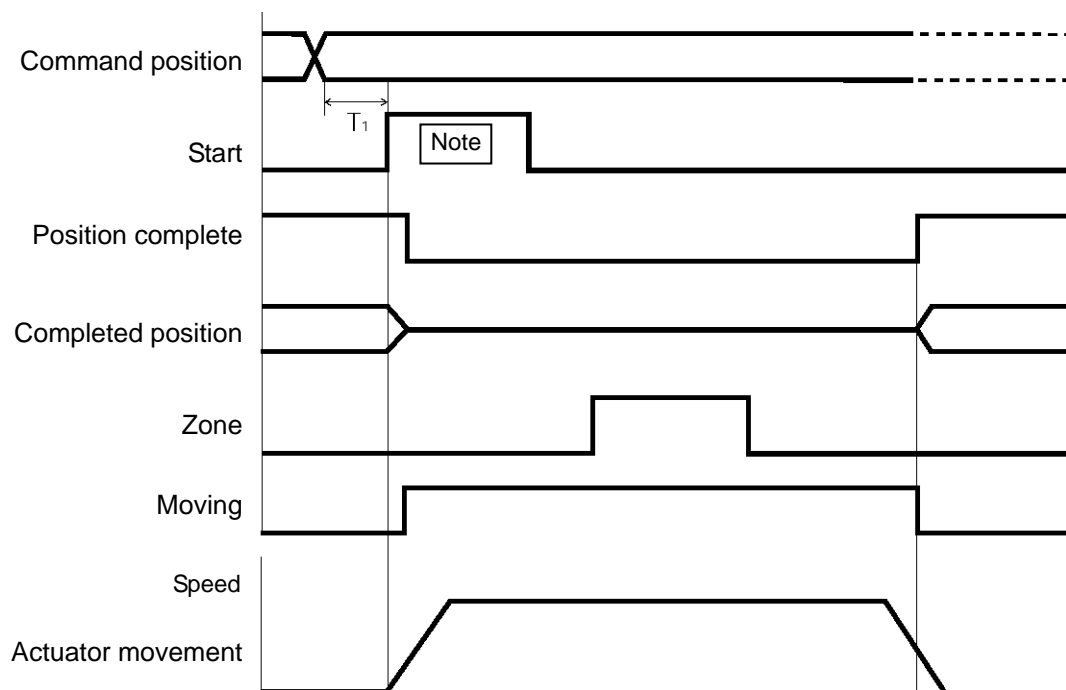
## 4.9 Zone Signal Output

Example of use in operation) While the actuator is moving a zone signal is output inside the zone enclosed by distances of 40 mm and 120 mm from the home. (40 mm ≤ Zone signal output ≤ 120 mm)

Method) Use the parameters "Zone boundary+" and "Zone boundary-" to set the zone in which the zone signal is output, as shown below:

Zone boundary+	120
Zone boundary-	40

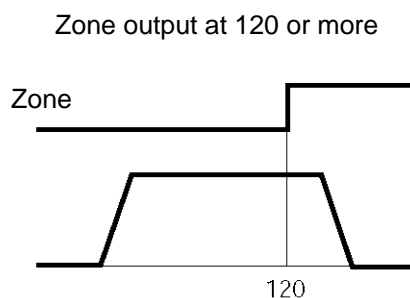




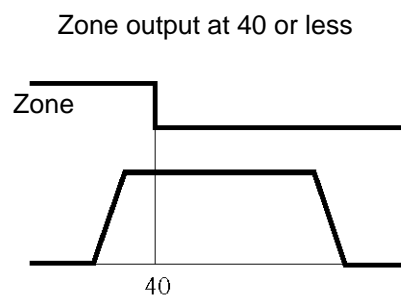
T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.

Example of other zone output)



Zone boundary+	Maximum stroke length
Zone boundary-	120



Zone boundary+	40
Zone boundary-	0

## 4.10 Returning Home

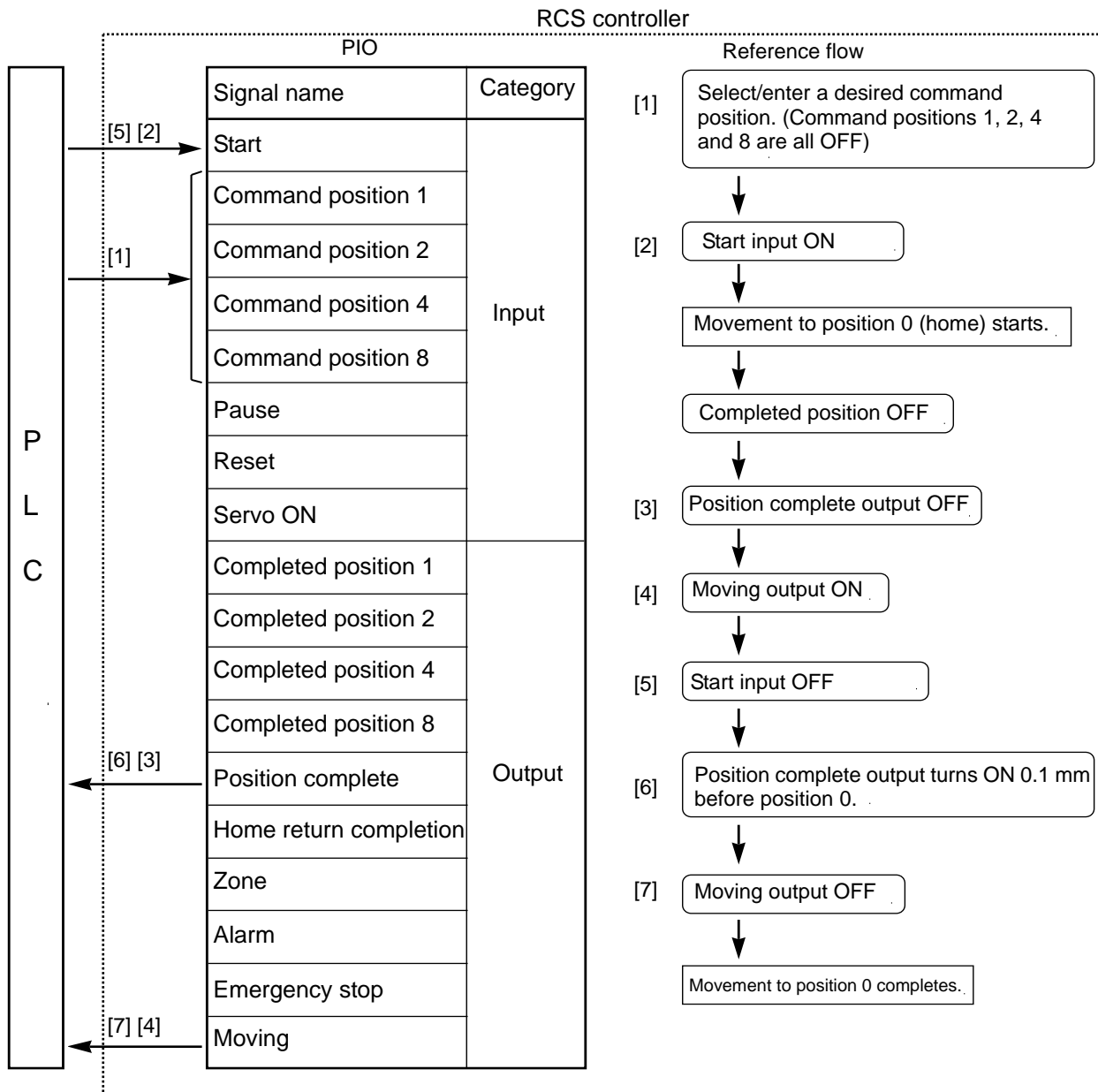
Example of use in operation) Home return alone cannot be performed using PIO.

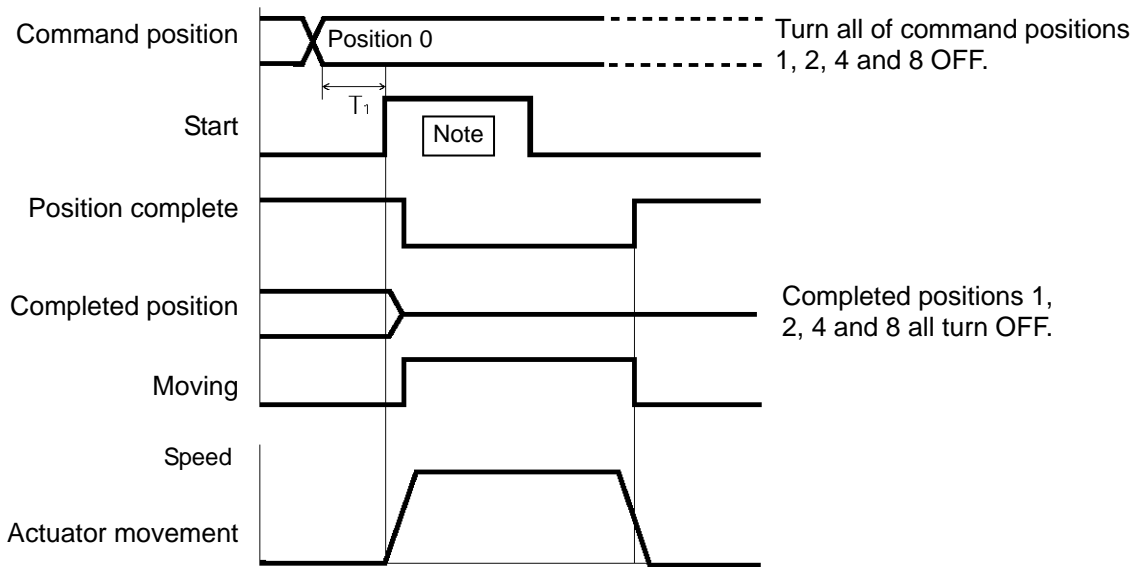
Method) Create point data of 0 distance from the home, and move the actuator to that position.

Enter home data in position 0. To return home, move the actuator to position 0.

Position-data table (Field(s) within thick line must be entered.)

No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	0	100	0.3	0	0.1	0
1	*	*	*	*	*	*
⋮						

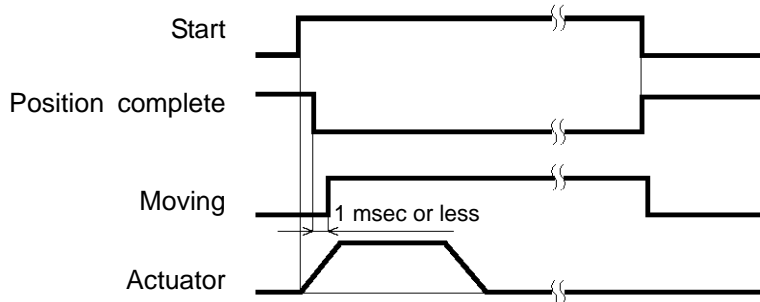




$T_1$ : 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

Data of 0 distance from the home need not be always entered in position 0.  
In this example, data of 0 distance from the home was entered in position 0. Of course, such data can also be entered in any other position of 1 to 15.

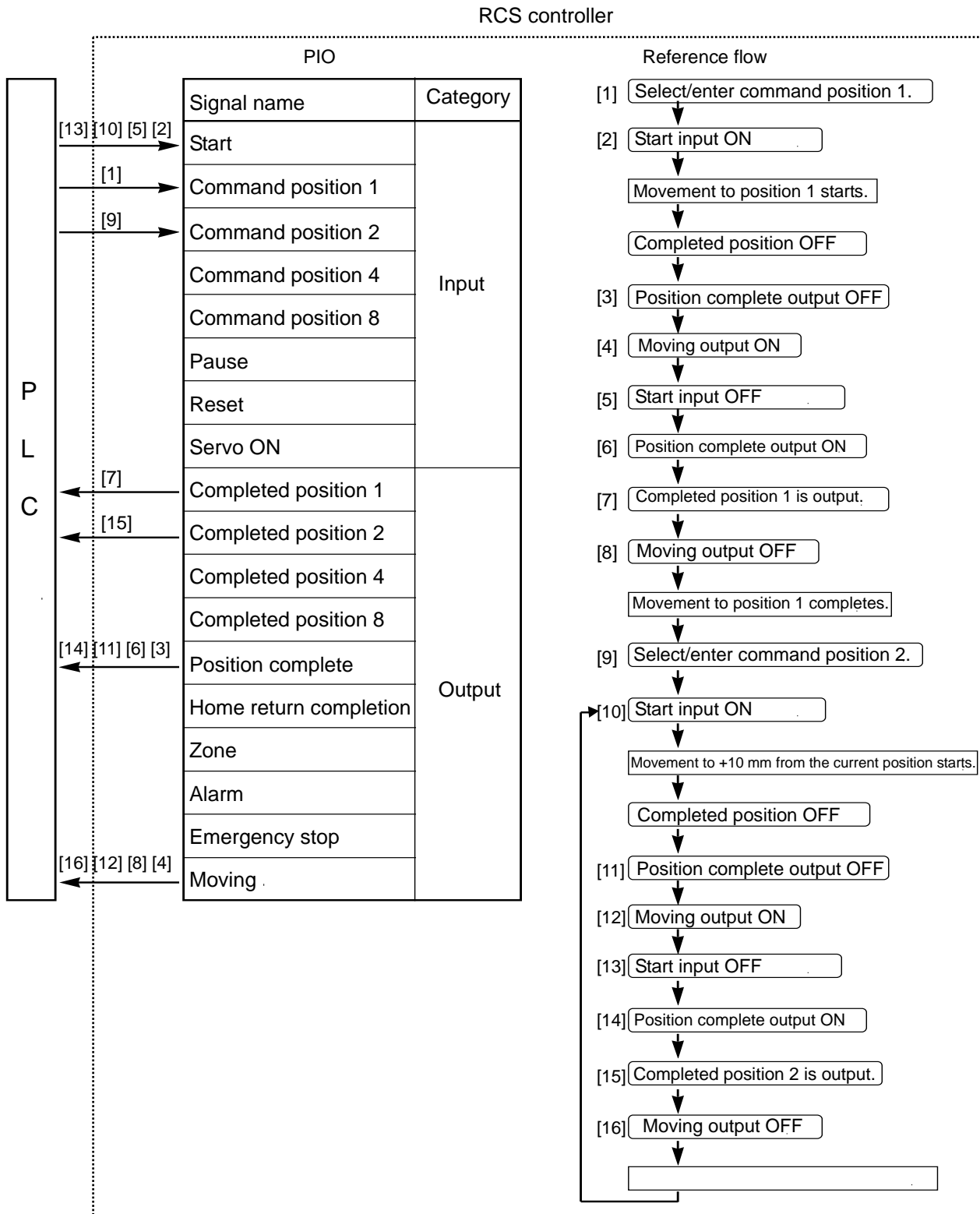
**Note:** When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.  
If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed. The moving output will not turn OFF, either.





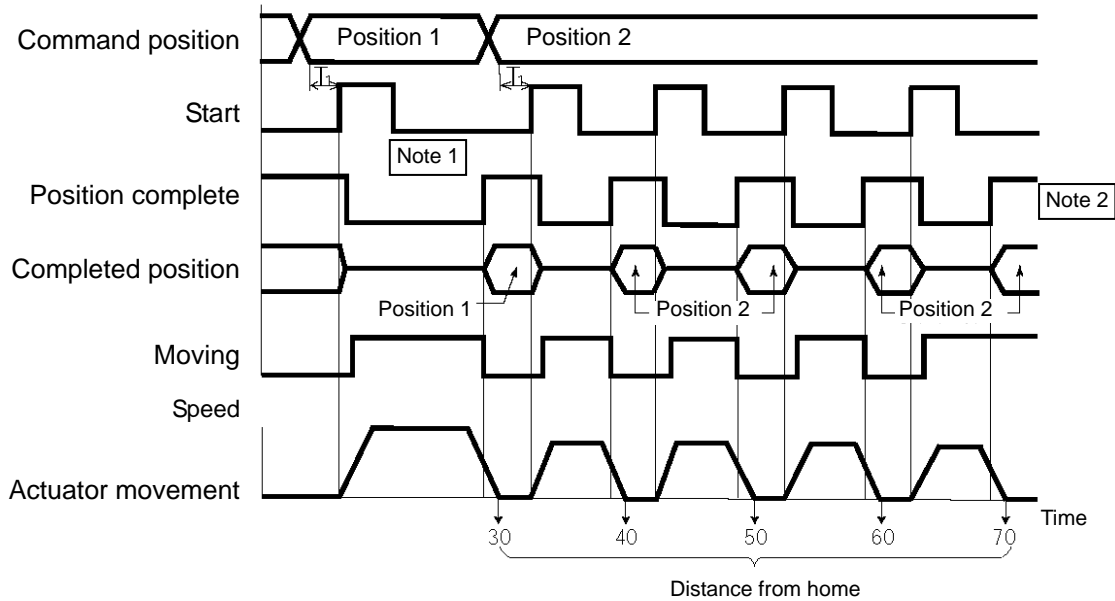
## 4.11 Incremental Moves

Example of use in operation) The actuator is caused to move from the home to the 30-mm position, from which it will be moved repeatedly in increments of 10 mm. The travel speed from the home to the 30-mm position is set as 100 mm/sec, and that for 10-mm incremental moves is set as 20 mm/sec.



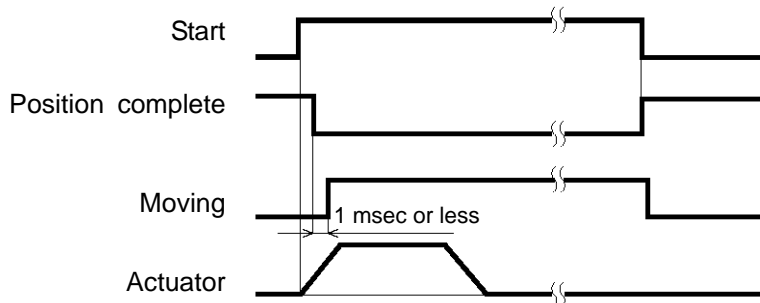
Position-data table (Field(s) within thick line must be entered.)

No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	30	100	0.3	0	0.1	0
2	10	20	0.3	0	0.1	0
...						



T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON  
(The scan time of the host controller must be considered.)

Note 1: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.  
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.  
If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed. The moving output will not turn OFF, either.



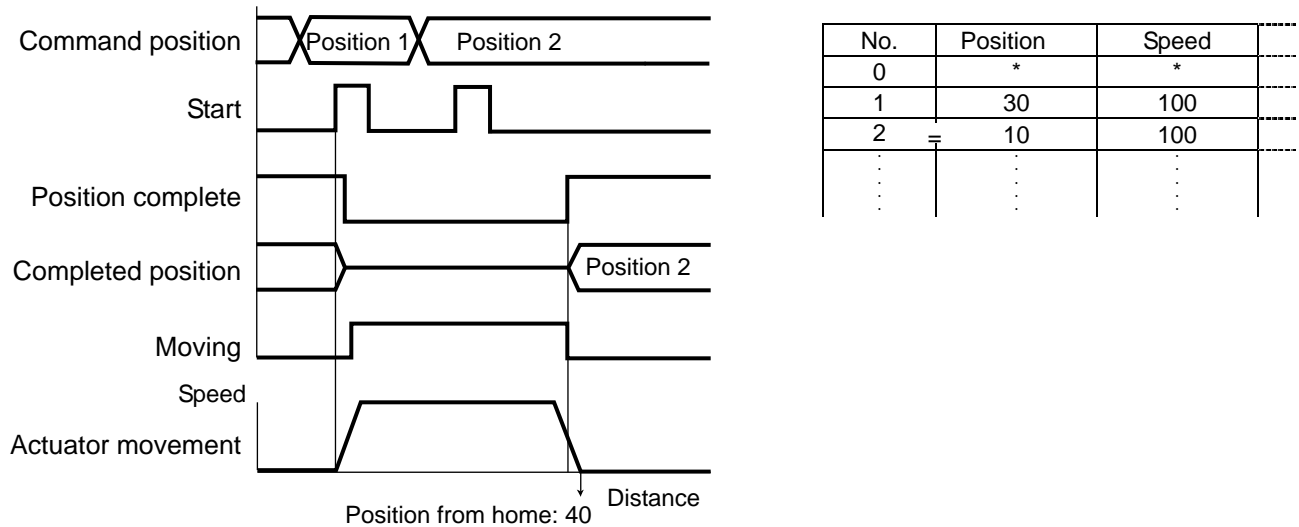
Note 2: When a soft limit is reached as a result of repeated incremental moves, the actuator will stop at that position and the position complete signal will be output.

## 4.12 Notes on Incremental Mode

### (1) Notes on positioning operation

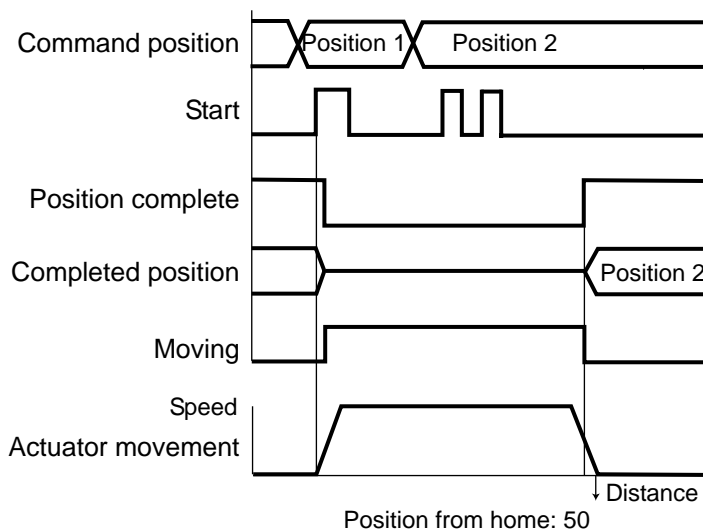
Selecting/entering a position number using relative coordinates during positioning will cause the actuator to move to the position corresponding to the initial position plus the increment. (If the increment is a negative value, the actuator will move to the position corresponding to the initial position minus the increment.)

Example) If the start signal for movement to position 2 is input while the actuator is moving to position 1, the actuator will move to the position 40 mm from the home.



If the start signal for movement to an incremental position number is input multiple times during positioning, the actuator will move to the position corresponding to the initial position plus the “increment x number of times the signal was input.”

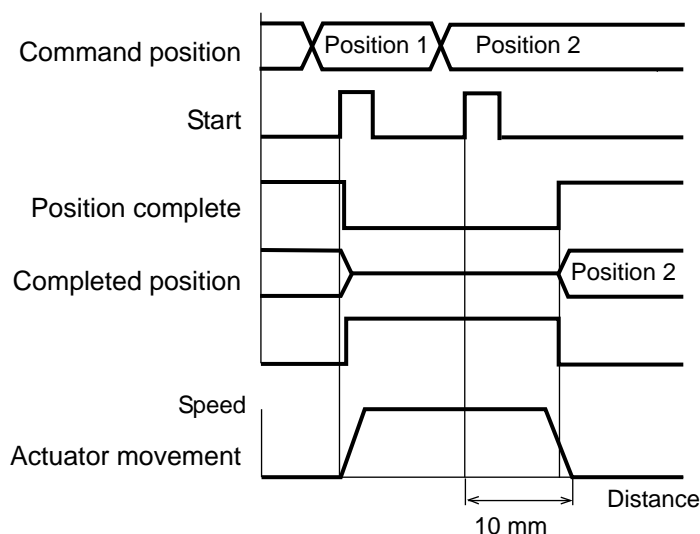
Example) If the start signal for movement to position 2 is input twice while the actuator is moving to position 1, the actuator will move to the position 50 mm from the home.



### (2) Note on push & hold operation

If the start signal is input with an incremental position number selected/entered while the actuator is moving in the push & hold mode, the actuator will move to the position corresponding to the position at the time of start input plus the increment. Therefore, the end position will become indeterminate.

Example) If the start signal for movement to position 2 is input while the actuator is moving to position 1 in the push & hold mode, the actuator will move to the position 10 mm from where it was when the input signal was input.



No.	Position	Speed
0	*	*
1	50	100
2	10	100
...	...	...
...	...	...

### (3) Cumulative errors due to repeated incremental moves

Position data is recognized only as a multiple of the minimum resolution. The minimum resolution is determined by the lead and the number of encoder pulses. Therefore, a margin of error may occur between the entered position value and the actual movement of the actuator. If an incremental move is repeated, this error will accumulate.

The maximum error range for each actuator type is shown below:

	Type	Motor (W)	Speed type	Screw lead (mm)	Maximum error ( $\mu$ )
Slider type	SA4	20	L	2.5	0.2
			M	5	0.3
			H	10	0.6
	SA5	20	L	3	0.2
			M	6	0.4
			H	12	0.7
	SA6	30	L	3	0.2
			M	6	0.4
			H	12	0.7
Flat type	F45	30	L	2.5	0.2
			M	5	0.3
			H	10	0.6

	Type	Motor (W)	Speed type	Screw lead (mm)	Maximum error ( $\mu$ )
Rod type	RA35	20	L	2.5	0.3
			M	5	0.6
			H	10	1.2
	RA45	30	L	2.5	0.2
			M	5	0.3
			H	10	0.6
	RB7525	60	M	5	1.6
			H	10	3.3

## 5. Parameters

### 5.1 Parameter Classification

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

### 5.2 Parameter List

No.	Type	Name	Unit	Factory default
1	a	Zone limit + side	mm	Effective actuator length
2	a	Zone limit – side	mm	Effective actuator length
3	a	Soft limit + side	mm	Effective actuator length
4	a	Soft limit – side	mm	Effective actuator length
5	a	Home direction [0: Reverse/1: Forward]	-	(In accordance with the ordered specification.)
6	b	Push & hold recognition time	msec	255
7	d	Servo gain No.	-	Set individually depending on the actuator characteristics.
8	b	Initial speed setting	mm/sec	Set individually depending on the actuator characteristics.
9	b	Initial acceleration/deceleration setting	G	Set individually depending on the actuator characteristics.
10	b	Initial positioning band (in-position)	mm	0.10
11	b	Initial acceleration only MAX flag	-	0
12	b	Current limit value during positioning stop	%	Set individually depending on the actuator characteristics.
13	b	Current limit value during homing	%	Set individually depending on the actuator characteristics.
14	b	Movement flag during stop	-	1
15	c	Hold input disable selection [0: Enable/1: Disable]	-	0
16	c	Serial communication speed	bps	38400
17	c	Minimum delay before slave transmitter activation	msec	5
18		Reserved	-	
19		Reserved	-	
20		Reserved	-	
21	c	Servo ON input disable selection [0: Enable/1: Disable]	-	0
22	a	Home offset	mm	Set individually depending on the actuator characteristics.

(Note) The numbers are shown on the PC software screen, but not on the teaching pendant.  
The type symbols are given for convenience and not shown on the PC software screen or teaching pendant.

## 5.3 Parameter Settings

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

### 5.3.1 Parameters Relating to Actuator Stroke Range

#### ● Soft limits

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.

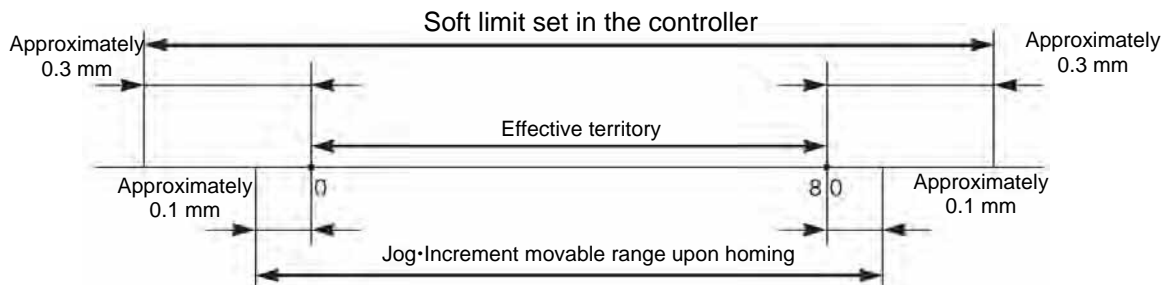
The minimum setting unit is 0.01 mm.

(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



#### ● Zone limits

Set the zone in which the zone output signal turns ON.

The zone signal will turn ON when the current coordinate is between the – setting and + setting.

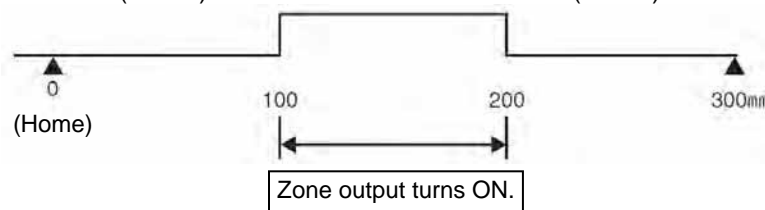
Set the + zone limit in parameter No. 1 and – zone limit in parameter No. 2.

The minimum setting unit is 0.01 mm.

Example) With the actuator of 300-mm stroke, use the zone limits as an intermediate LS actuating in a range of 100 to 200 mm

Parameter No. 1 (+ side): 200

Parameter No. 2 (– side): 100



#### ● Home direction

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, switch 0 and 1 in the setting of parameter No. 5.

If necessary, also change the home offset and soft limits.

**Caution:** Rod-type actuators do not permit reversing of the home direction.  
If the home direction is reversed, all position data currently input will be cleared.

- Home offset

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.

### 5.3.2 Parameters Relating to Actuator Operating Characteristics

- Initial speed setting

This parameter has been set to the rated speed of the actuator at the factory.

If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the speed data corresponding to the applicable position number.

To set a speed lower than the rated speed, change the setting of parameter No. 8.

- Initial acceleration/deceleration setting

This parameter has been set to the rated acceleration/deceleration of the actuator at the factory.

If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the acceleration/deceleration data corresponding to the applicable position number.

To set an acceleration/deceleration lower than the rated acceleration/deceleration, change the setting of parameter No. 9.

- Initial positioning band (in-position)

This parameter has been set to "0.10" mm at the factory.

If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the positioning band data corresponding to the applicable position number.

Since increasing this value will cause a position complete signal to output early, change the setting of parameter No. 10 as necessary.

- Initial acceleration only MAX flag

To cause the actuator to stop gradually at slow deceleration, you must set a lower acceleration/deceleration. However, this will also slow the acceleration.

This parameter lets you set a quicker acceleration without affecting the deceleration.

Note, however, that this parameter can be used only when the actual payload is no more than one-third of the rated loading capacity.

Check the rated loading capacity of your actuator by referring to the supplied specification list of supported actuators.

This parameter has been set to "0" (Disable) at the factory.

If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the "acceleration only MAX" data corresponding to the applicable position number.

To enable this function, change parameter No. 11 to "1" (Enable).

## ● Push & hold recognition time

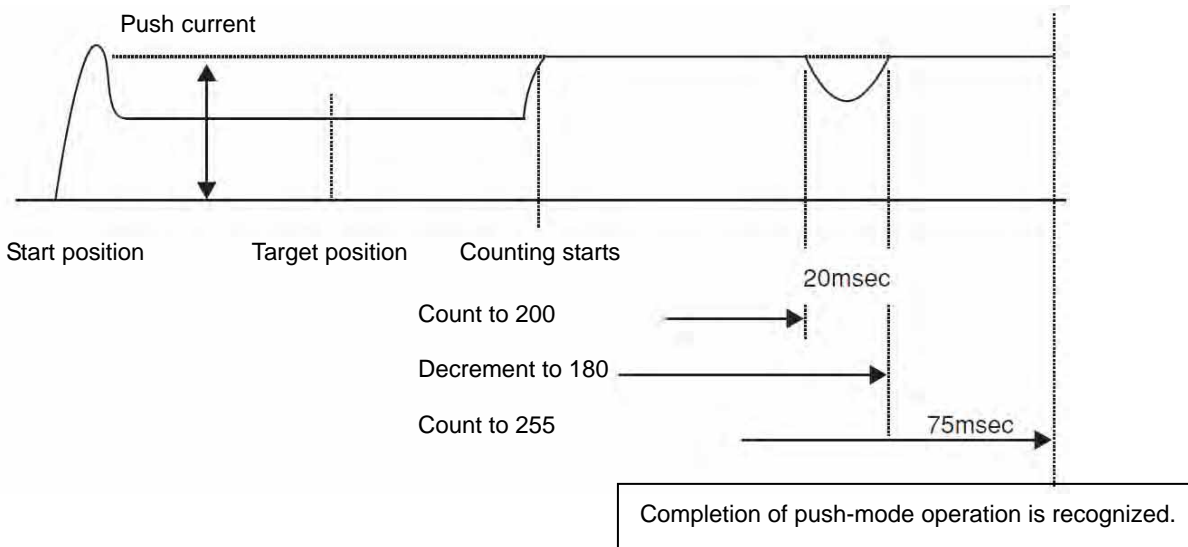
This parameter is used as a condition for determining if the actuator has contacted the work part and completed its push-mode operation.

Specifically, push-mode operation is deemed complete if the current limit value set in the position table has been maintained for the time set in parameter No. 6.

Set this parameter to an optimal value in accordance with the current limit value, by considering the shape and strength of the work part, etc.

The minimum setting unit is 1 msec, and the maximum value is 255 msec. This parameter has been set to "255" msec at the factory.

(Note) If the work part has shifted and current has changed during the push & hold recognition time, the judgment will be made as follows. In this example, the push & hold recognition time is set to 255 msec.



If the push current is maintained for 200 msec and then drops for 20 msec thereafter, the counter is decremented by 20. Upon recovery of the push current, counting resumes from 180. If the push current is maintained for 75 msec, the counter will have counted up to 255 and thus the controller will recognize completion of push-mode operation.

In this case, the judgment requires a total of 295 msec.

## ● Current limit value during positioning stop

At the factory, this parameter has been set to a current value corresponding to the standard specification of the actuator.

Increasing this value will increase the holding torque while the actuator is stopped.

This parameter need not be changed in normal conditions of use. However, hunting will occur if excessive external force applies to the actuator while the actuator is stopped. In this case, the value set in parameter No. 12 must be increased.

If you need to change this parameter, please contact IAI first.

## ● Current limit value during homing

At the factory, this parameter has been set to a current value corresponding to the standard specification of the actuator.

Increasing this value will increase the torque during homing.

This parameter need not be changed in normal conditions of use. However, the value set in parameter No. 13 must be increased if the slide resistance has increased in a vertical application due to the affixing method, load condition, etc., and homing completes before the correct position.

If you wish to change this parameter, please contact IAI first.



- Movement flag during stop

This parameter defines whether to enable or disable the dynamic brake while the actuator is stopped.

It has been set to “1” (Enable) at the factory.

This parameter need not be changed in normal conditions of use, but there are situations where the actuator must be moved by hand with the servo turned OFF but the actuator does not move smoothly due to large slide resistance (this often occurs with actuators having a short ball screw lead).

In this case, you can change the value of parameter No. 14 to “0” (Disable) to release the dynamic brake and make the actuator move smoothly.

Caution: Before resuming normal operation, be sure to reset this parameter to “1” (Enable).
---

### 5.3.3 Parameters Relating to External Interface

- Hold input disable selection

Parameter No. 15 sets whether to enable or disable the hold input signal.

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

This parameter has been set to "0" (Enable) at the factory.

- Servo ON input disable selection

Parameter No. 21 sets whether to enable or disable the servo ON input signal.

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

This parameter has been set to "0" (Enable) at the factory.

- Serial communication speed

This parameter 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.

This parameter has been set to "38400" bps at the factory.

- Minimum delay before slave transmitter activation

This parameter 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.

This parameter has been set to "5" msec at the factory. If the communication module specification exceeds 5 msec, set the required time in parameter No. 17.

### 5.3.4 Servo Gain Adjustment

- Servo gain No.

At the factory, this parameter has been set to an appropriate value in accordance with the standard specification of the actuator.

Although it need not be changed in normal conditions of use, vibration or noise may occur if the load condition has changed significantly after shipment due to change in the actuator affixing method, load condition, etc., when the actuator is used in a vertical application.

In this case, changing the value of parameter No. 7 will improve the situation, but the new setting must be determined carefully by taking into consideration all factors affecting the relationship of actuator operation. Please contact IAI.

## 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.

- Check the status indicator lamps
  - RDY (green) --- The controller is receiving power and the CPU is operating normally.
  - RUN (green) --- The servo is ON and the actuator is moving.
  - ALM (red) --- An alarm is present.
  - ENC (orange) --- The encoder circuit is open or the encoder is not recognized.
- Check the host controller for abnormality.
- Check the voltage of the main power supply.
- Check the voltage of the 24-VDC power supply for I/O signals.
- Check for alarms.
  - Check the details of each alarm on the PC or teaching pendant.
- 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).
- Check the I/O signals.
- Check the noise elimination measure (ground connection, surge killer installation, etc.).
- Identify how the problem occurred and the operating condition when the problem occurred.
- Check the serial numbers of the controller and actuator.
- Analyze the cause.
- Take an action.

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

	Servo OFF	Servo ON, stopped	Servo ON, moving	Alarm present (excluding message level alarms)	Emergency stop actuated
RDY lamp	Lit	Lit	Lit	Unlit	Unlit
RUN lamp	Unlit	Unlit	Lit	Unlit	Unlit
ALM lamp	Unlit	Unlit	Unlit	Lit	Unlit
ENC lamp	Unlit	Unlit	Unlit	This lamp turns on only when an encoder error has been detected.	Unlit
Position complete	OFF	ON	OFF	OFF	OFF
Moving	OFF	OFF	ON	OFF	OFF
*Emergency stop	ON	ON	ON	ON	OFF
*Alarm	ON	ON	ON	OFF	ON

- (Note) The \*emergency stop and \*alarm signals operate on the negative logic (contact b).  
 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	*Alarm	Condition at occurrence of alarm	How to reset
Message	Unlit	Not output	An error is displayed on the PC software screen or teaching pendant.	
Operation cancellation	Lit	Output	The actuator decelerates to a stop, and then the servo turns off.	Input a reset signal from the PLC. 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 Alarm Output by PIO

So that the PLC can identify each alarm occurring in the controller, the content of each controller alarm is output using the ports corresponding to the last four bits of the complete position output signal.

(This function is not available for message level errors.)

The PLC should be able to identify if a given output indicates a complete position number or alarm based on the status of the alarm output signal.

Alarm Bit Assignment Table (● = OFF, ○ = ON)

Alarm	Complete Position No.				Alarm Content	Alarm Code*
	8	4	2	1		
○	○	○	○	○	Normal	○
●	●	○	●	○	CPU abnormal	0FA
●	●	○	○	●	Wrong EEPROM Data Setting	0B0, 0B1
●	●	○	○	○	Homing abnormal	0BE
●	○	●	●	●	Servo malfunction	0C0
●	○	●	●	○	Electric conversion area abnormal	0B8 to 0CA
●	○	●	○	○	Excessive deviation abnormal	0D8, 0DC
●	○	○	●	●	Excessive load abnormal	0ED
●	○	○	●	○	Encoder breakage, battery voltage low	0E4 to 0E7
●	○	○	○	○	Corruption of EEPROM data	0F8

\* The alarm codes are displayed at teaching pendant and PC interface software.

## 6.4 Alarms, Causes and Actions

### (1) Message Alarms

Code	Error	Cause/action
040	Emergency stop	Cause: An emergency stop status was detected. (This is not an error.)
05A	Receive overrun	An error occurred during operation using the PC software/teaching pendant or serial communication via PLC's communication module. 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.
05B	Receive framing error	
05C	Receive timeout error	
05D	Header error	
05E	Delimiter error	
07F	BCC error	
061	FNCCHR W address error	An error occurred during serial communication via the PLC's communication module.
062	Operand 1 error	Cause: An undefined command or out-of-range data was received. Action: Review the data sent and correct the format.
063	Operand 2 error	
064	Operand 3 error	
065	EEPROM write timeout	Cause: Writing of parameter or position data to the nonvolatile memory does not complete within 200 ms. (This alarm does not occur during normal operation.) Action: Do not issue a PLC command and write data using the PC/teaching pendant at the same time.
070	Movement command at RUN-OFF	Cause: A movement command was issued when the servo was OFF. Action: Before issuing a movement command, confirm that the servo is ON (the position complete signal is ON).
071	PTP before homing completion	Cause: A movement command was issued to the absolute actuator via serial communication when the home position was not yet established. Action: Perform an absolute reset to establish the home position first. (Refer to 4-2, "Absolute Reset Procedure.")
073	Error reset at servo ON	Cause: An alarm reset command was issued while the actuator was operating via serial communication with the servo ON. (This alarm does not cover PIO commands.) Action: Before issuing an alarm reset command, confirm that the servo is OFF.
075	Movement command during homing	Cause: The next movement command was issued in the middle of homing. Action: Issue the next movement command after homing has completed.
07A	ABS battery voltage low	Cause: The battery voltage was 3.2 V or below when the power was input. Action: Replace the battery as soon as possible.

## (2) Operation Cancellation Alarms

Code	Error	Cause/action
0B0	Bank 30 data error	<p>Cause: Out-of-range or invalid data is included in the parameter area of the memory. (This alarm does not occur as a result of normal parameter input operation, but it may occur during serial communication using the PLC's communication module.)</p> <p>Action: Before transferring parameter data, confirm that the parameter values are correct.</p>
0B1	Bank 31 data error	<p>Cause: [1] A movement command was issued with an unregistered position data number selected. [2] The position data value exceeds a soft limit. [3] A position number was recognized wrongly due to start signal fluctuation or because a start signal was input too early.</p> <p>Action: [1] Revise the sequence so that an unregistered position will not be selected. [2] Change the position data to a value not exceeding the soft limit. [3] The minimum timer setting may not be recognized depending on the PLC. Pay attention to the timer setting.</p>
0BE	Homing timeout	<p>Cause: Homing was started but it does not complete after elapse of the time specified by the applicable manufacturer parameter. (This alarm does not occur during normal operation.)</p> <p>Action: As one possible cause, the controller and actuator may not be combined correctly. Please contact IAI.</p>
0C0	Excessive actual speed	<p>Cause: The motor speed exceeded the maximum level set by the applicable manufacturer parameter. This alarm does not occur during normal operation, but it may occur if the actuator moved rapidly as a result excessive load, but the load decreases before an overload is detected. This may be caused by the following conditions: [1] The slide resistance of the actuator increased locally. [2] The load increased due to momentary application of external force.</p> <p>Action: Check the assembled mechanical parts for abnormality. If the actuator itself is suspected to be the problem, please contact IAI.</p>
0C9	Overvoltage	<p>Cause: Regenerative energy was not fully absorbed during deceleration, and the voltage in the power circuit has become abnormally high as a result. In particular, this alarm tends to occur when the actuator installed vertically is decelerating to a stop following a downward movement command.</p> <p>Action: The regenerative resistance unit capacity may be insufficient. Check if the regenerative resistance unit capacity matches the motor wattage. If necessary, you can also reduce the acceleration/deceleration setting. If the error persists, please contact IAI.</p>

Code	Error	Cause/action
0CA	Overheat	<p>The surrounding air temperature of the power transistor in the controller rose excessively (to 95°C or above).</p> <p>Cause: [1] High surrounding air temperature of the controller [2] Defective internal part of the controller [3] The load increased when the input power capacity was lacking</p> <p>Action: [1] Lower the surrounding air temperature of the controller. If the surrounding air temperature is normal, please contact IAI.</p>
0CC	Abnormal control power voltage	<p>The voltage of the 24-V input power supply dropped (by 20% or more, or to 19.2 V or below).</p> <p>Cause: [1] Low voltage of the 24-V input power supply [2] Faulty internal part of the controller</p> <p>Action: Check the voltage of the input power-supply. If the voltage is normal, please contact IAI.</p>
0DC	Out of push operation range	<p>The actuator was “pushed back” during push-motion operation in the push mode.</p> <p>Cause: Strong external force is applied to the work part.</p> <p>Action: Revise the mechanism around the work part so that strong external force will not apply to the work part. Or, increase the current limit value.</p>
0E0	Overload	<p>Cause: [1] The load increased due to external force. [2] The brake cannot be released on the actuator with brake. [3] The slide resistance of the actuator increased locally.</p> <p>Action: [1] Review the area around the work part. If abnormal external force is being applied, correct the situation. [2] Turn on the break release switch to check if the break will be released. If the brake is not released, a faulty brake, open cable, or defective brake circuit part in the controller is suspected. [3] Move the controller by hand, if possible, to check for points where large slide resistance is felt. In the case of [2] or [3], please contact IAI.</p> <p>Note: Before resuming the operation, always remove the cause of the alarm. If the controller power was turned off, wait for at least 30 minutes before turning on the power to protect the motor coil from burn damage.</p>

### (3) Cold Start Alarms

Code	Error	Cause/action
0C8	Overcurrent	<p><b>Cause:</b> The output current from the power circuit became abnormally high. This alarm does not occur in normal conditions of use, but it may occur when the motor coil isolation has deteriorated.</p> <p><b>Action:</b> Measure inter-phase resistance between motor connection leads U, V and W as well as isolation resistance relative to the ground, to check for deterioration of isolation. Please contact IAI before performing these measurements.</p>
0CB	Current sensor offset adjustment error	<p>The condition of the current detection sensor in the controller is checked in the initialization process after the controller is started. This alarm occurs when a sensor error was found in this check.</p> <p><b>Cause:</b> [1] Faulty current detection sensor or peripheral part [2] Inappropriate offset adjustment</p> <p><b>Action:</b> You must change the board or adjust the offset. Please contact IAI.</p>
0D8	Deviation overflow	<p>The position deviation counter has overflowed.</p> <p><b>Cause:</b> [1] The work part hit a nearby object during movement, and the speed has decreased as a result. [2] The acceleration setting is too high with respect to the payload. [3] The brake is not fitted correctly and thus it cannot be released properly.</p> <p><b>Action:</b> [1] Revise the mechanism around the work part so that strong external force will not apply to the work part. If [2] or [3] is suspected, please contact IAI.</p>
0E4	Encoder send error	<p>The controller and encoder exchange position data via serial communication. This error occurs when the data sent from the controller could not be received by the encoder successfully.</p> <p><b>Cause:</b> [1] Garbage data due to noise [2] Faulty communication IC mounted on the encoder board [3] Faulty communication IC mounted on the controller board</p> <p><b>Action:</b> [1] Turn off the power to all peripherals and move only the controller and actuator. If the error does not occur, noise is the likely cause. In the case of [2] or [3], the encoder or controller must be replaced. If the cause cannot be specified, please contact IAI.</p>



Code	Error	Cause/action
0E5	Encoder receive error	<p>The controller and encoder exchange position data via serial communication. This error occurs when the encoder did not return correct data in response to a request from the controller, or the battery voltage became low.</p> <p>Cause: [1] Low battery voltage (Absolute controllers are shipped with the encoder cable removed. On these controllers, this error always occurs when the power is turned on for the first time at the user's site.) [2] Open encoder extension cable or supplied actuator cable, or poor connector contact [3] Garbage data due to noise [4] Faulty communication IC mounted on the encoder board [5] Faulty communication IC mounted on the controller board</p> <p>Action: [1] If the error occurred after the power was turned on for the first time, be sure to perform an absolute reset. (Refer to 4-2, "Absolute Reset Procedure.") [2] Check the connector for possibility of open circuit, and examine the connection condition. (Perform a continuity check by referring to 2-5, "Supplied Cables.") [3] Turn off the power to all peripherals and move only the controller and actuator. If the error does not occur, noise is the likely cause. In the case of [4] or [5], the encoder or controller must be replaced. If the cause cannot be specified, please contact IAI.</p>
0E6	Encoder count error	<p>The ASIC mounted on the encoder board is unable to detect position information correctly.</p> <p>Cause: [1] When the absolute actuator is installed vertically, the acceleration limit was exceeded due to a rapid drop of the load caused by the brake being released when the power was cut off. (This error does not occur in normal conditions of use, but it may occur if the work part received external force from above.) [2] Foreign deposit on the cable wheel [3] The position relationship of cable wheel and photo-sensor changed due to axis center run-out caused by excessive external force, etc.</p> <p>Action: [4] Faulty component mounted on the encoder board If [1] is suspected, perform an absolute reset. In the case of [2] to [4], you must clean the cable wheel (by air blow), adjust the installation position again, or replace the motor unit or actuator. In any case, please contact IAI.</p>

Code	Error	Cause/action
0E7	Phase A/B/Z open	Encoder signal cannot be detected properly. Cause: [1] Open encoder extension cable or supplied actuator cable, or poor connector contact [2] Faulty encoder Action: [1] Check the connector for possibility of open circuit, and examine the connection condition. (Perform a continuity check by referring to 2-5, "Supplied Cables.") If the cable is normal, the encoder may be faulty. Please contact IAI.
0F8	Corrupt nonvolatile memory	Abnormal data was detected during the nonvolatile memory check at the startup. Cause: [1] Faulty nonvolatile memory [2] The memory was written more than 100,000 times. (As a rough guide, the nominal life of nonvolatile memory is around 100,000 rewrites.) Action: If the alarm occurs again after the power has been reconnected, please contact IAI.
0F9	Abnormal expansion RAM	Abnormal data was detected during the expansion RAM check at the startup. Cause: [1] Malfunction due to noise, etc. [2] Faulty RAM [3] Faulty circuit component around RAM Action: Reconnect the power. If the alarm occurs again, check for effect of noise. If you have a spare controller, change to the spare controller. If the alarm still occurs, noise is suspected. If the cause cannot be specified, please contact IAI.
0FB	Abnormal FPGA	The FPGA (gate array) is not operating properly in the absolute controller. Cause: [1] Malfunction due to noise, etc. [2] Faulty FPGA [3] Faulty circuit component around FPGA [4] The board in the controller is not installed properly. Action: Reconnect the power. If the alarm occurs again, check for effect of noise. If you have a spare controller, change to the spare controller. If the alarm still occurs, noise is suspected. If the cause cannot be specified, please contact IAI.

## 6.5 Messages Displayed during Operations Using Teaching Pendant or PC Software

The warning messages that may be displayed during operations using the teaching pendant or PC software are explained below.

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	When new data is added, data already exists in the last position of the position table. Clear or delete the data in the last position first.
117	No movement data	No target position is set under the selected position number. Input a target position first.
11E	Inconsistent data pair	The magnitude relationship of a pair of data is inappropriate. (Example) The same value is set in both the + and – soft limit parameters. Input appropriate values again.
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 part. If it misses the work part, 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 was actuated. (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.
20C	CSTR-ON during operation	The start signal (CSTR) was turned ON by the PLC while the actuator was moving. As a result, duplication of movement commands occurred.
20D	STP-OFF during operation	The hold signal (*STP) was turned OFF by the PLC while the actuator was moving. As a result, the actuator stopped.
20E	Soft limit over	A soft limit was reached.
20F	Missed work part in push-motion operation	The actuator missed the work part in push-motion operation. Check the work part condition and review the target position/positioning band settings.

Code	Message	Description
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] When RCP2 and ERC controllers are linked together via SIO converters, not all link cables are connected although 24 V is supplied to all converters. [4] The piano switches are set to the same number on multiple controllers being linked. 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] Do not set the piano switches to the same number on multiple linked controllers. If the message persists, please contact IAI.

# \* Appendix

## Specification List of Supported Actuators

	Model	Stroke (mm), maximum speed (mm/sec) (Note 1)												Loading capacity (Note 2)		Rated acceleration	
		50	100	150	200	250	300	350	400	450	500	550	600	Horizontal (kg)	Vertical (kg)	Horizontal (G)	Vertical (G)
Slider type	RCS-SA4-□-20-H-□□□	665												4	1	0.3	0.2
	RCS-SA4-□-20-M-□□□	330												5	2.5		
	RCS-SA4-□-20-L-□□□	165												5	4.5	0.2	
	RCS-SA5-□-20-H-□□□	800						760						4	1	0.3	
	RCS-SA5-□-20-M-□□□	400						380						8	2		
	RCS-SA5-□-20-L-□□□	200						190							4	0.2	
	RCS-SA6-□-20-H-□□□	800						760 640 540						6	1.5	0.3	
	RCS-SA6-□-20-M-□□□	400						380 320 270						12	3		
	RCS-SA6-□-20-L-□□□	200						190 160 135							6	0.2	
Rod type	RCS-RA35-I-20-H-□□□	500												4	1	0.3	0.2
	RCS-RA35-I-20-M-□□□	250												9	3		
	RCS-RA35-I-20-L-□□□	125												18	6.5	0.2	
	RCS-RA45-I-30-H-□□□	500												7	1.5	0.3	
	RCS-RA45-I-30-M-□□□	250												15	4		
	RCS-RA45-I-30-L-□□□	125												30	8.5	0.2	
	RCS-RA35R-I-20-H-□□□	500												4	1	0.3	0.2
	RCS-RA35R-I-20-M-□□□	250												9	3		
	RCS-RA35R-I-20-L-□□□	125												18	6.5	0.2	
	RCS-RA45R-I-30-H-□□□	500												7	1.5	0.3	
	RCS-RA45R-I-30-M-□□□	250												15	4		
	RCS-RA45R-I-30-L-□□□	125												30	8.5	0.2	
	RCS-RB7525-I-60-H-□□□	500						485 350						25	4	0.1	0.1
	RCS-RB7525-I-60-M-□□□	250						245 175						45	7	0.08	0.08
Flat type	RCS-F45-□-30-H-□□□	500												(Note 3)	1.5	0.3	0.2
	RCS-F45-□-30-M-□□□	250													4		
	RCS-F45-□-30-L-□□□	125													9		

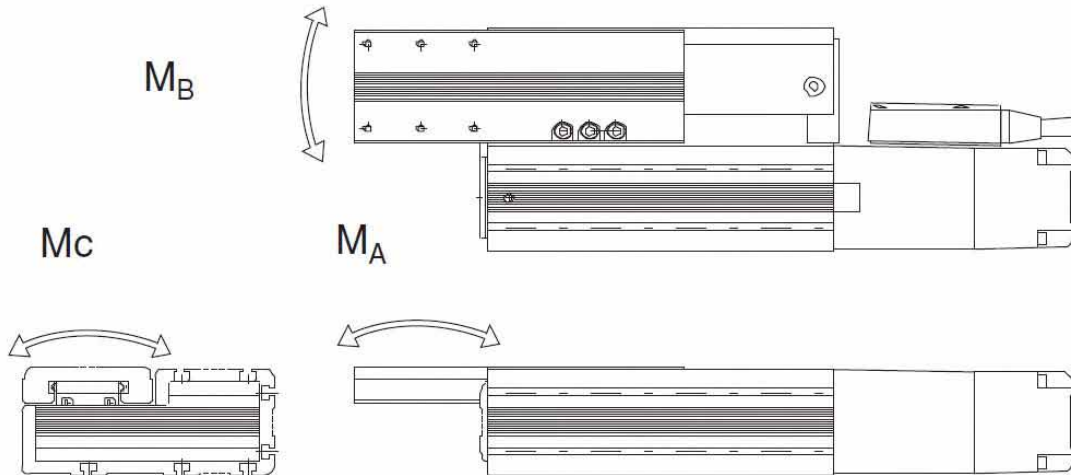
(Note 1) The figure in each elongated circle represents the maximum speed for the applicable stroke(s).

(Note 2) The loading capacity is calculated by assuming actuator operation at the rated acceleration.

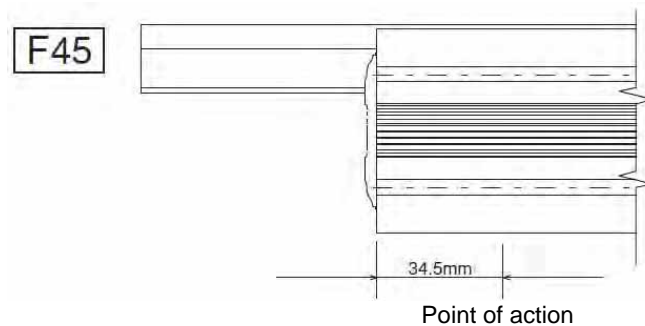
(Note 3) Refer to the table on the next page.

## Flat Type (F45) - Moments and Loading Capacity

The directions of moments generated around the flat type are shown in the figure below.

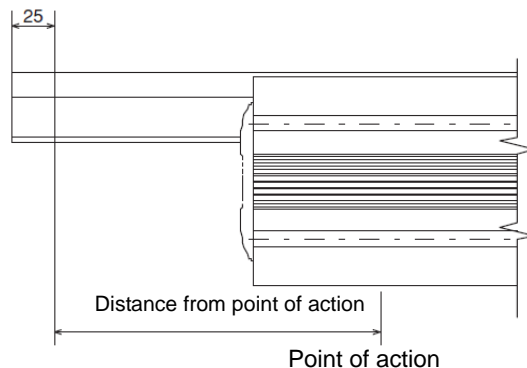


The points of action of  $M_a$  and  $M_b$  moments are shown in the figure below.



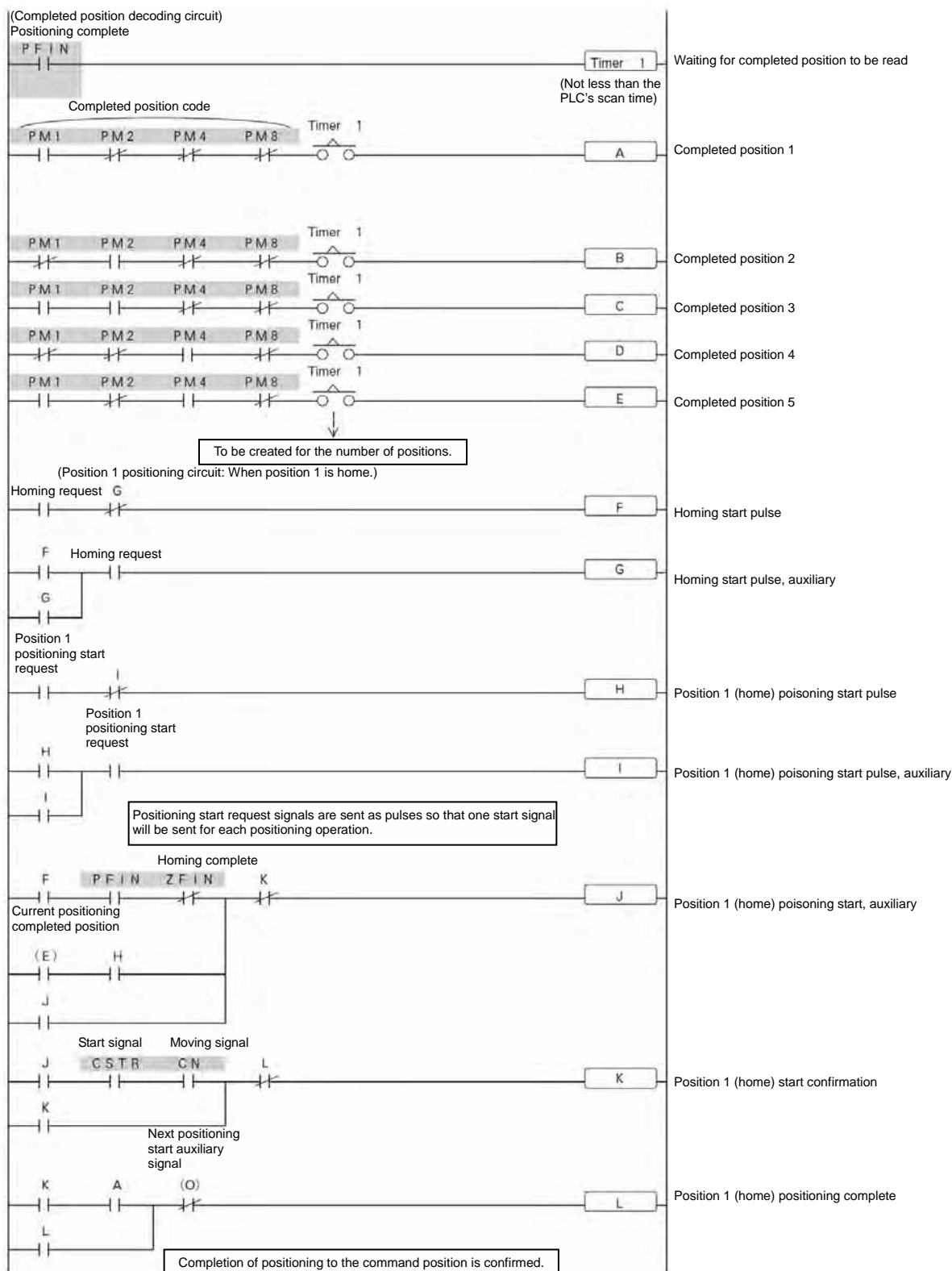
If the flat type is used horizontally, make sure the load applied to the end of the plate does not exceed the  $M_a$  moment. Refer to the table below listing the allowable loads at the tip as calculated from the  $M_a$  moment at each stroke.

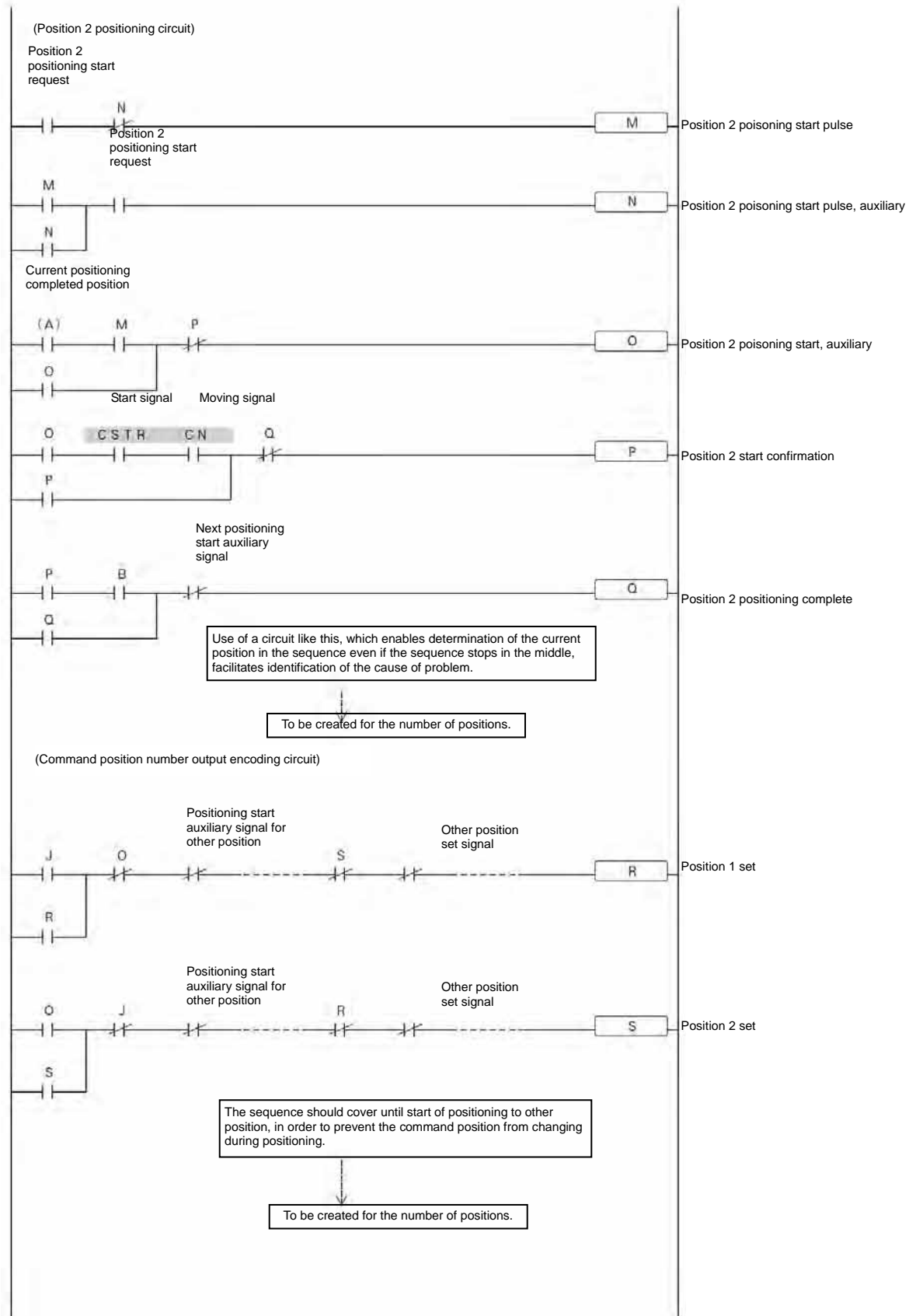
Stroke		50	100	150	200	250	300
F45 type	Distance from point of action (m)	0.06	0.11	0.16	0.21	0.26	0.31
	N	45.0	24.5	16.9	12.9	10.4	8.7
	(kgf)	4.59	2.50	1.72	1.31	1.06	0.89



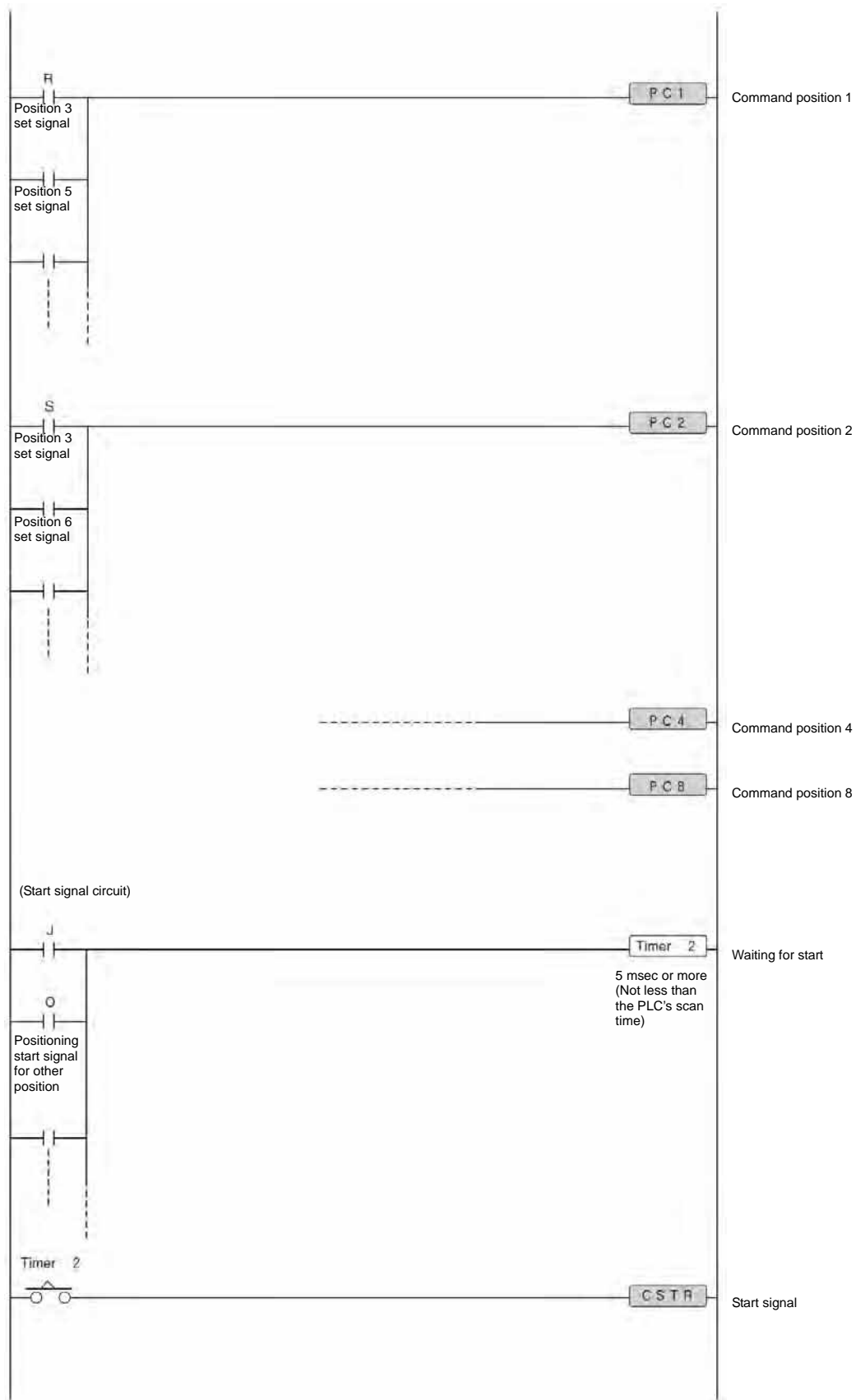
## Example of Basic RCS Positioning Sequence

An example of basic sequence is given below for reference when creating an RCS positioning sequence.  
 indicates a PIO signal of the RCS controller.









## Position Table Record (1/2)

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

No.	Position [mm]	Speed [mm/sec]	Acceleration/ deceleration [G]	Push [%]	Positioning band [mm]	Acceleration only MAX
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						

## Parameter Record

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

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

No.	Type	Name	Unit	Data
1	a	Zone limit + side	mm	
2	a	Zone limit – side	mm	
3	a	Soft limit + side	mm	
4	a	Soft limit – side	mm	
5	a	Home direction [0: Reverse/1: Forward]	-	
6	b	Push & hold recognition time	msec	
7	d	Servo gain No.	-	
8	b	Initial speed setting	mm/sec	
9	b	Initial acceleration/deceleration setting	G	
10	b	Initial positioning band (in-position)	mm	
11	b	Initial acceleration only MAX flag	-	
12	b	Current limit value during positioning stop	%	
13	b	Current limit value during homing	%	
14	b	Movement flag during stop	-	
15	c	Hold input disable selection [0: Enable/1: Disable]	-	
16	c	Serial communication speed	bps	
17	c	Minimum delay before slave transmitter activation	msec	
18		Reserved	-	
19		Reserved	-	
20		Reserved	-	
21	c	Servo ON input disable selection [0: Enable/1: Disable]	-	
22	a	Home offset	mm	

## Change History

Revision Date	Description of Revision
	First edition
November 2005	Sixth edition
June 2010	<p>Seventh edition</p> <ul style="list-style-type: none"> <li>• Added "Please Read Before Use" on the first page after the cover.</li> <li>• Deleted "Safety Precautions" before the table of contents and added "Safety Guide" immediately after the table of contents.</li> <li>• Deleted "Please Read Before Use" before the table of contents.</li> <li>• Specified "use environment of pollution degree 2" in 1.5.1, "Installation Environment" on p. 5.</li> <li>• Added "Change History" on the last page.</li> <li>• Updated the back cover. (Changed the addresses of the head office and sales offices, specified the 24-hour service of Eight, etc.)</li> </ul>





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