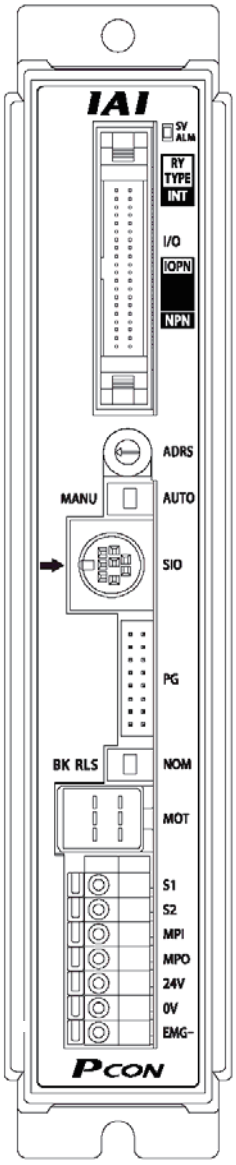
PCON

PCON-C/CG/CF
Controller
Positioner Type

Operation Manual Seventeenth 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 or DVD that comes with the product contains operation manuals for IAI products.
When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

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

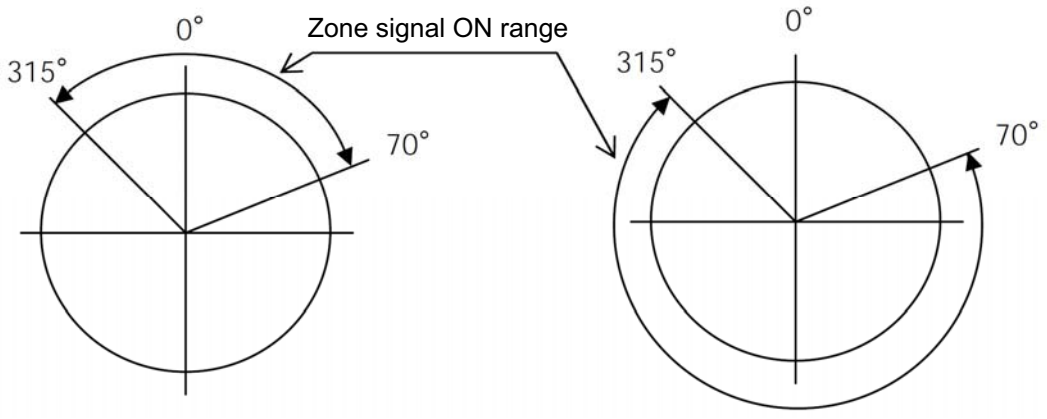
[Important]

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

- Changes to Zone Function

Applicable application versions: V0016 and later
Among the zone signal settings, those that result in “Zone setting+ < Zone setting-” are now effective.
V0015 and earlier: “Zone setting+ ≤ Zone setting-” → A zone signal is not output.
V0016 and later: “Zone setting+ = Zone setting-” → This is the only condition in which a zone signal is not output.
Accordingly, you can now output a zone signal even when a rotary actuator is operated over the 0° position in the index mode.
An example is given below.

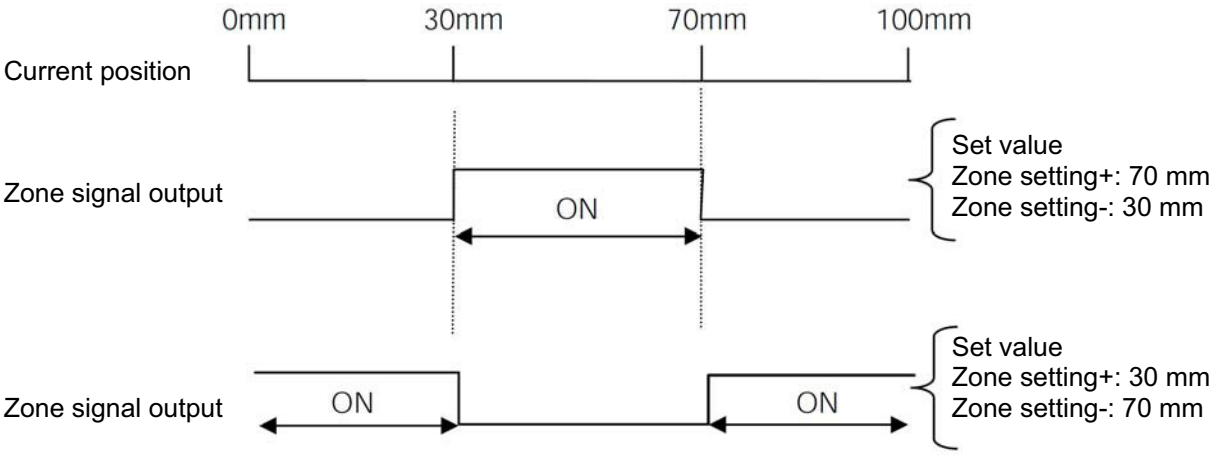
[Rotary actuator in index mode]



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

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

[Linear axis]



PCON	CAUTION

1. Use Environment

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

2. PC Software and Teaching Pendant Models

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

	Model number	Remarks
PC software	RCM-101-***	All are compatible with existing RCP2 controllers
Teaching pendant	CON-T, RCM-T	
Simple teaching pendant	RCM-E	
Data setting unit	RCM-P	
Touch panel display	RCM-PM-01	Not compatible with RCP2 controllers

3. Recommendation for Backing up Latest Data

This product uses nonvolatile memory to store the position table and parameters. Normally the memory will retain the stored data even after the power is disconnected. However, the data may be lost if the nonvolatile memory becomes faulty.
We strongly recommend that the latest position table and parameter data be backed up so that the data can be restored quickly when the controller must be replaced for a given reason.
The data can be backed up using the following methods:
[1] Save to a CD or FD from the PC software.
[2] Create a position table sheet or parameter sheet and keep a written record of backup.

4. Initial Parameter Settings at Startup

After applying power, at least the three parameters specified below must be set in accordance with the specific application.
Inappropriate settings of these parameters will prevent the controller from operating properly, so exercise due caution.
For details on how to set the parameters, refer to “Parameter Settings” in the operation manual for the PC or teaching pendant.

[1] Selecting the PIO pattern
This controller provides six PIO pattern types to meet the needs of various applications.
To select a desired type, set a corresponding value from 0 to 5 in parameter No. 25 (PIO pattern selection).
The factory setting is “0 [Standard type].”

Parameter No. 25 setting	Feature of PIO pattern
0	Standard type A basic type supporting 64 positioning points and two zone outputs. * How to set zone boundaries within which to output a zone signal: Zone boundaries are set using parameter Nos. 1 and 2 for one zone output, and in the position table for another zone output.
1	Teaching type In this type, 64 positioning points and one zone output (boundaries are set in the position table) are supported. In addition to the normal positioning mode, the user can also select the teaching mode in which the actuator can be jogged via commands from a PLC and the current actuator position can be written to a specified position. (Note 1) Jog commands from a PLC are also accepted in the positioning mode. (Note 2) Positions can be rewritten by approximately 100,000 times.
2	256-point positioning type The number of positioning points is increased to 256, so only one zone output is available (boundaries are set in the position table).
3	512-point positioning type The number of positioning points is increased to 512, so no zone output is available.
4	7-point type The number of positioning points is limited to seven to offer separate direct command inputs and position complete outputs for respective positions. PLC ladder sequence circuits can be designed easily.
5	3-point type Use of the controller as an air cylinder is assumed in this type. Position complete output signals function differently in this type, compared to the 7-point type. Specifically, the signal functions not only to “indicate position complete,” but also to “detect a position” in the same manner as auto-switches of an air cylinder.

[2] Enabling/disabling the servo ON input signal (SON)
The servo ON input signal has been added to allow for servo ON/OFF control on the PLC side. Depending on the needs, therefore, the user must enable/disable this signal.

To select a desired setting, set “0” or “1” in parameter No. 21 (Servo ON input disable selection).

Enable (use)	0
Disable (do not use)	1

The factory setting is “0 [Enable].”

[3] Enabling/disabling the pause signal (*STP)
The pause signal uses the contact b logic to provide a failsafe function.
Therefore, this signal must remain ON in normal conditions of use.
Since there are applications where this signal is not used, a parameter is provided to disable the pause signal so it doesn’ t have to be turned ON.

To select a desired setting, set “0” or “1” in parameter No. 15 (Pause input disable selection).

Enable (use)	0
Disable (do not use)	1

The factory setting is “0 [Enable].”

5. Using a Rotary Actuator in Multi-rotation Specification

Rotary actuators of multi-rotation specification models let you select multi-rotation operation or limited-rotation operation using a parameter.

5.1 Notes

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

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

5.2 Applicable Models

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

CE Marking

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

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Safety Guide

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

Safety Precautions for Our Products

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

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

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

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

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

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

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

Alert Indication

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

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

1. Overview

1.1 Introduction

This product is a dedicated RCP2 / RCP3 actuator controller that provides the same functions of the RCP2 controller as well as a set of new functions designed to achieve greater convenience and safety.
The product also provides a power-saving function in response to growing energy-saving needs.
The key features and functions are listed below.

- More positioning points
  The standard type supports up to 64 points, while the extended types can handle up to 512 points. Availability of more positioning points is ideal for production lines where many types of products are produced in small volumes.
- Setting of zone output boundaries for each position in the position table
  Before, zone output boundaries were set by parameters and therefore fixed. To add flexibility, new fields have been added to the position table so that different boundaries can be set for each position.
  This feature is useful in preventing contact with surrounding equipment and reducing the tact time, among others.
- Separate acceleration/deceleration settings
  Acceleration and deceleration are now set in separate fields of the position table.
  Depending on the material or shape of the load, it is desirable to reduce shock and vibration when the actuator stops.
  Since acceleration and deceleration can be set differently, only the deceleration value can be reduced to make the deceleration curve more gradual.
- Limitation of feed speed in test operation and adjustment
  The feed speed to be used in test operation and adjustment can be limited for added safety.
- Power-saving measures
  In general, pulse motors consume more holding current in standstill state than AC servo motors. This product provides a power-saving means to support situations where the actuator must stand by for a long period.

When actually starting up your system or if you have encountered any problem, also refer to the operation manuals for the actuator, teaching pendant, PC software and other components used with the system, in addition to this manual.

This manual does not cover all possible operations other than normal operations, or unexpected events such as complex signal changes resulting from use of critical timings. Accordingly, you should consider items not specifically explained in this manual as “prohibited.”

* We have made every effort to ensure precision of the information provided in this manual. Should you find an error, however, or if you have any comment, please contact IAI.
Keep this manual in a convenient place so it can be referenced readily when necessary.

1.2 How to Read the Model Specification

PCON - C - 56PI - NP - 2 - 0 - ABU - H

<Series>

<Type>
C: Positioner type with internal drive-power cutoff relay
CG: Positioner type with external drive-power cutoff relay
CF: High-output positioner type with internal drive-power cutoff relay

<Actuator type>
[Motor flange size]
20P: 20, square
28P: 28, square
28SP: 28, square (RA3 type only)
42P: 42, square
56P: 56, square
86P: 86 square
[Encoder type]
I: Incremental

<Input/output signal pattern>
NP: NPN (Sink type)
PN: PNP (Source type)
DV: DeviceNet connection specification
CC: CC-Link connection specification
PR: PROFIBUS connection specification
CN: CompoNet connection specification
ML: MECHATROLINK connection specification
EC: EtherCAT connection specification
EP: EtherNet/IP connection specification

<I/O flat cable length>
0: No cable
2: 2 m
3: 3 m
5: 5 m

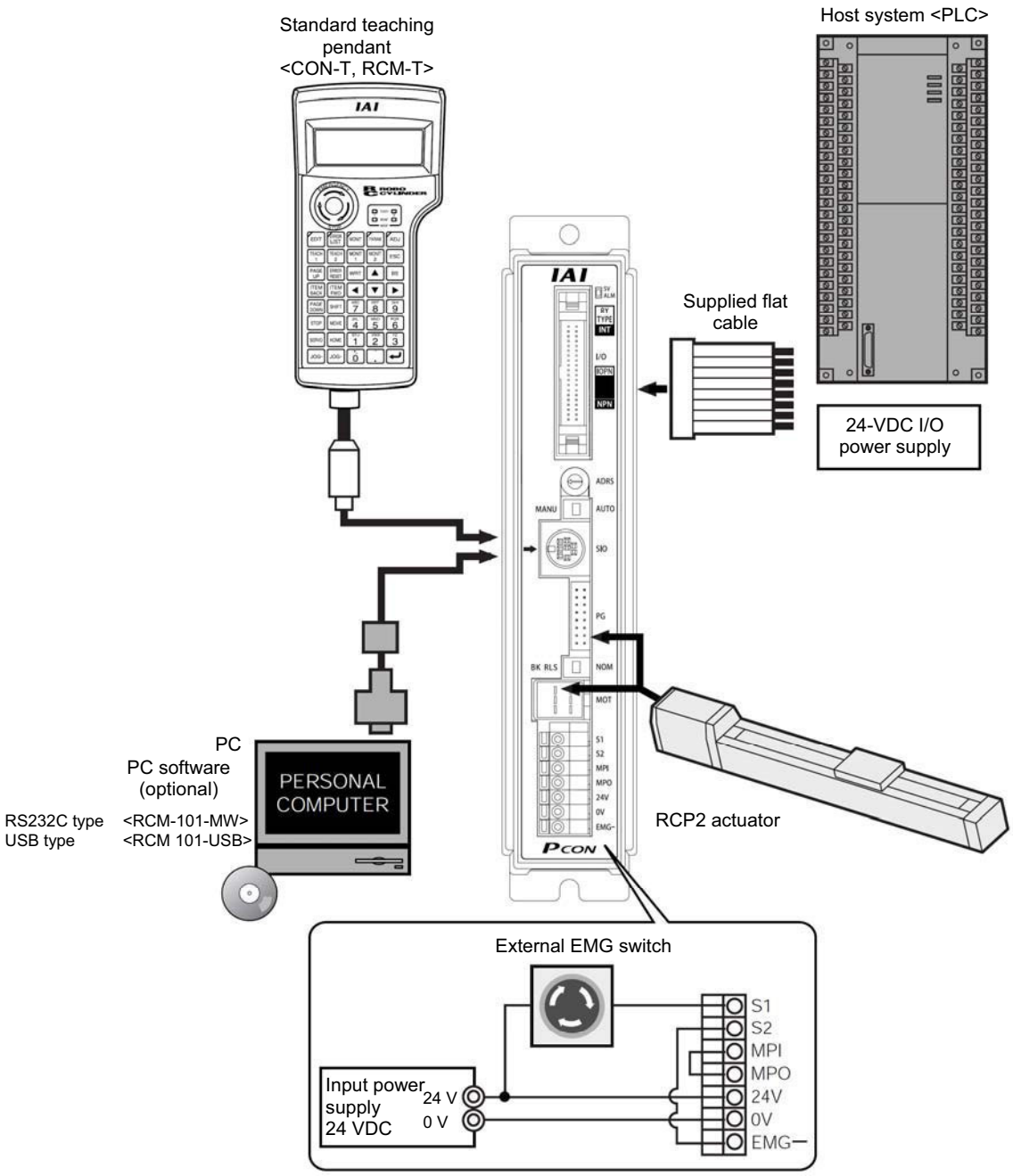
<Power-supply voltage>
0: 24 VDC

Specified for connecting the simple absolute unit

High-acceleration, loading specification

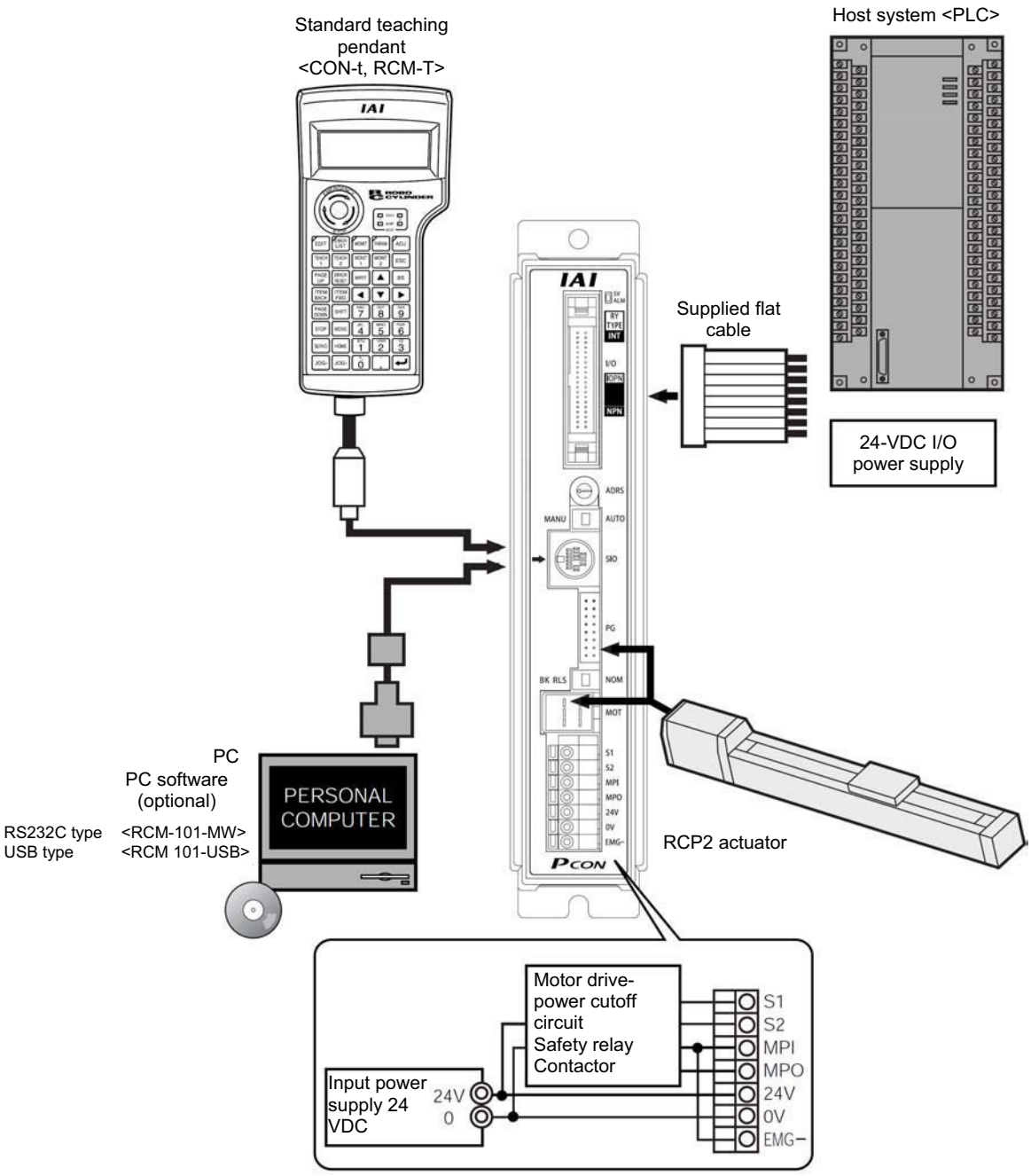
1.3 System Configuration

1.3.1 Internal Drive-Power Cutoff Relay Type (PCON-C/CF)



Caution: Connect one end of the EMG switch to the 24-V output of the input power supply and the other end to the S1 terminal. Also short the S2 and EMG terminals using a jumper wire.

1.3.2 External Drive-Power Cutoff Relay Type (PCON-CG)



1.4 Procedure from Unpacking to Test Operation and Adjustment

If you are using this product for the first time, carry out each step by referring to the procedure below to ensure that all necessary items are checked and all wires are connected correctly.

1 Check the content in the package

If you found any missing part or part specified for a different model, please contact your dealer.

- Controller
  PCON-C
  PCON-CG
  PCON-CF
- Actuator
- I/O flat cable
  CB-PAC PIO* * *
- Motor cable
  CB-RCP2-MA* * *
- Encoder cable
  CB-RCP2-PA* * *
- Operation manual

<Options>

- Teaching pendant
  RCM-T (standard)
  RCM-E (simple)
  RCM-P (data setting unit)
- PC software
  RC232C type <RCM-101-MW>
  RC232 type <RCM-101-USB>
  (Software comes with connection cables.)

2 Installation

[1] Affix the actuator first, and then install the robot hand. → Refer to the operation manual for the applicable actuator.

[2] Install the controller. → Chapter 3, “Installation”

3 Wiring/connection

- Wire the 24-V power supply.
- Connect the grounding wire to ground.
- Wire the emergency stop circuit and motor drive power supply.
- Connect the motor cable and encoder cable.
- Connect the I/O flat cable.

4 Turn on the power and check for alarms

Supply the 24-V power after confirming that the emergency stop circuit is not actuated.
If the monitor LED [SV/ALM] on the front face of the controller illuminates for two seconds and then turns off, the controller is functioning properly. If [SV/ALM] illuminates in red, it means an alarm has generated. Connect a PC or teaching pendant to check the nature of the alarm, and remove the cause by referring to Chapter 10, “Troubleshooting.”

5 Set the PIO pattern/safety speed

Set the mode selector switch on the front face of the controller to the “MANU” side.
On the PC screen or teaching pendant, set the MANU operating mode to [Teaching mode: Enable safety speed/Inhibit PIOs].
In this condition, set appropriate values in parameter No. 25 (PIO pattern selection) and parameter No. 35 (Safety speed).

* The factory-set PIO pattern and safety speed are “standard type” and “100 mm/s or less,” respectively. → Chapter 8, “Parameter Settings”

6 Turn on the servo

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

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

7 Check the operation of the safety circuit

Confirm that the emergency stop circuit (or motor drive-power cutoff circuit) operates properly.
→ Chapter 4, “Wiring”

8 Set a target position

Perform home return first, and then set a target position in the “Position” field for each position in the position table. Determine a desired position by finely adjusting the load or robot hand.

* Once a target position is set, all other fields (speed, acceleration/deceleration, positioning band, etc.) will be automatically populated with their default values. → Chapter 6, “Position Table Settings”
* To ensure safety, it is recommended that the safety speed be enabled during initial movements. To move the actuator at the actual speed set in the “Speed” field of the position table, change the MANU operating mode to [Teaching mode 2: Disable safety speed/Inhibit PIOs].

9 Trial operation and adjustment

Set the mode selector switch on the front panel of the controller to the “AUTO” side.
Input a movement command from the PLC to perform positioning.
If necessary, perform fine adjustments including the items specified below:

- Vibration or noise may generate depending on the weight, material or shape of the load. If vibration or noise is observed, lower the speed, acceleration and/or deceleration.
- To prevent contact with surrounding equipment or reduce the tact time, adjust the boundaries for each zone output signal and also adjust the positioning band.
- Adjust the current-limiting value, judgment time and push speed to be used in push & hold operation.

⚠ Caution: Before changing any parameter, set the mode selector switch to the “MANU” side. Or, keep the mode selector switch on the “AUTO” side and turn on the MODE input signal.

1.5 Warranty

1.5.1 Warranty Period

One of the following periods, whichever is shorter:

- 18 months after shipment from our factory
- 12 months after delivery to a specified location

1.5.2 Scope of Warranty

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

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

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

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

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

1.5.3 Honoring the Warranty

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

1.5.4 Limited Liability

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

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

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

(2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:
   [1] Medical equipment pertaining to maintenance or management of human life or health
   [2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
   [3] Important safety parts of mechanical equipment (such as safety devices)
   [4] Equipment used to handle cultural assets, art or other irreplaceable items

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

1.5.6 Other Items Excluded from Warranty

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

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

2. Specifications

2.1 Basic Specifications

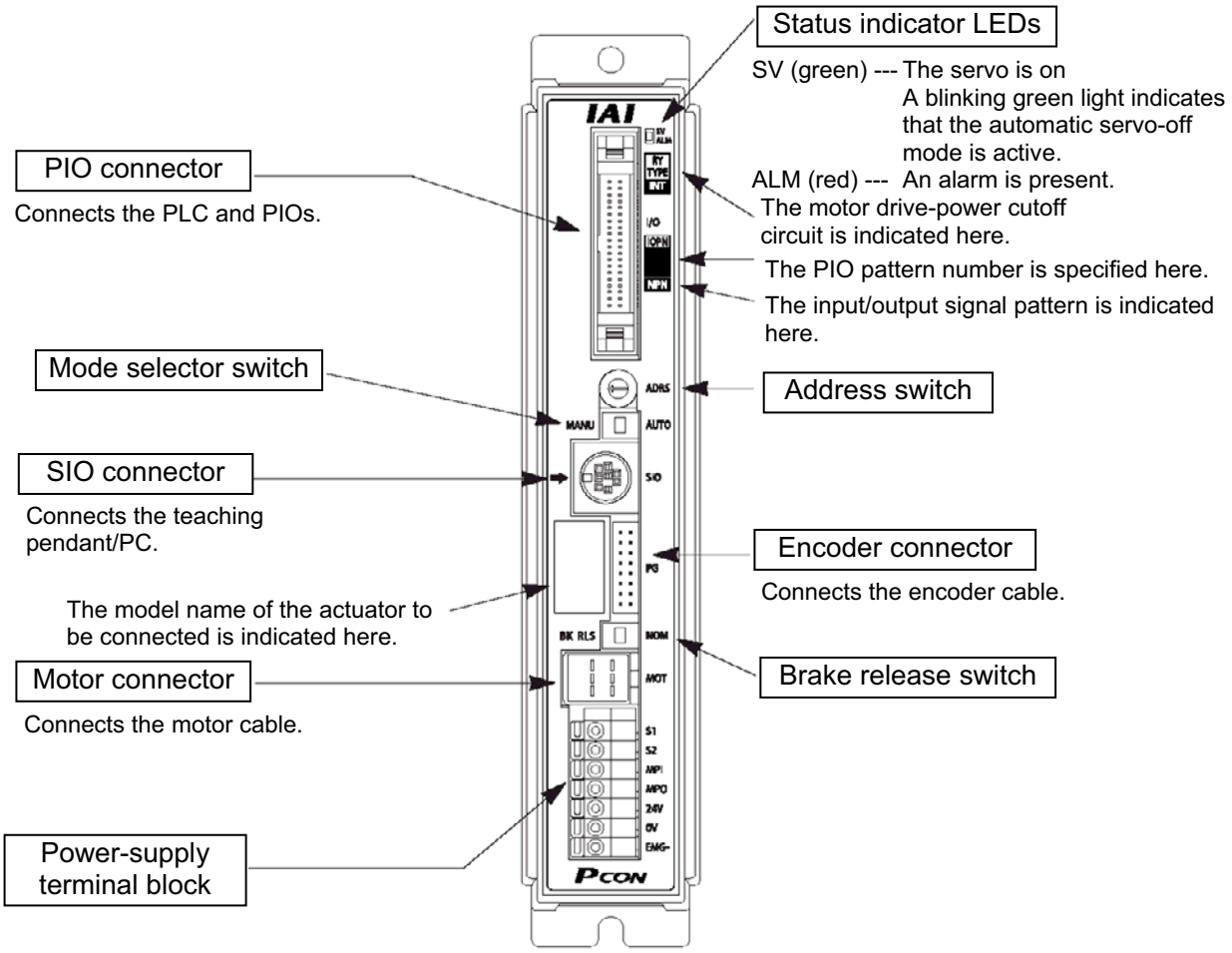
Specification item		PCON-C (Internal Drive-Power Cutoff Relay Type)		PCON-CG (External Drive-Power Cutoff Relay Type)		PCON-CF (Internal Drive-Power Cutoff Relay Type)	
Number of controlled axes		1 axis/unit					
Supply voltage		24 VDC ± 10%					
Power-source capacity	Actuator	Rated	Max. *2	Rated	Max. *2	Rated	Max. *3
	20, 28P motor	0.4 A	2.0 A	0.4 A	2.0 A		
	35, 42, 56P motor	1.2 A		1.2 A			
	86P motor					4.2 A	6.0 A
Heat output		9.6 W		9.6 W		26.4 W	
Control method		Weak field-magnet vector control					
Encoder resolution		Incremental specification 800 Puls/rev					
Positioning command		Number of positioning points: 64 points (standard) to 512 points (maximum) * The number of positioning points varies depending on the selected PIO pattern.					
Backup memory		Position data and parameters are saved in nonvolatile memory. Serial EEPROM can be rewritten approx. 100,000 times.					
PIO interface		24-VDC I/O					
LED indicators		SV (green) --- Servo on, ALM (red) --- Alarm present					
Serial communication		RS485, 1 channel (conforming to the Modbus protocol)					
Electromagnetic-brake forced release function		NOM/BK RLS switch (front panel)					
Cable length		Actuator cable: 20 m or less					
		I/O flat cable: 5 m or less					
Isolation strength		500 VDC, 10 MΩ					
Environment	Surrounding air temperature	0 to 40°C					
	Surrounding humidity	85%RH or less (non-condensing)					
	Surrounding environment	Refer to 3.1 Installation Environment					
	Storage temperature	-10 to 65°C					
	Storage humidity	90%RH or less (non-condensing)					
	Vibration resistance	10 to 57 Hz in XYZ directions / Pulsating amplitude: 0.035 mm (continuous), 0.075 mm (intermittent) 57 to 150 Hz in XYZ directions: 4.9 m/s^2 (continuous), 9.8 m/s^2					
Protection class		IP20					
Cooling method		Natural air cooling				Forced air cooling	
Weight		300 g or less		300 g or less		320 g or less	
External dimensions		35 W x 175.5 H x 68.1 D mm					

*1 Rush current of around 5 to 12 times the rated current flows for approx. 1 to 2 msec after the power is turned on. Take note that the value of rush current varies according to the impedance of the power-supply line.
*2 Excitation detection operation is performed after the power is turned on. The maximum current flows during this operation (normally for 100 msec).
Note, however, that approx. 6.0 A of current flows (for approx. 1 to 2 msec) if the motor drive source is cut off and then turned on again.
*3 Excitation detection operation is performed after the power is turned on. The maximum current flows during this operation (normally for 100 msec).
Note, however, that approx. 10.0 A of current flows (for approx. 1 to 2 msec) if the motor drive source is cut off and then turned on again.

For the +24-V DC power supply, select a unit of the “peak load accommodation” specification or having a sufficient allowance with respect to the peak load. In particular, exercise caution when your system has a remote sensing function.

⚠ Caution: Position data, parameters, etc., are written to the EEPROM. Take note that the EEPROM can be rewritten for up to approx. 100,000 times.

2.2 Name and Function of Each Part of the Controller



- Indication of PIO pattern number
  If you have multiple systems and a different PIO pattern is used for each system, it is recommended that you specify an applicable PIO pattern number on each controller to prevent confusion.

- Explanation of input/output signal pattern
  NPN --- Sink type
  PNP --- Source type

- Explanation of motor drive-power cutoff circuit
  INT --- PCON-C/CF [Internal drive-power cutoff relay type]
  EXT --- PCON-CG [External drive-power cutoff relay type]

- Indication of model name of actuator to be connected
  The type name, ball screw lead length and stroke of the applicable actuator are indicated. When connecting the cables, check this information to confirm that they are connected to the correct actuator.
  Example of indication:

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

■ Explanation of each switch

[1] Address switch

If multiple axes are used, the PC/teaching pendant must be plugged into/out of different connectors to communicate with different axes.
To save the hassle, you can use link cables to connect all axes via SIO converters.
Under this method, however, the PC/teaching pendant must be able to identify each axis by the number assigned to the axis.
This switch is used to set this number.
For details, refer to Chapter 9, “How to Connect a PC/Teaching Pendant to Multiple Axes.”

[2] Mode selector switch

This interlock switch is used to prevent unexpected movement or data rewrite as a result of duplicate operation in which a movement command is input from the PLC and operation using the PC/teaching pendant is performed at the same time.
AUTO: Always set to the “AUTO” side during auto operation using PIO signals from the PLC.
MANU: Always set to the “MANU” side during operation using the PC/teaching pendant.

[3] Brake release switch

When the actuator is equipped with a brake, this switch is used to forcibly release the brake.
RLS: Forcibly release the brake
NOR: Normal setting (The brake is released by the controller.)

△ Warning: The load may suddenly drop when the brake is forcibly released, so exercise due caution not to pinch your hand or damage the work part or robot hand by the falling load.

■ Explanation of power-supply terminal block

[1] PCON-C/CF [Internal drive-power cutoff relay type]

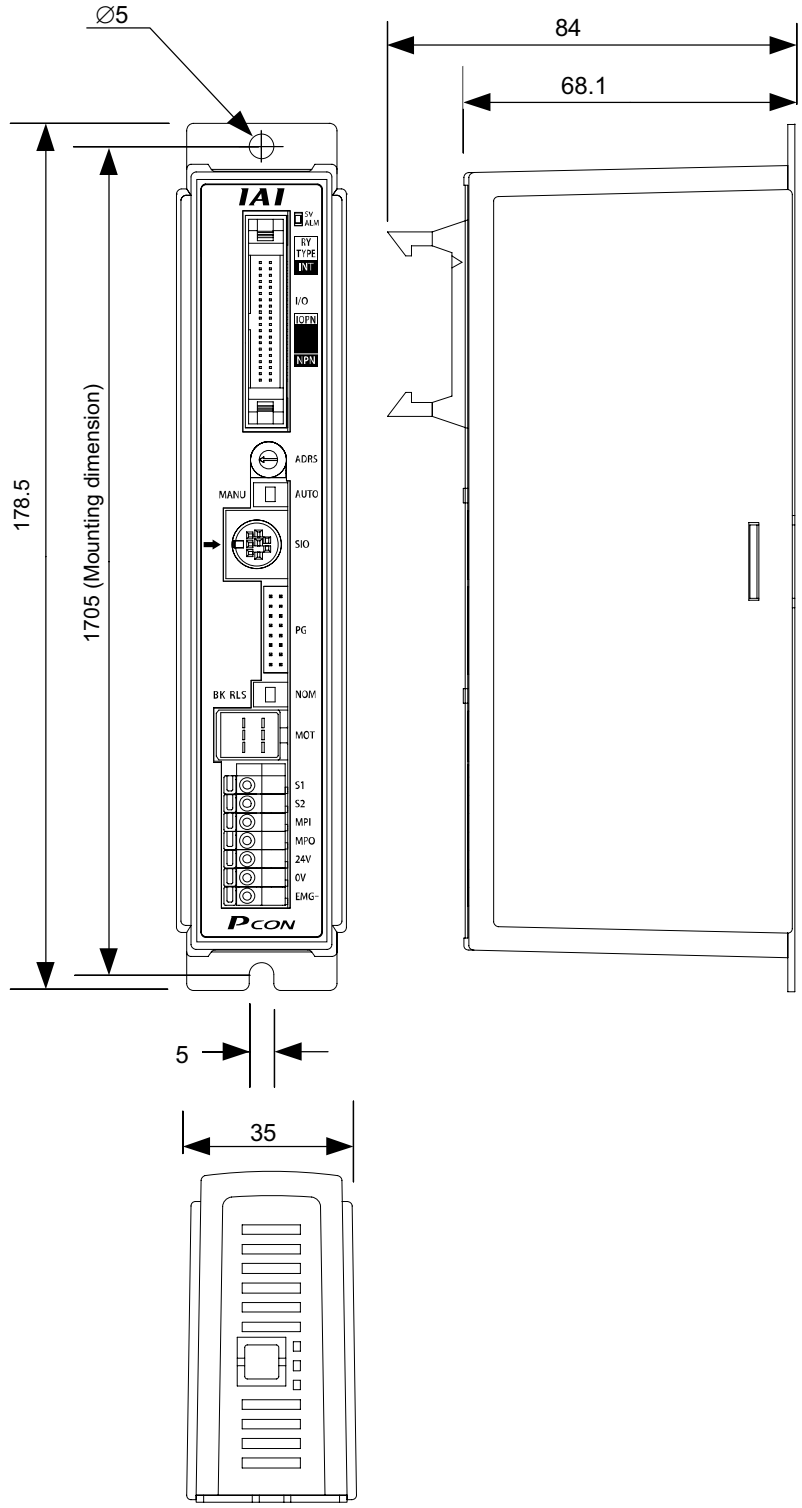
S1, S2	Provide a contact output for the emergency-stop button on the teaching pendant. * Whether or not a teaching pendant is connected is determined by an internal circuit. If no teaching pendant is connected, the S1 and S2 terminals are closed.
MPI, MPO	Provide a contact for cutting off the motor drive power. MPI and MPO represent the input side and output side of the motor power supply, respectively. (Short these terminals using a jumper wire if not used. The controller is shipped with MPI and MPO shorted.)
24V	Positive side of the 24-VDC input power supply
0V	Negative side of the 24-VDC input power supply
EMG-	Emergency-stop input

[2] PCON-CG [External driver-power cutoff relay type]

S1, S2	Provide a contact output for the emergency-stop button on the teaching pendant. * Whether or not a teaching pendant is connected is determined by an internal circuit. If no teaching pendant is connected, the S1 and S2 terminals are closed.
MPI, MPO	Motor drive-power cutoff contacts conforming to safety category 1 MPI and MPO represent the input side and output side of the motor power supply, respectively. (Connect an external safety circuit.)
24V	Positive side of the 24-VDC input power supply
0V	Negative side of the 24-VDC input power supply
EMG-	Emergency stop signal detection

2.3 External Dimensions

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



3. Installation and Noise Elimination

Pay due attention to the installation environment of the controller.

3.1 Installation Environment

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

[1] Installation Environment

Do not use this product in the following environment.

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

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

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

[2] Storage and Preservation Environment

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

3.2 Power Supply

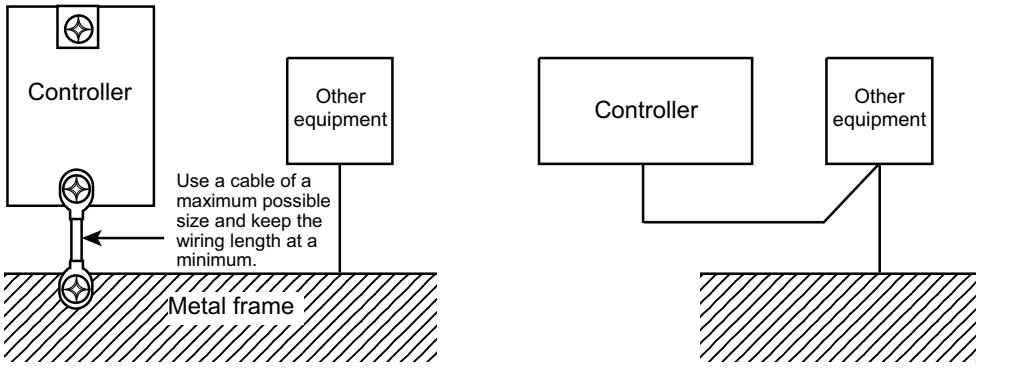
The power supply specification is 24 VDC ± 10%.
(Supply current: 2 A max.: C/CG, 6 A: CF)

3.3 Noise Elimination and Grounding

This section explains how to eliminate noise in the use of the controller.

(1) Wiring and power supply

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



Class D grounding Good Avoid this grounding method.

[2] Precautions regarding wiring method

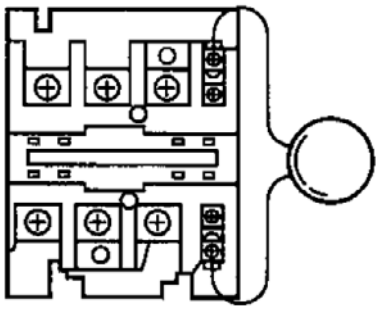
Use a twisted cable for connection to the 24-VDC external power supply.
Separate the controller cables from high-power lines such as a cable connecting to a power circuit. (Do not bundle together the controller cables with high-power lines or place them in the same cable duct.)
When extending the supplied motor cable or encoder cable, consult IAI's Technical Support.

(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

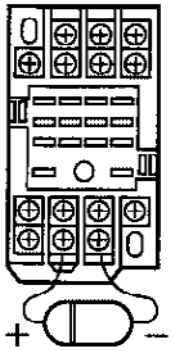
Measure: Install a surge absorber in parallel with the coil.



← 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.

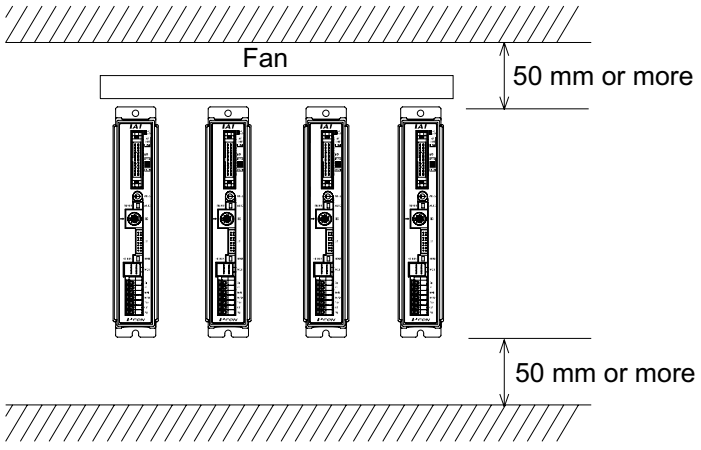
3.4 Heat Radiation and Installation

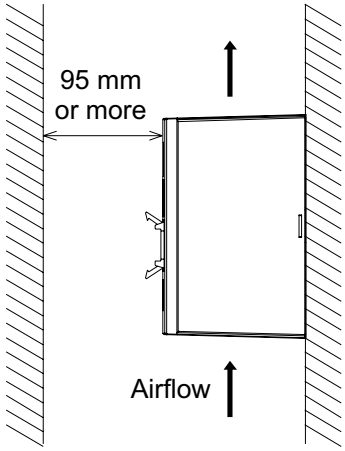
Design the control panel size, controller layout and cooling method in such a way that the temperature around the controller will not exceed 40°C.

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 95 mm.





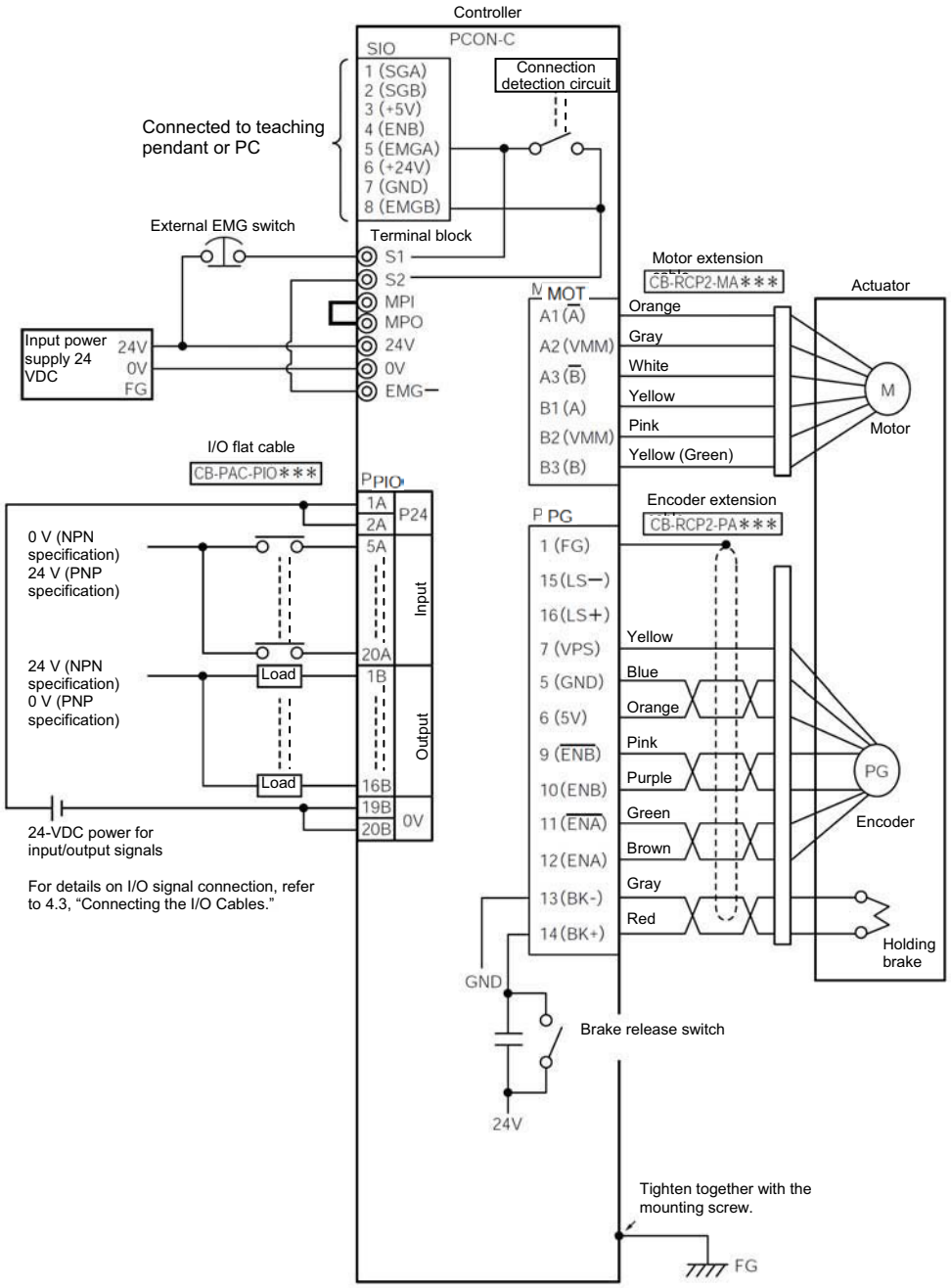
Regardless of whether your system consists of a single controller or multiple controllers, provide sufficient clearances around each controller so that it can be installed/removed easily.

4. Wiring

4.1 Internal Drive-Power Cutoff Relay Type (PCON-C/CF)

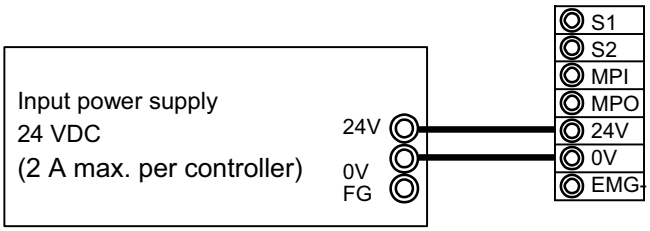
4.1.1 External Connection Diagram

An example of standard wiring is shown below.
(Note) The encoder cable shown in the example is the standard cable.
As for the robot cable, refer to 4.4.1 as the color of the cable is different.



4.1.2 Wiring the Power Supply/Emergency-Stop Switch

(1) Wiring the power supply



To connect multiple controllers, provide a relay terminal block.
Use a power cable satisfying the following specifications:

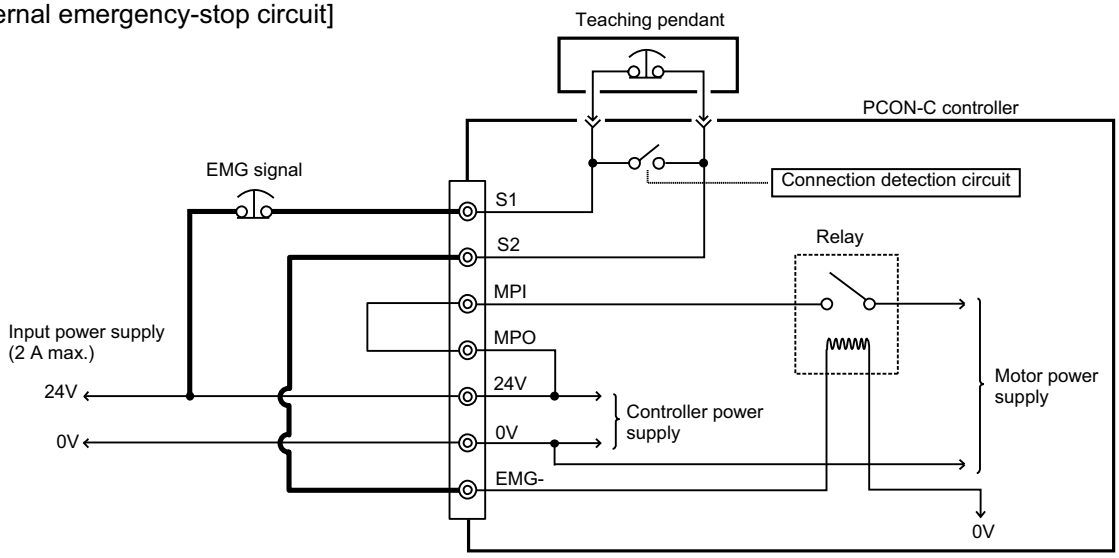
Item	Specification
Applicable wire length	Single wire: ∅1.0 / Stranded: 0.8 mm^2, AWG size 18, (copper wire)
Stripped wire length	10 mm
Temperature rating of isolated sheath	60°C or above

* Use a flathead screwdriver with a blade tip of approx. 2.6 mm to push in the wire.

(2) Wiring the emergency-stop switch

In many cases multiple controllers are used in a single system.
To provide an emergency-stop function for the entire system, the controller circuit is designed in such a way that a single EMG switch is able to actuate an emergency stop in all connected controllers.

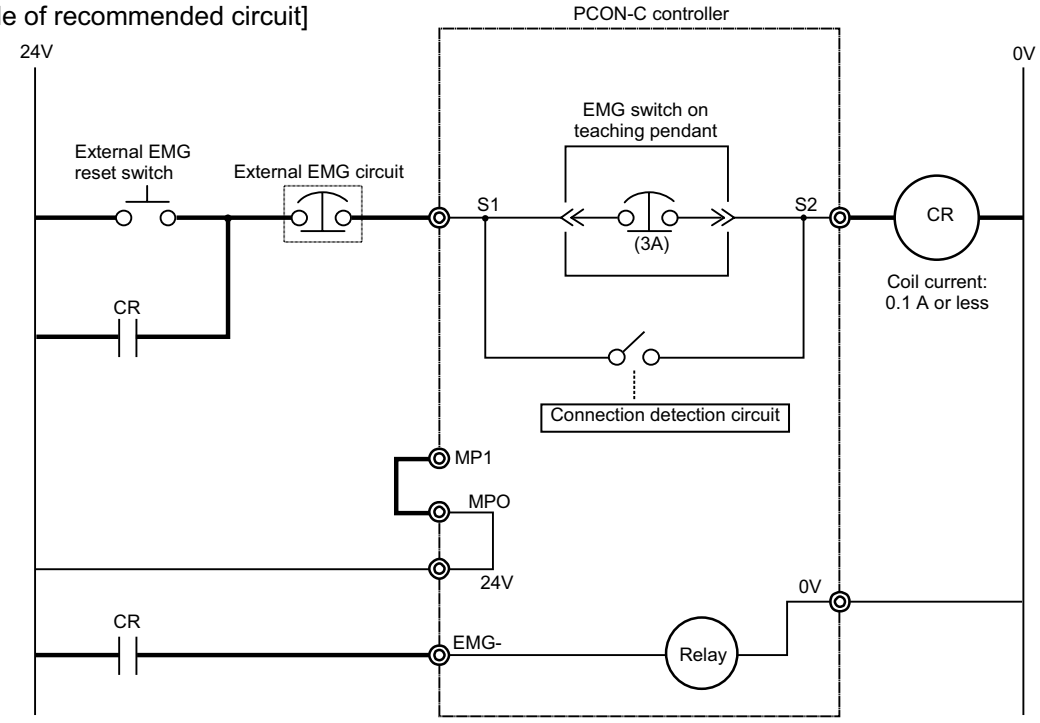
[Internal emergency-stop circuit]



(Note) The current consumption of the internal relay is 10 mA or less.

(Reference)	Cutoff voltage	Cutoff current
EMG switch on teaching pendant	30 VDC	3 A

[Example of recommended circuit]



(Note) To cut off the motor drive power supply in conformance with safety category 2, connect 24V to the EMG terminal and a contactor or other contact device to the MPI/MPO terminals. (Refer to 4.2.3; rush current: 8 A.)

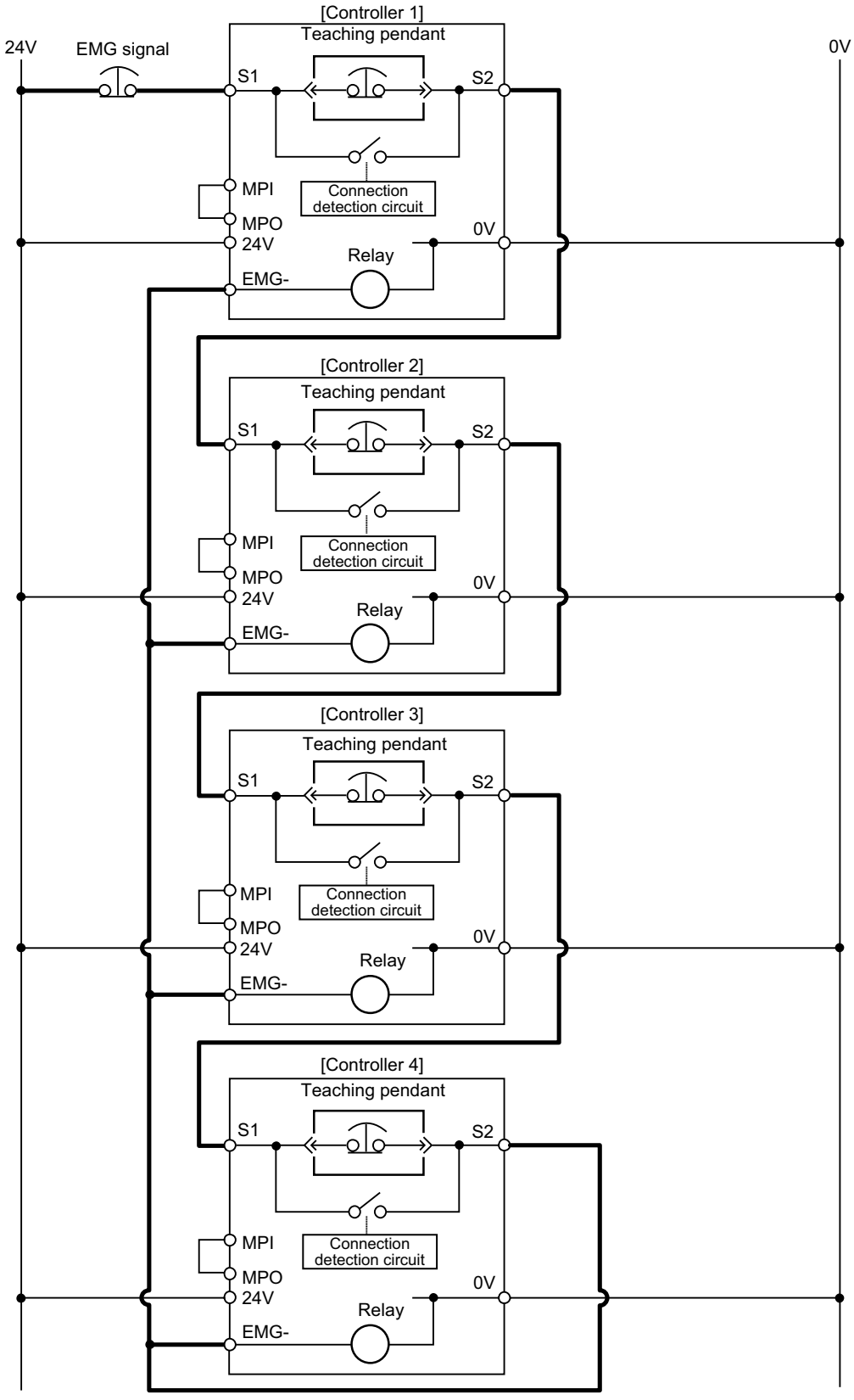
Representative connection examples are explained below.

- Connecting the teaching pendant directly to the controller

[1] Connecting multiple controllers (8 units or less) using a single power supply

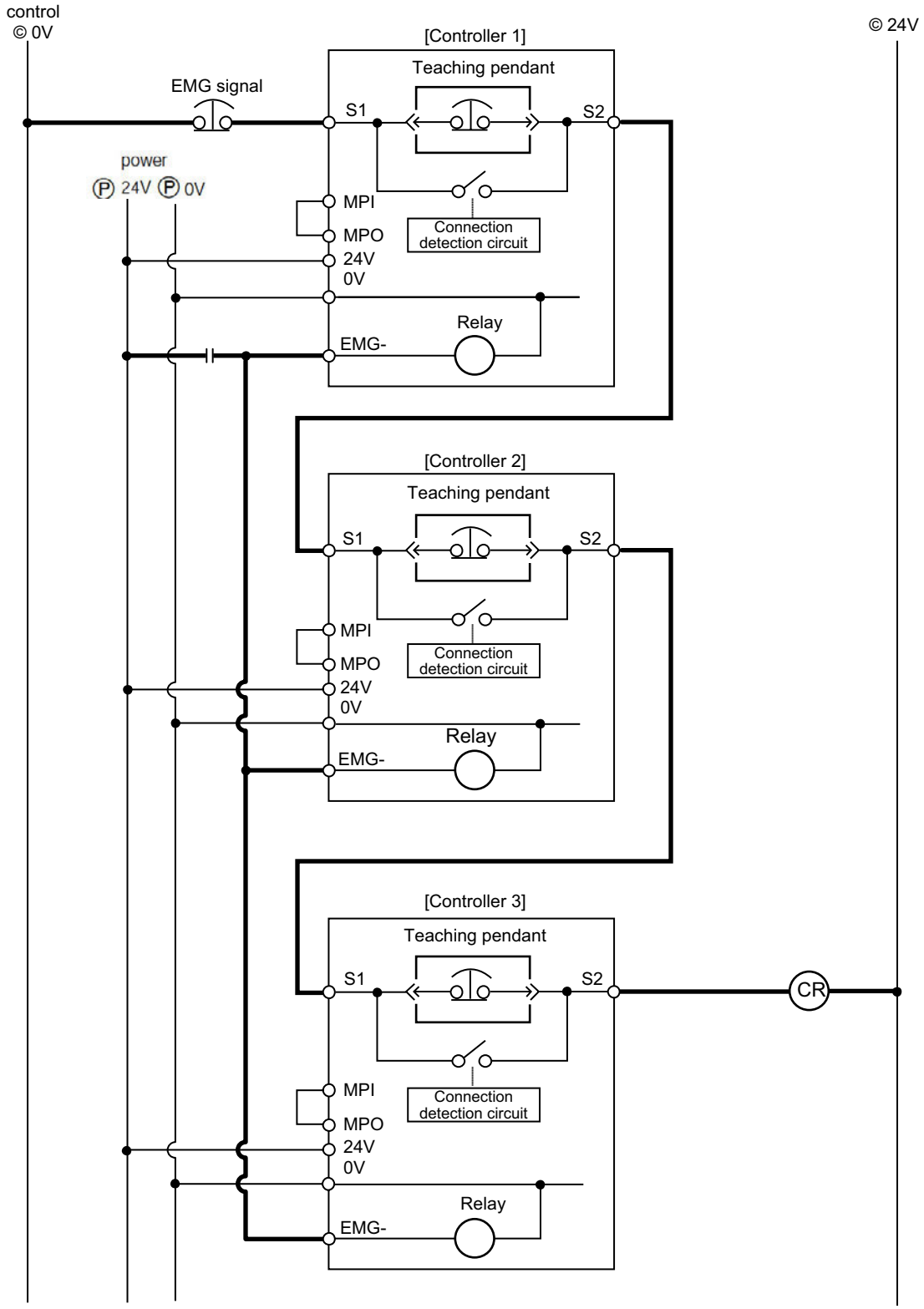
- Short the MPI and MPO terminals using a jumper wire. (The controller is shipped with these terminals shorted.)
- Connect one end of the EMG signal to the 24-V output of the input power supply and the other end to the S1 terminal.

Then, provide connections by sequentially connecting the S2 terminal of controller 1 to the S1 terminal of controller 2, the S2 terminal of controller 2 to the S1 terminal of controller 3, and so on, and connect the S2 terminal on the last controller to the EMG terminals on all controllers.
Use a relay terminal block for connection to the EMG terminals.
(Note) Do not connect two or more wires to one terminal.

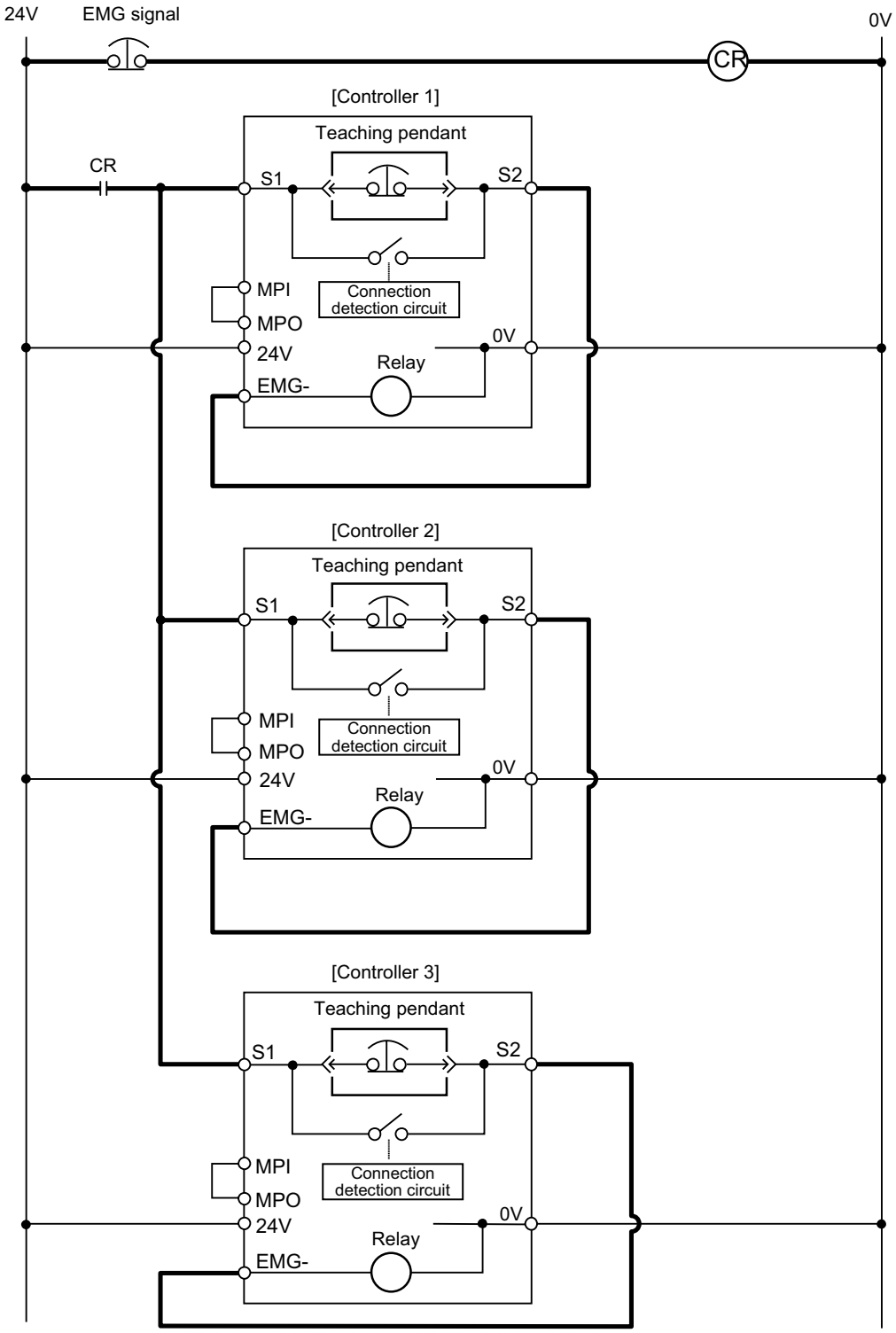

[Controller 1]
Teaching pendant
24V
EMG signal
0V
S1
S2
MPI
MPO
24V
EMG-
Connection detection circuit
Relay
0V
[Controller 2]
Teaching pendant
S1
S2
MPI
MPO
24V
EMG-
Connection detection circuit
Relay
0V
[Controller 3]
Teaching pendant
S1
S2
MPI
MPO
24V
EMG-
Connection detection circuit
Relay
0V
[Controller 4]
Teaching pendant
S1
S2
MPI
MPO
24V
EMG-
Connection detection circuit
Relay
0V

[2] Using a power supply other than the input power supply

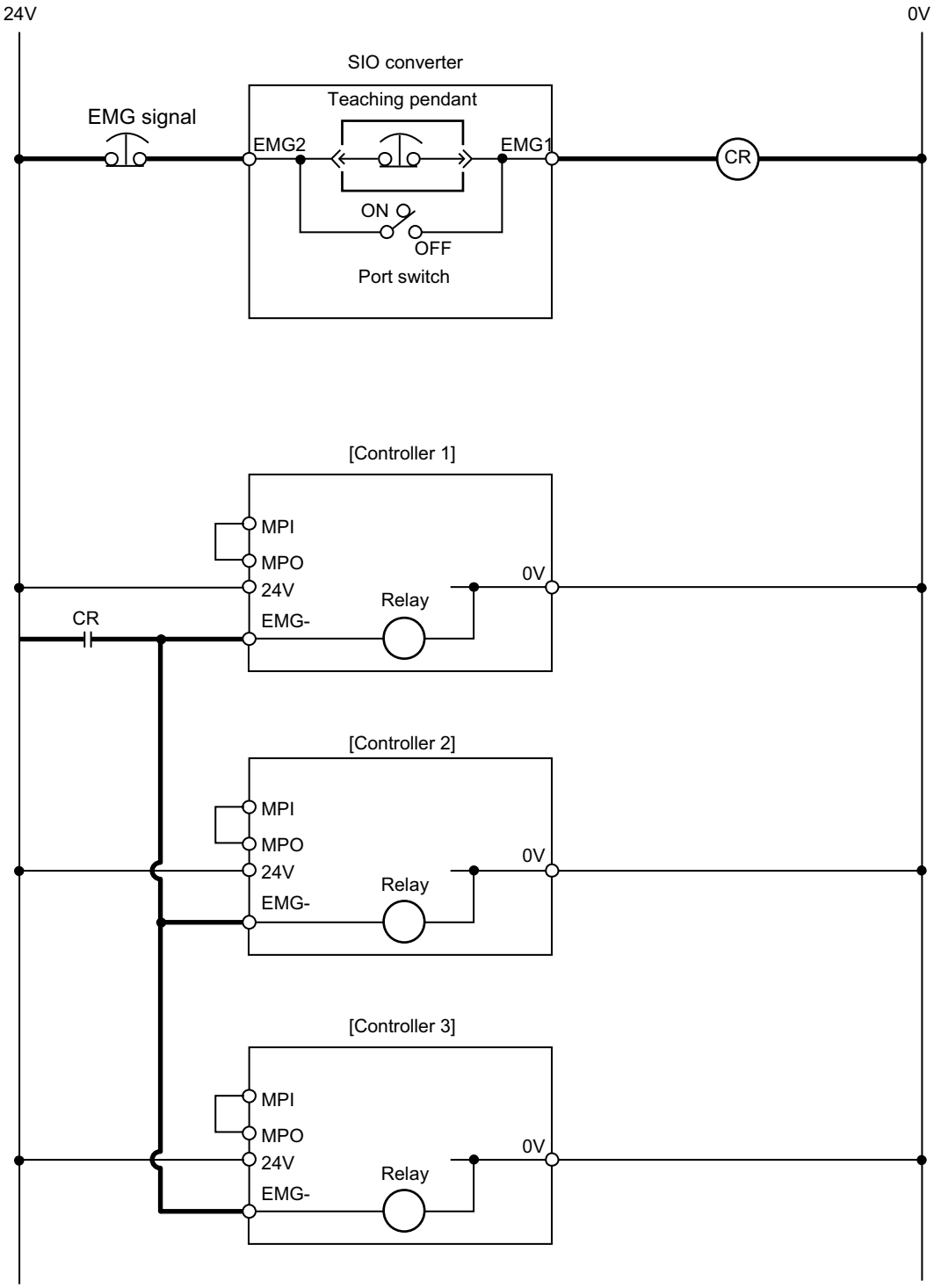
(Note) Use an auxiliary relay with a coil current of 0.1 A or less and connect a diode for coil surge absorption.



[3] Enabling the EMG switch on the teaching pendant for the connected axis or axes only



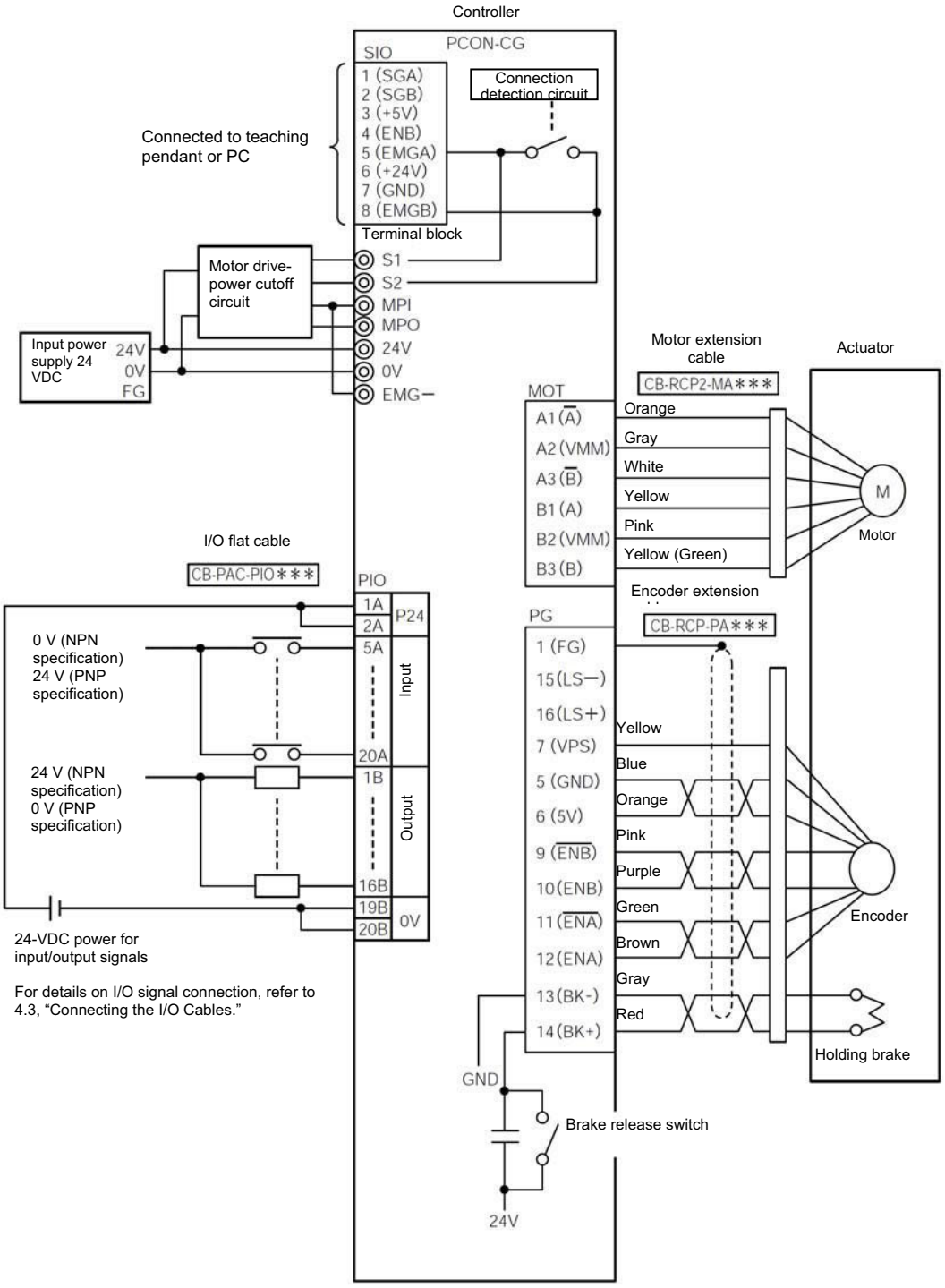
- Connecting the teaching pendant to a SIO converter
  Configure the contact circuit for the EMG switch on the teaching pendant using EMG1/EMG2 on the power/emergency-stop terminal block on the SIO converter.
  (S1/S2 on the controller's terminal block are not used.)



4.2 External Drive-Power Cutoff Relay Type (PCON-CG)

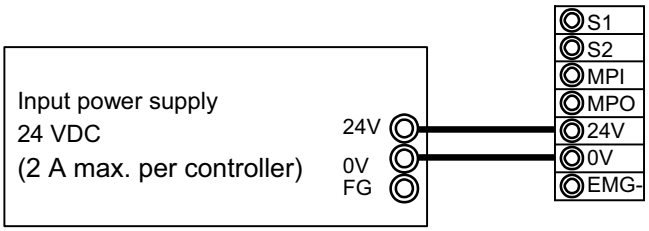
4.2.1 External Connection Diagram

An example of standard wiring is shown below.
(Note) The encoder cable shown in the example is the standard cable.
As for the robot cable, refer to 4.4.1 as the color of the cable is different.



4.2.2 Wiring the Power Supply/Emergency-Stop Switch

(1) Wiring the power supply



To connect multiple controllers, provide a relay terminal block.
Use a power cable satisfying the following specifications:

Item	Specification
Applicable wire length	Single wire: ∅1.0 / Stranded: 0.8 mm^2, AWG size 18, (copper wire)
Stripped wire length	10 mm
Temperature rating of isolated sheath	60°C or above

* Use a flathead screwdriver with a blade tip of approx. 2.6 mm to push in the wire.

(2) Wiring the motor power cutoff relay

Explained below is a safety circuit conforming to safety category 2.
The user is responsible for implementing additional safety measures in the actual circuit configuration, such as providing double contactor contacts to prevent fusing.

The circuit illustrated below is for reference purposes only.

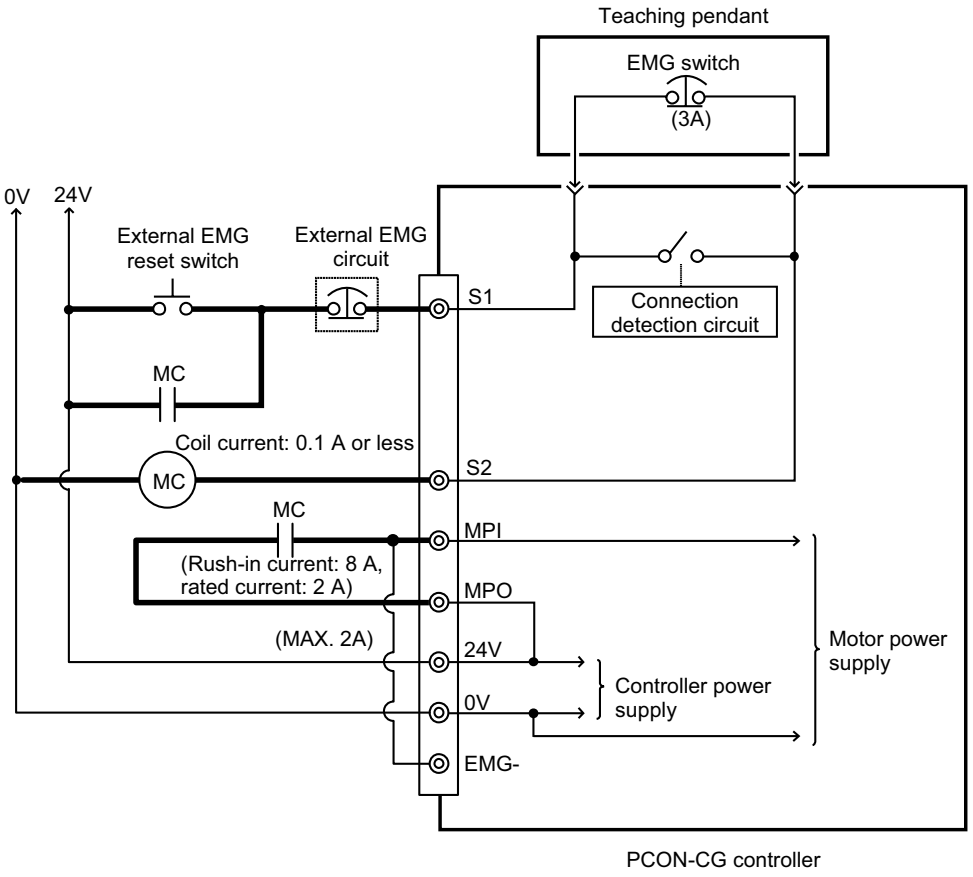
- The input side of the motor drive power supply is connected to the MPI terminal, while the output side is connected to the MPO terminal. Connect a contactor or other contact device to these terminals.

(Note) The rush current must be 8 A or less. The rated current is 2 A.

- The contact for the EMG switch on the teaching pendant is provided by the S1/S2 terminals.

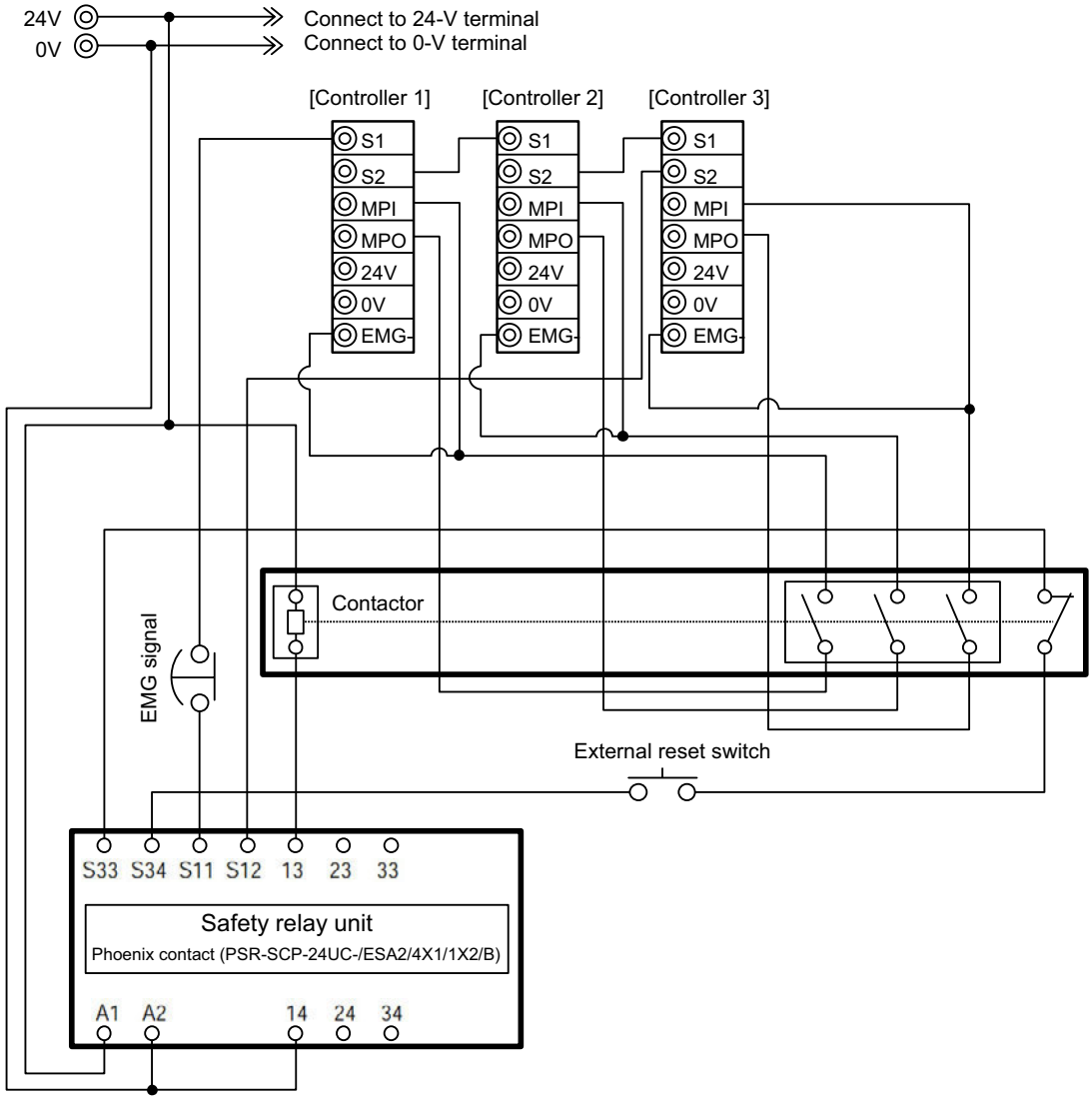
(Note) When connecting the teaching pendant to a SIO converter, the contact for the EMG switch on the teaching pendant is provided by the EMG1/EMG2 terminals on the SIO converter.

[Example of basic circuit]



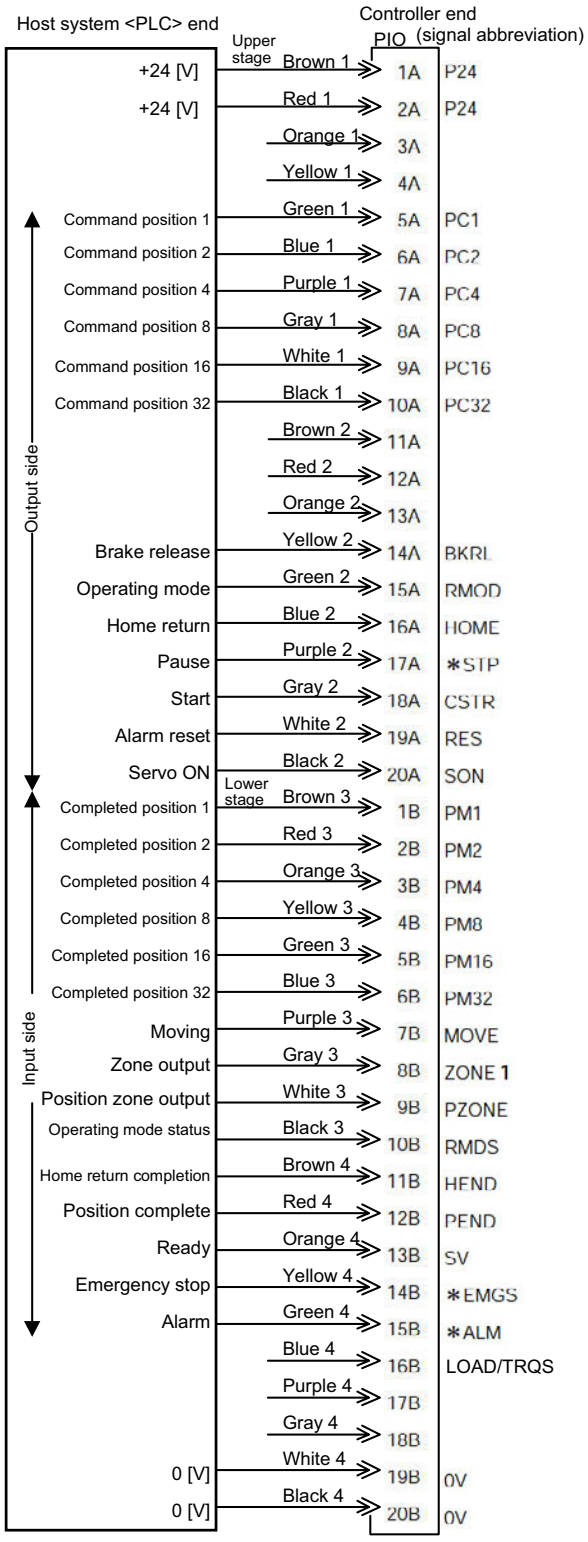
[Connection example of a multiple-axis configuration]

Input power supply



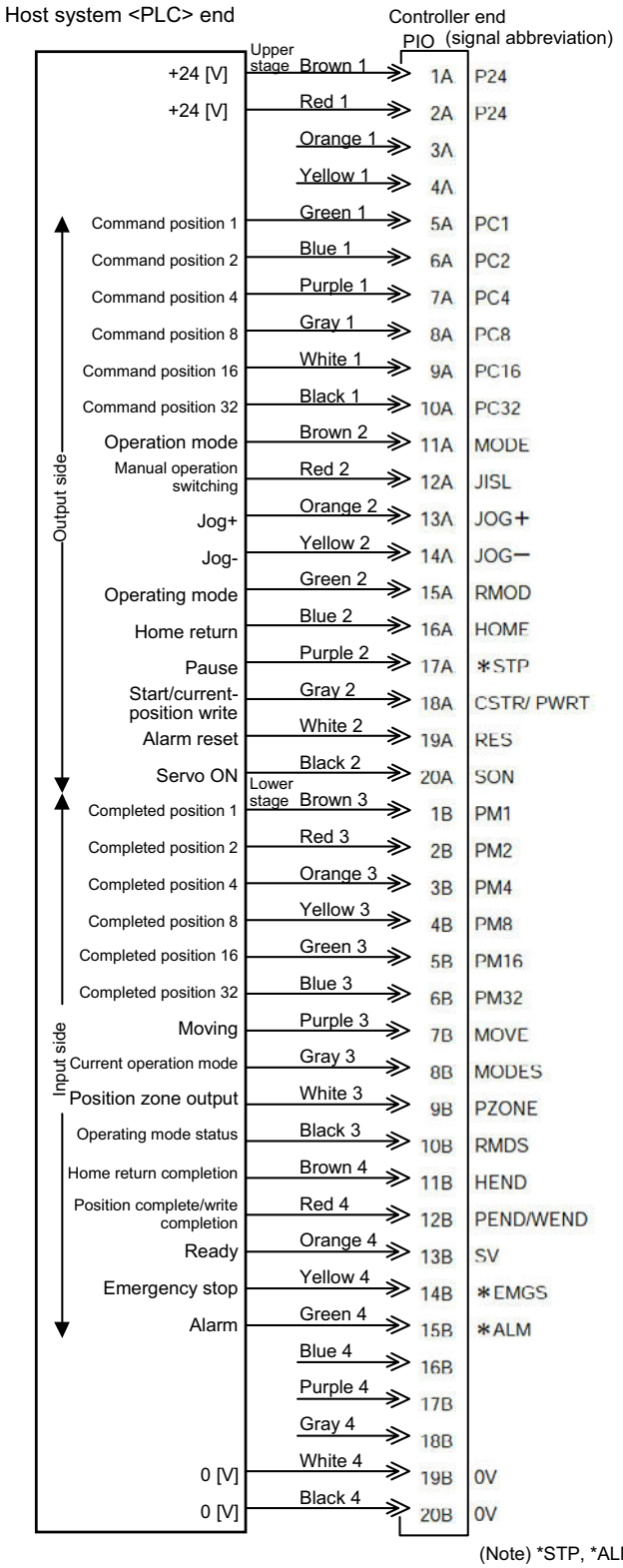
4.3 Connecting the I/O Cables

- PIO pattern 0 [Standard Type]



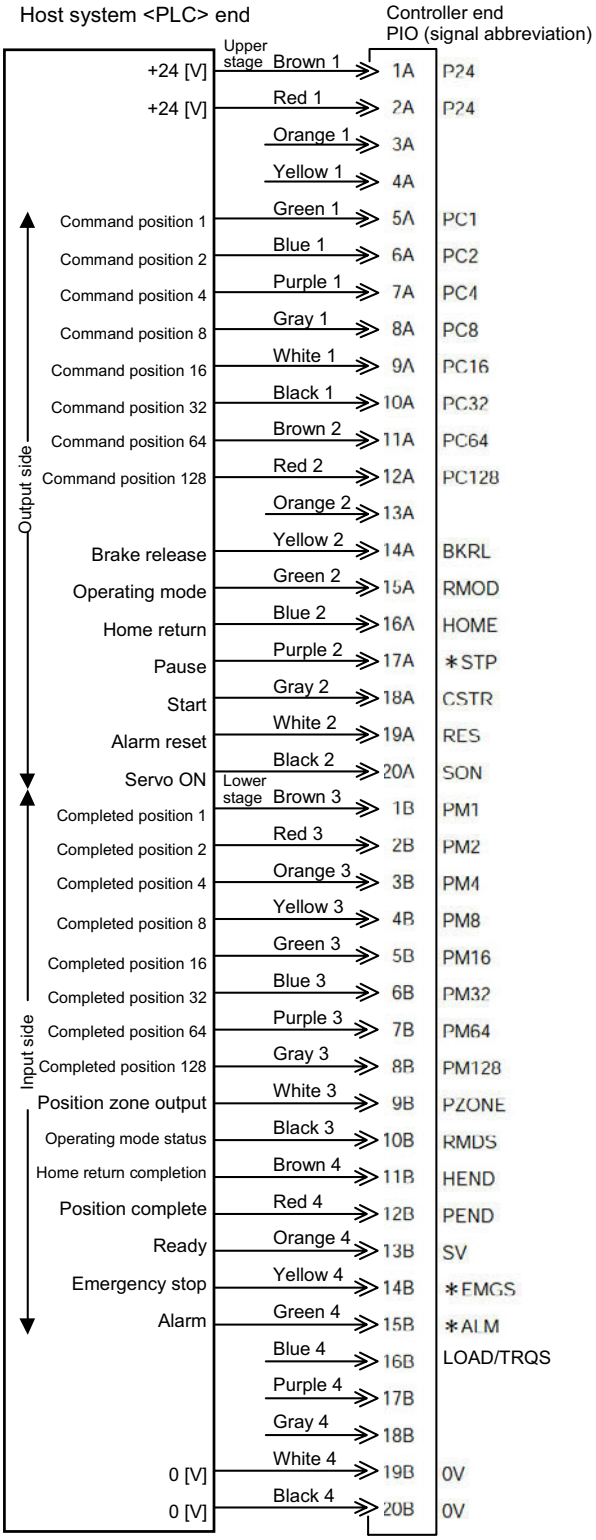
(Note) *STP, *ALM and *EMGS are based on the negative logic.

- PIO pattern 1 [Teaching Type]



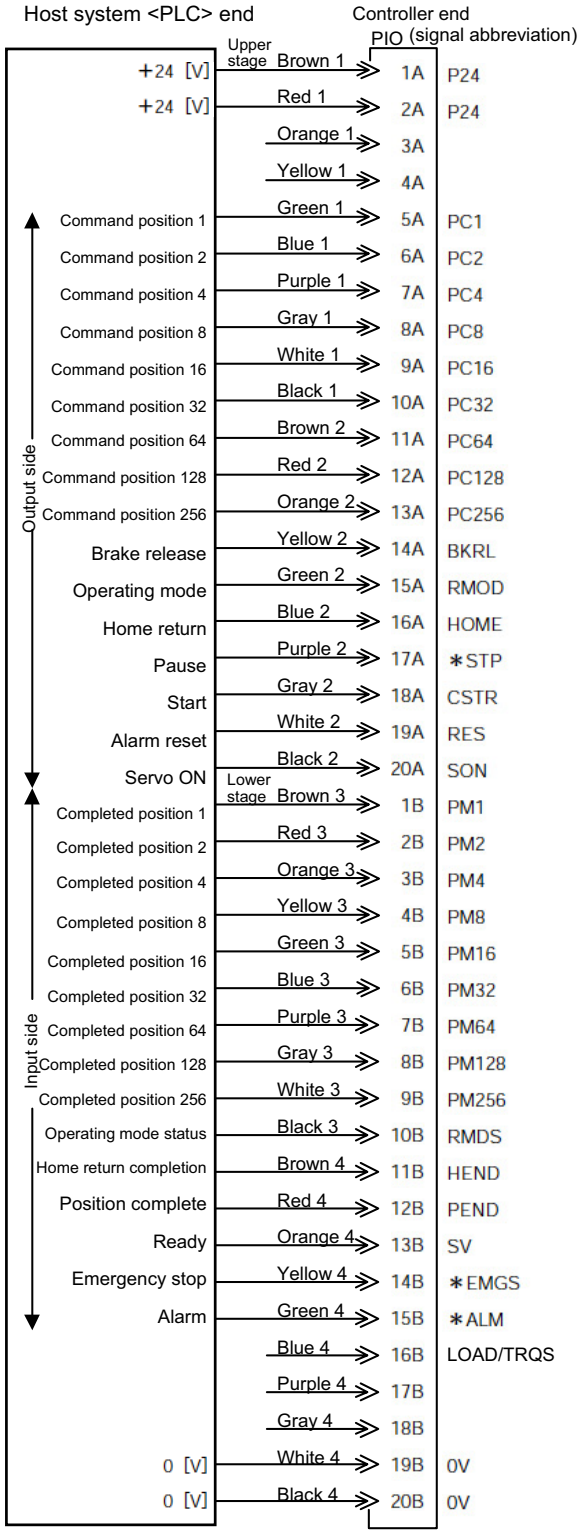
(Note) *STP, *ALM and *EMGS are based on the negative logic.

- PIO pattern 2 [256-piont mode]



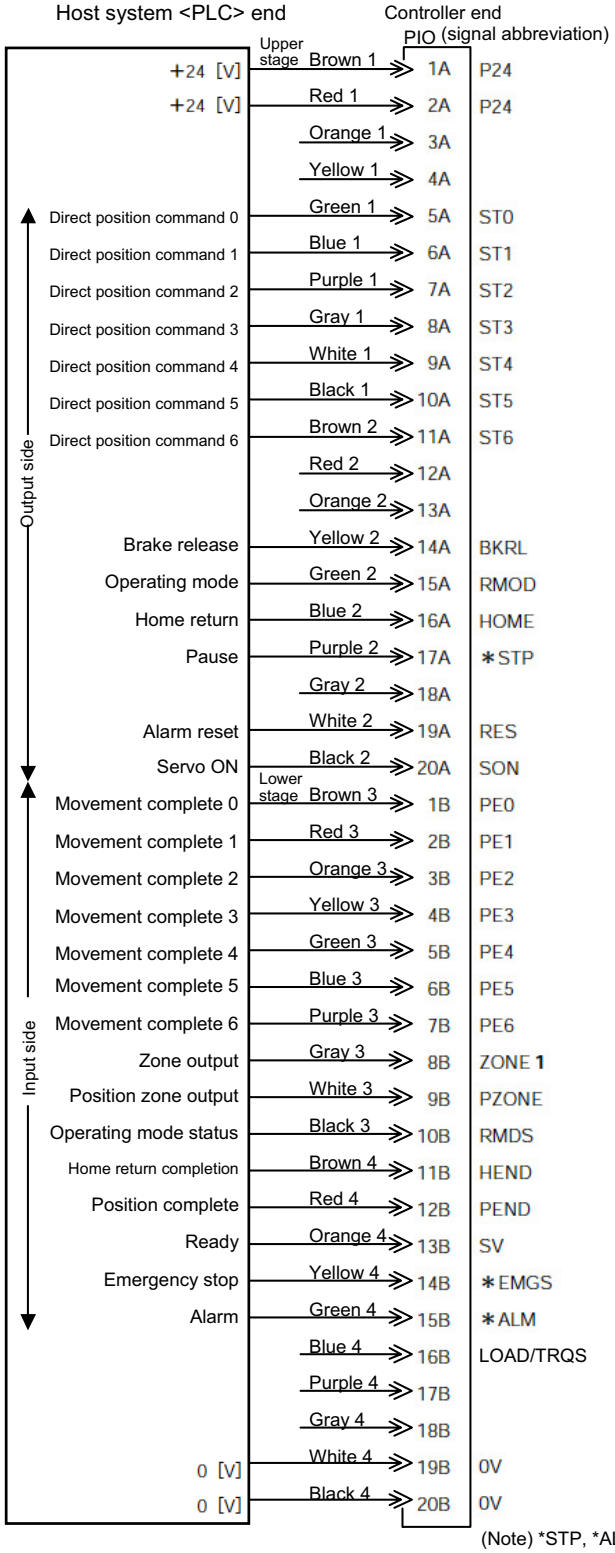
(Note) *STP, *ALM and *EMGS are based on the negative logic.

- PIO pattern 3 [512-piont mode]



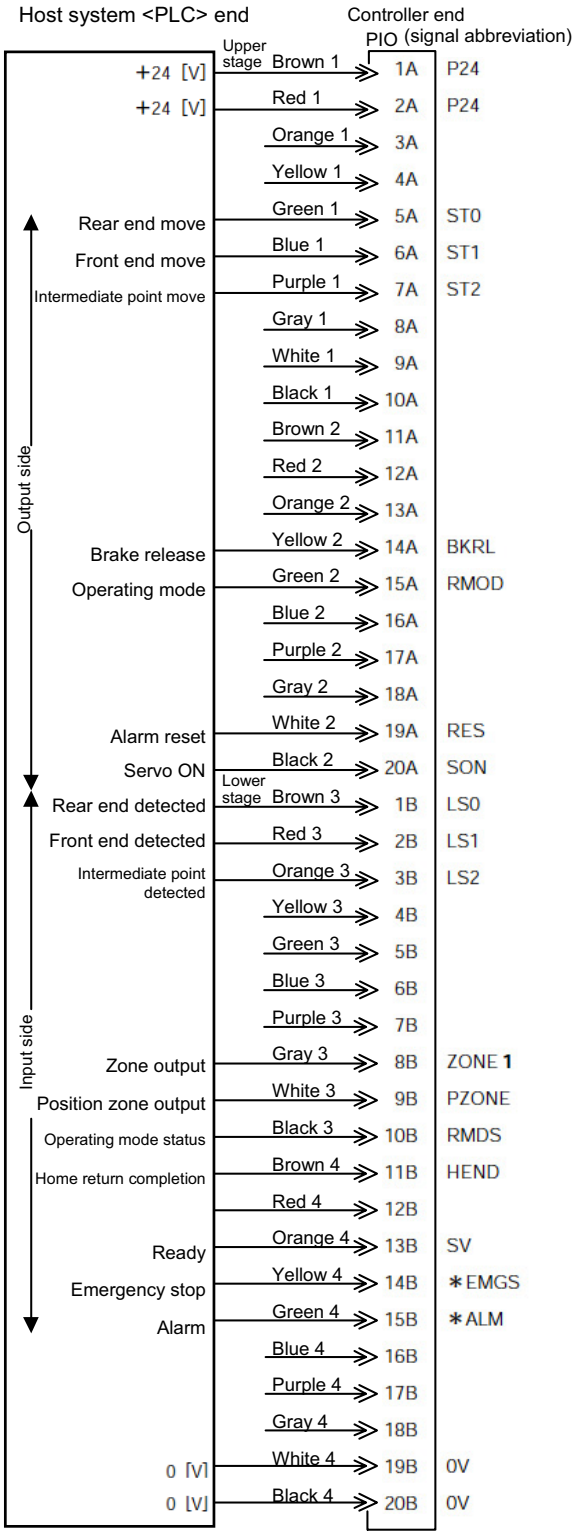
(Note) *STP, *ALM and *EMGS are based on the negative logic.

- PIO pattern 4 [Solenoid valve mode 1]



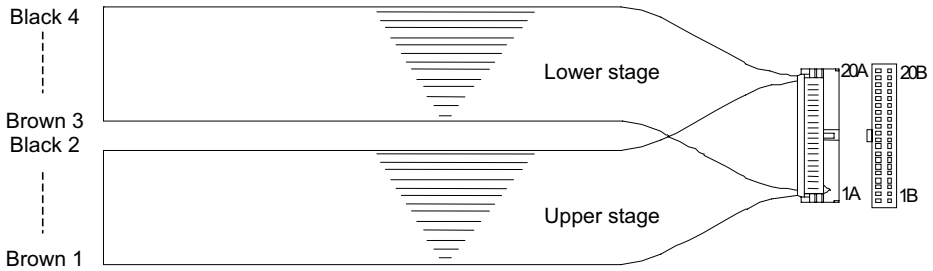
(Note) *STP, *ALM and *EMGS are based on the negative logic.

- PIO pattern 5 [Solenoid valve mode 2]



(Note) *STP, *ALM and *EMGS are based on the negative logic.

Caution: When performing a continuity check of the flat cable, pay due attention not to expand the female pins in the connector. It may cause contact failure and disable normal operation of the controller.



4.4 Connecting the Actuator

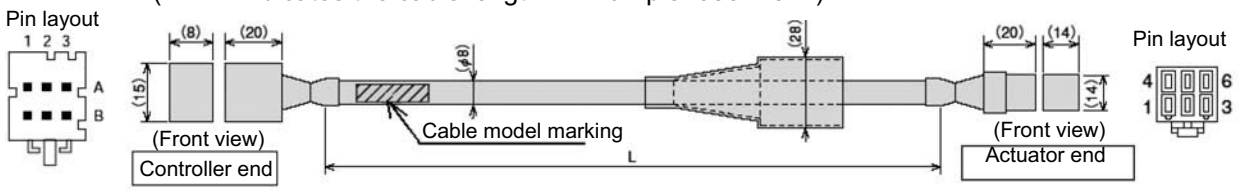
4.4.1 Connecting the PCON-C/CG and Actuator

Use dedicated extension cables to wire the controller and actuator.

(1) RCP2 motor cable

Model: CB-RCP2-MA□□□

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



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

Pin No.
1
2
3
4
5
6

Housing: 1-1318119-3 (AMP)
Contact: 1318107-1

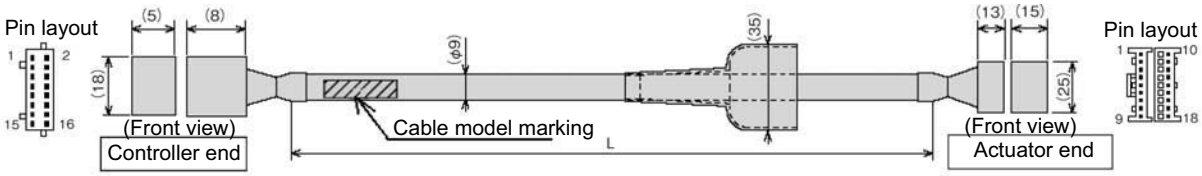
Housing: SLP-06V (J.S.T. Mfg.)
Socket contact: BSF-21T-P1.4

(2) RCP2 encoder cable/encoder robot cable

Model for standard cable: CB-RCP2-PB□□□

Model for robot cable: CB-RCP2-PB□□□-RB (optional)

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



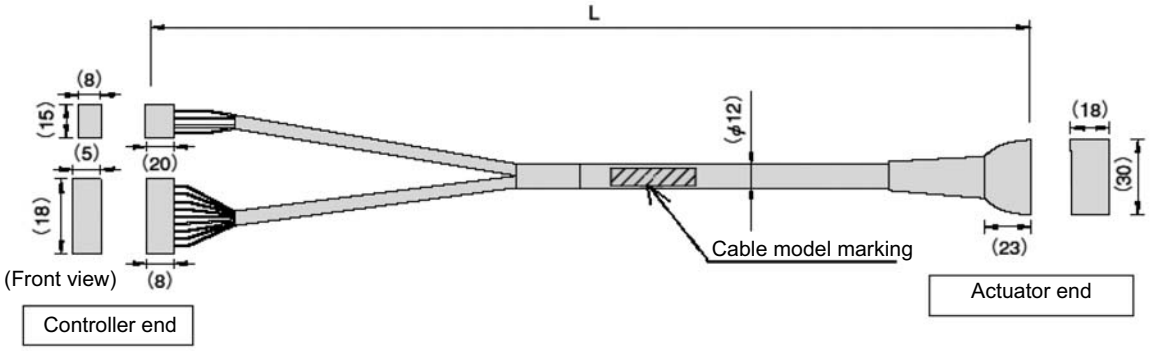
Pin No.	Signal name	Cable color		Description
		Standard cable	Robot cable	
16	LS+	Blue (Red 1)	Orange (Black 2)	Home check sensor
15	LS−	White	Orange (Red 2)	
14	BK+	Red	Orange (Black 1)	Brake power
13	BK−	Gray	Orange (Red 1)	
12	ENA	Brown	Light gray (Black 1)	Encoder phase A signal
11	$\overline{ENA}$	Green	Light gray (Red 1)	
10	ENB	Purple	White (Black 1)	Encoder phase B signal
9	$\overline{ENB}$	Pink	White (Red 1)	
8	—	—	—	
7	VPS	Yellow	Yellow (Black 1)	Encoder control signal
6	VBB	Orange	Pink (Red 1)	Encoder power
5	GND	Blue	Pink (Black 1)	
4	—	—	—	—
3	—	—	—	—
2	—	—	—	—
1	FG	Ground	Ground	Shield

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

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

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

(3) RCP3 motor/encoder integrated cable
Model: CB-PCS-MPA□□□
(□□□ indicates the cable length L. Example. 080 = 8 m)



Housing: D-2100D 1-1318119-3 (Hirose)
Contact: D-2 1318105-1

Pin No.	Signal name	Cable name
B1	A	Black
A2	VMM	White
A1	/A	Red
B3	B	Green
B2	VMM	Yellow
A3	/B	Brown

Pin No.	Signal name	Description	Cable name
16	LS+	Home check sensor	Pink (red dots)
15	LS−		Pink (blue dots)
14	BK+	Brake power	White (red dots)
13	BK−		White (blue dots)
12	A+	Encoder phase A signal	Pink (red dots)
11	A−		Orange (blue dots)
10	B+	Encoder phase B signal	Gray (red dots)
9	B−		Gray (blue dots)
8	—	——	Orange (continuous red dots)
7	/PS	Encoder control signal	Orange (continuous blue dots)
6	VOC	Encoder power	Gray (continuous red dots)
5	GND		Gray (continuous blue dots)
4	—	——	—
3	—	——	—
2	—	——	—
1	FG	Shield	Shield

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

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

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

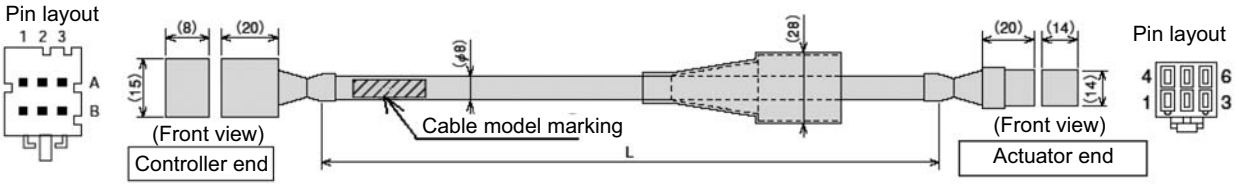
4.4.2 Connecting the PCON-CF and Actuator

Use dedicated extension cables to wire the controller and actuator.

(1) RCP2 motor cable

Model: CB-RCP2-MA□□□

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



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

Pin No.
1
2
3
4
5
6

Housing: 1-1318119-3 (AMP)
Contact: 1318107-1

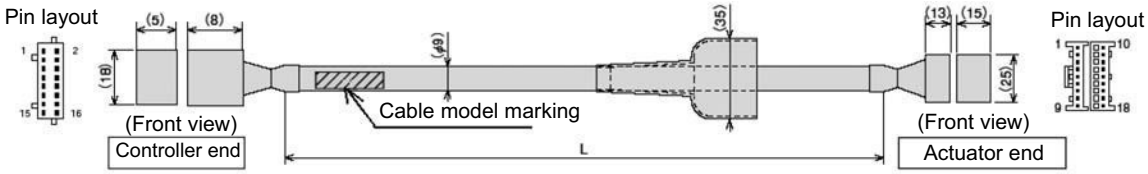
Housing: SLP-06V (J.S.T. Mfg.)
Socket contact: BSF-21T-P1.4

(2) RCP2 encoder cable/encoder robot cable (dedicated cable for PCON-CF)

Model for standard cable: CB-RFA-PA□□□

Model for robot cable: CB-RF-PA □□□-RB (optional)

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



Pin No.	Signal name	Cable color		Description
		Standard cable	Robot cable	
16	—	—	—	—
15	—	—	—	—
14	BK+	Red	Purple	Brake power
13	BK—	Gray	White	
12	$\overline{ENA}$	Brown	Blue	Encoder phase A signal
11	ENA	Green	White	
10	$\overline{ENB}$	Purple	Yellow	Encoder phase B signal
9	ENB	Pink	White	
8	—	—	—	—
7	VPS	Yellow	Green	Encoder control signal
6	—	—	—	—
5	GND	Blue	White	Encoder power
4	5V	Orange	Red	
3	—	—	—	—
2	—	—	—	—
1	FG	Ground	Ground	Shield

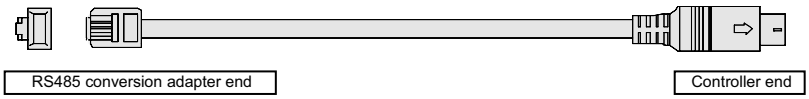
Pin No.	Signal name
1	ENA
2	$\overline{ENA}$
3	ENB
4	$\overline{ENB}$
5	—
6	—
7	—
8	—
9	GND
10	—
11	VPS
12	5V
13	—
14	—
15	—
16	BK+
17	BK—
18	FG

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

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

4.5 Connecting the Communication Cable

Connect the communication cable to the SIO connector.



CB-RCA-SIO***

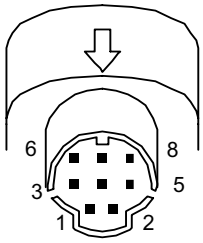
Cable color	Signal name	Pin No.
Brown	5V	1
Yellow	SGA	2
Red	GND	3
Orange	SGB	4
Blue	GND	5
Green	5V	6

Shorting wire UL1004AWG28 (black)

Shielded, not connected

Pin No.	Signal name	Cable color
1	SGA	Centered
2	SGB	Orange
3	5V	Brown/Green
4	EMGS	-
5	EMGA	Black
6	24V	-
7	GND	Red/Blue
8	EMGB	Black
FG		Shielded

Pin assignments of the cable-end connector



5. I/O Signal Control and Signal Functions

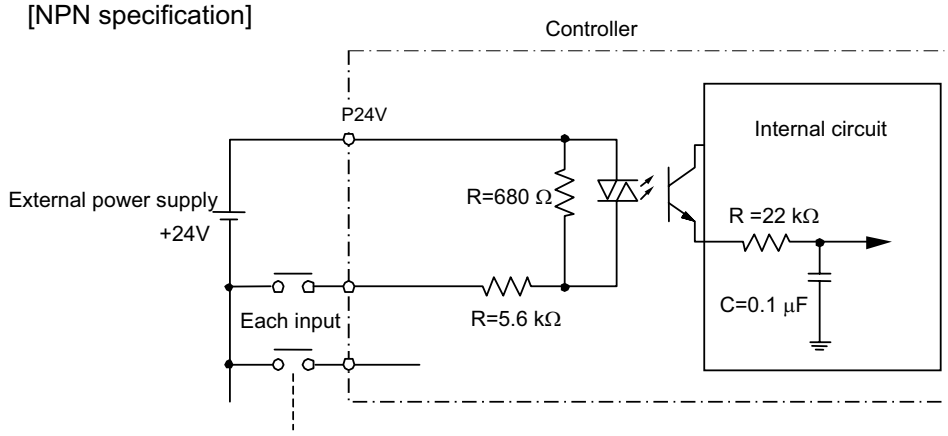
5.1 Interface Circuit

The standard interface specification of the controller is NPN, but the PNP specification is also available as an option.
To prevent confusion during wiring, the NPN and PNP specifications use the same power line configuration. Accordingly, there is no need to reverse the power signal assignments for a PNP controller.

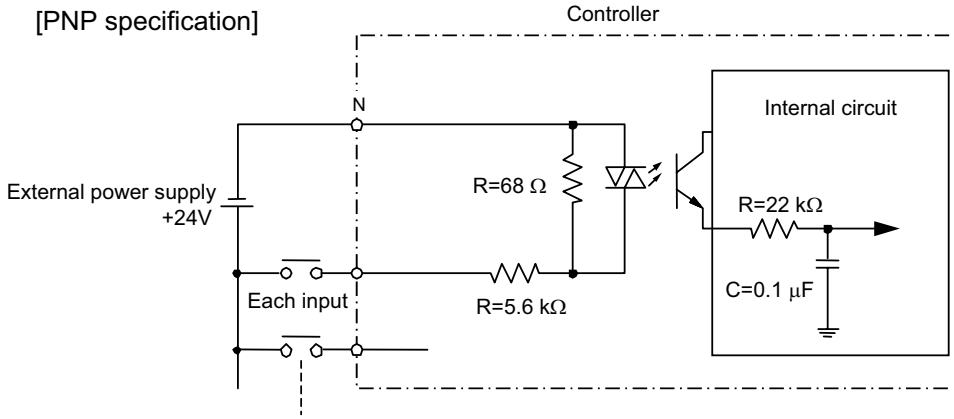
5.1.1 External Input Specifications

Item	Specification
Number of input points	16 points
Input voltage	24 VDC ± 10%
Input current	5 mA/point
Operating voltage	ON voltage: Min. 18 V (3.5 mA)
	OFF voltage: Max. 6 V (1 mA)
Leak current	1 mA or less/point
Isolation method	Photocoupler

Internal circuit configuration
[NPN specification]



[PNP specification]

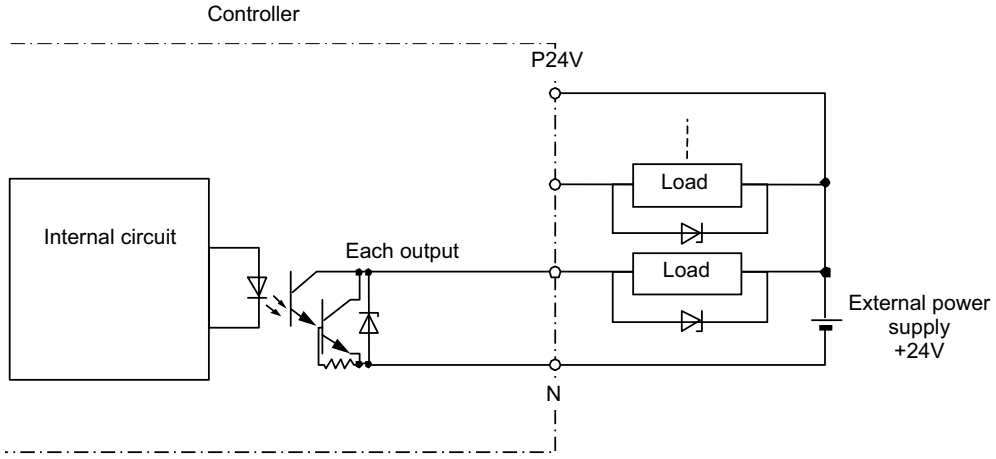


5.1.2 External Output Specifications

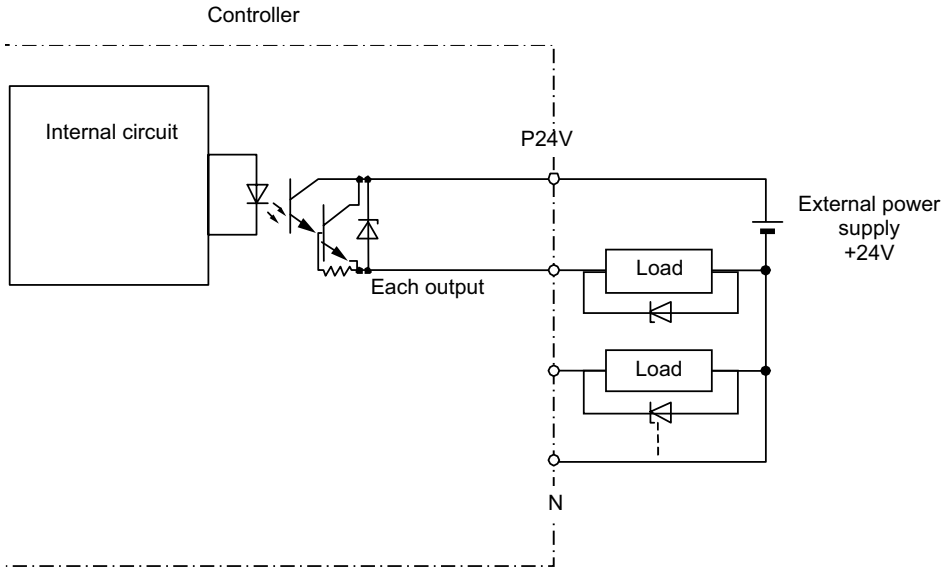
Item	Specification
Number of output points	16 points
Rated load voltage	24 VDC
Maximum current	50 mA/point
Residual voltage	2 V or less
Isolation method	Photocoupler

Internal circuit configuration

[NPN specification]



[PNP specification]



5.2 PIO Patterns and Signal Assignments

This controller provides six PIO pattern types to meet the needs of various applications.
To select a desired type, set a corresponding value from 0 to 5 in parameter No. 25 (PIO pattern selection).
The features of each PIO pattern are explained below:

Parameter No. 25 setting	Feature of PIO pattern
0	Positioning mode (Standard type) A basic type supporting 64 positioning points and two zone outputs. * How to set zone boundaries within which to output a zone signal: Zone boundaries are set using parameter Nos. 1 and 2 for one zone output, and in the position table for another zone output.
1	Teaching mode (Teaching type) In this type, 64 positioning points and one zone output (boundaries are set in the position table) are supported. In addition to the normal positioning mode, the user can also select the teaching mode in which the actuator can be jogged via I/Os and the current actuator position can be written to a specified position. (Note) Positions can be rewritten by approximately 100,000 times.
2	256-point mode (256-point positioning type) The number of positioning points is increased to 256, so only one zone output is available (boundaries are set in the position table).
3	512-point mod (512-point positioning) The number of positioning points is increased to 512, so no zone output is available.
4	Solenoid valve mode 1 (7-point type) The number of positioning points is limited to seven to offer separate direct command inputs and movement complete outputs. PLC ladder sequence circuits can be designed easily.
5	Solenoid valve mode 2 (3-point type) Use of the controller as an air cylinder is assumed in this type. Movement complete output signals function differently in this type, compared to the 7-point type. Specifically, the signal functions not only to “indicate movement complete,” but also to “detect a position” in the same manner as auto-switches of an air cylinder. Push & hold operation cannot be performed.

Quick reference table for functions available under each PIO pattern (○: Available, X: Not available)

No. 25	Number of positioning points	Input signals				Output signals		
		Brake release	Home return	Jog	Current-position write	Zone	Position zone	Ready
0	64 points	○	○	x	x	○	○	○
1	64 points	x	○	○	○	x	○	○
2	256 points	○	○	x	x	x	○	x
3	512 points	○	○	x	x	x	x	x
4	7 points	○	○	x	x	○	○	x
5	3 points	○	x	x	x	○	○	x

(Note) For “Zone” and “Position zone,” different methods are used to set boundaries defining the range within which the zone signal will turn ON.
“Zone” is set by parameter Nos. 1 and 2, and thus its setting will become effective after home return is completed.
“Position zone” is set in the “Zone+” and “Zone-“ fields for each position number in the position table, and thus its setting will become effective after a movement command is input.

5.2.1 Explanation of Signal Names

The following explains the signal names, and gives a function overview of each signal.
In the explanation of operation timings provided in a later section, each signal is referenced by its self-explanatory name for clarity. If necessary, however, such as when marker tubes are inserted as a termination of the flat cable, use the signal abbreviations.

- PIO pattern = 0: Positioning mode [Standard type]

Category	Signal name	Signal abbreviation	Function overview
Input	Command position number	PC1	The target position number is input. A command position number must be specified by 6 ms before the start signal (CSTR) turns ON.
		PC2	
		PC4	
		PC8	
		PC16	
		PC32	
	Brake release	BKRL	This signal is used on an actuator equipped with a brake to forcibly release the brake.
	Operating mode	RMDO	This signal switches the operating mode between AUTO and MANU.
	Home return	HOME	Home return operation is started at a rise edge of this signal.
	*Pause	*STP	ON: Actuator can be moved, OFF: Actuator decelerates to a stop
	Start	CSTR	The actuator will start moving at a rise edge of this signal.
	Alarm reset	RES	An alarm is reset at a rise edge of this signal.
	Servo ON	SON	The servo remains ON while this signal is ON. The servo remains OFF while this signal is OFF.
Output	Completed position number	PM1	The relevant position number is output when positioning has completed. The signal will turn OFF when the next start signal is received. It is used by the PLC to check if the commanded position has definitively been reached, and also to provide a position interlock, etc.
		PM2	
		PM4	
		PM8	
		PM16	
		PM32	
	Moving	MOVE	This signal will remain ON while the actuator is moving, and OFF while the actuator is standing still. It is used to determine whether the actuator is moving or paused.
	Zone	ZONE1	This signal becomes effective after home return. It will turn ON when the current actuator position enters the range set by the parameters and remain ON until the actuator exits the range.
	Position zone	PZONE	This signal becomes effective after a position movement command is input. It will turn ON when the current actuator position enters the range specified in the position table and remain ON until the actuator exits the range.
	Operating mode status	RMDS	This signal will remain OFF during the AUTO mode, and ON during the MANU mode.
	Home return completion	HEND	This signal is OFF immediately after the power is input, and turns ON when home return has completed.
	Position complete	PEND	This signal turns ON when the target position was reached and the actuator has entered the specified in-position range. It is used to determine whether positioning has completed.
	Ready	SV	This signal is always output once the servo is turned ON and the controller is ready to operate.
	*Emergency stop	*EMGS	When this signal is OFF, it means that an emergency stop is being actuated.
	*Alarm	*ALM	This signal remains ON in normal conditions of use and turns OFF when an alarm generates.
	Load output judgment status	LOAD	This signal will turn ON when the command torque exceeds the threshold while the actuator is inside the check range. Note) Dedicated output signal for the PCON-CF
	Torque level status	TRQS	This signal will turn ON when the motor current reaches the threshold. Note) Dedicated output signal for the PCON-CF

- PIO pattern = 1: Teaching mode [Teaching type]

Category	Signal name	Signal abbreviation	Function overview
Input	Command position number	PC1	The target position number is input. A command position number must be specified by 6 ms before the start signal (CSTR) turns ON.
		PC2	
		PC4	
		PC8	
		PC16	
		PC32	
	Operation mode	MODE	Mode selection (ON: Teaching mode, OFF: Normal mode)
	Jog/inching switching	JISL	OFF: Jog, ON: Inching
	+jog/inching movement	JOG+	The actuator will start jogging or inching in the positive direction at an ON edge of this signal.
	-jog/inching movement	JOG-	The actuator will start jogging or inching in the negative direction at an ON edge of this signal.
	Operating mode	RMDO	This signal switches the operating mode between AUTO and MANU.
	Home return	HOME	Home return operation is started at a rise edge of this signal.
	*Pause	*STP	ON: Actuator can be moved, OFF: Actuator decelerates to a stop
	Start	CSTR	The actuator will start moving at a rise edge of this signal.
	Current-position write	PWRT	When this signal has remained ON for 20 msec or longer, the current position will be stored under the position number selected by PC1 to PC32.
	Alarm reset	RES	An alarm is reset at a rise edge of this signal.
	Servo ON	SON	The servo remains ON while this signal is ON. The servo remains OFF while this signal is OFF.
Output	Completed position number	PM1	The relevant position number is output when positioning has completed. The signal will turn OFF when the next start signal is received. It is used by the PLC to check if the commanded position has definitively been reached, and also to provide a position interlock, etc.
		PM2	
		PM4	
		PM8	
		PM16	
		PM32	
	Moving	MOVE	This signal will remain ON while the actuator is moving, and OFF while the actuator is standing still. It is used to determine whether the actuator is moving or paused.
	Mode status	MODES	ON: Teaching mode, OFF: Normal mode
	Position zone	PZONE	This signal becomes effective after a position movement command is input. It will turn ON when the current actuator position enters the range specified in the position table and remain ON until the actuator exits the range.
	Operating mode status	RMDS	This signal will remain OFF during the AUTO mode, and ON during the MANU mode.
	Home return completion	HEND	This signal is OFF immediately after the power is input, and turns ON when home return has completed.
	Position complete	PEND	This signal turns ON when the target position was reached and the actuator has entered the specified in-position range. It is used to determine whether positioning has completed.
	Write completion	WEND	This signal is output upon completion of writing to the nonvolatile memory in response to a current-position write command (PWRT).
	Ready	SV	This signal is always output once the servo is turned ON and the controller is ready to operate.
	*Emergency stop	*EMGS	OFF: Emergency stop has been actuated
	*Alarm	*ALM	This signal remains ON in normal conditions of use and turns OFF when an alarm generates.

- PIO pattern = 2: 256-point mode [256-point type]

Category	Signal name	Signal abbreviation	Function overview
Input	Command position number	PC1	The target position number is input. A command position number must be specified by 6 ms before the start signal (CSTR) turns ON.
		PC2	
		PC4	
		PC8	
		PC16	
		PC32	
		PC64	
		PC128	
	Brake release	BKRL	This signal is used on an actuator equipped with a brake to forcibly release the brake.
	Operating mode	RMDO	This signal switches the operating mode between AUTO and MANU.
	Home return	HOME	Home return operation is started at a rise edge of this signal.
	*Pause	*STP	ON: Actuator can be moved, OFF: Actuator decelerates to a stop
	Start	CSTR	The actuator will start moving at a rise edge of this signal.
	Alarm reset	RES	An alarm is reset at a rise edge of this signal.
	Servo ON	SON	The servo remains ON while this signal is ON. The servo remains OFF while this signal is OFF.
Output	Completed position number	PM1	The relevant position number is output when positioning has completed. The signal will turn OFF when the next start signal is received. It is used by the PLC to check if the commanded position has definitively been reached, and also to provide a position interlock, etc.
		PM2	
		PM4	
		PM8	
		PM16	
		PM32	
		PM64	
		PM128	
	Position zone	PZONE	This signal becomes effective after a position movement command is input. It will turn ON when the current actuator position enters the range specified in the position table and remain ON until the actuator exits the range.
	Operating mode status	RMDS	This signal will remain OFF during the AUTO mode, and ON during the MANU mode.
	Home return completion	HEND	This signal is OFF immediately after the power is input, and turns ON when home return has completed.
	Position complete	PEND	This signal turns ON when the target position was reached and the actuator has entered the specified in-position range. It is used to determine whether positioning has completed.
	Ready	SV	This signal is always output once the servo is turned ON and the controller is ready to operate.
	*Emergency stop	*EMGS	OFF: Emergency stop has been actuated
	*Alarm	*ALM	This signal remains ON in normal conditions of use and turns OFF when an alarm generates.
	Load output judgment status	LOAD	This signal will turn ON when the command torque exceeds the threshold while the actuator is inside the check range. Note) Dedicated output signal for the PCON-CF
	Torque level status	TRQS	This signal will turn ON when the motor current reaches the threshold. Note) Dedicated output signal for the PCON-CF

- PIO pattern = 3: 512-point mode [512-point type]

Category	Signal name	Signal abbreviation	Function overview
Input	Command position number	PC1	The target position number is input. A command position number must be specified by 6 ms before the start signal (CSTR) turns ON.
		PC2	
		PC4	
		PC8	
		PC16	
		PC32	
		PC64	
		PC128	
		PC256	
	Brake release	BKRL	This signal is used on an actuator equipped with a brake to forcibly release the brake.
	Operating mode	RMDO	This signal switches the operating mode between AUTO and MANU.
	Home return	HOME	Home return operation is started at a rise edge of this signal.
	*Pause	*STP	ON: Actuator can be moved, OFF: Actuator decelerates to a stop
	Start	CSTR	The actuator will start moving at a rise edge of this signal.
	Alarm reset	RES	An alarm is reset at a rise edge of this signal.
	Servo ON	SON	The servo remains ON while this signal is ON. The servo remains OFF while this signal is OFF.
Output	Completed position number	PM1	The relevant position number is output when positioning has completed. The signal will turn OFF when the next start signal is received. It is used by the PLC to check if the commanded position has definitively been reached, and also to provide a position interlock, etc.
		PM2	
		PM4	
		PM8	
		PM16	
		PM32	
		PM64	
		PM128	
		PC256	
	Operating mode status	RMDS	This signal will remain OFF during the AUTO mode, and ON during the MANU mode.
	Home return completion	HEND	This signal is OFF immediately after the power is input, and turns ON when home return has completed.
	Position complete	PEND	This signal turns ON when the target position was reached and the actuator has entered the specified in-position range. It is used to determine whether positioning has completed.
	Ready	SV	This signal is always output once the servo is turned ON and the controller is ready to operate.
	*Emergency stop	*EMGS	OFF: Emergency stop has been actuated
	*Alarm	*ALM	This signal remains ON in normal conditions of use and turns OFF when an alarm generates.
	Load output judgment status	LOAD	This signal will turn ON when the command torque exceeds the threshold while the actuator is inside the check range. Note) Dedicated output signal for the PCON-CF
	Torque level status	TRQS	This signal will turn ON when the motor current reaches the threshold. Note) Dedicated output signal for the PCON-CF

- PIO pattern = 4: Solenoid valve mode 1 [7- point type]

Category	Signal name	Signal abbreviation	Function overview
Input	Direct position command 0	ST0	The actuator will start moving to position No. 0 at a rise edge of this signal.
	Direct position command 1	ST1	The actuator will start moving to position No. 1 at a rise edge of this signal.
	Direct position command 2	ST2	The actuator will start moving to position No. 2 at a rise edge of this signal.
	Direct position command 3	ST3	The actuator will start moving to position No. 3 at a rise edge of this signal.
	Direct position command 4	ST4	The actuator will start moving to position No. 4 at a rise edge of this signal.
	Direct position command 5	ST5	The actuator will start moving to position No. 5 at a rise edge of this signal.
	Direct position command 6	ST6	The actuator will start moving to position No. 6 at a rise edge of this signal.
	Brake release	BKRL	This signal is used on an actuator equipped with a brake to forcibly release the brake.
	Operating mode	RMDO	This signal switches the operating mode between AUTO and MANU.
	Home return	HOME	Home return operation is started at a rise edge of this signal.
	*Pause	*STP	ON: Actuator can be moved, OFF: Actuator decelerates to a stop
	Alarm reset	RES	An alarm is reset at a rise edge of this signal.
	Servo ON	SON	The servo remains ON while this signal is ON. The servo remains OFF while this signal is OFF.
Output	Movement complete 0	PE0	This signal will turn ON when the actuator completes moving to position No. 0.
	Movement complete 1	PE1	This signal will turn ON when the actuator completes moving to position No. 1.
	Movement complete 2	PE2	This signal will turn ON when the actuator completes moving to position No. 2.
	Movement complete 3	PE3	This signal will turn ON when the actuator completes moving to position No. 3.
	Movement complete 4	PE4	This signal will turn ON when the actuator completes moving to position No. 4.
	Movement complete 5	PE5	This signal will turn ON when the actuator completes moving to position No. 5.
	Movement complete 6	PE6	This signal will turn ON when the actuator completes moving to position No. 6.
	Zone	ZONE1	This signal becomes effective after home return. It will turn ON when the current actuator position enters the range set by the parameters and remain ON until the actuator exits the range.
	Position zone	PZONE	This signal becomes effective after a position movement command is input. It will turn ON when the current actuator position enters the range specified in the position table and remain ON until the actuator exits the range.
	Operating mode status	RMDS	This signal will remain OFF during the AUTO mode, and ON during the MANU mode.
	Home return completion	HEND	This signal is OFF immediately after the power is input, and turns ON when home return has completed.
	Position complete	PEND	This signal is used to determine if the controller is ready following the power on. The controller is ready to perform operation if an emergency stop is not actuated, motor drive power is not cut off (= the servo is on) and the pause signal is input.
	Ready	SV	This signal is always output once the servo is turned ON and the controller is ready to operate.
	*Emergency stop	*EMGS	OFF: Emergency stop has been actuated
	*Alarm	*ALM	This signal remains ON in normal conditions of use and turns OFF when an alarm generates.
	Load output judgment status	LOAD	This signal will turn ON when the command torque exceeds the threshold while the actuator is inside the check range. Note) Dedicated output signal for the PCON-CF
	Torque level status	TRQS	This signal will turn ON when the motor current reaches the threshold. Note) Dedicated output signal for the PCON-CF

- PIO pattern = 5: Solenoid valve mode 2 [3-point type]

Category	Signal name	Signal abbreviation	Function overview
Input	Rear end move command	ST0	The actuator will move toward the rear end while this signal remains at ON level.
	Front end move command	ST1	The actuator will move toward the front end while this signal remains at ON level.
	Intermediate point move command	ST2	The actuator will move toward the intermediate point while this signal remains at ON level.
	Brake release	BKRL	This signal is used on an actuator equipped with a brake to forcibly release the brake.
	Operating mode	RMDO	This signal switches the operating mode between AUTO and MANU.
	Alarm reset	RES	An alarm is reset at a rise edge of this signal.
	Servo ON	SON	The servo remains ON while this signal is ON. The servo remains OFF while this signal is OFF.
Output	Rear end detected	LS0	This signal will remain ON while the rear end is recognized. (This signal is not output during push & hold operation.)
	Front end detected	LS1	This signal will remain ON while the front end is recognized. (This signal is not output during push & hold operation.)
	Intermediate point detected	LS2	This signal will remain ON while the intermediate point is recognized. (This signal is not output during push & hold operation.)
	Zone	ZONE1	This signal becomes effective after home return. It will turn ON when the current actuator position enters the range set by the parameters and remain ON until the actuator exits the range.
	Position zone	PZONE	This signal becomes effective after a position movement command is input. It will turn ON when the current actuator position enters the range specified in the position table and remain ON until the actuator exits the range.
	Operating mode status	RMDS	This signal will remain OFF during the AUTO mode, and ON during the MANU mode.
	Home return completion	HEND	This signal is OFF immediately after the power is input, and turns ON when home return has completed.
	Ready	SV	This signal is always output once the servo is turned ON and the controller is ready to operate.
	*Emergency stop	*EMGS	OFF: Emergency stop has been actuated
	*Alarm	*ALM	This signal remains ON in normal conditions of use and turns OFF when an alarm generates.
	Load output judgment status	LOAD	This signal will turn ON when the command torque exceeds the threshold while the actuator is inside the check range. Note) Dedicated output signal for the PCON-CF
	Torque level status	TRQS	This signal will turn ON when the motor current reaches the threshold. Note) Dedicated output signal for the PCON-CF

5.2.2 Signal Assignment Table for Respective PIO Patterns

When creating a PLC sequence or wiring signals, assign each pin correctly by referring to the assignment table below.
When "1 [Teaching type]" is selected, the meaning of each pin number will vary depending on the mode. Accordingly, also pay due attention to the mode switch timings.

Pin No.	Category	Wire color	Parameter No. 25 setting					
			0	1	2	3	4	5
1A	+24V	Upper stage Brown - 1	P24					
2A		Red - 1						
3A		Orange - 1	(Not used)					
4A		Yellow - 1	(Not used)					
5A	Input	Green - 1	PC1	PC1	PC1	PC1	ST0	ST0
6A		Blue - 1	PC2	PC2	PC2	PC2	ST1	ST1 (JOG+)
7A		Purple - 1	PC4	PC4	PC4	PC4	ST2	ST2 (-)
8A		Gray - 1	PC8	PC8	PC8	PC8	ST3	-
9A		White - 1	PC16	PC16	PC16	PC16	ST4	-
10A		Black - 1	PC32	PC32	PC32	PC32	ST5	-
11A		Brown - 2	-	MODE	PC64	PC64	ST6	-
12A		Red - 2	-	JISE	PC128	PC128	-	-
13A		Orange - 2	-	JOG+	-	PC256	-	-
14A		Yellow - 2	BKRL	JOG-	BKRL	BKRL	BKRL	BKRL
15A		Green - 2	RMOD					
16A		Blue - 2	HOME					-
17A		Purple - 2	*STP					-
18A		Gray - 2	CSTR	CSTR/PWRT	CSTR	CSTR	-	-
19A		White - 2	RES					
20A		Black - 2	SON					
1B	Output	Lower stage Brown - 3	PM1	PM1	PM1	PM1	PE0	LS0
2B		Red - 3	PM2	PM2	PM2	PM2	PE1	LS1 (TRQS)
3B		Orange - 3	PM4	PM4	PM4	PM4	PE2	LS2 (-)
4B		Yellow - 3	PM8	PM8	PM8	PM8	PE3	-
5B		Green - 3	PM16	PM16	PM16	PM16	PE4	-
6B		Blue - 3	PM32	PM32	PM32	PM32	PE5	-
7B		Purple - 3	MOVE	MOVE	PM64	PM64	PE6	-
8B		Gray - 3	ZONE1	MODES	PM128	PM128	ZONE1	ZONE1
9B		White - 3	PZONE	PZONE	PZONE	PM256	PZONE	PZONE
10B		Black - 3	RMDS					
11B		Brown - 4	HEND					
12B		Red - 4	PEND	PEND/WND	PEND	PEND	PEND	-
13B		Orange - 4	SV					
14B		Yellow - 4	*EMGS					
15B		Green - 4	*ALM					
16B		Blue - 4	LOAD/TRQS	-	LOAD/TRQS	LOAD/TRQS	LOAD/TRQS	-
17B		Purple -4	(Not used)					
18B		Gray - 4	(Not used)					
19B	0V	White - 4	0V					
20B		Black - 4						

Caution: [1] The signals indicated by * in the table (*ALM, *STP and *EMGS) are based on the negative logic, meaning that they remain ON in normal conditions of use.
[2] Do not connect pins denoted by "Not used" (orange-1, yellow-1, blue-4, purple-4, gray-4), but insulate them instead.
[3] The NPN and PNP specifications use the same power line configuration, so there is no need to reverse the power signal assignments for a PNP controller.

( ) indicates signals before home return.

5.3 Details of I/O Signal Functions

An input time constant is provided for the input signals of this controller, in order to prevent malfunction due to chattering, noise, etc.
Except for certain signals, switching of each input signal will be effected when the signal has been received continuously for at least 6 msec. For example, when an input is switched from OFF to ON, the controller will only recognize that the input signal is ON after 6 msec. The same applies to switching of input signals from ON to OFF (Fig. 1).

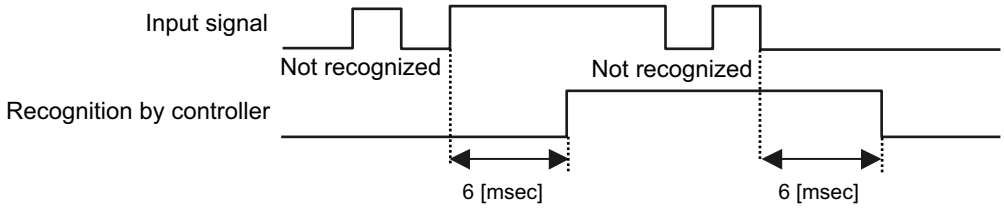


Fig. 1 Recognition of Input Signal

5.3.1. Details of Each Input Signal

■ Operating mode (RMOD)

This controller has a mode selector switch on the front panel of the controller to prevent malfunction and data loss due to duplicate operations.
Normally this switch should be set to the “AUTO” position when the actuator is operated in the auto mode using I/O signals exchanged with a PLC, or to the “MANU” position when the actuator is operated manually using a PC or teaching pendant.
If the controller is mounted in a control panel, however, this switch is not readily accessible. Accordingly, a function has been added to allow the setting of this switch to be changed from a PLC for added convenience. Specifically, the internal operating mode of the controller will become “AUTO” when this signal is turned OFF, or “MANU” when this signal is turned ON, if the mode selector switch is set to the “AUTO” position.
If the mode selector switch is set to the “MANU” position, the internal operating mode of the controller will remain “MANU” regardless of the status of this signal.
Use this signal in applications where the operation mode must be switched frequently between auto and manual and the selector switch is provided on the equipment side.

■ Start (CSTR)

Upon detecting an OFF → ON rise edge of this signal, the controller will read, as a binary code, the target position number consisting of six bits from PC1 to PC32 (or eight bits from PC1 to PC128 when the PIO pattern is “256-point type,” or nine bits from PC1 to PC256 when the PIO pattern is “512-point type”), and execute positioning to the target position of the corresponding position data.
Before executing this command, the target position, speed and other operation data must be set in the position table using a PC/teaching pendant.
If a start command is issued when home return operation has not been performed yet after the power was input (the HEND output signal is OFF), the controller will automatically perform home return operation before positioning to the target position.

■ Command position number (PC1 to PC256)

When a movement command is effected upon OFF → ON of the start signal, the nine-bit binary code consisting of signals PC1 to PC256 will be read as the command position number.
In the standard or teaching type, six bits of PC1 through PC32 are used. In the 256-point type, eight bits of PC1 to PC128 are used. In the 512-point type, nine bits of PC1 through PC256 are used.
The weight of each bit is as follows: 2^0 for PC1, 2^1 for PC2, 2^2 for PC4, …, and 2^9 for PC256. A desired position number between 0 and 511 (maximum) can be specified.

■ Pause (*STP)

When this signal turns OFF while the actuator is moving, the actuator will decelerate to a stop.
The remaining movement is retained and will be resumed when the signal is turned ON again.
To abort the movement command, turn ON the alarm reset signal while this signal is OFF to cancel the remaining movement.
The *STP signal can be used for the following purposes:

[1] Provide a low-level safety measure to stop the axis while the servo is ON, such as a sensor that detects a person approaching the system
[2] Prevent contact with other equipment
[3] Perform positioning based on sensor or LS detection

(Note) If the *STP signal is input while the actuator is performing home return, the movement command will be retained if the actuator is yet to contact a mechanical end. If the signal is input after the actuator has reversed upon contacting a mechanical end, home return will be performed again from the beginning.

■ Home return (HOME)

The controller will start home return operation upon detection of an OFF → ON edge of this signal.
When the home return is complete, the HEND signal will be output. The HOME signal can be input as many times as required.

■ Servo ON (SON)

The servo remains ON while this signal is ON.
When the power is turned on, make sure this signal will turn ON after the safety of the entire equipment is ensured, i.e., after a confirmation that the actuator will not contact surrounding equipment.
If the SON signal need not be used in view of the nature of the equipment, you can disable the signal using parameter No. 21.
When this signal is disabled, the servo will turn on automatically after the power is turned on.
The factory setting is to enable the SON signal.

■ Alarm reset (RES)

This signal provides two functions.

[1] Reset the alarm output signal (*ALM) that turned OFF due to an alarm
If an alarm has generated, turn ON this signal after confirming the nature of the alarm.
The controller will reset the alarm upon detection of a rise edge of the RES signal.
(Note) Certain alarms cannot be reset by the RES signal. For details, refer to 10, “Troubleshooting.”

[2] Cancel the remaining movement when the pause signal is OFF
This function is used when the remaining movement must be cancelled to allow for incremental moves (movements at a constant increment) from the position where the actuator stopped following a sensor detection.

■ Brake release (BKRL)

When the actuator is equipped with a brake, you may want to forcibly release the brake in certain situations such as when starting up the system for the first time. Normally the brake release switch on the front panel of the controller is set to the “RLS” side to release the brake. For added convenience, the brake can now be released from the PLC.
If this signal is ON while the servo is off, the brake is released.
Use this signal to provide a release switch near the actuator when the actuator is located away from the controller.

■ Operation mode (MODE)

This signal is effective when the teaching type is selected.
When this signal is turned ON while the actuator is standing still, the normal operation mode will change to the teaching mode.
The controller will turn ON the MODES output signal upon receiving this signal.
Program the PLC so that it will accept a current-position write command after confirming that the MODES output signal is ON.
When this signal is turned OFF, the controller will return to the normal operation mode.

■ Current-position write (PWRT)

This signal is enabled when the aforementioned MODES output signal is ON.
When this signal has remained ON for 20 msec or longer, the controller will read the position number specified by a binary code consisting of PC1 through PC32 as currently detected, and write the current position data in the “Position” field of the corresponding position number.
If data of other items (speed, acceleration/deceleration, positioning band, etc.) are yet to be defined, the default settings of the corresponding parameters will be written.
When the writing completes successfully, the WEND output signal will turn ON.
Configure the system in such a way that the PLC will turn OFF the PWRT signal when WEND turns ON. The controller will turn OFF WEND once the PWRT signal turns OFF.
(Note) An alarm will generate if a write command is issued when home return has not been performed yet or while the actuator is moving.

■ Manual operation switching (JISL)

This signal is enabled when the teaching type is selected.
The JISL signal is used to switch operations in the manual mode. Specifically, the actuator will jog when this signal is OFF, or inch when this signal is ON.
If this signal is turned ON while the actuator is jogging, the actuator will decelerate to a stop.
If this signal is turned OFF while the actuator is inching, the actuator will continue with its inching movement.

■ Jog (JOG+, JOG-)

This signal is enabled when the teaching type is selected.
When the actuator is jogging (i.e., the JISL signal is OFF), it will jog toward the +/- software stroke limit upon detection of an OFF → ON rise edge of this signal.
If an ON → OFF fall edge of this signal is detected while the actuator is moving, the actuator will decelerate to a stop.
The jogging speed is defined by parameter No. 26, "PIO jog speed."

* If any of the following input signal changes occurs while the actuator is jogging, the actuator will decelerate to a stop:
  [1] Both the JOG+ and JOG- signals have turned ON.
  [2] The JISL signal has turned ON (i.e., the operation mode has changed to inching).
  [3] The CSTR signal has turned ON (i.e., a positioning command has been input).

Upon detection of an OFF → ON rise edge of this signal while the actuator is inching (i.e., the JISL signal is ON), the actuator will travel the distance defined in parameter No. 48, "PIO inching distance."
The actuator will continue with its inching movement if this signal is switched while the actuator is inching.

⚠ Caution: If jogging or inching is performed before a home return is completed, the actuator may collide with a mechanical end because the software stroke limits are not yet effective. Exercise due caution.

■ Direct position command (ST0 to ST6) [7-point type]

These signals are effective when "4" is set in parameter No. 25.
Upon detection of an OFF → ON rise edge of this signal or detection of the ON level of the signal, the actuator will move to the target position set in the corresponding position data.
Before executing this command, the target position, speed and other operation data must be set in the position table using a PC/teaching pendant.
If ON edges of two or more signals are detected at the same time, priority will be given to the position command of the smallest number among all detected command signals. (Example: If ON edges of ST0 and ST1 signals are detected at the same time, the actuator will start moving to position 0.)
Although commands are executed upon detection of an ON signal edge, priority is given to the command that was specified the earliest. In other words, a signal input will not be accepted while the actuator is moving. Even if a different position signal is turned ON while the actuator is moving, the actuator will not commence moving to the new position after reaching the target position.

Correspondence table of input signals and command positions

Input signal	Command position
ST0	Position No. 0
ST1	Position No. 1
ST2	Position No. 2
ST3	Position No. 3
ST4	Position No. 4
ST5	Position No. 5
ST6	Position No. 6

If a movement command is issued when the first home return is not yet completed after the power was input, home return will be performed automatically to establish the coordinates first, after which the actuator will move to the target position.

■ Movement to each position (ST0 to ST2) [3-point type]

Since the number of positioning points is limited to three, the actuator can be controlled just like an air cylinder.
While this signal is ON, the actuator will move toward the target position.
If the signal turns OFF while the actuator is moving, the actuator will decelerate to a stop.
Before executing this command, enter a target position in the “Position” field for position No. 0, 1 or 2 in the position table.

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

5.3.2 Details of Each Output Signal

■ Operating mode status (RMDS)

The internal operating mode of the controller is output based on the AUTO/MANU selector switch on the controller and the RMOD signal received by the input port. If the selector switch is set to “AUTO” and the RMOD signal is OFF (AUTO), the controller is in the AUTO (OFF) mode. If the selector switch is set to “MANU” and/or the RMOD signal is ON (MANU), the controller is in the MANU (ON) mode.

■ Completed position number (PM1 to PM256)

These signals can be used to check the completed position number when the PEND signal turns ON.
The signals are output as a binary code.
Immediately after the power is input, all of the PM1 to PM256 signals are OFF.
In the standard or teaching type, six bits of PM1 through PM32 are used. In the 256-point type, eight bits of PM1 through PM128 are used. In the 512-point type, nine bits of PM1 through PM256 are used.
All of these signals are OFF also when the actuator is moving.
As described above, this signal is output only when positioning is completed.

(Note) All of these signals will turn OFF when the servo is turned OFF or an emergency stop is actuated. They will return to the ON status when the servo is turned ON again, provided that the current position is inside the in-position range with respect to the target position. If the current position is outside the range, the signals will remain OFF.
When the power is input, the PEND signal will turn ON. These signals are all OFF, this condition is the same as one achieved after positioning to position “0” is completed.
Check the position of position 0 after the movement command has completed.

If an alarm is present, the corresponding alarm code (abbreviated form) consisting of four bits from PM1 to PM8 will be output.
The meanings of these signals vary between the normal condition and the alarm condition, so be careful not to use them wrongly in the sequence.

■ Moving (MOVE)

This signal is output while the servo is ON and the actuator is moving (also during home return, push & hold operation or jogging).
Use the MOVE signal together with the PEND signal to allow the PLC to determine the actuator status.
The MOVE signal will turn OFF after positioning or home return is completed or a judgment is made during push & hold operation that the work part is being contacted.

■ Position complete (PEND)

This signal indicates that the target position was reached and positioning has completed.
Use the PEND signal together with the MOVE signal to allow the PLC to determine the positioning status.
When the controller becomes ready after the power was input and the servo has turned ON, this signal will turn ON if the position deviation is within the in-position range.
Then, when a movement command is issued by turning ON the start signal, the PEND signal will turn OFF. It will turn ON again when the deviation from the target position falls within the in-position range.
Once turned ON, the PEND signal will not turn OFF even when the position deviation subsequently exceeds the in-position range.

(Note) If the start signal remains ON, the PEND signal will not turn OFF even when the deviation from the target position falls within the in-position range: it will turn ON when the start signal turns OFF.
Even when the motor is stopped, the PEND signal will remain OFF if the pause signal is input or the servo is OFF.

■ Home return completion (HEND)

This signal is OFF immediately after the power is input, and turns ON in either of the following two conditions:

[1] Home return operation has completed with respect to the first movement command issued with the start signal.

[2] Home return operation has completed following an input of the home return signal.

Once turned ON, the HEND signal will not turn OFF unless the input power supply is cut off, a soft reset is executed, or the home return signal is input again.

The HEND signal can be used for the following purposes:

[1] Check prior to establishing the home if movement toward the home direction is permitted, in cases where an obstacle is located in the direction of the home

[2] Use as a condition for writing the current position in the teaching mode

[3] Use as a condition for enabling the zone output signal

■ Zone (ZONE1, ZONE2)

[1] ZONE1

This signal will remain ON while the current actuator position is inside the zone specified by Parameter No. 1, “Zone boundary+” and Parameter No. 2, “Zone boundary-,” or OFF while the actuator is outside this range. This signal is always effective once home return has been completed and is not affected by the servo status or presence of an alarm.

(Note) This signal becomes effective only after the coordinate system has been established following a completion of home return. It will not be output immediately after the power is turned on.

[2] PZONE

This signal will turn ON when the current actuator position enters the area between the zone boundaries set in the position table. After the current position movement command is completed, the signal will remain effective until the next position movement command is received.

■ Current operation mode (MODES)

This signal is enabled when the teaching type is selected.

The MODES signal will turn ON when the teaching mode is enabled upon selection of the teaching mode via the operation mode input signal (MODE signal ON).

Thereafter, the MODES signal will remain ON until the MODE signal turns OFF.

Configure the system in such a way that the PLC will start teaching operation after confirming that the MODES signal has turned ON.

■ Write completion (WEND)

This signal is enabled only when the teaching type is selected.

The WEND signal is OFF immediately after the controller has switched to the teaching mode. It will turn ON when the writing of position data in response to the current-position write signal is completed.

When the current-position write signal turns OFF, this signal will also turn OFF.

Configure the system in such a way that the PLC will acknowledge completion of writing when the WEND signal turns OFF.

■ Movement complete at each position (PE0 to PE6) [7-point type]

When PIO pattern is “4,” a position number (0 through 6) corresponding to each movement command will be output upon completion of positioning. Simple alarm-code output function is not provided for these signals. If an alarm generates, only the *ALM signal will turn OFF. Check the details of the alarm code using each tool.

Correspondence table of output signals and positions completed

Output signal	Position completed
PE0	Position No. 0
PE1	Position No. 1
PE2	Position No. 2
PE3	Position No. 3
PE4	Position No. 4
PE5	Position No. 5
PE6	Position No. 6

Note) These signals turn OFF when the servo is turned OFF or an emergency stop is actuated. They will return to the ON status when the servo is turned ON again, provided that the current position is inside the in-position range with respect to the target position. If the current position is outside the range, the signals will remain OFF.

■ Position detection output at each position (LS0 to LS2) [3-point type]

These signals have the same meanings as the LS signals of an air cylinder. Each signal will turn ON when the current position enters the positioning band of the target position.

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

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

■ Ready (SV)

This is a monitor signal indicating that the servo is ON and the motor is ready.
Use this signal as a condition for starting a movement command on the PLC side.

■ Alarm (*ALM)

This signal remains ON while the controller is operating properly, and turns OFF when an alarm has generated. Provide an appropriate safety measure for the entire system by allowing the PLC to monitor the OFF status of this signal.
For details of alarms, refer to 10, “Troubleshooting.”

■ Emergency stop (*EMGS)

This signal remains ON while the controller is normal, and will turn OFF if the emergency stop circuit is cut off. Program the PLC so that it will monitor this signal and implement appropriate safety measures for the entire system if the signal turns OFF.

■ Load output judgment status (LOAD)

* This is a dedicated signal available only with the PCON-CF.
If used in a press-fitting application, the controller must be able to know if the specified load threshold was reached during push & hold operation.
A desired load threshold and check band range are set in the position table, and this signal will turn ON when the command torque exceeds the threshold while the actuator is inside the check band range.
With the LOAD signal, judgment is made based on whether the total duration of periods in which the command torque has exceeded the threshold corresponds at least to a specified time. The specific processing procedure is the same as the one used when determining a completion of push action. The time used for judgment of load output can be changed freely using user parameter No. 50, “Load output judgment time.”

■ Torque level status (TRQS)

* This is a dedicated signal available only with the PCON-CF.
If a load threshold is set, this signal will turn ON when the motor current reaches the load threshold while the actuator is moving.
Since the level of current is monitored, the ON/OFF status of this signal will change when the current changes. In the weak field-magnet vector control used for stepping motors, the balance of current and torque will be lost once a specific speed is exceeded. To use the command current to determine if the threshold has been reached, therefore, the push speed must be limited. Note, however, that the range of permissible push speeds varies depending on the motor and lead, which means that the push speed set in user parameter No. 34 must also be adjusted according to the applicable motor and lead.

■ Output Signal Changes in Each Mode

Mode classification	MOVE	PEND	SV	HEND	PM1 ~ PM256
Actuator is stopped with the servo ON after the power was input	OFF	ON	ON	OFF	OFF
Home return is in progress following an input of the home return signal	ON	OFF	ON	OFF	OFF
Home return has completed following an input of the home return signal	OFF	ON	ON	ON	OFF
Actuator is moving in the positioning/push & hold mode	ON	OFF	ON	ON	OFF
Actuator is paused in the positioning/push & hold mode	OFF	OFF	ON	ON	OFF
Positioning has completed in the positioning mode	OFF	ON	ON	ON	ON
Actuator has stopped after contacting the work part in the push & hold mode	OFF	ON	ON	ON	ON
Actuator has stopped after missing the work part (no work part) in the push & hold mode	OFF	OFF	ON	ON	ON
Actuator is stopped with the servo ON in the teaching mode	OFF		ON	ON	
Actuator is jogging in the teaching mode	ON		ON	ON	
Actuator is being moved by hand with the servo OFF in the teaching mode	OFF		OFF	ON	
Servo is OFF after home return	OFF	OFF	OFF	ON	OFF
Emergency stop has been actuated after home return	OFF	OFF	OFF	ON	

(Note) Determine whether the actuator has stopped after contacting the work part or missing the work part from the signal statuses of MOVE, PEND and PM1 to PM256.

6. Data Entry <Basics>

To move the actuator to a specified position, a target position must be entered in the “Position” field.
A target position can be specified in the absolute mode where a distance from the home is entered, or in the incremental mode where a relative travel from the current position is entered.
Once a target position is entered, all other fields will be automatically populated with their default values set by the applicable parameters.
The default values vary depending on the characteristics of the actuator.

6.1 Description of Position Table

The position table is explained using an example on the PC software screen.
(The items displayed on the teaching pendant are different.)

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

Zone+ [mm]	Zone- [mm]	Acceleration/ deceleration mode	Incremental	Command mode	Standstill mode	Comment
100.00	0.00	0	0	0	4	Standby position
400.00	300.00	0	0	0	0	
250.00	150.00	0	0	0	0	

(1) No.

- Indicate the position data number.

(2) Position

- Enter the target position to move the actuator to, in [mm].

Absolute mode: Enter a distance from the actuator home.
Incremental mode: Enter a relative travel from the current position based on constant-pitch feed.

No	Position [mm]
0	30.00
1 =	10.00
2 =	-10.00

Absolute mode The target position is 30 mm from the home.
Incremental mode +10 mm from the current position
Incremental mode -10 mm from the current position

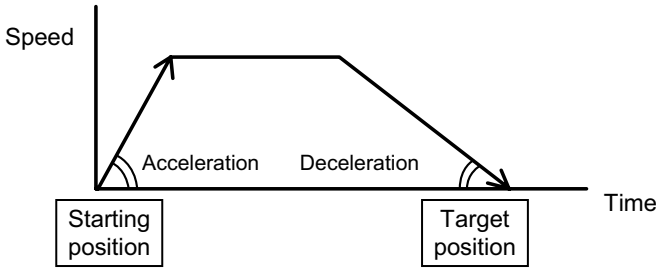
* On the teaching pendant, this sign indicates that the position is set in the incremental mode.

(3) 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

- Enter the acceleration/deceleration at which to move the actuator, in [G].
  Basically, the acceleration and deceleration should be inside the rated acceleration/deceleration range specified in the catalog.
  The input range is greater than the rated range in the catalog to accommodate situations where you want to “reduce the tact time when the transferring mass is significantly smaller than the rated value.”
  If vibration of the load causes problem during acceleration/deceleration, decrease the set value.



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

⚠ Caution: Refer to the attached list of supported actuator specifications and set appropriate speed and acceleration/deceleration so that the actuator will not receive excessive impact or vibration under the applicable installation condition and for the load of the specific shape. Increasing the speed and acceleration/deceleration may significantly impact the actuator depending on the transferring mass, and the actuator characteristics also vary from one model to another. Contact IAI for the maximum limits that can be entered in your specific application.

(5) Push

- Select “positioning operation” or “push & hold operation.”
  The factory setting is “0.”
  0: Normal positioning operation
  Other than 0: Push & hold operation, where the entry indicates a current-limiting value.

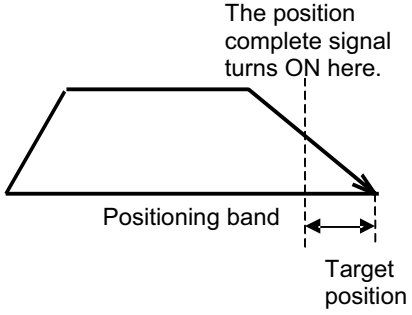
(6) Threshold

- This field sets the threshold for motor current. The factory setting is “0.”

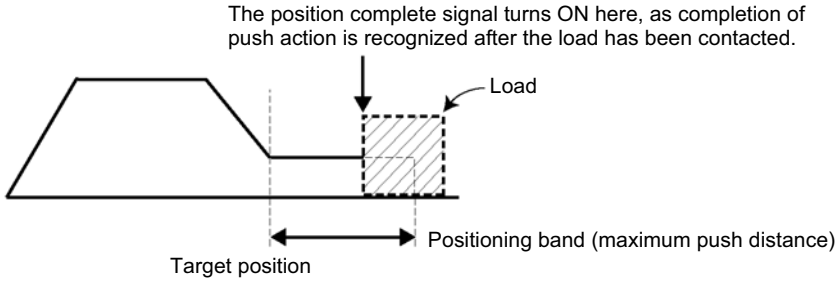
(7) Positioning band

- The meaning of this field varies between “positioning operation” and “push & hold operation.”

“Positioning operation”
This field defines how much before the target position the completion signal will turn ON.
Increasing the positioning band allows the next operation in the sequence to be started early, and consequently the tact time can be reduced. Set an optimal value by checking the overall balance of the system.



"Push & hold operation"
This field defines the maximum push distance after reaching the target position in push & hold operation.
Consider possible mechanical variation of the work part and set an appropriate positioning band that will prevent the positioning from completing before the work part is contacted.



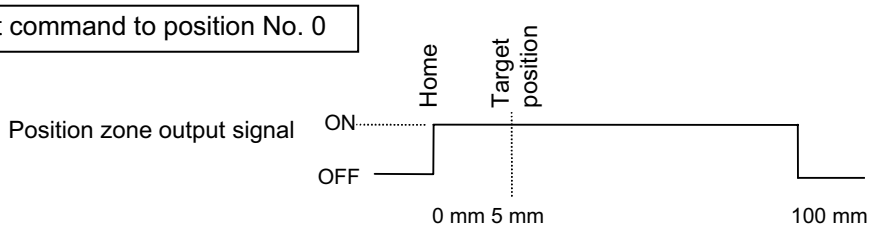
(8) Zone +/-

- This field defines the zone within which the position zone output signal (PZONE) will turn ON. To add flexibility, a different zone can now be set for each target position.

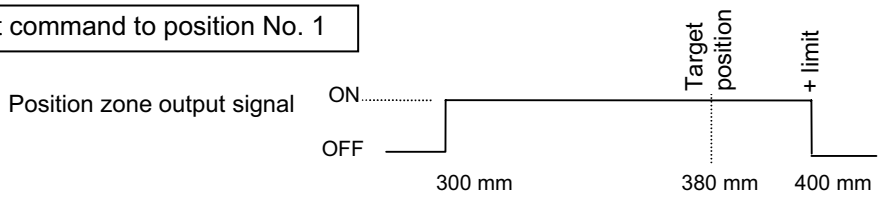
[Setting example]

No.	Position [mm]	Zone+ [mm]	Zone- [mm]
0	5.00	100.00	0.00
1	380.00	400.00	300.00
2	200.00	250.00	150.00

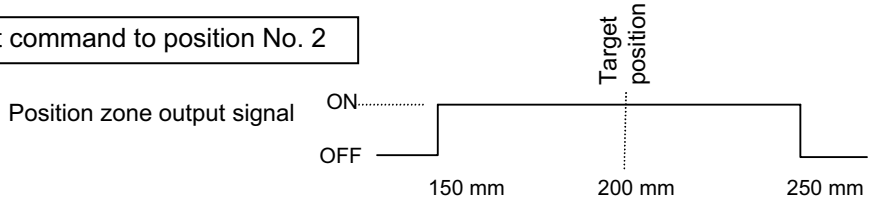
Movement command to position No. 0



Movement command to position No. 1



Movement command to position No. 2



(9) Acceleration/deceleration mode

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

(10) Incremental

- This field defines whether the position is specified in the absolute mode or incremental mode.
  The factory setting is “0.”
  0: Absolute mode
  1: Incremental mode

(11) Command mode

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

(12) Standstill mode

- This field defines the power-saving mode to be applied while the actuator is standing by after completing its movement to the target position set in the “Position” field for the applicable position number.
  0: Disable all power-saving modes * The factory setting is “0” (Disable).
  1: Automatic servo-off mode, with the delay time defined by parameter No. 36
  2: Automatic servo-off mode, with the delay time defined by parameter No. 37
  3: Automatic servo-off mode, with the delay time defined by parameter No. 38
  4: Full servo control mode

Full servo control mode

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

Automatic servo-off mode

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

※ For details,refer to 6.4,"Power-saving Modes at Standby Positions."

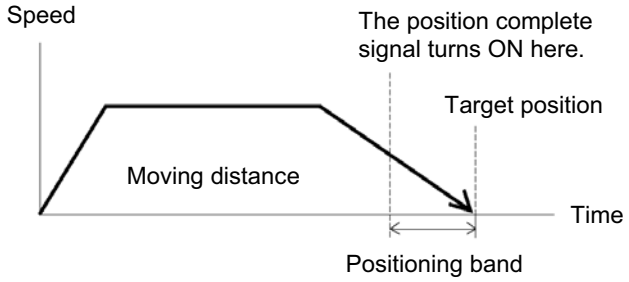
6.1.1 Relationship of Push Force at Standstill and Current-Limiting Value

When performing operation in the push & hold mode, enter the current-limiting value (%) in the push column of the position-data table.
Determine the current-limiting value (%) from the push force to be applied to the work part at standstill.
For the relationship of push force at standstill and current-limiting value for each actuator type, refer to the Appendix.

6.2 Explanation of Modes

6.2.1 Positioning Mode Push = 0

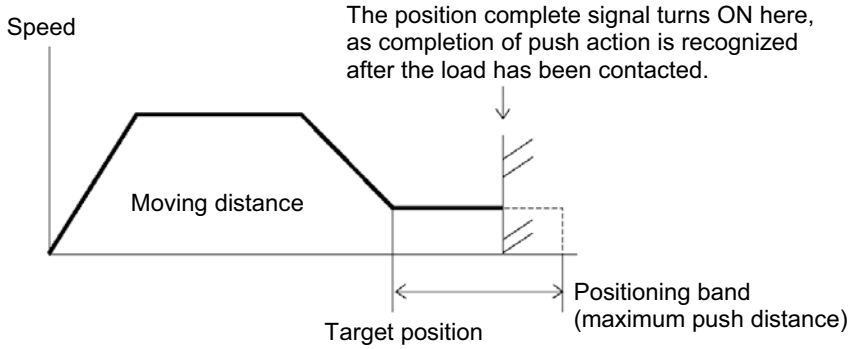
The actuator moves to the target position set in the “Position” field of the position table.



6.2.2 Push & Hold Mode Push = Other than 0

(1) Work part was contacted successfully

Upon reaching the target position set in the “Position” field of the position table, the actuator moves at the push speed for the distance set in the “Positioning band” field.
If the actuator contacts the work part while moving and the controller recognizes that “push action has completed,” the position complete signal will turn ON.



- The push speed is set by parameter No. 34.
  The factory setting varies with each actuator in accordance with the actuator’s characteristics.
  Set an appropriate speed by considering the material and shape of the work part, among others.
  Since the maximum speed is 20 mm/s, operate the actuator at a speed not exceeding this value.
- Set a positioning band slightly longer than the last position, in order to absorb possible mechanical variation of the work part.

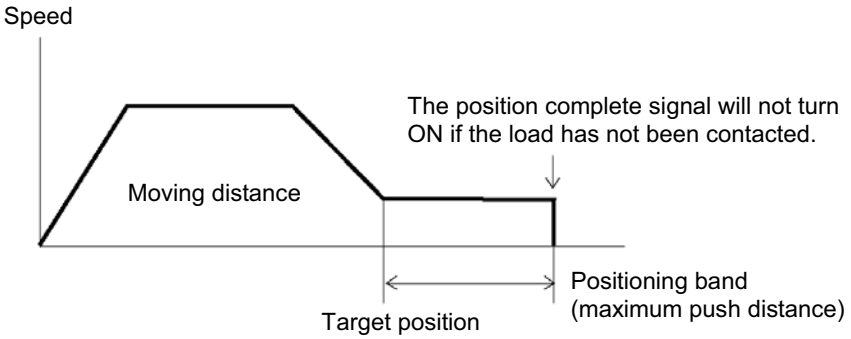
■ “Completion of push action” is determined based on a combination of the current-limiting value set in the “Push” field of the position table and the push completion judgment time set by parameter No. 6.
Set an appropriate condition by considering the material and shape of the work part, among others.
For details, refer to Chapter 8, “Parameter Settings.”

Warning	• If the actuator contacts the work part before reaching the target position, a servo error alarm will generate. Pay due attention to the relationship of the target position and the work part position. • The actuator continues to push the work part 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.

(2) Work part was not contacted (missed)

If the actuator does not still contact the work part after having moved the distance specified in the “Positioning band” field, the position complete signal will not turn ON.
Therefore, include timeout check processing in the sequence circuit on the PLC side.

- It is recommended that a zone signal be also used as a “simple ruler” to supplement the judgment of missed work part.

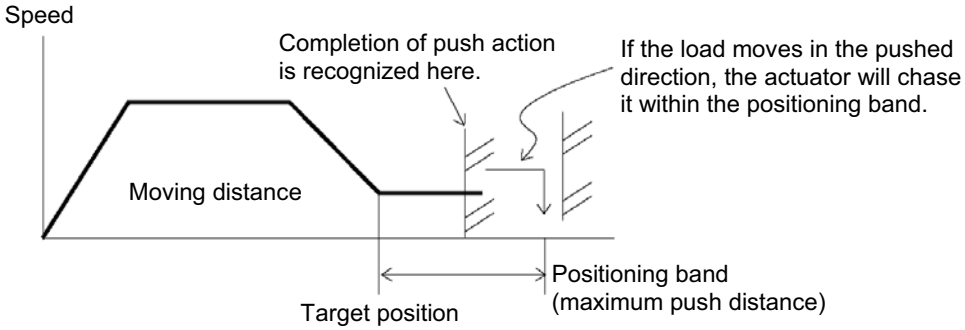


(3) Work part moves during push & hold operation

[1] Work part moves in the pushed direction

If the work part moves in the pushed direction after completion of push action, the actuator will chase the work part within the positioning band.

If the current drops to below the current-limiting value set in the “Push” field of the position table while the actuator is moving, the position complete signal will turn OFF. The position complete signal will turn ON when the current-limiting value increases to the specified level again.

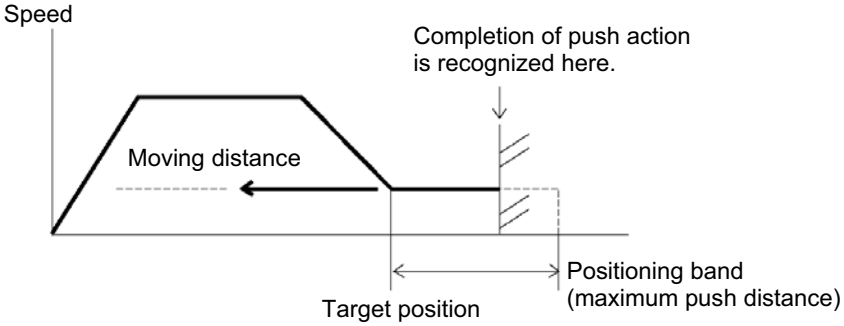


[2] Work part moves in the opposite direction

(Actuator is pushed back by the strong reactive force of the work part)

If the actuator is pushed back after completion of push action because the reactive force of the work part is greater than the thrust force of the actuator, the actuator will be pushed back until its push force balances out with the reactive force of the work part.

The position complete signal will remain ON.

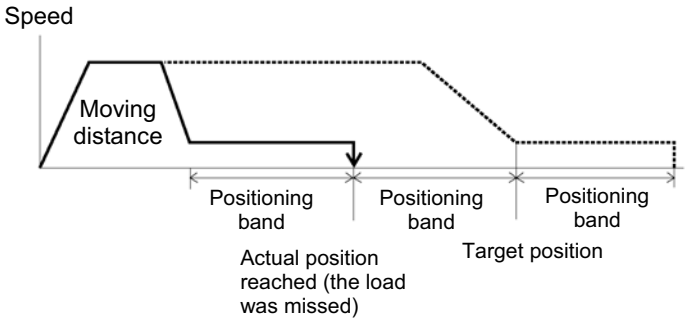


(Note) If the actuator is pushed back to the target position, an alarm will generate.

⚠Caution: As the maximum push distance is approached during push-motion operation, the actuator decelerates by assuming that it has missed the work part and stops at the position corresponding to the maximum push distance. If the speed drops significantly immediately before the actuator stops, the set push force cannot be maintained. For this reason, do not perform any push-motion operation where the entire range of the maximum push distance is used.

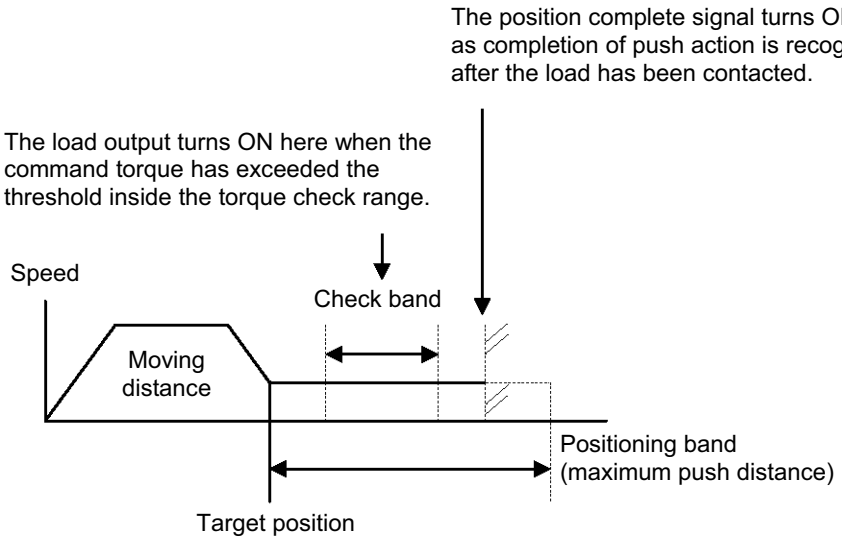
(4) Positioning band was entered with a wrong sign

Take note that if a value with a wrong sign is set in the “Positioning band” field of the position table, the operation will deviate by a distance corresponding to “positioning band x 2,” as shown below.



6.2.3 Torque Check Function in Push & Hold Operation

(1) Torque check function when a check band is set

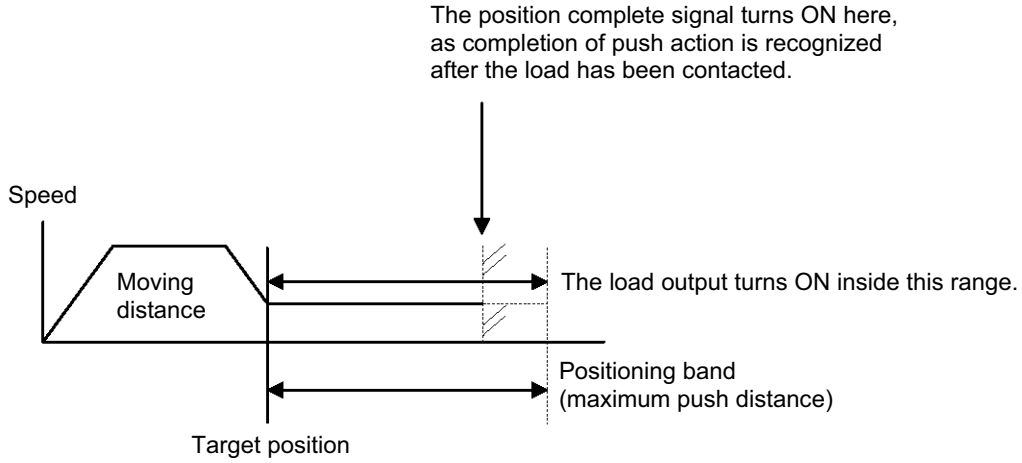


After reaching the target position set in the “Position” field of the position table, the actuator moves at the push speed by the distance set in the “Positioning band” field. If the command torque reaches the threshold before the specified distance is traveled and while the actuator is inside the threshold check band, the load output will turn ON.

- The push speed is set by parameter No. 34, “Push speed.”
  The factory setting varies with each actuator in accordance with the characteristics of the actuator.
  Set an appropriate speed by considering the material and shape of the work part, among others.
  Take note, however, that the maximum speed is limited to 10 mm/s.
- Set parameter No. 51, “Torque check range” to “0 [Enable].”
- Set a threshold check band in the "zone + or zone -" filed of the position table.
- Set a desired threshold in the “Threshold” field of the position table (input range: a desired value within the specified push force range).
- Set a desired positioning band in the “Positioning band” field of the position table.
  Set a positioning band slightly longer than the last position, in order to absorb possible mechanical variation of the work part.
  For details, refer to Chapter 8, “Parameter Settings.”

Warning	• If the actuator contacts the work part before reaching the target position, a servo error alarm will generate. Pay due attention to the relationship of the target position and the work part position. • The actuator continues to push the work part at the push force at standstill determined by the current-limiting value. Since the actuator is not inactive, exercise due caution when handling the equipment in this condition.

(2) Torque check function when a check band is not used



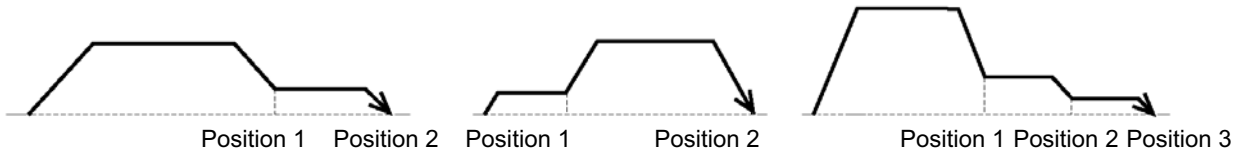
After reaching the target position set in the “Position” field of the position table, the actuator moves at the push speed by the distance set in the “Positioning band” field. If the command torque reaches the threshold before the end of the positioning band is reached, the load output will turn ON. The load output will turn OFF once the command torque drops to below the threshold.

- The push speed is set by parameter No. 34, “Push speed.”
  The factory setting varies with each actuator in accordance with the characteristics of the actuator.
  Set an appropriate speed by considering the material and shape of the work part, among others.
  Take note, however, that the maximum speed is limited to 10 mm/s.
- Set parameter No. 51, “Torque check range” to “1 [Disable].”
- Set a desired threshold in the “Threshold” field of the position table (input range: a desired value within the specified push force range).
- Set a desired positioning band in the “Positioning band” field of the position table.
  Set a positioning band slightly longer than the last position, in order to absorb possible mechanical variation of the work part.
  For details, refer to Chapter 8, “Parameter Settings.”

Warning	• If the actuator contacts the work part before reaching the target position, a servo error alarm will generate. Pay due attention to the relationship of the target position and the work part position. • The actuator continues to push the work part at the push force at standstill determined by the current-limiting value. Since the actuator is not inactive, exercise due caution when handling the equipment in this condition.

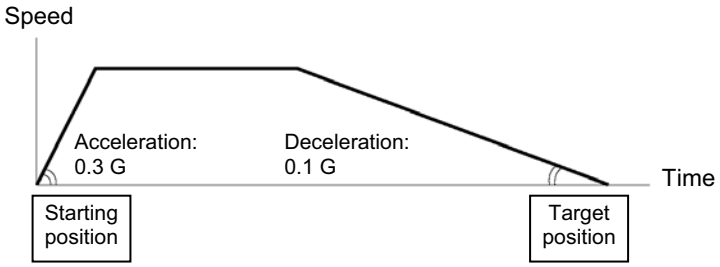
6.2.4 Speed Change during Movement

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.



6.2.5 Operation at Different Acceleration and Deceleration Settings

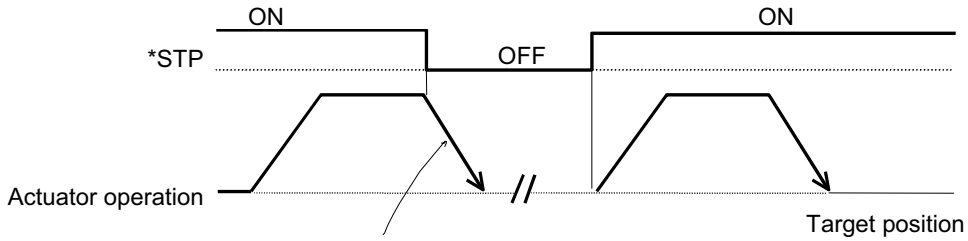
If the work part is a CCD camera or other precision equipment, the deceleration curb at stop must be made as gradual as possible.
To accommodate these sensitive applications, the position table has separate fields for “acceleration” and “deceleration.”
For example, you can set the deceleration differently from the acceleration, such as setting 0.3 G (rated acceleration) in “Acceleration” and 0.1 G in “Deceleration.”



⚠ Caution: Basically, the acceleration and deceleration should be inside the rated acceleration/deceleration range specified in the catalog.
The input range is greater than the rated range in the catalog, but this is only to accommodate situations where you want to “reduce the tact time when the transferring mass is significantly smaller than the rated value.”
If you want to use acceleration/deceleration settings greater than the rating, consult IAI beforehand because it may affect the life of the actuator.

6.2.6 Pause

The actuator can be paused during movement using an external input signal (*STP).
The pause signal uses the contact b logic (always ON) to ensure safety.
Turning the *STP signal OFF causes the actuator to decelerate to a stop. When *STP is turned ON subsequently, the actuator will resume the remaining movement.



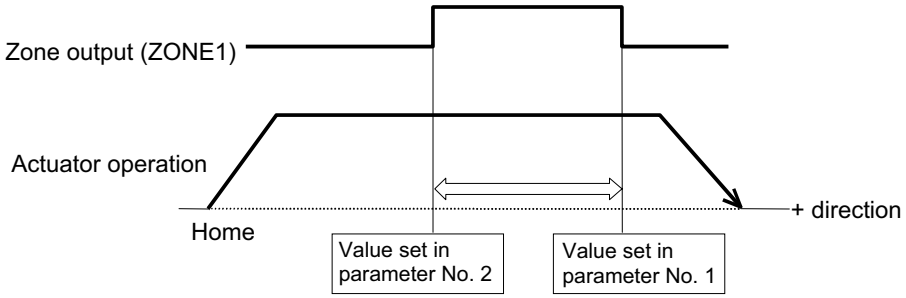
(Note) The deceleration corresponds to the value set in the “Deceleration” field for the current position number in the position table.

6.2.7 Zone Signal Output

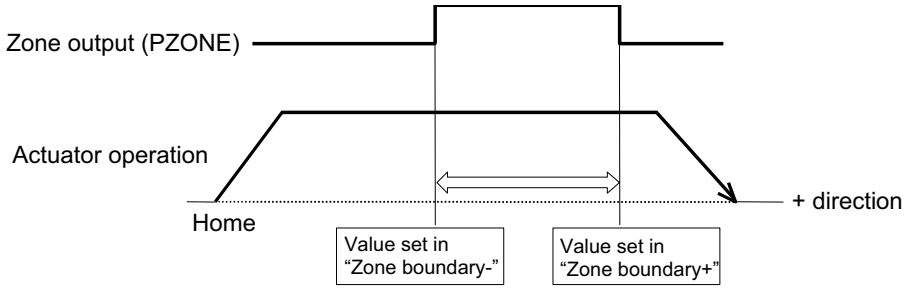
The zone output is suitable for the following applications, because a signal can be output when the actuator enters a specified zone during movement:
[1] Issue a trigger signal to surrounding equipment to reduce the tact time
[2] Prevent contact with surrounding equipment
[3] Use as a “simple ruler” in push & hold operation

A different method is used for the zone output signal, and for the position zone output signal, to set the zone within which the signal will turn ON.

- Zone output signal (ZONE1)
  Set the signal ON zone using parameters.
  Parameter No. 1 = Zone boundary+, Parameter No. 2 = Zone boundary-



- Position zone output signal (PZONE)
  Set the signal ON zone using the “Zone boundary-“ and “Zone boundary+” fields of the position table.



6.2.8 Home Return

After the power is turned on, home return must be performed to establish the home position.

The method of home return varies depending on the PIO pattern.

- When a dedicated input is used [PIO pattern ≠ 5]
  Home return is performed using the home return (HOME) input.
  The actuator will return home regardless of whether or not home return has been completed once before.
  When home return is completed, the home return complete (HEND) output signal will turn ON.

- When a dedicated input is not used [PIO pattern = 5]
  When a rear end move command is input while home return is not yet completed, the actuator will perform home return first and then move to the rear end.

★ For details, refer to 7.2, “How to Execute Home Return.”

6.2.9 Overview of Teaching Type

Depending on your system, it may be desirable to be able to use a touch panel, etc., to perform jogging operation or write the current position to the “Position” field of the position table, without using a PC or teaching pendant.
The teaching type is provided to support these applications.
The features of the teaching type are summarized below:

[1] The actuator can be jogged using I/O signals input from the PLC.
Continuous jog feed or inching feed can be selected by the manual switching signal to facilitate fine position adjustment.
* This function is effective regardless of the ON/OFF state of the operation mode input (MODE) signal.

[2] The current position can be written to the “Position” field of the position table using I/O signals input from the PLC.
* This function is effective only when the operation mode input (MODE) signal is ON.

(Note) The number of I/O points is limited, so some I/O ports are used in both the teaching type and the normal positioning type. Remember this when creating a sequence circuit for the PLC.

Operation mode input (MODE) * Signal for switching to the teaching mode	ON (teaching mode)	OFF (positioning mode)
Current operation mode output (MODES) * Monitor output indicating the internal mode of the controller	ON (teaching mode)	OFF (positioning mode)
Meaning of I/O connector pin 18A	Current-position write input (PWRT)	Start input (CSTR)
Meaning of I/O connector pin 12B	Write completion output (WEND)	Position complete output (PEND)

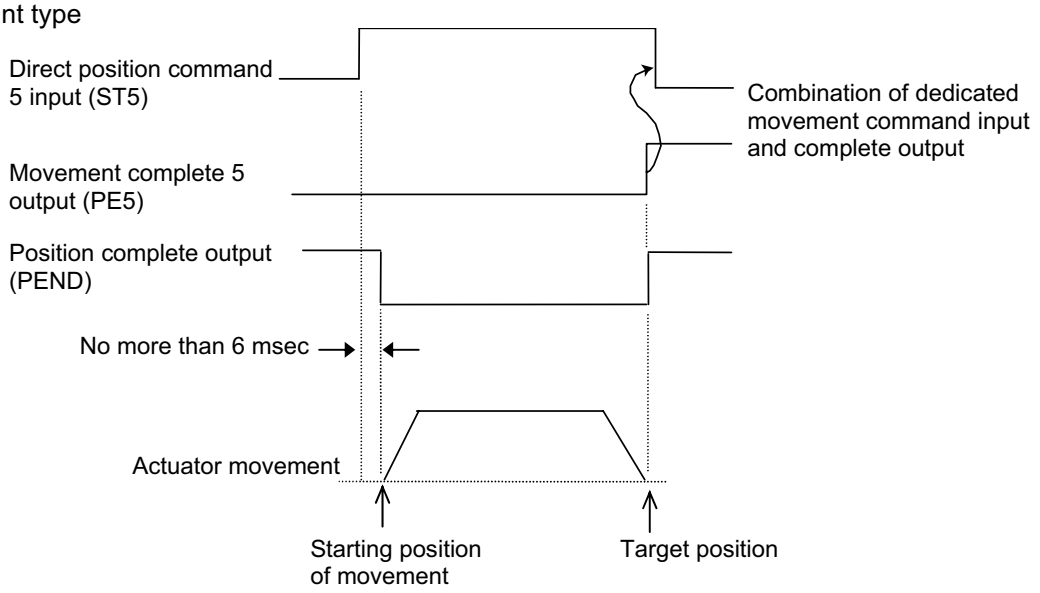
⚠ Warning: Jog commands are effective even before home return is completed, but the soft stroke checks are not performed prior to home return. Accordingly, the actuator may move all the way to the mechanical end if the jog command (JOG+/JOG-) signal remains ON. Exercise caution not to let the actuator hit the mechanical end.

6.2.10 Overview of 7-point Type

The number of positioning points is kept small, or specifically to seven or less. This type assumes simple applications where the PLC ladder sequence only requires a simple circuit configuration.
I/O signals provide separate command inputs and movement complete outputs for respective position numbers. Accordingly, the signal pattern is different from the one in the 64-point positioning type (PIO pattern = 0).

Example) The differences are explained by using an example of moving the actuator to the target position for position No. 5.

[1] 7-point type

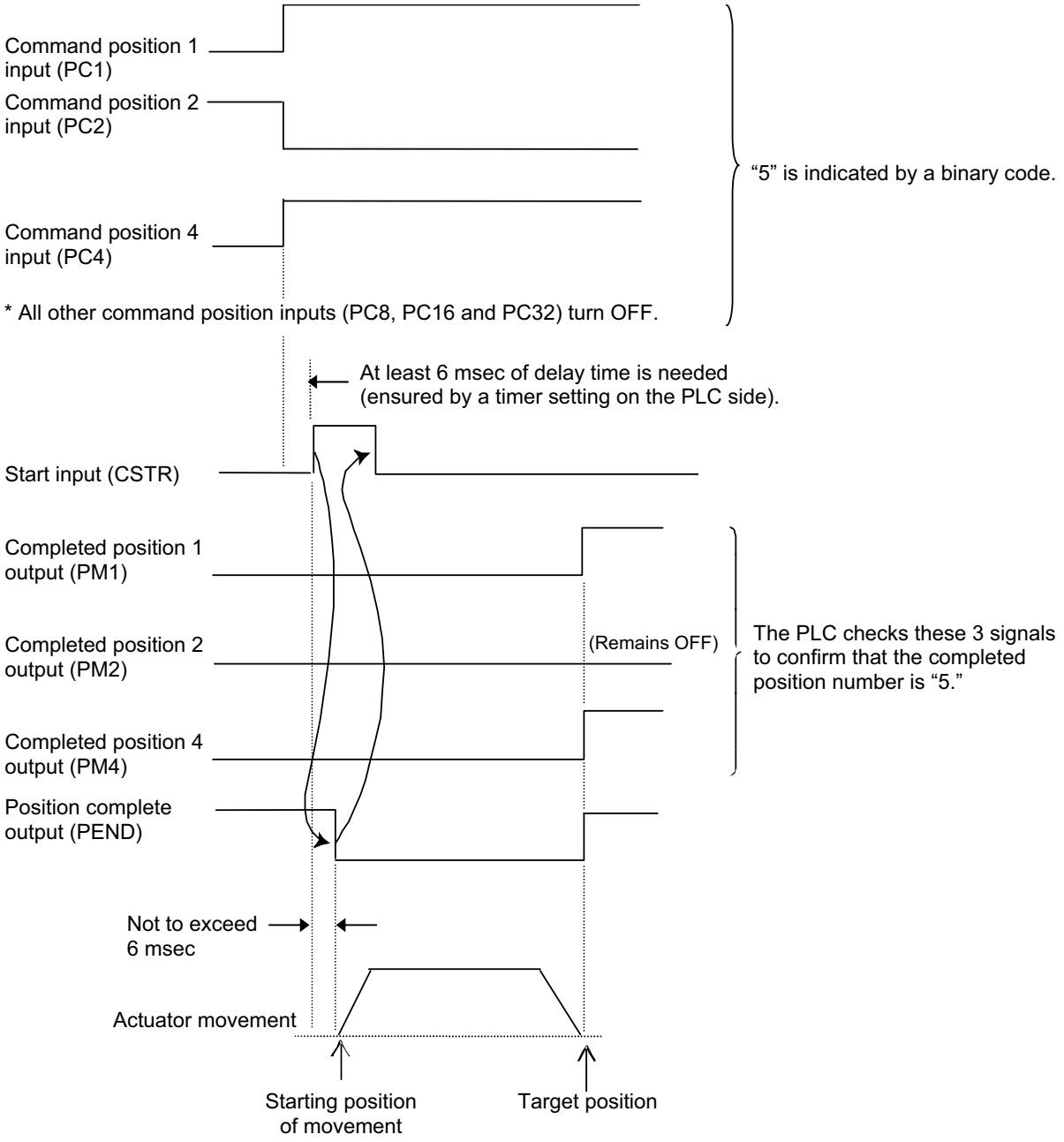


* In the 64-point type, a position command input (binary) signal and a start input signal must be turned ON at staggered timings to initiate movement (refer to the next page). In this type, however, there is only one input signal that needs to be turned ON.

■ Explanation of I/O signals

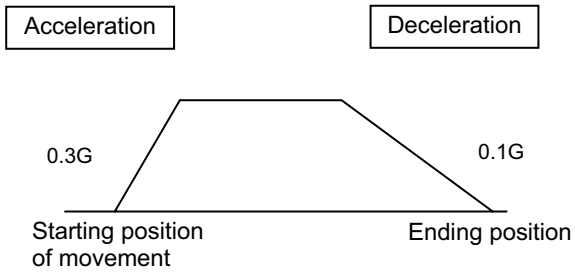
Signal name	Category	Function explanation
Direct position command 0 (ST0)	Input	Movement command to the target position for position No. 0
Direct position command 1 (ST1)		Movement command to the target position for position No. 1
Direct position command 2 (ST2)		Movement command to the target position for position No. 2
Direct position command 3 (ST3)		Movement command to the target position for position No. 3
Direct position command 4 (ST4)		Movement command to the target position for position No. 4
Direct position command 5 (ST5)		Movement command to the target position for position No. 5
Direct position command 6 (ST6)		Movement command to the target position for position No. 6
Movement complete 0 (PE0)	Output	Indicates that the actuator reached the target position for position No. 0.
Movement complete 1 (PE1)		Indicates that the actuator reached the target position for position No. 1.
Movement complete 2 (PE2)		Indicates that the actuator reached the target position for position No. 2.
Movement complete 3 (PE3)		Indicates that the actuator reached the target position for position No. 3.
Movement complete 4 (PE4)		Indicates that the actuator reached the target position for position No. 4.
Movement complete 5 (PE5)		Indicates that the actuator reached the target position for position No. 5.
Movement complete 6 (PE6)		Indicates that the actuator reached the target position for position No. 6.

[2] 64-point type

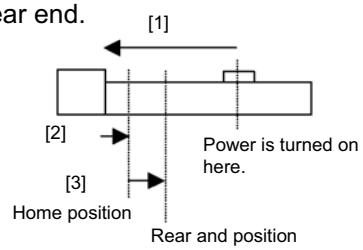


6.2.11 Overview of 3-point Type

This type provides a control method adjusted to that of an air cylinder by assuming that the controller is used as an air cylinder.
The key differences between this controller and an air cylinder are summarized in the table below. Program appropriate controls by referring to this table.
* Do not use this mode for push & hold operation.

<table>
<tr><th>Item</th><th>Air cylinder</th><th>PCON</th></tr>
<tr><td>Drive method</td><td>Air pressure supplied via electromagnetic valve control</td><td>Ball-screw or timing-belt drive using a pulse motor</td></tr>
<tr><td>Target position setting</td><td>Mechanical stopper (including shock absorber)</td><td>Desired coordinates are entered in the [Position] field of the position table.
Coordinates can be entered from the PC/teaching pendant using the keyboard/keys, or the actuator can be moved to the desired position to read the achieved coordinates directly.
Example) 400-mm stroke
<table>
<tr><th>Position No.</th><th>Position</th></tr>
<tr><td>0</td><td>5 (mm) Rear end</td></tr>
<tr><td>1</td><td>400 (mm) Front end</td></tr>
<tr><td>2</td><td>200 (mm) Intermediate point</td></tr>
</table></td></tr>
<tr><td>Target position detection</td><td>An external detection sensor, such as a reed switch, is installed.</td><td>Determined based on the internal coordinates provided by the position information from the position detector (encoder). Accordingly, external detection sensor is not required.</td></tr>
<tr><td>Speed setting</td><td>Adjusted by a speed controller.</td><td>A desired feed speed is entered in the [Speed] field of the position table (unit: mm/sec).
Note that the rated speed is automatically set as the initial value.</td></tr>
<tr><td>Acceleration/ deceleration setting</td><td>Determined in accordance with the load, supplied air volume, as well as the performance of the speed controller and electromagnetic valve.</td><td>Desired acceleration/deceleration are entered in the [Acceleration] and [Deceleration] fields of the position table (minimum setting unit: 0.01 G).
Reference: 1 G = Gravitational acceleration
Note that the rated acceleration/deceleration is automatically set as the initial value.
Since the acceleration/deceleration can be set in fine steps, a gradual acceleration/deceleration curve can be programmed.


Setting a larger value makes the curve steeper, while setting a smaller value makes the curb more gradual.</td></tr>
</table>

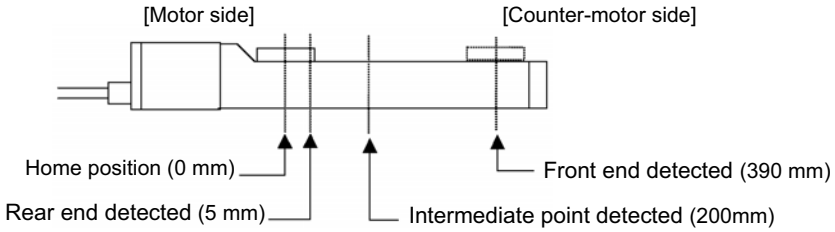
Item	Air cylinder	RCP2
Position check upon power ON	Determined by an external detection sensor, such as a reed switch.	Immediately after the power is turned on, the controller cannot identify the current position because the mechanical coordinates have been lost. Accordingly, a rear end command must always be executed after the power is turned on, to establish the coordinates. The actuator will perform home-return operation first, and then move to the rear end.  [1] The actuator moves at the home return speed toward the mechanical end on the motor side. [2] The actuator contacts the mechanical end and turns back, and then stops temporarily at the home position. [3] The actuator moves to the rear end at the speed set in the [Speed] field of the position table. (Note) Pay attention not to allow any obstacle in the travel path of the actuator during home return.

The relationship of each movement command input/position detected and corresponding position number is shown below.
The input/output signals are given easy-to-identify names by following the naming convention of air-cylinder switches. However, the target position is determined by the value set in the [Position] field for each position number. Therefore, changing the magnitude relationships of settings under position Nos. 0, 1 and 2 will change the meanings of input/output signals.
For this reason, it is recommended that you always use the signals under their names defined in this manual, unless doing so presents problem, so that the signals have the same meanings at all time.

Input signal	Output signal	Target position
Rear end move (ST0)	Rear end detected (LS0)	Value set in the [Position] field for position No. 0 Example) 5 mm
Front end move (ST1)	Front end detected (LS1)	Value set in the [Position] field for position No. 1 Example) 390 mm
Intermediate point move (ST2)	Intermediate point detected (LS2)	Value set in the [Position] field for position No. 2 Example) 200 mm

- Positioning relationship on the ROBO Cylinder

An example of a slider type with a stroke of 400 mm is explained.



- Position table (Enter in the fields indicated in bold)

No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]
0	5.00	500.00	0.30	0.30	0	0.10
1	390.00	500.00	0.30	0.30	0	0.10
2	200.00	500.00	0.30	0.30	0	0.10

6.3 Notes on the ROBO Gripper

(1) Finger operation

[1] Definition of position

The specified stroke of the 2-finger type indicates the sum of travel distances of both fingers. In other words, the travel distance of one finger is one half the specified stroke.

A position you specify defines the distance traveled by one finger from the home position in the closing direction.

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

[2] Definition of speed and acceleration

The command value applies to each finger.

The relative speed and acceleration of the 2-finger type are twice the command values.

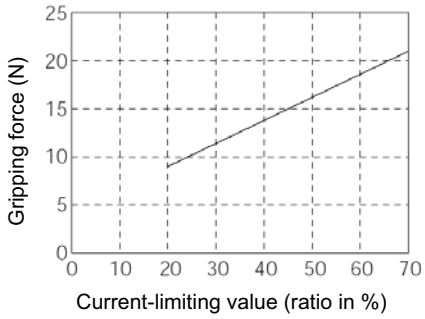
[3] Operation mode in gripper applications

When the actuator is used to grip the work part, be sure to select the “push & hold mode.”

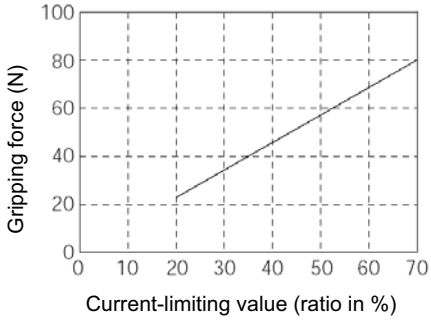
(Note) In the “positioning mode,” a servo error may occur while the work part is gripped.

[Diagrams of gripping force and current-limiting value]

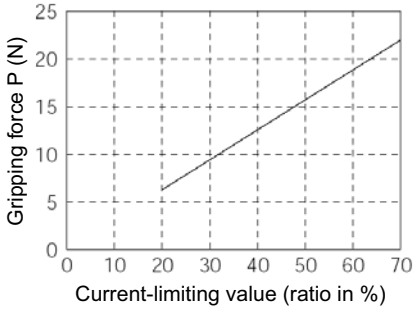
[GRS]



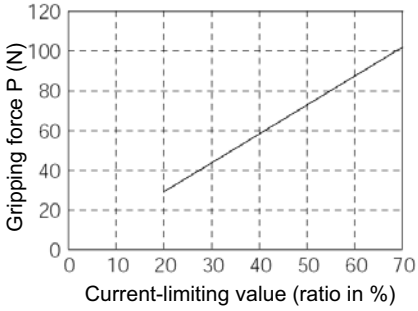
[GRM]



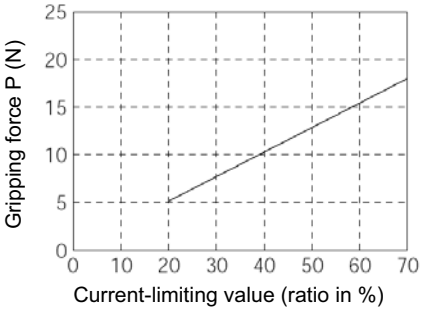
[GR3SS]



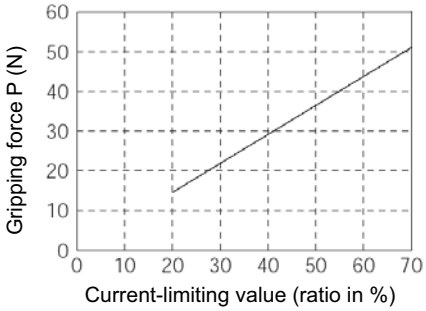
[GR3SM]



[GR3LS]



[GR3LM]



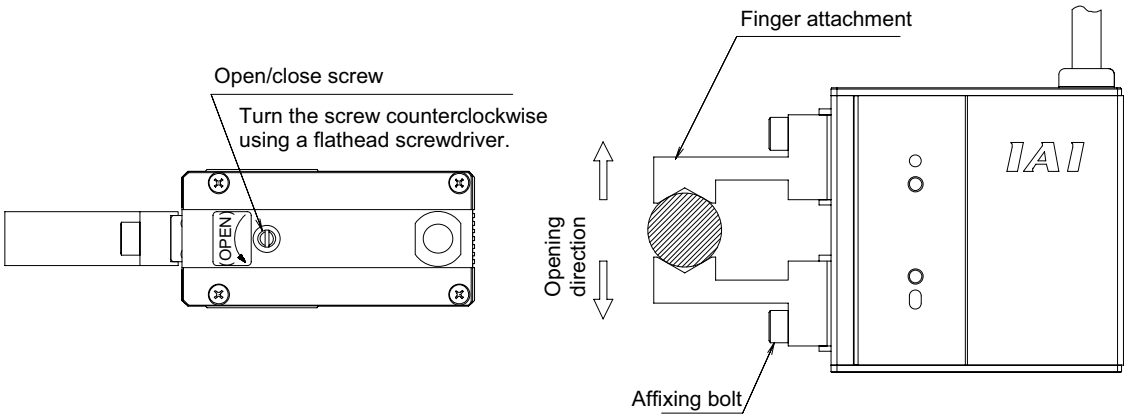
(2) Removing the gripped work part

This gripper is designed to maintain the work part-gripping force via a self-lock mechanism even when the servo is turned OFF or the controller power is cut off.

If the gripped work part must be removed while the power is cut off, do so by turning the open/close screw or removing the finger attachment on one side.

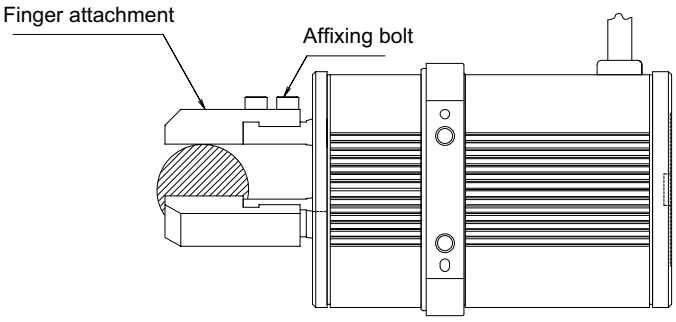
[2-finger type]

Turn the open/close screw or remove the finger attachment on one side.



[3-finger type]

Remove one finger attachment.



6.4 Power-saving Modes at Standby Positions

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

Setting / Status	PIO Pattern 0 to 4	PIO Pattern 0 to 5
Standby after home return is complete (Positioning to the target point is not done)	Power saving function executed with the values set in Parameter No.53 (Stop Mode of the position number is invalid)	
Standby with the servo turned ON after the power is supplied (Positioning to the target point is not done)		Power saving function executed with the values set in Parameter No.53 (Stop Mode of the position number is invalid)
Standby after the positioning is complete to the target position set in the position table	Power saving function executed with the values set in “Stop Mode” in each position number (Setting of Parameter No.53 is invalid)	

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

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

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

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

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

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

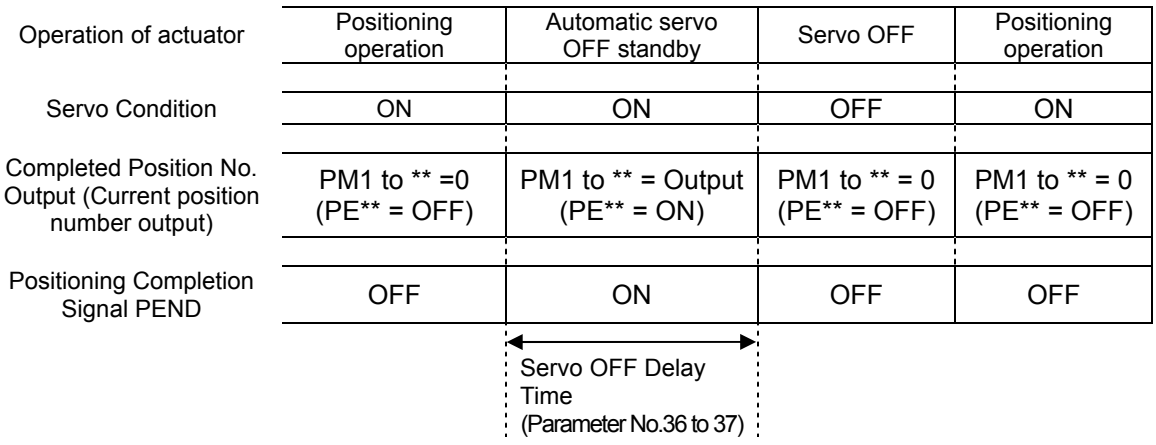
Set Value	Operation after completion of positioning
0	Servo ON not changed
1	Automatic servo off in a certain time (set in Parameter No.36)
2	Automatic servo off in a certain time (set in Parameter No.37)
3	Automatic servo off in a certain time (set in Parameter No.38
4	Full Servo Control

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

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

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

[For Parameter No.39 = 0]



[For Parameter No.39 = 1]

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

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

6.5 Using a Rotary Actuator in Multi-rotation Specification

Rotary actuators of multi-rotation specification models let you select multi-rotation operation or limited-rotation operation using a parameter.

6.5.1 How to Use

(1) Home return
When a home return command is issued, a signal from the limit switch located in the home return direction is detected. Once a limit switch signal is detected, the actuator reverses its direction. When a limit switch signal turns off again thereafter, the actuator travels by the home return offset specified in parameter No. 22 and completes the home return.

(2) Operation commands

Limited-rotation specification (Normal mode [Selected by parameter No. 79])	Multi-rotation specification (Index mode [Selected by parameter No. 79])
Push & hold operation permitted	Push & hold operation not permitted
Absolute coordinate specification -0.15° to 360.15°	Absolute coordinate specification 0.00° to 359.99°
Relative coordinate specification -360.15° to 360.15°	Relative coordinate specification -360.00° to 360.00°

Notes

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

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

Applicable Models

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

7. Operation <Practical Steps>

7.1 How to Start

7.1.1 Timings after Power On

■ Procedure after initial startup until actuator adjustment

[1] Connect the motor extension cable to the MOT connector and encoder relay connector to the PG connector.
[2] Connect the supplied flat cable to the PIO connector (for connection between the host PLC and I/O unit).
[3] Reset the emergency stop or enable the supply of motor drive power.
[4] Supply the 24-VDC I/O power (1A/2A pins (+24 V) and 19B/20B pins (0 V) in the PIO connector).
[5] Supply the 24-VDC controller power (24-V and 0-V terminals on the power-supply terminal block).
* If the monitor LED [SV/ALM] on the front panel illuminates for 2 seconds initially and then turns off, the controller is normal. If [SV/ALM] illuminates in red, an alarm is present. In this case, connect a PC or teaching pendant to check the nature of the alarm and remove the cause by referring to Chapter 10, “Troubleshooting.”
[6] Set the minimum set of required parameters initially.
Set the mode selector switch on the front panel to the “MANU” side.
On the PC or teaching pendant, set the MANU operation mode to “Teaching mode: Enable safety speed].
Change the necessary parameters in this condition.
(Example) • Use a PIO pattern other than “Standard type” → Parameter No. 25 (PIO pattern selection)
• Reduce the safety jog speed → Parameter No. 35 (Safety speed)
[7] Check the actuator position.
Confirm that the slider or rod is not contacting a mechanical end.
If the slider/rod is contacting a mechanical end, move it away from the mechanical end. If the slider/rod is not contacting a mechanical end but is closer to the home position, move the slider/rod away from the home position.
If the actuator is equipped with a brake, turn on the brake forced-release switch to forcibly release the brake before moving the actuator.
The slider/rod may suddenly drop due to its dead weight when the brake is released, so exercise caution not to damage the robot hand or work part by the falling slider/rod.
If the actuator cannot be moved by hand because the screw lead is short, change the setting of parameter No. 28 (Default direction of excited-phase signal detection) to the direction opposite to the mechanical end.

Warning	If the servo is turned ON while the slider/rod is contacting the mechanical end, excitation phase detection may not be performed correctly and an abnormal operation or excitation detection error may result.

[8] Turn on the servo.
Turn on the servo using the “servo ON function” of the PC software or teaching pendant.
If the actuator enters a servo lock mode and the monitor LED [SV/ALM] on the front panel illuminates in green, the controller is functioning properly.
[9] Check the operation of the safety circuit.
Confirm that the emergency stop circuit (or motor drive-power cutoff circuit) operates properly.

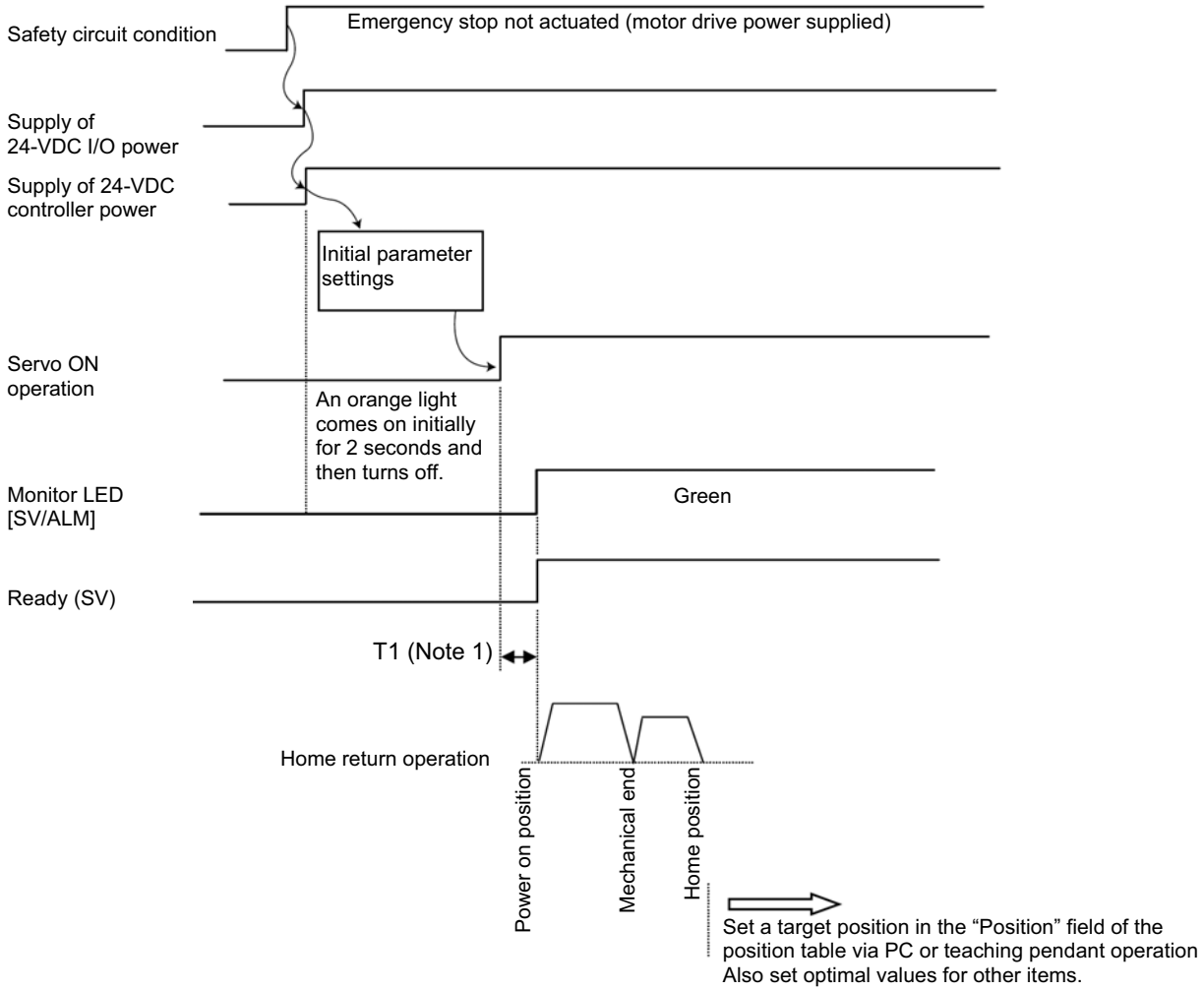
[10] Perform home return.

- Overview of operation on the teaching pendant
  - On the RCM-T, select the “Edit/Teach” screen, bring the cursor to “*Home” in the sub display area, and then press the Return key.
  - On the RCM-E, select the “Teach/Play” screen, scroll until “*Home Return” is displayed, and then press the Return key.

[11] Set a target position in the “Position” field of the position table.
Set a target position in the “Position” field of each position table.
Determine a desired target position by fine-adjusting the load and hand via jogging or inching.
Also adjust the servo gain, if necessary.

* Once a target position has been set, other fields (speed, acceleration/deceleration, positioning band, etc.) will be automatically populated by their default values. Set optimal values for the speed, acceleration/deceleration, positioning band, etc.

* For safety reasons, it is recommended that the safety speed be enabled during the initial movement. To move the actuator at the actual speed set in the “Speed” field of the position table, change the MANU operation mode to [Teaching mode: Disable safety speed].



(Note 1) T1: Excited-pole detection time = 0.2 to 12 sec
Normally the detection of excited pole completes in approx. 0.2 sec, although the exact time varies from one actuator to another due to individual differences and also depending on the load condition. If the detection of excited pole has failed, the excited-pole detection operation will be continued for up to 12 sec.

■ Procedure of Normal Operation

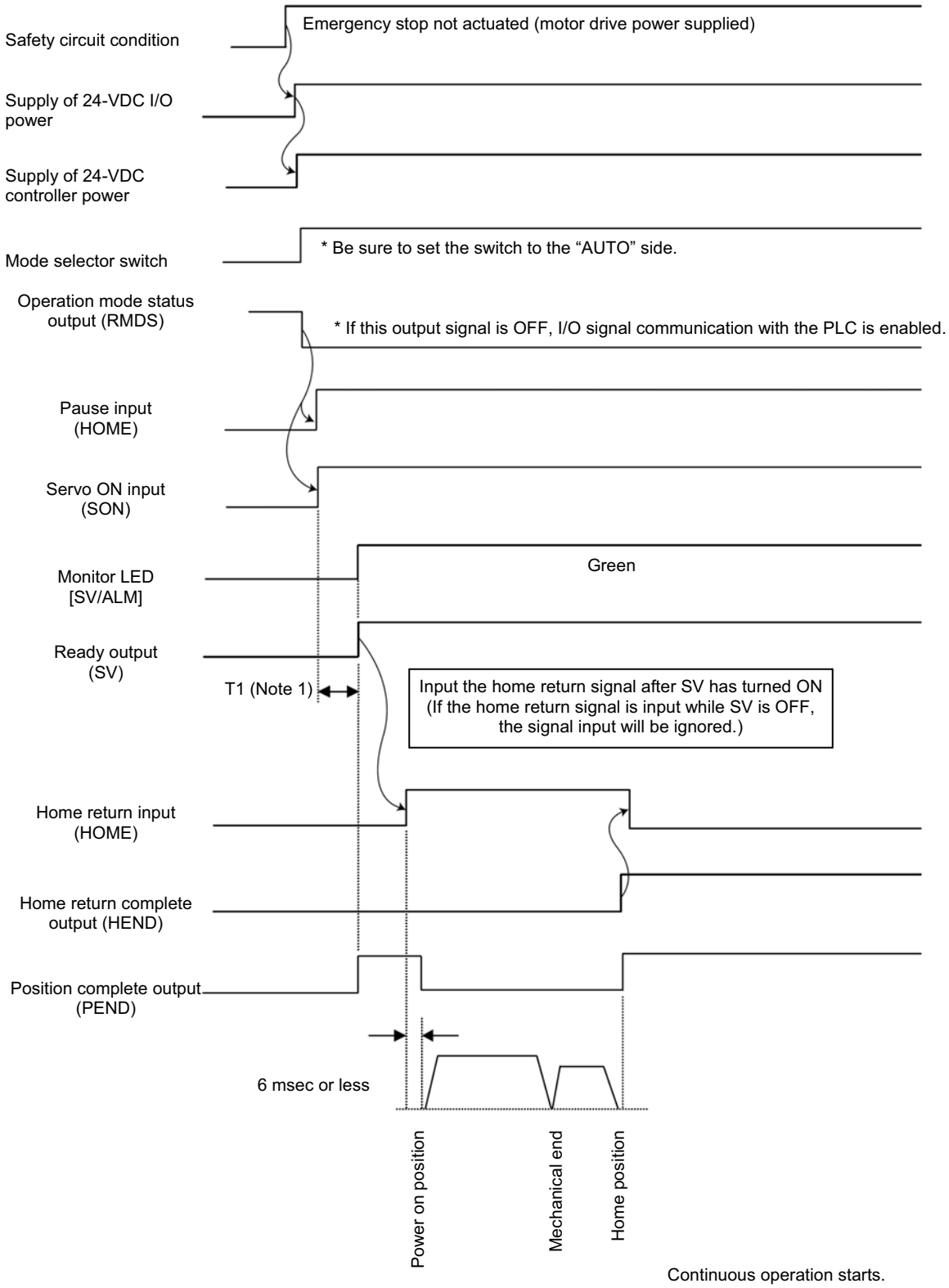
The operating procedure in normal condition is specified below:

[1] Reset the emergency stop or enable the supply of motor drive power.
[2] Supply the 24-VDC I/O power.
[3] Supply the 24-VDC controller power.
    * If the monitor LED [SV/ALM] on the front panel illuminates for 2 seconds initially and then turns off, the controller is normal. If [SV/ALM] illuminates in red, an alarm is present. In this case, connect a PC or teaching pendant to check the nature of the alarm and remove the cause by referring to Chapter 10, “Troubleshooting.”
[4] Check the actuator position.
    Confirm that the slider or rod is not contacting a mechanical end.
    If the slider/rod is contacting a mechanical end, move it away from the mechanical end. If the slider/rod is not contacting a mechanical end but is closer to the home position, move the slider/rod away from the home position.
    If the actuator is equipped with a brake, turn on the brake forced-release switch to forcibly release the brake before moving the actuator.
    The slider/rod may suddenly drop due to its dead weight when the brake is released, so exercise caution not to damage the robot hand or work part by the falling slider/rod.
    If the actuator cannot be moved by hand because the screw lead is short, change the setting of parameter No. 28 (Default direction of excited-phase signal detection) to the direction opposite to the mechanical end.

Warning	If the servo is turned ON while the slider/rod is contacting the mechanical end, excitation phase detection may not be performed correctly and an abnormal operation or excitation detection error may result.

[5] Set the mode selector switch on the front panel of the controller to the “AUTO” side.
[6] Input the servo ON signal/pause signal from the PLC.
[7] Input the home return signal from the PLC to perform home return operation.
[8] Start automatic operation.

⚠ Caution: When operating the actuator using the PLC and I/O signals, be sure to set the mode selector switch on the front panel to the “AUTO” side.



(Note 1) T1: Excited-pole detection time = 0.2 to 12 sec
Normally the detection of excited pole completes in approx. 0.2 sec, although the exact time varies from one actuator to another due to individual differences and also depending on the load condition. If the detection of excited pole has failed, the excited-pole detection operation will be continued for up to 12 sec.

Warning: Since the drive motor uses a pulse motor, excited-phase detection is performed when the servo is first turned on after the power on.
Therefore, the actuator must be able to move when the servo turns on.
If the slider or rod is contacting a mechanical end or the work part is contacting any surrounding equipment, excited-phase detection will not be performed correctly and an abnormal operation or excited-phase detection error may occur.
In this case, move the actuator by hand to a position where it can move before the servo turns on.
If the actuator is equipped with a brake, the brake must be forcibly released by turning on the brake release switch. The slider/rod may suddenly drop due to its dead weight when the brake is released, so exercise caution not to pinch your hand or damage the robot hand or work part by the falling slider/rod.
If the actuator cannot be moved by hand, one possible solution is to change the setting of parameter No. 28 (Default direction of excited-phase signal detection). If you wish to change this parameter, consult IAI beforehand.

7.1.2 Position Table and Parameter Settings Required for Operation

■ Startup adjustment

Immediately after the system has been started, the moving speed can be reduced by the methods specified below to ensure safety of operators and prevent damage to jigs, etc.
Change the applicable parameters, if necessary.

→ For details on the setting-change operations, refer to the operation manual for your PC software/teaching pendant.

Safety speed during manual feed

To move the actuator using the PC/teaching pendant, set the mode selector switch on the front panel of the controller to the “MANU” side.
For safety reasons, it is recommended that the actuator be moved at the safety speed during manual feed.
To do this, change the MANU operation mode to [Teaching mode: Enable safety speed] on the PC/teaching pendant.
The safety speed is defined by parameter No. 35. Change the parameter value, if necessary.
Take note that the maximum speed is limited to 250 mm/s or below.
The factory setting is “100 mm/s” or below.

Speed override for movement commands from the PLC

You can lower the feed speed to be applied when the actuator is moved by the movement commands output from the PLC.
To lower the speed to below the level set in the “Speed” field of the position table, you can use parameter No. 46 to override the “Speed” field.
Actual moving speed = [Speed set in the position table] x [Value of parameter No. 46] ÷ 100
Example) Value in the “Speed” field of the position table500 (mm/s)
Value of parameter No. 46 20 (%)
Under the above settings, the actual moving speed becomes 100 mm/s.
The minimum setting unit is “1%,” while the input range is “1 to 100 %.” The factory setting is “100 %.”

■ Full-scale operation

This product provides energy-saving modes to reduce power consumption in situations where the actuator remains standstill for a long period at a standby position.
You can also select the status of position complete signal to be applied if the servo turns off or “position deviation” occurs while the actuator is standing still after completing positioning.
Use these functions after confirming that they will not present problems to any part of your system.

Saving energy when the actuator stands by for a long time after the power has been turned on

Applicable to PIO pattern = 5 (3-point type)
In this condition, you can select full servo control using parameter No. 53 (Default standstill mode).
(This setting is not affected by the value in the “Standstill mode” field of the position table.)

Saving energy when the actuator stands by after completing the home return operation effected by the HOME input signal

Applicable to PIO pattern = 0 to 4
In this condition, you can select one of two modes based on the value in parameter No. 53 (Default standstill mode). (This setting is not affected by the value in the “Standstill mode” field of the position table.)
[1] Full servo control
[2] Automatic servo-off control

Saving energy when the actuator stands by for a long time at the target position

Common to all PIO patterns
In this condition, you can select one of two modes based on the value in the “Standstill mode” field of the position table. (This setting is not affected by the value in Parameter No. 53.)
[1] Full servo control
[2] Automatic servo-off control
→ For details, refer to 6.4, “Power-saving Modes at Standby Positions” and 8.2.2, “Parameters Relating to the Actuator Operating Characteristics.”

Output mode of complete signal

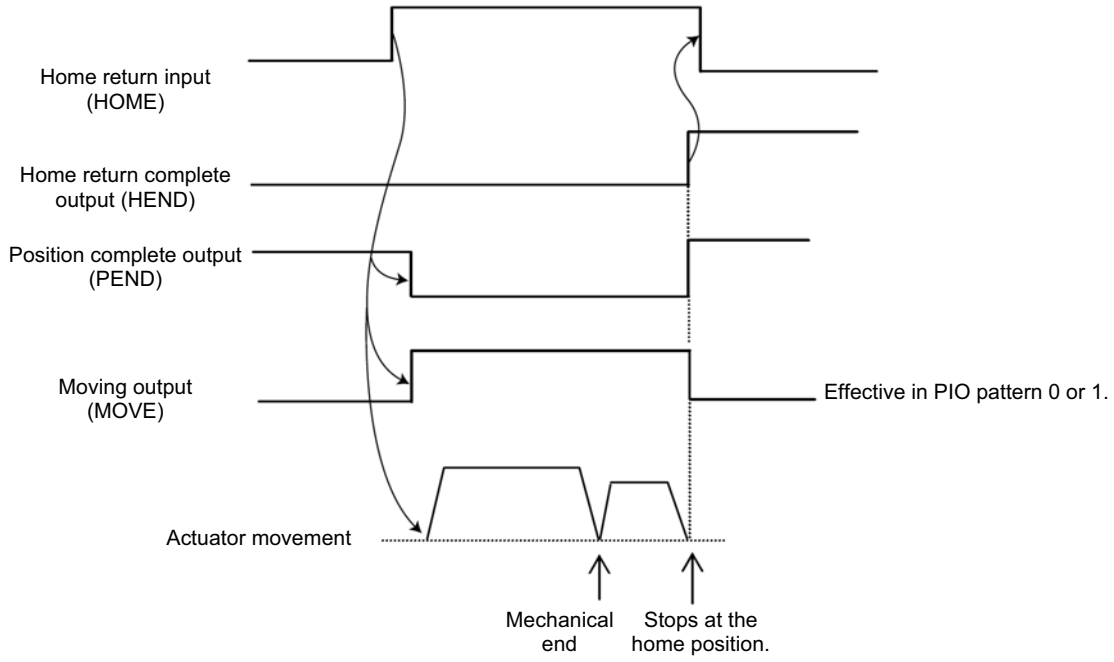
Applicable to PIO pattern = 0 to 4
You can select the status of position complete signal to be applied if the servo turns off or “position deviation” occurs while the actuator is standing still after completing positioning.
This setting uses parameter No. 39. Consider the characteristics of the control you need and select an appropriate mode.
→ For details, refer to 8.2.3, “Parameters Relating to the External Interface.”

7.2 Home Return Operation

7.2.1 Method Using the HOME Input Signal (PIO Pattern = 0 to 4)

Since the home return signal (HOME) is provided in PIO patterns 0 to 4, perform home return using this signal.

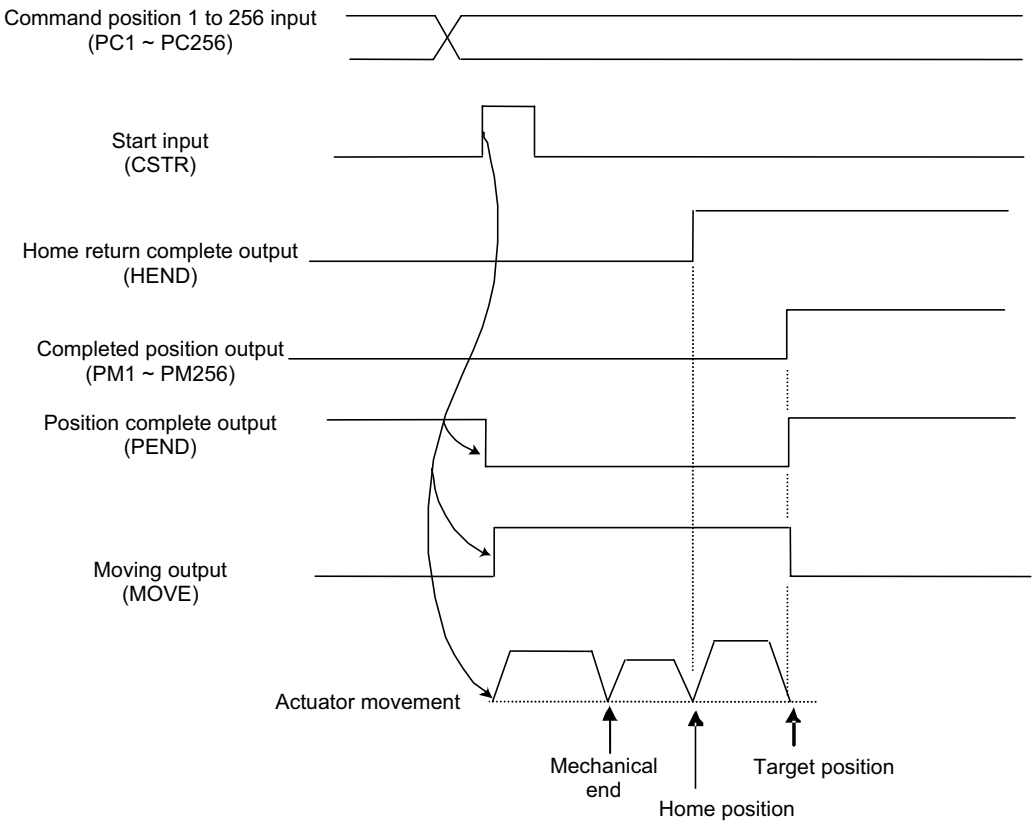
- When the home return signal (HOME) turns ON, the actuator starts moving toward the mechanical end on the home side.
  Once the mechanical end is contacted, the actuator reverses its direction and moves, and then stops at the home position.
- At the start of movement, the position complete output (PEND) turns OFF while the moving output (MOVE) turns ON.
- When the actuator stops at the home position, the position complete output (PEND) and home return complete output (HEND) turn ON. On the other hand, the moving output (MOVE) turns OFF.
- On the PLC side, turn OFF the home return signal (HOME) after the home return complete output (HEND) has turned ON.



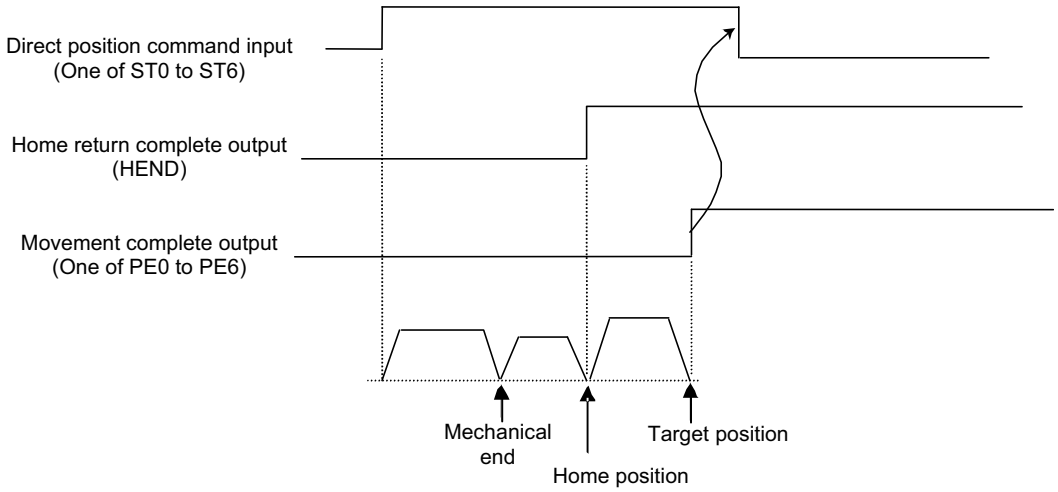
⚠ Caution: When performing home return, pay attention to the following:
[1] Confirm that no obstacle is present in the home return direction.
[2] If any obstacle is present in the home return direction, review the PLC sequence circuit and change the circuit so that home return will be executed only when there is no obstacle.

(Note) If the home is not yet established immediately after the power has been turned on, directly inputting the command position signal and start signal without inputting the home return signal (HOME) first will cause the actuator to perform home return operation and then move to the target position.
However, it is recommended that the PLC sequence circuit use the home return signal (HOME) to prevent errors.

[1] PIO pattern = 0 to 3



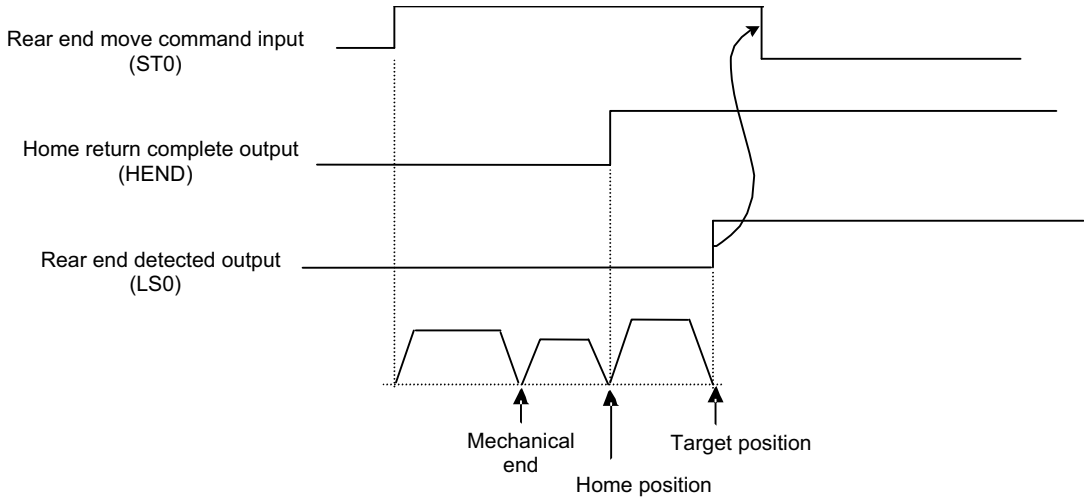
[2] PIO pattern = 4



7.2.2 Method Used When No HOME Input Signal Is Available (PIO Pattern = 5)

Since no home return signal (HOME) is available in PIO pattern 5, input the rear end move command (ST0) first to perform home return.

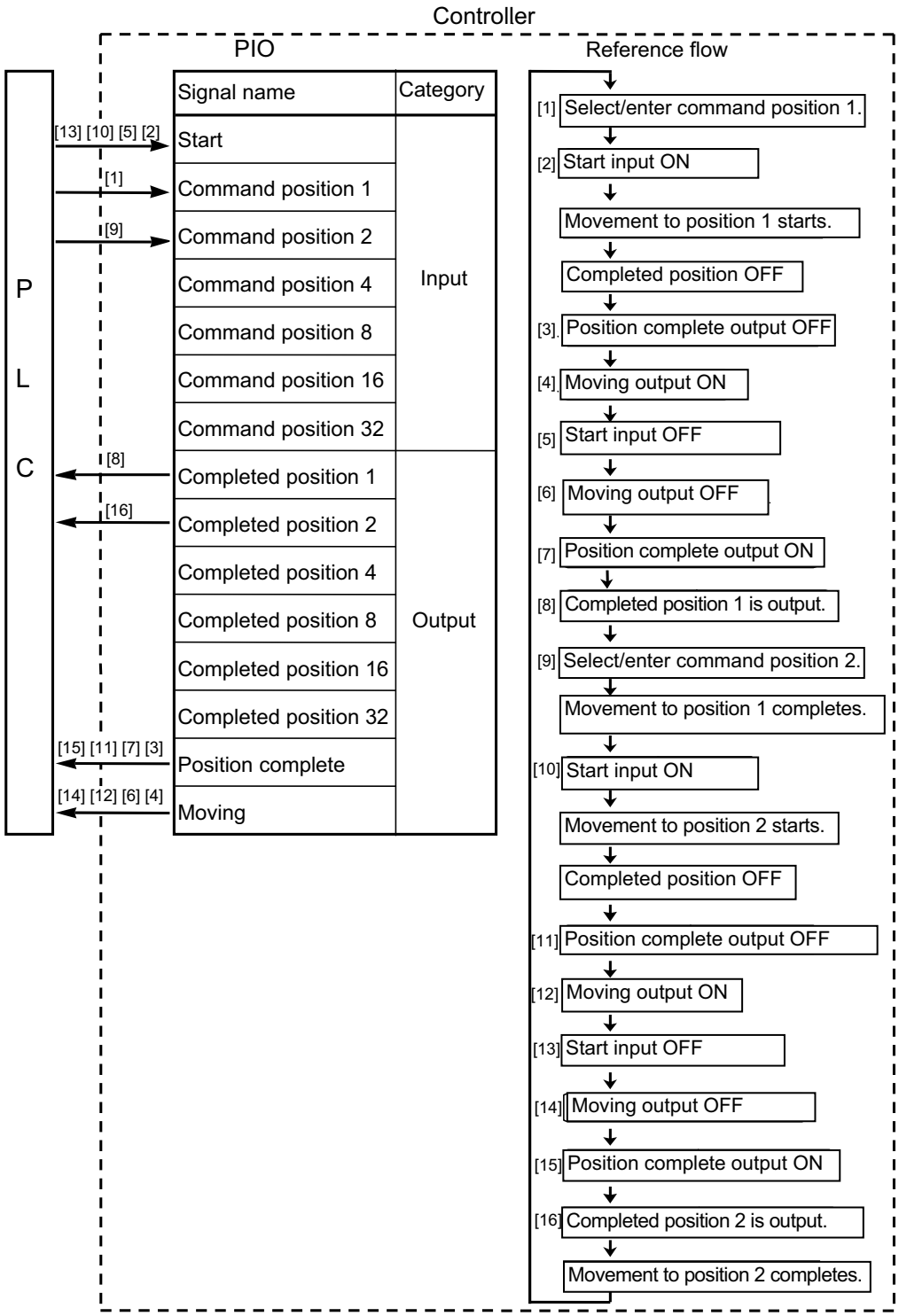
- When the rear end movement command (ST0) turns ON, the actuator starts moving toward the mechanical end on the home side.
  Once the mechanical end is contacted, the actuator reverses its direction and moves to the home position, stops temporarily at the home position, and then moves to the rear end.
- Once the home position is reached, the home return complete output (HEND) turns ON.



⚠ Caution: When performing home return, pay attention to the following:
[1] Confirm that no obstacle is present in the rear end direction.
[2] If any obstacle is present in the rear end direction, move the actuator toward the front end and remove the obstacle. Issuance of the front end move command is permitted for this reason. In this case, the actuator moves forward at the home return speed and when the actuator reaches the mechanical end, the front end position complete output (LS1) turns ON.
[3] Do not input the intermediate point move command (even if the command is input, it will be ignored).

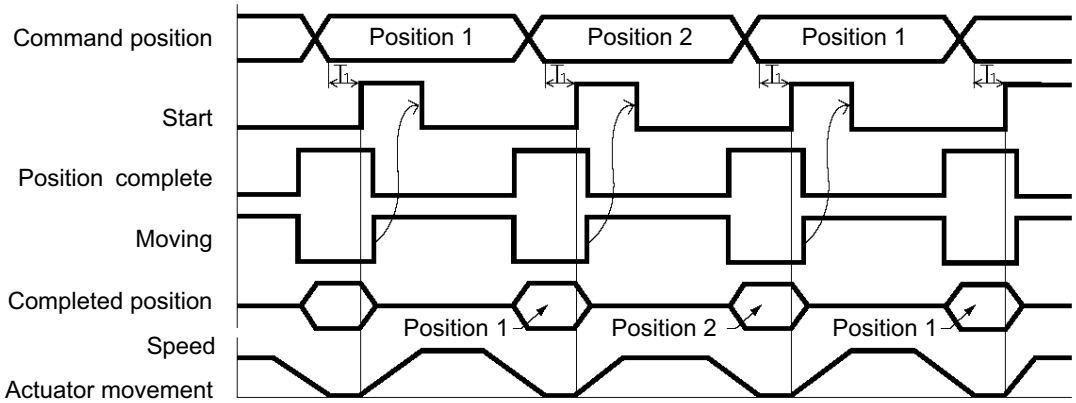
7.3 Positioning Mode (Back and Forth Movement between Two Points)

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

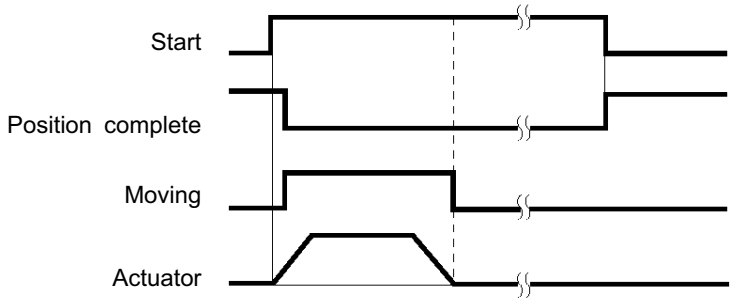
No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]
0	*	*	*	*	*	*
1	250.00	200.00	0.30	0.30	**0**	0.10
2	100.00	100.00	0.30	0.30	**0**	0.10
:						



T1: 6 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.

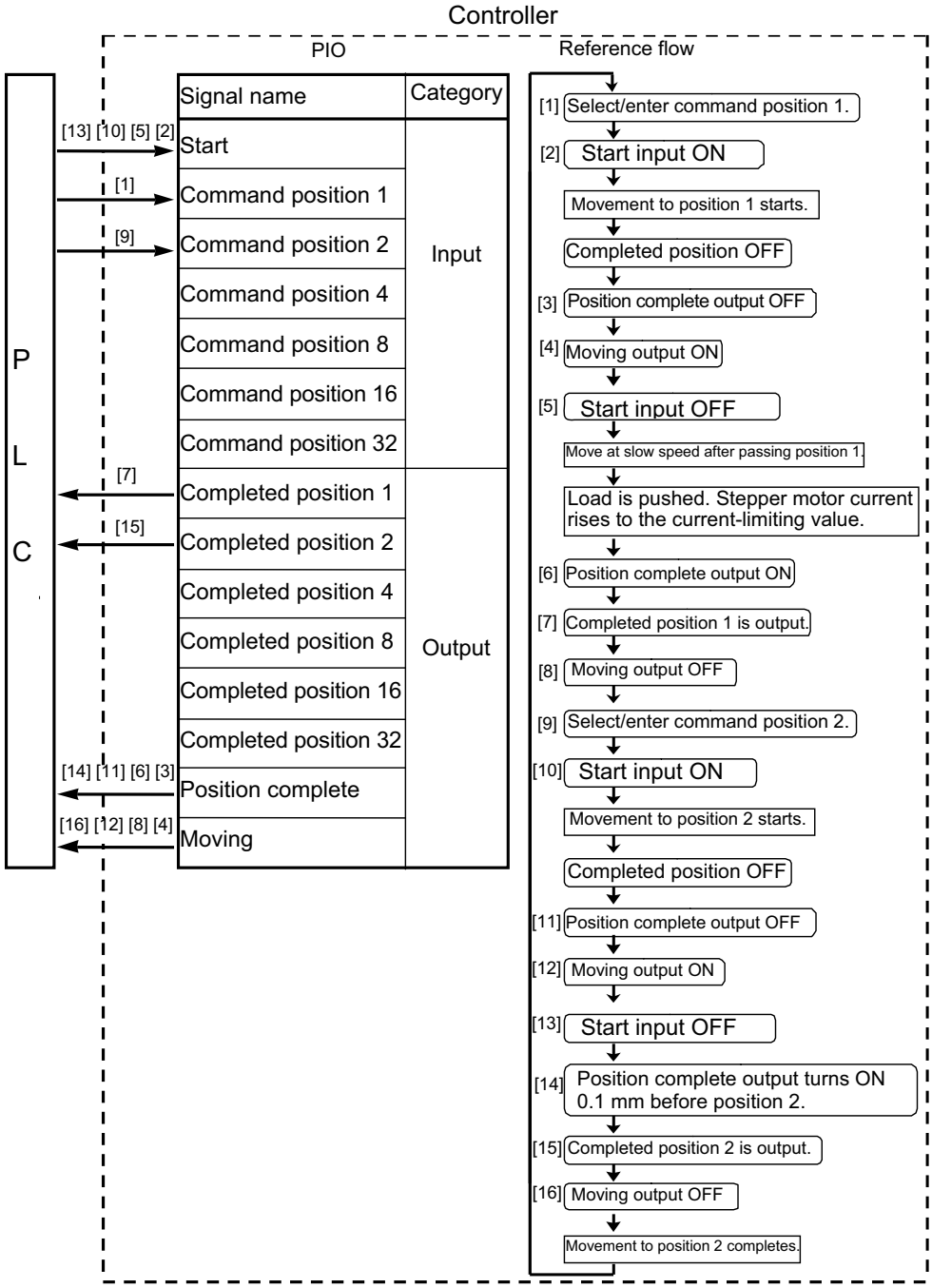
Caution:
- When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
  Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.
  If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed.



- If another movement command to the same position is issued, the position complete output will turn OFF, but the moving output will not turn ON.
- If the position complete signal turns ON, the moving output will also turn OFF simultaneously even when the actuator is moving.
  This means that, if the positioning band in the position data is increased, there may be cases where the actuator will continue to move after the moving output turns OFF simultaneously when the position complete output turns ON.
- When a software stroke limit is reached after continuous incremental moves, the actuator will stop immediately and a position complete signal will be output.

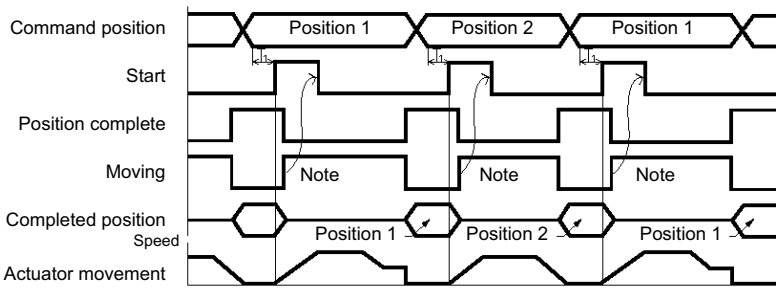
7.4 Push & Hold Mode

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 work part 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 stepper 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 table (Field(s) within thick line must be entered.)

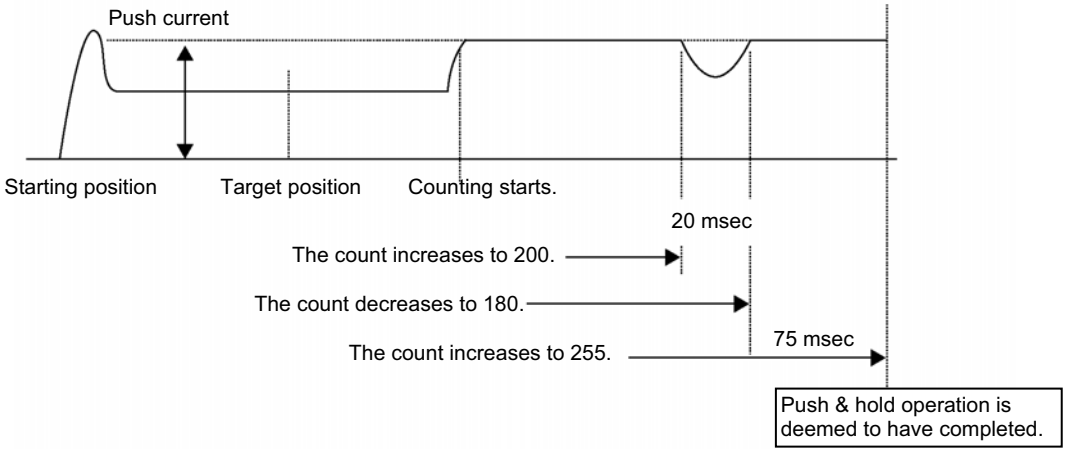
No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]
0	*	*	*	*	*	*
1	280.00	200.00	0.30	0.30	50	15.00
2	40.00	100.00	0.30	0.30	**0**	0.10
:						



T1: 6 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.

- Conditions for determining completion of push & hold operation

Push & hold operation is deemed to have completed upon elapse of the time set by parameter No. 6 (Push completion judgment time) after the motor current reached the current-limiting value set in the “Push” field of the position table.
Set an appropriate value by considering the material and shape of the work part, and so on.
The minimum setting unit is “1 msec,” while the maximum value is “9999 msec.” The factory setting is “255 msec.”
(Note) The chart below explains how completion of push & hold operation is determined if the work part shifted during the judgment and the current has changed as a result, based on a judgment time of 255 msec.

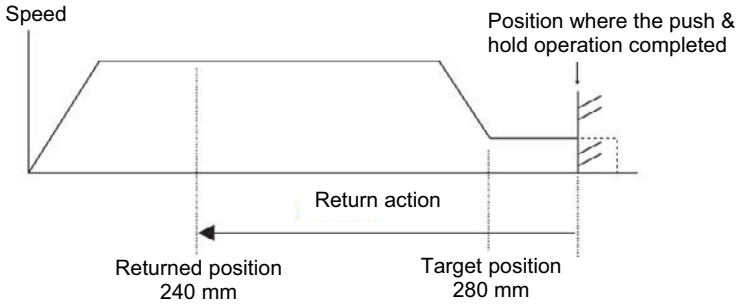


If the motor current remains at or above the push current for 200 msec and then drops below this level for 20 msec, the count will decrease by 20. When the push current is reached again thereafter, counting will start from 180. If the motor current remains at or above the push current for 75 msec, the count will increase to 255 and thus push & hold operation will be deemed to have completed.
In total, 295 msec was required for the judgment.

7.4.1 Return Action after Push & Hold by Relative Coordinate Specification

- Positioning mode

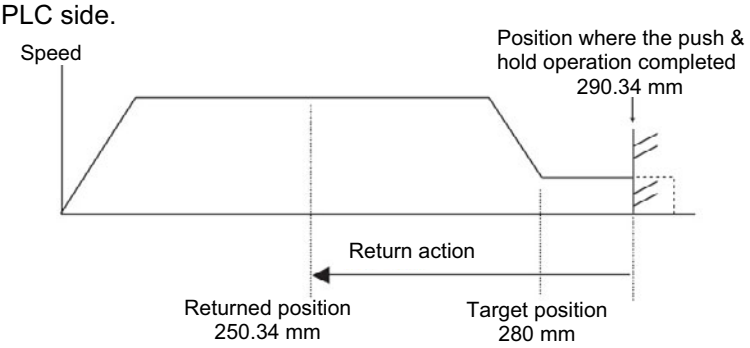
The reference position is the target position for the position number used in the applicable push & hold operation.
In the aforementioned example, the actuator moves to the 240-mm position if position No. 2 is set to -40 mm in the incremental mode (280 – 40 = 240 mm).



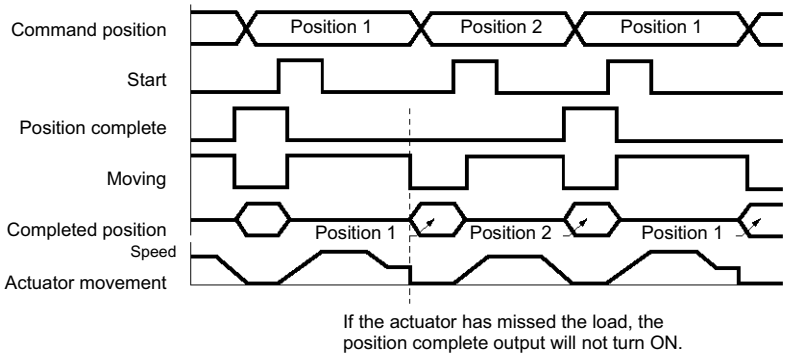
- Push & hold mode

The reference position is the position where the push & hold operation completed.
In the aforementioned example, the actuator moves to the 250.34-mm position if position No. 2 is set to -40 mm in the incremental mode and the push & hold operation completed at 290. 34 mm (290.34 – 40 = 250.34 mm).

(Note) In this case, the controller determines that the actuator has missed the work part and thus does not turn ON the position complete signal.
It is therefore recommended that the zone output signal be used to determine completion of push & hold operation on the PLC side.



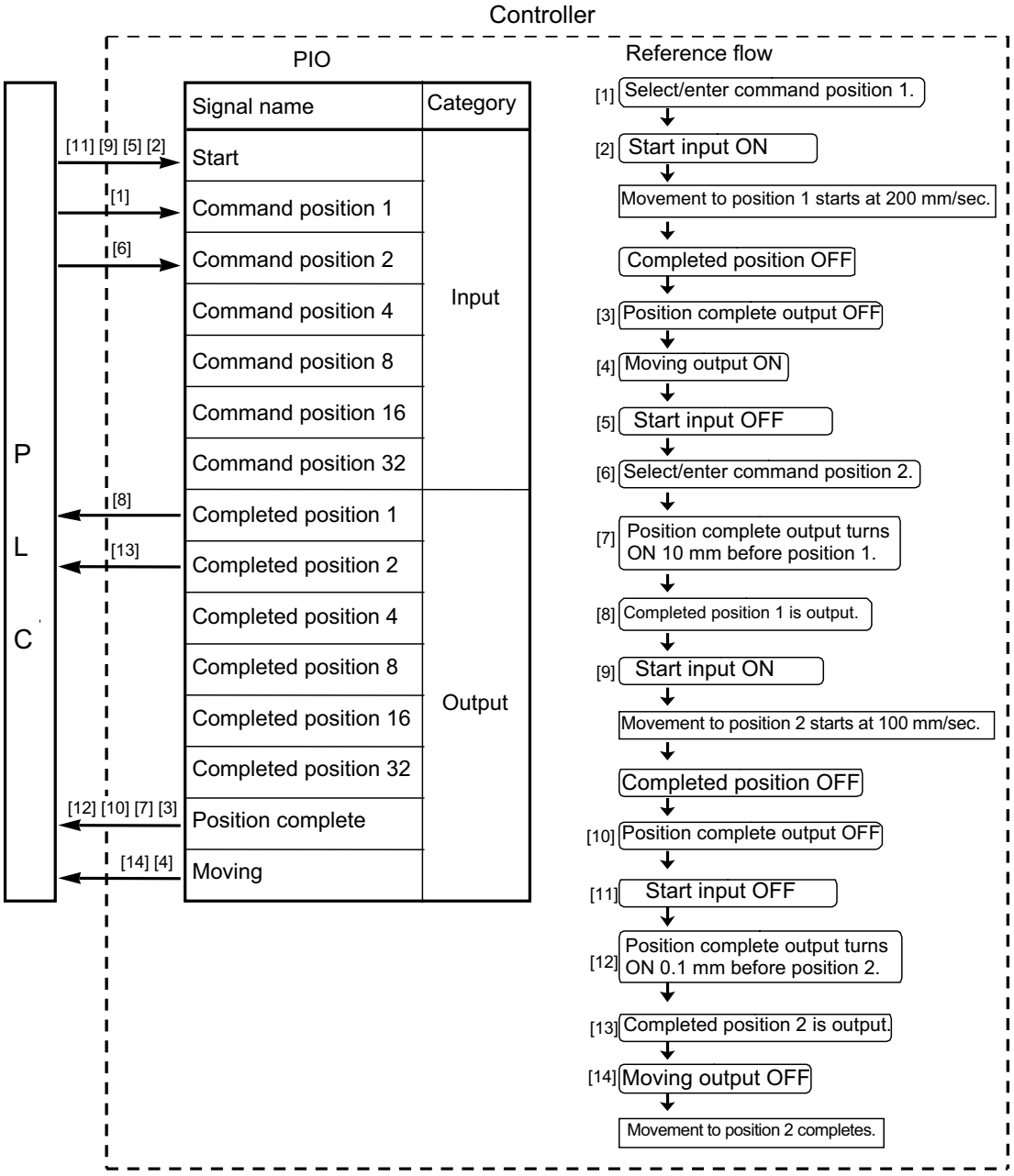
Caution: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.
If the actuator has missed the work part, the position complete output will not turn ON as shown below. The completed position will be output and the moving output will turn OFF.



7.5 Speed Change during Movement

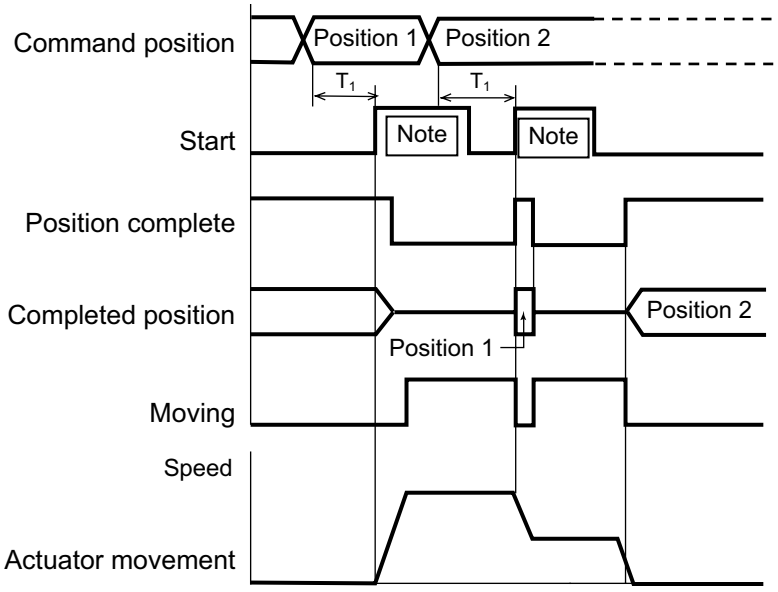
Example of use in operation) The actuator speed is reduced at a certain point during movement.
The position 150 mm from the home is set as position 1, and the position 200 mm from the home is set as position 2. The actuator is initially located between the home and position 1. The actuator is moved to 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.

Method) 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.)



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

No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]
0	*	*	*	*	*	*
1	150.00	200.00	0.30	0.30	**0**	10.00
2	200.00	100.00	0.30	0.30	**0**	0.10
:						



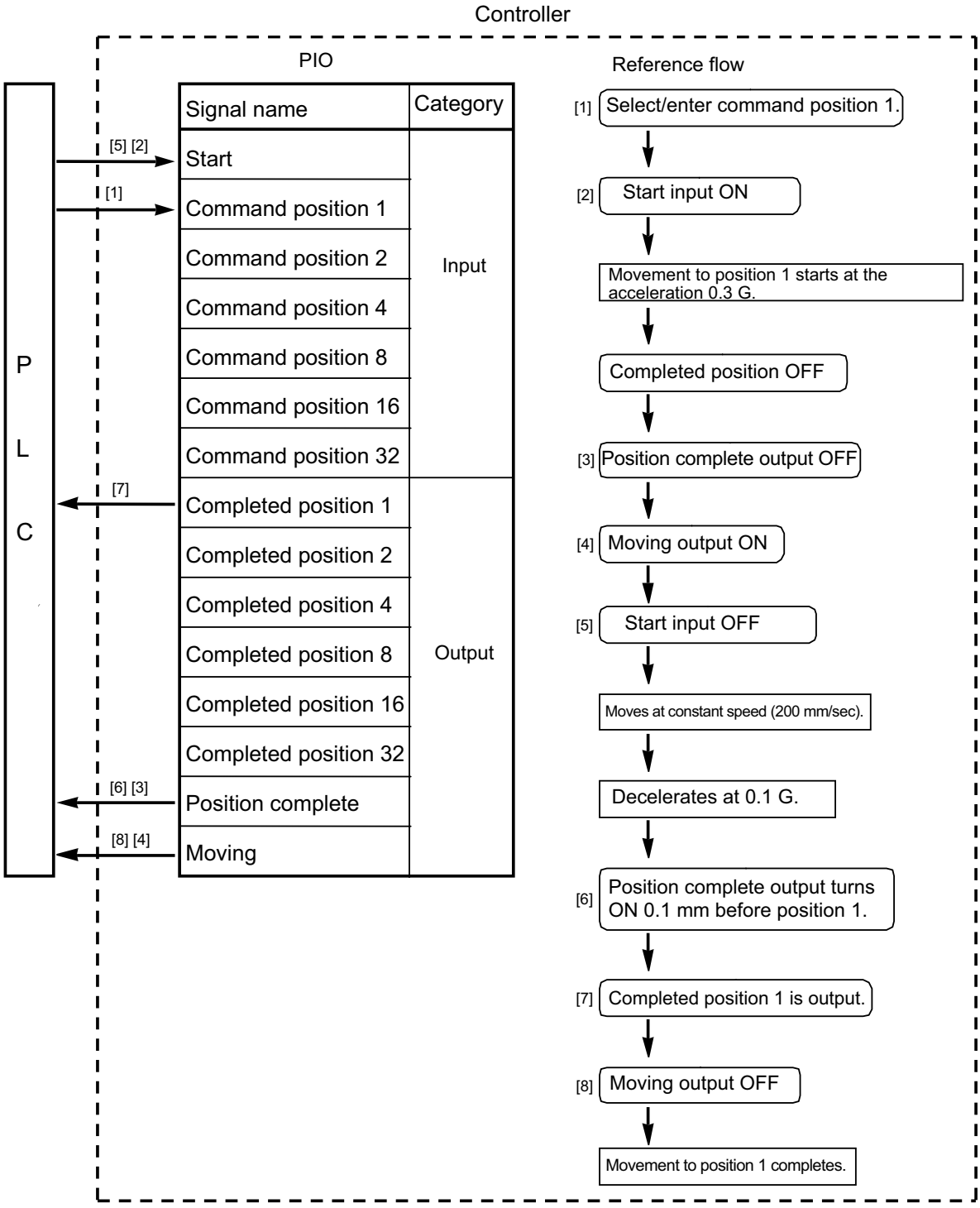
T1: 6 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

Caution: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.

7.6 Operation at Different Acceleration and Deceleration Settings

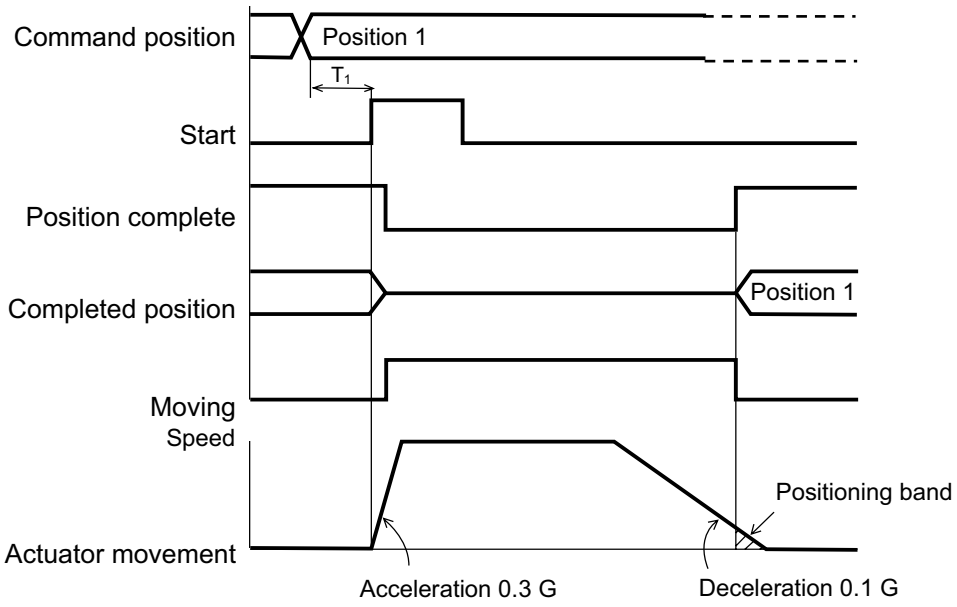
Example of use in operation) Positioning is performed to the position 150 mm from the home (position 1) at a speed of 200 mm/sec.
The acceleration is 0.3 G and the deceleration is 0.1 G.

Method) Set 0.3 [G] in the “Acceleration” field and 0.1 [G] in the “Deceleration” field of the position table.



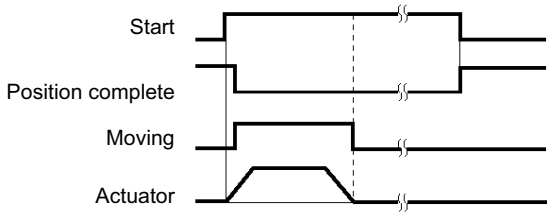
Position table (Field(s) within thick line must be entered.)

No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]
0	*	*	*	*	*	*
1	150.00	200.00	0.30	0.10	**0**	0.10
:						



T1: 6 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.)

Caution: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.
If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed.

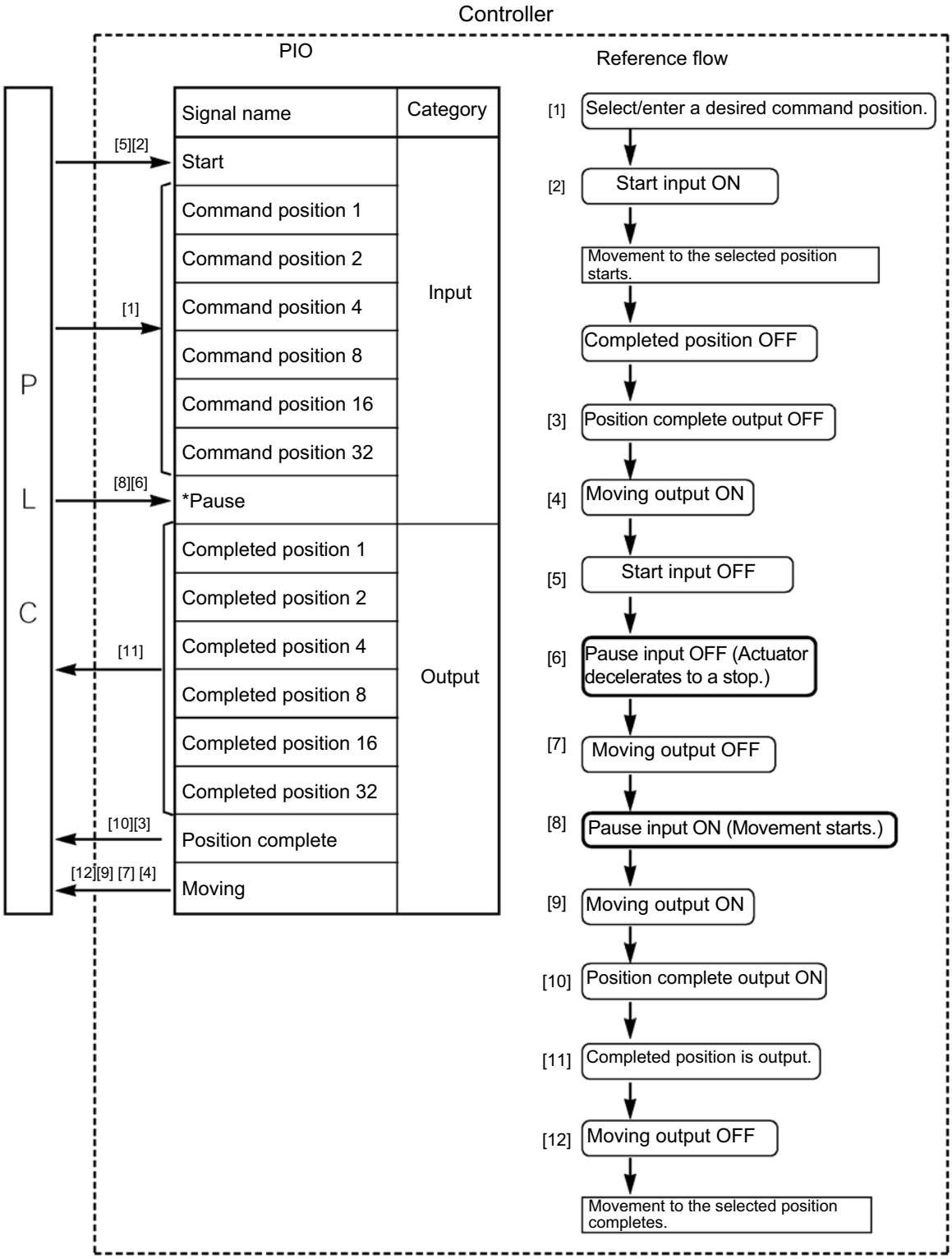


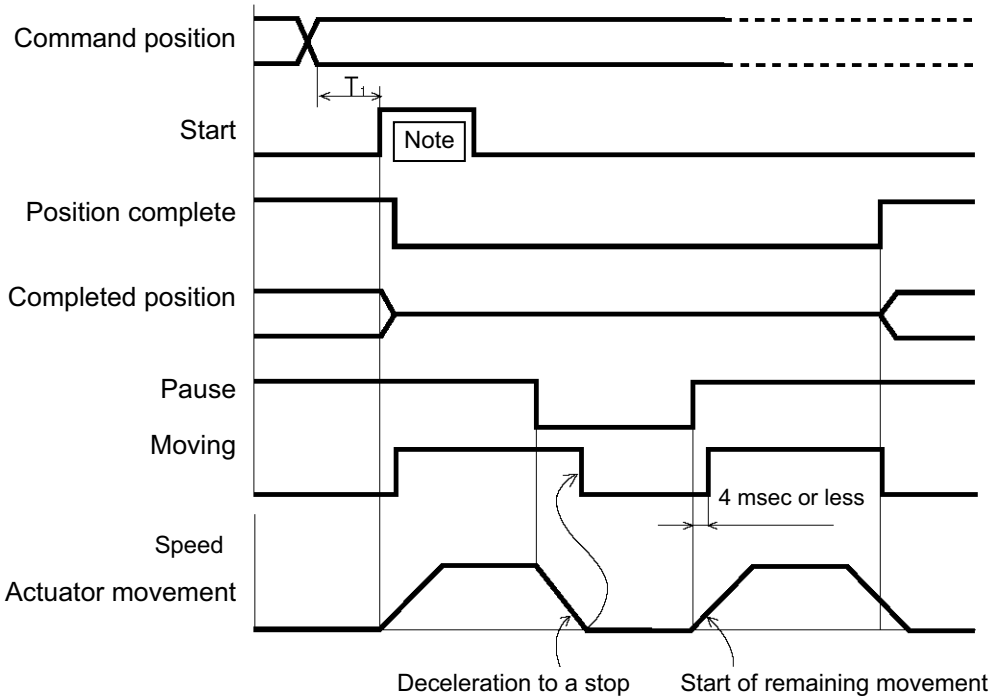
Movement is complete.

- If another movement command to the same position is issued, the position complete output will turn OFF, but the moving output will not turn ON.
- If the position complete signal turns ON, the moving output will also turn OFF simultaneously even when the actuator is moving.
  This means that, if the positioning band in the position data is increased, there may be cases where the actuator will continue to move after the moving output turns OFF simultaneously when the position complete output turns ON.
- When a software stroke limit is reached after continuous incremental moves, the actuator will stop immediately and a position complete signal will be output.

7.7 Pause

Example of use in operation) Pause the actuator during movement. [Effective in PIO pattern = 0 to 4]
Method) Use the pause input.

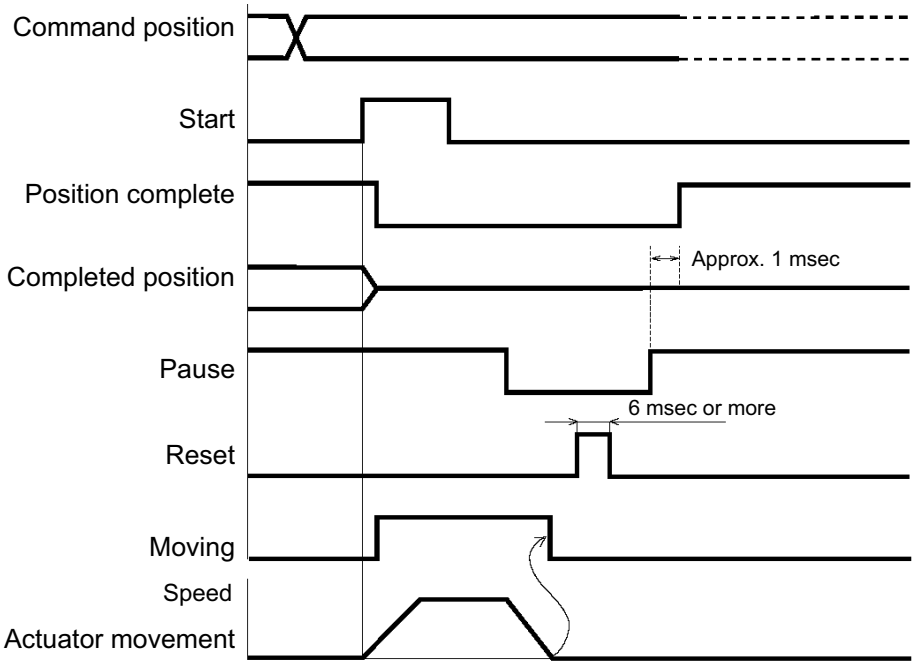




T1: 6 msec or more; time after selecting/entering a command position until the start input turns ON
(The scan time of the host controller must be considered.)

Caution: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.

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.)



7.8 Zone Signal Output

Two types of zone output signals are available: zone output (ZONE1) and position zone output (PZONE). The boundaries defining the signal ON range are set differently for each zone output.

[1] Zone output (ZONE1) --- Set by parameter No. 1/No. 2.

[2] Position zone output (PZONE) --- Set in the “Zone boundary-“ and “Zone boundary+” fields of the position table.

Whether these signals are available or not varies depending on the PIO pattern, as shown below.

○: Available / x: Not available

Signal classification	PIO pattern					
	0	1	2	3	4	5
Zone output (ZONE1)	○	x	x	x	○	○
Position zone output (PZONE)	○	○	○	x	○	○

Example of use in operation) Move the actuator from the home to the 150-mm position (position 1) and output a zone signal once the actuator enters the range between 40 mm and 120 mm.

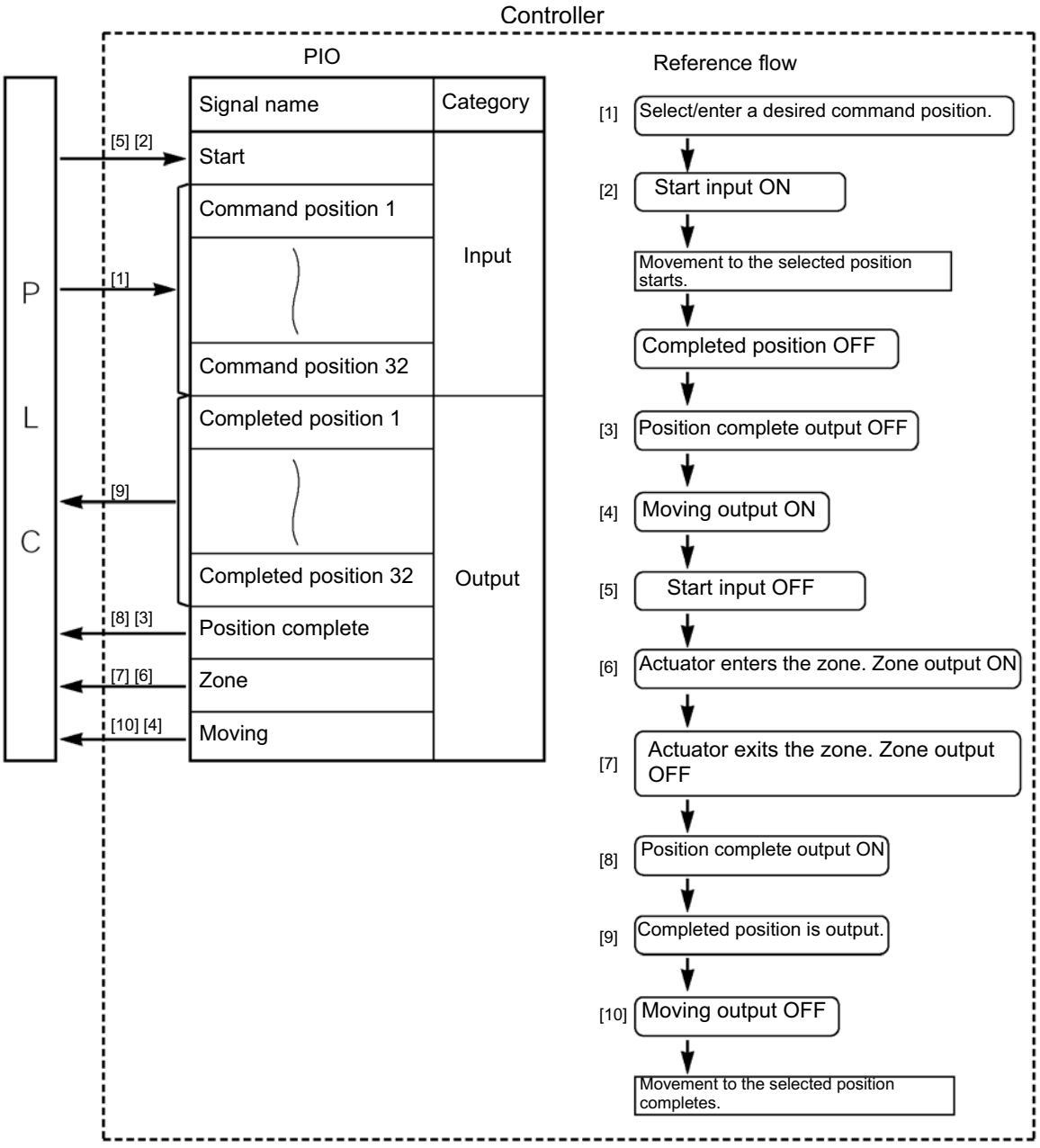
Method)

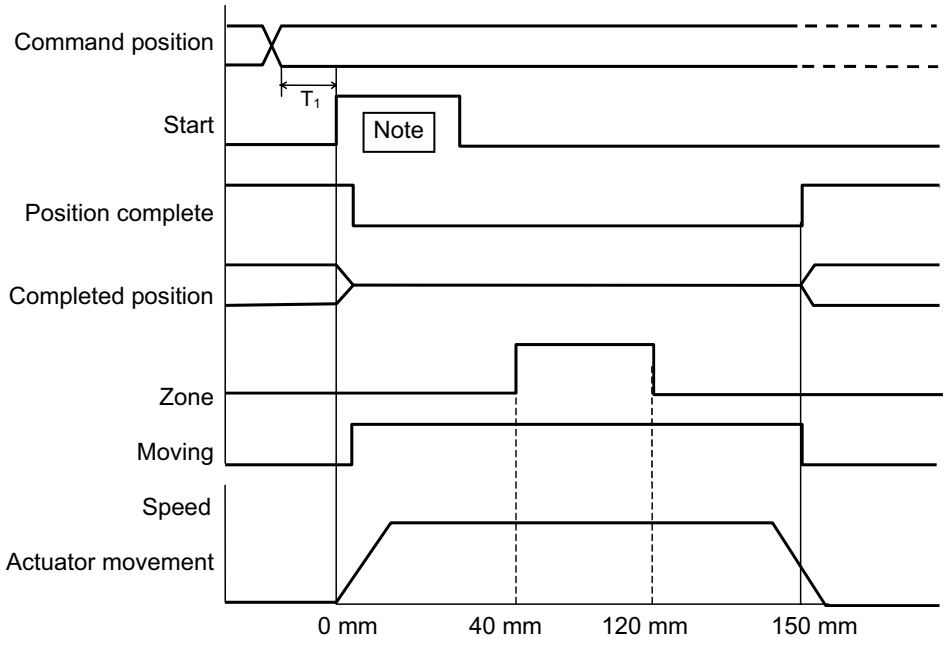
- Zone output (ZONE1)
  The signal ON range is set by the “Zone boundary+” and “Zone boundary-” parameters.

Parameter No. 1	Zone boundary+	120 (mm)
Parameter No. 2	Zone boundary–	40 (mm)

- Position zone output (PZONE)
  The signal ON range is set in the “Zone boundary+” and “Zone boundary-” fields of the position table.

No.	Position [mm]	Zone boundary+ [mm]	Zone boundary- [mm]
0	*	*	*
1	150.00	120.00	40.00


Controller
PIO
Reference flow
P
L
C
Signal name
Category
[5] [2]
Start
Command position 1
[1]
Input
Command position 32
Completed position 1
[9]
Completed position 32
Output
[8] [3]
Position complete
[7] [6]
Zone
[10] [4]
Moving
[1] Select/enter a desired command position.
[2] Start input ON
Movement to the selected position starts.
Completed position OFF
[3] Position complete output OFF
[4] Moving output ON
[5] Start input OFF
[6] Actuator enters the zone. Zone output ON
[7] Actuator exits the zone. Zone output OFF
[8] Position complete output ON
[9] Completed position is output.
[10] Moving output OFF
Movement to the selected position completes.

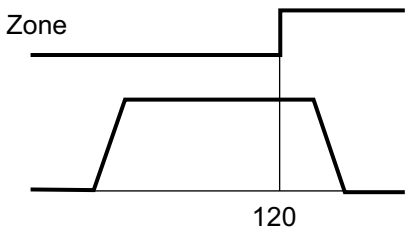


T1: 6 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

Caution: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON. Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.

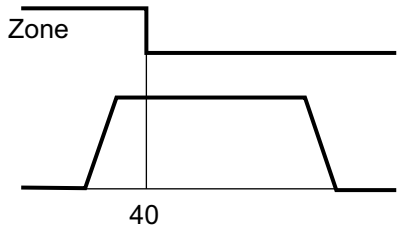
Example of other zone output)

Zone output at 120 or more



Zone boundary+	Maximum stroke length
Zone boundary–	120

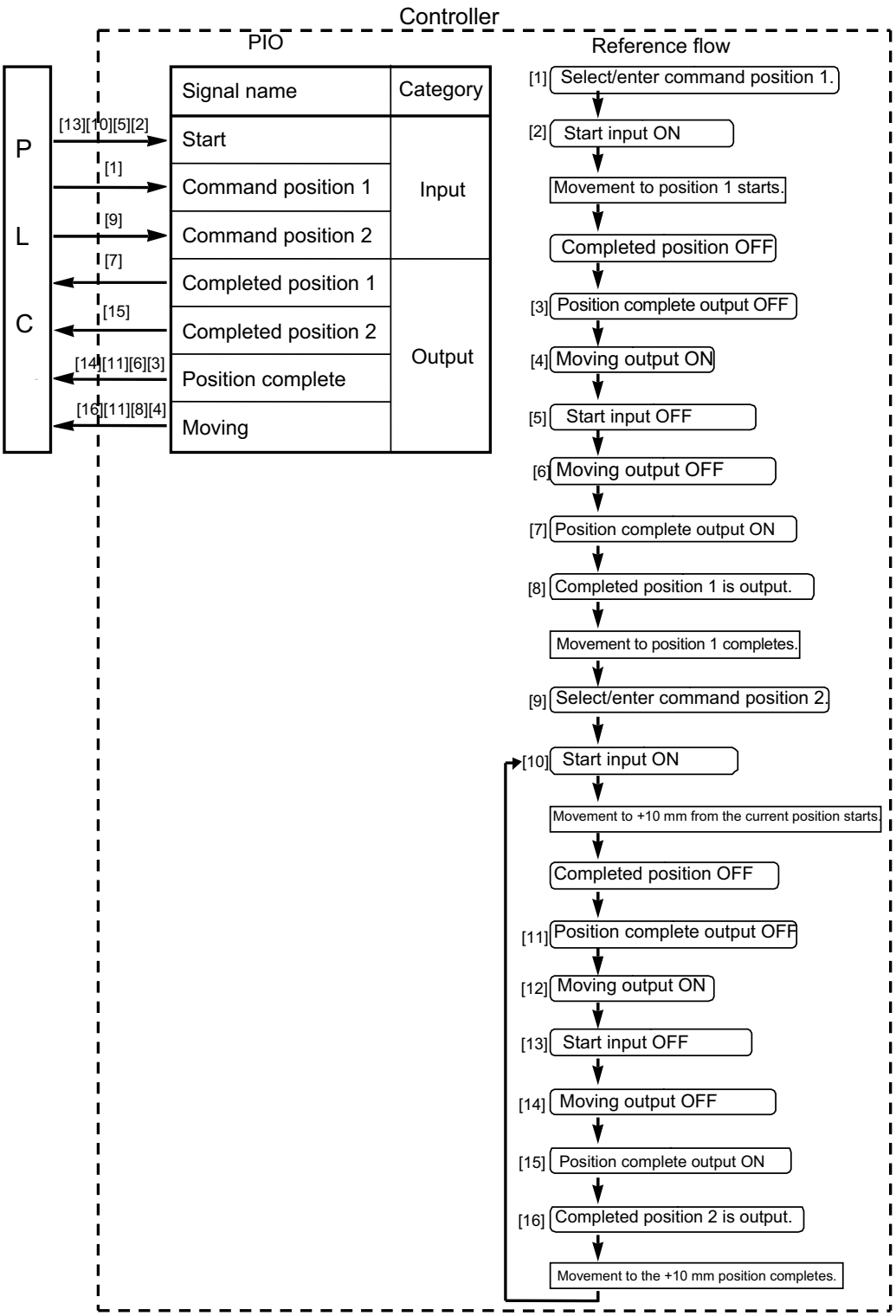
Zone output at 40 or less



Zone boundary+	40
Zone boundary–	0

7.9 Incremental Moves

Example of use in operation) Move the actuator from the home to the 30-mm position by issuing an absolute position command (position No. 1), and thereafter move the actuator continuously at a 10-mm pitch until the final position of 200 mm is reached. (Pitch feed command: Position No. 2)

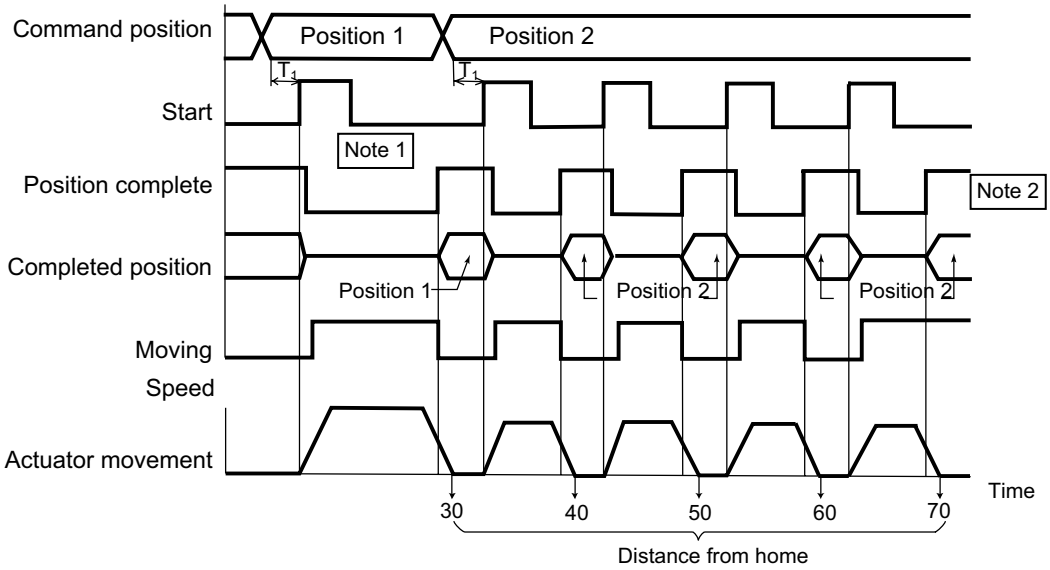


Position table (Field(s) within thick line must be entered.)

No.	Position [mm]	Speed [mm/ss]	Positioning band [mm]	Zone + [mm]	Zone - [mm]	Incremental
0	∗	∗	∗	∗	∗	∗
1	30.00	100.00	0.10	**0**	**0**	**0**
2 =	10.00	20.00	0.10	190.50	29.50	1
⋮						

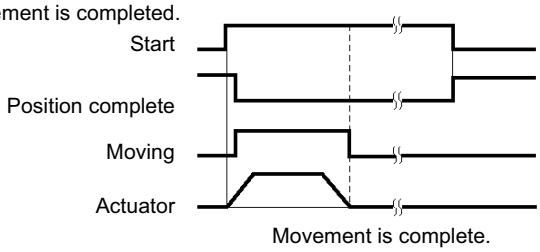
Incremental feed

* On the teaching pendant screen, this sign indicates that the position is specified in the incremental mode.



T1: 6 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.)

Caution 1:
- When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON. Always turn OFF the start signal after confirming that the start signal is currently ON and the position complete output has turned OFF.
  If the start input remains ON as shown below, the position complete output will not turn ON even when the actuator movement is completed.



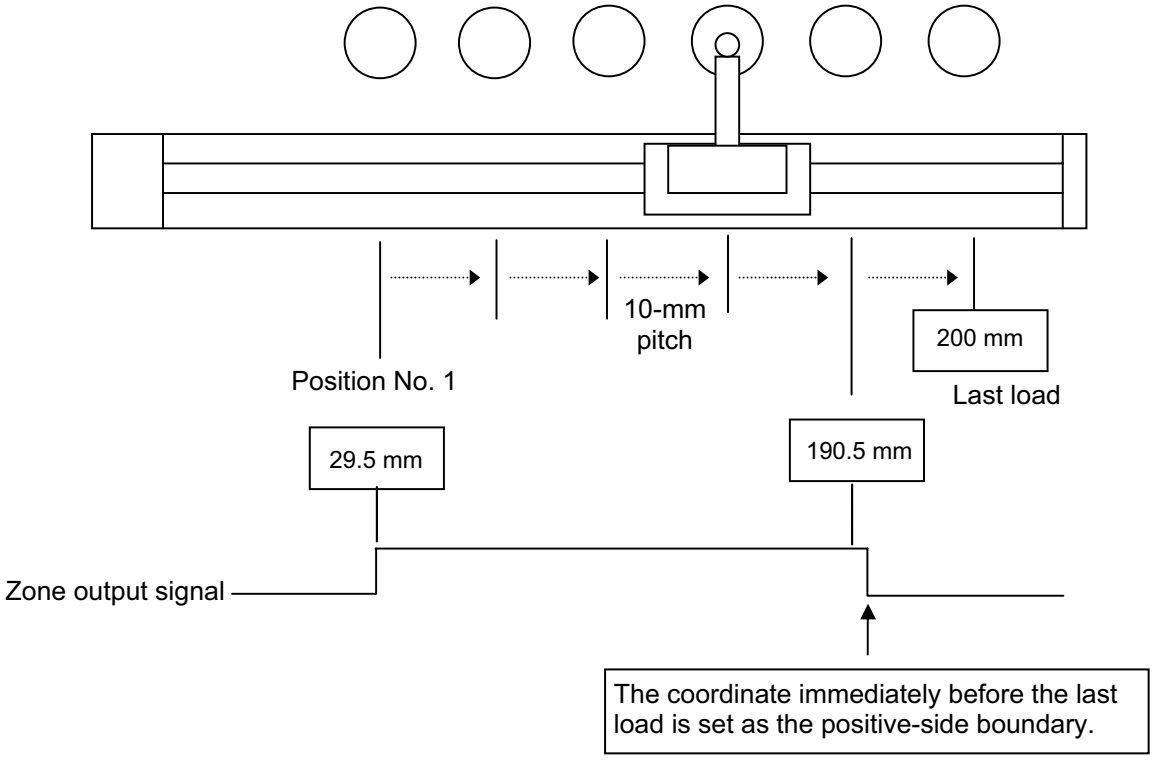
Movement is complete.

- If another movement command to the same position is issued, the position complete output will turn OFF, but the moving output will not turn ON.
- If the position complete signal turns ON, the moving output will also turn OFF simultaneously even when the actuator is moving.
  This means that, if the positioning band in the position data is increased, there may be cases where the actuator will continue to move after the moving output turns OFF simultaneously when the position complete output turns ON.
- When a software stroke limit is reached after continuous incremental moves, the actuator will stop immediately and a position complete signal will be output.

Caution 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 output will be output.

7.9.1 Judgment Method of End Position

Although completion judgment is based on the applicable count managed by the PLC, the zone output signal can be used additionally to double-check the completion of movement.
Program the PLC so that the ON/OFF status of the zone output signal is checked when positioning is completed, and if the signal is OFF, the applicable position will be determined as the last work part position.
If the count in the PLC does not match the zone output signal status, signal timings may not be synchronized.



7.9.2 Notes on Incremental Mode

If an operation command is issued based on relative coordinate specification while the actuator is moving (in the normal positioning mode or push & hold mode), how the actuator will operate varies depending on whether or not push action is specified in the operation command by relative coordinate specification, as explained below.

(1) When the relative coordinate operation command specifies an operation in the normal positioning mode (without push action)

[1] When a relative coordinate operation command is specified while the actuator is moving in the normal positioning mode

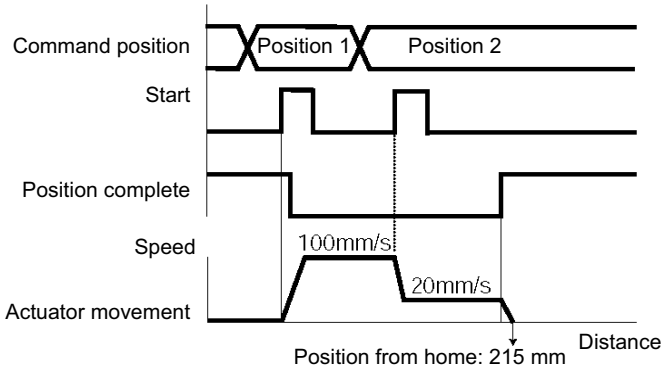
If any incremental position number is selected and input and then a start signal is input while positioning is in progress, the actuator will move to the position corresponding to the target position of the initial command plus the incremental distance.
(If the incremental distance is a negative value, the actuator will move to the position corresponding to the target position minus the incremental distance.)

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 215 mm from the home.

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

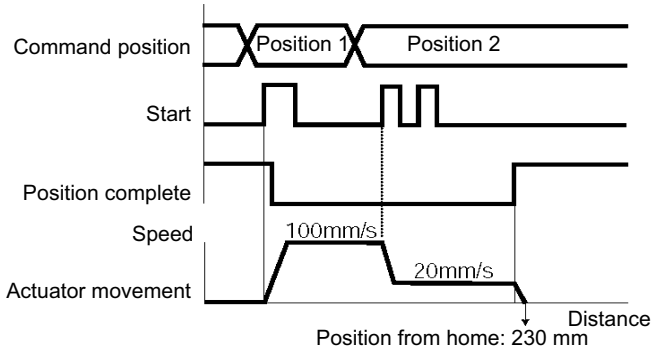
No.	Position [mm]	Speed [mm/ss]	Positioning band [mm]	Push [%]	Incremental	
0	∗	∗	∗	∗	∗	
1	200.00	100.00	0.10	**0**	**0**	Positioning mode
2 =	15.00	20.00	0.10	**0**	1	Incremental feed
⋮						

* On the teaching pendant screen, this sign indicates that the position is specified in the incremental mode.



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 230 mm from the home.



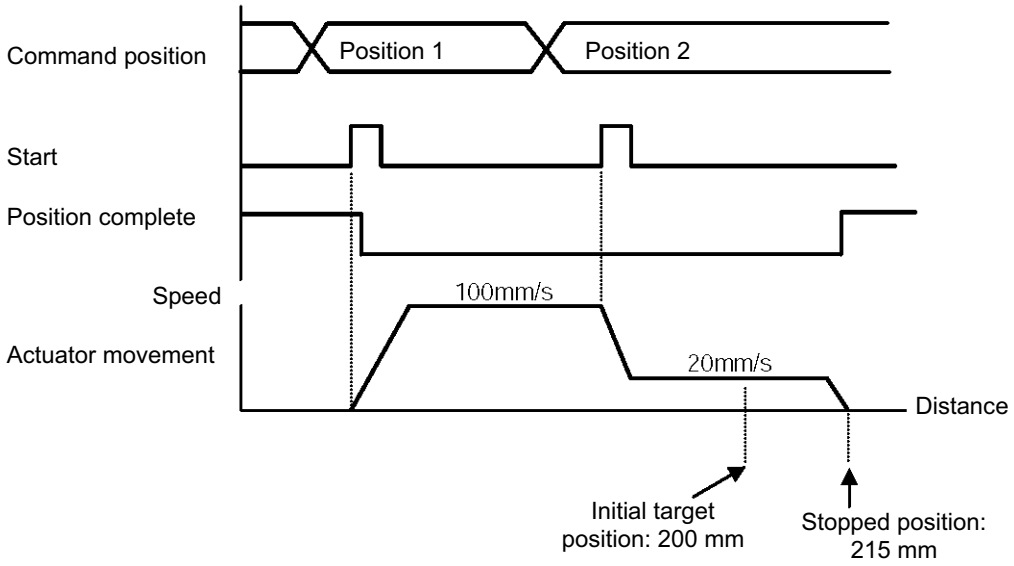
[2] When a relative coordinate operation command is specified while the actuator is moving in the push & hold mode
The following explains how the actuator will move if an incremental position number is selected and input and then a start signal is input while the actuator is moving in the push & hold mode.

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 corresponding to the target position set in the position 1 data plus the incremental distance. Accordingly, the push & hold mode will be cancelled.
If the position table is set as follows, the actuator will move to the 215-mm position.

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

No.	Position [mm]	Speed [mm/ss]	Positioning band [mm]	Push [%]	Incremental	
0	*	*	*	*	*	
1	200.00	100.00	30.00	50	**0**	Push & hold mode
2 =	15.00	20.00	0.10	**0**	1	Incremental feed
⋮						

* On the teaching pendant screen, this sign indicates that the position is specified in the incremental mode.



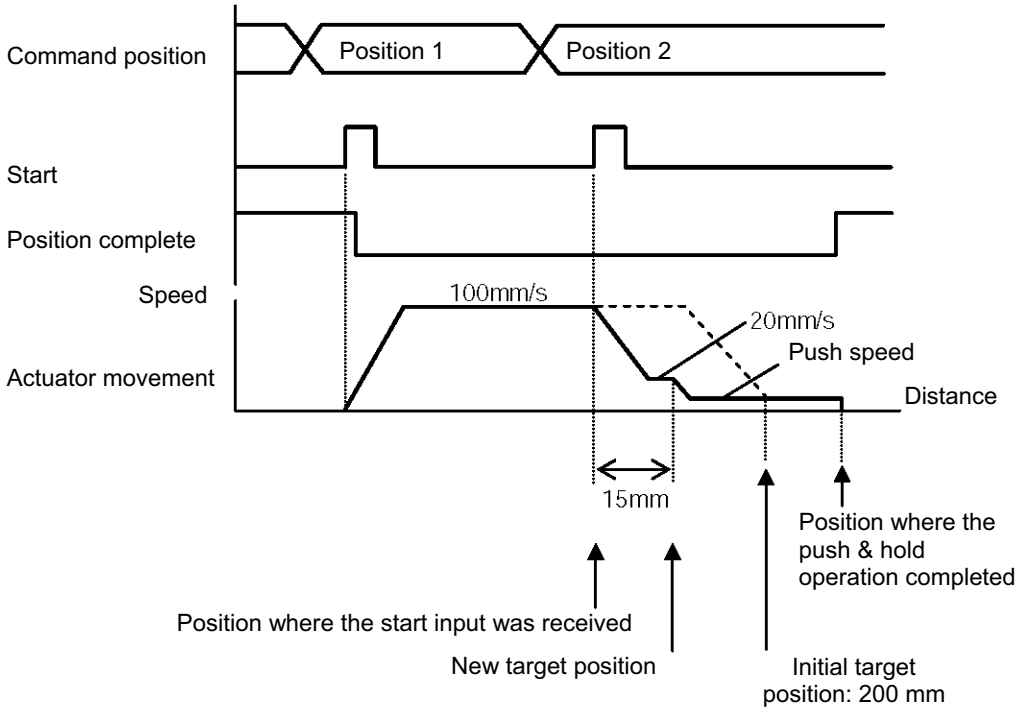
(2) When the relative coordinate operation command specifies an operation in the push & hold mode

Example) If a position 2 command is input followed by a start signal while the actuator is moving to position 1, a new target position will be set by adding the incremental distance to the current position where the start input was received. Since the target position is indeterminable, never use this method.

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

No.	Position [mm]	Speed [mm/ss]	Positioning band [mm]	Push [%]	Incremental	
0	∗	∗	∗	∗	∗	
1	200.00	100.00	30.00	50	**0**	Push & hold mode
2 =	15.00	20.00	60.00	50	1	Incremental feed
⋮						

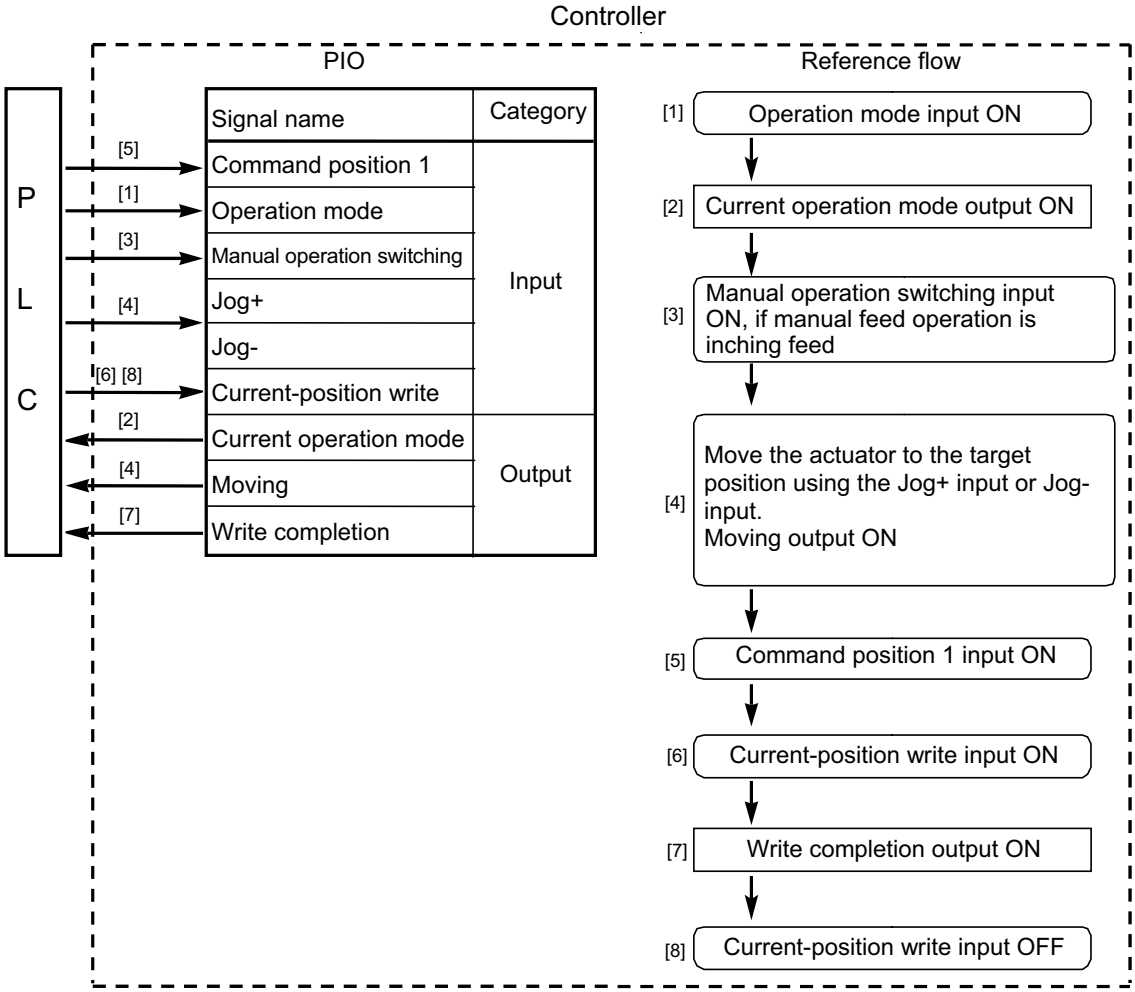
* On the teaching pendant screen, this sign indicates that the position is specified in the incremental mode.



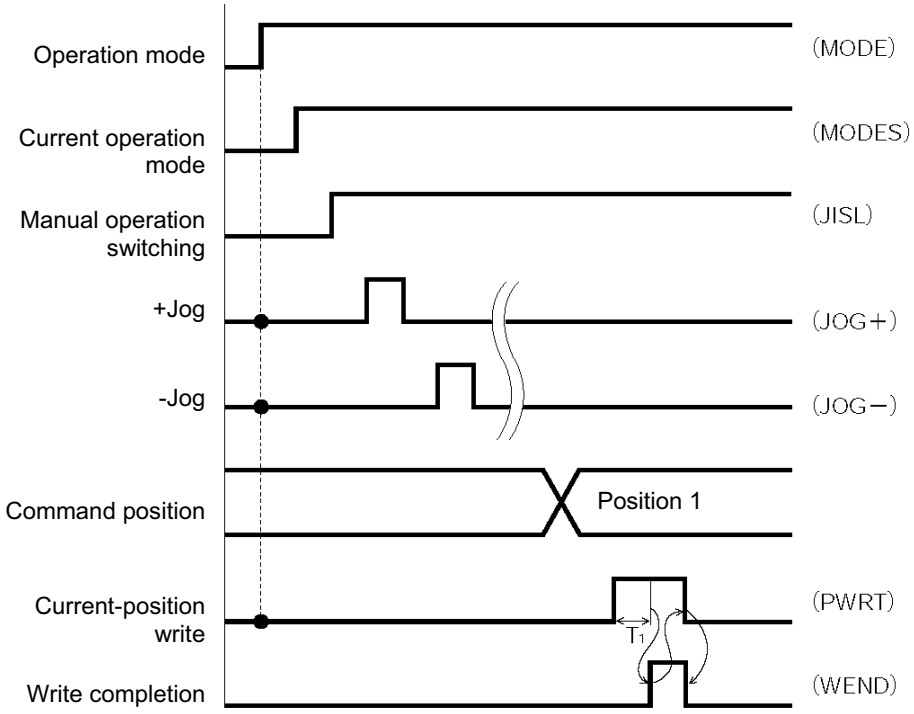
The operation explained above also applies to cases where the operation mode of the position 1 data is the normal positioning mode (without push action).

7.10 Jogging/Teaching Using PIO

If the teaching type is selected, you can jog the actuator via operation from the PLC.
You can also write the current actuator position to the “Position” field of the position table under a specified position number via operation from the PLC.
If the actuator position is written to a blank “Position” field where no position has yet been defined, the positioning band and other fields will be automatically populated by their default values set in the applicable parameters.
Example of use in operation) Move the actuator to the target position by inputting a jog command from the PLC and write the achieved position to position No. 1.



Jogging/teaching timing



T1: 20 msec or more; time after the current-position write input is turned ON until writing of the current position is started

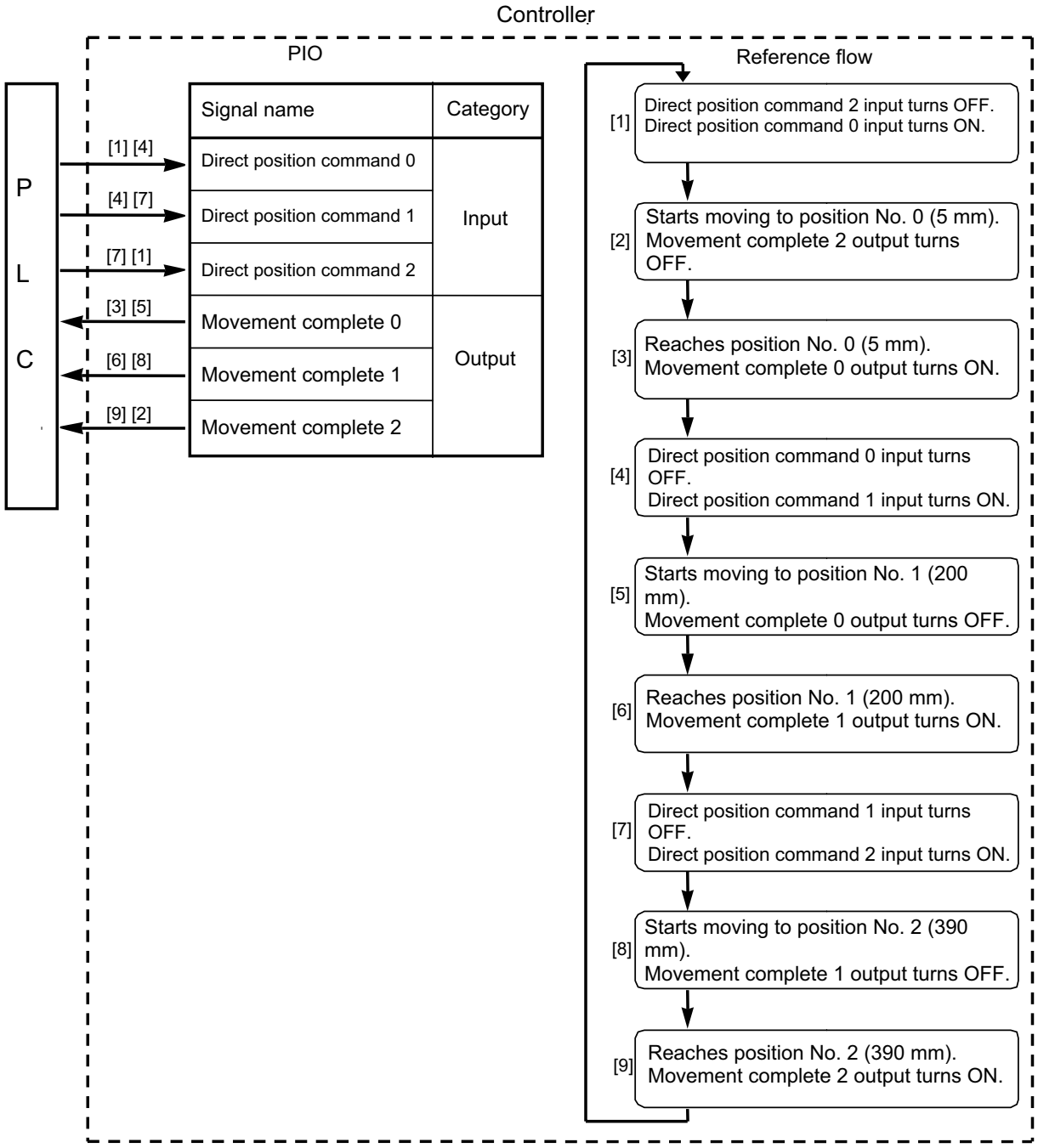
When the operation mode (MODE) input is turned ON, the current operation mode (MODES) output will turn ON and the teaching mode permitting PIO teaching will become effective.
The teaching mode will not become effective unless the operation mode (MODE) input is turned ON while the actuator is stopped.
To confirm that the teaching mode is effective, check if the current operation mode (MODES) output is ON.
If both the Jog+ input and Jog- input turn ON at the same time, the actuator will stop. In this case, turn both inputs OFF and then restart jogging.
The manual operation switching (JISL) input is ON during inching and OFF during jogging.
The inching distance is set by parameter No. 48, while the jog speed is set by parameter No. 26.
If the current-position write (PWRT) input has remained ON for 20 msec or longer, the current actuator position will be written to the selected command position number.
When writing is completed, the write complete (WEND) output will turn ON.
When the current-position write (PWRT) input is subsequently turned OFF, the write complete (WEND) output will turn OFF.

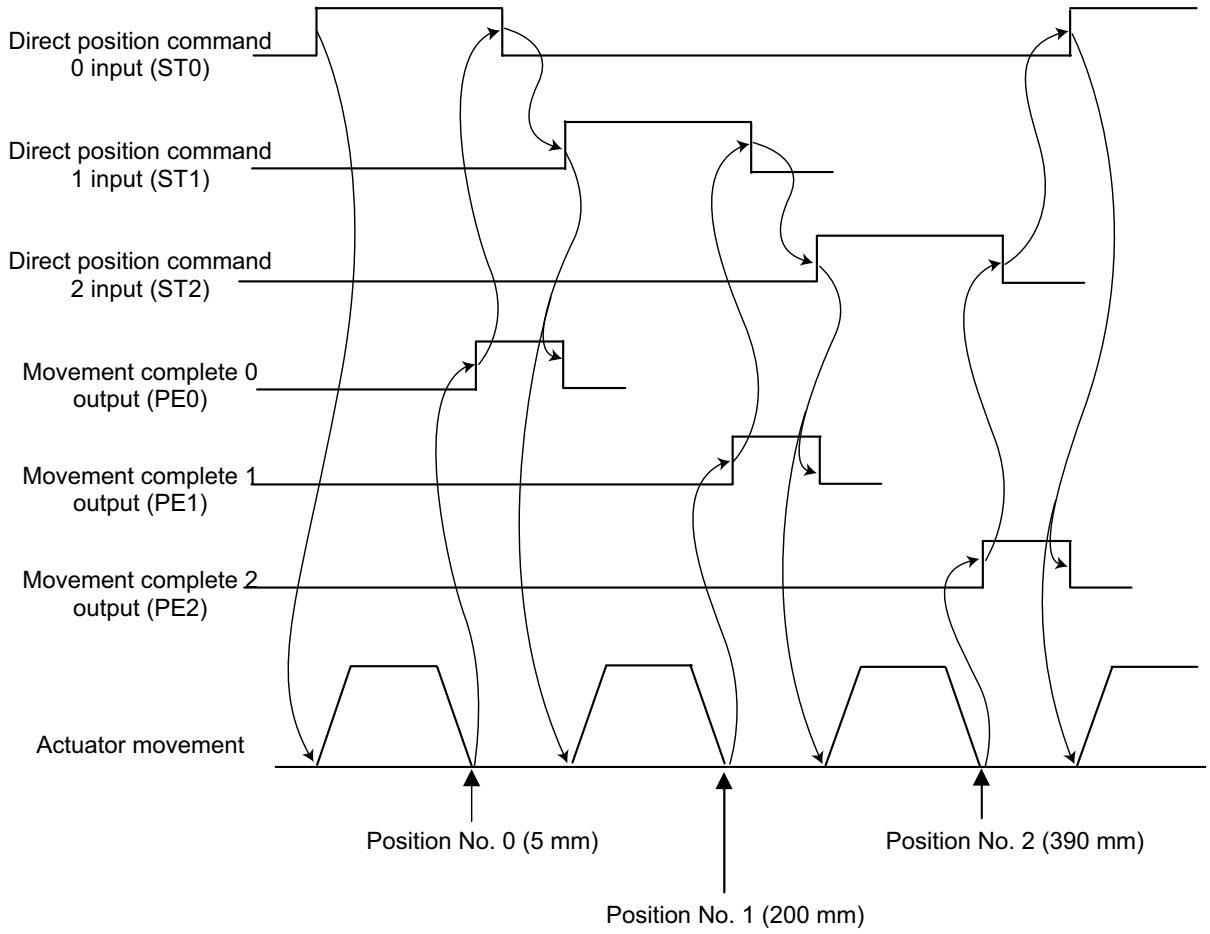
If a signal to be written is input from the PLC while the position table screen is open on the PC or teaching pendant, the position data display will not be refreshed. Perform one of the following operations to check the retrieved position data:
PC --- Click the button.
Teaching pendant --- Open the user adjustment screen and enter “4” as the adjustment number to reset the software.

7.11 Operation in 7-point Type

Separate movement command inputs are provided for the target positions for position Nos. 0 to 6, so simply turn ON the input signal corresponding to the position you wish to move the actuator to, and the actuator will start moving.

Example of use in operation) Move the actuator to position No. 0 (5 mm), position No. 1 (200 mm) and position No. 2 (390 mm) in sequence.





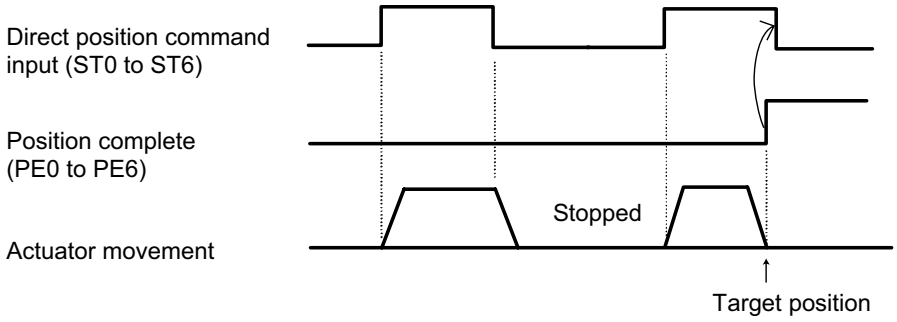
Caution:	Movement commands are executed based on the rise edge, so input each signal continuously for 6 msec or more. (Even if the level mode is selected for the movement command input (parameter No. 27), the movement command is still executed based on the rise edge.) If two or more movement commands are input simultaneously, they will be executed according to the following priorities: The priorities follow the command numbers in ascending order: [1] Direct position command 0, [2] Direct position command 1, …, [7] Direct position command 6. The sequence circuit on the PLC side must ensure only one command is input at a time.

- The movement command input operates in two modes.

You can select the operation condition of the movement command input (ST0 to ST6) in parameter No. 27.
The factory setting is “0: [Level mode].”

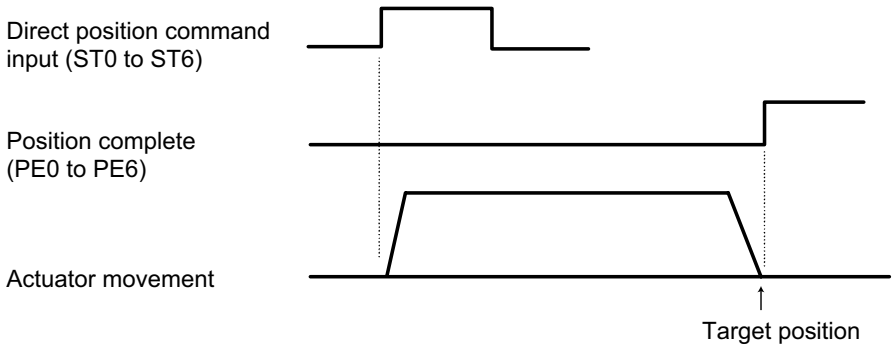
Description of the movement command input	Setting
Level mode: The actuator starts moving when the input signal turns ON. When the signal turns OFF during the movement, the actuator will decelerate to a stop and complete its operation.	0
Edge mode: The actuator starts moving when the rise edge of the input signal is detected. The actuator will not stop even when the signal turns OFF during the movement, until the target position is reached.	1

[Level mode]



(Note) Turn OFF the movement command input after confirming that the target position has been reached.

[Edge mode]



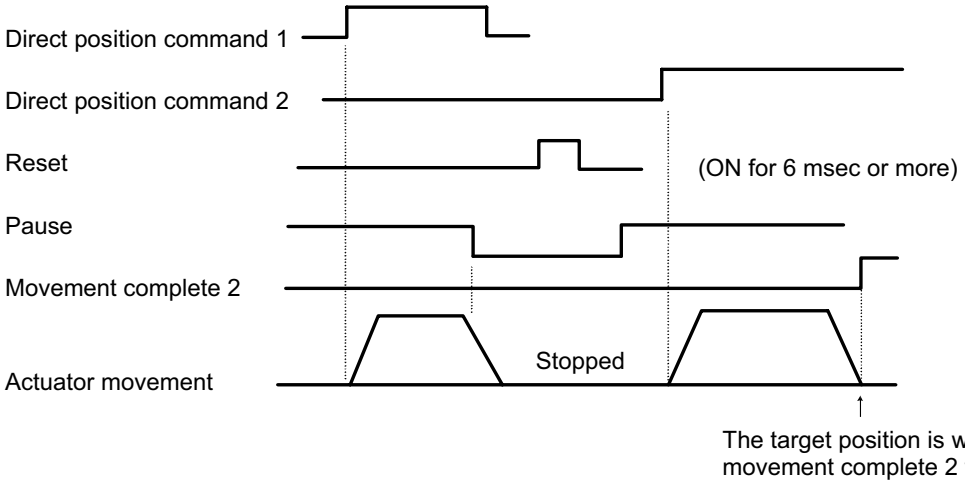
- Handling of the pause (*STP) signal

This signal is a contact B signal, meaning that it must remain ON while the actuator is moving.
If the pause signal turns OFF while the actuator is moving, the actuator will decelerate to a stop.
The actuator will start moving when the signal turns ON again.
Use this signal as an interlock that actuates when an operator entry prohibition sensor or contact prevention sensor is activated.

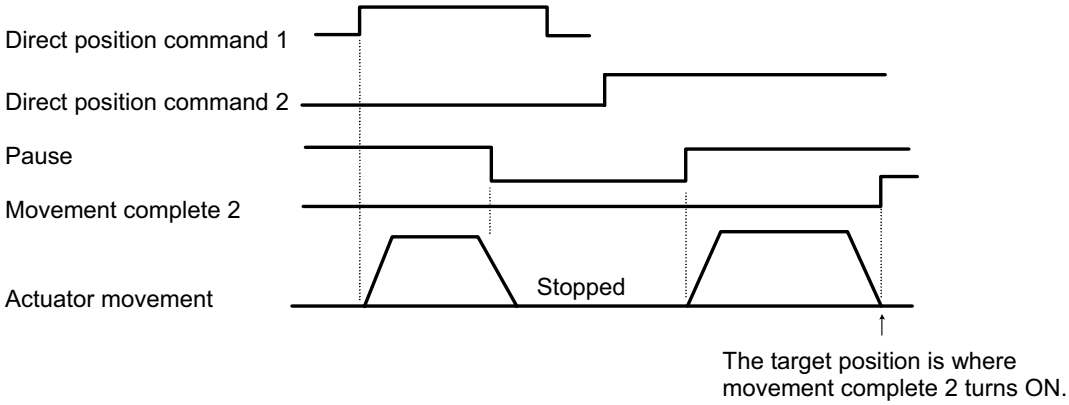
If the pause signal is not to be used, set parameter No. 15 (Pause input disable selection) to “1,” and the actuator will move even when this signal is OFF.

(Note) When the “edge mode” is selected as the movement command type, you can change the target position while the actuator is stopped with this signal turned OFF, as follows:

[1] Input a reset signal (RES) for 6 msec or more to cancel the remaining travel.
Next, turn ON the pause signal, and then input a movement command specifying the new target position.
(Example) Turn OFF the pause signal while the actuator is moving under direct position command 1.
The actuator decelerates to a stop.
→ Turn OFF direct position command 1, and turn ON the reset signal for 6 msec or more.
→ Turn ON the pause signal again, and input direct position command 2.



[2] After inputting a movement command specifying the new target position, turn ON the pause input.
(Example) Turn OFF the pause signal while the actuator is moving under direct position command 1.
The actuator decelerates to a stop.
→ Turn OFF direct position command 1, and turn ON direct position command 2.
→ Turn ON the pause signal again. The front end is recognized as the new target position.



7.12 Operation in 3-point Type

After the power has been turned on, input the rear end move command first to complete home return, and then perform continuous operation.

→ Refer to 7.2.2, “Method Used When No HOME Input Signal Is Available.”

Example of use in operation) How to move the actuator from the rear end to the front end is explained. Although the actuator does not stop at the intermediate point, you can increase the positioning band and use the intermediate point detected output signal (LS2) as a quasi zone output signal.

Example of position table

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

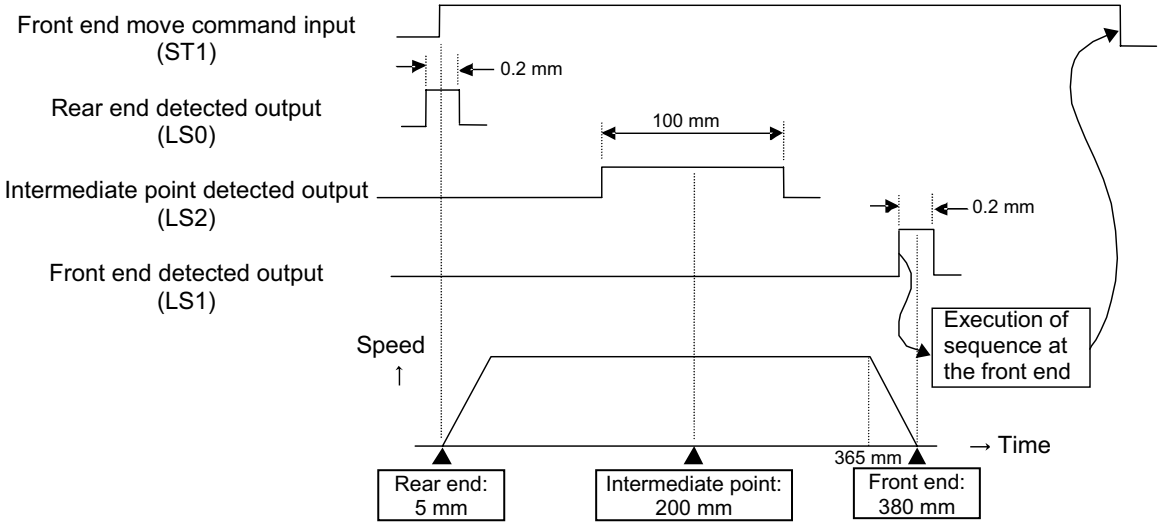
Operation timings

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

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

PLC processing 2: If necessary, use the intermediate point detected output (LS2) as a trigger signal with respect to surrounding equipment.
[4] When the current position reaches 379.9 mm, the front end detected output (LS1) turns ON.
[5] When the current position reaches 380 mm, the actuator stops.

PLC processing 3: Once the front end detected output (LS1) turns ON, the sequence processing at the front end is executed. Upon completion of the sequence processing, the front end move command signal (ST1) turns OFF.



⚠ Caution: Provide a ladder sequence circuit where only one move command signal turns ON at a time. If two or more signals are input at the same time, the signals will be processed in the following priorities:
Priorities: [1] Rear end, [2] Front end, [3] Intermediate point

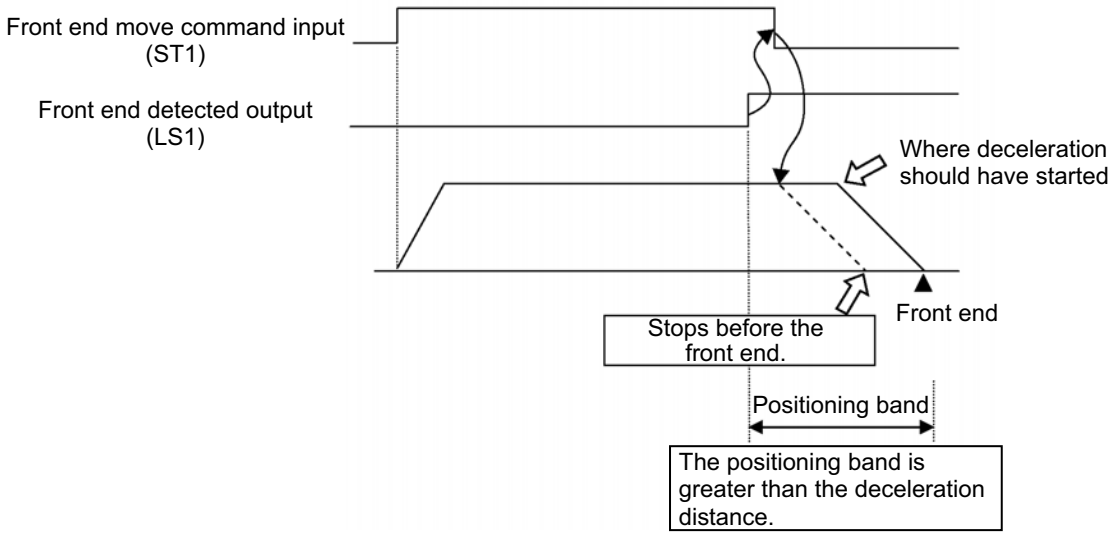
- Meaning of position detected output signals (LS0, LS1, LS2)
  These signals are handled in the same manner as limit switches (LSs), and turn ON when the following conditions are met:
  [1] The home return complete output signal (HEND) is ON.
  [2] The current position is within the positioning band from each target position in the positive or negative direction.
  Accordingly, these signals turn ON not only when the actuator is moving under a move command, but also when the actuator is moved by hand with the servo turned off.
  In a case where none of these signals (LS0, LS1, LS2) is ON when an emergency stop was actuated while the actuator was moving, if LS0, LS1 or LS2 must be ON as a condition for resuming actuator operation from the PLC, move the actuator to any target position.

⚠ Caution: These signals will turn OFF if a phase-A/B disconnection detection alarm occurs.

- Notes on positioning band setting
  The positioning band setting defines the range within which the position detected output signal turns ON.
  Condition for the position detected output signal to turn ON = Target position ± (Positioning band)

  With any normal move command, once the position detected output signal turns ON the sequence processing will be executed and the move command input signal will turn OFF.
  Take note that if the positioning band is wide and the move command input signal turns OFF quickly, the actuator may not reach the target position.

  (Example) When the feed speed is 300 mm/s and deceleration is 0.3 G, the deceleration distance becomes approx. 15 mm.
  If the positioning band is set to 30 mm, the position detected output signal will turn ON before the actuator starts decelerating.
  In this case, promptly turning OFF the move command input signal on the PLC will cause the controller to initiate the deceleration stop processing.
  Depending on the timing, therefore, the actuator may stop before the target position.



- Speed change during movement

If the load is made of soft material or is a bottle or otherwise topples easily due to its shape, one of the following two methods can be used to prevent the load from receiving vibration or impact when it stops:

[1] Reduce the deceleration to make the deceleration curve gradual.
[2] Initially move the actuator at the rated speed, and reduce the feed speed immediately before the target position.

Method [2], where the feed speed is reduced, is explained below.
(Example) Move the actuator from the rear end to the front end by using the intermediate point as a dummy point, where the feed speed is set to 300 mm/s until the intermediate point and then reduced to 20 mm/s after passing the intermediate point.

Example of position table

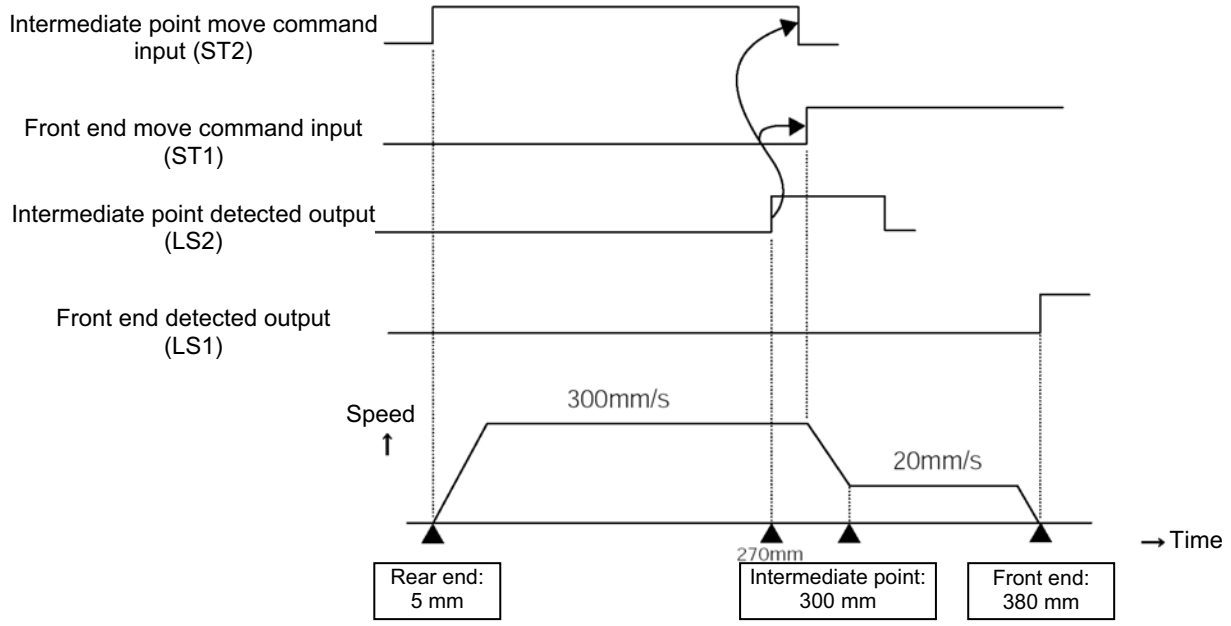
No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Positioning band [mm]	Remarks
0	5.00	300.00	0.30	0.30	0	0.10	Rear end
1	380.00	20.00	0.30	0.30	0	0.10	Front end
2	300.00	300.00	0.30	0.30	0	30.00	Intermediate point

Operation timings

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

Operation: [1] The actuator starts moving toward the intermediate point.
[2] When the current position reaches 270 mm, the intermediate point detected output (LS2) turns ON.

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

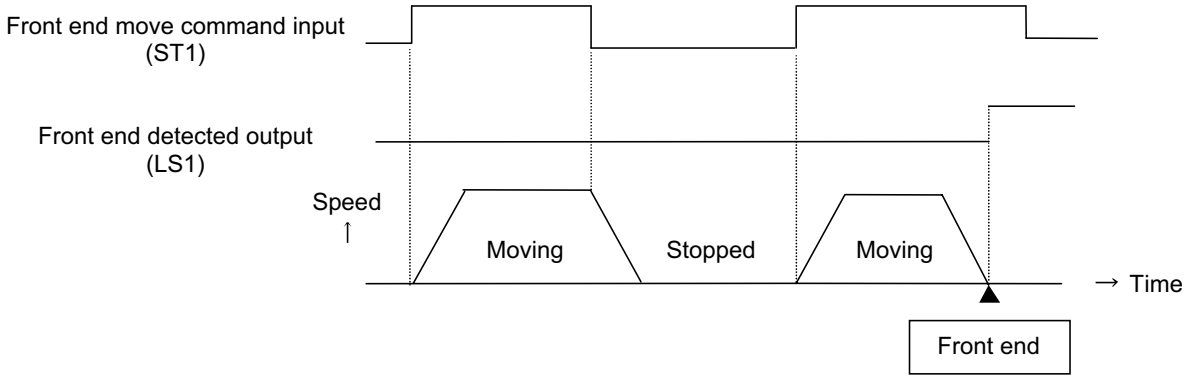


⚠ Caution: By setting a wide positioning band for the intermediate point, smooth speed change can be implemented without requiring the actuator to stop temporarily at the intermediate point.

● Pause during movement

Since move commands are based on level mode, the actuator continues to move while a move command is ON. Once the move command turns OFF, the actuator will decelerate to a stop and complete the operation. Therefore, turn OFF the move command if the actuator must be stopped temporarily as a low-degree safety measure.

(Example) Temporarily stop the actuator while it is moving to the front end.



● Emergency return operation

The following explains what to do when an emergency situation occurred while the actuator was moving and you want to return the actuator to the standby position (rear end).

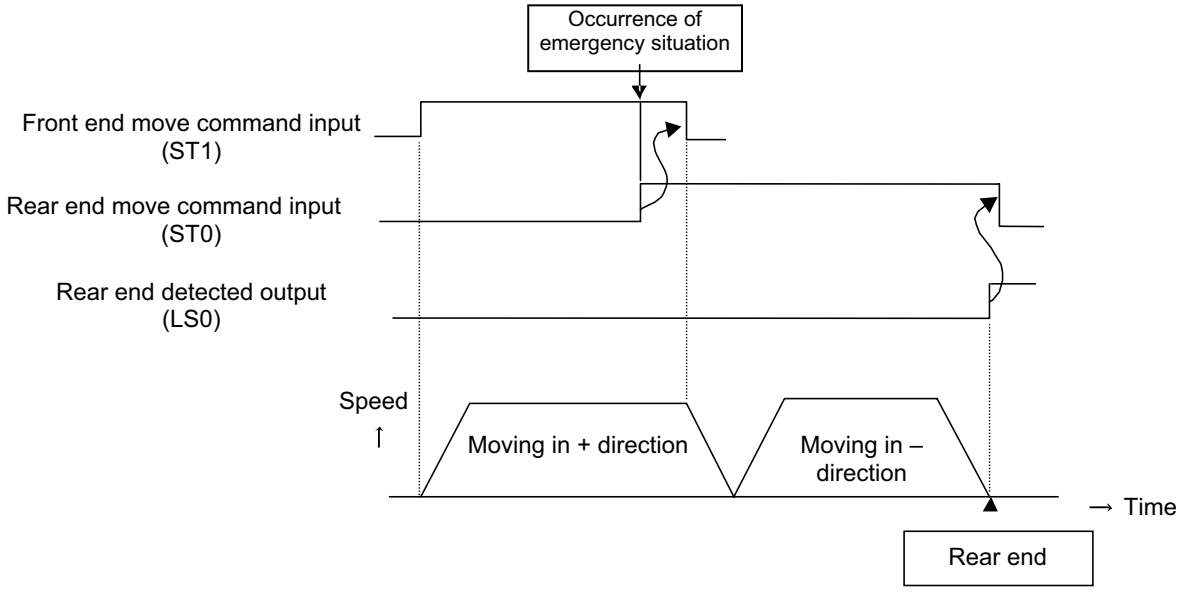
(Example) Return the actuator to the standby position (rear end) following an emergency situation occurring while the actuator was moving to the front end.

Operation timings

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

Operation: [1] The actuator starts decelerating upon turning OFF of the front end move command signal (ST1), and stops.
[2] The actuator reverses its direction and starts moving toward the rear end.
[3] When the rear end is reached, the rear end position complete output (PE0) turns ON.

PLC processing 2: Turn OFF the rear end move command signal (ST0).



8. Parameter Settings

8.1 Parameter Table

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

No.	Category	Symbol	Name	Unit	Default factory setting
1	a	ZONM	Zone boundary 1+	mm	Effective actuator length
2	a	ZONL	Zone boundary 1–	mm	Effective actuator length
3	a	LIMM	Soft limit+	mm	Effective actuator length
4	a	LIML	Soft limit–	mm	Effective actuator length
5	a	ORG	Home return direction [0: Reverse / 1: Forward]	-	(In accordance with the specification at the time of order)
6	b	PSWT	Push & hold stop judgment period	msec	255
7	d	PLG0	Servo gain number	-	6
8	b	VCMD	Default speed	mm/sec	Set individually in accordance with the actuator characteristics.
9	b	ACMD	Default acceleration/deceleration	G	Set individually in accordance with the actuator characteristics.
10	b	INP	Default positioning band (in-position)	mm	Set individually in accordance with the actuator characteristics.
12	b	SPOW	Current-limiting value at standstill during positioning	%	60
13	b	ODPW	Current-limiting value during home return	%	Set individually in accordance with the actuator characteristics.
15	c	FPIO	Pause input disable selection [0: Enable / 1: Disable]	-	0 [Enable]
16	c	BRSL	SIO communication speed	bps	38400
17	c	RTIM	Minimum delay time for slave transmitter activation	msec	5
18	b	LS	Home sensor input polarity	-	Set individually in accordance with the actuator characteristics.
21	c	SON	Servo ON input [0: Enable / 1: Disable]		0
22	a	OFST	Home return offset	mm	Set individually in accordance with the actuator characteristics.
23	a	ZNM2	Zone boundary 2+	mm	Effective actuator length
24	a	ZNL2	Zone boundary 2–	mm	Effective actuator length
25	c	IOPN	PIO pattern selection	-	0 [Standard type]
26	b	IOJV	PIO jog speed	mm/sec	100
27	c	FPIO	Movement command type [0: Level / 1: Edge]	-	0 [Level]
28	b	PHSP	Default direction of excited-phase signal detection [0: Reverse / 1: Forward]		Set individually in accordance with the actuator characteristics.
29	b	PHSP	Excited-phase signal detection time	msec	Set individually in accordance with the actuator characteristics.
31	d	VLPG	Speed loop proportional gain	-	Set individually in accordance with the actuator characteristics.
32	d	VLPT	Speed loop integral gain	-	Set individually in accordance with the actuator characteristics.
33	d	TRQF	Torque filter time constant	-	Set individually in accordance with the actuator characteristics.
34	b	PSHV	Push speed	mm/sec	Set individually in accordance with the actuator characteristics.
35	b	SAFV	Safety speed	mm/sec	100
36	b	ASO1	Automatic servo-off delay time 1	sec	0
37	b	ASO2	Automatic servo-off delay time 2	sec	0
38	b	ASO3	Automatic servo-off delay time 3	sec	0
39	c	FPIO	Output mode of position complete signal [0: PEND / 1: INP]	-	0 [PEND]
40	c	HOME	Home-return input disable selection [0: Enable / 1: Disable]	-	0 [Enable]

No.	Category	Symbol	Name	Unit	Default factory setting
41	c	FPIO	Operating-mode input disable selection [0: Enable / 1: Disable]	-	0 [Enable]
42	b	ENBL	Enable function [0: Enable/1: Disable]	-	1 [Disable]
43	b	HMC	Polarity of home check sensor input [0: Contact a / 1: Contact b]	-	Set individually in accordance with the actuator characteristics.
45	c	SIVM	Silent interval multiplier	-	0 [Do not apply multiplier]
46	b	OVRD	Speed override	%	100
47	b	IOV2	PIO jog speed	mm/sec	100
48	b	IOID	PIO inching distance	mm	0.1
49	b	IOD2	PIO inching distance 2	mm	0.1
50	b	LDWT	Load output judgment time	msec	0
51	b	TRQZ	Torque check range [0: Enable / 1: Disable]	-	0 [Enable]
53	b	HSTP	Default stop mode	-	0 [Power-saving mode is disabled]
77	b	LEAD	Ball screw lead	mm	Set individually in accordance with the actuator characteristics.
78	b	ATYP	Axis operation type	-	Set individually in accordance with the actuator characteristics.
79	b	ATYP	Rotational axis mode selection	-	Set individually in accordance with the actuator characteristics.
80	b	ATYP	Shortcut selection for rotation	-	Set individually in accordance with the actuator characteristics.
83	b	ETYP	Absolute unit [0: Not used / 1: Used]	-	Set individually in accordance with the actuator characteristics.
84	C	FMOD	Fieldbus operation mode	-	Set for each network.
85	C	NADR	Fieldbus node address	-	Set for each network.
86	C	FBRS	Fieldbus baud rate	-	Set for each network.
87	C	NTYP	Network type	-	Set for each network.
88	a	SWLM	Software limit margin	mm	Set individually in accordance with the actuator characteristics.
90	C	FMIO	Fieldbus I/O format	-	Set for each network.
91	b	PSFC	Current-limiting value at standstill after missing work part in push & hold operation	-	0 [Current-limiting value at standstill]

(Note 1) The numbers are shown in the PC software, but not on the teaching pendant.
The missing numbers are not used and therefore omitted.
The category codes are provided as a matter of convenience and not displayed.

(Note 2) Parameter Nos. 84 to 87 and 90 are used when a network connection specification is selected. For details, refer to the operation manual for each network (CC-Link, DeviceNet or PROFIBUS).

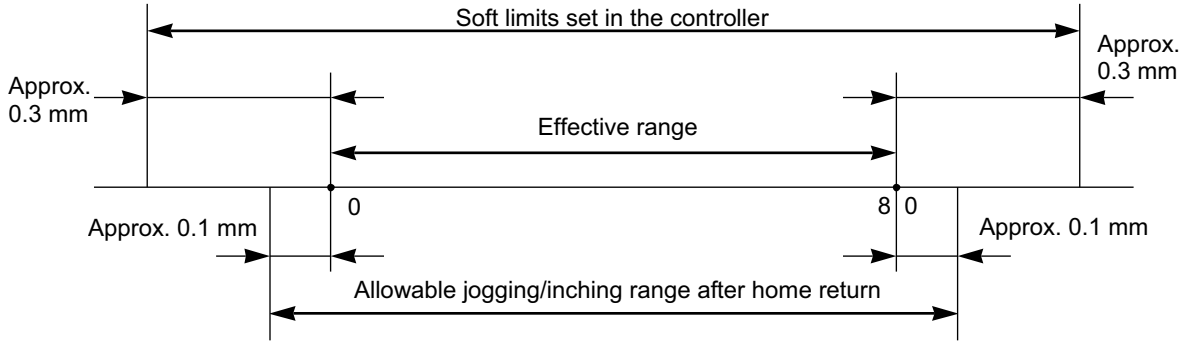
8.2 Detail Explanation of Parameters

If a parameter has been changed, always restart the controller using a software reset command or by reconnecting the power.

8.2.1 Parameters Relating to the Actuator Stroke Range

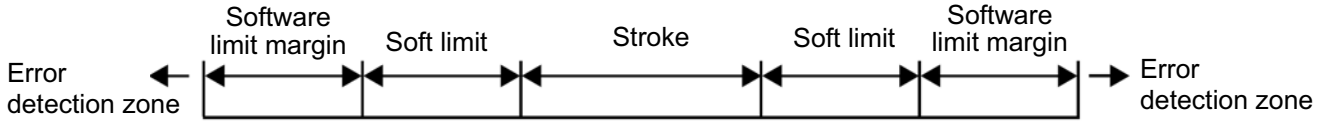
- Soft limit (No.3/4 LIMM/LIML)

Set the soft limit in the positive direction in parameter No. 3, and that in the negative direction in parameter No. 4. The factory setting for the soft limits conforms to the effective actuator length. Change the settings, as necessary, to prevent crash with an obstacle or when the actuator must be stroked slightly beyond its effective length.
A wrong soft limit setting will cause the actuator to crash into the mechanical end, so exercise due caution.
The minimum setting unit is “0.01 [mm].”
(Note) To change a soft limit, set a value corresponding to 0.3 mm outside of the effective range.
Example) Set the effective range to between 0 mm and 80 mm
Parameter No. 3 (positive side) 80.3
Parameter No. 4 (negative side) –0.3



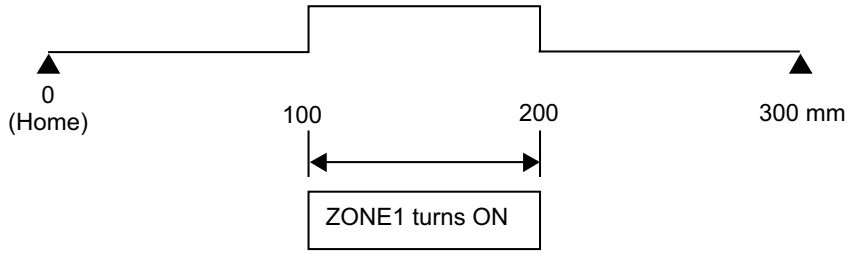
- Software limit margin (No. 88 SWLM)

If the actuator exceeds the range defined by the soft limits, a “soft limit over error” will occur.
By setting parameter No. 88, you can suppress detection of this error for the distance corresponding to the value set in parameter No. 88 from the soft limits.
The minimum setting range is 0.01 mm.



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

These parameters set the zone within which the zone output signal (ZONE1) turns ON when the selected PIO pattern is “0” (standard type), “4” (7-point type) or “5” (3-point type).
The zone output signal turns ON when the current position is between the negative-side boundary and positive-side boundary. Set the positive-side boundary in parameter No. 1, and negative-side boundary in No. 2.
The minimum setting unit is “0.01 [mm].”
Example) To turn ON the ZONE1 signal when the actuator with a 300-mm stroke enters the section of 100 to 200 mm, set 200.00 in parameter No. 1 (Zone boundary+) and 100.00 in parameter No. 2 (Zone boundary-).



(Note) This controller does not use parameter No. 23 (Zone boundary 2+) and parameter No. 24 (Zone boundary 2-).

- Home return direction (No.5 ORG)

Unless specified by the user, the home return direction is set to the motor direction at the factory.
Should a need arise to change the home direction after the actuator has been assembled into your system, reverse the setting in parameter No. 5 between “0” and “1.”
If necessary, also change the home return offset, soft limit and excited-phase signal detection direction parameters.

Caution: The home direction cannot be reversed for a rod-type actuator.

- Home return offset (No.22 OFST)

The controller is shipped from the factory with an optimal value set in parameter No. 22, so the distance from each mechanical end to the home becomes uniform.
The minimum setting unit is “0.01 [mm].”
The home return offset can be adjusted in the following conditions:
[1] Want to align the actuator home and the system’s mechanical home after the actuator has been assembled into the system
[2] Want to set a new home after reversing the factory-set home direction
[3] Want to eliminate a slight deviation generated after replacing the actuator

Caution: If the home return offset has been changed, the soft limit parameters must also be adjusted accordingly.

8.2.2 Parameters Relating to the Actuator Operating Characteristics

- PIO jog speed (No.26 IOJV)

When the selected PIO pattern is “1” (teaching type), this parameter defines the jog speed to be applied when jog input commands are received from the PLC.
The factory setting is “100 [mm/sec].”
Set an appropriate value in parameter No. 26 in accordance with the purpose of use.
The maximum speed is limited to “250 [mm/sec].”
(Note) Parameter No. 47 (PIO jog speed 2) is not used for this controller.

- PIO inching distance (No.48 IOID)

When the selected PIO pattern is “1” (teaching type), this parameter defines the inching distance to be applied when inching input commands are received from the PLC.
The factory setting is “0.1 [mm].”
Set an appropriate value in parameter No. 48 in accordance with the purpose of use.
The maximum limit is limited to “1 [mm].”
(Note) Parameter No. 49 (PIO inching distance 2) is not used for this controller.

- Default speed (No.8 VCMD)

The factory setting is the rated speed of the actuator.
When a target position is set in an unregistered position table, the setting in this parameter will be used as the speed data for the applicable position number.
To reduce the default speed from the rated speed, change the setting in parameter No. 8.

- Default acceleration/deceleration (No.9 ACMD)

The factory setting is the rated acceleration/deceleration of the actuator.
When a target position is written to an unregistered position table or the current position is read in the teaching mode, the setting in this parameter will be used as the acceleration/deceleration data for the applicable position number.
To reduce the default acceleration/deceleration from the rated acceleration/deceleration, change the setting in parameter No. 9.

- Default positioning band (in-position) (No.10 INP)

The factory setting is “0.10 [mm].”
When a target position is written to an unregistered position table or the current position is read in the teaching mode, the setting in this parameter will be used as the positioning band data for the applicable position number.
Increasing the default positioning band will allow the position complete signal to be output early. Change the setting in parameter No. 10, as necessary.

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

- Current-limiting value at standstill during positioning (No.12 SPOW)

The factory setting conforms to the standard specification of the actuator.
Increasing this setting will increase the holding torque at standstill.
This setting need not be changed in normal conditions of use. However, to prevent hunting caused by large external force applied while the actuator is at standstill, the value set in parameter No. 12 must be increased. (Do not increase the value beyond 70%.)

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

The factory setting conforms to the standard specification of the actuator.
Increasing this setting will increase the home return torque.
This setting need not be changed in normal conditions of use. However, if an increased slide resistance causes the home return to complete before the correct position depending on the affixing method, load condition or other factor when the actuator is used in a vertical application, the value set in parameter No. 13 must be increased. (As a guide, the maximum limit is 100% for the RA3C/RA3D types and 75% for all other types.)

- Home sensor input polarity (No. 18 LS)

This parameter is supported when a RCP2-RTB/RTC rotational axis is used in the home sensor mode.
Definition of settings : 0 (Sensor not used)
: 1 (Sensor polarity of contact a)
: 2 (Sensor polarity of contact b)

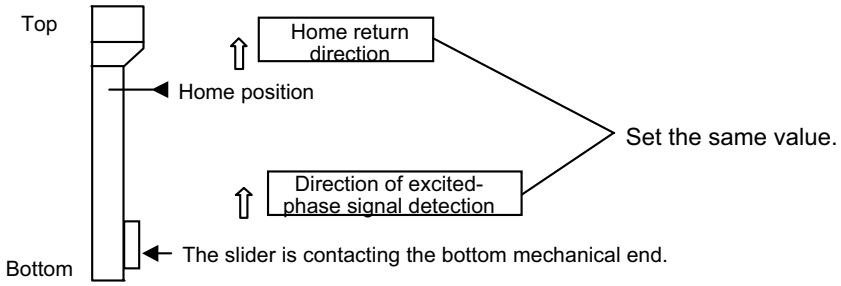
- Speed override (No.46 OVRD)

Use this parameter when moving the actuator at a slower speed to prevent danger when the system is initially started for test operation.
When move commands are issued from the PLC, the moving speed set in the “Speed” field of the position table can be overridden by the value set by parameter No. 46.
Actual moving speed = [Speed set in the position table] x [Value of parameter No. 46] ÷ 100
Example) Value in the “Speed” field of the position table500 (mm/s)
Value of parameter No. 46 20 (%)
Under the above settings, the actual moving speed becomes 100 mm/s.
The minimum setting unit is “1 [%],” while the input range is “1 to 100 [%].” The factory setting is “100 [%].”
(Note) This parameter is ignored for move commands from the PC and teaching pendant.

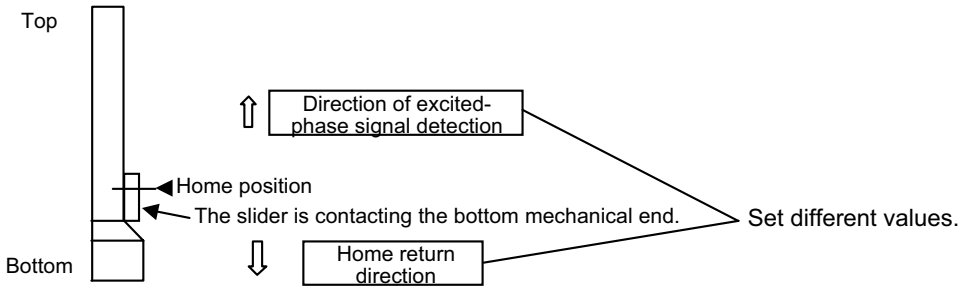
- Default direction of excited-phase signal detection (No.28 PHSP)

When the servo is turned on for the first time after the power on, excited-phase detection is performed This parameter defines the direction of this detection.
The parameter need not be changed in normal conditions. In certain situations, such as when the actuator was contacting a mechanical end or obstacle when the power was turned on and cannot be moved by hand, change the direction to one that allows the motor to operate smoothly.
To do so, set parameter No. 28 to “0” or “1.” If the detection direction should be the same as the home return direction, specify the same value currently set in parameter No. 5 (Home return direction).
To set a direction opposite to the home return direction, specify the value different from the one currently set in parameter No. 5 (Home return direction).

(Example 1) Power was turned on when the slider was contacting the bottom mechanical end in a configuration where the actuator is installed vertically with the motor at the top.



(Example 2) Power was turned on when the slider was contacting the bottom mechanical end in a configuration where the actuator is installed vertically with the motor at the bottom.



- Excited-phase signal detection time (No.29 PHSP)

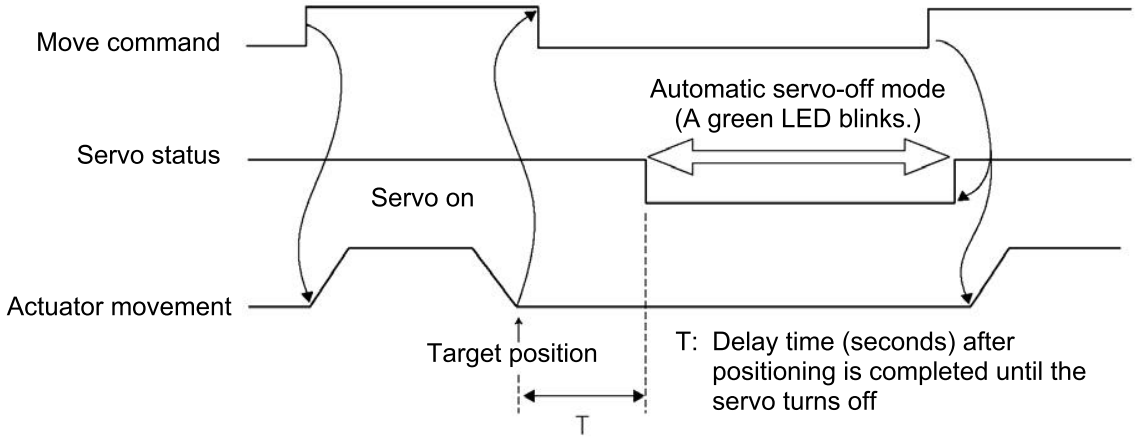
When the servo is turned on for the first time after the power on, excited-phase detection is performed. This parameter defines the time of this detection.
The parameter need not be changed in normal conditions, because a detection time appropriate for the standard specification of the actuator has been set at the factory.
Should an excitation detection error or abnormal operation occur when the servo is turned on for the first time after the power on, one remedial action that can be taken is to change the detection time set by parameter No. 29.
If you wish to change this parameter, contact IAI beforehand.

- Safety speed (No.35 SAFV)

This parameter defines the feed speed to be applied during manual operation.
The factory setting is “100 [mm/sec].”
To change this speed, set an optimal value in parameter No. 35.
Take note that the maximum speed is limited to “250 [mm/s]” and that you should set a speed not exceeding this value.

- Automatic servo-off delay time (No.36 ASO1/No.37 ASO2/No.38 ASO3)

This parameter defines the delay time after the positioning is completed until the servo turns off automatically, when the “Standstill mode” field of the position table is set to “1,” “2” or “3” (automatic servo-off control enabled) or parameter No. 53 (Default standstill mode) is set to “1,” “2” or “3”(automatic servo-off control enabled).
Meaning of settings: 1: T becomes the value set by parameter No. 36.
2: T becomes the value set by parameter No. 37.
3: T becomes the value set by parameter No. 38.
The factory setting is “0 [sec].”

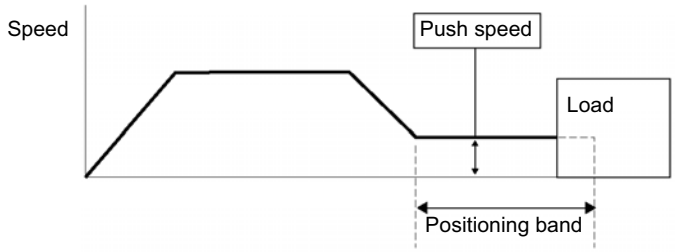


- Default standstill mode (No.53 HSTP)

This parameter defines the power-saving modes.
For details,refer to 6.4,"Power-saving Modes at Standby Positions."

- Push speed (No.34 PSHV)

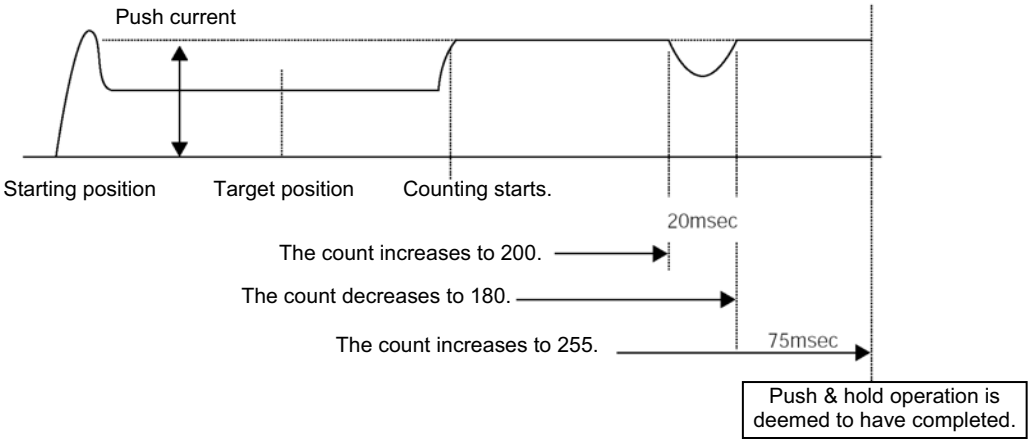
This parameter defines the push speed to be applied after the actuator reaches the target position in push & hold operation.
Before the shipment, this parameter has been set to the default value selected in accordance with the characteristics of the actuator.
Set an appropriate speed in parameter No. 34 by considering the material and shape of the work part, and so on.
Take note that maximum speed is limited to “20 [mm/sec]” even on high-speed types and that you should use the actuator at push speeds not exceeding this level.



⚠ Caution: It is recommended that you set the push speed to 5 [mm/s] or above to minimize the negative effect of push force variation.

- Push completion judgment time (No.6 PSWT)

This parameter is used as a condition for determining that the work part was contacted and the push & hold operation has completed.
As for the specific method of judgment, the push & hold operation is deemed to have completed if the current-limiting value set in the position table has been retained for the time set by parameter No. 6.
Set an optimal time matching the current-limiting value, by considering the material and shape of the work part, and so on.
The minimum setting unit is “1 [msec],” while the maximum value is “9999 [msec].” The factory setting is “255 [msec].”
(Note) The chart below explains how completion of push & hold operation is determined if the work part shifted during the judgment and the current has changed as a result, based on a judgment time of 255 msec.



If the motor current remains at or above the push current for 200 msec and then drops below this level for 20 msec, the count will decrease by 20. When the push current is reached again thereafter, counting will start from 180. If the motor current remains at or above the push current for 75 msec, the count will increase to 255 and thus push & hold operation will be deemed to have completed.
In total, 295 msec was required for the judgment.

- Enable function (No.42 FDIO4)

Whether to enable or disable the deadman switch function on an ANSI-type teaching pendant is defined by parameter No. 42.

* An ANSI-type teaching pendant will be developed in the future.

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

The factory setting is “1 [Disable].”

- Polarity of home check sensor input (No.43 AIOF)

The home check sensor is not included in the standard specification, but it can be installed as an option. Normally this parameter need not be changed, but if the customer wishes to change the mode after the shipment, change the value of Parameter No. 43.

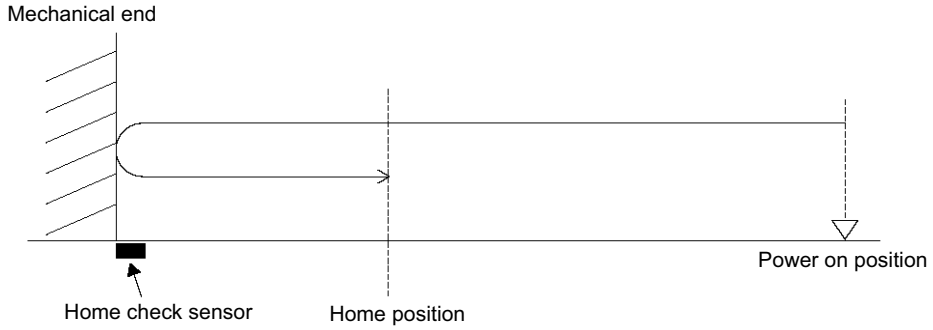
Definition of settings: 0 (Standard specification without home check sensor)
1 (Use the home check sensor based on contact-a sensor polarity)
2 (Use the home check sensor based on contact-b sensor polarity)

[Explanation of operation]

[1] When a home return command is issued, the actuator moves until contacting the mechanical end. Upon contact with the mechanical end, the home check sensor signal is detected.

[2] Next, the actuator reverses its direction and stops at the home position.

[3] The controller determines that the movement has completed successfully if the home check sensor signal had changed when the actuator stopped. If the sensor signal remains the same, the controller recognizes that “position deviation” has occurred, in which case the controller will generate a “Home sensor not detected” error and output an alarm signal.



- Load output judgment time (No.50 LDWT)

If the torque check function is used in push & hold operation, the load output (LOAD signal) will turn ON when a specified condition is met. Since the command torque does not remain constant but fluctuates within a certain band while the actuator is moving, whether or not to turn ON the load output is determined based on whether the total duration of periods in which the command torque has exceeded the threshold corresponds at least to a specified time. This specified time is set using this parameter. The default value is “255 msec.”

- Torque check range (No.51 TRQZ)

This parameter sets whether or not to use the check range when determining if the threshold has been exceeded. The default value is “0,” i.e., to enable the check range.

	Setting
Enable (Use the check range to make judgment)	0
Disable (Do not use the check range to make judgment)	1

- Ball screw lead length (No.77 LEAD)

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

- Axis operation type (No.78 ATYP)

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

- Rotational axis mode selection (No.79 ATYP)

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

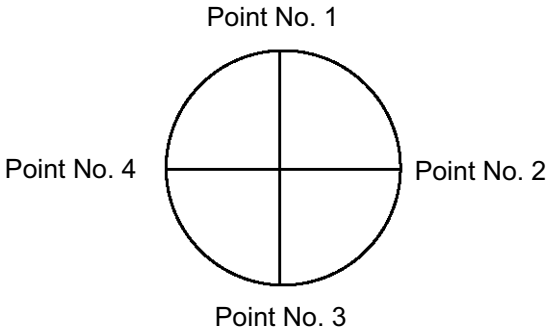
Caution:	Push & hold operation cannot be performed in the index mode. If push action data is entered in the position data, the data will be disabled and the actuator will perform normal movement. The positioning band will correspond to the default positioning band set by the applicable parameter.

- Shortcut selection for rotational axis (No.80 ATYP)

Set this parameter if you want to rotate the rotational axis in a specific direction.
“Shortcut” refers to a type of operation in which the actuator moves to the next point by taking the shortest path.

	Setting
Do not select	0
Select	1

* When shortcut is selected, the actuator can be rotated in a specific direction.



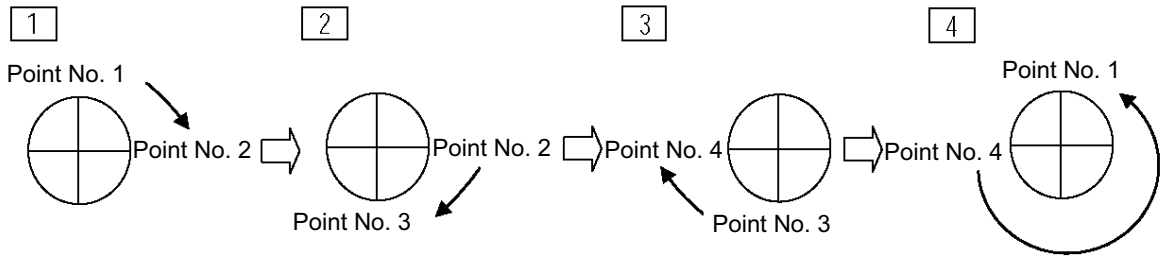
Positions

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

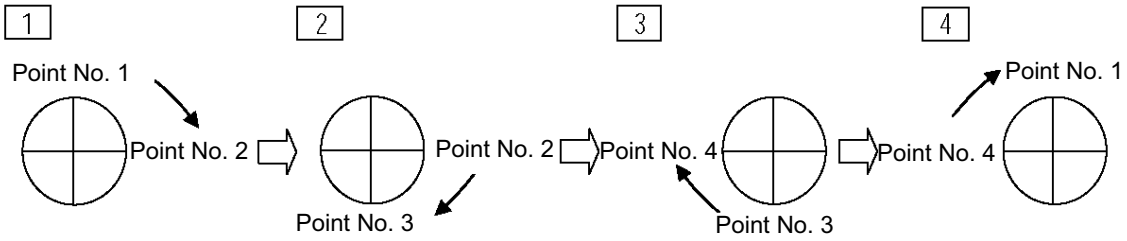
One degree of position data corresponds to 1 mm.

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

When shortcut is not selected



When shortcut is selected



- Absolute unit (No.83 ETYP)

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

	Setting
Not used	0
Used	1

- Current-limiting value at standstill after missing work part in push & hold operation (No. 91 PSFC)

This parameter defines the current-limiting value when the actuator is at standstill after missing the work part in push & hold operation.

Parameter No. 91	Description
0	Current-limiting value at standstill (An appropriate value has been set according to the characteristics of the applicable actuator.)
1	Current-limiting value during push & hold operation

8.2.3 Parameters Relating to the External Interface

- PIO pattern selection (No.25 IOPN)

Select the PIO operation pattern in parameter No. 25.
This setting forms the basis of operation, so be sure to set this parameter at the beginning.
The factory setting is “0 [Standard type].”

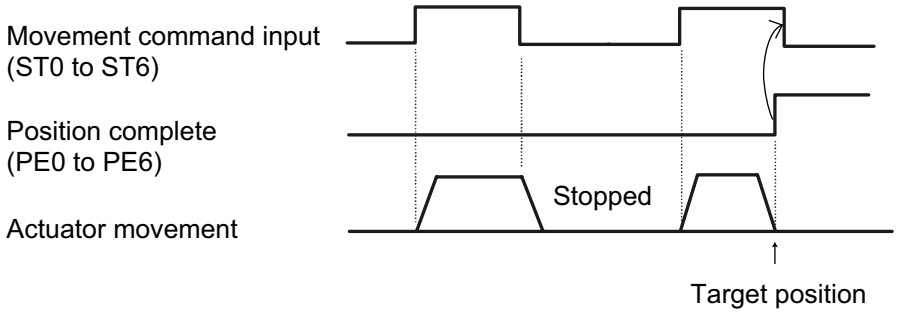
Parameter No. 25 setting	Feature of PIO pattern
0	Standard type A basic type supporting 64 positioning points and two zone outputs. * How to set zone boundaries within which to output a zone signal: Zone boundaries are set using parameter Nos. 1 and 2 for one zone output, and in the position table for another zone output.
1	Teaching type In this type, 64 positioning points and one zone output (boundaries are set in the position table) are supported. In addition to the normal positioning mode, the user can also select the teaching mode in which the actuator can be jogged via commands from a PLC and the current actuator position can be written to a specified position. (Note 1) Jog commands from a PLC are also accepted in the positioning mode. (Note 2) Positions can be rewritten by approximately 100,000 times.
2	256-point positioning type The number of positioning points is increased to 256, so only one zone output is available (boundaries are set in the position table).
3	512-point positioning type The number of positioning points is increased to 512, so no zone output is available.
4	7-point type The number of positioning points is limited to seven to offer separate direct command inputs and movement complete outputs for respective positions. PLC ladder sequence circuits can be designed easily.
5	3-point type Use of the controller as an air cylinder is assumed in this type. Movement complete output signals function differently in this type, compared to the 7-point type. Specifically, the signal functions not only to “indicate movement complete,” but also to “detect a position” in the same manner as auto-switches of an air cylinder. Push & hold operation cannot be performed.

- Movement command type (No.27 FPIO)

When the PIO pattern is set to “7-point type,” define the operation condition of the movement command input (ST0 to ST6) in parameter No. 27.
The factory setting is “0 [Level mode].”

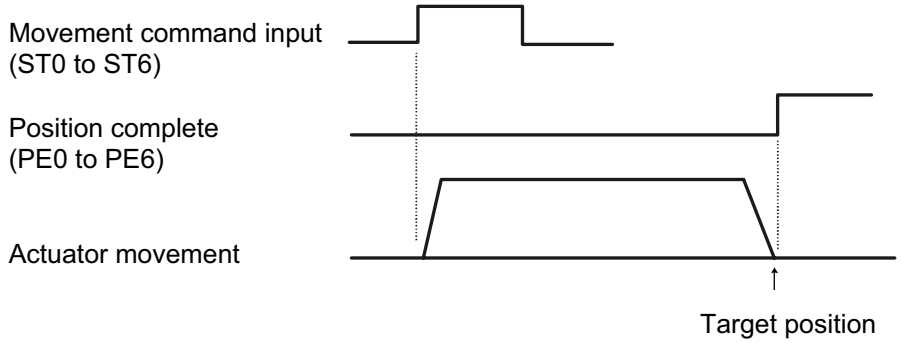
Description of the movement command input	Setting
Level mode: The actuator starts moving when the input signal turns ON. When the signal turns OFF during the movement, the actuator will decelerate to a stop and complete its operation.	0
Edge mode: The actuator starts moving when the rise edge of the input signal is detected. The actuator will not stop even when the signal turns OFF during the movement, until the target position is reached.	1

[Level mode]



(Note) Turn OFF the movement command input after confirming that the target position has been reached.

[Edge mode]



- Pause input disable selection (No.15 FPIO)

Parameter No. 15 defines whether the pause input signal is disabled or enabled.

	Setting
Enable (use)	0
Disable (do not use) the signal	1

The factory setting is “0 [Enable].”

- Servo ON input disable selection (No.21 FPIO)

Parameter No. 21 defines whether the servo ON input signal is disabled or enabled.

	Setting
Enable (use)	0
Disable (do not use)	1

The factory setting is “0 [Enable].”

- Home-return input disable selection (No.40 FPIO)

Parameter No. 40 defines whether the home-return input signal is disabled or enabled.

	Setting
Enable (use)	0
Disable (do not use)	1

The factory setting is “0 [Enable].”

- Operating-mode input disable selection (No.41 FPIO)

Parameter No. 41 defines whether the operating-mode input signal is disabled or enabled.

	Setting
Enable (use)	0
Disable (do not use)	1

The factory setting is “0 [Enable].”

- Output mode of position complete signal (No.39 FPIO)

This parameter is effective when any PIO pattern other than “5” [3-point type] is selected.
It defines the status of completed position number signals [PM1 to PM256], movement complete signals at respective positions [PE0 to PE6] and position complete signal [PEND] to be applied if the servo turns off or “position deviation” occurs while the actuator is standing still after completing positioning.

The following two conditions can be considered:
[1] The position has deviated, due to external force and while the servo was on, beyond the value set in the “Positioning band” field of the position table.
[2] The position has deviated, due to external force and while the servo was off, beyond the value set in the “Positioning band” field of the position table.

This parameter is provided to permit flexible specification of how the “position complete status” is monitored in accordance with the characteristics of the system or sequence circuit on the PLC side.
The ON/OFF status of each position complete signal is controlled as follows in accordance with the setting of parameter No. 39.

Setting of parameter No. 39	Definition of completed position number signals [PM1 to PM256], movement complete signals at respective positions [PE0 to PE6] and position complete signal [PEND]
0 [PEND]	[1] The servo is on The signal remains ON even after the current position has exited the range set by the “Positioning band” field of the position table, with respect to the target position. [2] The servo is off The signal is OFF unconditionally regardless of the current position.
1 [INP]	Regardless of the servo on/off status, the signal turns ON if the current position is within the range set by the “Positioning band” field of the position table, with respect to the target position, and turns OFF if the current position is outside this range. * In this mode, the applicable signals are used as limit switches.

The factory setting is “0 [PEND].”

- SIO communication speed (No.16 BRSL)

Set the communication speed to be used when the control is performed via serial communication using the PLC’s communication module.
Set an appropriate value in parameter No. 16 in accordance with the specification of the communication module.
One of 9600, 19200, 38400 and 115200 bps can be selected as the communication speed.
The factory setting is “38400 [bps].”

- Minimum delay time for slave transmitter activation (No.17 RTIM)

This parameter defines the minimum delay until the controller’s transmitter will be activated after completion of command reception, when serial communication is performed using the PLC’s communication module.
The factory setting is “5 [msec],” but other necessary delay time must be set in parameter No. 17 if the specification of the communication module exceeds 5 msec.

- Silent interval multiplier (No.45 SIVM)

This parameter is not used for this controller. It is applied to controllers of RS485 serial communication type.
If specified, this parameter defines the multiplier to be applied to the silent interval time for delimiter judgment in the RTU mode.
The default setting is the communication time corresponding to 3.5 characters in accordance with the Modbus specification.
This setting need not be changed for normal operations performed with a PC or teaching pendant.
If the scan time of the PLC is not optimal and the character transmission interval exceeds the silent interval, the silent interval time can be extended using parameter No. 45.
The minimum setting unit is “1 [time],” while the input range is “0 to 10.” If “0” is set, no multiplier is applied.

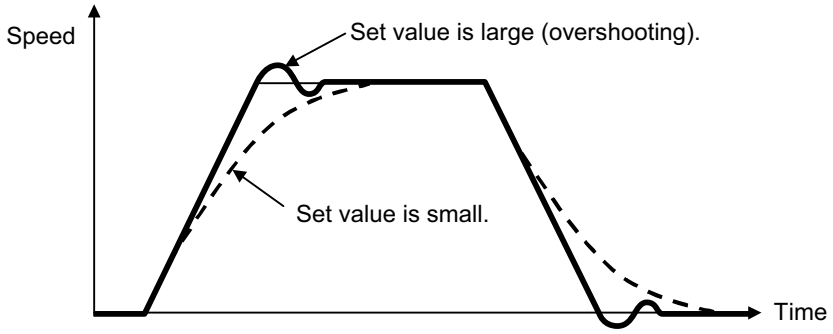
8.2.4 Servo Gain Adjustment

Before the shipment, the servo has been adjusted in accordance with the standard specification of the actuator. Accordingly, the servo settings need not be changed in normal conditions.
Nonetheless, the parameters relating to servo adjustment are made accessible by the customer so that speedy actions can be taken in situations where vibration or noise occurs due to the affixing method of the actuator, load condition, or the like.
In particular, custom types (having a longer ball screw lead or stroke than standard types) are more vulnerable to vibration and noise due to external conditions.
In these circumstances, the following parameters must be changed. Contact IAI for details.

- Servo gain number (No.7 PLG0)

Parameter No.	Unit	Input range	Default
7	5 rad/sec	0 ~ 31	6

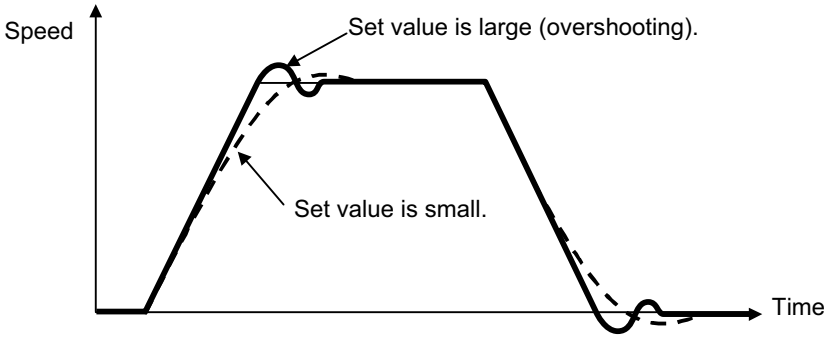
This parameter determines the response when a position control loop is used.
Increasing the set value improves the tracking performance with respect to the position command.
However, increasing the parameter value excessively increases the chances of overshooting.
If the set value is small, the tracking performance with respect to the position command drops and positioning takes a longer time.



- Speed loop proportional gain (No.31 VLPG)

Parameter No.	Unit	Input range	Default
31	---	1 ~ 27661	Set individually in accordance with the actuator characteristics.

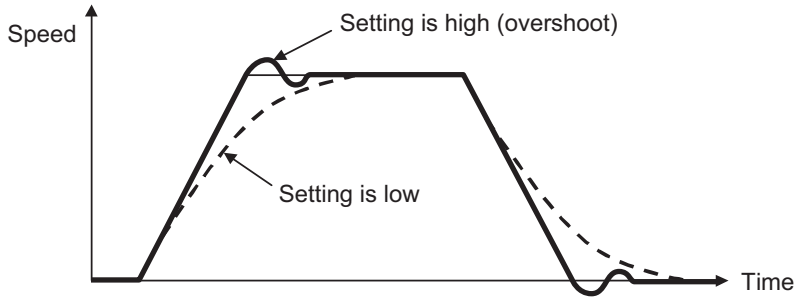
This parameter determines the response when a speed control loop is used.
Increasing the set value improves the tracking performance with respect to the speed command (i.e., servo rigidity increases).
The greater the load inertia, the larger this parameter value should be.
However, increasing the parameter value excessively makes the actuator more vulnerable to overshooting or shaking, leading to mechanical vibration.



- Speed loop integral gain (No.32 VLPT)

Parameter No.	Unit	Input range	Default
32	---	1 ~ 217270	Set individually in accordance with the actuator characteristics.

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



- Torque filter time constant (No.33 TRQF)

Parameter No.	Unit	Input range	Default
33	---	1 ~ 2500	Set individually in accordance with the actuator characteristics.

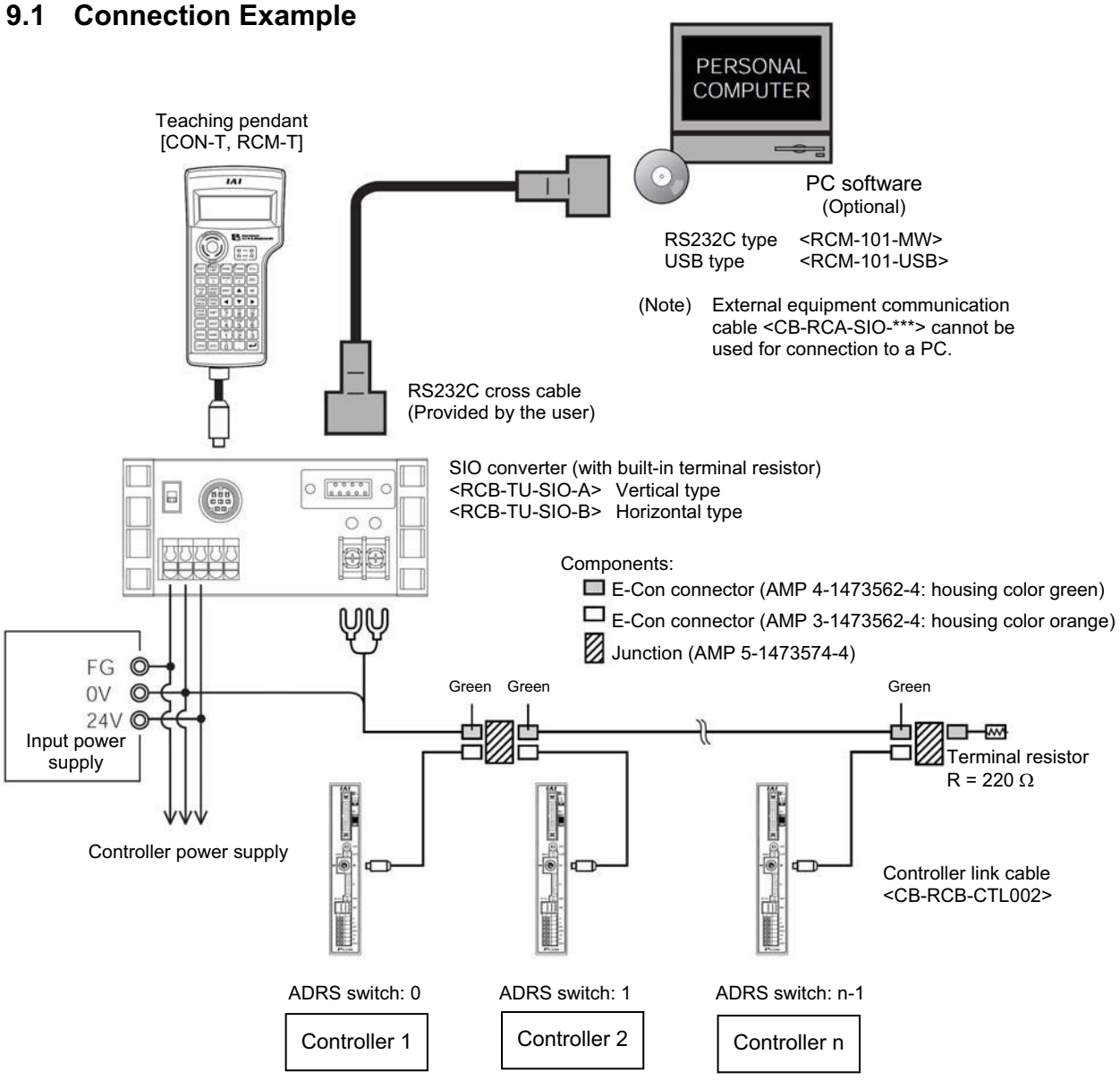
This parameter determines the filter time constant for torque commands.
If the resonance frequency of the machine is smaller than the response frequency of the servo loop, the motor vibrates.
This mechanical resonance can be suppressed by increasing the value set in this parameter.
However, increasing the parameter value excessively may reduce the stability of control.

9. PC/Teaching Pendant Connection Method in Multi-axis Configurations

This section explains the method to permanently connect a PC/teaching pendant in configurations consisting of multiple axes, so that the PC/teaching pendant connector need not be removed/inserted each time.
The connector is connected to a SIO converter, and the SIO converter sends/receives data to/from each controller via RS485 serial communication.
The basic specifications are as follow:

[1] Maximum number of connected axes: 16
[2] Maximum length of serial communication cable: 100 m or less
[3] Terminal resistor: 220 Ω (Be sure to install a terminal resistor for the last axis to prevent the effect of radiating noise.)

9.1 Connection Example

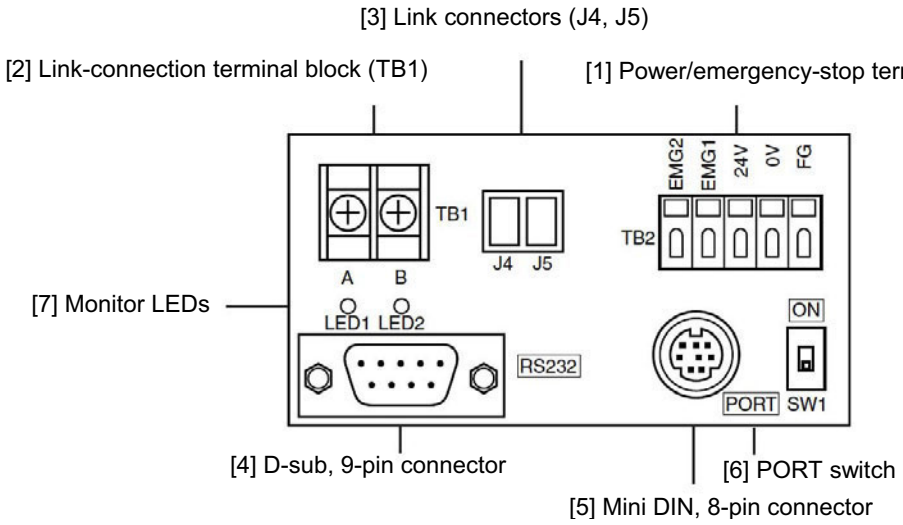


Caution: Do not connect the teaching pendant and PC at the same time.
If both are connected at the same time, a communication error (message level) will occur.

9.2 SIO Converter (Optional)

This unit is a RS232C-RS485 converter.
When multiple controllers are linked, you can connect a teaching pendant to the mini DIN 8-pin connector to move all axes together or edit the parameters of all axes at once.

- Explanation of function



[1] Power/emergency-stop terminal block (TB2)

EMG1, EMG2	Provide a contact output for the emergency-stop switch on the teaching pendant (RCM-T/E). EMG1 and EMG2 connect to the emergency-stop switch on the teaching pendant when the PORT switch is ON, or are shorted when the PORT switch is OFF. These terminals comprise an interlock with a safety circuit provided by the user.
24V	Positive side of the 24-V power supply (power supply for the teaching pendant and conversion circuit Current consumption: 0.1 A max.)
0V	Negative side of the 24-V power supply
FG	FG of the 24-V power supply

[2] Link-connection terminal block (TB1)
A connection port for linking the controller.
"A" on the left side connects to SGA (wire color: orange/red 1) on the extension cable.
"B" on the right connects to SGB (wire color: orange/black 1) on the extension cable.
(Note) Be sure to use twisted pair wires for the above two connections (SGA/SGB).

[3] Link connectors (J4, J5)
e-con connector ports for linking controllers. You can connect an optional link cable (CB-RCB-CTL002) directly to each connector. Take note that J4 and J5 are provided for connection of two axes only. If you want to connect three or more axes, use the terminal block indicated by [2].

[4] D-sub, 9-pin connector (RS232C)
A connection port with a PLC's communication module. It can also be connected to a PC. For the communication cable, use the RS232C cross cable specified below.

[5] Mini DIN, 8-pin connector (RS485)
A connection port with a teaching pendant or PC. For the communication cable, use the cable (equipped with a RS232C/RS485 converter) that comes with the PC software (RCM-101-MW).

[6] PORT switch
A switch for enabling/disabling the mini DIN connector.
Set the switch to the ON position if a device is connected to the mini DIN connector, or to the OFF position if no device is connected.

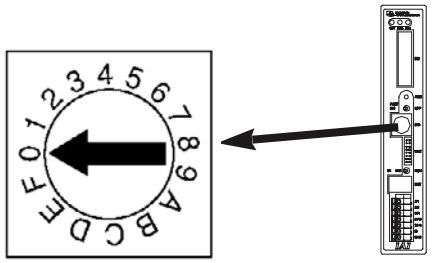
[7] Monitor LEDs
LED1 --- Lit when the controller is transmitting
LED2 --- Lit when the RS232 is transmitting

9.3 Address Switch

Set an address (0 to 15) as a hexadecimal (0 to F) using the ADRS switch on the front panel of each controller to define the slave number for the controller.
Assign “0” to the controller nearest the host, and then assign 1, 2, 3, …, E and F to the remaining controllers in the direction of moving away from the host.
After all addresses have been set, reconnect the power.

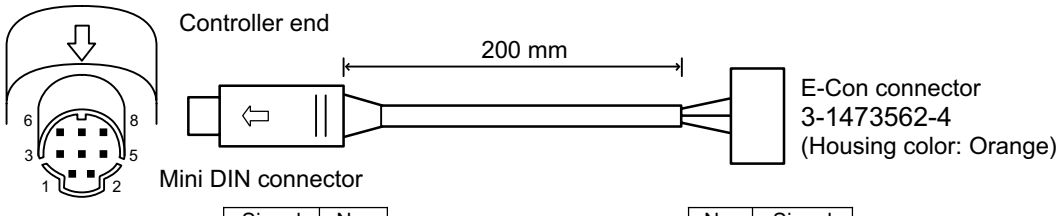
Caution: After the setting, be sure to confirm that the addresses are not duplicated.

Adjust the arrow to a desired position using a flathead screwdriver.



9.4 Connection Cables

- Controller link cable
  Model number: CB-RCB-CTL002

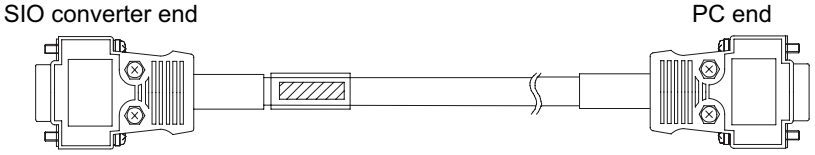


Signal	No.
SGA	1
SGB	2
+5V	3
EMB	4
EMGA	5
+24V	6
GND	7
EMGB	8

Yellow
Orange
Blue

No.	Signal
1	SGA
2	SGB
3	GND
4	

(Reference) Connection diagram for RS232C cross cable



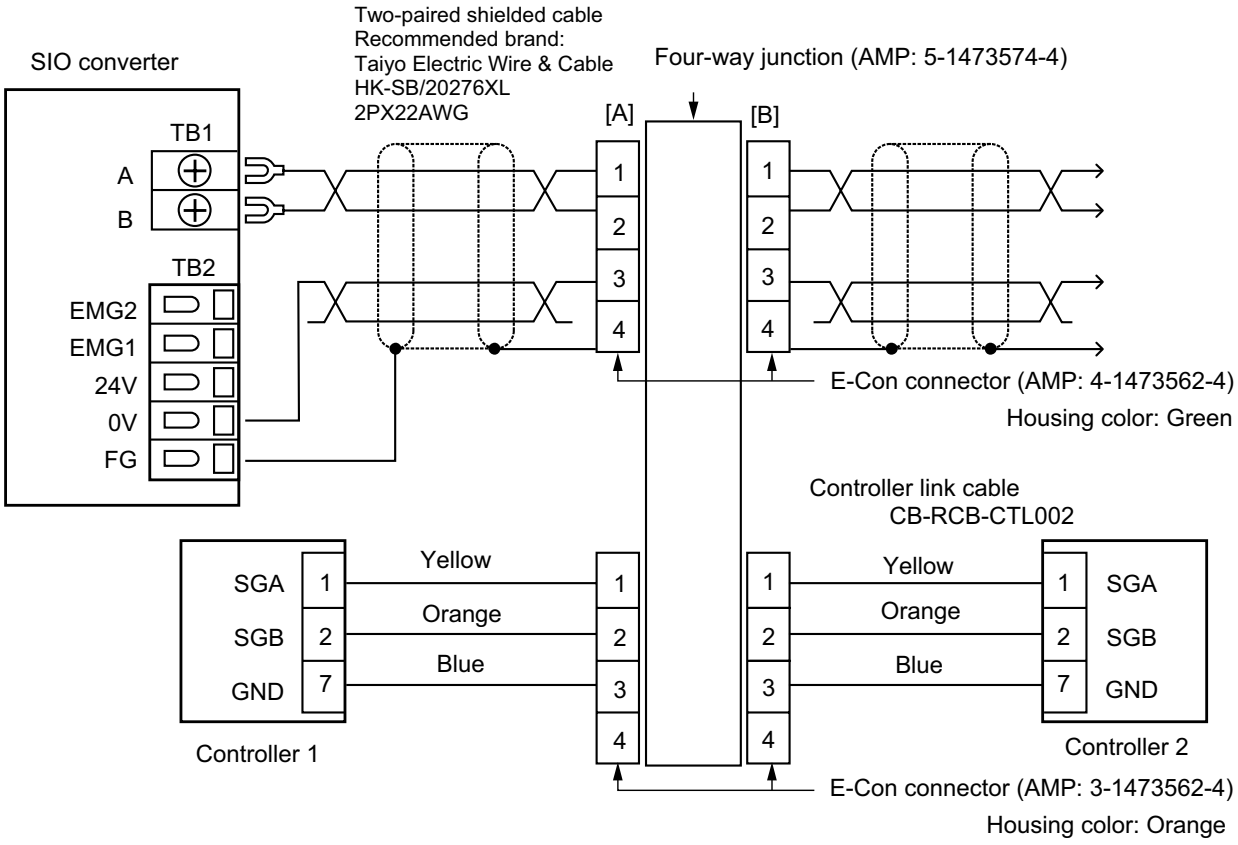
D-sub, 9-pin female connector

Signal	No.
	1
RD	2
SD	3
DTR	4
SG	5
DSR	6
RS	7
CS	8
	9

No.	Signal
1	
2	RD
3	SD
4	DTR
5	SG
6	DSR
7	RS
8	CS
9	

D-sub, 9-pin
(Female connector for PC,
Male connector for PLC)

9.5 Detail Connection Diagram



(Note) The user must provide the two-paired shielded cable.
If cables other than the recommended brands are connected to [A] and [B], use those with a cable-sheath outer diameter of 1.35 to 1.60 mm.

Accessories (Optional):
[1] Controller link cable CB-RCB-CTL002 (connector on both ends), length 200 mm
[2] Four-way junction, made by AMP: 5-1473574-4
[3] E-Con connector, made by AMP: 4-1473562-4 (green)
[4] Terminal resistor 220 Ω (with E-Con connector)
Of the above, [2], [3] and [4] are provided for the same number as the controller link cables. Therefore, not all units are needed when multiple axes are used.

10. Troubleshooting

10.1 Action to Be Taken upon Occurrence of Problem

Upon occurrence of a problem, take an appropriate action according to the procedure below in order to ensure speedy recovery and prevent recurrence of the problem.

a. Check the status indicator lamps.
   SV (green) --- The servo is ON.
   ALM (red) --- An alarm is present, or an emergency stop has been actuated or the motor drive power is cut off.
b. Check for error in the host controller.
c. Check the voltage of the main 24-VDC power supply.
d. Check the voltage of the 24-VDC power supply for I/O signals.
e. Check for alarm.
   Confirm the details of error on the PC or teaching pendant.
f. Check the cables for connection error, disconnection or pinching.
   Before performing a continuity check, turn off the power (to prevent a runaway actuator) and disconnect the cables (to prevent accidental power connection due to a sneak current path).
g. Check the I/O signals.
h. Check the noise elimination measures (grounding, installation of surge killer, etc.).
i. Review the events leading to the occurrence of problem, as well as the operating condition at the time of occurrence.
j. Check the serial numbers of the controller and actuator.
k. Analyze the cause.
l. Take action.

Please check items a through j before contacting IAI.

(Reference) Changes in status indicator lamps and *ALM output signal in respective conditions

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

(Note 2) The *ALM output signal is a contact-b signal.
After the power is turned on, this signal remains ON while the controller is normal. It remains OFF while the power is cut off.
It cannot be used as a contact-b interlock when the power is cut off.

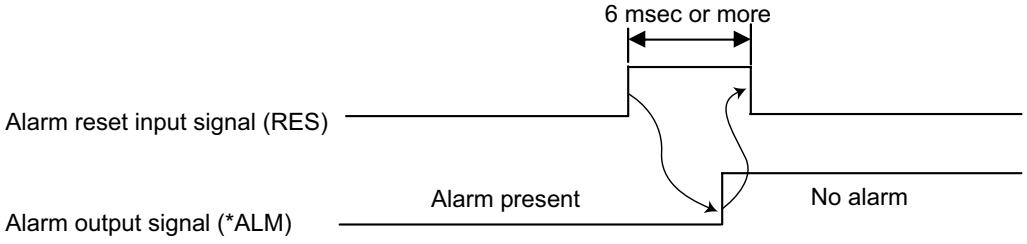
10.2 Alarm Level Classification

Alarms are classified into two levels based on the corresponding symptoms.

Alarm level	ALM lamp	*ALM signal	What happens when alarm generates	How to reset
Operation cancellation	Lit	Output	The actuator decelerates to a stop and then the servo turns OFF.	Input an alarm reset signal (RES) from the PLC. Reset by the PC/teaching pendant.
Cold start	Lit	Output	The actuator decelerates to a stop and then the servo turns OFF.	Reconnect the power.

(Note) The *ALM output signal is a contact-b signal.
After the power is turned on, this signal will remain ON while the controller is normal, and turn OFF if an alarm occurs.
Although the *ALM signal will turn OFF when the power is cut off, it cannot be used as a contact-b interlock.

■ How to reset operation-cancellation level alarms
Input an alarm reset signal (RES) continuously for 6 msec or more.
This resets the *ALM signal to ON, so turn OFF the RES signal after confirming that the *ALM signal is ON.



⚠ Caution: Reset each alarm after identifying and removing the cause of the alarm. If the cause of the alarm cannot be removed or the alarm still persists after the cause has been removed, contact IAI.
If the same error occurs again after resetting the alarm, it means that the cause of the alarm still remains.

10.3 Alarm Description Output Using PIO

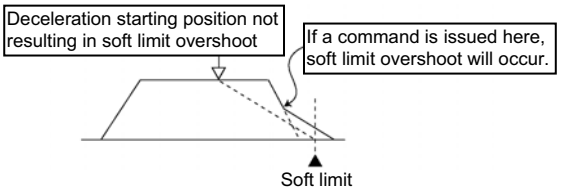
In PIO patterns 0 to 3 (64 to 512-point positioning type), alarm information can be output using the ports for completed position output signals (four bits of PM1 to PM8) so that when an alarm occurs, the nature of the alarm can be identified on the PLC side.
Program the PLC so that whether a given output is a completed position number or alarm can be identified based on the status of the alarm output signal (*ALM).
Bit assignment table for alarm description (●= OFF, ○ = ON)

∗ALM	PM8	PM4	PM2	PM1	Description: Code number in ( )
○	x	x	x	x	Normal
●	●	●	○	●	Software reset command when servo ON (090) Position number error during teaching (091) PWRT signal detected during movement (092) PWRT signal detected before completion of home return (093)
●	●	●	○	○	Movement command when servo OFF (080) Position movement command before home return completion (082) Absolute position movement command before home return completion (083) Movement command during home return (084) Position number error during movement (085) Deceleration command error (0A7)
●	●	○	●	●	Unmatched PCB (0F4)
●	●	○	○	●	Parameter data error (0A1) Position data error (0A2) Position command information data error (0A3) Unsupported motor/encoder type (0A8)
●	●	○	○	○	Excitation detection error (0B8) Home sensor not detected (0BA) Home return timeout (0BE)
●	○	●	●	●	Excessive actual speed (0C0)
●	○	●	●	○	Motor power-supply overvoltage (0C9) Overheating (0CA) Control power-supply overvoltage (0CC) Control power-supply voltage low (0CE)
●	○	●	○	○	Deviation overflow (0D8) Software stroke limit overtravel error (0D9) Out of push & hold operation range error (0DC)
●	○	○	●	●	Servo error (0C1)
●	○	○	●	○	Relating to encoder disconnection Encoder receive error (0E5) Phase-A/B disconnection detection (0E8) Phase-A disconnection detection (0E9) Phase-B disconnection detection (0EA) Absolute encoder error detected 1 (0ED) Absolute encoder error detected 2 (0EE) Absolute encoder error detected 3 (0EF)
●	○	○	○	●	CPU error (0FA) FPGA error (0FB) Logic error (0FC)
●	○	○	○	○	Nonvolatile memory write verification error (0F5) Nonvolatile memory write timeout (0F6) Damaged nonvolatile memory (0F8)

10.4 Alarm Description and Cause/Action

(1) Message level alarms

Code	Error name	Cause/Action
080	Movement command when servo OFF	Cause: A movement command was input as a numerical command when the servo was OFF. Action: Input a SON signal to turn the servo ON (the SV signal or PEND signal should turn ON). If this error occurred when parameter No. 21 was set to “Disable,” contact IAI.
082	Position movement command before home return completion	Cause: A position movement command was input when home return was not yet completed. Action: Input a HOME signal to perform home return, confirm that the home return has completed (the HEND signal should be ON), and then input the position movement command.
083	Absolute position movement command before home return completion	Cause: An absolute position movement command was input when home return was not yet completed. (This action will not generate an error in the position number specification mode.) Action: Input a HOME signal to perform home return, confirm that the home return has completed (the HEND signal should be ON), and then input the position movement command.
084	Movement command during home return	Cause: A movement command was input as a numerical command when home return was in progress. Action: Input the movement command after confirming that the home return has completed (the HEND signal should be ON).
085	Position number error during movement	Cause: No value is entered under the specified position number. Action: Enter valid data in the position table.
090	Software reset command when servo ON	Cause: A software reset command was input when the servo was ON. Action: Perform the software reset when the servo is OFF (the SV signal is OFF).
091	Position number error during teaching	Cause: The specified position number is not inside the specifiable range when writing the current position in the teaching mode. Action: Specify a position number inside the specifiable range.
092	PWRT signal detected during movement	Cause: The current-position write signal (PWRT) was input in the teaching mode while the actuator was jogging. Action: Input the PWRT signal after confirming that the jog button is not pressed and the actuator is stopped (MOVE output signal is OFF).
093	PWRT signal detected before completion of home return	Cause: The current-position write signal (PWRT) was input in the teaching mode when home return was not yet completed. Action: Input the HOME signal first to perform home return, and then input the PWRT signal after confirming that home return has completed (HEND output signal is ON).
0A2	Position data error	Cause: [1] A move command was input when no target position was set in the “Position” field. [2] The target position in the “Position” field exceeds a soft limit setting. [3] An incremental target position was specified in the “Position” field in the 3-point type. Action: [1] Set a target position first. [2] Change the target position to a value inside the soft limit setting. [3] Specify an absolute target position.

Code	Error name	Cause/Action
0A3	Position command information data error	Cause: The speed or acceleration/deceleration effective when the numerical command was issued exceeded the maximum settable value. Action: Change the speed or acceleration/deceleration to an appropriate value.
0A7	Deceleration command error	If a position command is issued while the actuator is moving where the target position corresponding to the position number is located near a soft limit and the deceleration is also set low, the actuator may move past the soft limit.  Cause: When the speed was changed during movement, the next move command was not issued quick enough. Action: Quicken the speed change timing so that the actuator will not overshoot the soft limit.
0BA	Home sensor not detected	This error indicates that the actuator equipped with the home check sensor has not yet successfully completed the home return operation. Cause: [1] The work part contacted any surrounding equipment or structure during home return. [2] The slide resistance of the actuator is high in some location. [3] The home check sensor is not properly installed, faulty or open. Action: If the work part is not contacting any surrounding equipment or structure, [2] or [3] is suspected. Please contact IAI.
0BE	Home return timeout	Cause: Home return does not complete after elapse of the time set by the applicable manufacturer's parameter following the start of home return operation. (This error does not occur in normal operations.) Action: The controller and actuator combination is wrong, among others. Please contact IAI.
0C0	Excessive actual speed	Cause: The motor speed exceeded the maximum level set by the applicable manufacturer's parameter. Although this error does not occur in normal operations, it may occur if the load decreased before a servo error was detected and the actuator moved quickly as a result, which can be caused by various reasons including the following: [1] The slide resistance of the actuator is high in some location. [2] The load increased due to momentary application of external force. Action: Check the assembly condition of mechanical parts for any abnormality. If the actuator itself is suspected as the cause, please contact IAI.

Code	Error name	Cause/Action
0C1	Servo error	This error indicates that the motor could not be operated for 2 seconds or more after the move command was accepted and before the target position was reached. Cause: [1] The motor extension cable connector is loose or open. [2] If the actuator is equipped with a brake, the brake cannot be released. [3] The load increased due to application of external force. [4] The slide resistance of the actuator itself is high. [5] The positioning band setting is smaller than the encoder resolution. Action: [1] Check the wiring condition of the motor extension cable. [2] Check the wiring condition of the brake cable. Also, turn on/off the brake release switch and check if the brake makes “click” sounds. [3] Check the assembly condition of mechanical parts for any abnormality. [4] If the payload is normal, turn off the power and move the actuator by hand to check the slide resistance. If the actuator itself is suspected as the cause, please contact IAI. [5] Set the positioning band value greater than that of the encoder resolution.
0C9	Motor power-supply overvoltage	This error indicates that the motor power-supply voltage is excessively high (24 V + 20%: 28.8 V or above). Cause: [1] The 24-V input power-supply voltage is high. [2] A faulty part inside the controller. Action: Check the input power-supply voltage. If the voltage is normal, please contact IAI.
0CA	Overheating	This error indicates that the temperature around the power transistor in the controller is excessively high (95°C or above). Cause: [1] The surrounding air temperature is high. [2] A faulty part inside the controller. Action: [1] Lower the surrounding air temperature. If [1] does not apply, please contact IAI.
0CC	Control power-supply overvoltage	This error indicates that the 24-V input power-supply voltage is excessively high (24 V + 20%: 28.8 V or above). Cause: [1] The 24-V input power-supply voltage is high. [2] A faulty part inside the controller. Action: Check the input power-supply voltage. If the voltage is normal, please contact IAI.
0CE	Control power-supply voltage low	This error indicates that the 24-V input power-supply voltage is low (24 V - 20%: 19.2 V or below). Cause: [1] The 24-V input power-supply voltage is low. [2] A faulty part inside the controller. Action: Check the input power-supply voltage. If the voltage is normal, please contact IAI.
0D8	Deviation overflow	The position deviation counter has overflowed. Cause: [1] The speed dropped during movement due to the effect of an external force, etc. [2] The pole sense detection operation after power on is unstable. Action: [1] Check the load conditions—such as whether the work part is contacting a surrounding object or the brake is disengaged—and then correct the abnormality, if any [2] An overload condition is suspected, so review the load weight.

Code	Error name	Cause/Action
0D9	Software stroke limit overtravel error	Cause: [1] The actuator installed vertically overshot and exceeded a software stroke limit due to a large load or high deceleration setting when the target position was set to a point near the software stroke limit. [2] The actuator was moved to outside the software stroke limits with the servo turned off, and then the servo was turned on. Action: [1] Set the deceleration curve properly so that the actuator will not overshoot when stopping. [2] Return the actuator to inside the software stroke limits, and then turn on the servo.
0DC	Out of push & hold operation range error	This error occurs when the actuator was pushed back to the target position due to an excessive push force after completion of push & hold operation. Review the entire system.
0ED	Absolute encoder error (1)	Cause: [1] When the power was reconnected after completion of an absolute reset, the current position changed due to an external factor or for other reason while the absolute unit was communicating with the controller. [2] When an absolute reset was performed, the current position changed due to an external factor or for other reason while the simple absolute unit was communicating with the controller. Action: [1] When the detail code is H'0001 Turn off the power, make sure the actuator is not receiving vibration, etc., and then turn the power back on. [2] When the detail code is H'0002 Make sure the actuator is not receiving vibration, etc., and then perform a home return operation again.
0EE	Absolute encoder error (2)	Cause: [1] The power was turned on for the first time after connecting the battery to the simple absolute unit. [2] When the detail code is H'0001 The battery voltage dropped to a level at which the encoder counter in the simple absolute unit could no longer retain the count. [3] When the detail code is H'0002 The encoder connector was unplugged during a power outage, or the encoder cable was disconnected. [4] When the detail code is H'0003 A parameter was changed. Action: If [1], [2] or [4] is suspected as the cause, perform an absolute reset by referring to the operation manual for the simple absolute unit (5.2, "Absolute Reset Method"). [2] Supply power for at least 48 hours to charge the battery fully, and then perform an absolute reset.

Code	Error name	Cause/Action
0EF	Absolute encoder error (3)	Cause: The current value changed at a speed equal to or greater than the specified rotational speed due to an external factor or for other reason while the power was cut off. Action: Change the speed setting in the simple absolute unit and also implement measures to prevent the actuator from moving at a speed equal to or above the specified setting while the power is cut off. If the battery backup time is more than sufficient, try setting a higher motor speed. See also: 5.1.1, “Piano Switch Settings” in the operation manual for the simple absolute unit. If this error occurred, perform an absolute reset by following the specified procedure (5.2, “Absolute Reset Method”).
0F5	Nonvolatile memory write verification error	When data has been written to the nonvolatile memory, the written data is read again to check (verify) if it matches the original data. This error indicates that the two data do not match. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm generates again after reconnecting the power, please contact IAI.
0F6	Nonvolatile memory write timeout	This error indicates that response is not received within the specified time after data was written to the nonvolatile memory. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm generates again after reconnecting the power, please contact IAI.

(2) Cold-start level alarms

Code	Error name	Cause/Action
0A1	Parameter data error	Cause: The input range of parameter range data is not appropriate. (Example) This error occurs when the magnitude relationship of a pair of range parameters is inappropriate, such as when the value of soft limit- is mistakenly set to 300 mm when the value of soft limit+ is 200.3 mm. Action: Change the parameters to appropriate values.
0A8	Unsupported motor/encoder type	Cause: The motor type or encoder type set in the parameter is not supported. Action: If the error persist after reconnecting the power, contact IAI.
0B8	Pole sense error	This controller performs excited-phase detection when the servo is turned on for the first time after the power on. This error indicates that the specified encoder signal level could not be detected after excitation for the time set by parameter No. 29 (Excited-phase signal detection time). Cause: [1] Loose or disconnected motor-extension cable connector [2] Brake cannot be released on a controller equipped with brake. [3] Large motor load due to application of external force [4] Power was input when the actuator was contacting a mechanical end. [5] Large slide resistance of the actuator itself Action: [1] Check the wiring condition of the motor extension cable. [2] Check the wiring condition of the brake cable, and also turn on/off the brake release switch to see if the brake makes “click” sounds. [3] Check for abnormality in the assembly condition of mechanical parts. [4] Move the actuator away from the mechanical end and then reconnect the power. [5] If the load weight is normal, cut off the power and move the actuator by hand to check the slide resistance. If the actuator is suspected to be the cause, please contact IAI.
0E5	Encoder reception error	Cause: [1] The controller was powered up before the simple absolute unit when the 24-V power supply was turned on. [2] When the detail code is H’ 0001 The controller cannot communicate with the simple absolute unit properly due to noise, etc. [3] When the detail code is H’ 0002 The controller cannot communicate with the simple absolute unit properly due to encoder cable disconnection, etc. Action: [1] Make sure the simple absolute unit is powered up before the controller (or at least the two are powered up simultaneously). [2] Change the installation location of the controller. Provide noise elimination measures such as setting a frame ground, noise filter or clamp filter. [3] Check the encoder extension cable connecting the controller and simple absolute unit to see if the connectors are loose. Or, replace the cable.

Code	Error name	Cause/Action
0E8	Phase-A/B disconnection detection	Encoder signals cannot be detected correctly. Cause: [1] Loose or disconnected encoder-extension cable connector [2] Piano switch 4 on the simple absolute unit is not set correctly. [3] If a RA10C actuator is used together with an actuator or actuators of other type, the encoder cables may not be connected in the correct combination. Action: [1] Check for loose or disconnected connector. [2] Check if the settings conform to 5.1.1, “Piano Switch Settings” in the operation manual for the simple absolute unit. [3] Check the model number of the encoder cable. (Encoder cable connecting the simple absolute unit and actuator) Note) This action is applicable only to RCP2 series controllers. Cable for RA10C type: CB-RFA-*Other actuators: CB-RCP2-*
0E9	Phase-A disconnection detection	
0EA	Phase-B disconnection detection	
0F4	Unmatched PCB	This controller uses a different motor drive circuit depending on the motor capacity, and thus adopts a different printed circuit board (PCB) appropriate for each motor capacity. For this reason, whether the motor type set by the applicable manufacturer’s parameter matches the board is checked in the initialization process after startup. This error indicates that the two do not match. Cause: The parameter was not entered correctly or the correct board was not assembled. Action: Should this error occur, please contact IAI.
0F8	Damaged nonvolatile memory	Abnormal data was detected during the nonvolatile memory check after starting. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (The nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm generates again after reconnecting the power, please contact IAI.
0FA	CPU error	The CPU is not operating properly. Cause: [1] Faulty CPU [2] Malfunction due to noise Action: If the alarm generates again after reconnecting the power, please contact IAI.
0FB	FPGA error	Malfunction occurred in the controller. Cause: Faulty internal part of the controller (FPGA) Malfunction due to noise Action: If the alarm generates again after reconnecting the power, please contact IAI.
0FC	Logic error	Malfunction occurred in the controller. Cause: Faulty internal part of the controller Malfunction due to noise Action: If the alarm generates again after reconnecting the power, please contact IAI.

10.5 Messages Displayed during Operation Using the Teaching Pendant

This section explains the warning messages that may be displayed during operation using the teaching pendant.

Code	Message name	Description
112	Invalid data	An inappropriate value was entered in a parameter. (Example) 9601 was entered as the serial communication speed by mistake. Enter an appropriate value again.
113 114	Value too small Value too large	The entered value is smaller than the setting range. The entered value is larger than the setting range. Refer to the actuator specifications or parameter table and enter an appropriate value again.
115	Home return non-completion	The current position was written when home return was not yet completed. Execute home return again.
117	No movement data	Target position is not set under the selected position number. Enter the target position first.
11E	Paired data mismatch	The values indicating the magnitude relationship of a pair of data are inappropriate. (Example) The same value was entered in both the parameters for + and – soft limits. Enter appropriate values again.
11F	Absolute position too small	The minimum movement toward the target position is determined by the lead length of the drive system and resolution of the encoder. This message indicates that the entered target value is smaller than the minimum movement. (Example) If the lead length is 20 mm, the encoder's resolution is 800 pulses and accordingly the minimum movement becomes 20 ÷ 800 = 0.025 mm/pulse. In this case, this message will be displayed if 0.02 mm is entered as the target position.
121	Push & hold search end over	The final position in push & hold operation exceeds the soft limit. This has no negative effect if the actuator contacts the work part. If the actuator misses the work part, however, the soft limit will be reached and thus this message is displayed as a warning. Change either the target position or positioning band.
122	Multiple axes connected at assignment	Address was assigned when multiple axes were connected. Assign each address only when one axis is connected.
133	Address change prohibited	Address numbers are set using the rotary switches on the front panel. They cannot be set using the teaching pendant.

Code	Message name	Description
180 181 182 183	Address change OK Controller initialization OK Home change all clear I/O function changed	These messages are displayed to confirm operation. (They don't indicate an operation error or other abnormality.)
202	Emergency stop	This message indicates that an emergency stop has been actuated.
203	Motor voltage low	This message indicates that the motor drive power is cut off on the CG type. (Note) If the MPI and MPO terminals are closed, the controller may be faulty.
20A	Servo OFF during operation	This message indicates that the servo ON signal (SON) was turned OFF by the PLC while the actuator was moving, and that the servo turned OFF and the movement was disabled as a result.
20C	CSTR-ON during operation	This message indicates that a movement command signal was turned ON by the PLC while the actuator was moving, and that duplicate movement commands occurred as a result.
20D	STP-OFF during operation	This message indicates that the pause signal (*STP) was turned OFF by the PLC while the actuator was moving, and that the movement was disabled as a result.
20E	Soft limit over	This message indicates that a soft limit was reached.
210	HOME-ON during operation	This message indicates that the home return signal (HOME) was turned ON by the PLC while the actuator was moving, and that duplicate movement commands occurred as a result.
211	JOG-ON during operation	This message indicates that the jog signal (JOG) was turned ON by the PLC while the actuator was moving, and that duplicate movement commands occurred as a result.
220	Write prohibited during AUTO	This message indicates that an attempt was made to write position table data or parameter in the AUTO mode.
222	Operation prohibited during AUTO	This message indicates that an attempt was made to move the actuator in the AUTO mode.
301 302 304 305 306 308 30A 30B	Overrun error (M) Framing error (M) SCIR-QUE OV (M) SCIS-QUE OV (M) R-BF OV Response timeout (M) Packet R-QUE OV Packet S-QUE OV	These messages indicate an error in the serial communication with the controller. Cause: [1] Garbage data due to the effect of noise [2] Duplicate slave numbers when multiple controllers are controlled by serial communication Action: [1] Adjust the wiring in a manner eliminating the effect of noise and review the installation of equipment, etc. [2] Change the slave numbers to avoid duplication. If the message is still displayed after taking the above actions, please contact IAI.
307	Memory command refused	This message indicates that the command was refused in the serial communication with the controller.
309	Write address error	This message indicates that an indeterminate WRITE address error occurred in the serial communication with the controller. These conditions do not occur in normal operation. Should they occur, record the entire error list before cutting off the power for use in the cause investigation. Also contact IAI.

Code	Message name	Description
30C	No connected axis	This message indicates that no controller address is recognized. Cause: [1] The controller is not operating properly. [2] Only the supplied communication cable (SGA/SGB) is disconnected. [3] If a SIO converter is used, 24V is supplied to the converter but the link cable is not connected. [4] The ADRS switch settings are duplicated by mistake when multiple controllers are linked. Action: [1] Check if the RDY lamp on the controller is lit. If the lamp is not lit, the controller is faulty. [2] If a spare teaching pendant is available, replace the current pendant with the spare unit, or with a PC, and see if the message disappears. [3] Supply power after connecting the link cable between the converter and controller. [4] Make sure the ADRS switch settings are not duplicated. If the message is still displayed after taking the above actions, please contact IAI.

10.6 Specific Problems

- I/O signals cannot be exchanged with the PLC.

  Cause: [1] The 24-V I/O power supply is connected in reverse.
  [2] If the problem is with an output circuit, a circuit component may have been damaged due to a large load that caused the current flowing into the circuit to exceed the maximum current.
  [3] Contact failure in the connector or relay terminal block on the PLC end.
  [4] Contact failure between the female pins in the flat cable connector and the male pins on the controller due to expanded female pins.

  Action: Check the connection condition of the power supply and connector, as well as the load on the output side.
  If the cause is identified as [1] or [2], the controller must be replaced. If there is a possibility of [4], the flat cable must be replaced. Please contact IAI.

> ⚠ Warning: When performing a continuity check of the flat cable, pay due attention not to expand the female pins in the connector. It may cause contact failure and disable normal operation of the controller.

- The ALM lamp illuminates when the power is input.

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

  [1] Is the emergency-stop switch on the operation panel pressed or any necessary interlock released?
  [2] Is the emergency-stop switch on the teaching pendant pressed?
  [3] Is parameter No. 42 (Enable function) enabled by mistake by connecting a teaching pendant not supporting the enable switch?
  [4] If multiple controllers are connected, is the crossover wiring correct?

- The SV lamp does not illuminate when the servo ON signal is input after the power was input.

  (The servo does not turn ON.)

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

- Home return ends in the middle in a vertical application.
  Cause: [1] The load exceeds the rating.
  [2] The ball screw is receiving torsional stress due to the affixing method of the actuator, tightening of bolts only on one side, etc.
  [3] The slide resistance of the actuator itself is large.
  Action: [1] Increase the value set in parameter No. 13 (Current-limiting value during home return). Increasing the parameter value will increase the home return torque. As a guide, however, remember that the maximum limit is 100% for the RA3C/RGD3C types and 75% for all other types.
  [2] Loosen the fixing bolts and check if the slider moves smoothly. If the slider moves smoothly, review the affixing method and bolt tightening condition.
  [3] If the slide resistance of the actuator itself is large, please contact IAI.

- Noise occurs during downward movements in a vertical application.
  Cause: The load exceeds the rating.
  Action: [1] Decrease the speed.
  [2] Decrease the value set in the parameter No. 7 (Servo gain number). Do not decrease the parameter setting below “3.”

- Vibration occurs when the actuator is stopped.
  Cause: The slider is receiving an external force.
  Action: If the external force cannot be removed, increase the value set in parameter No. 12 (Current-limiting value at standstill during positioning).
  Increasing this value will cause the holding torque at standstill to increase, so do not increase the parameter setting above 70%.

- The actuator overshoots when decelerated to a stop.
  Cause: The load inertia is high due to an inappropriate balance of load and deceleration.
  Action: Decrease the acceleration/deceleration setting.

- The home and target positions sometimes shift.
  Cause: [1] The encoder waveform is disturbed by the effect of noise.
  [2] In the case of a rod-type actuator, the non-rotation precision increased due to application of rotating moment to the rod.
  Action: [1] Check if the grounding is implemented correctly. Also check for any equipment being a potential noise source.
  [2] The actuator may have to be replaced in some cases. Please contact IAI.

- The speed is slow during push & hold operation.
  Cause: The set current-limiting value is low with respect to the loading mass and slide resistance.
  Action: Increase the current-limiting value for push & hold operation.

- The actuator moves only a half of, or twice as much as, the specified movement.
  Cause: [1] The combination of controller and actuator is wrong.
  The lead length of the ball screw varies depending on the actuator type, so a wrong combination will cause the movement and speed to change.
  [2] Factory setting error at IAI
  Action: [1] If multiple actuators of different types must be used, confirm using the identification labels, etc., that the correct actuator is connected to the controller.
  [2] Please contact IAI.

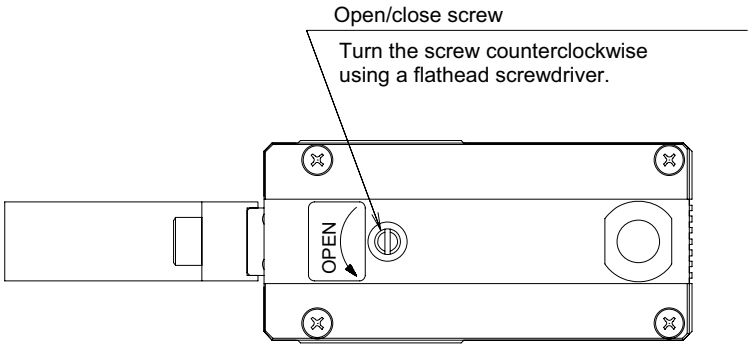
- A servo error occurred while the actuator was moving (ROBO Gripper).

  Cause: The work part was not positioned properly and contacted the finger attachment in the positioning mode.

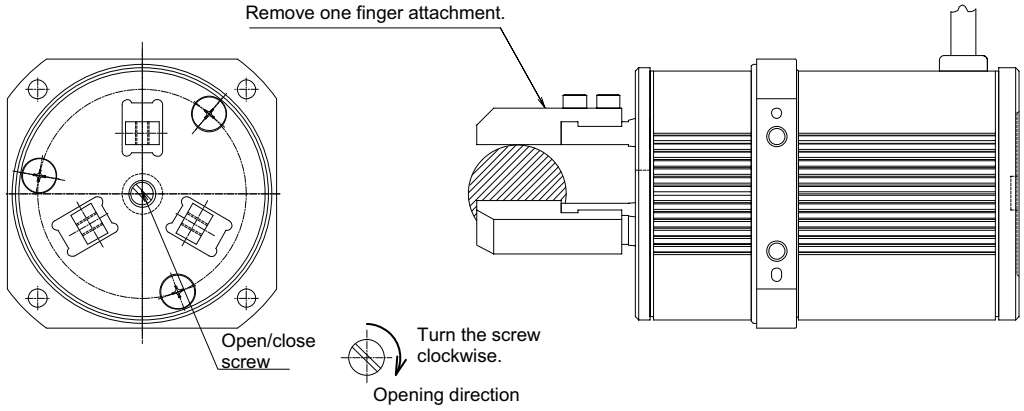
  Action: Adjust the starting position of push action and the thickness of finger attachment (including buffer material) by considering a possible offset of work part position, so that the work part can be clamped properly in the push & hold mode.
  Immediately after recovery from the error, the feed mechanism may still be locked. Be sure to turn the open/close screw to loosen each finger attachment before resetting the alarm.

> ⚠ Caution: If the servo ON signal is disabled or the alarm is reset while the servo ON signal is still ON, the servo will remain ON.
> If the open/close screw is turned in this condition, the screw will return automatically and the lock cannot be released. Therefore, reissuing a movement command will cause the alarm to generate again.

[2-finger type]



[3-finger type]
Remove one finger attachment and take out the work part first, and then turn the open/close screw clockwise.



- Abnormal operation results when the servo is turned ON after the power ON.

  Cause: Excitation phase detection was not performed correctly when the servo was turned ON, because one of the following conditions existed when the power was input:
  [1] The slider or rod was contacting the mechanical end.
  [2] The work part was being pushed by a strong external force.

  Action: [1] Check if the slider or rod is contacting the mechanical end.
  If the slider/rod is contacting the mechanical end, move it away from the mechanical end.
  If the actuator is equipped with a brake, move the slider/rod after turning ON the brake release switch to forcibly release the brake.
  At this time, exercise caution not to allow the load to drop suddenly due to its own weight. Your hand may be caught by the dropped load or the robot hand or work part itself may be damaged.
  If the actuator cannot be moved by hand, one possible solution is to check the direction of excited-phase signal detection and change the direction if necessary. If you wish to use this method, consult IAI beforehand.
  For details, refer to the applicable parameter in 8.2.2, “Parameters Relating to Actuator Operating Characteristics.”
  [2] Check if the load is contacting any surrounding part.
  If the load is contacting any surrounding part, provide a clearance of 1 mm or more from the applicable part.
  If the checks in [1] and [2] did not find any problem, please contact IAI.

- The SV lamp blinks.

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

* Appendix

List of Specifications of Connectable Actuators

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

⚠ Caution

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

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

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

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

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

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

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

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

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

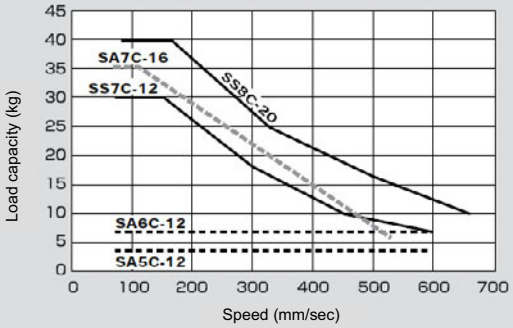
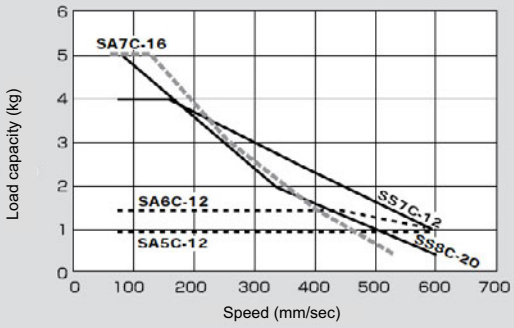
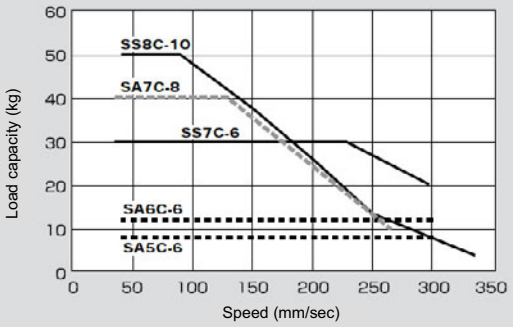
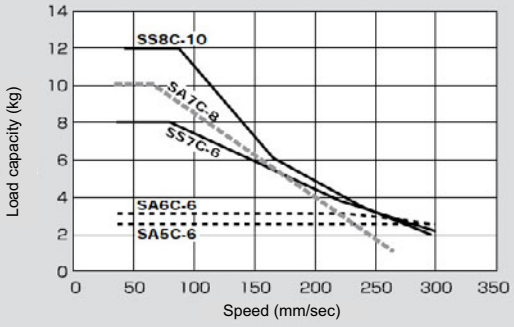
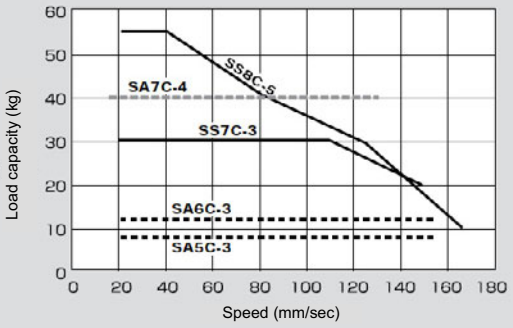
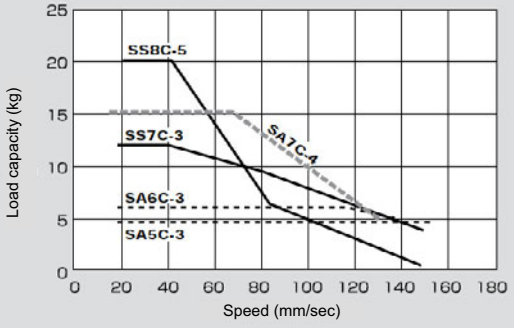
Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (slider type)	SA4C	Ball screw	800	10	Horizontal	12.5	380 (at 50st)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

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

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

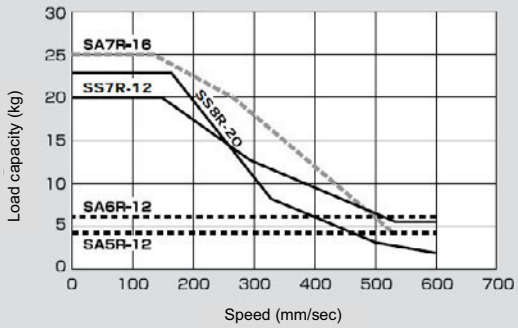
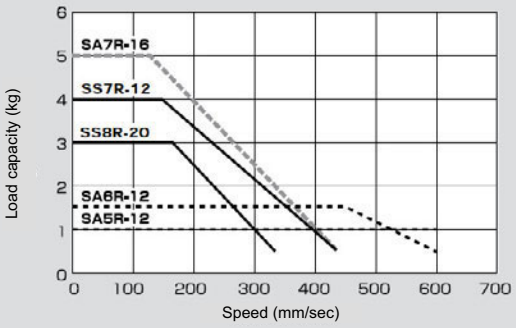
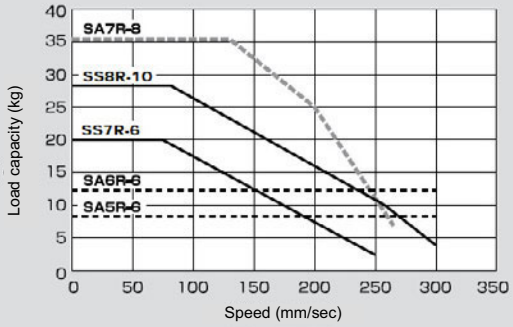
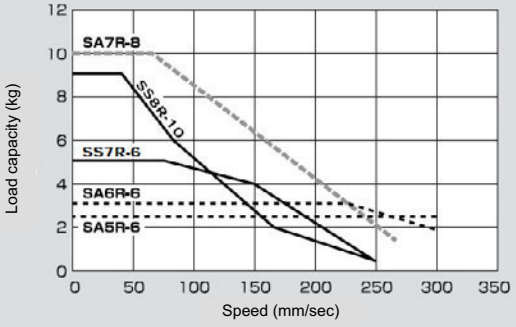
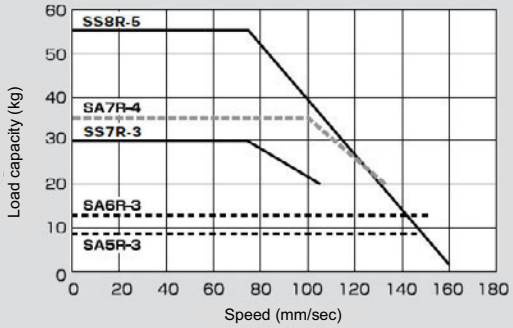
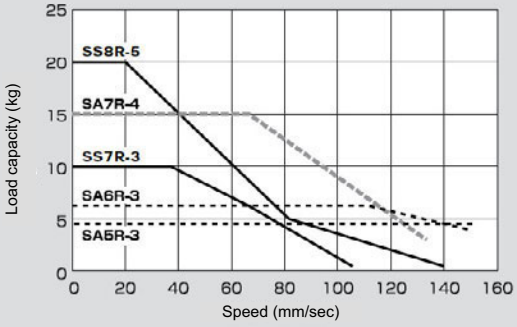
Actuator series	Type	Feed screw	No. of encoder pulses	Lead [mm]	Mounting direction	Minimum speed [mm/s]	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (table type)	TA6C	Ball screw	800	12	Horizontal	15	560	0.3	30	47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

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

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

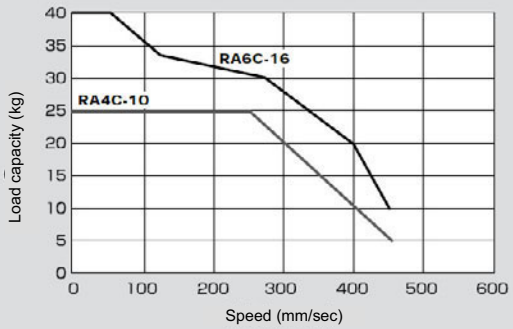
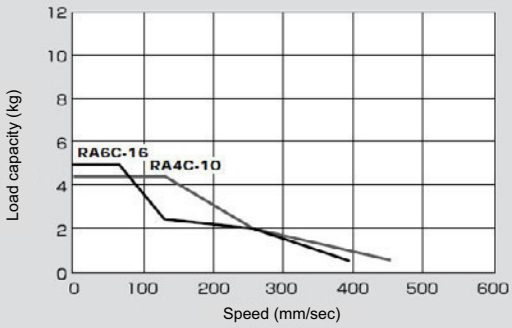
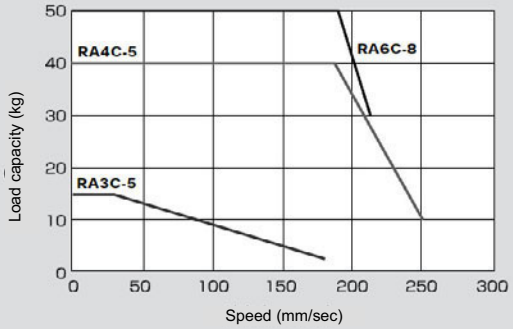
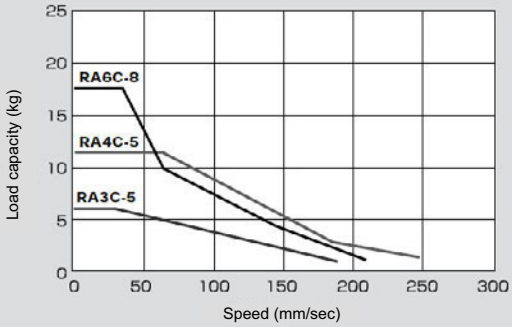
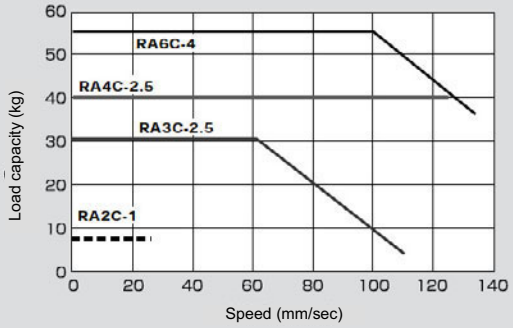
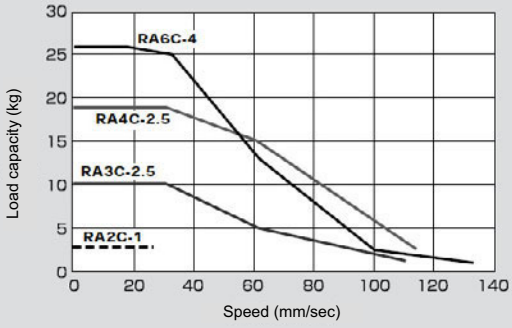
(Note) In the above graphs, the number after the type code indicates the lead.

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

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

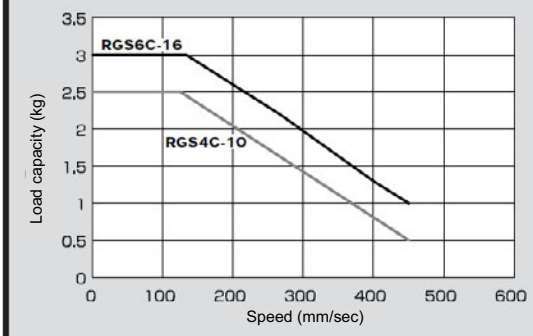
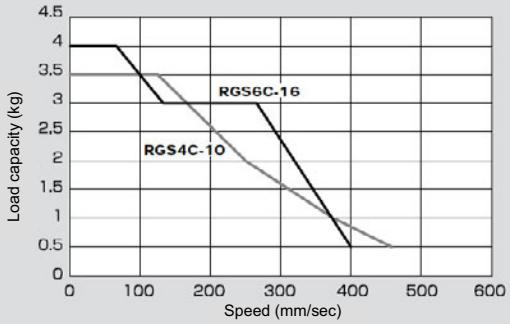
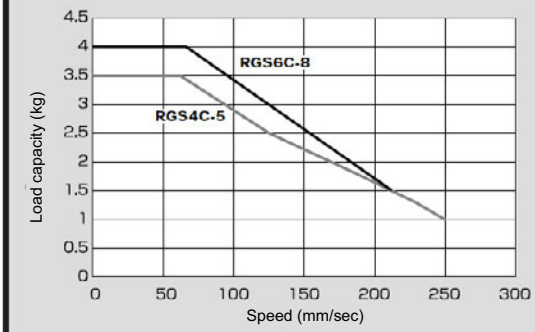
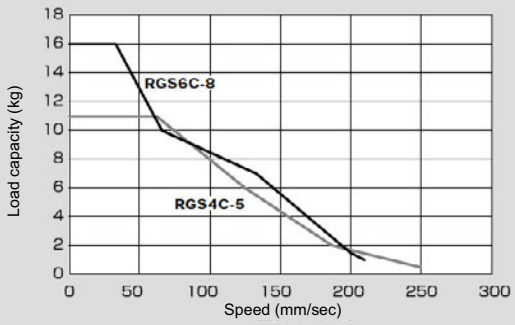
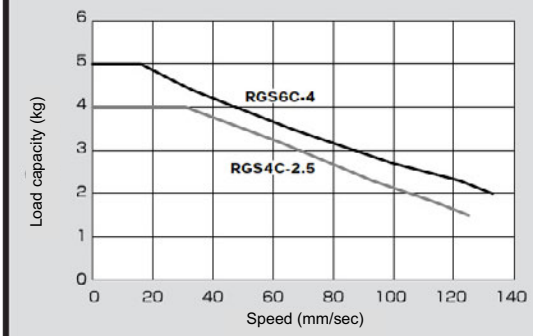
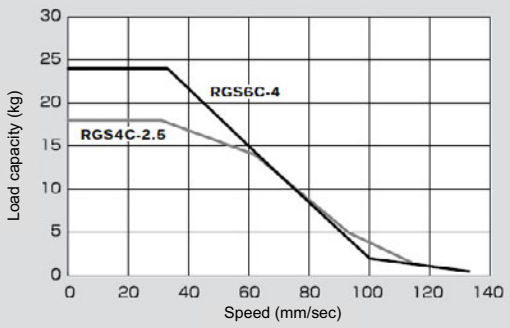
(Note) In the above graphs, the number after the type code indicates the lead.

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

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

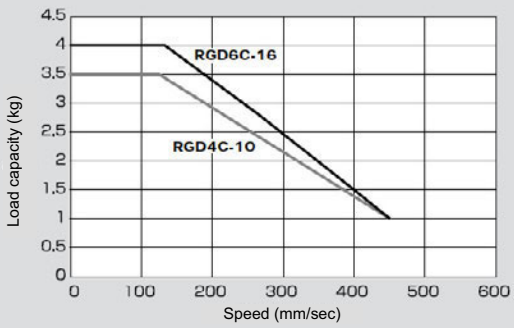
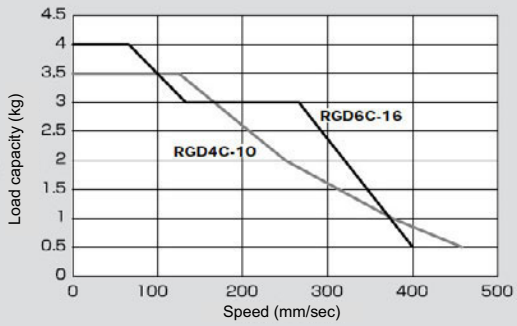
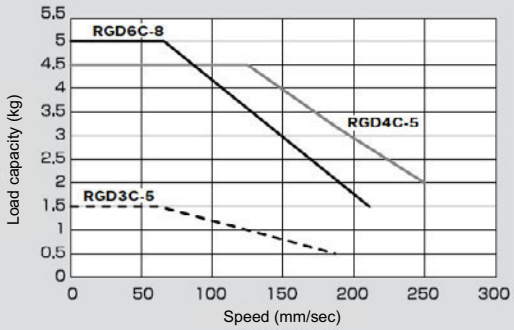
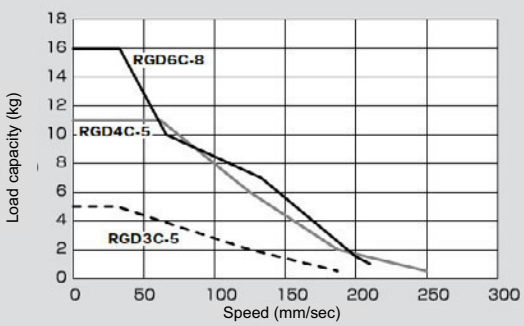
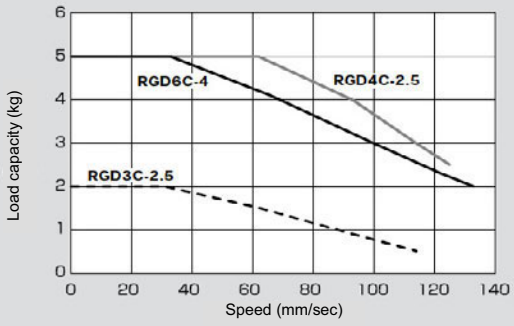
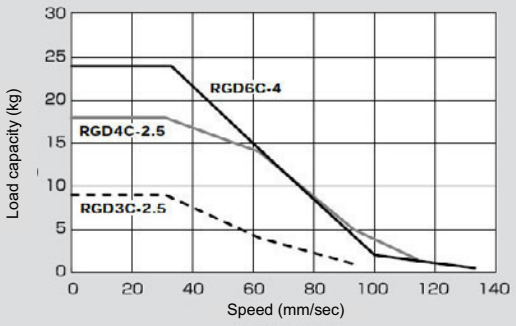
(Note) In the above graphs, the number after the type code indicates the lead.
(Note 1) The figures for horizontal installation assume use of an external guide.

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

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

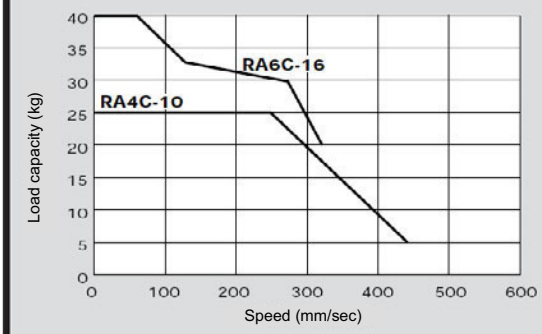
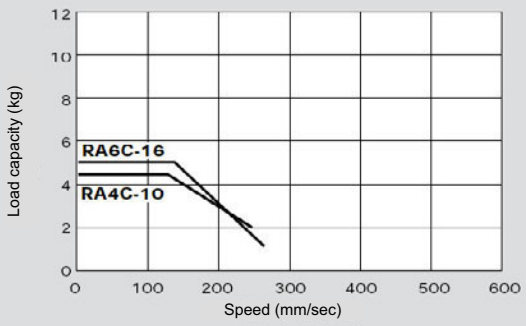
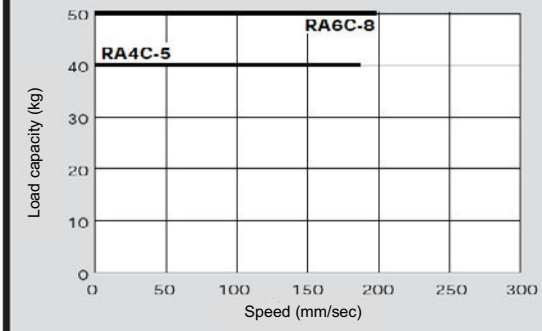
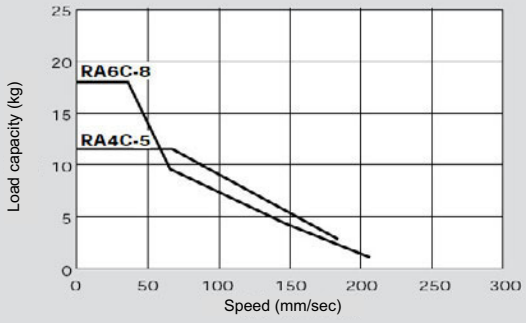
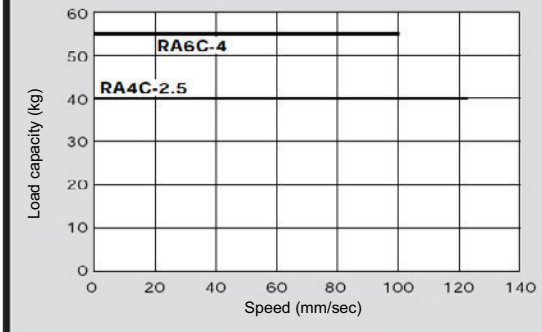
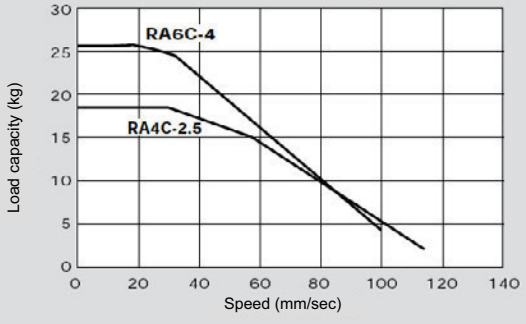
(Note) In the above graphs, the number after the type code indicates the lead.

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

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

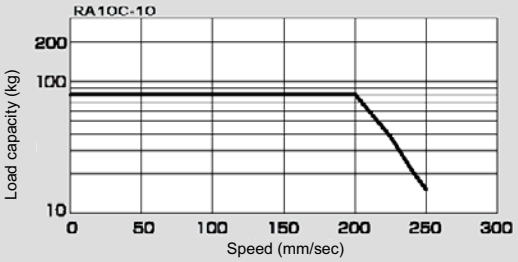
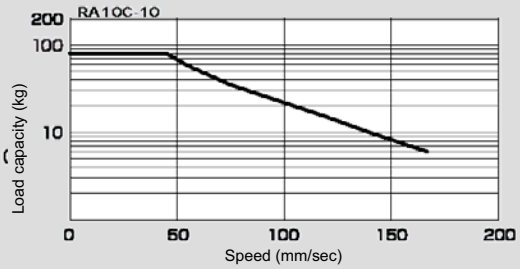
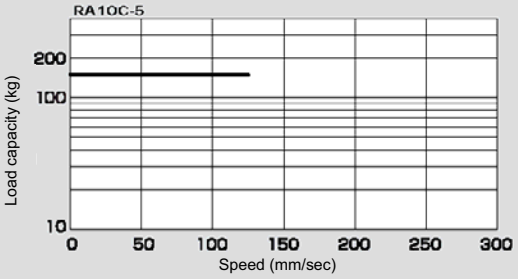
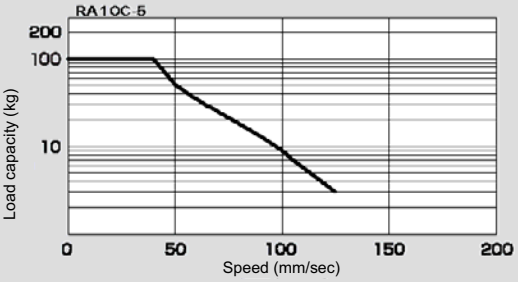
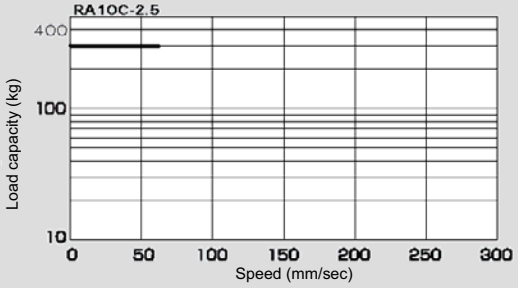
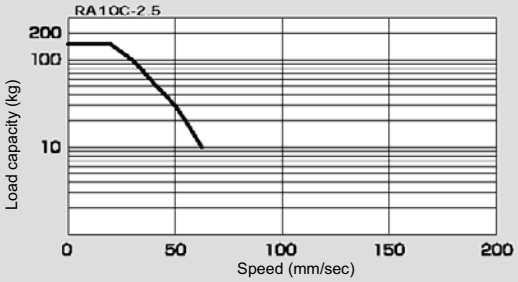
(Note) In the above graphs, the number after the type code indicates the lead.

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

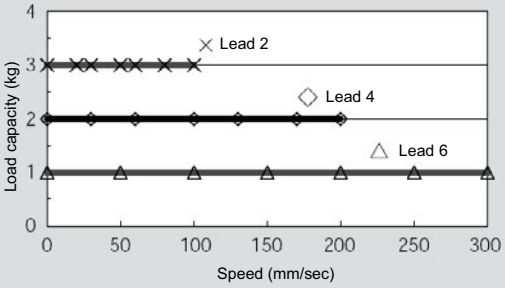
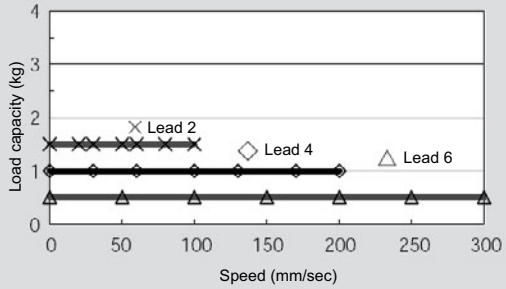
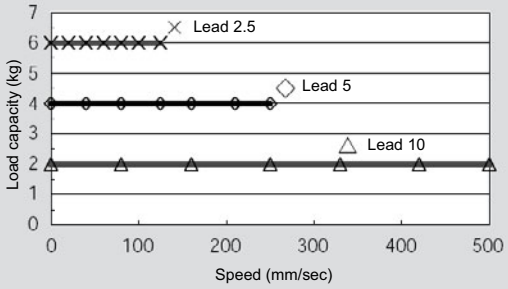
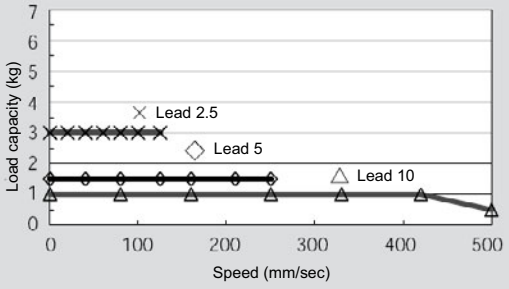
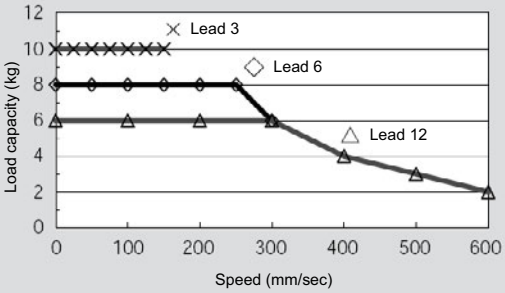
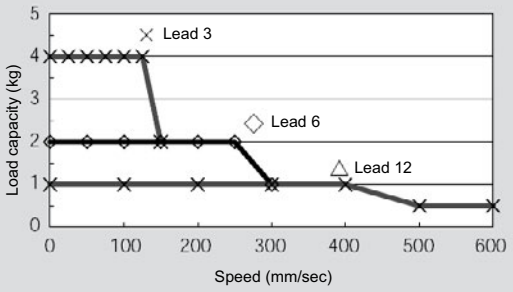
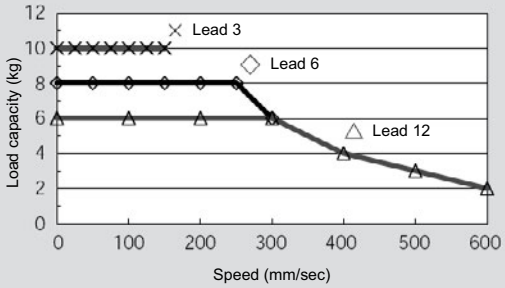
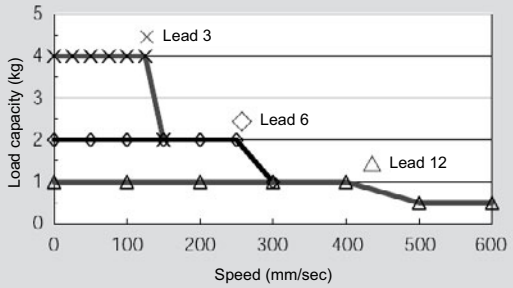
	Horizontal installation (Note 1)	Vertical installation (Note 2)
High-speed type		
Medium-speed type		
Low-speed type		

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

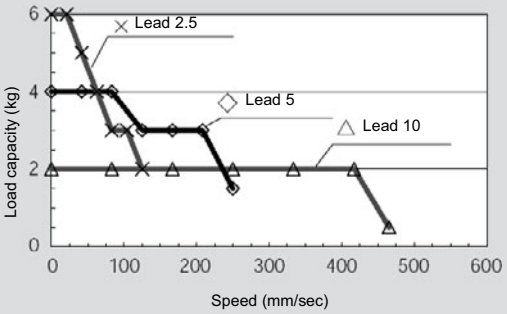
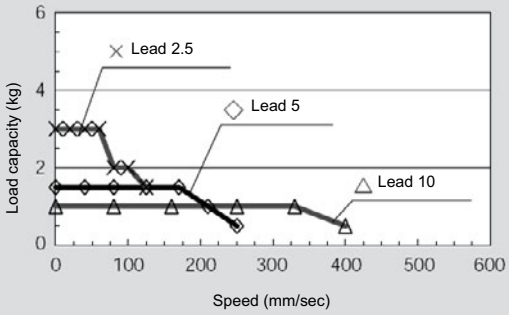
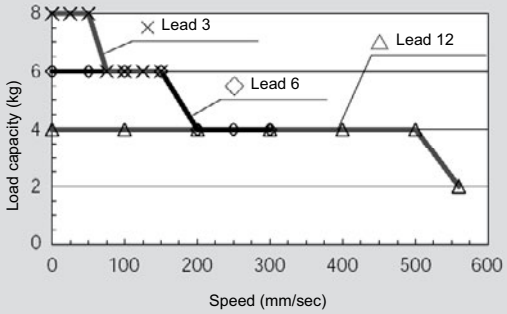
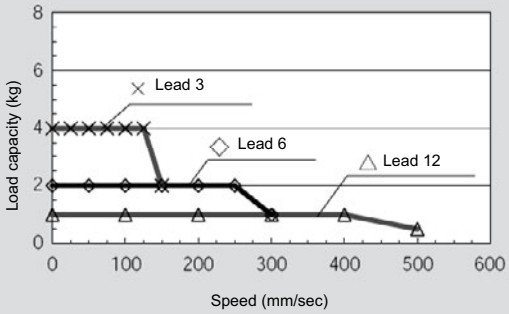
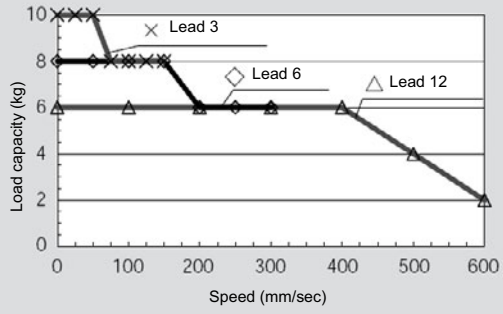
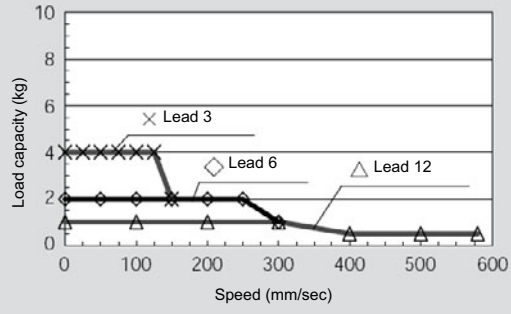
Correlation diagram of speed and load capacity for the high-thrust type

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

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

	Horizontal installation	Vertical installation
SA3C		
SA4C		
SA5C		
SA6C		

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

	Horizontal installation	Vertical installation
TA5C		
TA6C		
TA7C		

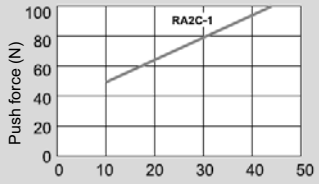
Push Force and Current-limiting Value

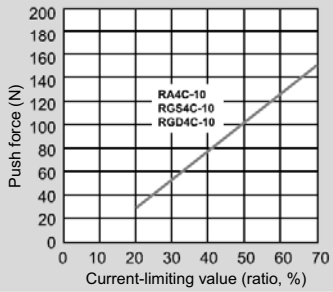
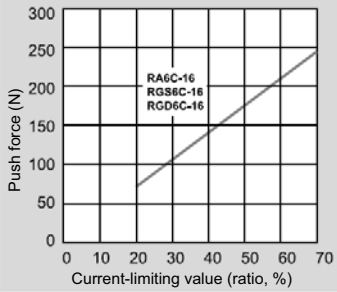
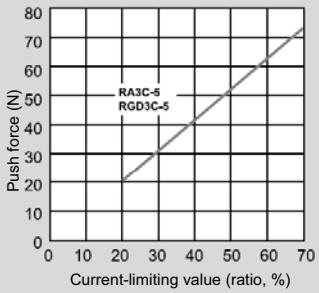
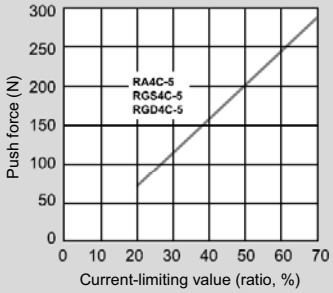
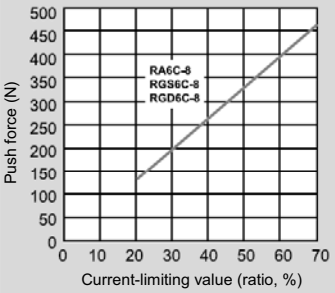
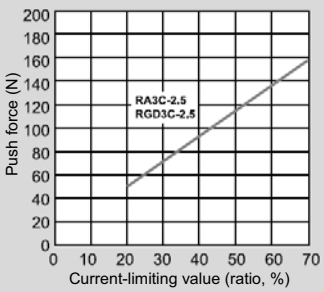
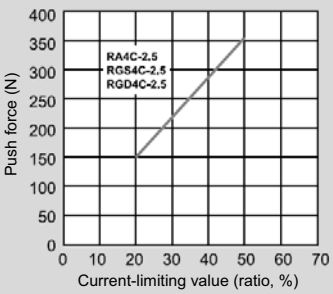
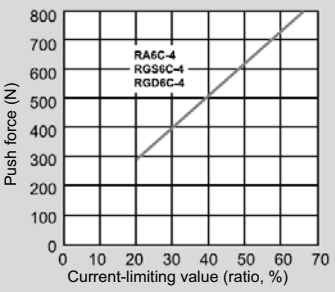
Caution

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

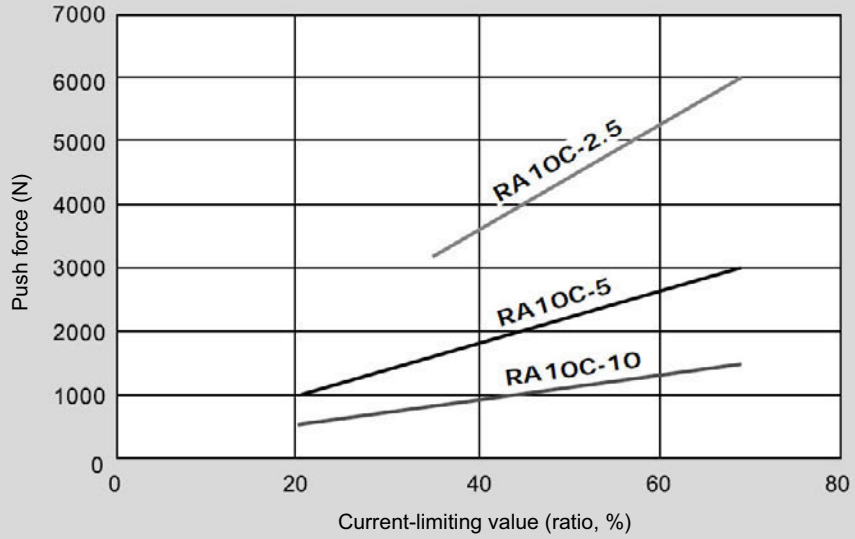
RCP2 Series | Rod Type

RA2C Type



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

RA10C type



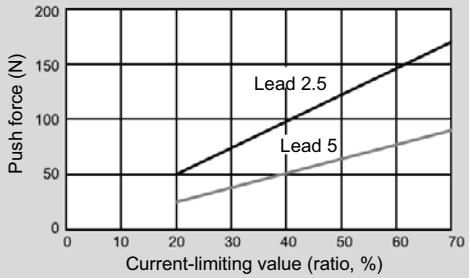
Note
Use the table below as reference on the maximum limit number of push-motion operations when an actuator of each lead type is operated with the maximum push force and push-motion travel of 1 mm.

Lead (type)	2.5	5	10
Number of push-motion operations	1.4 million times	25 million times	157.6 million times

* The maximum limit number of push-motion operations varies depending on operating conditions such as impact and vibration. The figures on the left assume that there is no shock or vibration.

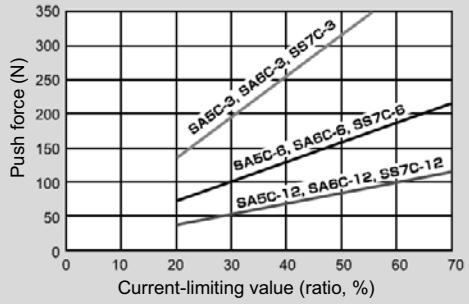
RCP2 Series **Short Type**

SRA4R/SRGS4R/SRGD4R

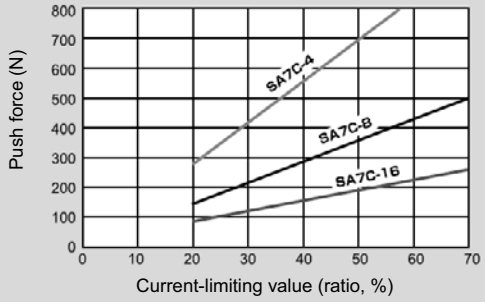


RCP2 Series **Slider Type**

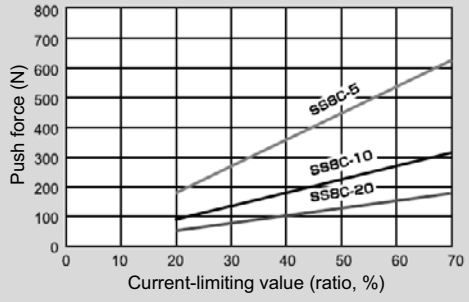
SA5C/SA6C/SS7C Type



SA7C Type

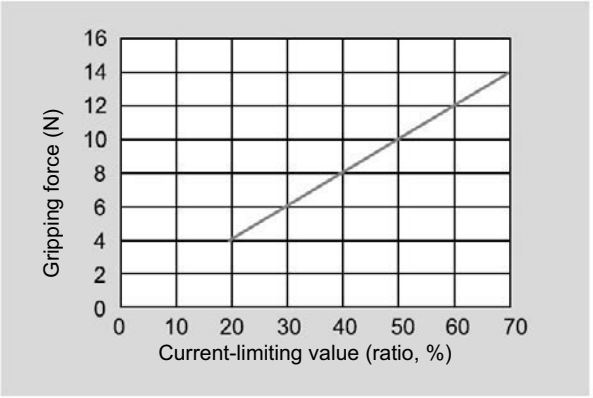


SS8C Type

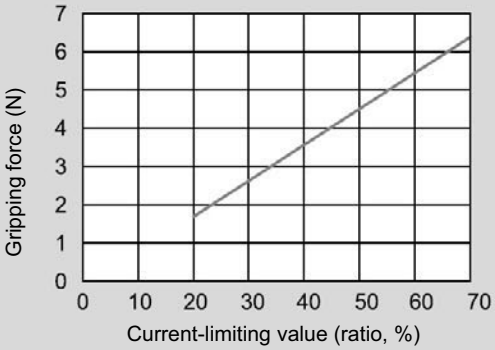


RCP2 Series | Gripper

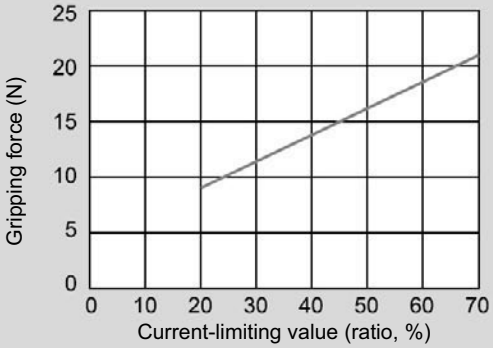
GRSS



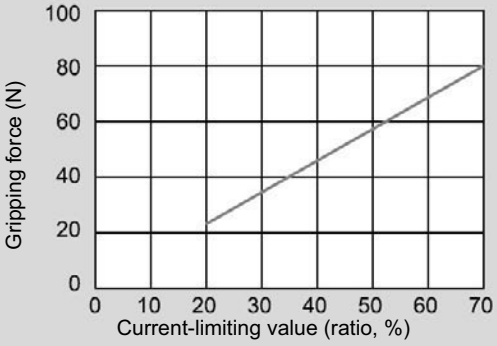
GRLS



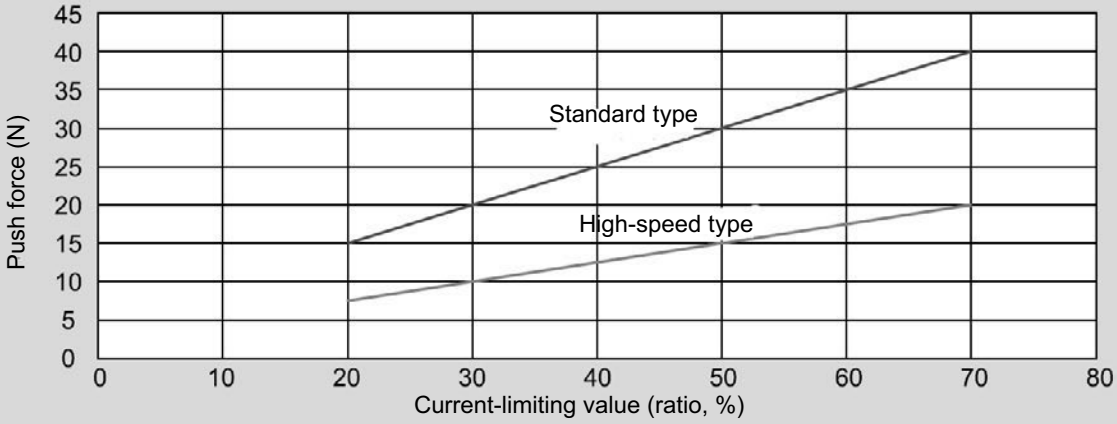
GRS



GRM

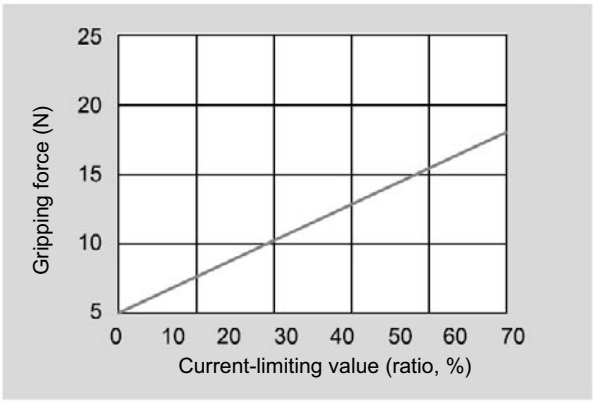


GRST

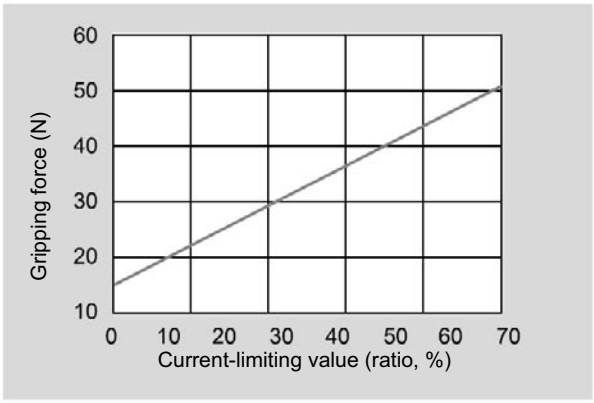


RCP2 Series | 3-finger Gripper

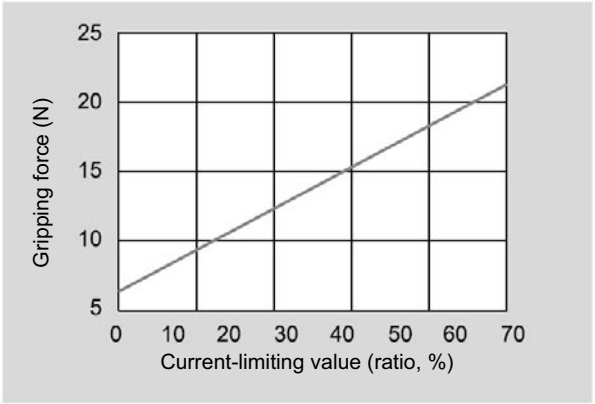
GR3LS



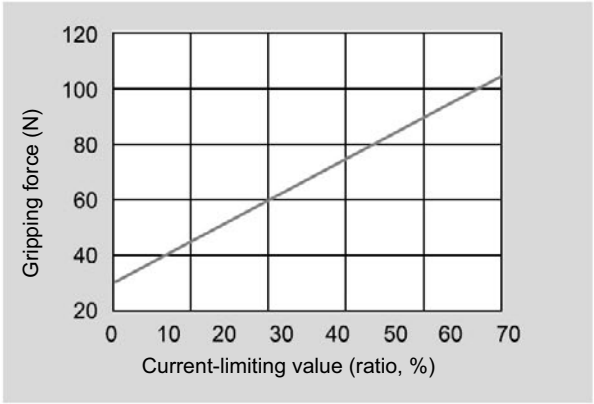
GR3LM



GR3SS

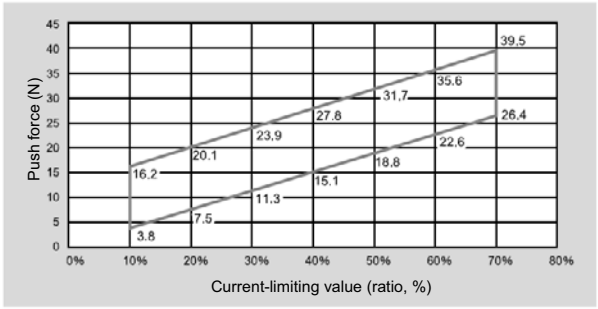


GR3SM

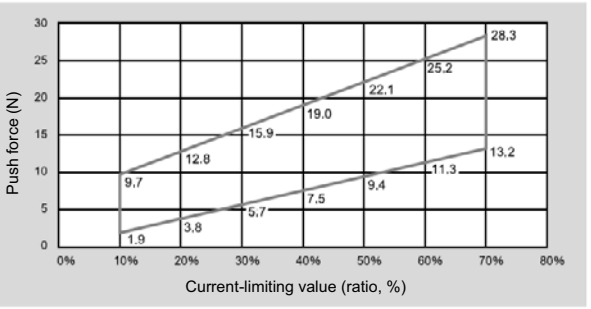


RCP3 Series **Slim, Compact Rod Type**

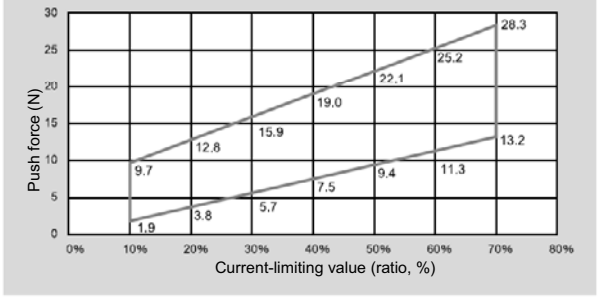
RA2AC/RA2AR Lead 1



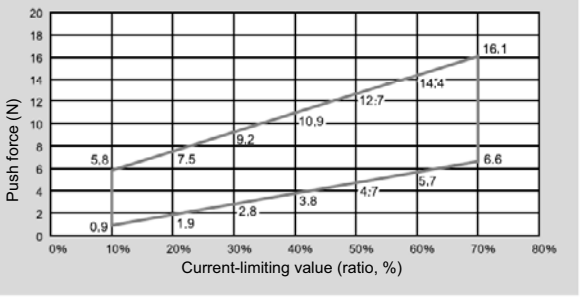
RA2BC/RA2BR Lead 2



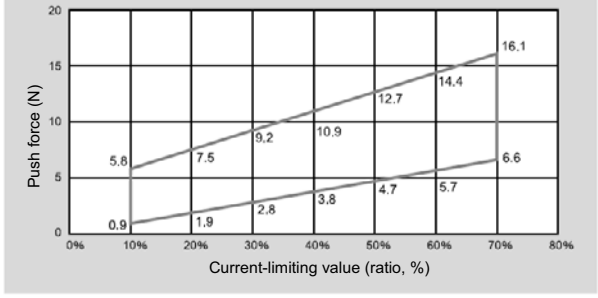
RA2AC/RA2AR Lead 2



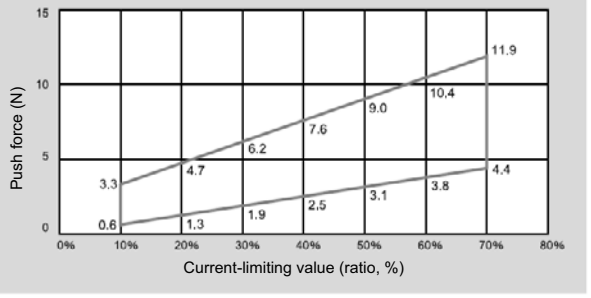
RA2BC/RA2BR Lead 4



RA2AC/RA2AR Lead 4

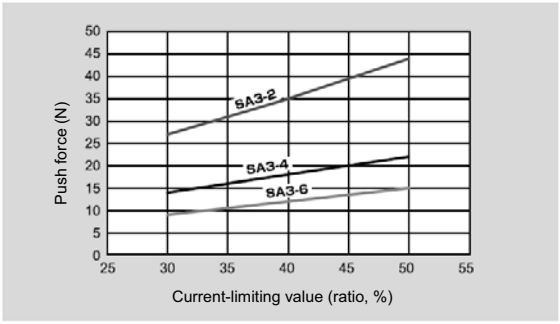


RA2BC/RA2BR Lead 6

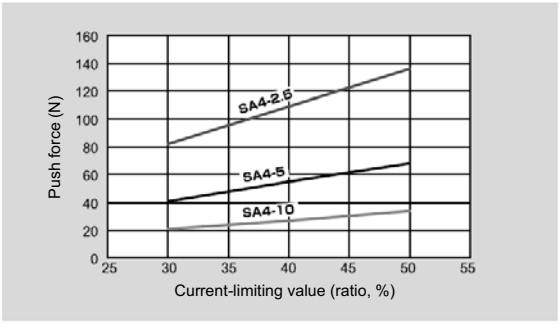


RCP3 Series Slider Type

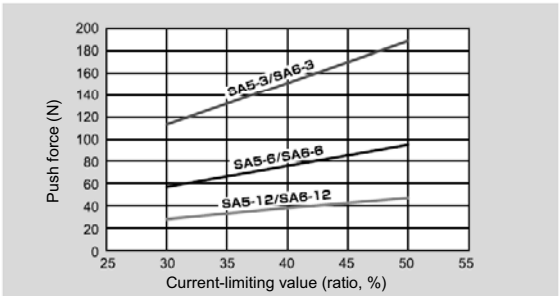
SA3C Type



SA4C Type

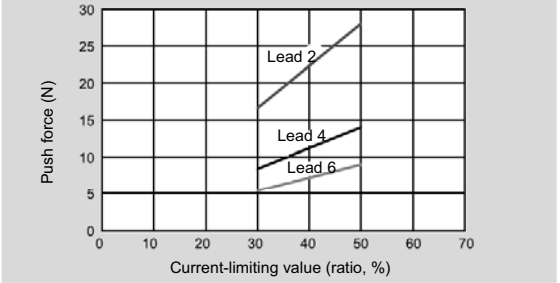


SA5C/SA6C Type

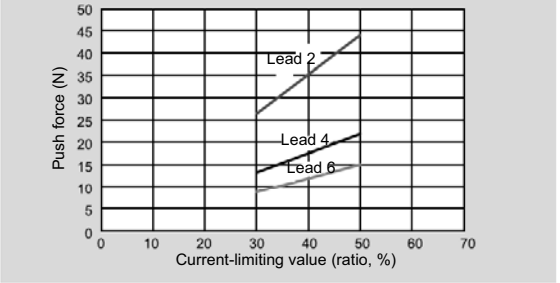


RCP3 Series Slim, Compact Table Type

TA3C/TA3R Type

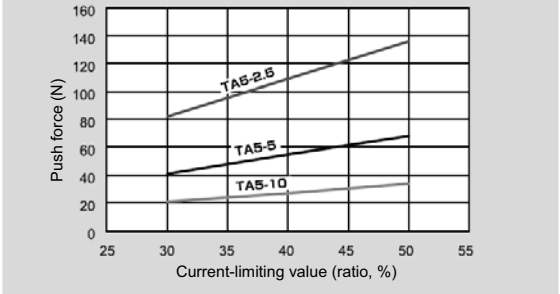


TA4C/TA4R Type

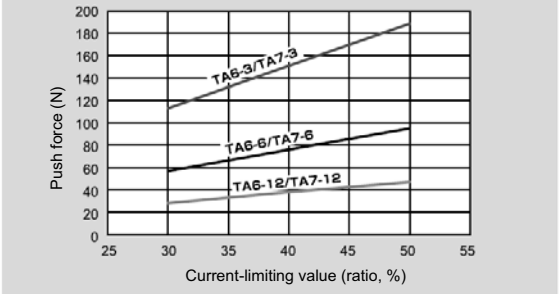


RCP3 Series Table Type

TA5C Type



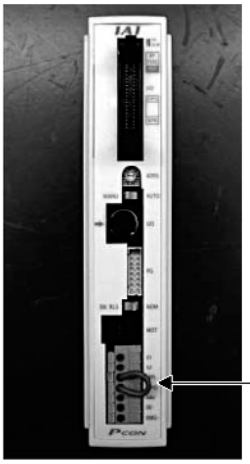
TA6C/TA7C Type



Fault check and replacement of the cooling fan

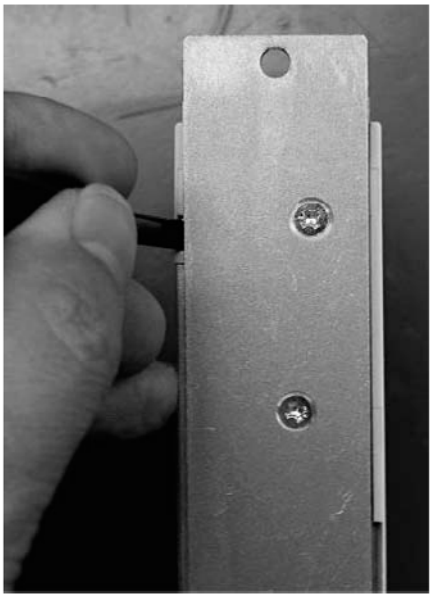
A cooling fan is installed in the large-capacity type (PCON-CF).
To check if the fan is faulty, or when replacing the fan, follow the procedure below:

1) Unplug all connectors and wires connected to the controller, and take out the controller.



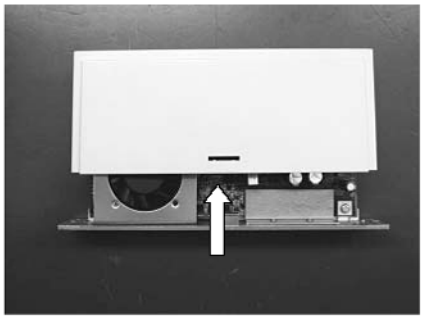
Remove all cables except for the MPI/MPO jumper wire.

2) Remove the resin case.
   - The cutout holes in the resin case are engaged with the hooks on the mounting base plate. Use a screwdriver, etc., to release the case from each hook, and push the mounting base plate upward.



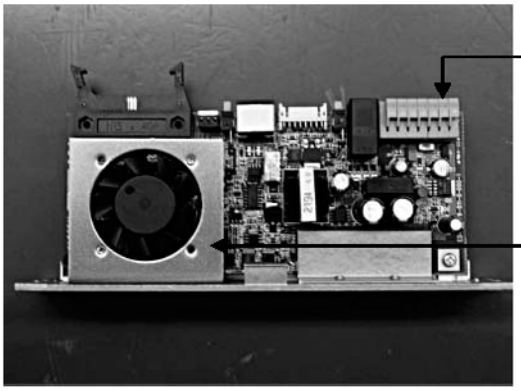






- Pull out the resin case.

3) Check if the fan is normal.



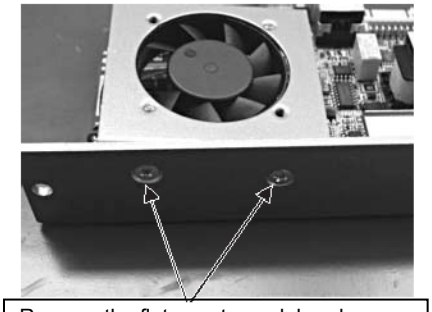
Check method:

[1] Connect the power cable to the 24-V and 0-V terminals on the power-supply terminal block.

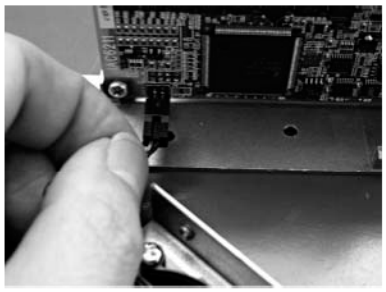
[2] Turn on the power to check if the fan operates.
If the fan is normal, it should operate for approx. 2 seconds.
If the fan is faulty, it will not operate.

(Note) To extend the service life of the fan, a temperature sensor is used to detect the temperature around the power transistor. The fan will operate when the detected temperature reaches 60°C or above, and stop when the temperature drops to 50°C or below.
Because of this specification, the fan is designed to operate for approx. 2 seconds when the power is turned on to allow the user to check if the fan is faulty.

4) If the fan is faulty, replace it after cutting off the power.
[1] Remove the fan.



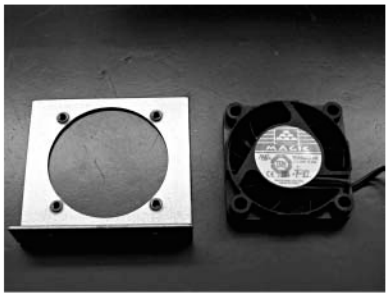
Remove the flat countersunk head screws (M3x5 x 2 pcs).



Pull out the connector by hand.



Remove the pan head screws (M3x12 x 2 pcs).



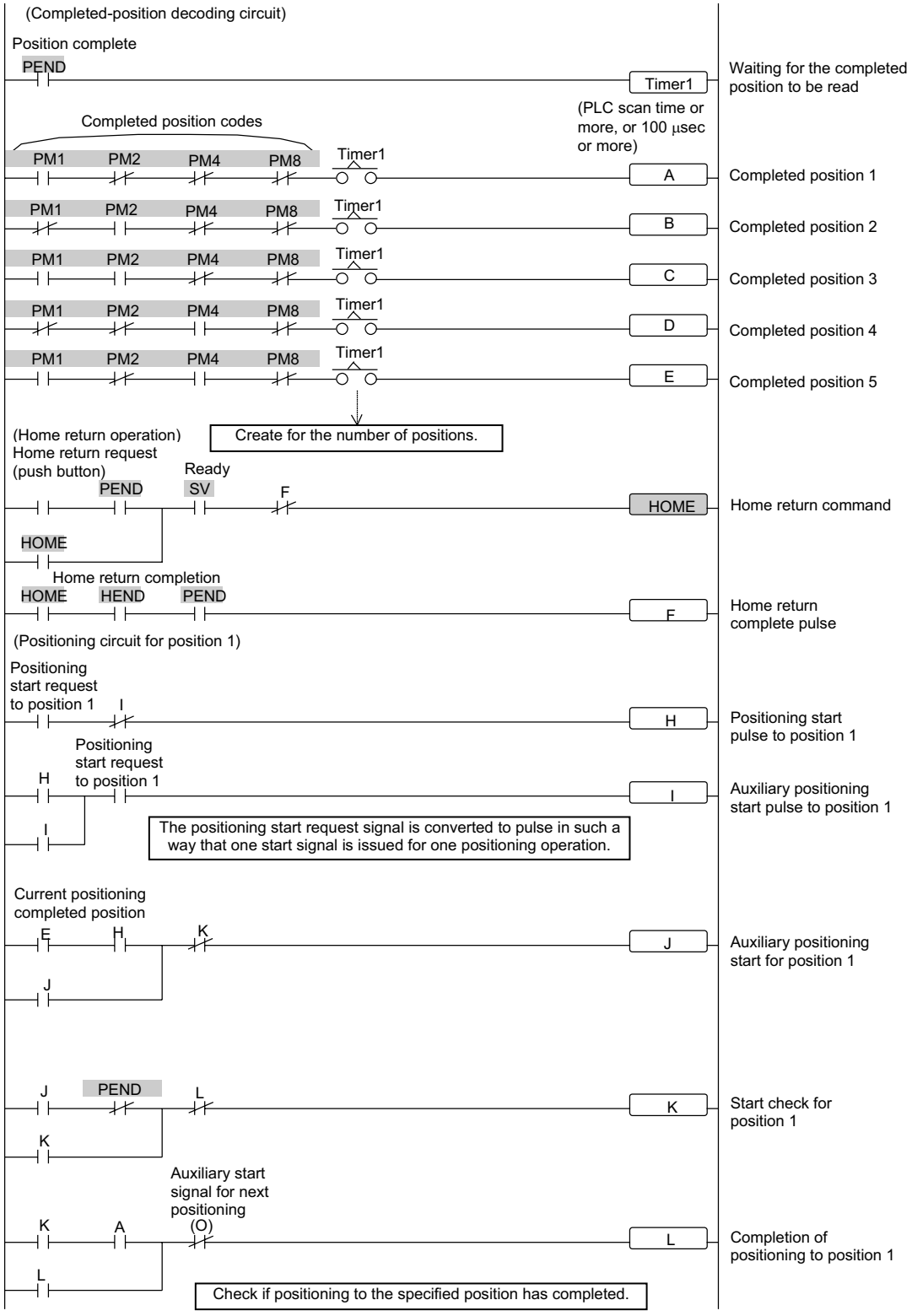
Removed fan and mounting bracket

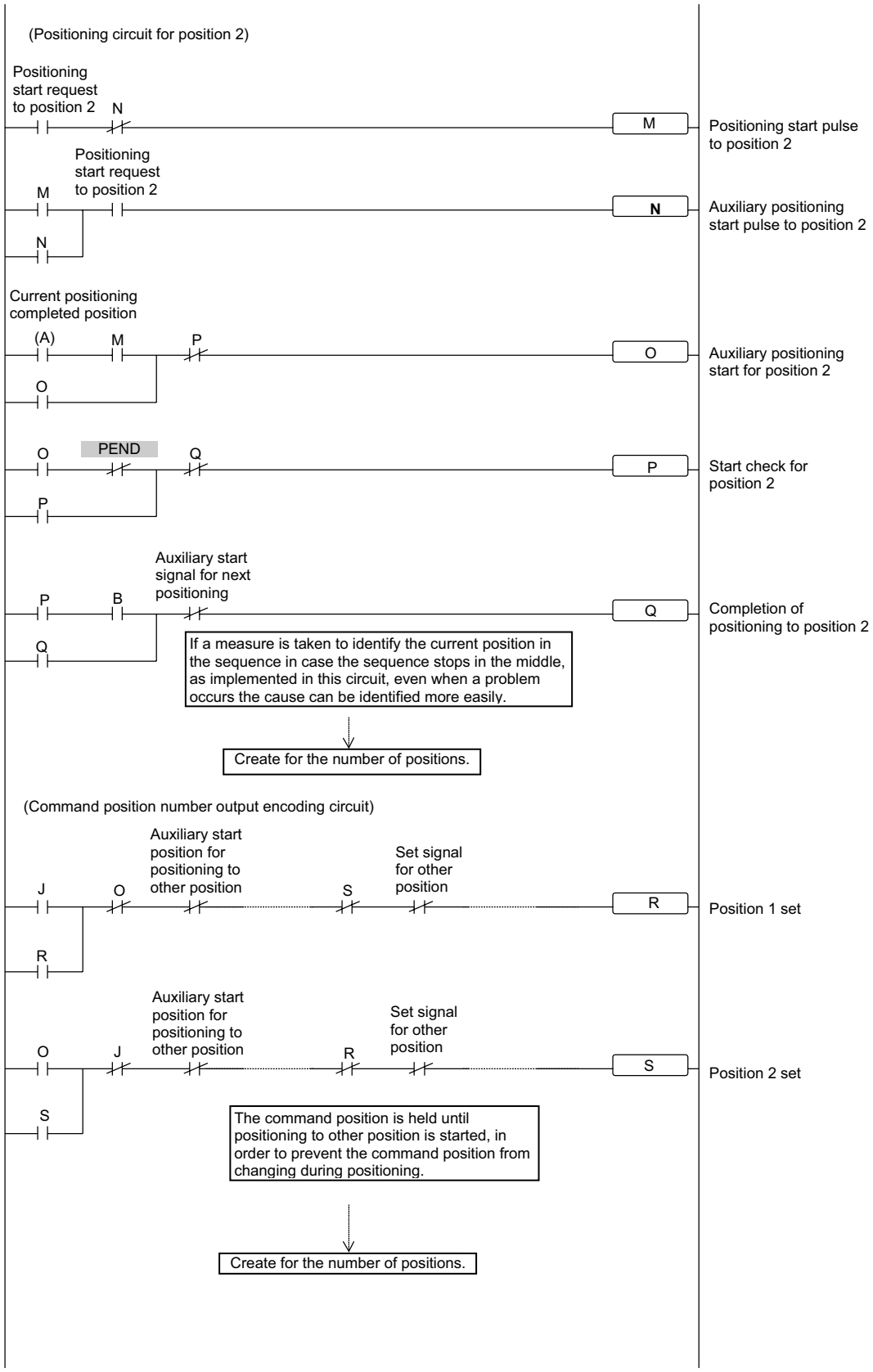
[2] Install a new fan to the mounting bracket, plug in the connector, and affix the mounting bracket using the flat countersunk head screws.
(Reference) Tightening torque for pan head screws: 61.5 N•cm (6.27 kgf•cm)
[3] To make sure, turn on the power to confirm that the fan operates.

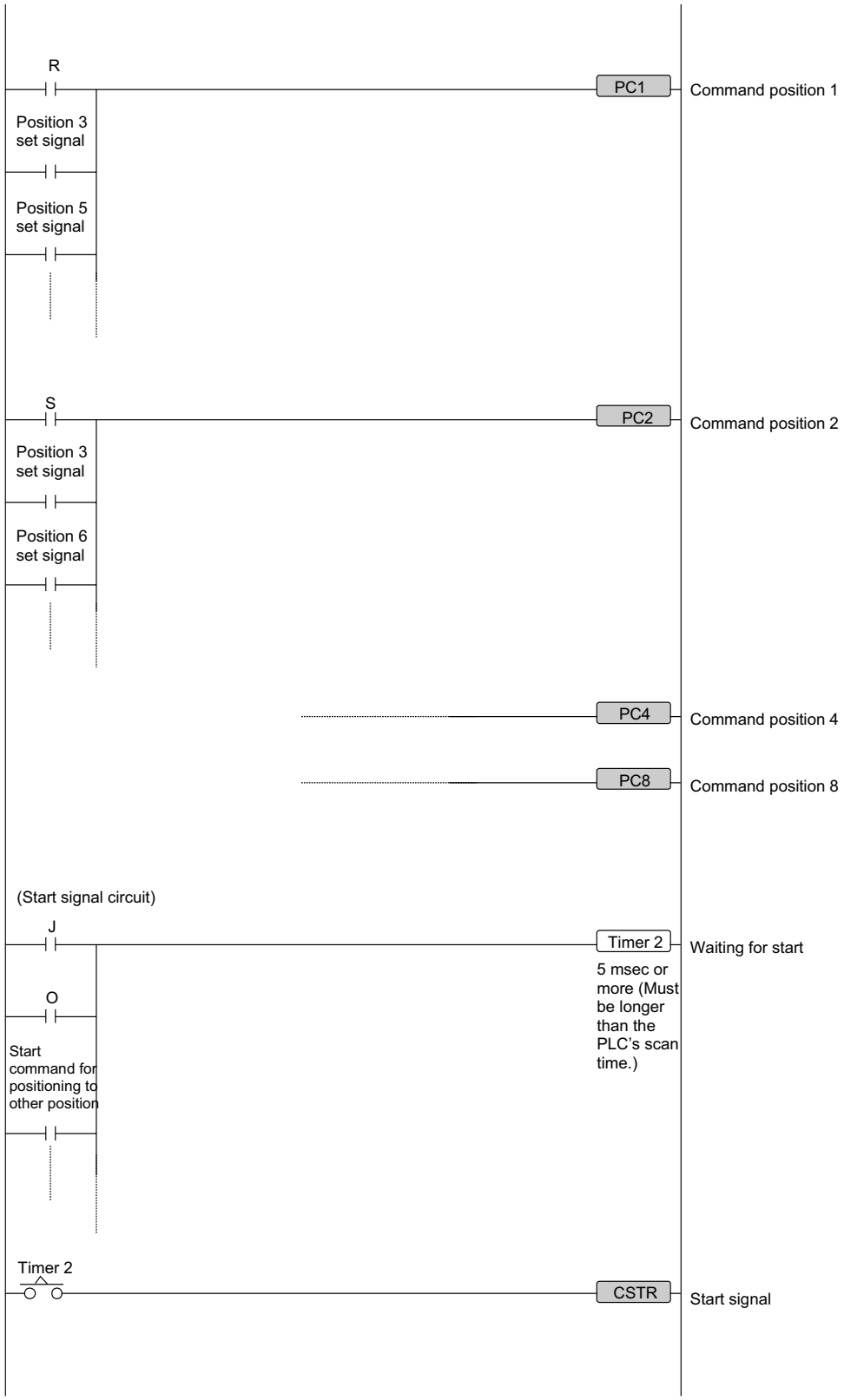
5) Turn off the power and pull out the power cable.
6) Install the resin case. Engage the cutout holes in the resin case with the hooks on the mounting base plate.
7) Plug in the connectors and cables back to their original conditions.

Example of Basic PCON Positioning Sequence

Given below is an example of basic sequence for creating a positioning sequence using the PCON.
indicates PIO signals of the controller.




(Positioning circuit for position 2)
Positioning start request to position 2
N
M
Positioning start pulse to position 2
Positioning start request to position 2
M
N
N
Auxiliary positioning start pulse to position 2
Current positioning completed position
(A)
M
P
O
Auxiliary positioning start for position 2
O
PEND
Q
P
P
Start check for position 2
Auxiliary start signal for next positioning
P
B
Q
Q
Completion of positioning to position 2
If a measure is taken to identify the current position in the sequence in case the sequence stops in the middle, as implemented in this circuit, even when a problem occurs the cause can be identified more easily.
Create for the number of positions.
(Command position number output encoding circuit)
Auxiliary start position for positioning to other position
Set signal for other position
J
O
S
R
R
Position 1 set
Auxiliary start position for positioning to other position
Set signal for other position
O
J
R
S
S
Position 2 set
The command position is held until positioning to other position is started, in order to prevent the command position from changing during positioning.
Create for the number of positions.


R
PC1
Command position 1
Position 3 set signal
Position 5 set signal
S
PC2
Command position 2
Position 3 set signal
Position 6 set signal
PC4
Command position 4
PC8
Command position 8
(Start signal circuit)
J
Timer 2
Waiting for start
5 msec or more (Must be longer than the PLC's scan time.)
O
Start command for positioning to other position
Timer 2
CSTR
Start signal

Recording of Parameters

Recorded date: _____

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

No.	Category	Name	Unit	Recorded data
1	a	Zone boundary 1+	mm	
2	a	Zone boundary 1–	mm	
3	a	Soft limit+	mm	
4	a	Soft limit–	mm	
5	a	Home return direction [0: Reverse / 1: Forward]	-	
6	b	Push & hold stop judgment period	msec	
7	d	Servo gain number	-	
8	b	Default speed	mm/sec	
9	b	Default acceleration/deceleration	G	
10	b	Default positioning band (in-position)	mm	
12	b	Current-limiting value at standstill during positioning	%	
13	b	Current-limiting value during home return	%	
15	c	Pause input disable selection [0: Enable / 1: Disable]	-	
16	c	SIO communication speed	bps	
17	c	Minimum delay time for slave transmitter activation	msec	
18	b	Home sensor input polarity	-	
21	c	Servo ON input [0: Enable / 1: Disable]		
22	a	Home return offset	mm	
23	a	Zone boundary 2+	mm	
24	a	Zone boundary 2–	mm	
25	c	PIO pattern selection	-	
26	b	PIO jog speed	mm/sec	
27	c	Movement command type [0: Level / 1: Edge]	-	
28	b	Default direction of excited-phase signal detection [0: Reverse / 1: Forward]		
29	b	Excited-phase signal detection time	msec	
31	d	Speed loop proportional gain	-	
32	d	Speed loop integral gain	-	
33	d	Torque filter time constant	-	
34	b	Push speed	mm/sec	
35	b	Safety speed	mm/sec	
36	b	Automatic servo-off delay time 1	sec	
37	b	Automatic servo-off delay time 2	sec	
38	b	Automatic servo-off delay time 3	sec	
39	c	Output mode of position complete signal [0: PEND / 1: INP]	-	
40	c	Home-return input disable selection [0: Enable / 1: Disable]		

No.	Category	Name	Unit	Recorded data
41	c	Operating-mode input disable selection [0: Enable / 1: Disable]	-	
42	b	Enable function [0: Enable / 1: Disable]	-	
43	b	Polarity of home check sensor input [0: Contact a / 1: Contact b]	-	
45	c	Silent interval multiplier	-	
46	b	Speed override	%	
47	b	PIO jog speed	mm/sec	
48	b	PIO inching distance	mm	
49	b	PIO inching distance 2	mm	
50	b	Load output judgment time	msec	
51	b	Torque check range [0: Enable / 1: Disable]	-	
53	b	Default stop mode	-	
77	b	Ball screw lead length	mm	
78	b	Axis operation type	-	
79	b	Rotational axis mode selection	-	
80	b	Shortcut selection for rotation	-	
83	b	Absolute unit [0: Not used / 1: Used]	-	
84	C	Fieldbus operation mode	-	
85	C	Fieldbus node address	-	
86	C	Fieldbus baud rate	-	
87	C	Network type	-	
88	a	Software limit margin	mm	
90	C	Fieldbus I/O format	-	
91	b	Current-limiting value at standstill after missing work part in push & hold operation	-	

Change History

Revision Date	Description of Revision
	First edition
2006.10	Second edition
2007.03	Third edition
2007.04	Fourth edition
	Fifth edition
2009.10	Sixth edition
2009.12	Sixth B edition • Note added regarding CE Marking at the beginning
2010.02	Seventh edition • Operation Manual Catalog No. changed
2010.03	Eighth edition • “Please Read Before Use” added after top page • “H: High-acceleration loading specification” added to model name in P.2
2010.04	Ninth edition • “Precautions for Safety” in P.1 to 7, before Table of Contents, deleted and swapped to “Safety Guide” after Table of Contents • “List of Specifications of Applicable Actuators” in Appendix in P.172 swapped with “List of Specifications of Connectable Actuators” • “Push Force and Current-limiting Value” added to Appendix in P.189
	Tenth edition • Skipped
2010.09	Eleventh edition • Note added regarding CE Marking at the beginning • Graph of push force and current-limiting value in P.69 moved to last pages and note added asking to refer to these pages • Cautions for push-motion operation added to P. 71 • Correction made to explanations of excited phase signal detection time in P.89 • Correction made to explanations of excited phase signal detection time in P.91 • Correction made to explanation for when setting 0 to Parameter No.91 in P.138 • 0C8 error added in P.159 • Correction made to referable parameter numbers in caution note in P.168
2011.01	Twelfth edition • Correction made in “Speed loop integral gain” in P.145
2011.04	Thirteenth edition • Swapped over the page for CE Marking

Revision Date	Description of Revision
2011.07	Fourteenth edition • Contents changed in 1.5 Warranty in P. 15 to P. 16 • Caution note added regarding positioning band setting in P. 133 and P. 157 • Overcurrent error deleted in P. 160 • Contents changed and added in Appendix: List of Specifications of Connectable Actuators
2012.05	Fifteenth edition • “Explanation for UL Compliance” added before Contents • Contents added and changed in Safety Guide • 3.1 Installation Environment revised
2012.07	Sixteenth edition • Contents changed in UL
2013.01	Seventeenth edition • Contents deleted in UL
2013.11	Eighteenth edition ・6.4 Power-saving Modes at Standby Positions revised

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