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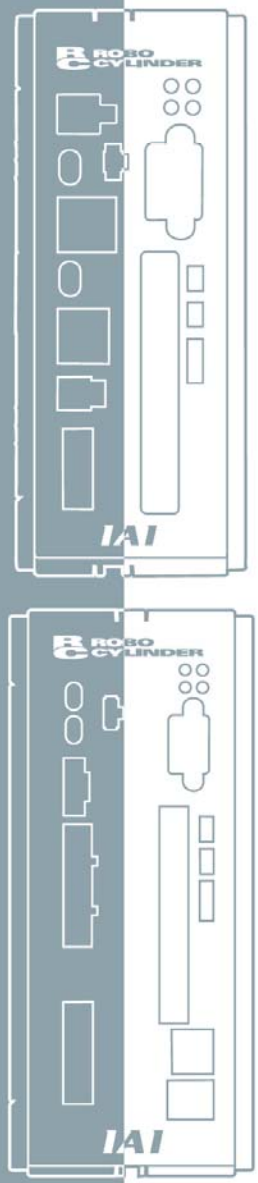
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Find the *IAI RCS-C-RB7535I-100-1* at our website: *Click HERE*

ROBO CYLINDER

RCS Series
ROBO Cylinder Controller
RCS-C Type

Operation Manual Nineteenth Edition



IAI America, Inc.

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ROBO CYLINDER

CAUTION

(1) Hold · Servo ON Signal

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



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

(2) The 100-V controller looks the same as the 200-V controller. However, the 100-V controller will be damaged if 200 V is supplied. Pay due attention when connecting the controller to a power source.

(3) Position 0 may be output regardless of the actual position. At the timings specified below, the position complete signal turns ON no matter where the actual position is. As a result, the output status becomes “Position 0.”

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

Be extra careful when using Position 0.

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

(5) Recommendation for backing up latest data

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

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

Use the following methods to back up data:

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

[2] Create a position table sheet or parameter sheet and keep a written record of backup.

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Safety Precautions (Please read before using the product.)

Before installing, operating, maintaining or inspecting this product, please peruse this operating manual as well as the operating manuals and other related documentations for all equipment and peripheral devices connected to this product in order to ensure the correct use of this product and connected equipment/devices. Those performing installation, operation, maintenance and inspection of the product must have sufficient knowledge of the relevant equipment and their safety. The precautions provided below are designed to help you use the product safely and avoid bodily injury and/or property damage.

In this operating manual, safety precautions are classified as “Danger,” “Warning,” “Caution” and “Note,” according to the degree of risk.

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

It should be noted that the instructions under the ⚠ Caution and ⓘ Note headings may also lead to serious consequences, if unheeded, depending on the situation.
All instructions contained herein provide vital information for ensuring safety. Please read the contents carefully and handle the product with due caution.
Please keep this operating manual in a convenient place for quick reference whenever needed, and also make sure that the manual will get to the end-user.

⚠ Danger

[General]

- Do not use this product for 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
  3. Important safety parts of machinery

  This product has not been planned or designed for applications requiring high levels of safety. Use of this product in such applications may jeopardize the safety of human life. The warranty covers only the product as it is delivered.

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[Installation]

- Do not use this product in a place exposed to ignitable, inflammable or explosive substances. The product may ignite, burn or explode.
- Avoid using the product in a place where the main unit or controller may come in contact with water or oil droplets.
- Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Doing so may result in fire.

[Operation]

- If you are using a pace maker or other mechanical implant, do not come within one meter of the product. Doing so may cause the pace maker, etc., to malfunction due to the strong magnetic force generated by the product.
- Do not pour water onto the product. Spraying water over the product, washing it with water or using it in water may cause the product to malfunction, resulting in injury, electric shock, fire, etc.

[Maintenance, Inspection, Repair]

- Never modify the product. Unauthorized modification may cause the product to malfunction, resulting in injury, electric shock, fire, etc.
- Do not disassemble and reassemble the product. Doing so may result in injury, electric shock, fire, etc.

⚠ Warning

[General]

- Do not use the product outside the specifications. Using the product outside the specifications may cause it to fail, stop functioning or sustain damage. It may also significantly reduce the service life of the product. In particular, observe the maximum loading capacity and speed.

[Installation]

- If the machine will stop in the case of system problem such as emergency stop or power failure, design a safety circuit or other device that will prevent equipment damage or injury.
- Be sure to provide Class D grounding for the controller and actuator (formerly Class 3 grounding: Grounding resistance at 100 Ω or less). Leakage current may cause electric shock or malfunction.
- Before supplying power to and operating the product, always check the operation area of the equipment to ensure safety. Supplying power to the product carelessly may cause electric shock or injury due to contact with the moving parts.
- Wire the product correctly by referring to the operation manual. Securely connect the cables and connectors so that they will not be disconnected or come loose. Failure to do so may cause the product to malfunction or cause fire.

[Operation]

- Do not touch the terminal block or various switches while the power is supplied to the product. Failure to observe this instruction may result in electric shock or malfunction.
- Before operating the moving parts of the product by hand (for the purpose of manual positioning, etc.), confirm that the servo is turned off (using the teaching pendant). Failure to observe this instruction may result in injury.
- Do not scratch the cables. Scratching, forcibly bending, pulling, winding, crushing with heavy object or pinching a cable may cause it to leak current or lose continuity, resulting in fire, electric shock, malfunction, etc.

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- Turn off the power to the product in the event of power failure. Failure to do so may cause the product to suddenly start moving when the power is restored, thus resulting in injury or product damage.
- If the product is generating heat, smoke or a strange smell, turn off the power immediately. Continuing to use the product may result in product damage or fire.
- If any of the internal protective devices (alarms) of the product has actuated, turn off the power immediately. Continuing to use the product may result in product damage or injury due to malfunction. Once the power supply is cut off, investigate and remove the cause and then turn on the power again.
- If the LEDs on the product do not illuminate after turning on the power, turn off the power immediately. The protective device (fuse, etc.) on the live side may remain active. Request repair to the IAI sales office from which you purchased the product.

[Maintenance, Inspection, Repair]

- Before conducting maintenance/inspection, parts replacement or other operations on the product, completely shut down the power supply. At this time, take the following measures:
  1. Display a sign that reads, “WORK IN PROGRESS. DO NOT TURN ON POWER” at a conspicuous place, in order to prevent a person other than the operator from accidentally turning on the power.
  2. When two or more operators are to perform maintenance/inspection together, always call out every time the power is turned on/off or an axis is moved in order to ensure safety.

[Disposal]

- Do not throw the product into fire. The product may burst or generate toxic gases.

⚠ Caution

[Installation]

- Do not use the product under direct sunlight (UV ray), in a place exposed to dust, salt or iron powder, in a humid place, or in an atmosphere of organic solvent, phosphate-ester machine oil, etc. The product may lose its function over a short period of time, or exhibit a sudden drop in performance or its service life may be significantly reduced.
- Do not use the product in an atmosphere of corrosive gases (sulfuric acid or hydrochloric acid), etc. Rust may form and reduce the structural strength.
- When using the product in any of the places specified below, provide a sufficient shield. Failure to do so may result in malfunction:
  1. Place where large current or high magnetic field is present
  2. Place where welding or other operations are performed that cause arc discharge
  3. Place subject to electrostatic noise
  4. Place with potential exposure to radiation
- Do not install the product in a place subject to large vibration or impact (4.9 m/s^2 or more). Doing so may result in the malfunctioning of the product.
- Provide an emergency-stop device in a readily accessible position so the device can be actuated immediately upon occurrence of a dangerous situation during operation. Lack of such device in an appropriate position may result in injury.
- Provide sufficient maintenance space when installing the product. Routine inspection and maintenance cannot be performed without sufficient space, which will eventually cause the equipment to stop or the product to sustain damage.
- Do not hold the moving parts of the product or its cables during installation. It may result in injury.
- Always use IAI’s genuine cables for connection between the controller and the actuator. Also use IAI’s genuine products for the key component units such as the actuator, controller and teaching pendant.

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- Before installing or adjusting the product or performing other operations on the product, display a sign that reads, “WORK IN PROGRESS. DO NOT TURN ON POWER.” If the power is turned on inadvertently, injury may result due to electric shock or sudden activation of an actuator.

[Operation]

- Turn on the power to individual equipment one by one, starting from the equipment at the highest level in the system hierarchy. Failure to do so may cause the product to start suddenly, resulting in injury or product damage.
- Do not insert a finger or object in the openings in the product. It may cause fire, electric shock or injury.
- Do not bring a floppy disk or other magnetic data storage medium within one meter of the product. The data inside the floppy disk, etc., may be damaged due to the magnetic force generated by the magnet in the product.

[Maintenance, Inspection, Repair]

- Do not touch the terminals when performing an isolation resistance test. Electric shock may result. (Do not perform any withstand voltage test on a product that uses DC power supply.)

Note

[Installation]

- Do not place objects around the controller that will block airflows. Insufficient ventilation may damage the controller.
- Do not configure a control circuit that will cause the load to drop in case of power failure. Configure a control circuit that will prevent the table or load from dropping when the power to the machine is cut off or an emergency stop is actuated.

[Installation, Operation, Maintenance]

- When handling the product, wear protective gloves, protective goggles, safety shoes or other necessary gear to ensure safety.

[Disposal]

- When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste.

Others

- IAI shall not be liable whatsoever for any loss or damage arising from a failure to observe the items specified in “Safety Precautions.”
- If you have any question regarding the product, please contact your nearest IAI sales office. The addresses and phone numbers of our sales offices are provided at the end of this operation manual.

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Before Use

■ Caution

[1] Be sure to read this operation manual to ensure the proper use of this product.
[2] Unauthorized use or reproduction of a part or all of this operation manual is prohibited.
[3] IAI shall not be liable whatsoever for any loss or damage arising from a handling or operation not specified in this operation manual.
[4] The information contained in this operation manual is subject to change without notice.

■ Action to Be Taken in Case of Emergency

* If this product is found to be in a dangerous condition, immediately turn off all power switches of the main unit and connected equipment or immediately disconnect all power cables from the outlets. (“Dangerous condition” refers to a situation where the product is generating abnormal heat or smoke or has ignited and a fire or danger to human health is anticipated.)

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1. Overview

1.1 Introduction

Thank you for purchasing the RCS controller. This manual explains the features and operating procedures of the product.

If not used or handled properly, any product cannot fully demonstrate its function or may cause an unexpected breakdown or end its life prematurely. Please read this manual carefully and handle the product with utmost care while ensuring its correct operation. Keep this manual in a convenient place so the relevant sections can be referenced readily when necessary.

If you are also using any of IAI's various actuators and/or optional PC software or teaching pendant, also refer to the operation manual for each item.

Absolute Specification

- The absolute RCS controller is able to perform positioning operation immediately after the power has been input and an absolute reset performed. You need not perform home return every time the power is reconnected. Other basic functions are the same as those of the standard RCS controller.
- The absolute RCS controller is shipped without an absolute reset executed. It must be done by the user.
  Only RCS actuators of absolute specification can be used with the absolute RCS controller. It cannot be used with RCS actuators of incremental specification.
- Notes on installing the absolute-data backup battery
  Be sure to follow the installation steps below to initialize the battery circuit and thereby prevent an early consumption of the battery:
  [1] Connect the encoder cable.
  [2] Turn on the power.
  [3] Install the absolute-data backup battery.
  The above steps must always be followed when the encoder cable has been disconnected for relocation, etc.

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

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

- Controller version
  A label on which a serial number is printed is attached on the right side of the controller.
  The last two digits of the serial number, consisting of an alphabet and a number, indicate the version of your controller.
  Example) SERIAL No. ET352720 N5
  In this example, the controller version is "N5."
  When the controller is updated to a higher version, the alphabet will change to a higher letter and the number will increase. Take note that some controller specifications will vary depending on the version.

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*We have made every effort to ensure accuracy 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 Model Number

RCS－C－SA5－I－20－DV－O－EU－P

<Series>

<Controller type>
C: Standard

<Applicable actuator>
[1] Actuator type
Slider type
- SA4
- SA5
- SA6
- SS ・SSR
- SM ・SMR

Rod type
- RA35 ・RA35R
- RA45 ・RA45R
- RA55 ・RA55R
- RB7525
- RB7530
- RB7535

Flat type
- F45
- F55

Gripper
- G20

Rotary
R10
R20
R30

[2] Encoder type
I: Incremental
A: Absolute

[3] Motor capacity
- 20 (20 W)
- 30 (30 W)
- 60 (60 W)
- 100 (100 W)
- 150 (150 W)

<I/O signal type>
P: PNP specification [Source]
Blank: NPN specification [Sink]

<CE compliance>
EU: CE-compliant
Blank: Not CE-compliant

<Input supply voltage>
0: 24 VDC
1: 100 VAC
2: 200 VAC

<Open network>
DV: DeviceNet specification
CC: CC-Link specification
PR: ProfiBus specification
Blank: Not network-ready

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1.3 Safety Precautions

Read the following information carefully and provide safety measures with due consideration.

This system product has been developed as a drive component for automated machinery and the like, and is therefore designed not to generate excessive torque or speed beyond the levels needed to drive automated equipment. However, the following instructions must be strictly observed to prevent an unexpected accident.

1. Do not handle this product in any manner not specified in this manual. If you have questions regarding any of the information provided in this manual, please contact IAI.

2. Always use a genuine cable specified by IAI for connecting the actuator and RCS controller.

3. Do not enter the operating range of the machine while the machine is operating or is able to operate (the controller power is ON). If the machine is used in a place accessible to other people, enclose its operating range using a safety cage, etc.

4. Always turn off the power supply to the controller before assembling/adjusting or maintaining/inspecting the machine. During assembly/adjustment or maintenance/inspection, put a plate or other visible sign in a conspicuous place indicating that work is in progress. The operator should keep the entire power cable beside him or her to prevent another person from inadvertently plugging in the cable.

5. If two or more persons work together, set signaling methods so each person can confirm the safety of other(s) during work. Especially when the work requires an axis or axes to be moved—with or without the power and by motor drive or manual operation—the person moving each axis should always call out beforehand to ensure safety.

6. If you have extended a cable or made other alteration to the standard wiring specification, thoroughly check the wiring and ensure absence of problem before turning on the power, in order to prevent malfunction due to miswiring.

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1.4 Warranty Period and Scope of Warranty

The RCS controller you have purchased passed IAI's shipping inspection implemented under the strictest standards. The unit is covered by the following warranty:

1. Warranty Period

   The warranty period shall be one of the following periods, whichever ends first:
   - 18 months after shipment from our factory
   - 12 months after delivery to a specified location

2. Scope of Warranty
   If an obvious manufacturing defect is found during the above period under an appropriate condition of use, IAI will repair the defect free of charge. Note, however, that the following items are excluded from the scope of warranty:

   - Aging such as natural discoloration of coating
   - Wear of a consumable part due to use
   - Noise or other sensory deviation that doesn't affect the mechanical function
   - Defect caused by inappropriate handling or use by the user
   - Defect caused by inappropriate or erroneous maintenance/inspection
   - Defect caused by use of a part other than IAI's genuine part
   - Defect caused by an alteration or other change not approved by IAI or its agent
   - Defect caused by an act of God, accident, fire, etc.

   The warranty covers only the product as it has been delivered and shall not cover any losses arising in connection with the delivered product. The defective product must be brought to our factory for repair.

Please read carefully the above conditions of warranty.

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1.5 Installation Environment and Noise Elimination

Pay due attention to the installation environment of the controller.

1.5.1 Installation Environment

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

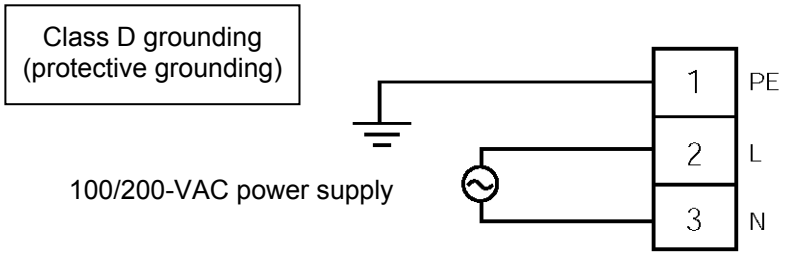
1.5.2 Power Supply

The power supply specification is 24 VDC, 100 VAC or 200 VAC depending on the controller type.

1.5.3 Noise Elimination and Grounding

(1) Wiring and power supply

[1] 100/200-VAC controller
PE on the power terminal block is a protective grounding terminal. Provide Class D grounding.
Use a grounding cable of 0.75 mm^2 (AWG18) or larger. The grounding cable must be longer than the AC cable.

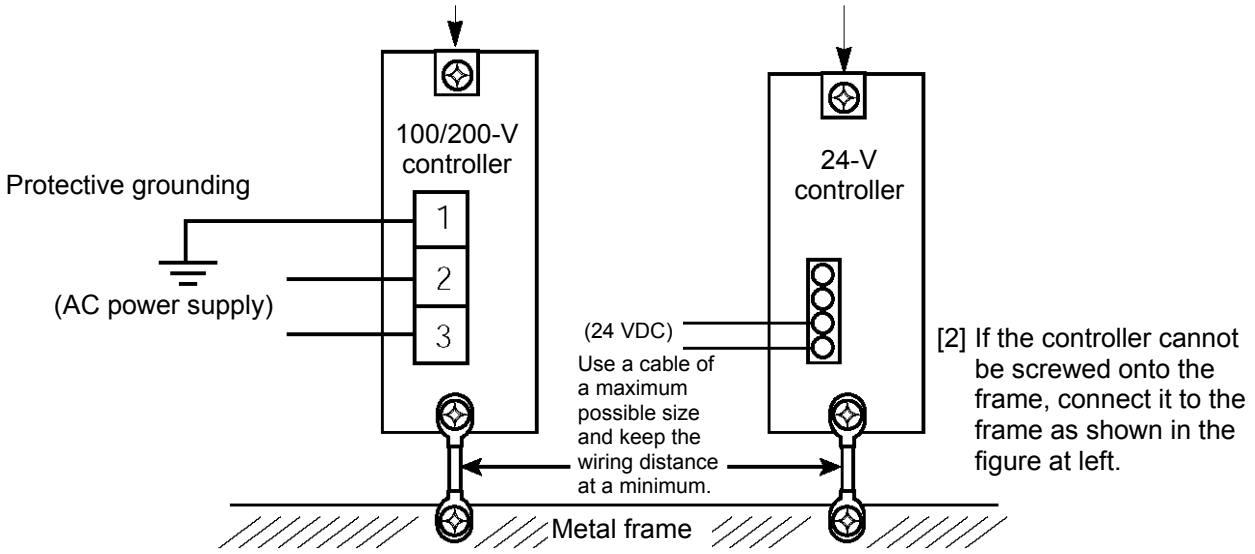


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[2] 24-VDC controller
The power terminal block does not have a protective grounding terminal, but the user must separately provide a noise elimination measure and grounding.

(2) Grounding for noise elimination
Regardless of whether the power supply is 100/200 VAC or 24 VDC, the controller must always be grounded to eliminate noise.

[1] Connect the controller by directly screwing it onto a metal frame.



[2] If the controller cannot be screwed onto the frame, connect it to the frame as shown in the figure at left.

[3] Precautions regarding wiring method

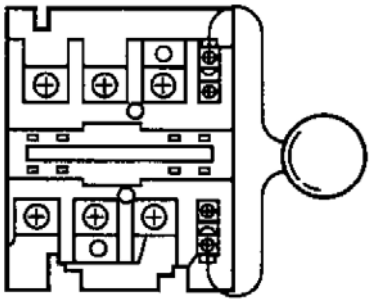
Use a twisted cable for connection to the 24-VDC external power supply.
Separate the controller cables from high-power lines such as a cable connecting to a power circuit. (Do not bundle together the controller cables with high-power lines or place them in the same cable duct.)
When extending the supplied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

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(3) 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

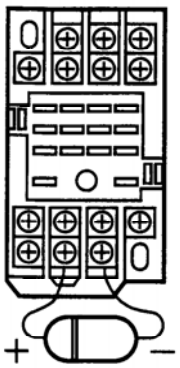
Measure: Install a surge absorber in parallel with the coil.



← 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.

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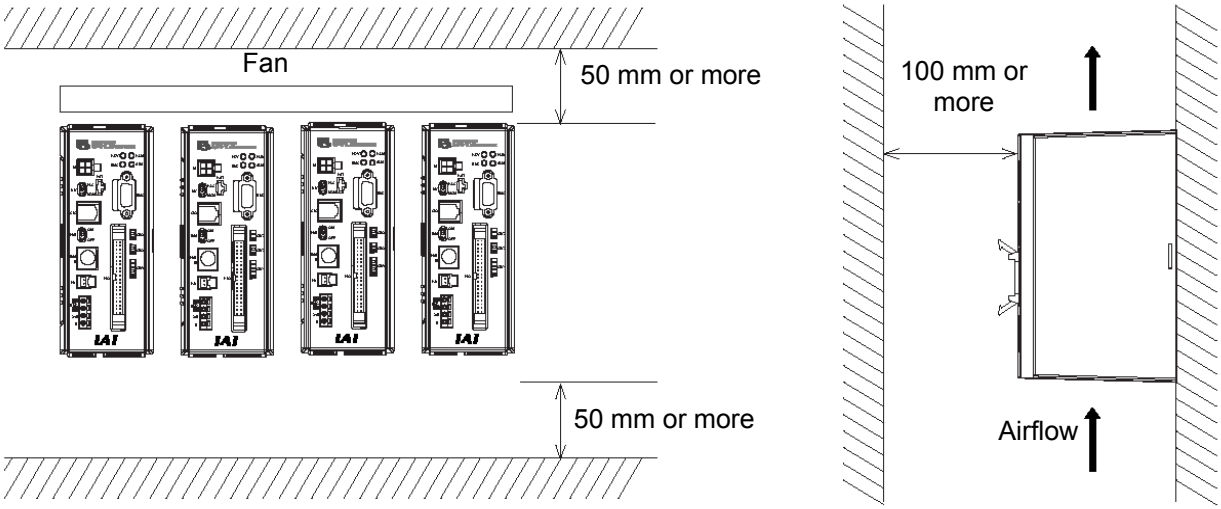
1.6 Heat Radiation and Installation

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

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

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

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



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

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2. Specification for 24-VDC Input Power

2.1 Basic Specifications

<table>
<tr><td colspan="2">Item</td><td colspan="12">Specification</td></tr>
<tr><td colspan="2">Supply voltage</td><td colspan="12">24 VDC ± 10%</td></tr>
<tr><td colspan="2" rowspan="2">Supply current [A]</td><td colspan="2">Type</td><td colspan="2">RA35</td><td colspan="2">RA45, F45</td><td colspan="2">RB75 (60 W)</td><td colspan="2">SA4, SA5</td><td colspan="2">SA6</td></tr>
<tr><td>Rating</td><td>Peak</td><td>1.8</td><td>4.3</td><td>2.4</td><td>6.0</td><td>3.9</td><td>7.5</td><td>1.2</td><td>3.7</td><td>1.4</td><td>3.9</td></tr>
<tr><td colspan="2">Maximum motor output</td><td colspan="12">60 W (Torque limit x 2) / Other (x 3)</td></tr>
<tr><td colspan="2">Surrounding air temperature/humidity</td><td colspan="12">0 to 40°C, 85%RH or less</td></tr>
<tr><td colspan="2">Surrrounding environment</td><td colspan="12">IP10, free from corrosive gases</td></tr>
<tr><td colspan="2">Weight</td><td colspan="12">540 g (Standard), 740 g (Absolute specification)</td></tr>
<tr><td colspan="2">Protective functions</td><td colspan="12">Regenerative voltage error, motor overcurrent, power-stage overheat, encoder error, motor overload, overspeed</td></tr>
<tr><td colspan="2">LED indicators</td><td colspan="12">RDY (ready), RUN, ALM (alarm), ENC (encoder error)</td></tr>
<tr><td colspan="2">DI/DO interface</td><td colspan="12">24 VDC, isolated</td></tr>
<tr><td rowspan="3">Input/output</td><td>8 dedicated input ports</td><td colspan="12">Start
Command position number (4-bit binary)
* Pause
Reset
Servo ON</td></tr>
<tr><td>10 dedicated output ports</td><td colspan="12">Completed position number (4-bit binary)
Position complete
Home return completion
Zone
* Alarm
* Emergency stop
Moving</td></tr>
<tr><td colspan="2">Serial interface input/output</td><td colspan="12"></td></tr>
<tr><td colspan="2">Number of positions</td><td colspan="12">16</td></tr>
<tr><td colspan="2">Data entry method</td><td colspan="12">Teaching pendant, PC software</td></tr>
<tr><td colspan="2">Storage device</td><td colspan="12">EEPROM 8 kbytes, S-RAM 128 kbytes</td></tr>
</table>

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

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2.1.1 Backup Battery (Absolute Specification)

(1) Battery Specification

Item	Description
Model number	AB-1
Type	Lithium battery
Manufacturer	Toshiba Battery Co., Ltd. (ER6VP)
Nominal voltage	3.6 V
Rated capacity	2000 mAh
Weight	Approx. 8.5 g
Battery retention time Note 1)	Approx. 20,000 hours (at surrounding air temperature of 20°C).

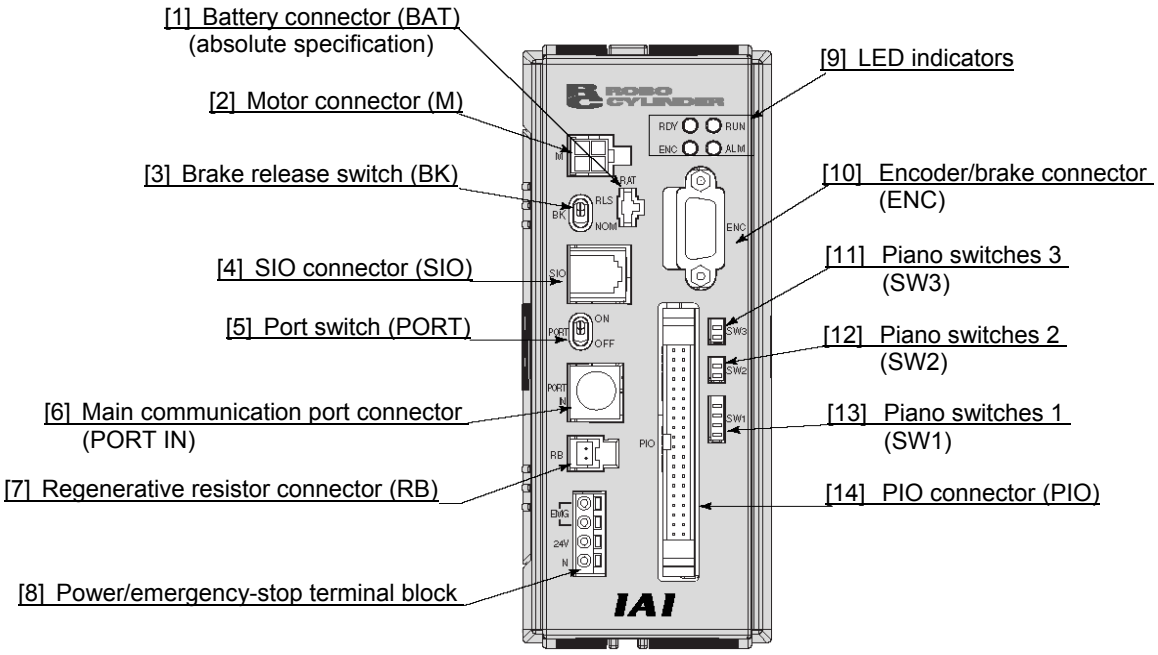
Note 1) Approx. 100 μA of current is consumed while data is backed up by the absolute data backup battery (as opposed to approx. 4 μA consumed while the main controller power is on).

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

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2.2 Names and Functions of Parts

2.2.1 Names



2.2.2 Functions

[1] Battery connector

A connector for absolute-data backup battery (absolute specification).

[2] Motor connector (M)

A connector for the actuator's motor power cable.

[3] Brake release switch (BK)

This switch is available only when the brake option is selected.
RLS: Brake is forcibly released
NOM: Brake is in use (Normal setting)

[4] SIO connector (SIO)

A connector for linking another controller when two or more controllers are connected.

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[5] Port switch (PORT)

ON: The PORT IN port (teaching pendant/PC software) becomes active. If a dedicated teaching pendant or cable is not connected to this port, the controller will recognize an emergency-stop condition.

OFF: The PORT IN port (teaching pendant/PC software) becomes inactive. (Controller-to-controller communication is possible.)

[6] Main communication port connector (PORT IN)

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

[7] Regenerative resistor connector (RB)

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

[8] Power/emergency-stop terminal block

EMG: Both terminals are used to connect an emergency-stop switch. (The controller is shipped with the EMG terminals shorted.)

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

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

[9] LEDs

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

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

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

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

[10] Encoder/brake connector (ENC)

A connector for encoder/brake power cable.

[11] Piano switches 3

Switches for selecting the encoder voltage. Use these switches if a custom cable is used and possibility of voltage drop must be taken into consideration.

Set switches 1 and 2 to ON or OFF in accordance with the cable length.

1	2	Cable length
ON	OFF	1 to 5 m
OFF	ON	5 to 10 m
ON	ON	10 to 15 m

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

[12] Piano switches 2

1 (bottom): ABS-CLR. Clear the absolute encoder data. Set this switch to ON when performing an absolute reset. --- Normally OFF

2 (top): FWP. Write protect switch. Set this switch to ON when performing a remote upload. --- Normally OFF

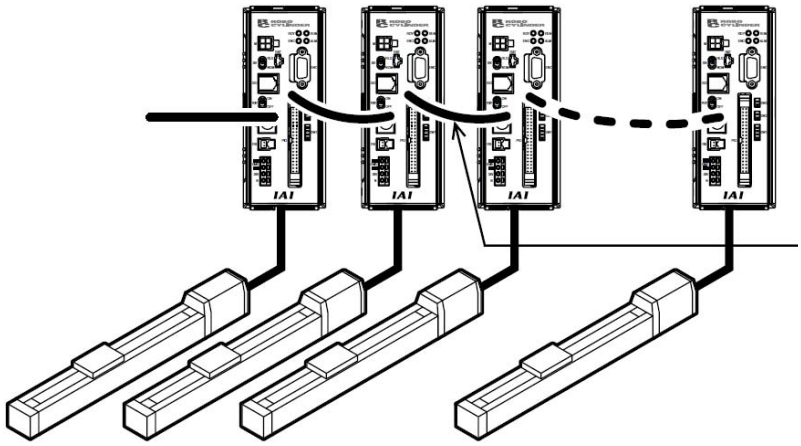
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[13] Piano switches 1 (SW1)

Nos. 1 to 4 --- Address switches

Use these switches to set the address of the applicable actuator if two or more axes are connected to the SIO connector. A desired address between 0 to 15 can be set.
(The factory setting is OFF for all of switch Nos. 1 to 4. This setting represents a condition where only one axis is used.)
Use these switches to set a desired address for each controller. Make sure no address is duplicated among the controllers. As long as they are unique, the addresses may not be contiguous and missing numbers are allowed.

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



The controller link cable is 200 mm long.
A maximum of 16 controllers can be connected.

Note: If multiple controllers are connected using link cables, the EMERGENCY STOP/ENABLE SW on the teaching pendant (optional) becomes effective only with respect to the controller to which the teaching pendant is connected.

[14] PIO connector (PIO)

A connector for PIO cable.

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2.2.3 Pin Assignments of the Communication Ports

- Pin assignments of the SIO connector

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

- Pin assignments of the main communication port

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

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

Motor connector [Molex 5569-04A1]

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

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・ Encoder/brake connector [High-density D-sub, DE-15 type]

Pin No.	Signal name	Connected wire
1	EN A+	Encoder A+
2	EN A–	Encoder A-
3	EN B+	Encoder B+
4	EN B–	Encoder B-
5	EN Z+	Encoder Z+
6	EN Z–	Encoder Z-
7	SD+	Encoder SD+
8	SD–	Encoder SD-
9	BAT+	(Battery+)
10	GND	(Battery-)
11	EN 5	Encoder 5V+
12	EN GND	Encoder COM-
13	BK N	Brake-
14	BK P	Brake+
15	FG	Shield

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

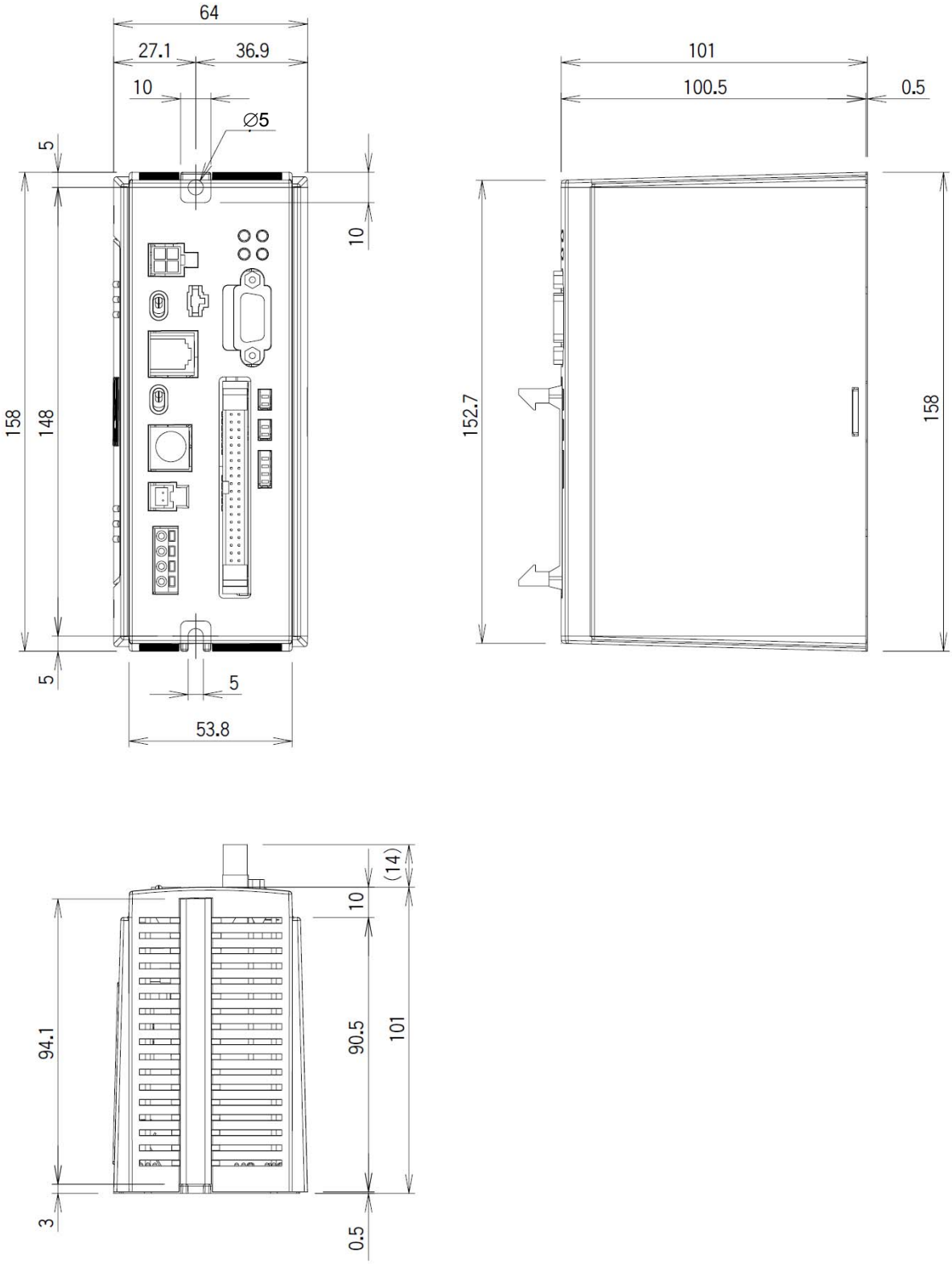
Signal Name	Connected wire
[2] EMG [1]	These terminals are connected to the emergency stop circuit. 24 V is output to [1]. (These terminals have been shorted prior to shipment.)
24 V	Positive side of the 24-V power supply
N	Negative side of the 24-V power supply

24 V and ENG [1] are connected internally.

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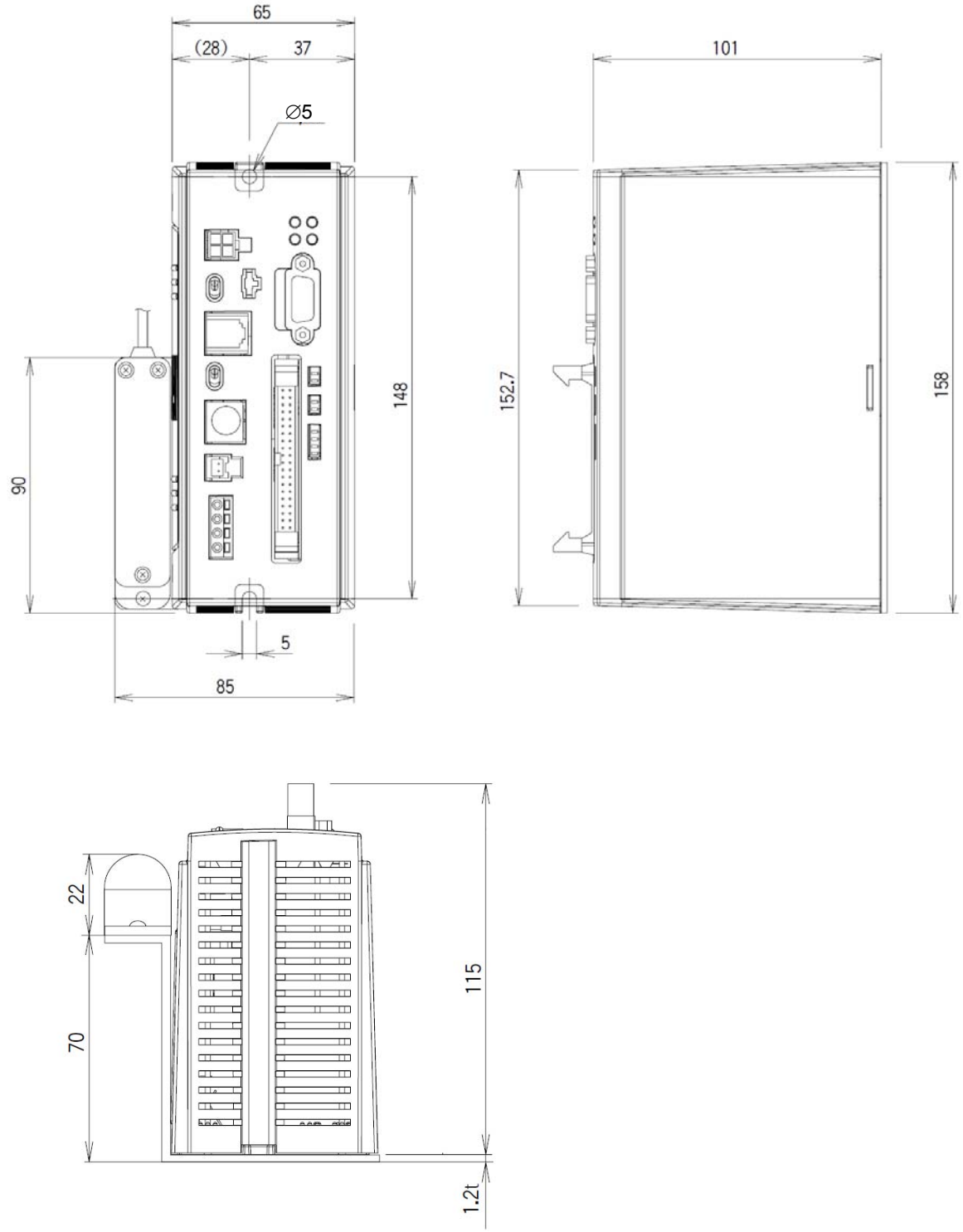
2.3 External Dimensional Diagram

2.3.1 Standard Specifications



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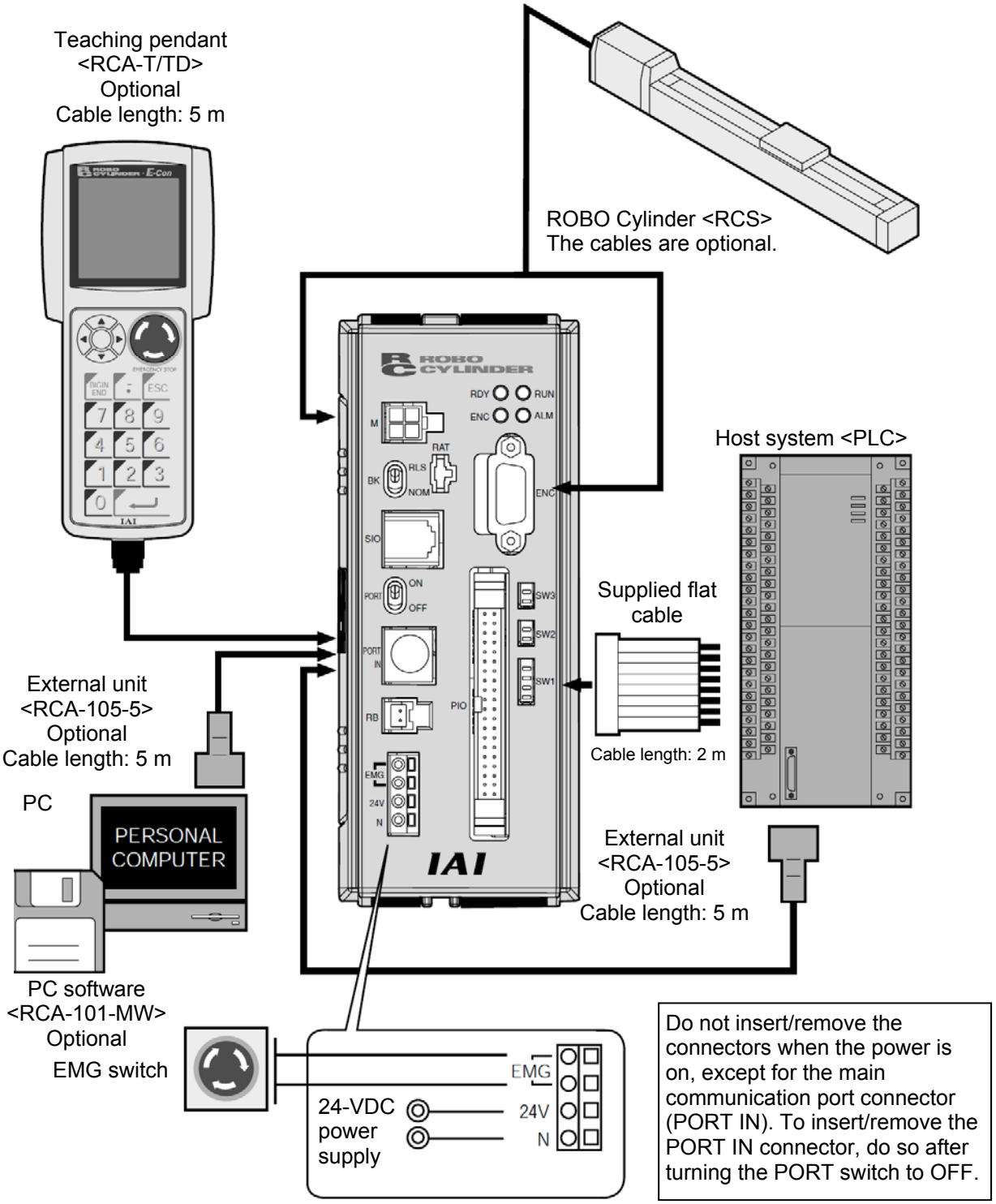
2.3.2 Absolute Specification



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2.4 Connection Method

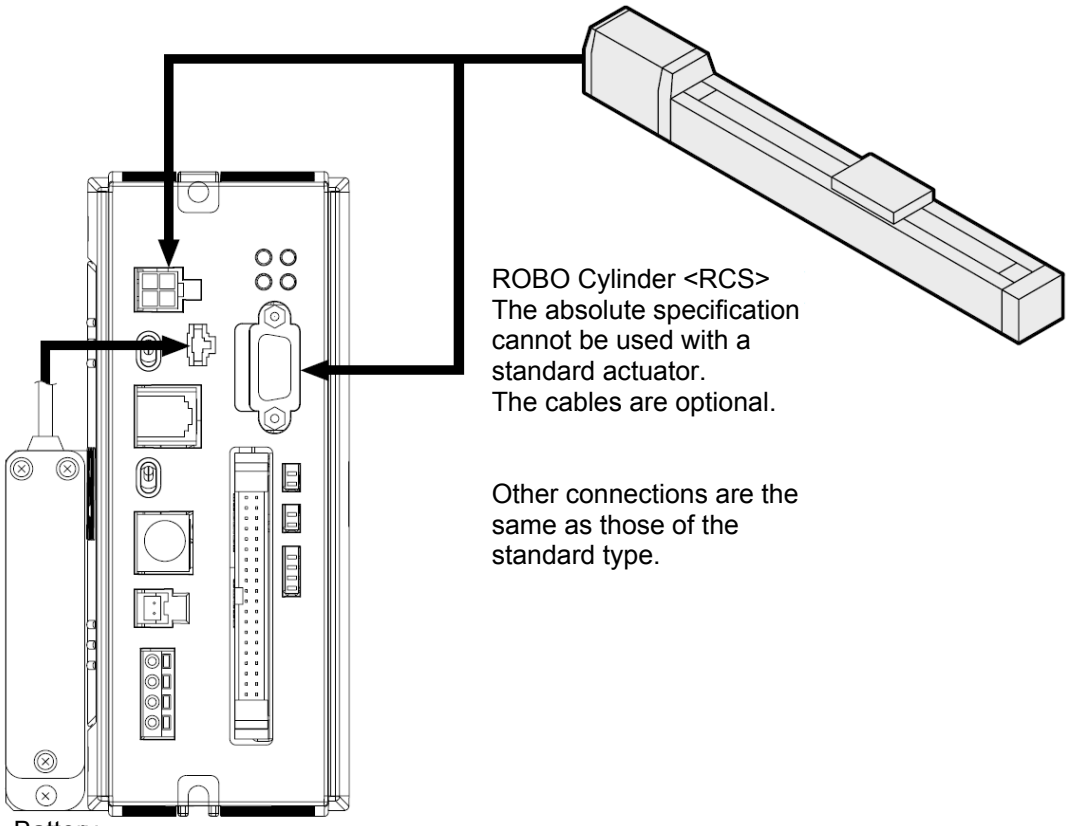
2.4.1 Standard Type



Do not insert/remove the connectors when the power is on, except for the main communication port connector (PORT IN). To insert/remove the PORT IN connector, do so after turning the PORT switch to OFF.

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2.4.2 Absolute Specifications

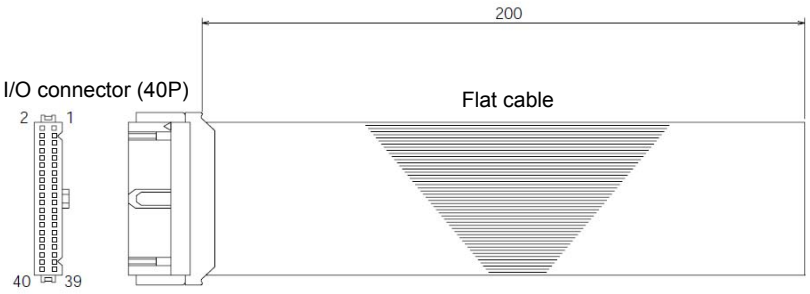


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2.5 Supplied Cable

2.5.1 I/O Flat Cable

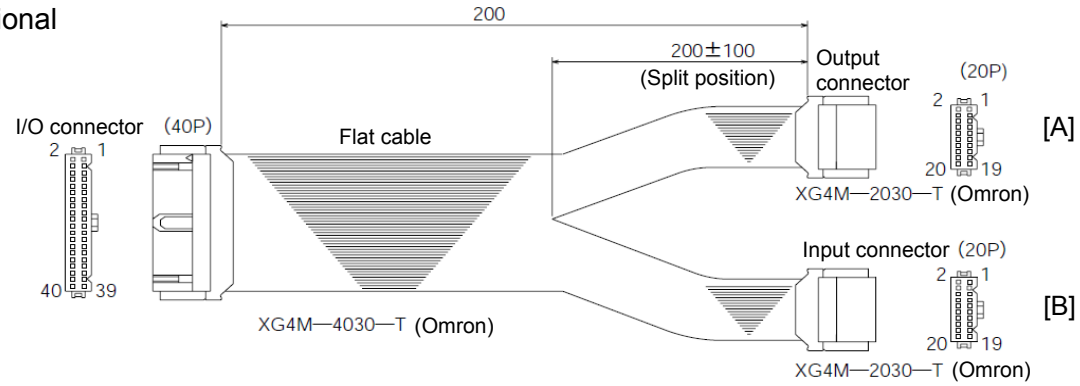
- Accessory



I/O connector (40P)

No	Signal name	Color	No	Signal name	Color	No	Signal name	Color	No	Signal name	Color
1	COM-OA	Brown-1	11	NC	Brown-2	21	COM-IA	Brown-3	31	NC	Brown-4
2	COM-OA	Red-1	12	Position complete	Red-2	22	COM-IA	Red-3	32	Start	Red-4
3	COM-OB	Orange-1	13	NC	Orange-2	23	COM-IB	Orange-3	33	NC	Orange-4
4	COM-OB	Yellow-1	14	Completed position 8	Yellow-2	24	COM-IB	Yellow-3	34	Command position 8	Yellow-4
5	NC	Green-1	15	NC	Green-2	25	NC	Green-3	35	NC	Green-4
6	*Alarm	Blue-1	16	Completed position 4	Blue-2	26	*Pause	Blue-3	36	Command position 4	Blue-4
7	NC	Purple-1	17	Moving	Purple-2	27	NC	Purple-3	37	NC	Purple-4
8	Zone	Gray-1	18	Completed position 2	Gray-2	28	Servo ON	Gray-3	38	Command position 2	Gray-4
9	NC	White-1	19	*Emergency stop	White-2	29	NC	White-3	39	NC	White-4
10	Home return completion	Black-1	20	Completed position 1	Black-2	30	Reset	Black-3	40	Command position 1	Black-4

- Optional



[A] Output connector (20P)

No	Signal name	Color	No	Signal name	Color
1	COM-OA	Brown-1	11	NC	Brown-2
2	COM-OA	Red-1	12	Position complete	Red-2
3	COM-OB	Orange-1	13	NC	Orange-2
4	COM-OB	Yellow-1	14	Completed position 8	Yellow-2
5	NC	Green-1	15	NC	Green-2
6	*Alarm	Blue-1	16	Completed position 4	Blue-2
7	NC	Purple-1	17	Moving	Purple-2
8	Zone	Gray-1	18	Completed position 2	Gray-2
9	NC	White-1	19	*Emergency stop	White-2
10	Home return completion	Black-1	20	Completed position 1	Black-2

[B] Input connector (20P)

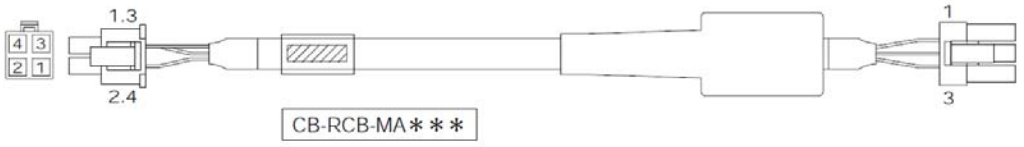
No	Signal name	Color	No	Signal name	Color
1	COM-IA	Brown-1	11	NC	Brown-2
2	COM-IA	Red-1	12	Start	Red-2
3	COM-IB	Orange-1	13	NC	Orange-2
4	COM-IB	Yellow-1	14	Command position 8	Yellow-2
5	NC	Green-1	15	NC	Green-2
6	*Pause	Blue-1	16	Command position 4	Blue-2
7	NC	Purple-1	17	NC	Purple-2
8	Servo ON	Gray-1	18	Command position 2	Gray-2
9	NC	White-1	19	NC	White-2
10	Reset	Black-1	20	Command position 1	Black-2

* The I/O connector (40P) is the same as the above accessory

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2.5.2 Motor Extension Cable

Controller end — Actuator end



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

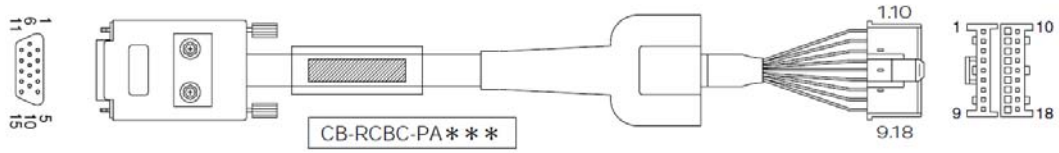
Receptacle: 5557-04R (Molex)
Female terminal: 5556-TL (Molex)

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

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

2.5.3 Encoder Extension Cable

Controller end — Actuator end



Cable color	Signal abbreviation	Pin no.
Pink	A/U	1
Purple	$\overline{A}/\overline{U}$	2
White	B/V	3
lue/red	$\overline{B}/\overline{V}$	4
Orange/white	Z/W	5
Green/white	$\overline{Z}/\overline{W}$	6
Blue	SD	7
Orange	$\overline{SD}$	8
Black	BAT＋	9
Yellow	BAT−	10
Green	VCC	11
Brown	GND	12
Gray	BK−	13
Red	BK＋	14
—	—	15
Connect the shield to the hood using a clamp.		

Plug connector with hood:17HE-23150-C (D13A) (DDK)
Contact:17H-7PCR-102 (P500) (DDK)

Ground and braided shield wires

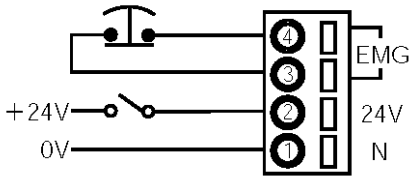
Pin no.	Signal abbreviation	Cable color
1	A/U	Pink
2	$\overline{A}/\overline{U}$	Purple
3	B/V	White
4	$\overline{B}/\overline{V}$	lue/red
5	Z/W	Orange/white
6	$\overline{Z}/\overline{W}$	Green/white
7	—	—
8	—	—
9	FG	Ground
10	SD	Blue
11	$\overline{SD}$	Orange
12	BAT＋	Black
13	BAT−	Yellow
14	VCC	Green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

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

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2.6 Wiring

2.6.1 Wiring for Power Supply/Emergency Stop



Power/emergency-stop terminal block

* The two EMG terminals are contact-b inputs used for connecting an emergency-stop switch. The controller is shipped with these terminals shorted, so that an emergency stop will not be actuated. 24 VDC is output to EMG of pin No. 3.
The current consumption of the emergency-stop circuit is approx. 35 mA (24-V controller).

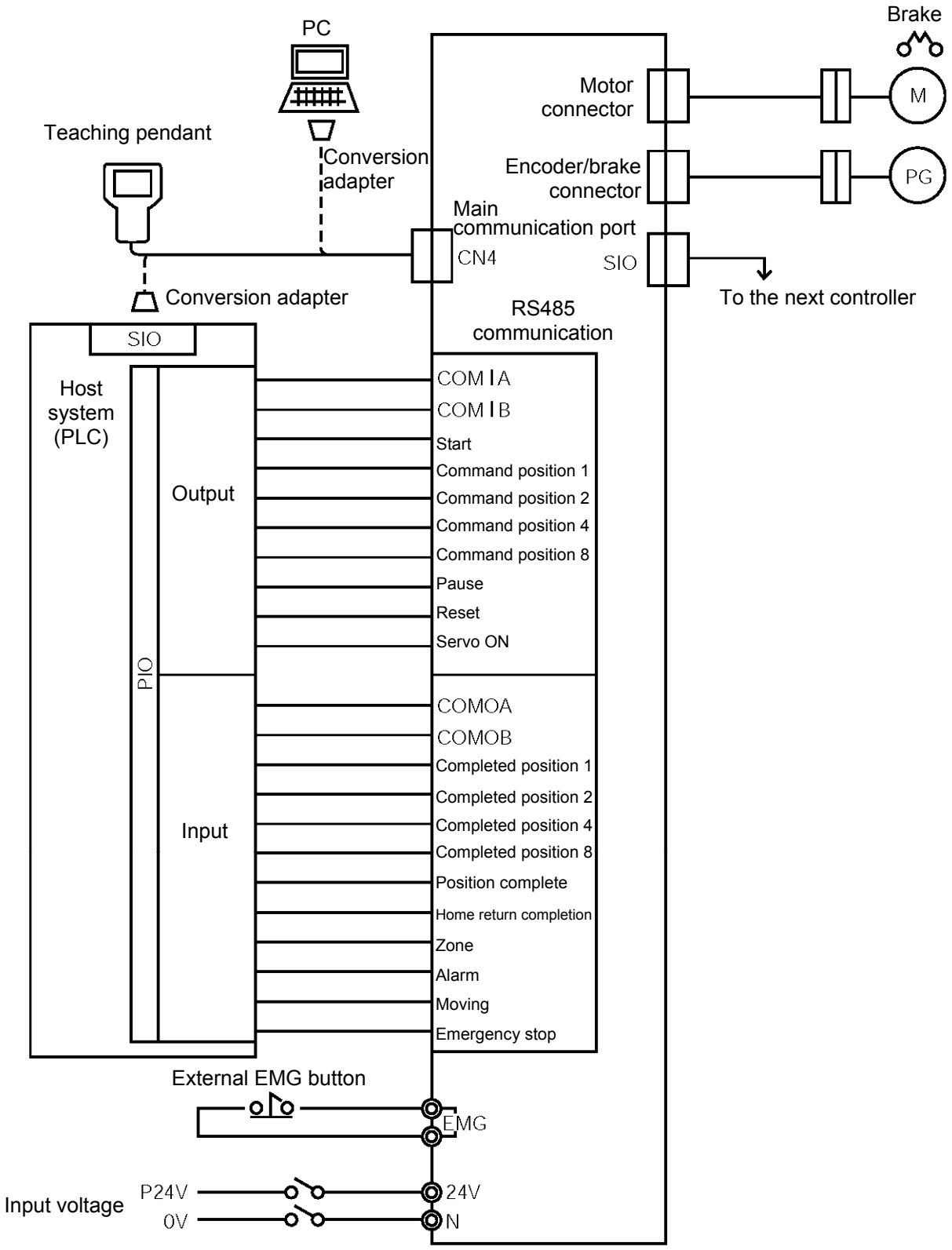
Note: When performing power connection, make sure the following specifications for power cable, etc., are satisfied.

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

Note: This controller has no power switch.

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2.6.2 External Connection Diagram



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2.6.3 PIO Interface

A PIO interface list is given below.
The PIO cable is a flat cable with no connector attached on the end connected to the external equipment.

PIO connector (40 pins)

Pin No.	Category	Reference No.	Signal name	Cable color	Pin No.	Category	Reference No.	Signal name	Cable color
1		[1]	COMOA	Brown-1	2		[1]	COMOA	Red-1
3		[2]	COMOB	Orange-1	4		[2]	COMOB	Yellow-1
5	Output		NC	Green-1	6	Output	[3]	*Alarm	Blue-1
7				Purple-1	8		[4]	Zone	Gray-1
9				White-1	10		[5]	Home return completion	Black-1
11				Brown-2	12		[6]	Position complete	Red-2
13				Orange-2	14		[7]	Completed position 8	Yellow-2
15				Green-2	16			Completed position 4	Blue-2
17		[8]	Moving	Purple-2	18			Completed position 2	Gray-2
19		[9]	*Emergency stop	White-2	20			Completed position 1	Black-2
21		[10]	COMIA	Brown-3	22		[10]	COMIA	Red-3
23		[11]	COMIB	Orange-3	24		[11]	COMIB	Yellow-3
25	Input		NC	Green-3	26	Input	[12]	*Pause	Blue-3
27				Purple-3	28		[13]	Servo ON	Gray-3
29				White-3	30		[14]	Reset	Black-3
31				Brown-4	32		[15]	Start	Red-4
33				Orange-4	34		[16]	Command position 8	Yellow-4
35				Green-4	36			Command position 4	Blue-4
37				Purple-4	38			Command position 2	Gray-4
39				White-4	40			Command position 1	Black-4

Note: The ports indicated by an asterisk (*) conform to the contact-b signal logic (always ON).
Never connect those ports that are not used.

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[1] COMOA
[2] COMOB
} Power supply for output ports

Connect the 24-VDC power supply for output ports between COMOA and COMOB.
COMOA and COMOB have no polarities.
Pin Nos. 1 & 2, and 3 & 4 are connected internally.

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

[4] Zone
A zone signal will be output when the actuator enters the range set by the applicable parameter.

[5] Home return completion
This signal will turn ON when the initial home return is completed after a power connection. Thereafter, this signal will remain ON until the power is turned off. It will not turn OFF following an emergency-stop signal input.
If the home return completion signal is OFF, it means home return will be performed before the next movement operation.

Note:	With the absolute specification, the home return completion signal will turn ON when the power is turned on, after an absolute reset was executed once. If the home return completion signal turns OFF due to an alarm, an absolute reset must be executed again.

[6] Position complete
This signal will turn ON when the controller becomes ready following a power connection. It will turn OFF when a start signal is input, and turn ON when a movement is completed.

[7] Completed position
All completed position signals will turn OFF the moment the position complete signal turns OFF.
All completed position signals remain OFF while an emergency stop is actuated or during the direct teaching mode.
When the controller returns to the ready mode thereafter, the completed position signal corresponding to the current actuator position will be output if the current actuator position is within the positioning band from the last position complete position. If the current actuator position is outside the positioning band, all completed position signals will remain OFF.
In the push & hold mode, all completed position signals will remain OFF when the controller returns to the ready mode from an emergency-stop status or the direct teaching mode, regardless of the current actuator position.
When an alarm occurs, a corresponding alarm code (short form) is output by the four bits of completed positions 1, 2, 4 and 8. The meanings of these signals vary in a normal state and when an alarm is present, so exercise caution when writing a sequence program. (Refer to 7.3, "Alarm Output by PIO.")

[8] Moving
This signal remains ON while the actuator is moving.
Use this signal if you want to detect stopping of the motor during pause.

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[9] Emergency stop
This signal will turn OFF when an emergency stop is actuated. It remains ON as long as the controller is operating properly.
When the emergency stop is cancelled, the signal will turn ON.

[10] COMIA
[11] COMIB
} Power supply for input ports

Connect the 24-VDC power supply for input ports between COMIA and COMIB.
Pin Nos. 21 & 22, and 23 & 24 are connected internally.

[12] Pause
This is a contact-b input. Keep the signal ON while the actuator is moving, and cause it to turn OFF when the movement pauses.

[13] Servo ON
The servo is ON while this signal is ON.

[14] Reset
An alarm will be reset once a rise of this signal is detected. If the cause of the alarm is not yet removed, the alarm will come back after the reset action.
When this signal is input while the actuator is in pause, the remaining travel will be cancelled.

[15] Start
Inputting this signal will start movement.

[16] Command position
Input the position number you want to select.
Relationship of input pin numbers and selected position numbers (4-bit binary)

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

1: ON 0: OFF

Pin No.	40	Command position 1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	38	Command position 2	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	36	Command position 4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	34	Command position 8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Selected position No.			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

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

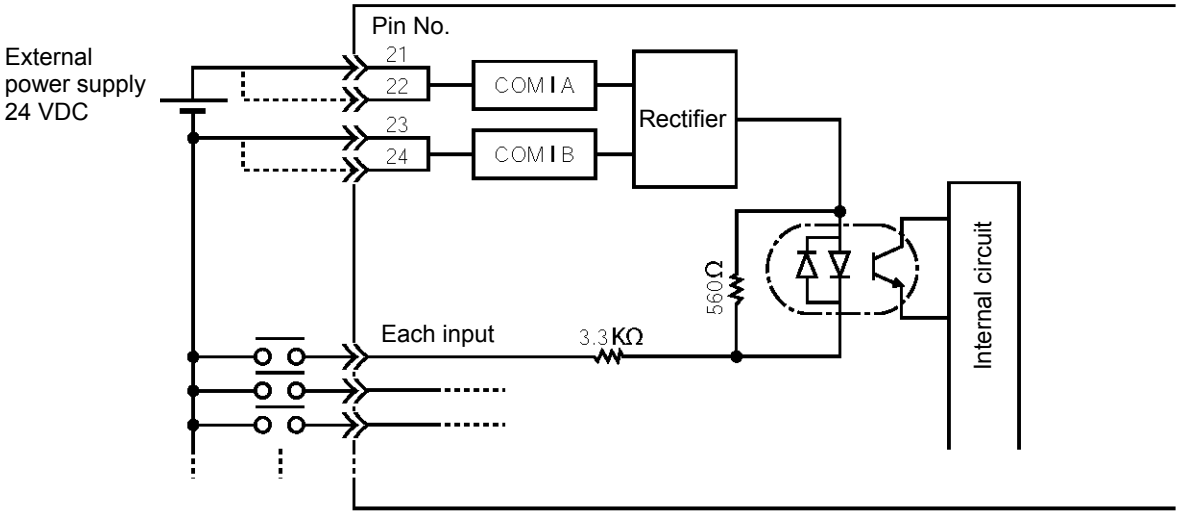
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2.6.4 External I/O Specifications

Input Part

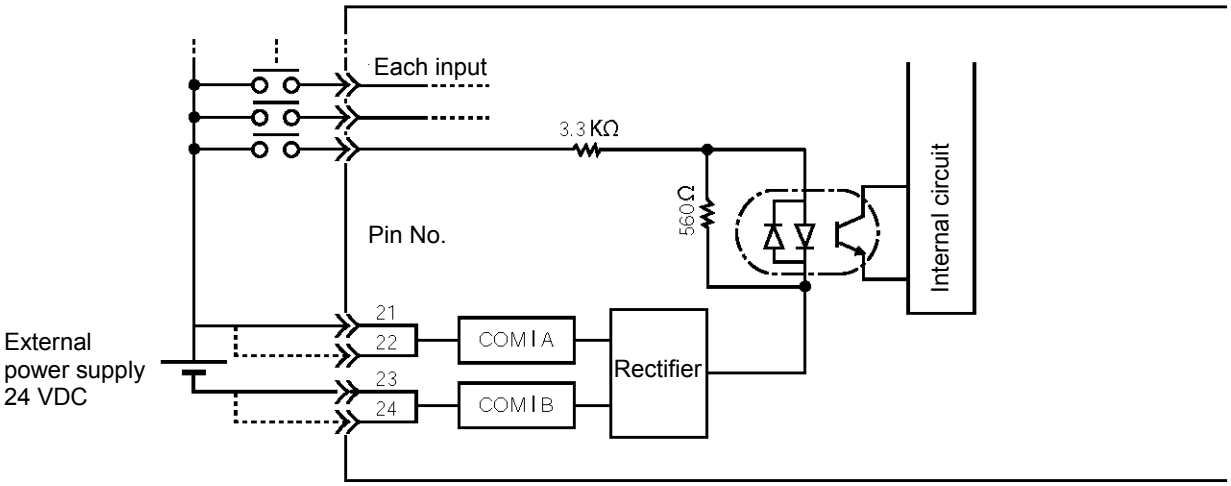
Item	Specification
Number of input points	8 points
Input voltage	24 VDC ± 20 %
Input current	7 mA per circuit
Operating voltage	ON voltage --- 16 V min. (4.5 mA) OFF voltage --- 6 V max. (1.4 mA)
Isolation method	Photocoupler

Internal circuit configuration (Standard NPN specification)



- Connect a 24-V power supply between COMIA and COMIB.
- Connect the input common to the negative side of the external power supply.
- Pin Nos. 21 and 22 of COMIA and 23 and 24 of COMIB are connected internally.

Internal circuit configuration (Optional PNP specification)



- Connect a 24-V power supply between COMIA and COMIB.
- Connect the input common to the positive side of the external power supply.
- Pin Nos. 21 and 22 of COMIA and 23 and 24 of COMIB are connected internally.

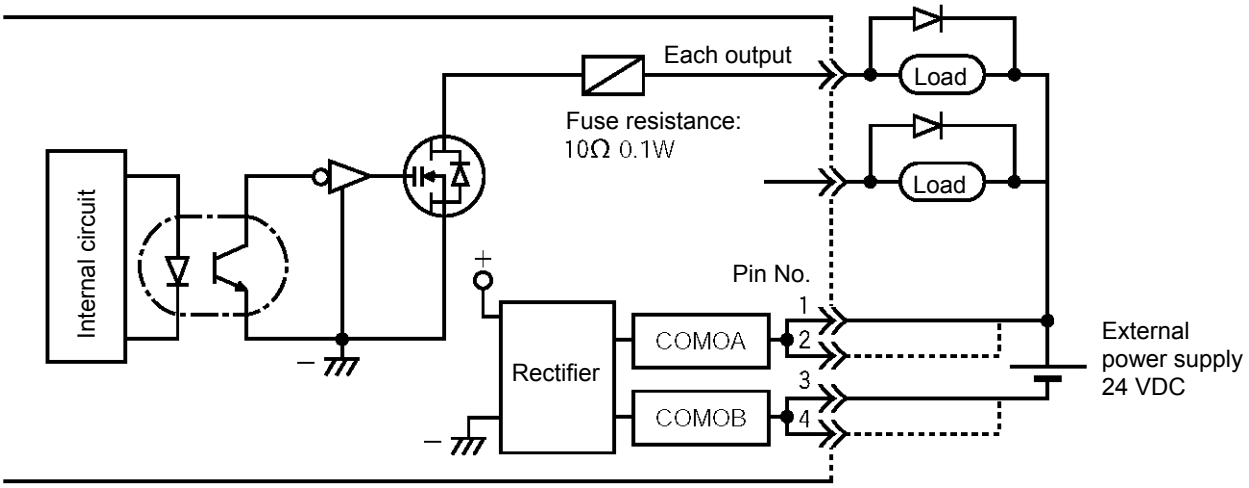
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Output Part

100-mA output circuit by power MOSFET

Item	Specification
Number of output points	10 points
Rated load voltage	24 VDC; 60 VDC (peak) (without flywheel diode)
Maximum load current	100 mA per point
Residual voltage	1.8 V / 100 mA
Isolation method	Photocoupler
Overcurrent protection	Fuse resistance: 10 Ω, 0.1 W

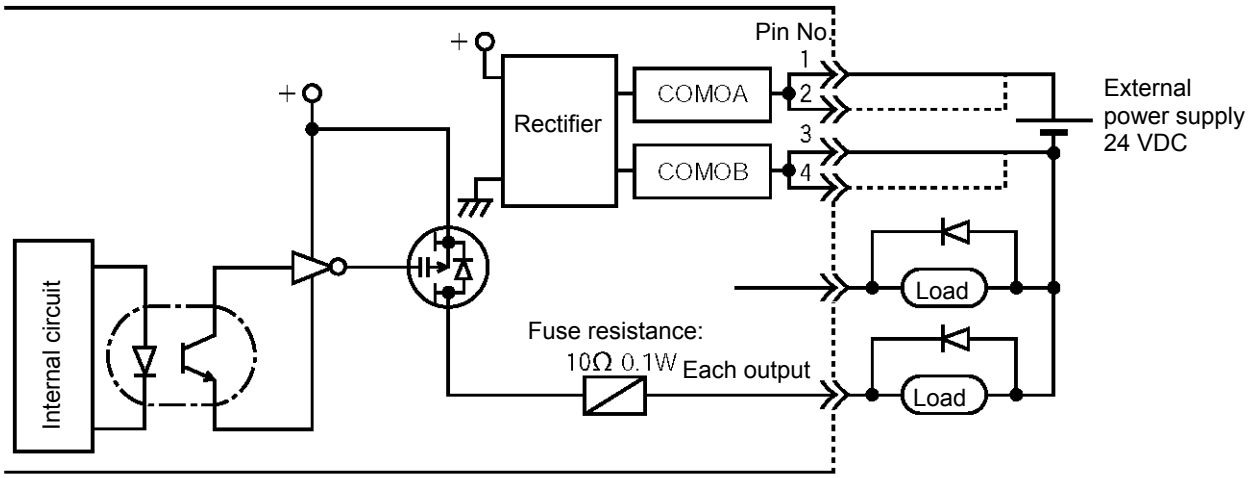
Internal circuit configuration (Standard NPN specification)



- Supply 24 VDC between COMOA and COMOB. COMOA and COMOB have no polarities.
- Pin Nos. 1 & 2, and 3 & 4, are connected internally.

Note 1) The output circuit is an open-drain circuit provided by a power MOSFET and has no flywheel diode. When connecting a load, such as a relay, also connect a diode, etc., to suppress flyback voltage. (Spike noise can be eliminated most effectively when a diode is connected at the closet possible position to the coil).

Internal circuit configuration (Optional PNP specification)



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3. Input Power 100/200 VAC Specification

3.1 Base Specification

<table>
<tr><td colspan="2">Item</td><td colspan="14">Specification</td></tr>
<tr><td colspan="2">Supply voltage</td><td colspan="14">90 to 125 / 180 to 250 VAC</td></tr>
<tr><td colspan="2" rowspan="2">Supply current [VA]</td><td colspan="2">Type</td><td colspan="2">RB75 (60 W)</td><td colspan="2">RB75 (100 W)</td><td colspan="2">RB75 (150 W)</td><td colspan="2">RA55 (60 W), SSR (60 W), F55 (60 W)</td><td colspan="2">RA55 (100 W), SMR (100 W), F55 (100 W)</td><td colspan="2">SMR (150 W)</td></tr>
<tr><td>Rating</td><td>Peak</td><td>152</td><td>487</td><td>246</td><td>700</td><td>333</td><td>1026</td><td>166</td><td>546</td><td>265</td><td>902</td><td>364</td><td>1285</td></tr>
<tr><td colspan="2">Maximum motor output</td><td colspan="14">150 W (torque limit at 3 times)</td></tr>
<tr><td colspan="2">Rush current (maximum instantaneous value)</td><td colspan="14">44 A
(Select the medium-speed type for the NFB.)</td></tr>
<tr><td colspan="2">Surrounding air temperature/humidity</td><td colspan="14">0 to 40°C, 85%RH or less</td></tr>
<tr><td colspan="2">Surrounding environment</td><td colspan="14">IP10, free from corrosive gases</td></tr>
<tr><td colspan="2">Weight</td><td colspan="14">Standard: 1,320 g / Absolute specification: 1,610 g</td></tr>
<tr><td colspan="2">Protective functions</td><td colspan="14">Regenerative voltage error, motor overcurrent, power-stage overheat, encoder error, motor overload, overspeed</td></tr>
<tr><td colspan="2">Withstand voltage (Note 2)</td><td colspan="14">1500 VAC, 1 minute</td></tr>
<tr><td colspan="2">LED indicators</td><td colspan="14">RDY (green), RUN (green), ALM (red), ENC (orange)</td></tr>
<tr><td colspan="2">DI/DO interface</td><td colspan="14">24 VDC, isolated</td></tr>
<tr><td rowspan="3">Input/output (Note 1)</td><td>8 dedicated input ports</td><td colspan="14">Start
Command position number (4-bit binary)
Pause
Reset
Servo ON</td></tr>
<tr><td rowspan="2">11 dedicated output ports</td><td colspan="14">Completed position number (4-bit binary)
Position complete
Home return completion
Zone
Alarm
Emergency stop
Moving
Battery alarm</td></tr>
<tr><td colspan="14">Serial interface input/output</td></tr>
<tr><td colspan="2">Number of positions</td><td colspan="14">16</td></tr>
<tr><td colspan="2">Data entry method</td><td colspan="14">Teaching pendant, PC software</td></tr>
<tr><td colspan="2">Storage device</td><td colspan="14">EEPROM 8 kbytes, S-RAM 128 kbytes</td></tr>
</table>

(Note 1): Supplying the power-supply port or any I/O port with a voltage beyond the specified level may result in controller failure.

(Note 2): The withstand voltage of the motor driving the actuator is 1000 V for 1 minute. When conducting a withstand voltage test while the controller and actuator are connected, make sure a voltage exceeding 1000 V is not supplied for more than 1 minute.

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3.1.1 Backup Battery (Absolute Specification)

(1) Battery specifications

Item	Description
Model number	AB-1
Classification	Lithium battery
Manufacturer	Toshiba Battery (ER6VP)
Nominal voltage	3.6 V
Rated capacity	2000 mAh
Weight	Approx. 8.5 g
Battery retention time Note 1)	Approx. 20,000 hours (at surrounding air temperature of 20°C)

Note 1) The absolute-data backup battery consumers approx. 100 μA during backup. (When the main controller power is on, the current consumption is approx. 4 μA.)

* Do not modify or extend the cable. It may result in controller failure.
* The battery is replaced together with the battery board. The battery cannot be replaced alone. Be sure to use the battery module specified by IAI.

(2) Battery alarm and battery error

A battery alarm (alarm code: 07A) will occur when the battery voltage drops to approx. 3.1 V. This alarm is output to PIO connector pin No. 15. The controller operation will not be disabled right away after a battery alarm occurs. The alarm merely indicates that the battery should be replaced soon. Once a battery alarm occurs, the controller will generate a battery error in approx. 220 hours (around nine days).
A battery alarm can be temporarily reset by inputting a reset signal or pressing the BEGIN/END key on the teaching pendant for at least 2.5 seconds.

Note) The battery-alarm function is supported by the 100/200-V controller of version M5 or later.

A battery error will occur when the battery voltage drops to approx. 2.5 V. Once the battery voltage drops to this level, the controller will detect an error (alarm code: 0E5) the next time the power is turned on. A battery error is detected only when the controller power is turned on.
The controller operation will be disabled once a battery error occurs. You must replace the battery, and then execute an absolute reset.

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If the battery was replaced while the controller power was off, the position information (absolute data) may or may not be retained depending on how long the controller remained without battery.

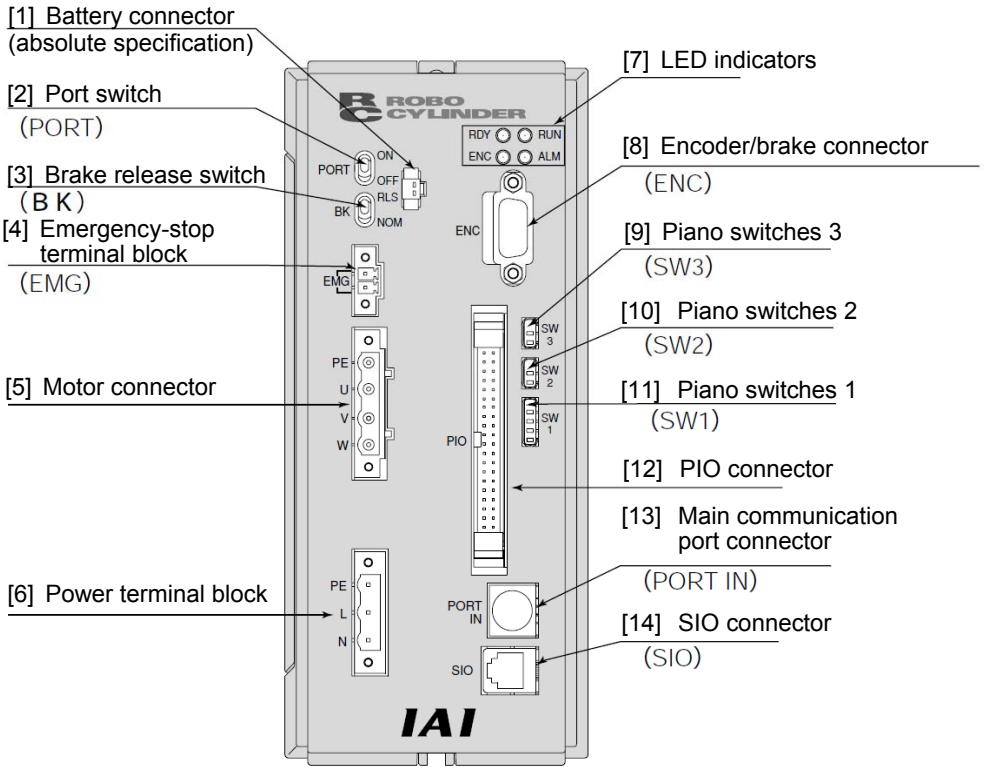
Time without battery	Retention of position information (absolute data)
Less than 5 minutes	Position information (absolute data) is retained. Absolute reset is not necessary.
5 to 15 minutes	A battery alarm occurs. Position information is retained. Absolute reset is not necessary.
More than 15 minutes	A battery error occurs. Position information is not retained. Absolute reset is necessary.

Note) The position-information (absolute-data) retention function during battery replacement is supported by the 100/200-V controller of version M5 or later.
If a battery error was already present before the replacement, an absolute reset will be required even if the controller has been without battery for no more than 15 minutes.

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3.2 Names and Functions of Parts

3.2.1 Names



3.2.2 Functions

[1] Battery connector
A connector for absolute-data backup battery (absolute specification).

[2] Port switch (PORT)
ON: The PORT IN port (teaching pendant/PC software) becomes active. If a dedicated teaching pendant or cable is not connected to this port, the controller will recognize an emergency-stop condition.
OFF: The PORT IN port (teaching pendant/PC software) becomes inactive. (The SIO line remains live, so controller-to-controller communication is possible.)

[3] Brake release switch (BK)
This switch is available only when the brake option is selected.
RLS: Brake is forcibly released
NOM: Brake is in use (Normal setting)

[4] Emergency-stop terminal block
EMG: Both terminals are used to connect an emergency-stop switch.

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[5] Motor connector
A connector for the actuator's motor power cable.

[6] Power terminal block
L/N: An AC-power connection terminal.
PE: A protective grounding terminal. Provide class D grounding.

[7] LEDs
RDY: Indicate that the CPU is operating normally.
RUN: This LED turns on while the actuator is moving.
ENC: This LED turns on when the encoder cable is open or otherwise the encoder cannot be recognized. The LED also turns on when the voltage of the absolute-data backup battery drops.
ALM: This LED remains lit while an alarm is present.

[8] Encoder/brake connector (ENC)
A connector for encoder/brake power cable.

[9] Piano switches 3
Switches for selecting the encoder voltage. Use these switches if a custom cable is used and possibility of voltage drop must be taken into consideration.
Set switches 1 and 2 to ON or OFF in accordance with the cable length.

1	2	Cable length
ON	OFF	1 to 5 m
OFF	ON	5 to 10 m
ON	ON	10 to 15 m

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

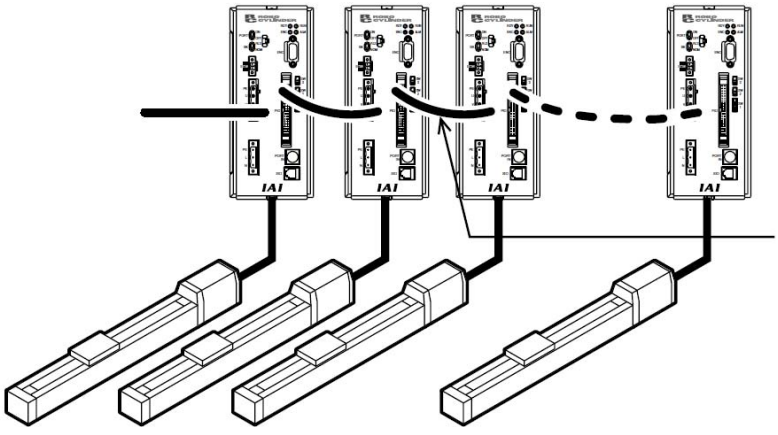
[10] Piano switches 2
1 (bottom): ABS-CLR. Clear the absolute encoder data. Set this switch to ON when performing an absolute reset. --- Normally OFF
2 (top): FWP. Write protect switch. Set this switch to ON when performing a remote upload. --- Normally OFF

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[11] Piano switches 1 (SW1)
Nos. 1 to 4 --- Address switches

Use these switches to set the address of the applicable actuator if two or more axes are connected to the SIO connector. A desired address between 0 to 15 can be set.
(The factory setting is OFF for all of switch Nos. 1 to 4. This setting represents a condition where only one axis is used.)
Use these switches to set a desired address for each controller. Make sure no address is duplicated among the controllers. As long as they are unique, the addresses may not be contiguous and missing numbers are allowed.

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



The controller link cable is 200 mm long.
A maximum of 16 controllers can be connected.

Note: If multiple controllers are connected using link cables, the EMERGENCY STOP/ENABLE SW on the teaching pendant (optional) becomes effective only with respect to the controller to which the teaching pendant is connected.

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[12] PIO connector (PIO)
A connector for PIO cable.

[13] Main communication port connector (PORT IN)
A connector for receiving the communication cable from a dedicated teaching pendant or external equipment. It also receives a controller link cable when two or more axes are connected.

[14] SIO connector (SIO)
A connector for linking another controller when two or more controllers are connected.

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3.2.3 Signal Tables of Connectors and Terminal Blocks

・ Pin assignments of the SIO connector

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

・ Pin assignments of the main communication port

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

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

Motor connector [Molex 5569-04A1]

Signal name	Connected wire
PE	Motor FG
U	Motor phase U
V	Motor phase V
W	Motor phase W

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・ Encoder/brake connector [High-density D-sub, DE-15 type]

Pin No.	Signal name	Connected wire
1	EN A+	Encoder A+
2	EN A–	Encoder A-
3	EN B+	Encoder B+
4	EN B–	Encoder B-
5	EN Z+	Encoder Z+
6	EN Z–	Encoder Z-
7	SD+	Encoder SD+
8	SD–	Encoder SD-
9	BAT+	(Battery+)
10	GND	(Battery-)
11	EN 5N	Encoder 5V+
12	EN GND	Encoder COM-
13	BK N	Brake -
14	BK P	Brake +
15	FG	Shield

・ Power terminal block [Phoenix]

Signal name	Connected wire
PE	Ground
L	AC single-phase power supply, live side
N	AC single-phase power supply, ground side

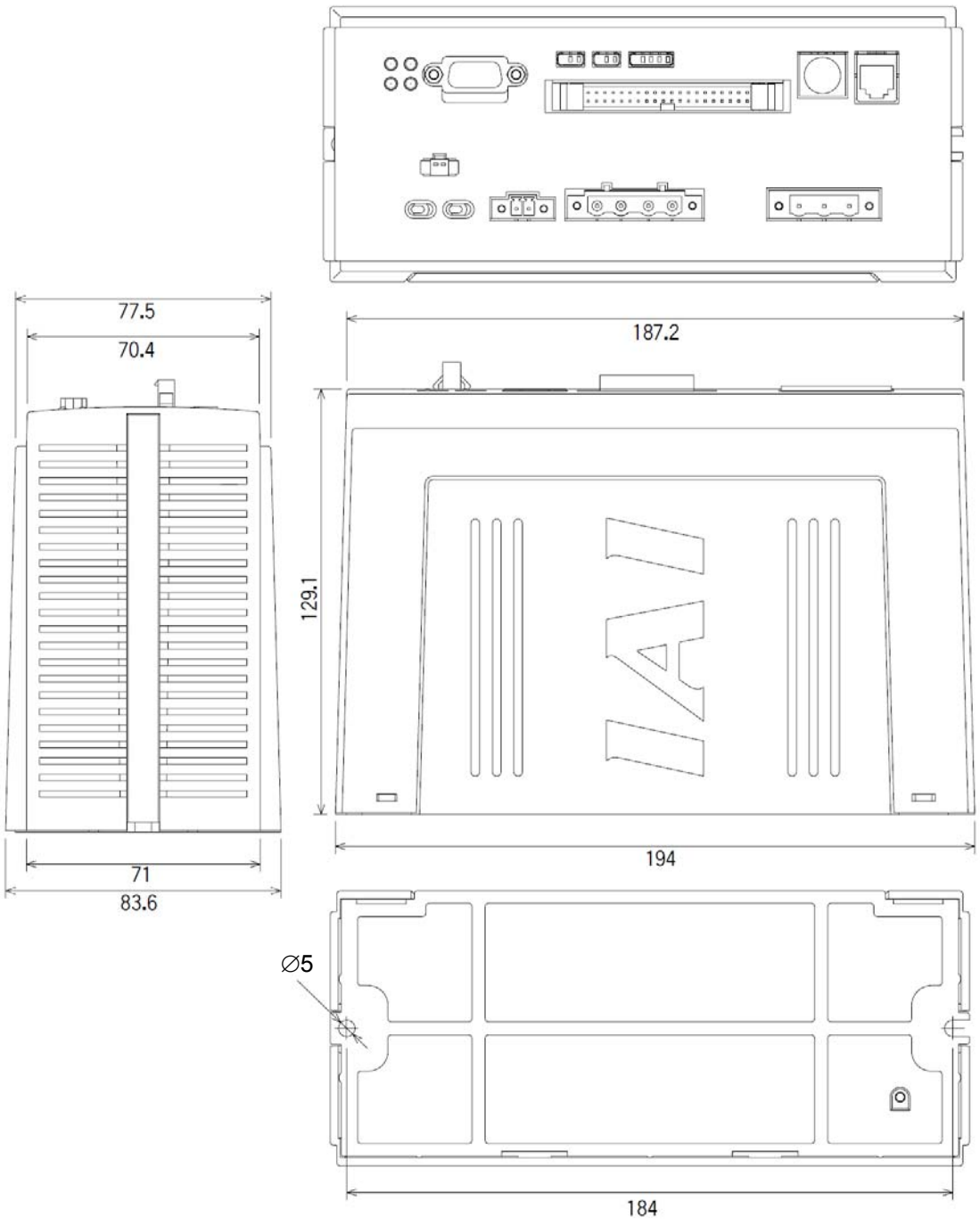
・ Emergency-stop terminal block

Signal name	Connected wire
EMG	Connection of emergency stop circuit (shorted when shipped)

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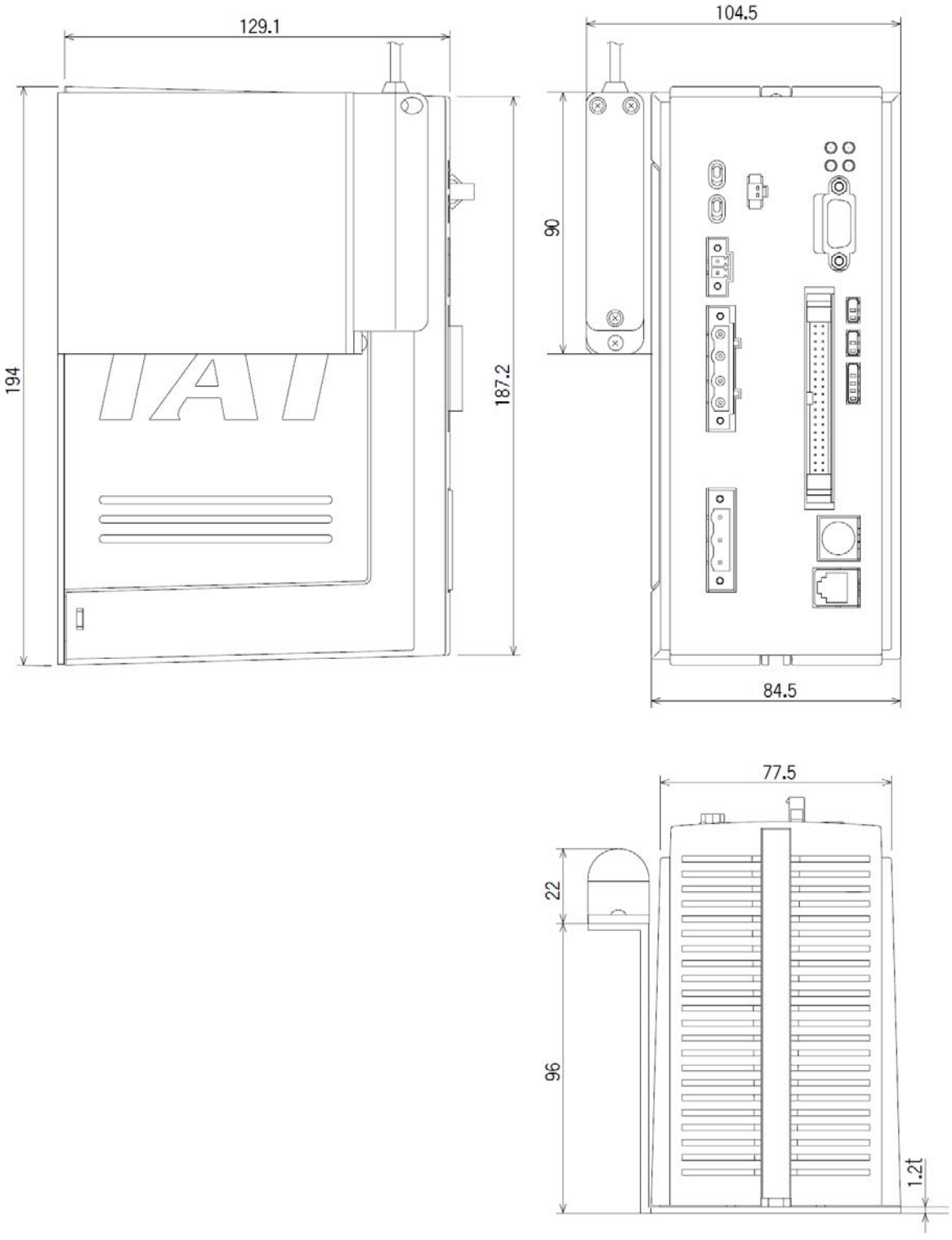
3.3 External Dimensions

3.3.1 Standard Type



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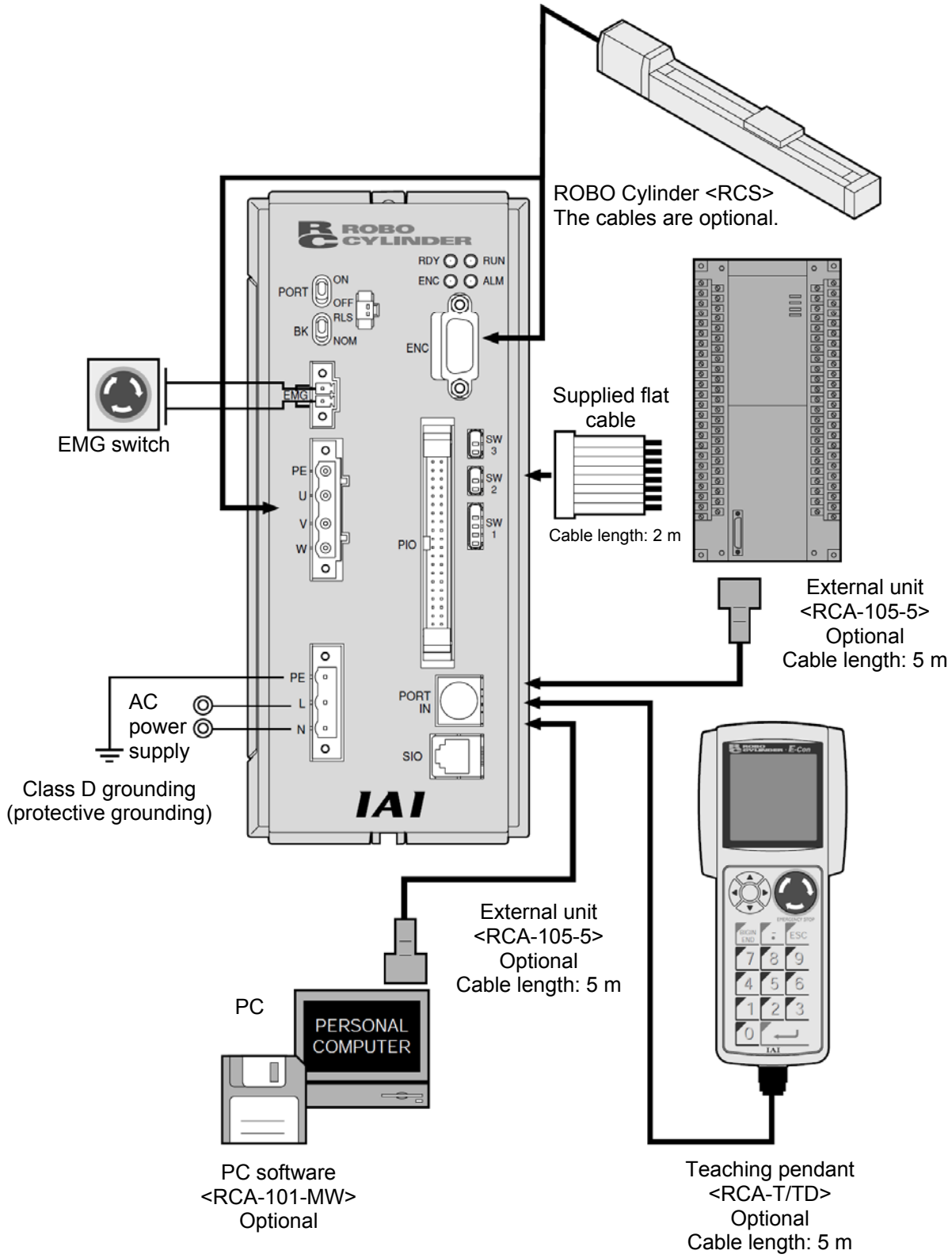
3.3.2 Absolute Specification



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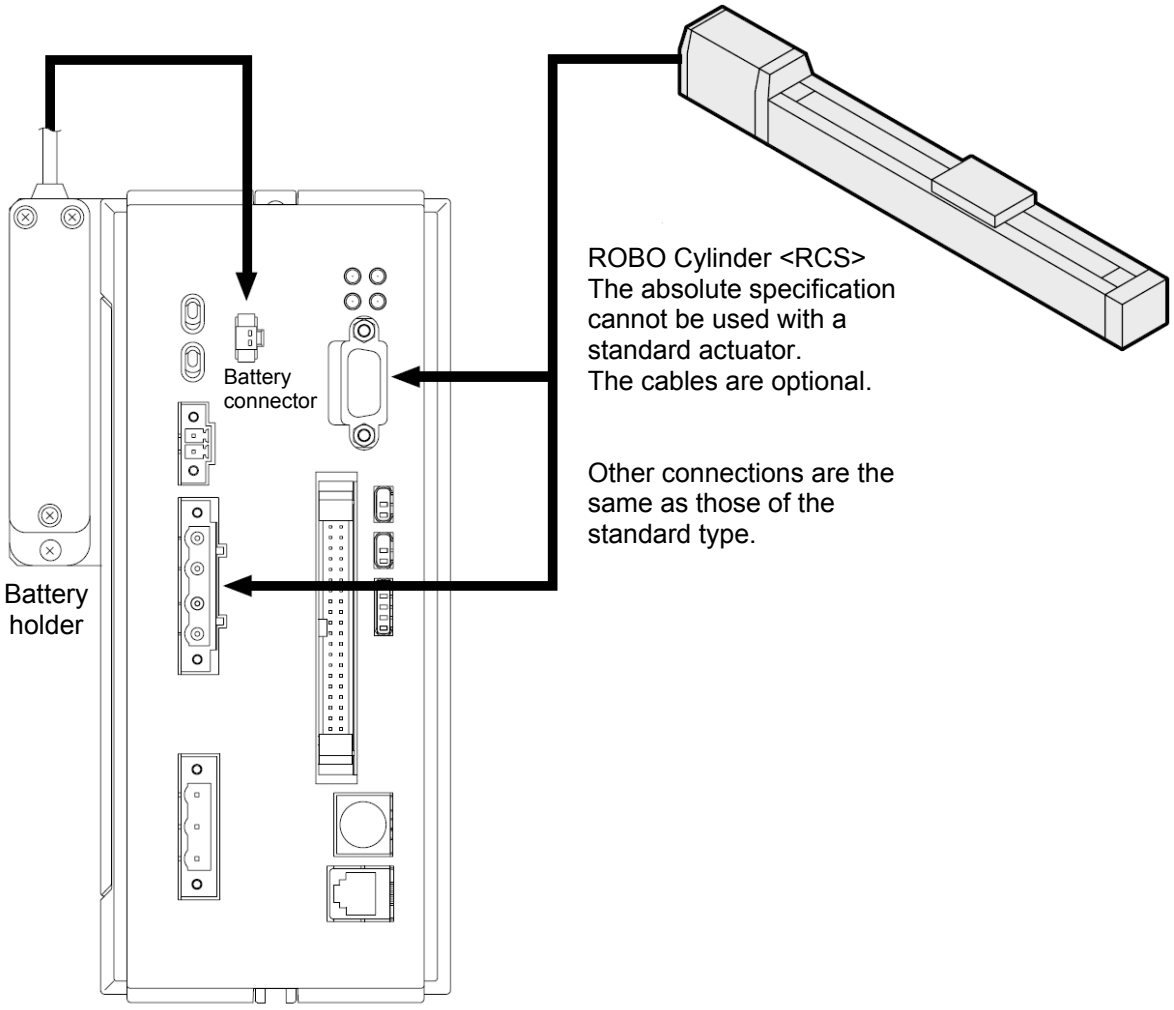
3.4 Connection Method

3.4.1 Standard Type



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3.4.2 Absolute Specifications

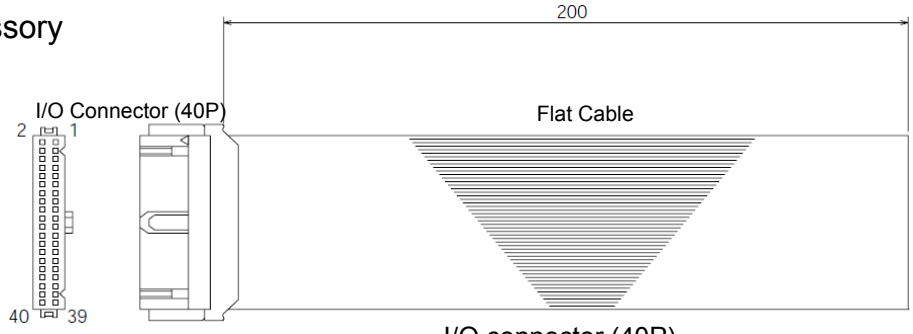


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3.5 Supplied Cables

3.5.1 I/O Flat Cable

・Accessory

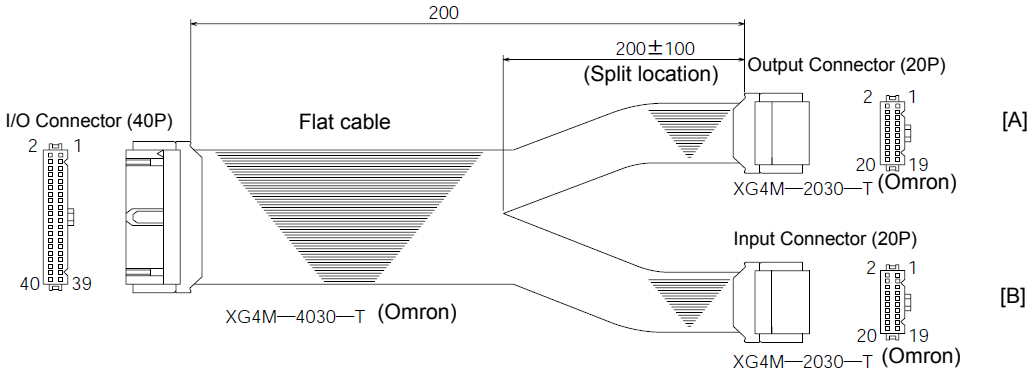


I/O connector (40P)

No.	Signal Name	Color	No.	Signal Name	Color
1	C OMOA	Brown - 1	11	* Emergency stop	Brown - 2
2	C OMOA	Red - 1	12	Complete position 16	Red - 2
3	C OMOB	Orange - 1	13	* Alarm	Orange - 2
4	C OMOB	Yellow - 1	14	Complete position 8	Yellow - 2
5	N C	Green - 1	15	Z one	Green - 2
6	N C	Blue - 1	16	Complete position 4	Blue - 2
7	*Battery alarm	Purple - 1	17	Homing complete	Purple - 2
8	N C	Gray - 1	18	Complete position 2	Gray - 2
9	Moving	White - 1	19	Positioning complete	White - 2
10	Complete position 32	Black - 1	20	Complete position 1	Black - 2

No.	Signal Name	Color	No.	Signal Name	Color
21	C OMIA	Brown - 3	31	N C	Brown - 4
22	C OMIA	Red - 3	32	Command position 16	Red - 4
23	C OMIB	Orange - 3	33	* Hold	Orange - 4
24	C OMIB	Yellow - 3	34	Command position 8	Yellow - 4
25	N C	Green - 3	35	Servo ON	Green - 4
26	N C	Blue - 3	36	Command position 4	Blue - 4
27	N C	Purple - 3	37	Reset	Purple - 4
28	N C	Gray - 3	38	Command position 2	Gray - 4
29	N C	White - 3	39	Start	White - 4
30	Command position 32	Black - 3	40	Command position 1	Black - 4

・Optional



[A] Output connector (20P)

[B] Input connector (20P)

No.	Signal Name	Color	No.	Signal Name	Color
1	C OMOA	Brown - 1	11	* Emergency stop	Brown - 2
2	C OMOA	Red - 1	12	Complete position 16	Red - 2
3	C OMOB	Orange - 1	13	* Alarm	Orange - 2
4	C OMOB	Yellow - 1	14	Complete position 8	Yellow - 2
5	N C	Green - 1	15	Zone	Green - 2
6	N C	Blue - 1	16	Complete position 4	Blue - 2
7	*Battery alarm	Purple - 1	17	Homing complete	Purple - 2
8	N C	Gray - 1	18	Complete position 2	Gray - 2
9	Moving	White - 1	19	Positioning complete	White - 2
10	Complete position 32	Black - 1	20	Complete position 1	Black - 2

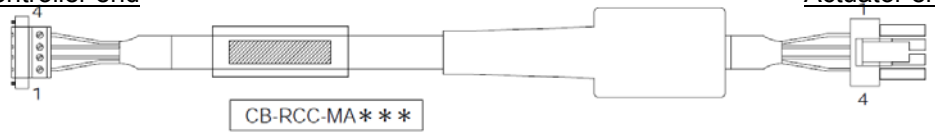
No.	Signal Name	Color	No.	Signal Name	Color
1	C OMIA	Brown - 1	11	N C	Brown - 2
2	C OMIA	Red - 1	12	Command position 16	Red - 2
3	C OMIB	Orange - 1	13	* Hold	Orange - 2
4	C OMIB	Yellow - 1	14	Command position 8	Yellow - 2
5	N C	Green - 1	15	Servo ON	Green - 2
6	N C	Blue - 1	16	Command position 4	Blue - 2
7	N C	Purple - 1	17	Reset	Purple - 2
8	N C	Gray - 1	18	Command position 2	Gray - 2
9	N C	White - 1	19	Start	White - 2
10	Command position 32	Black - 1	20	Command position 1	Black - 2

* I/O connector (40P) is the same as the above accessory.

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3.5.2 Motor Extension Cable

Controller end — Actuator end



Cable color	Signal abbreviation	Pin no.
Green	PE	1
Red	U	2
White	V	3
Black	W	4

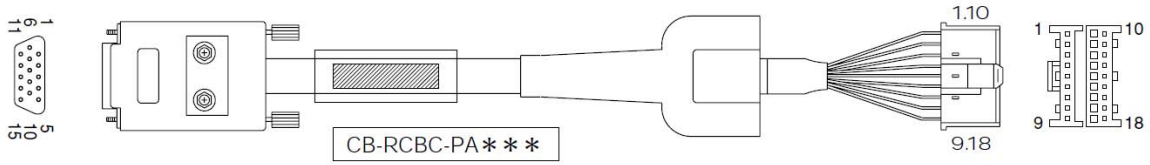
Reverse plug: GIC2.5/4-STF-7.62 (Phoenix)

Pin no.	Signal abbreviation	Cable color
1	U	Red
2	V	White
3	W	Black
4	PE	Green

Plug housing: SLP-04V (JST)
Socket contact BSF-21T-P1.4 (JST)

3.5.3 Encoder Extension Cable

Controller end — Actuator end



Cable color	Signal abbreviation	Pin no.
Pink	A/U	1
Purple	$\overline{A}/\overline{U}$	2
White	B/V	3
Blue/red	$\overline{B}/\overline{V}$	4
Orange/white	Z/W	5
Green/white	$\overline{Z}/\overline{W}$	6
Blue	SD	7
Orange	$\overline{SD}$	8
Black	BAT+	9
Yellow	BAT−	10
Green	VCC	11
Brown	GND	12
Gray	BK−	13
Red	BK+	14
—	—	15
Connect the shield to the hood using a clamp.		

Ground and braided shield wires

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

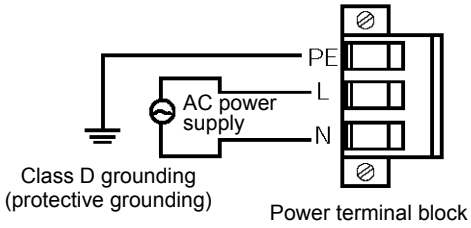
Plug connector with hood:17HE-23150-C (D13A) (DDK)
Contact:17H-7PCR-102 (P500) (DDK)

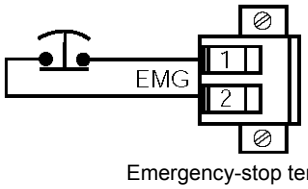
Plug housing: XMP-18V (JST)
Socket contact: BXA-001T-PO.6 (JST)
Retainer: XMS-09V (JST)

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3.6 Wiring

3.6.1 Wiring for Power Supply/Emergency Stop





* The two EMG terminals are contact-b inputs used for connecting an emergency-stop switch. The controller is shipped with these terminals shorted, so that an emergency stop will not be actuated. 24 VDC is output to EMG of pin No. 1.
  The current consumption of the emergency-stop circuit is approx. 15 mA (100/200-V controller).

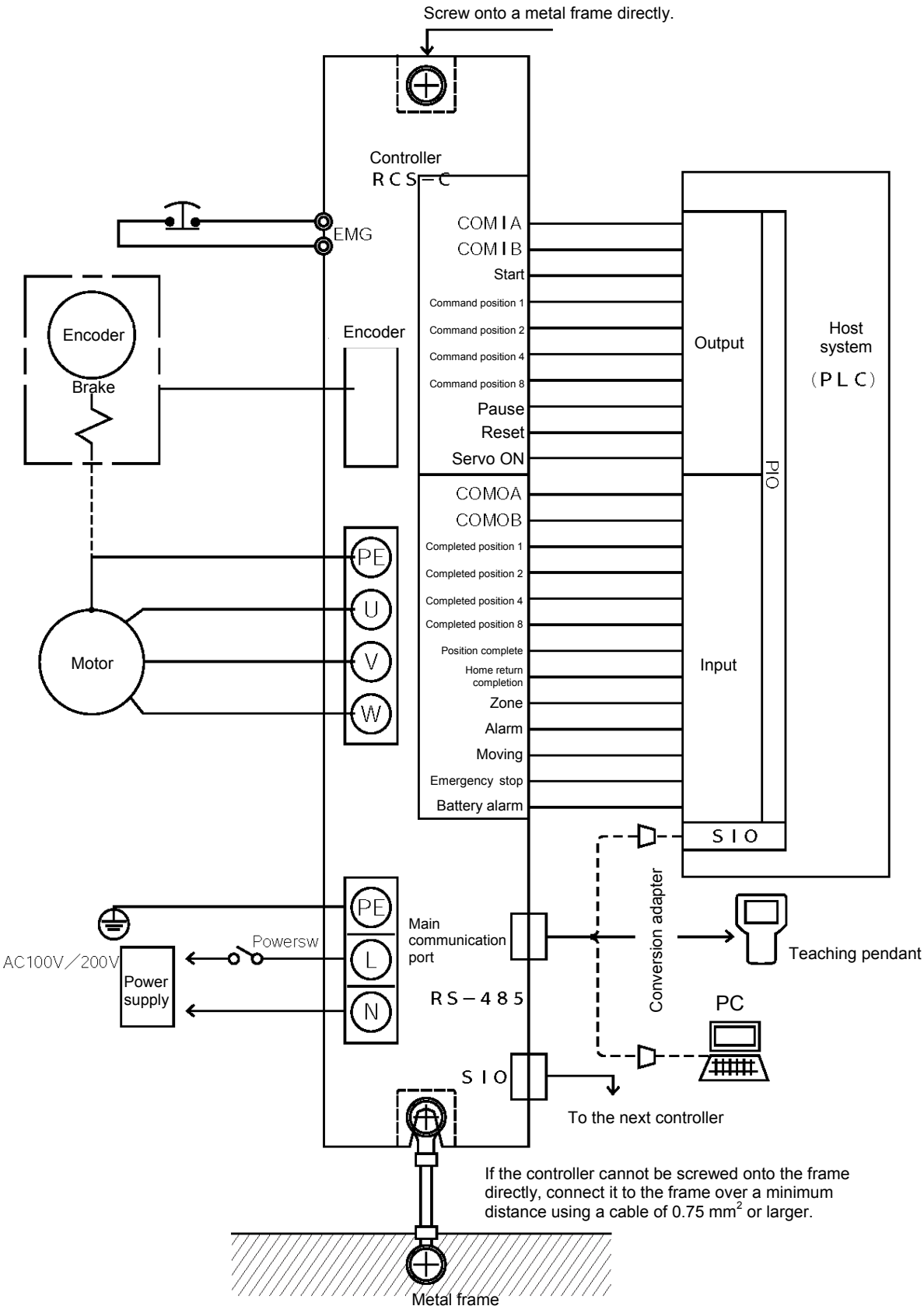
Note:	When performing power connection, make sure the following specifications for power cable, etc., are satisfied.

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

Note:	This controller has no power switch.

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3.6.2 External Connection Diagram



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3.6.3 PIO Interface

A PIO interface list is given below.
The PIO cable is a flat cable with no connector attached on the end connected to the external equipment.

PIO connector (40 pins)

Pin No.	Category	Reference No.	Signal name	Cable color	Pin No.	Category	Reference No.	Signal name	Cable color
1		[1]	COMOA	Brown-1	2		[1]	COMOA	Red-1
3		[2]	COMOB	Orange-1	4		[2]	COMOB	Yellow-1
5	Output		NC	Green-1	6	Output	[3]	*Alarm	Blue-1
7				Purple-1	8		[4]	Zone	Gray-1
9				White-1	10		[5]	Home return completion	Black-1
11				Brown-2	12		[6]	Position complete	Red-2
13				Orange-2	14		[7]	Completed position 8	Yellow-2
15		[8]	* Battery alarm	Green-2	16			Completed position 4	Blue-2
17		[9]	Moving	Purple-2	18			Completed position 2	Gray-2
19		[10]	* Emergency stop	White-2	20			Completed position 1	Black-2
21		[11]	COMIA	Brown-3	22		[11]	COMIA	Red-3
23		[12]	COMIB	Orange-3	24		[12]	COMIB	Yellow-3
25	Input		NC	Green-3	26	Input	[13]	*Pause	Blue-3
27				Purple-3	28		[14]	Servo ON	Gray-3
29				White-3	30		[15]	Reset	Black-3
31				Brown-4	32		[16]	Start	Red-4
33				Orange-4	34		[17]	Command position 8	Yellow-4
35				Green-4	36			Command position 4	Blue-4
37				Purple-4	38			Command position 2	Gray-4
39				White-4	40			Command position 1	Black-4

Note: The ports indicated by an asterisk (*) conform to the contact-b signal logic (always ON).
Never connect those ports that are not used.

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[1] COMIA
[2] COMIB
} Power supply for output ports

Connect the 24-VDC power supply for output ports between COMOA and COMOB.
COMOA and COMOB have no polarities.
Pin Nos. 1 & 2, and 3 & 4, are connected internally.

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

[4] Zone
A zone signal will be output when the actuator enters the range set by the applicable parameter.

[5] Home return completion
This signal will turn ON when the initial home return is completed after a power connection. Thereafter, this signal will remain ON until the power is turned off. It will not turn OFF following an emergency-stop signal input.
If the home return completion signal is OFF, it means home return will be performed before the next movement operation.

Note:	With the absolute specification, the home return completion signal will turn ON when the power is turned on, after an absolute reset was executed once. If the home return completion signal turns OFF due to an alarm, an absolute reset must be executed again.

[6] Position complete
This signal will turn ON when the controller becomes ready following a power connection. It will turn OFF when a start signal is input, and turn ON when a movement is completed.

[7] Completed position
All completed position signals will turn OFF the moment the position complete signal turns OFF.
All completed position signals remain OFF while an emergency stop is actuated or during the direct teaching mode.
When the controller returns to the ready mode thereafter, the completed position signal corresponding to the current actuator position will be output if the current actuator position is within the positioning band from the last position complete position. If the current actuator position is outside the positioning band, all completed position signals will remain OFF.
In the push & hold mode, all completed position signals will remain OFF when the controller returns to the ready mode from an emergency-stop status or the direct teaching mode, regardless of the current actuator position.
When an alarm occurs, a corresponding alarm code (short form) is output by the four bits of completed positions 1, 2, 4 and 8. The meanings of these signals vary in a normal state and when an alarm is present, so exercise caution when writing a sequence program. (Refer to 7.3, "Alarm Output by PIO.")

[8] Battery alarm (100/200-V specification)
With the absolute specification, this signal will turn OFF when the voltage of the backup battery drops to 3.1 V or below (the alarm signal is a contact-b signal, meaning that it is always ON). This alarm indicates that the battery should be replaced soon. The controller operation will not be disabled right away after a battery alarm occurs. Once a battery alarm occurs, the controller will generate a battery error in approx. 220 hours (around nine days).

Note) The battery-alarm function is supported by the 100/200-V controller of version M5 or later. With the incremental specification, this signal remains OFF.

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[9] Moving
This signal remains ON while the actuator is moving.
Use this signal if you want to detect stopping of the motor during pause.

[10] Emergency stop
This signal will turn OFF when an emergency stop is actuated. It remains ON as long as the controller is operating properly. (Contact-b signal)
When the emergency stop is cancelled, the signal will turn ON.

[11] COMIA
[12] COMIB
} Power supply for input ports

Connect the 24-VDC power supply for input ports between COMIA and COMIB.
Pin Nos. 21 & 22, and 23 & 24, are connected internally.

[13] Pause
This is a contact-b input. Keep the signal ON while the actuator is moving, and cause it to turn OFF when the movement pauses.

[14] Servo ON
The servo is ON while this signal is ON.

[15] Reset
An alarm will be reset once a rise of this signal is detected. If the cause of the alarm is not yet removed, the alarm will come back after the reset action. When this signal is input while the actuator is in pause, the remaining travel will be cancelled.

[16] Start
Inputting this signal will start movement.

[17] Command position
Input the position number you want to select.
Relationship of input pin numbers and selected position numbers (4-bit binary)

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

1: ON 0: OFF

Pin No.	40	Command position 1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	38	Command position 2	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	36	Command position 4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	34	Command position 8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Selected position No.			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

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

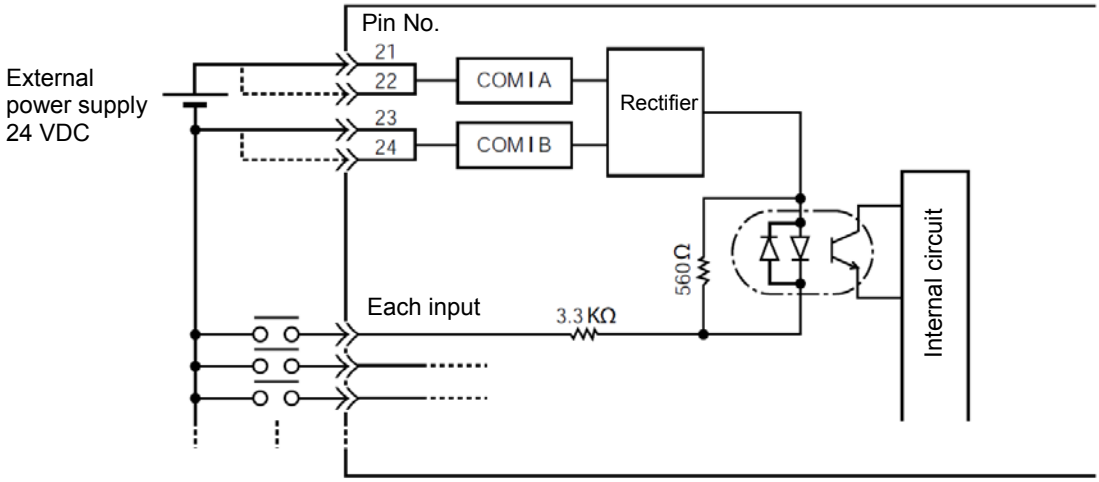
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3.6.4 External I/O Specifications

Input Part

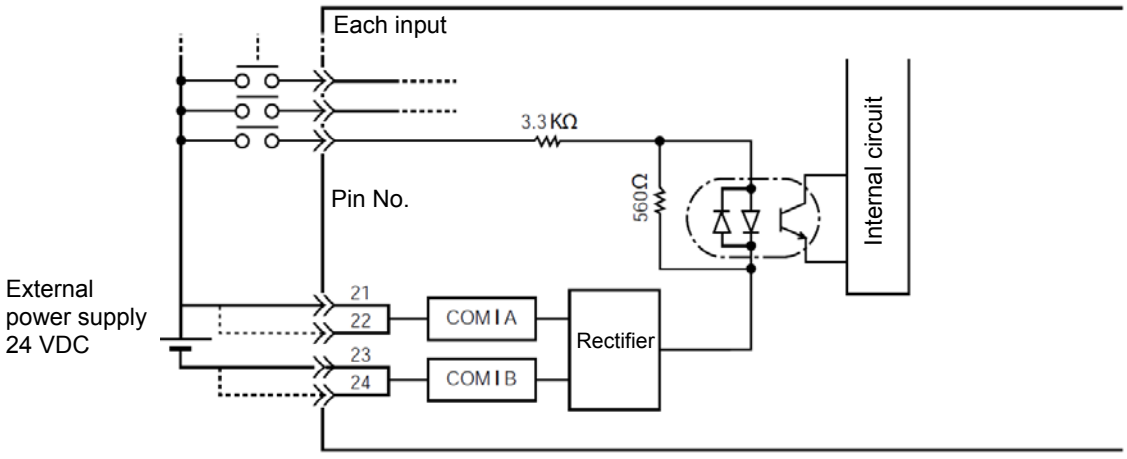
Item	Specification
Number of input points	8 points
Input voltage	24 VDC ± 20 %
Input current	7 mA per circuit
Operating voltage	ON voltage --- 16 V min. (4.5 mA) OFF voltage --- 6 V max. (1.4 mA)
Isolation method	Photocoupler

Internal circuit configuration (Standard NPN specification)



- Connect a 24-V power supply between COMIA and COMIB.
- Connect the input common to the negative side of the external power supply.
- Pin Nos. 21 and 22 of COMIA and 23 and 24 of COMIB are connected internally.

Internal circuit configuration (Optional PNP specification)



- Connect a 24-V power supply between COMIA and COMIB.
- Connect the input common to the positive side of the external power supply.
- Pin Nos. 21 & 22 of COMIA and 23 & 24 of COMIB are connected internally.

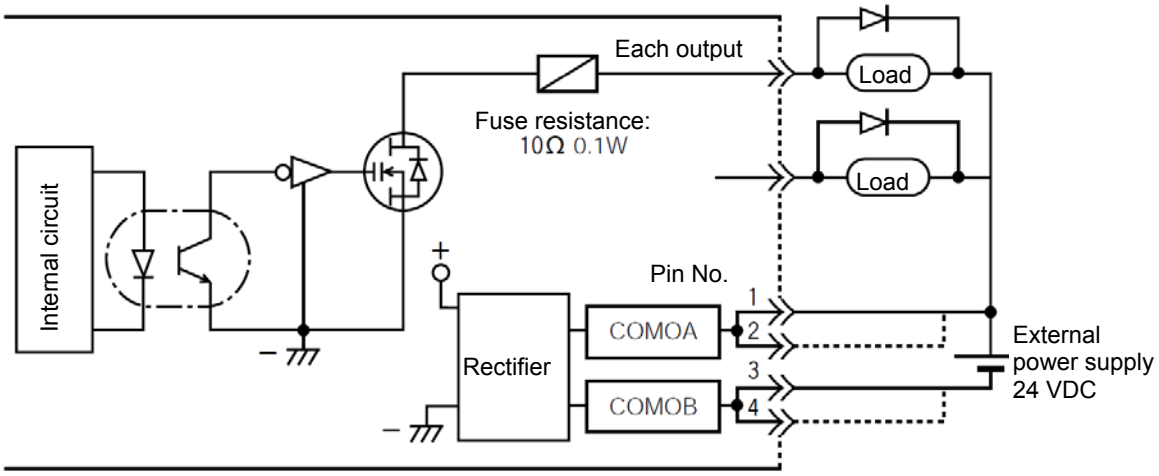
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Output Part

100-mA output circuit by power MOSFET

Item	Specification
Number of output points	11 points
Rated load voltage	24 VDC; 60 VDC (peak) (without flywheel diode)
Maximum load current	100 mA per point
Residual voltage	1.8 V / 100 mA
Isolation method	Photocoupler
Overcurrent protection	Fuse resistance: 10 Ω 0.1 W

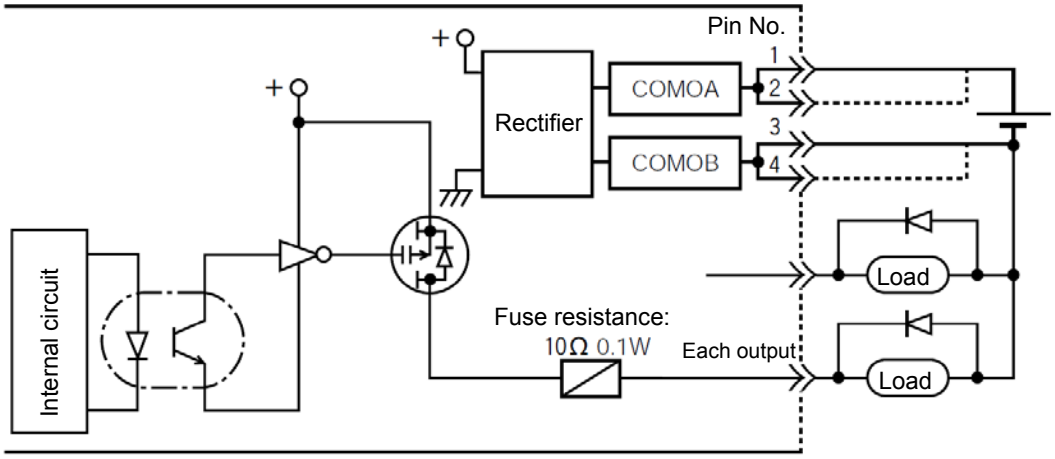
Internal circuit configuration (Standard NPN specification)



- Supply 24 VDC between COMOA and COMOB.
- Pin Nos. 1 & 2, and 3 & 4, are connected internally.

Note 1) The output circuit is an open-drain circuit provided by a power MOSFET and has no flywheel diode. When connecting a load, such as a relay, also connect a diode, etc., to suppress flyback voltage. (Spike noise can be eliminated most effectively when a diode is connected at the closet possible position to the coil).

Internal circuit configuration (Optional PNP specification)



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4. Data Entry <Basics>

This controller doesn't use command words, so there is no need to create a program.
All you need is to enter position data in the position-data table, and the actuator will move to the specified position.
Position data consists of number (No.), position (Position), speed (Speed), acceleration/deceleration (ACC), push (Push), positioning band (Pos. band), and acceleration only MAX (ACC MAX). The description in parentheses is as displayed on the teaching pendant.
Position data can be specified in two different modes: by absolute coordinate specification (absolute mode) in which the distance from the home is entered, or by relative coordinate specification (incremental mode) in which the incremental movement from the current position is entered.

Position-data table

No.	Position Note	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	0	100	0.3	0	0.1	0
1	30	100	0.3	0	0.1	0
2 =	10	100	0.3	0	0.1	0
~ .	.	.	.	.	.	. ~
~ .	.	.	.	.	.	. ~
.	.	.	.	.	.	.
15	100	100	0.3	0	0.1	0

When data is entered in the position column of the position-data table, the default values will be automatically entered in the remaining columns. Change the default values as necessary.
To change a default value, change the corresponding parameters starting with "Default."
The default values vary depending on the actuator type.

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

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

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4.1 Description of Position-Data Table

(1) No.

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

(2) Position (Position)

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

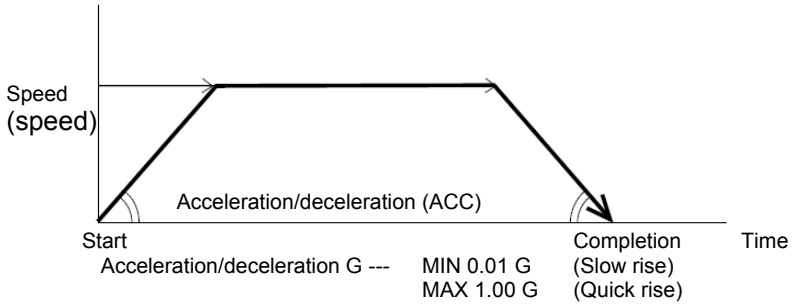
No.	Position		
0	30	Absolute mode	30 mm from the home
1 =	10	Incremental mode	+10 mm from the current position
2 =	-10	Incremental mode	-10 mm from the current position
3	100	Absolute mode	100 mm from the home

(3) Speed (Speed)

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

(4) Acceleration/deceleration (ACC)

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



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

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(5) Push (Push)

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

The table in 4.1.1, "Push Force at Standstill" lists the push force at standstill for each controller type when the current-limiting value is set to 70%. Be sure to reference this table.

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

(6) Positioning band (Pos. band)

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

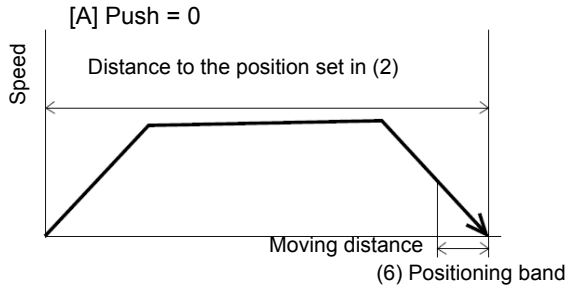


Fig. A

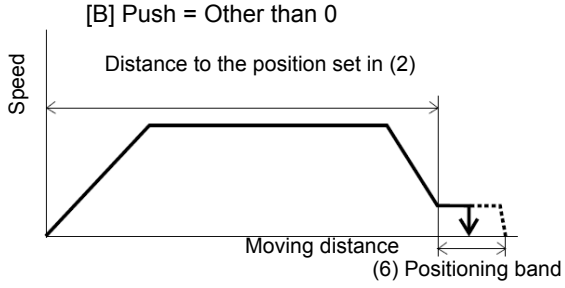


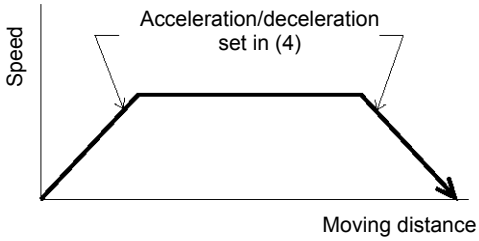
Fig. B

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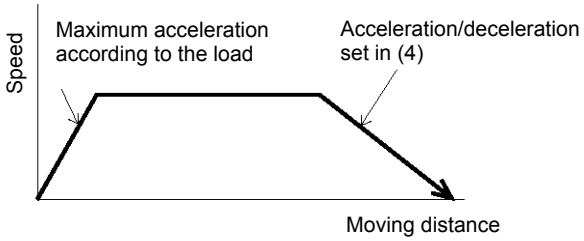
(7) Acceleration only MAX (ACC MAX)

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

(7) Acceleration only MAX = 0



(7) Acceleration only MAX = 1



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

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4.1.1 Push Force at Standstill

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

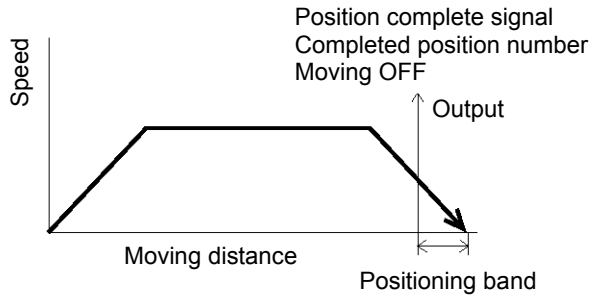
	Type	Motor (W)	Speed type	Push force (N (kgf))
Rod type	RA35	20	L	95 (9.7)
			M	47 (4.8)
			H	23 (2.4)
	RA45	30	L	142 (14.5)
			M	70 (7.2)
			H	35 (3.6)
	RA55	60	L	178 (18.2)
			M	89 (9.1)
			H	44 (4.5)
		100	L	296 (30.3)
			M	149 (15.2)
			H	74 (7.6)
	RB7525	30	L	142 (14.5)
			M	70 (7.2)
			H	35 (3.6)
		60	M	143 (14.6)
			H	71 (7.3)
	RB7530	60	L	238 (24.3)
			M	118 (12.1)
			H	59 (6.1)
		100	M	198 (20.2)
			H	99 (10.1)
	RB7535	100	L	296 (30.3)
			M	149 (15.2)
			H	74 (7.6)
		150	M	222 (22.7)
			H	111 (11.4)
Flat type	F45	30	L	142 (14.5)
			M	70 (7.2)
			H	35 (3.6)
	F55	60	L	178 (18.2)
			M	89 (9.1)
			H	44 (4.5)
		100	L	296 (30.3)
			M	149 (15.2)
			H	74 (7.6)

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

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4.2 Explanation of Modes

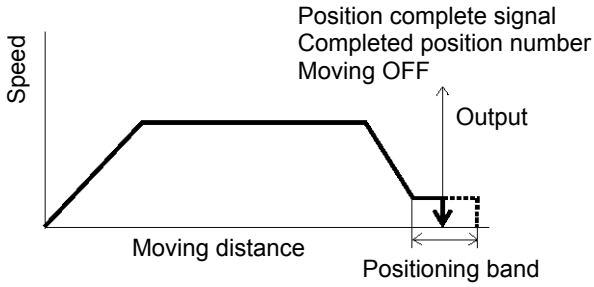
4.2.1 Positioning Mode Push = 0



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

4.2.2 Push & Hold Mode Push = Other than 0

(1) Load was contacted successfully



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

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

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

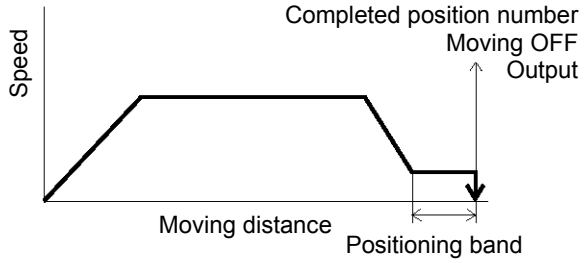
Warning	The actuator continues to push the load at the push force at standstill determined by the current-limiting value. Since the actuator is not inactive, exercise due caution when handling the machine in this condition.

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

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

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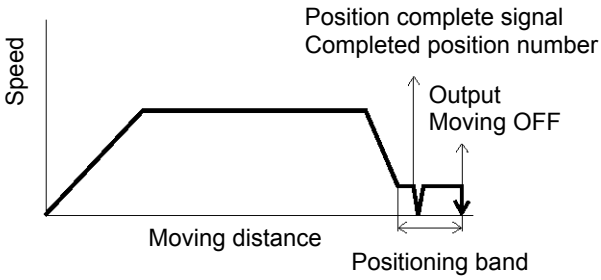
(2) Load was not contacted (missed)



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

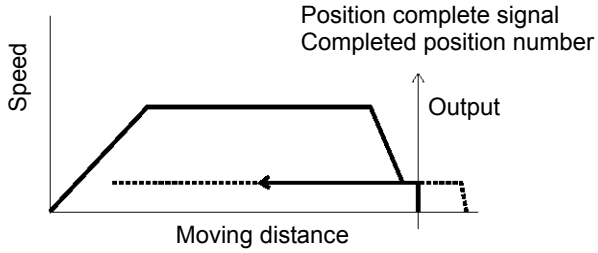
(3) Load moves during push & hold operation

[1] Load moves in the pushed direction



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

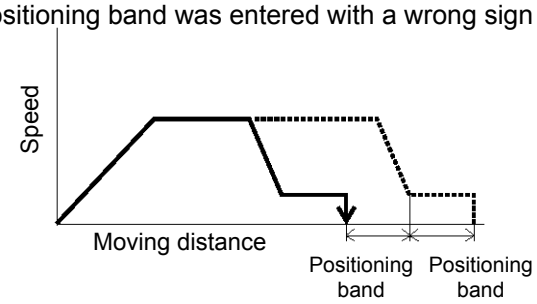
[2] Load moves in the opposite direction from the push force (Actuator is pushed back by the reactive force of the load)



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

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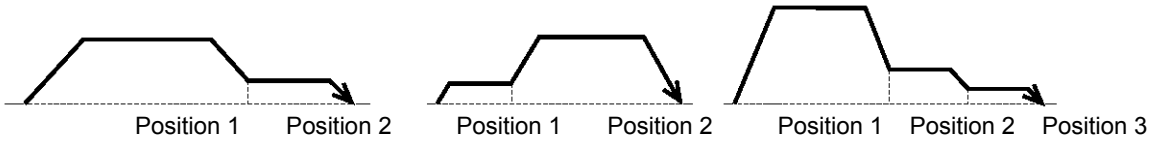
(4) Positioning band was entered with a wrong sign



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

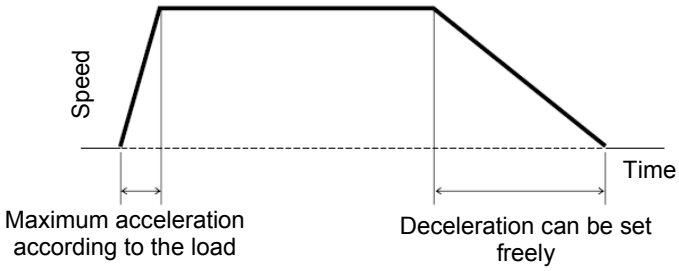
4.2.3 Speed Change during Movement

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



4.2.4 Operation at Different Acceleration and Deceleration Settings

The actuator will accelerate and decelerate at different speeds if “1” is entered under “Acceleration only MAX” in the position data.
The acceleration will conform to the maximum acceleration set according to the load, while the deceleration will conform to the value entered in “Acceleration/deceleration” of the position data.

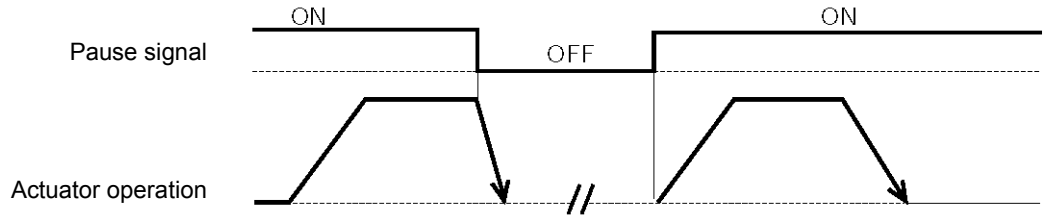


Note:	Although the specific value differs depending on the actuator, the maximum acceleration cannot be more than three times the rated acceleration. Accordingly, this function should be enabled only when the transfer weight is no more than one-third of the rated loading capacity and the actuator needs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

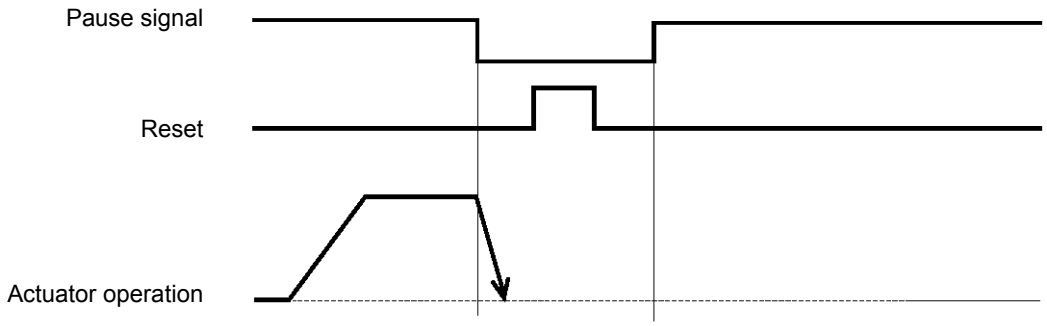
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4.2.5 Pause

This signal can be used to stop the actuator in case of emergency.
The movement of the actuator can be paused via an external input signal (pause).
For safety reasons, this signal is provided as a contact-b input (based on the negative logic).
The actuator will decelerate to a stop when the pause input is turned OFF, and resume movement when the pause input is turned ON.

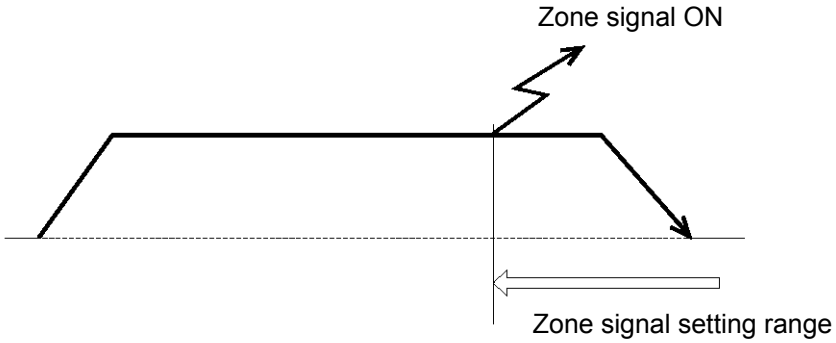


The remaining movement of the actuator can be cancelled by turning ON the reset input during pause (the movement will be cancelled upon rise of the reset input signal).



4.2.6 Zone Signal Output

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



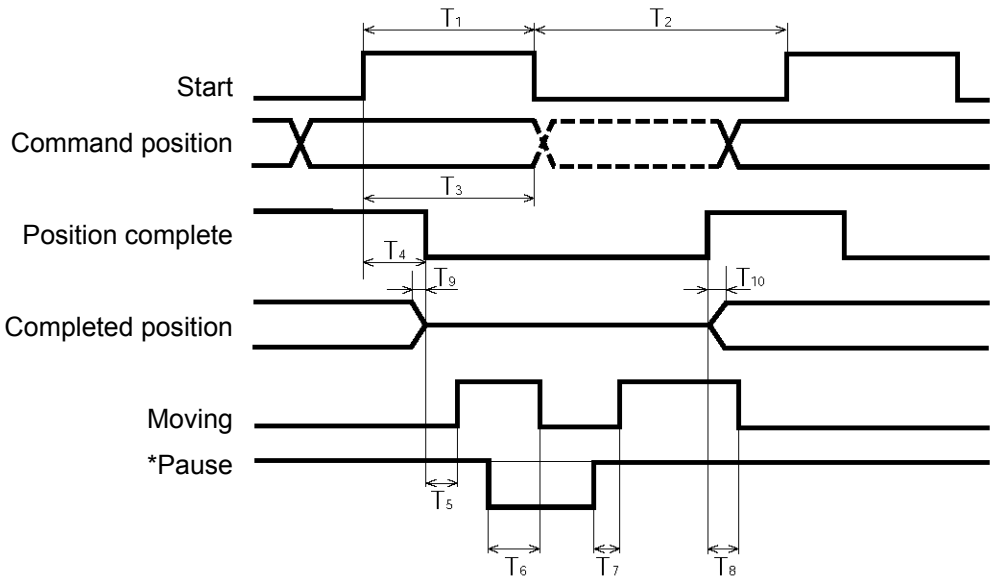
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4.2.7 Home Return

With the standard specification, home return must be performed after the power has been input or an encoder open or CPU error alarm has been reset. Selecting a position number and then initiating a start will cause the controller to automatically perform home return before commencing the subsequent operation. Once home return is complete, the home return completion output will turn ON (standard specification).
Home return alone cannot be performed using PIO. To move the actuator to the home position in a normal condition, set a position number for which "0" is set in the position-data table under "Position," and then issue a movement command to that position.

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

4.3 Timing Chart



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

*1: The maximum value will vary depending on the acceleration/deceleration.
*2: After the position complete signal turned ON, wait for at least the sequencer's scan time before checking the completed position.

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4.4 Items to Note on Gripper (RCS-G20)

(1) Finger Operation

[1] Definition of position

The stroke in the specification table indicates a sum of travels of both fingers.
In other words, the travel of each finger is a half of the stroke.
The specified position therefore represents the distance traveled by each finger from its home position toward the closing side.

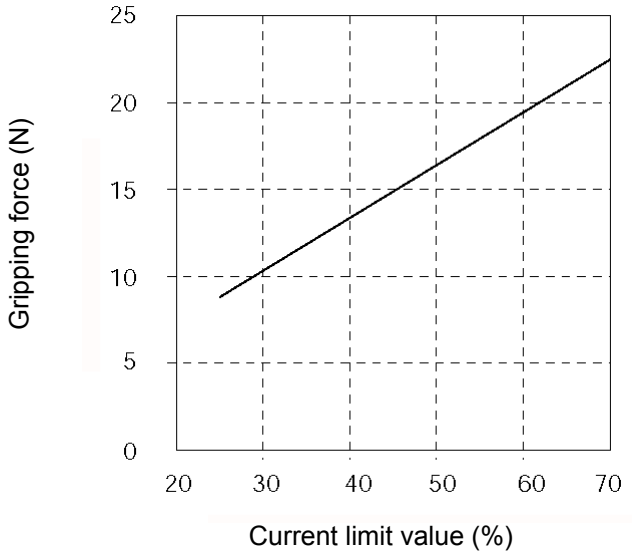
[2] Definition of speed and acceleration

Speed and acceleration command values indicate a sum of both fingers.
In other words, the speed or acceleration applicable to each finger is a half of the command value.

[3] Gripper operation mode

If the actuator is used as a gripper to grip the work part, it is recommended to operate the actuator in the "push mode."
If the actuator is operated in the "positioning mode," an overload or deviation overflow error may occur when the work part is gripped.

[Diagram of Gripping Force Per Finger vs. Current Limit Value]



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5. Using the Controller <Practical Steps>

5-1 How to Start (Standard Specification)

(Refer to 5-2, “How to Execute An Absolute Reset,” for the absolute specification.)

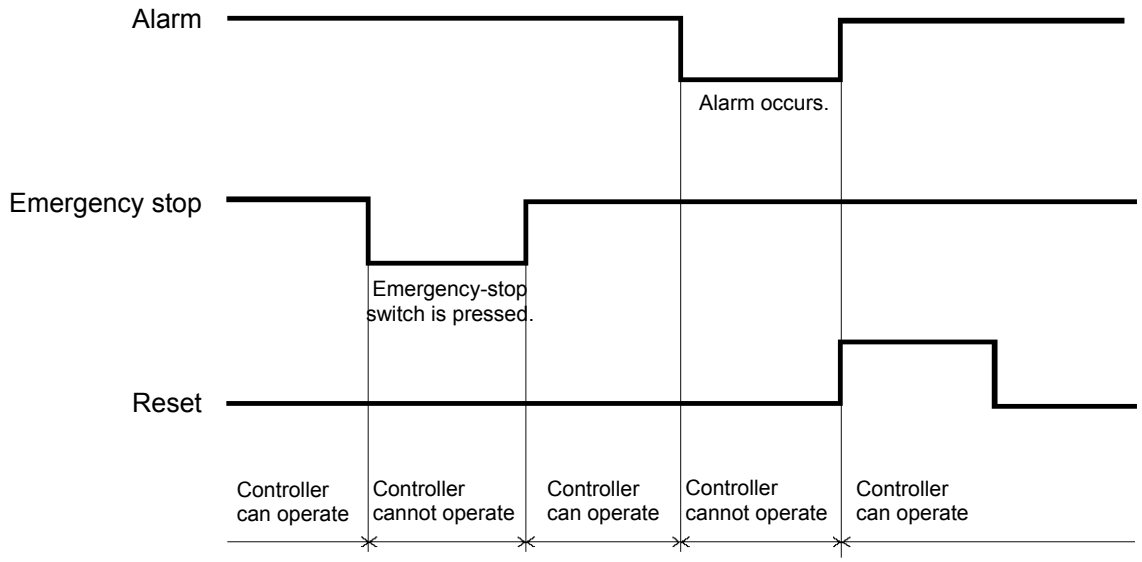
(1) Confirm that both Nos. 1 and 2 of piano switch 2 (SW2) are set to OFF. If these switches are set to ON, tilt them back to the OFF positions.
(2) Connect the motor/brake cables and encoder cable to the controller.
(3) Connect the host PLC to the PIO connector using the supplied flat cable.
(4) If two or more axes are connected, set the necessary items using the piano switches. For details, refer to “Names and Functions of Parts.”
(5) Supply the main power to the controller’s terminal block.
(6) Turn ON the pause and servo ON inputs at the PIO connector.
(7) The controller is working properly if the RDY LED is lit. If the ALM LED is lit, there is an error. Refer to the alarm table and take an appropriate action.

Note:	When the P I/O is powered before main power or when the power source is common, upon supplying power, the P I/O output may be in an unstable status for approximately 1 msec or less. **As for signal to the Input I/O, please execute after the Position Complete Signal turns ON after power-up.**

The controller is ready once the above operation is completed.

5.1.1 When the Controller Can/Cannot Operate

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



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5.2 How to Execute Absolute Reset (Absolute Specification)

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

The specific method to execute an absolute reset will vary depending on the controller version.
A label on which a serial number is printed is attached on the right side of the controller.
In the serial number, check the alphabet in the second digit from the last.

Example) SERIAL No. AD251031 J3

In this example, the controller version is “J.”
An absolute reset is executed in different ways on controllers of version J* or earlier (A* to J*) and controllers of version K* or later (K*, L*, etc.) (* indicates a number).
(If the controller version is K* or later, perform home return from the teaching pendant or PC software when executing an absolute reset.)

How to Execute an Absolute Reset on a Controller of Version K* or Later

[1] Connect the motor cable and encoder/brake cables to the controller.
[2] Connect the host PLC to the PIO connector using the supplied flat cable.
[3] If two or more axes are connected using a controller link cable, set the address using the piano switches (SW) on the controller. For details, refer to 2.2, “Names and Functions of Parts” and 3.2, "Names and Functions of Parts" in this manual.
[4] Turn switch No. 1 (bottom switch) of the controller’s piano switches 2 (SW2) to ON (tilt to the right).
[5] Turn on the main controller power.
[6] Connect the battery to the controller.
[7] The ALM LED will illuminate.
[8] Turn ON the pause and servo ON input signals at the PIO connector.
[9] Input a reset signal via the PIO connector to reset the alarm.
[10] Perform home return from the teaching pendant or PC software.
[11] Turn switch No. 1 of the controller’s piano switches 2 (SW2) to OFF (tilt to the left).

An absolute reset has been executed.

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How to Execute an Absolute Reset on a Controller of Version J* or Earlier

[1] Connect the motor and encoder/brake cables to the controller.
[2] Connect the host PLC to the PIO connector using the supplied flat cable.
[3] If two or more axes are connected, set the address using SW1 on the controller. For details, refer to 2.2, “Names and Functions of Parts” and 3.2, "Names and Functions of Parts"
[4] Move the actuator slider or rod to a position where it is in contact with the mechanical end on the home side.
[5] Turn switch No. 1 (bottom switch) of the controller’s SW2 to ON (tilt to the right).
[6] Turn on the main controller power.
[7] Connect the battery to the controller.
[8] The RDY LED will illuminate.
[9] Turn switch No. 1 of the controller’s SW2 to OFF (tilt to the left). Note 1)
An absolute reset has been executed. The home has been set several millimeters ahead of the current position (mechanical end) (the specific distance from the mechanical end will vary depending on the actuator model).
[10] To operate the actuator right away, turn ON the PIO pause/servo ON inputs.

Note 1) If switch No. 1 of SW2 remains ON, the next time the power is turned on an absolute reset will be executed based on the actuator position at that time.

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

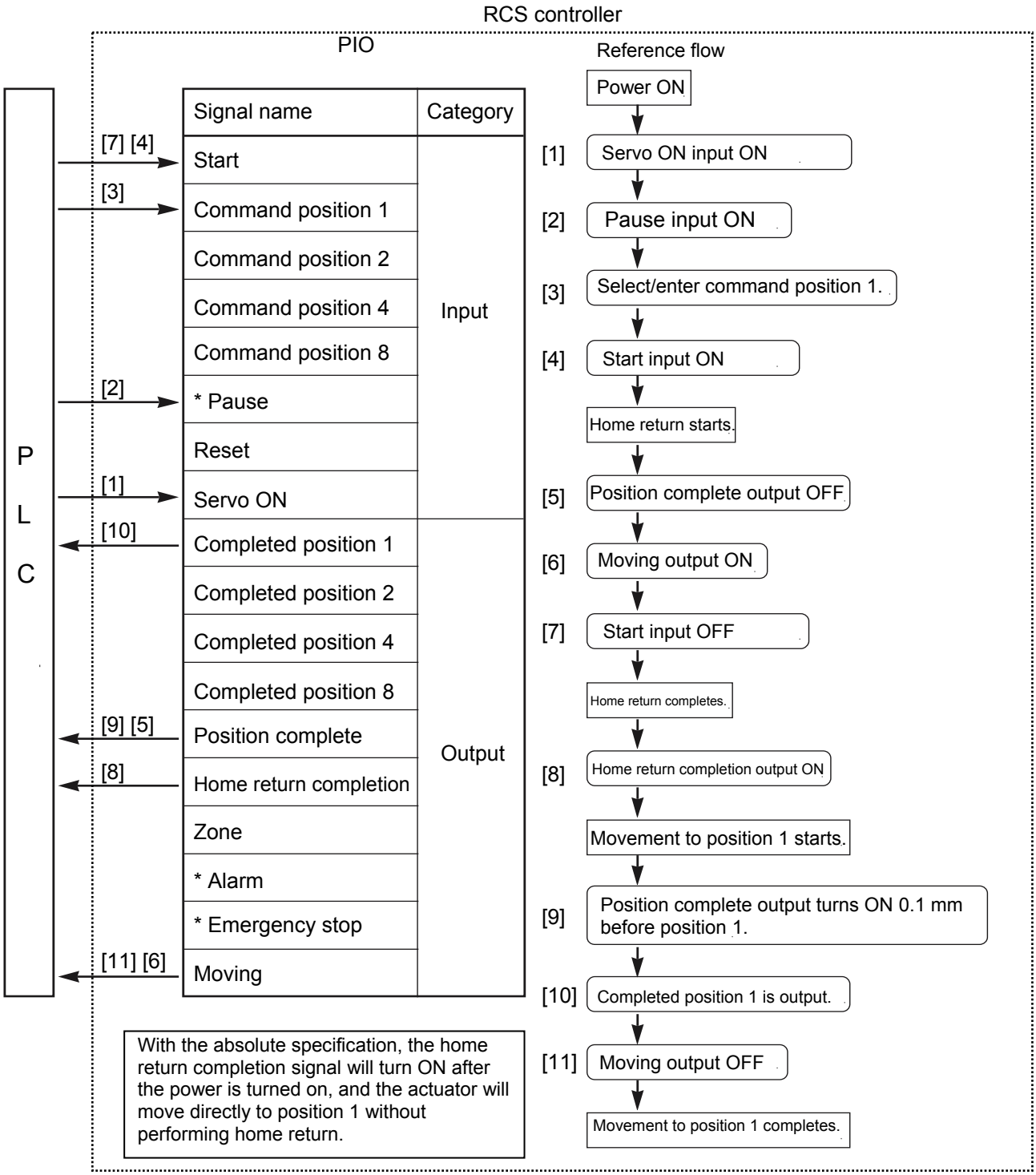
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5.3 Movement after Power On (Standard Type)

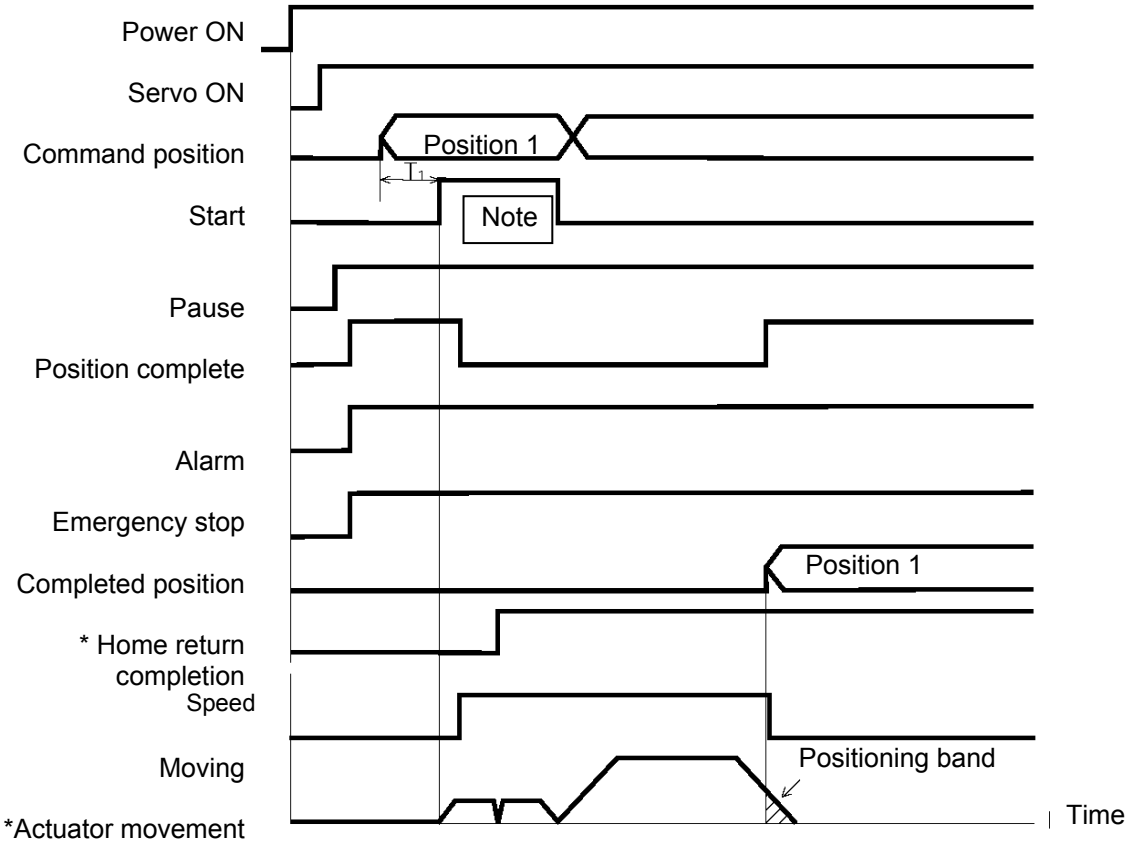
Example of use in operation) After the power is turned on, move the actuator to the position 150 mm from the home at a speed of 200 mm/sec.

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

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

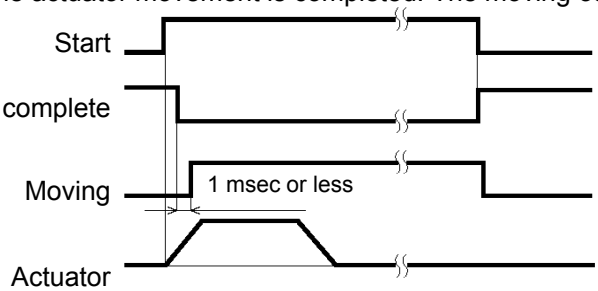


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The position complete output will turn ON when the controller becomes ready following the power ON. (The position complete output will not turn ON if the servo ON input is OFF.)
To check if the controller is ready, always check if the position complete output is ON.
All completed position outputs are OFF immediately after the power is turned on. When the commanded movement is complete, the completed position will be output. If the movement command was to position No. 0, all of the completed positions will remain OFF.
The actuator will not operate unless the pause input is turned ON.
T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON
(The scan time of the host controller must be considered.)
* With the absolute specification, the home return completion signal will turn ON after the power is turned on, and home return will not be performed.

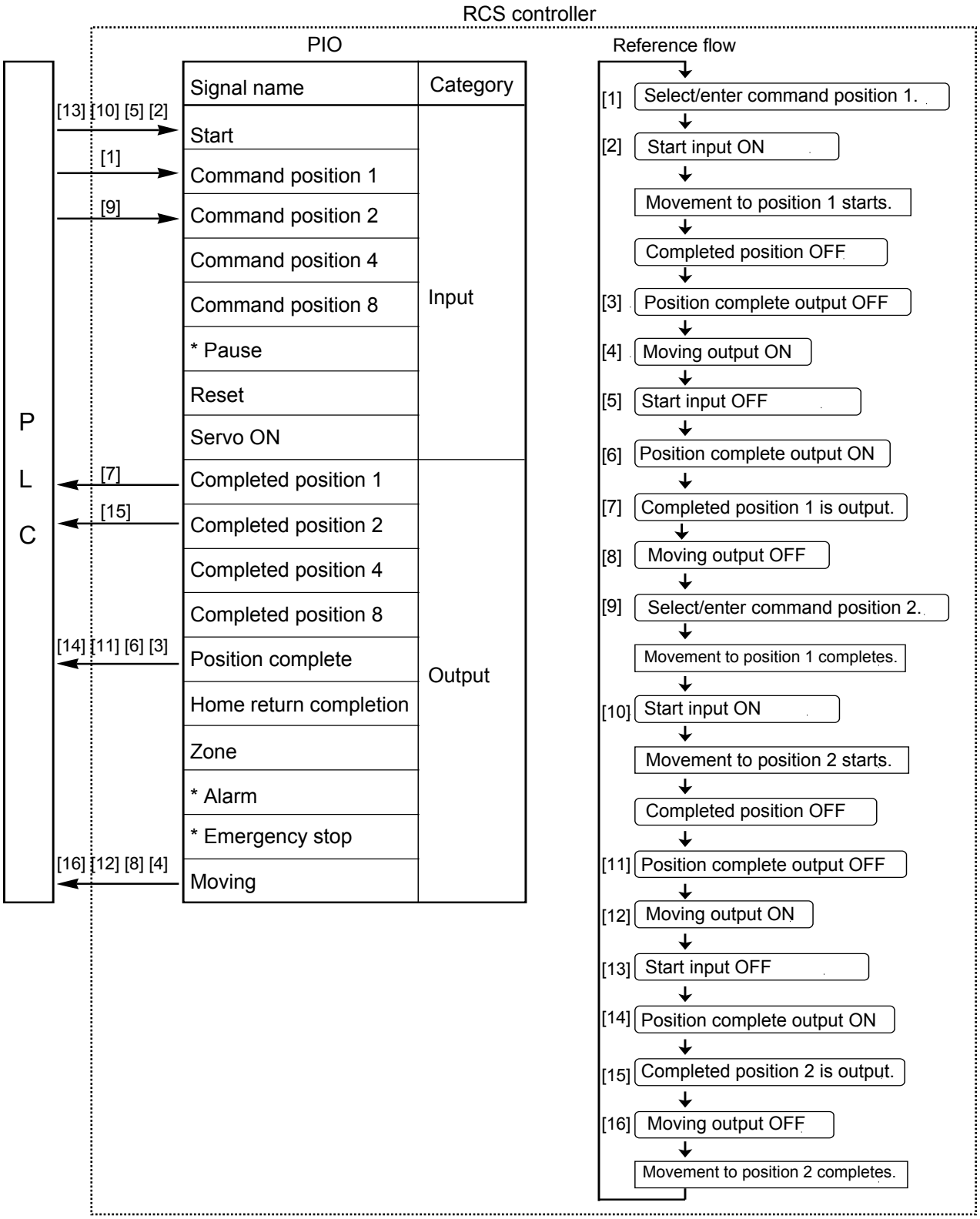
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.
If the start input remains ON as shown below, the position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



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

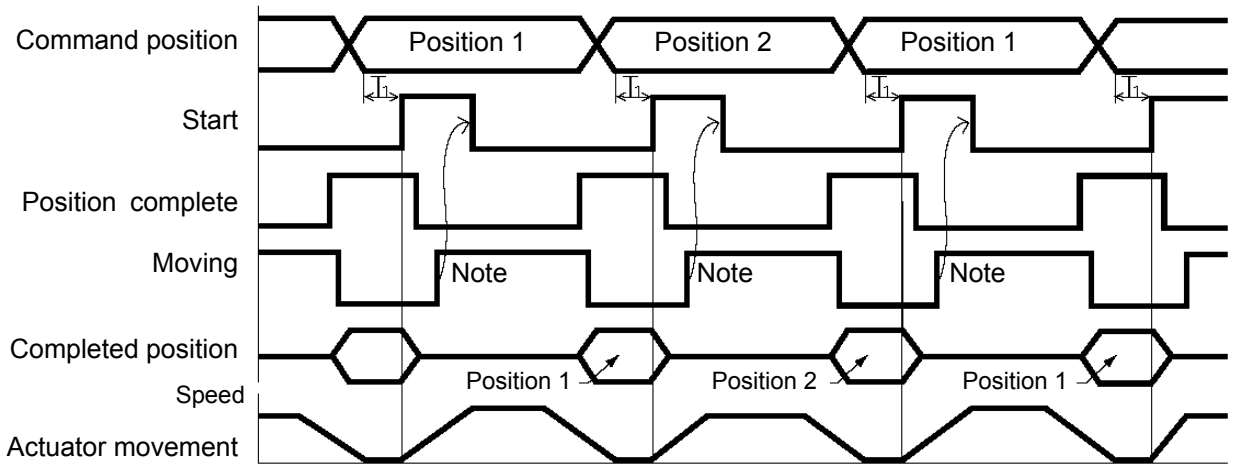
Example of use in operation) The actuator moves back and forth between two positions. The position 250 mm from the home is set as position 1, and the position 100 mm from the home is set as position 2. The travel speed to position 1 is set as 200 mm/sec, and to position 2 is set as 100 mm/sec.



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

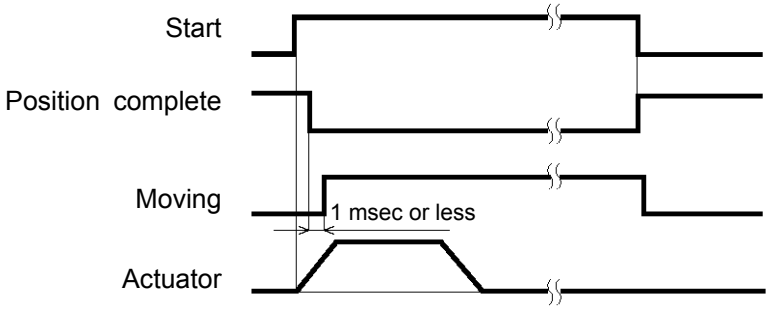
No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	250	200	0.3	0	0.1	0
2	100	100	0.3	0	0.1	0
⋮						



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

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

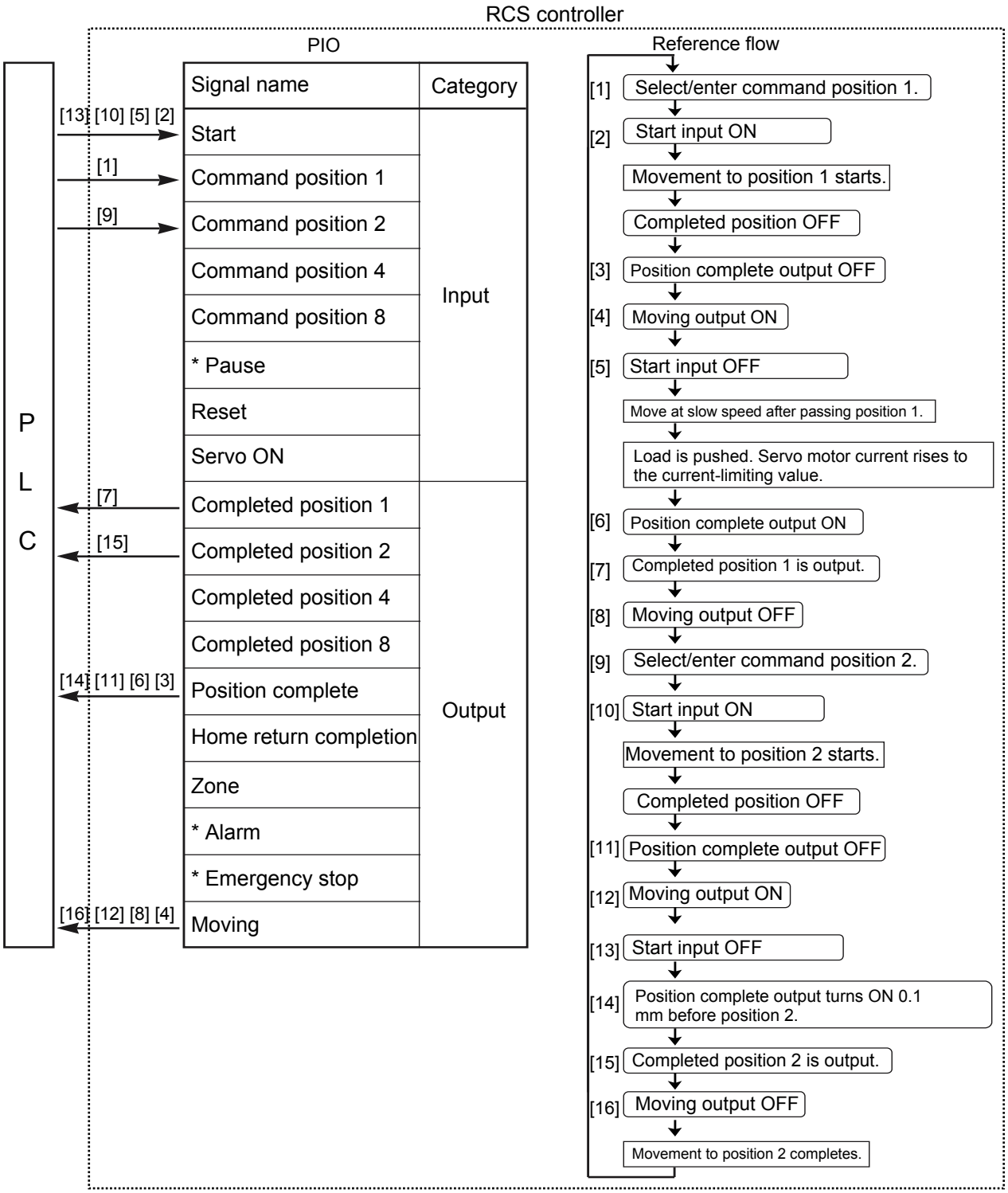
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.
If the start input remains ON as shown below, the position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



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5.5 Push & Hold Mode

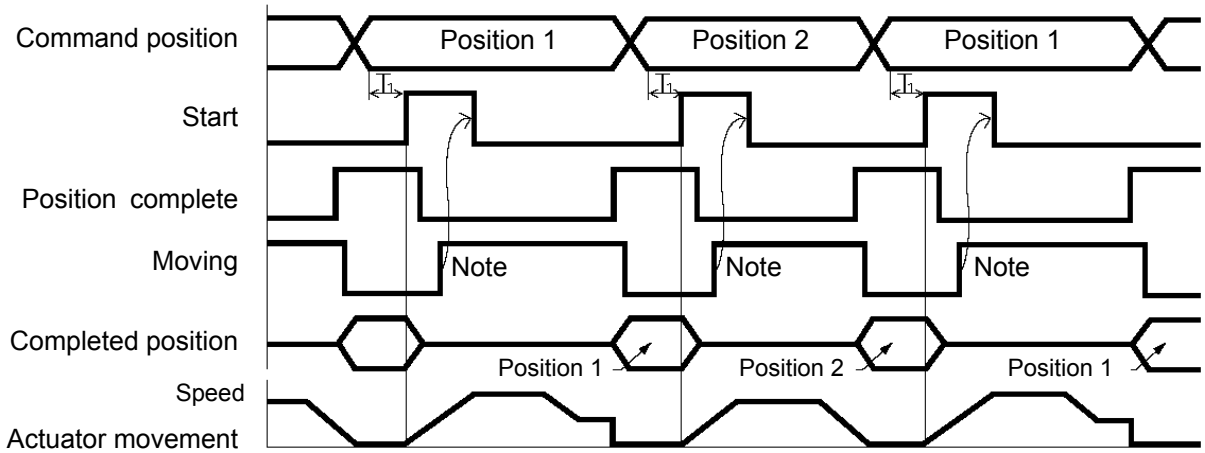
Example of use in operation) The actuator is caused to move back and forth in the push & hold mode and positioning mode. The position 280 mm from the home is set as position 1, and the position 40 mm from the home is set as position 2.
Movement to position 1 is performed in the push & hold mode (the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



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

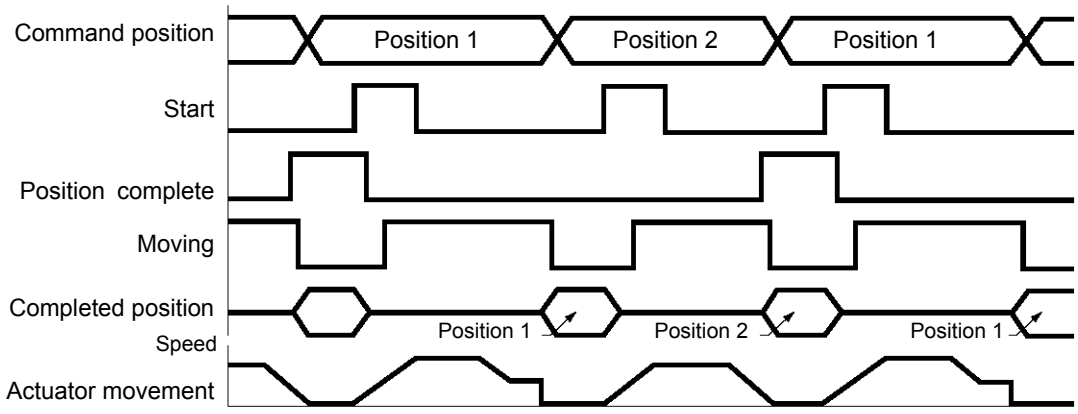
No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	280	200	0.3	50	15	0
2	40	100	0.3	0	0.1	0
⋮						



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

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

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

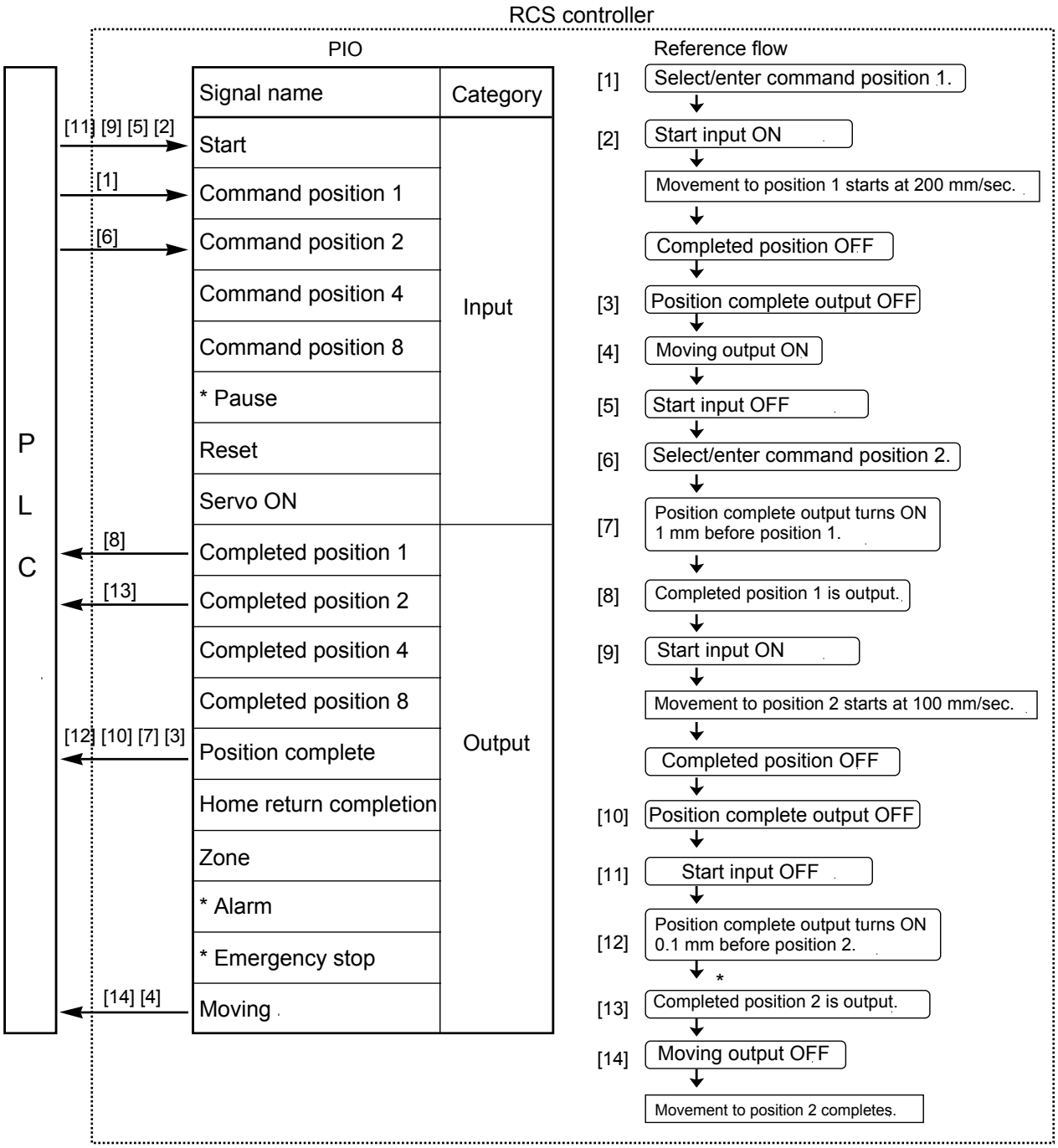


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5.6 Speed Change during Movement

Example of use in operation) The actuator speed is reduced at a certain point during movement. The position 150 mm from the home is set as position 1, and the position 200 mm from the home is set as position 2. The actuator is initially located between the home and position 1. The actuator is moved to position 2 being the target position, at a travel speed of 200 mm/sec to position 1 and that of 100 mm/sec from position 1 to position 2.

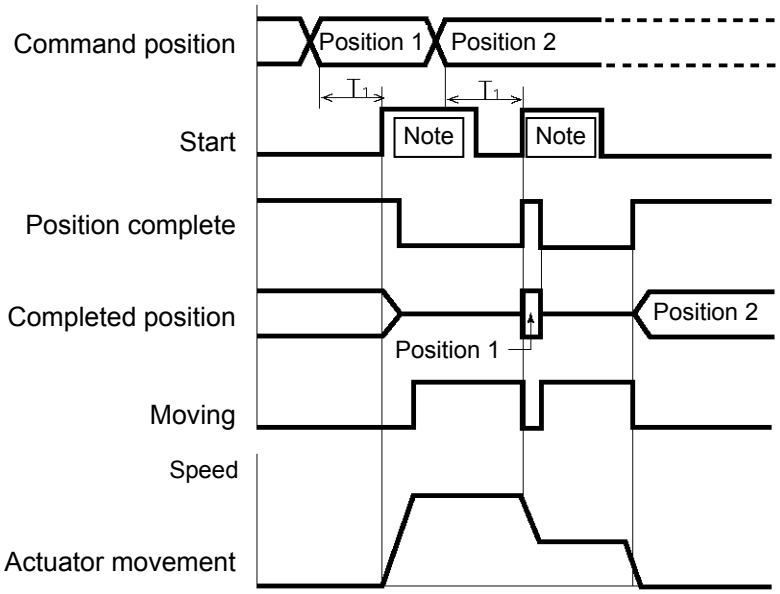
Method) In this example, the actuator is caused to move to position 1 and to position 2 successively. Before the actuator is stopped at position 1, command position 2 must be selected/entered and the start signal must be input. To do this, set a wide positioning band at position 1 and cause the start 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.)



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

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



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

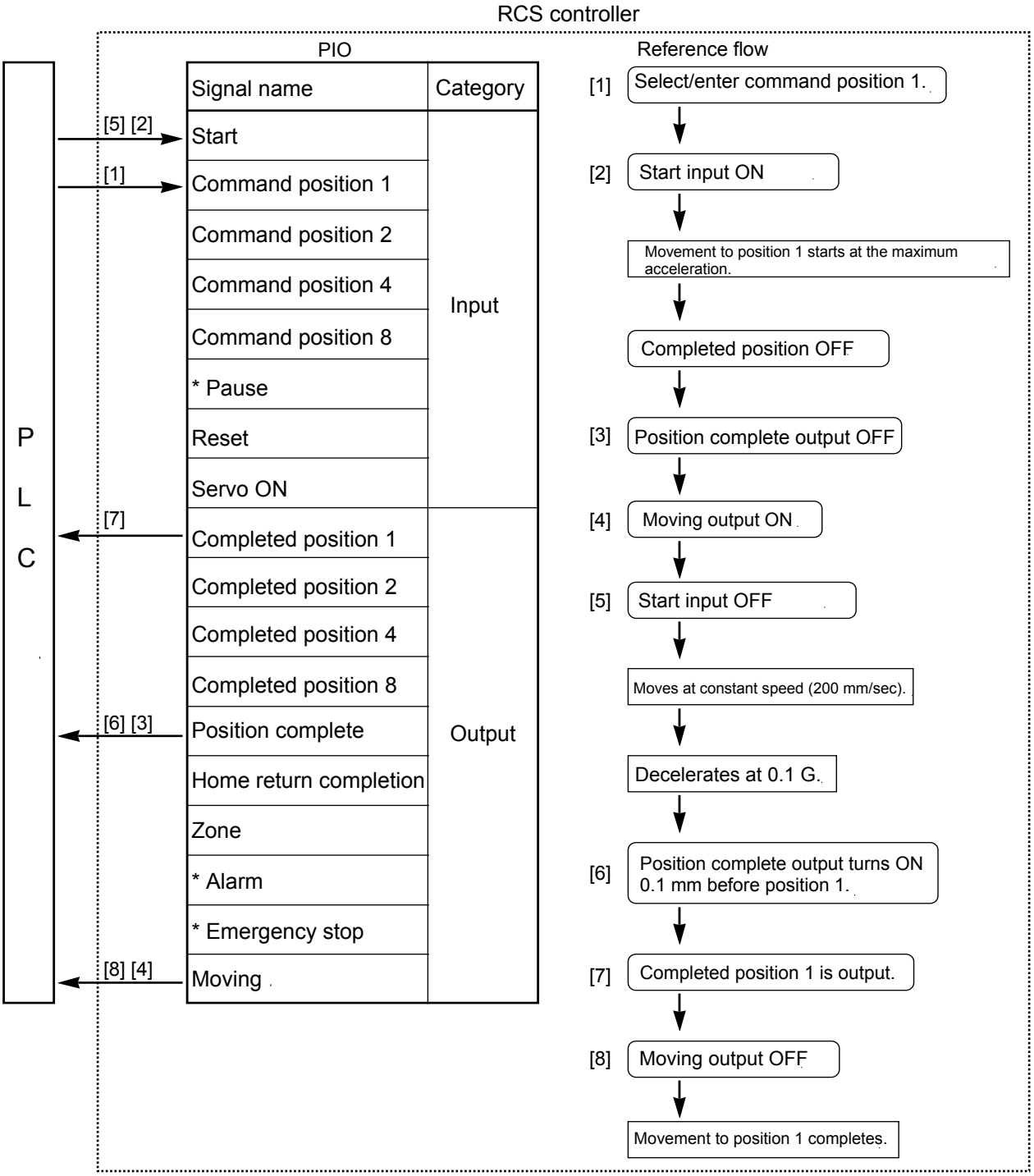
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.

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5-7 Operation at Different Acceleration and Deceleration Settings

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

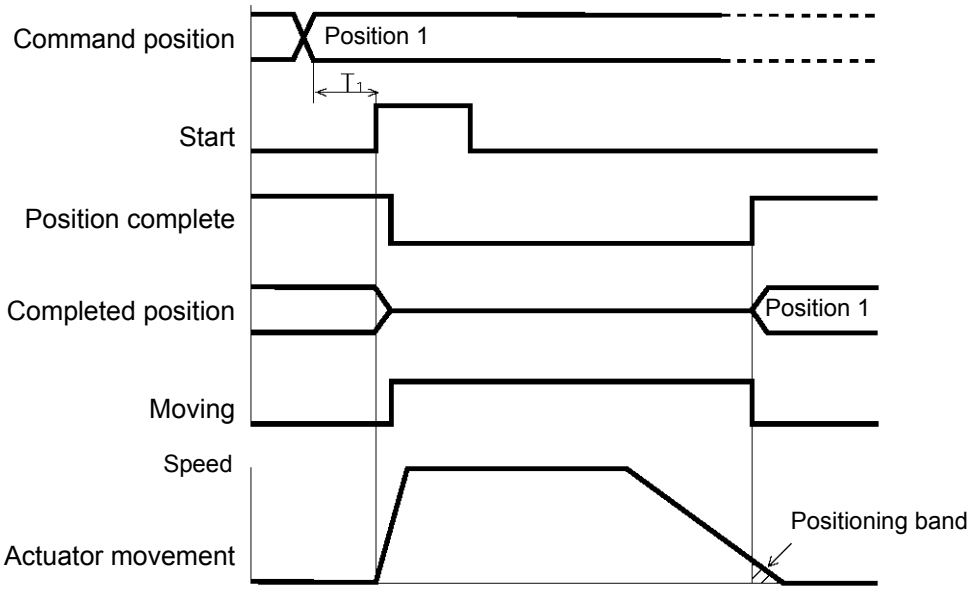
Method) Entering “1” under “Acceleration only MAX” in the position data will automatically adjust the acceleration to the maximum acceleration set according to the load. Entering “0.1” under “Acceleration/deceleration” in the position data will set the deceleration to 0.1 G.



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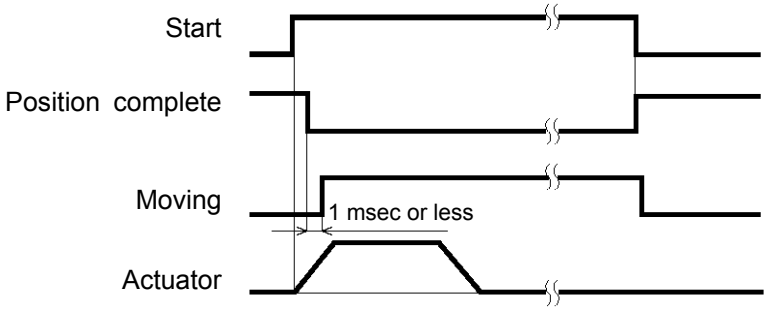
Position-data table (Field(s) within thick line must be entered.)

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



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

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

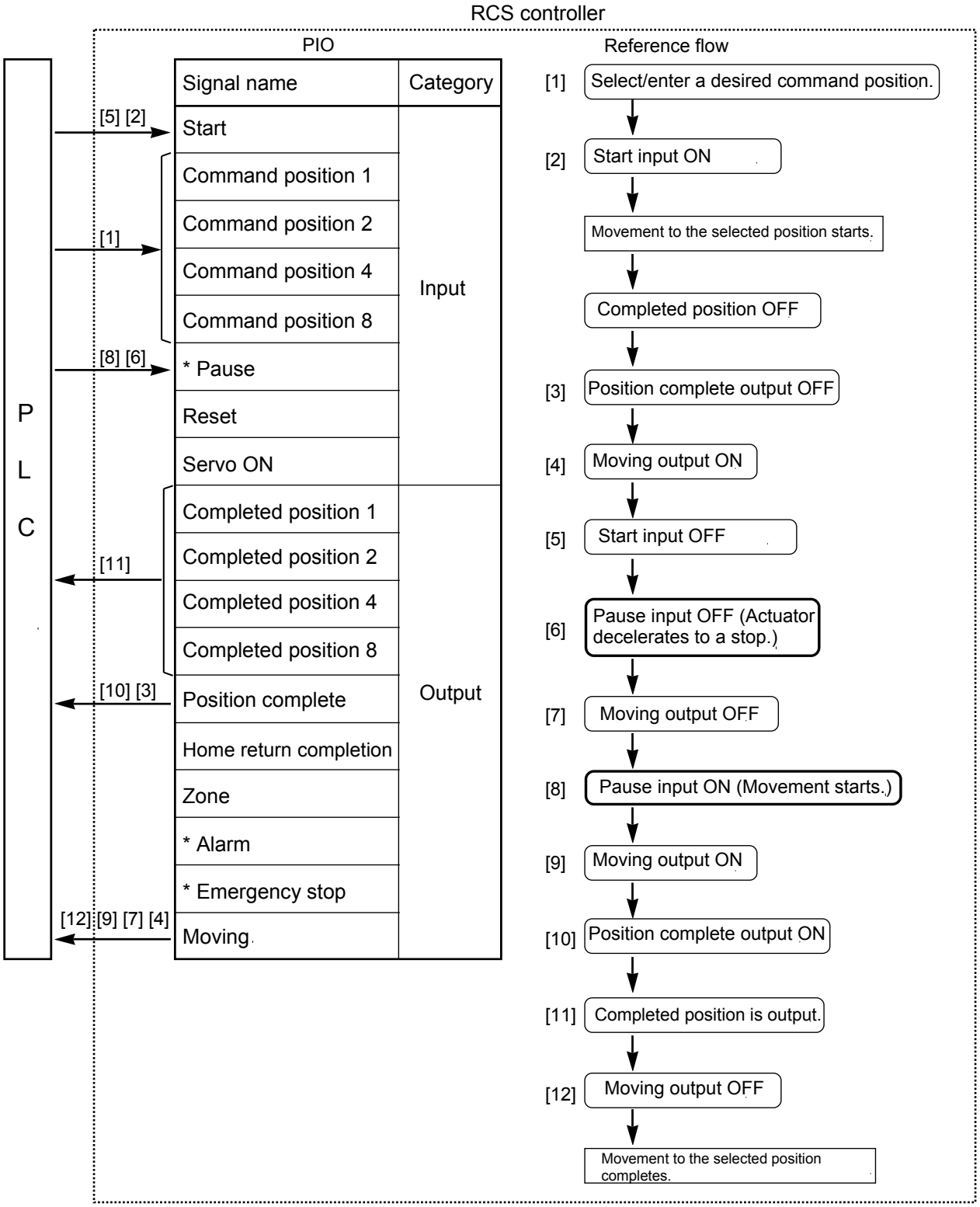


If an overload alarm occurs frequently when this function is used, disable the “acceleration only MAX” function.

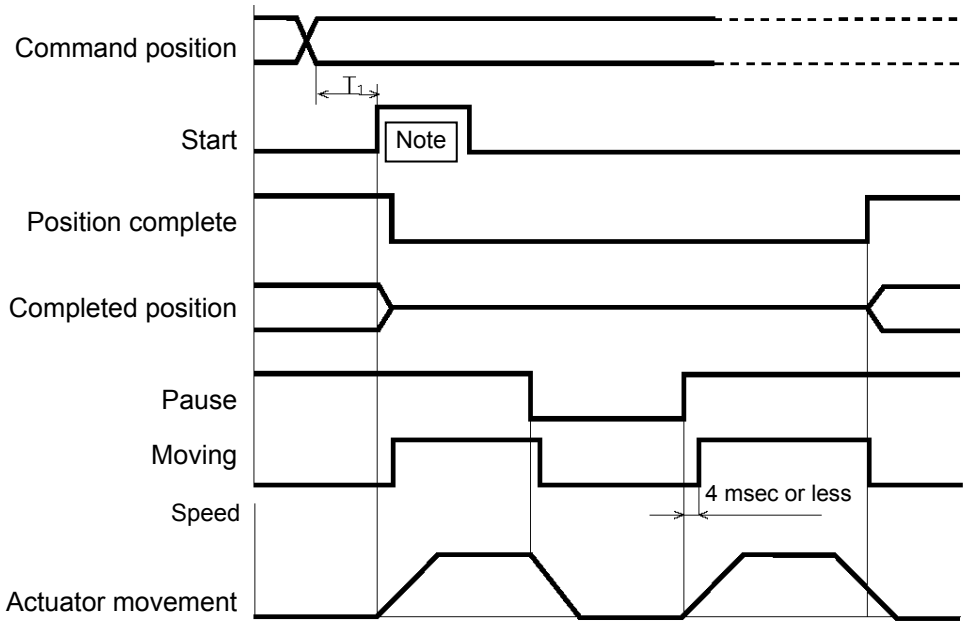
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5.8 Pause

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



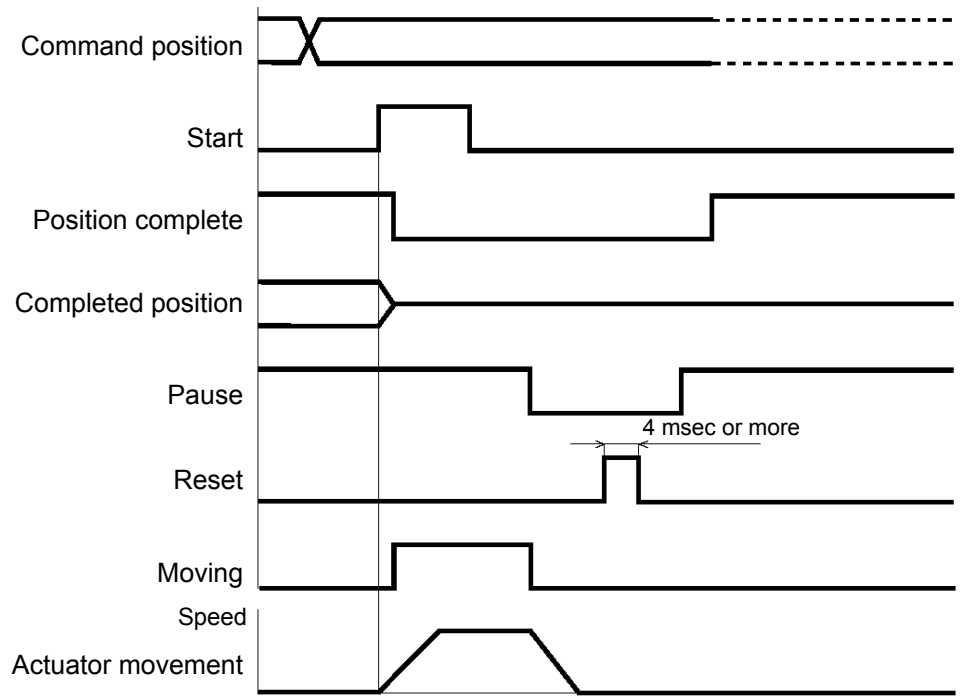
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T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

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

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



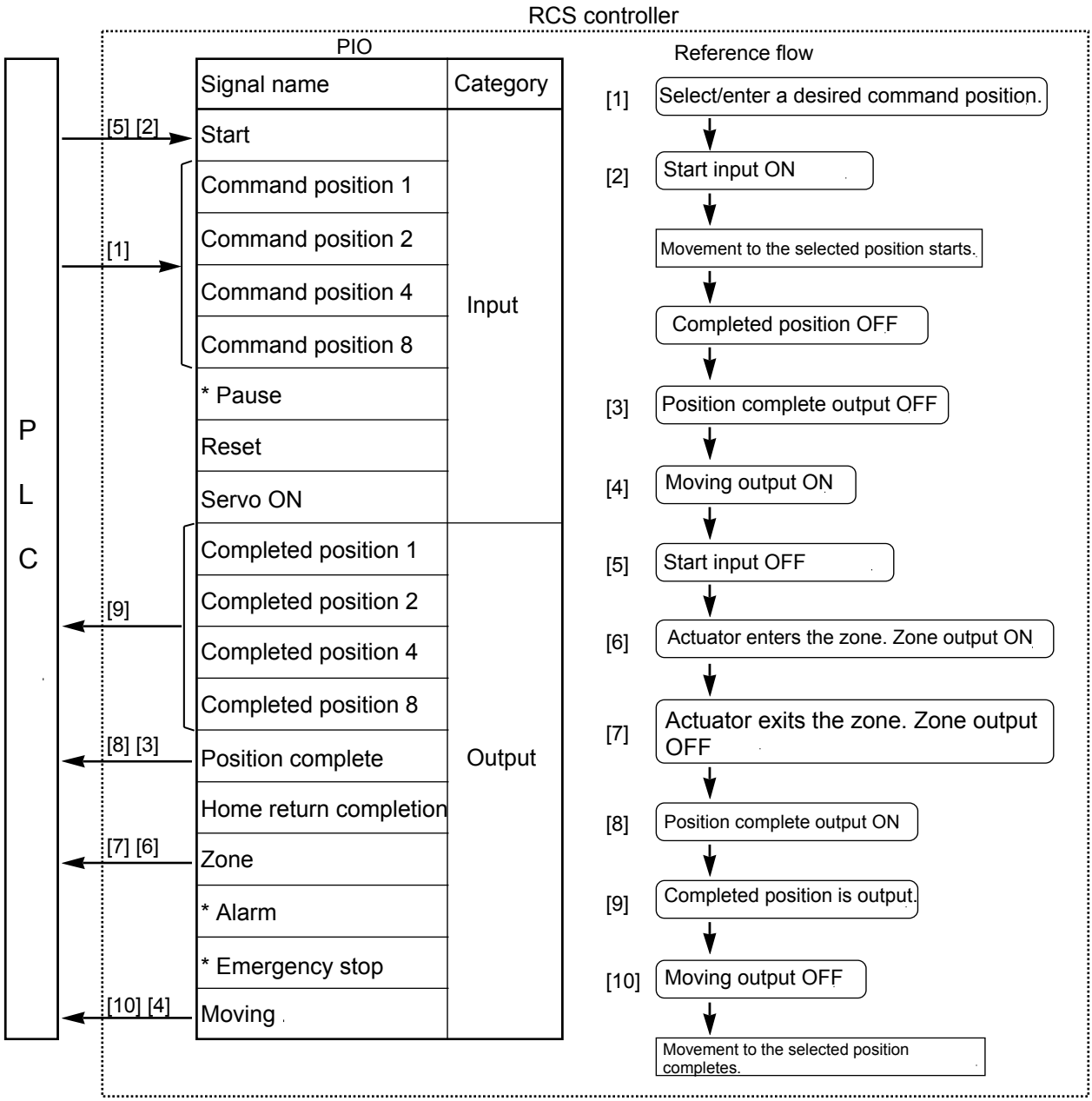
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5.9 Zone Signal Output

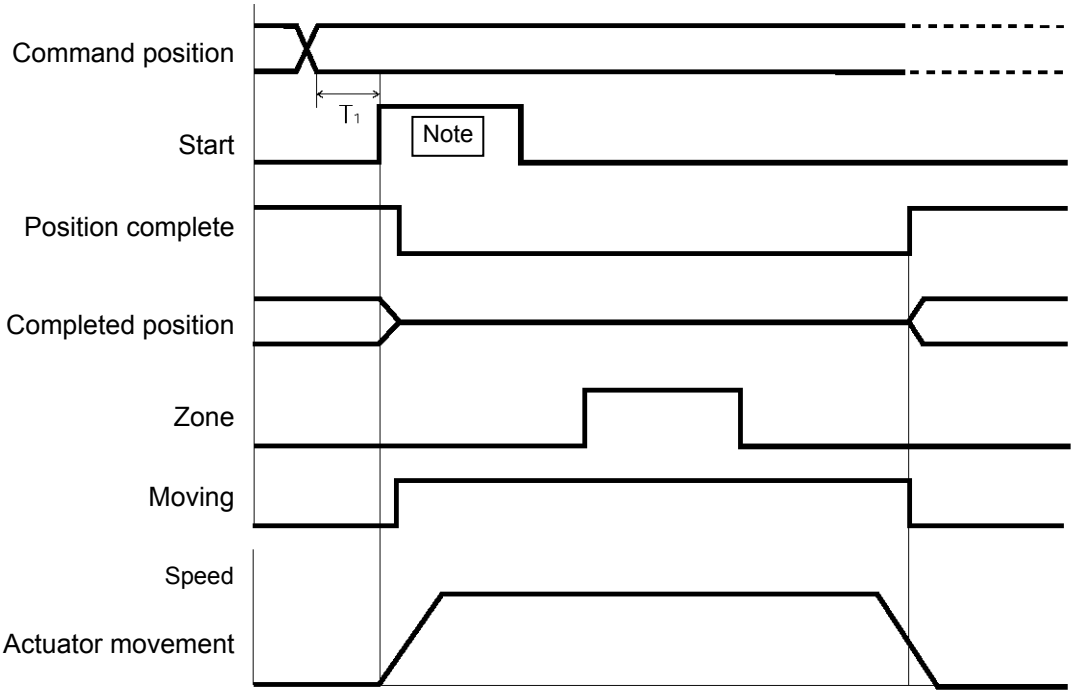
Example of use in operation) While the actuator is moving a zone signal is output inside the zone enclosed by distances of 40 mm and 120 mm from the home. (40 mm ≤ Zone signal output ≤ 120 mm)

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

Zone boundary+	120
Zone boundary–	40



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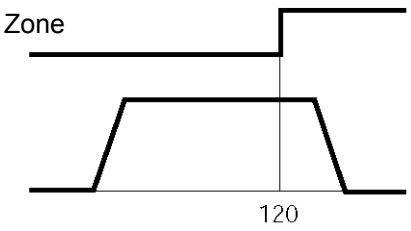


T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

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

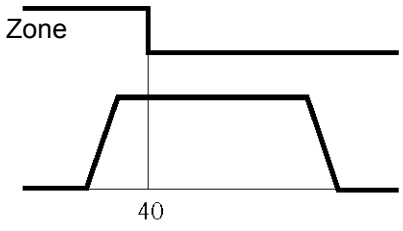
Example of other zone output)

Zone 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

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5.10 Returning Home

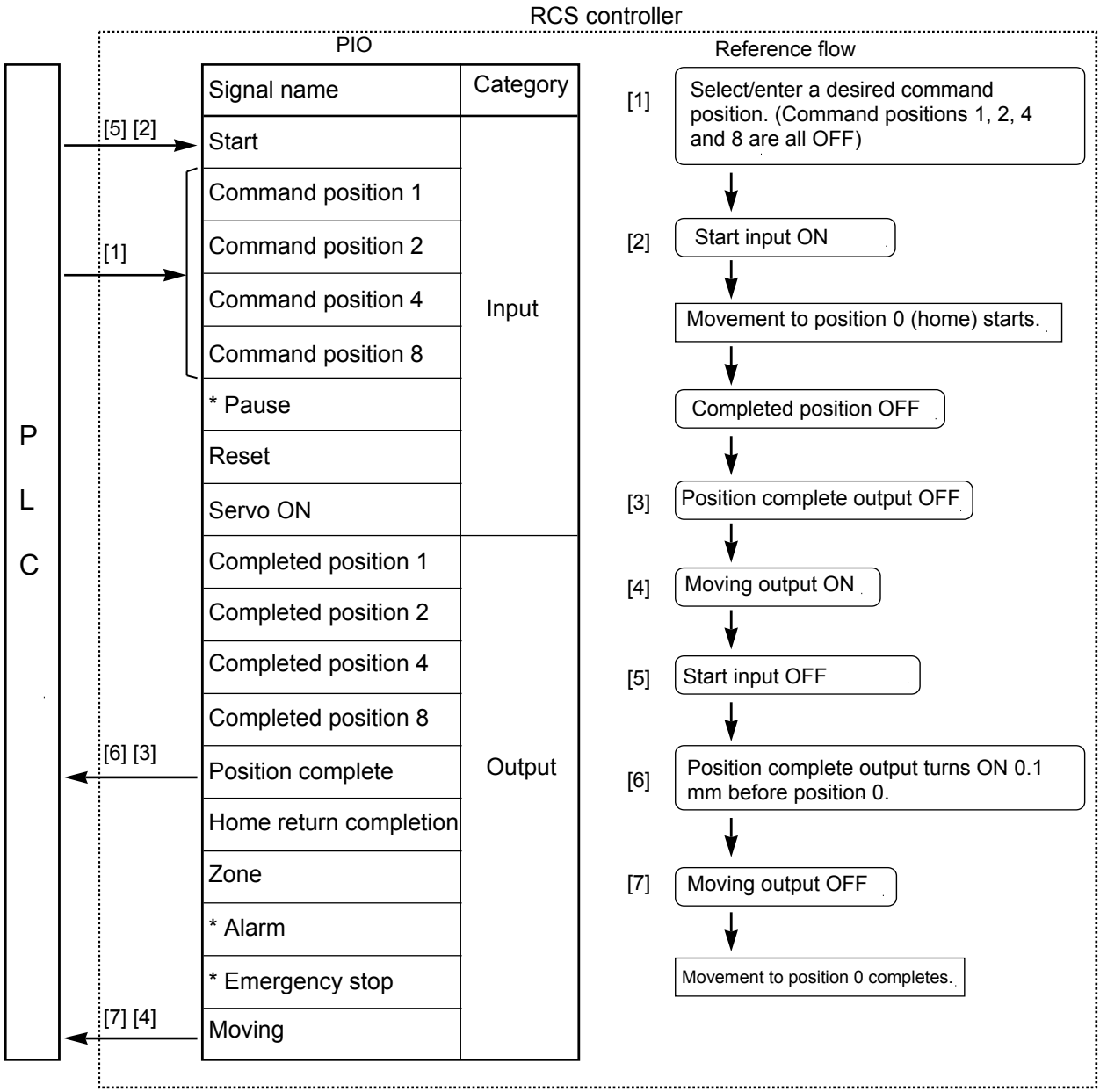
Example of use in operation) Home return alone cannot be performed using PIO.

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

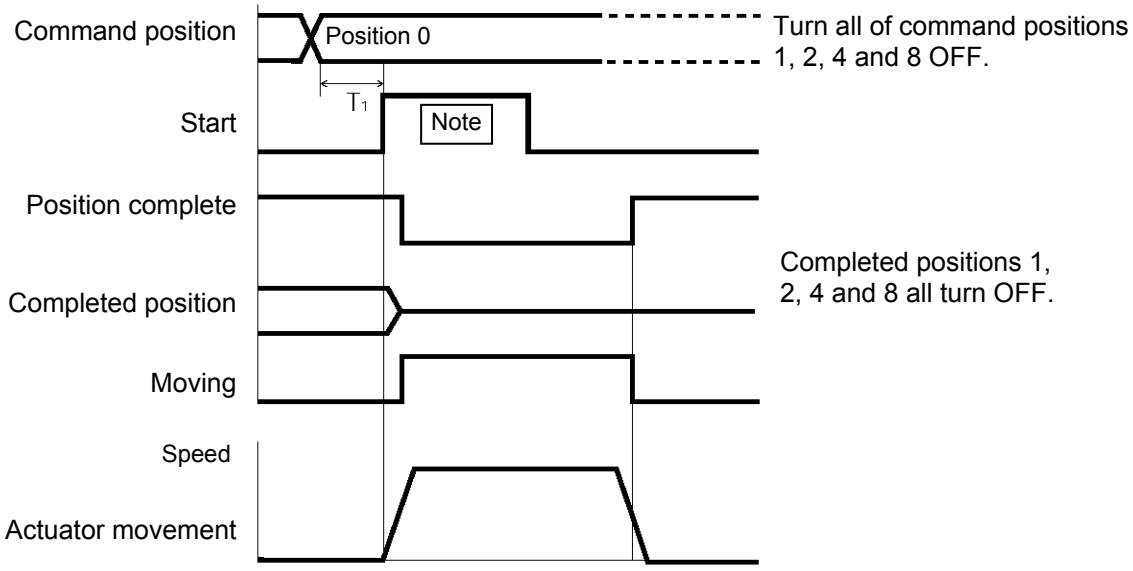
Enter home data in position 0. To return home, move the actuator to position 0.

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

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



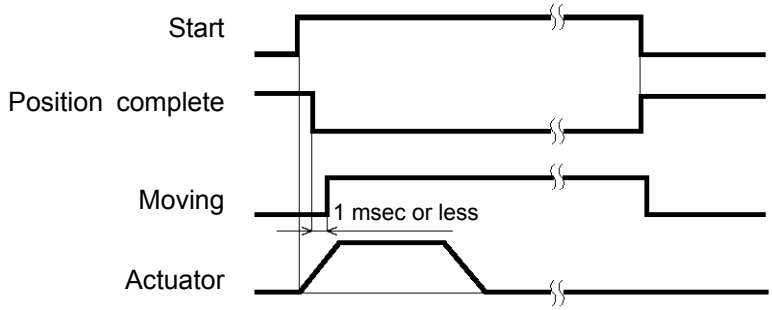
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T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

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

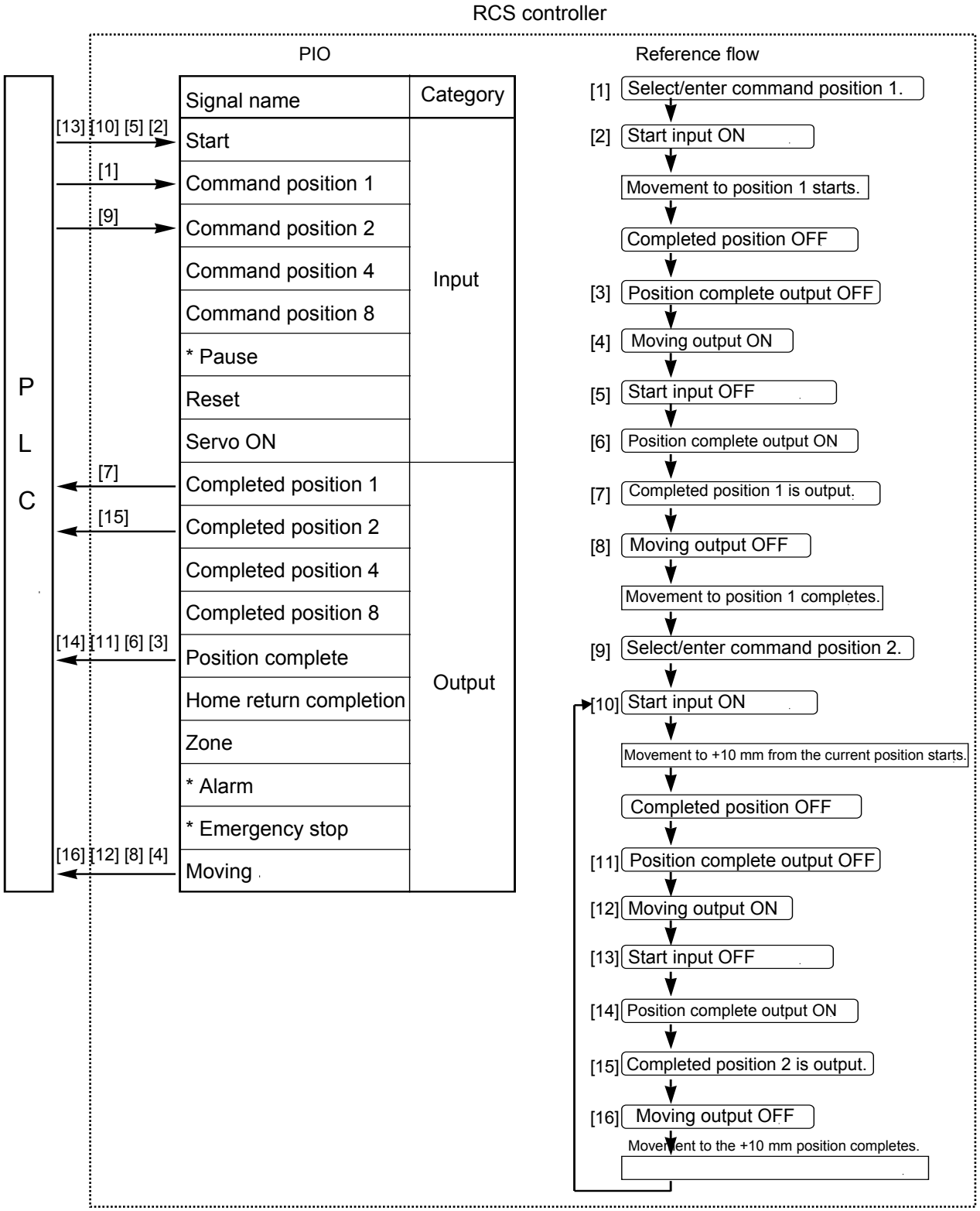
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.
If the start input remains ON as shown below, the position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



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5.11 Incremental Moves

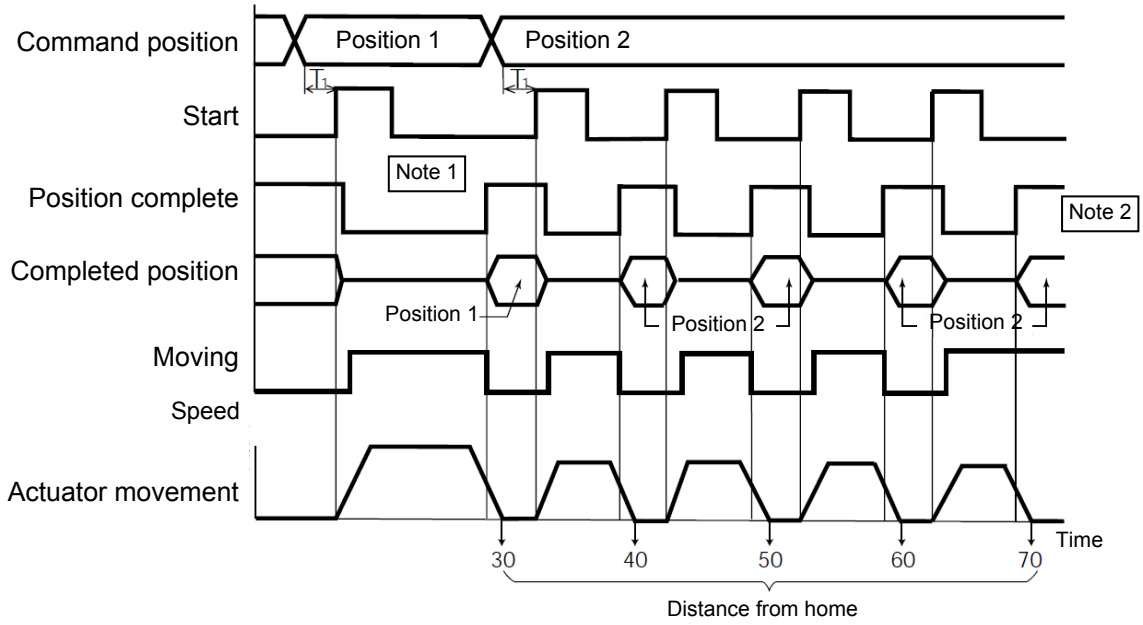
Example of use in operation) The actuator is caused to move from the home to the 30-mm position, from which it will be moved repeatedly in increments of 10 mm. The travel speed from the home to the 30-mm position is set as 100 mm/sec, and that for 10-mm incremental moves is set as 20 mm/sec.



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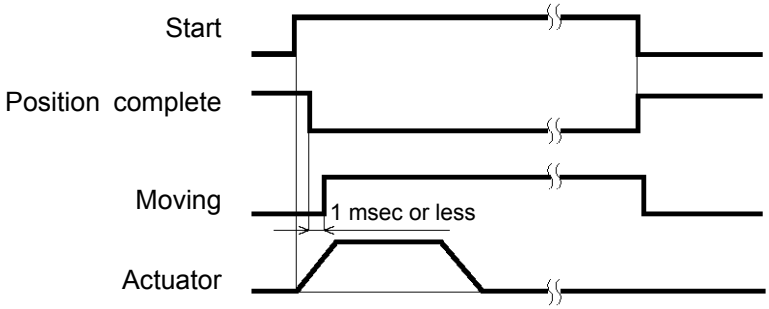
Position-data table (Field(s) within thick line must be entered.)

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



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

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



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

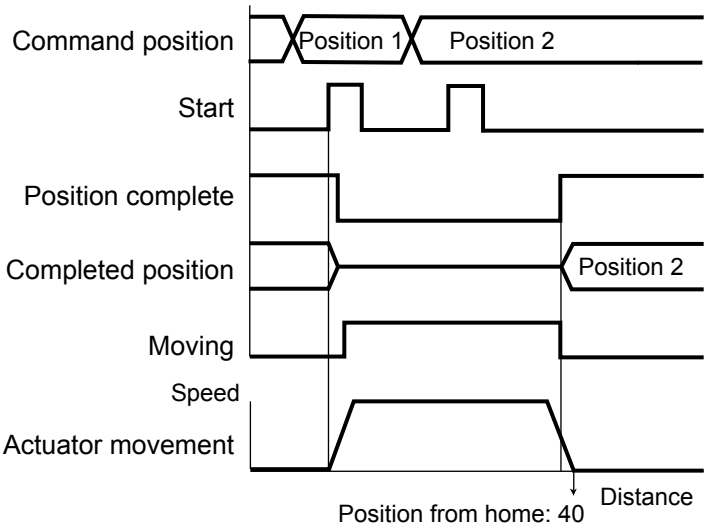
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5.12 Notes on Incremental Mode

(1) Notes on positioning operation

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

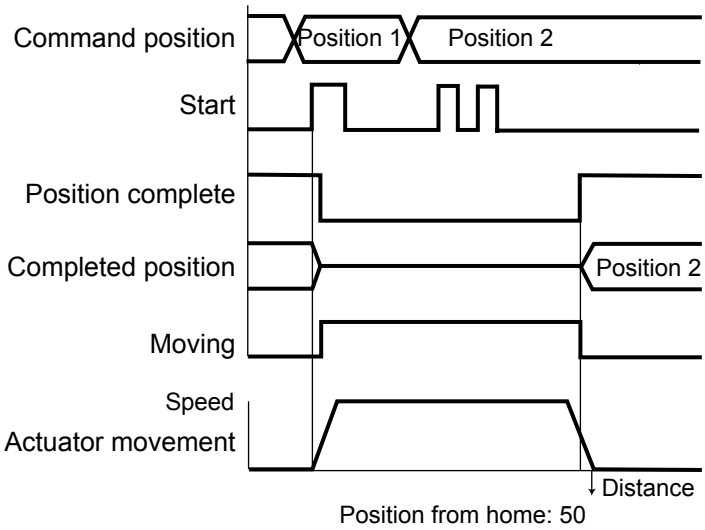
Example) If the start signal for movement to position 2 is input while the actuator is moving to position 1, the actuator will move to the position 40 mm from the home.



No.	Position	Speed
0	*	*
1	30	100
2	10	100
⋮	⋮	⋮

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

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

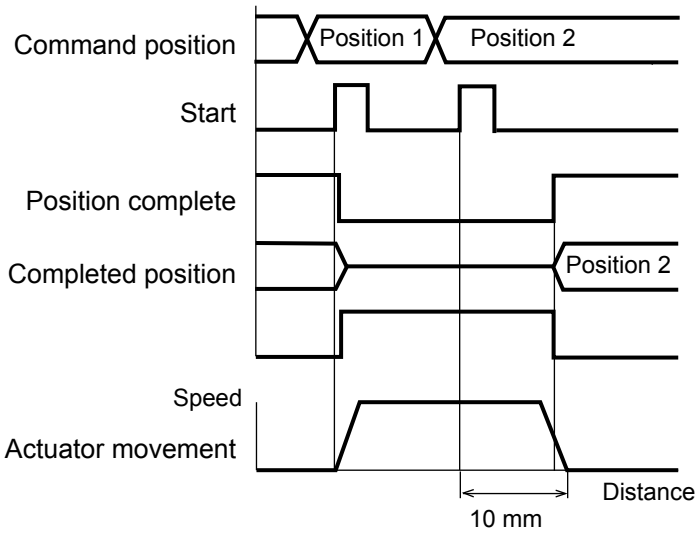


(2) Note on push & hold operation

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

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



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

(3) Cumulative errors due to repeated incremental moves
Position data is recognized only as a multiple of the minimum resolution. The minimum resolution is determined by the lead and the number of encoder pulses. Therefore, a margin of error may occur between the entered position value and the actual movement of the actuator. If an incremental move is repeated, this error will accumulate.
The maximum error range for each actuator type is shown below:

	Type	Motor (W)	Speed type	Screw lead (mm)	Maximum error (μ)
Slider type	SA4	20	L	2.5	0.2
			M	5	0.3
			H	10	0.6
	SA5	20	L	3	0.2
			M	6	0.4
			H	12	0.7
	SA6	30	L	3	0.2
			M	6	0.4
			H	12	0.7
	SSR	60	M	6	0.4
			H	12	0.7
	SMR	100	M	10	0.6
			H	20	1.2
		150	M	10	0.6
			H	20	1.2
Flat type	F45	30	L	2.5	0.2
			M	5	0.3
			H	10	0.6
	F55	60	L	4	0.2
			M	8	0.5
			H	16	1.0
		100	L	4	0.2
			M	8	0.5
			H	16	1.0

	Type	Motor (W)	Speed type	Screw lead (mm)	Maximum error (μ)
Rod type	RA35	20	L	2.5	0.3
			M	5	0.6
			H	10	1.2
	RA45	30	L	2.5	0.2
			M	5	0.3
			H	10	0.6
	RA55	60	L	4	0.2
			M	8	0.5
			H	16	1.0
		100	L	4	0.2
			M	8	0.5
			H	16	1.0
	RB7525	60	M	5	1.6
			H	10	3.3
	RB7530	60	L	3	1.0
			M	6	2.0
			H	12	3.9
		100	M	6	2.0
			H	12	3.9
	RB7535	100	L	4	1.3
			M	8	2.6
			H	16	5.2
		150	M	8	2.6
			H	16	5.2

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6. Parameters

6.1 Parameter Classification

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

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

6.2 Parameter List

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

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

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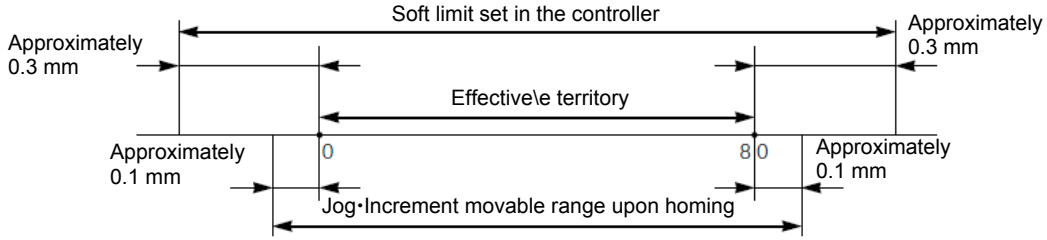
6.3 Parameter Settings

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

6.3.1 Parameters Relating to Actuator Stroke Range

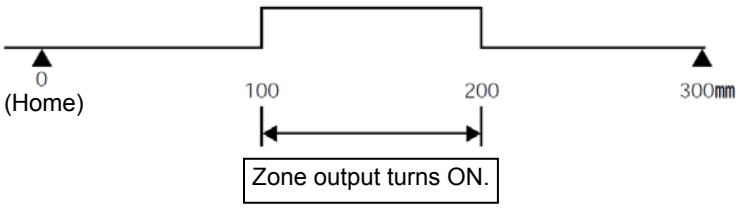
- Soft limits

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



- Zone limits

Set the zone in which the zone output signal turns ON.
The zone signal will turn ON when the current coordinate is between the – setting and + setting.
Set the + zone limit in parameter No. 1 and – zone limit in parameter No. 2.
The minimum setting unit is 0.01 mm.
Example) With the actuator of 300-mm stroke, use the zone limits as an intermediate LS actuating in a range of 100 to 200 mm
Parameter No. 1 (+ side): 200 Parameter No. 2 (– side): 100



- Home direction

If not specified by the user, the home direction is set to the motor side before shipment.
If you must change the home direction after the actuator has been assembled to your equipment, switch 0 and 1 in the setting of parameter No. 5.
If necessary, also change the home offset and soft limits.

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

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- Home offset

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

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

6.3.2 Parameters Relating to Actuator Operating Characteristics

- Initial speed setting

This parameter has been set to the rated speed of the actuator at the factory.
If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the speed data corresponding to the applicable position number.
To set a speed lower than the rated speed, change the setting of parameter No. 8.

- Initial acceleration/deceleration setting

This parameter has been set to the rated acceleration/deceleration of the actuator at the factory.
If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the acceleration/deceleration data corresponding to the applicable position number.
To set an acceleration/deceleration lower than the rated acceleration/deceleration, change the setting of parameter No. 9.

- Initial positioning band (in-position)

This parameter has been set to "0.10" mm at the factory.
If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the positioning band data corresponding to the applicable position number.
Since increasing this value will cause a position complete signal to output early, change the setting of parameter No. 10 as necessary.

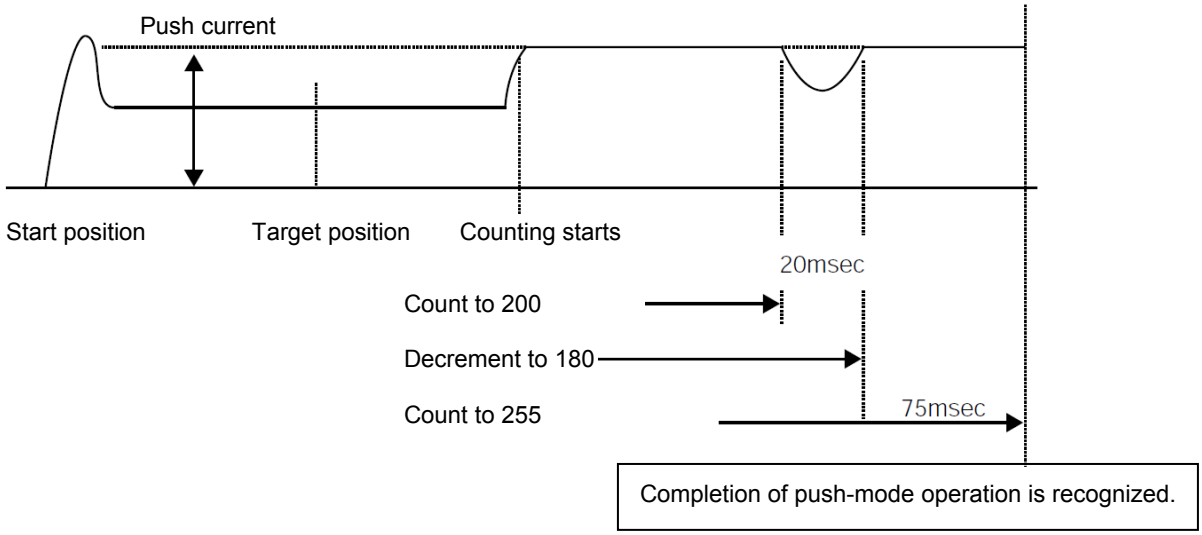
- Initial acceleration only MAX flag

To cause the actuator to stop gradually at slow deceleration, you must set a lower acceleration/deceleration. However, this will also slow the acceleration.
This parameter lets you set a quicker acceleration without affecting the deceleration.
Note, however, that this parameter can be used only when the actual payload is no more than one-third of the rated loading capacity.
Check the rated loading capacity of your actuator by referring to the supplied specification list of supported actuators.
This parameter has been set to "0" (Disable) at the factory.
If a target position was written to an unregistered position table or the current position was acquired in the teaching mode, the controller regards the value of this parameter as the "acceleration only MAX" data corresponding to the applicable position number.
To enable this function, change parameter No. 11 to "1" (Enable).

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- Push & hold recognition time

This parameter is used as a condition for determining if the actuator has contacted the work part and completed its push-mode operation.
Specifically, push-mode operation is deemed complete if the current limit value set in the position table has been maintained for the time set in parameter No. 6.
Set this parameter to an optimal value in accordance with the current limit value, by considering the shape and strength of the work part, etc.
The minimum setting unit is 1 msec, and the maximum value is 255 msec. This parameter has been set to “255” msec at the factory.
(Note) If the work part has shifted and current has changed during the push & hold recognition time, the judgment will be made as follows. In this example, the push & hold recognition time is set to 255 msec.



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

- Current limit value during positioning stop

At the factory, this parameter has been set to a current value corresponding to the standard specification of the actuator.
Increasing this value will increase the holding torque while the actuator is stopped.
This parameter need not be changed in normal conditions of use. However, hunting will occur if excessive external force applies to the actuator while the actuator is stopped. In this case, the value set in parameter No. 12 must be increased.
If you need to change this parameter, please contact IAI first.

- Current limit value during homing

At the factory, this parameter has been set to a current value corresponding to the standard specification of the actuator.
Increasing this value will increase the torque during homing.
This parameter need not be changed in normal conditions of use. However, the value set in parameter No. 13 must be increased if the slide resistance has increased in a vertical application due to the affixing method, load condition, etc., and homing completes before the correct position.
If you wish to change this parameter, please contact IAI first.

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- Movement flag during stop

This parameter defines whether to enable or disable the dynamic brake while the actuator is stopped.
It has been set to “1” (Enable) at the factory.
This parameter need not be changed in normal conditions of use, but there are situations where the actuator must be moved by hand with the servo turned OFF but the actuator does not move smoothly due to large slide resistance (this often occurs with actuators having a short ball screw lead).
In this case, you can change the value of parameter No. 14 to “0” (Disable) to release the dynamic brake and make the actuator move smoothly.

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

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6.3.3 Parameters Relating to External Interface

- Hold input disable selection

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

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

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

- Servo ON input disable selection

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

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

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

- Serial communication speed

This parameter sets the communication speed to be used when the controller implements serial communication control via the PLC’s communication module.
Set parameter No. 16 to a value appropriate for the specification of the communication module.
9600, 19200, 38400 or 115200 bps can be selected as the communication speed.
This parameter has been set to “38400” bps at the factory.

- Minimum delay before slave transmitter activation

This parameter defines the minimum delay before the controller’s transmitter is activated following the completion of command reception, when the controller implements serial communication control via the PLC’s communication module.
This parameter has been set to “5” msec at the factory. If the communication module specification exceeds 5 msec, set the required time in parameter No. 17.

6.3.3 Servo Gain Adjustment

- Servo gain No.

At the factory, this parameter has been set to an appropriate value in accordance with the standard specification of the actuator.
Although it need not be changed in normal conditions of use, vibration or noise may occur if the load condition has changed significantly after shipment due to change in the actuator affixing method, load condition, etc., when the actuator is used in a vertical application.
In this case, changing the value of parameter No. 7 will improve the situation, but the new setting must be determined carefully by taking into consideration all factors affecting the relationship of actuator operation.
Please contact IAI.

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7. Troubleshooting

7.1 What to Do When A Problem Occurs

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

a. Check the status indicator lamps
   RDY (green) --- The controller is receiving power and the CPU is operating normally.
   RUN (green) --- The servo is ON and the actuator is moving.
   ALM (red) --- An alarm is present.
   ENC (orange) --- The encoder circuit is open or the encoder is not recognized.
b. Check the host controller for abnormality.
c. Check the voltage of the main power supply.
d. Check the voltage of the 24-VDC power supply for I/O signals.
e. Check for alarms.
   Check the details of each alarm on the PC or teaching pendant.
f. Check the cables for miswiring, disconnection and pinching.
   Before checking the continuity of cables, turn off the power (to prevent a runaway actuator) and disconnect all wirings (to prevent the power from being supplied unexpectedly due to a sneak path).
g. Check the I/O signals.
h. Check the noise elimination measure (ground connection, surge killer installation, etc.).
i. Identify how the problem occurred and the operating condition when the problem occurred.
j. Check the serial numbers of the controller and actuator.
k. Analyze the cause.
l. Take an action.

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

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

(Note) The *emergency stop and *alarm signals operate on the negative logic.
After the power is input, these signals remain ON while the controller is normal. They turn OFF when the power is cut off.
These signals cannot be used for providing a contact-b interlock when the power is not supplied to the controller.

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7.2 Alarm Level Classification

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

Alarm level	ALM lamp	*Alarm	Condition at occurrence of alarm	How to reset
Message	Unlit	Not output	An error is displayed on the PC software screen or teaching pendant.	
Operation cancellation	Lit	Output	The actuator decelerates to a stop, and then the servo turns off.	Input a reset signal from the PLC. Execute reset using the PC/teaching pendant.
Cold start	Lit	Output	The actuator decelerates to a stop, and then the servo turns off.	Reconnect the power.

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

7.3 Alarm Output by PIO

So that the PLC can identify each alarm occurring in the controller, the content of each controller alarm is output using the ports corresponding to the last four bits of the complete position output signal.
(This function is not available for message level errors.)
The PLC should be able to identify if a given output indicates a complete position number or alarm based on the status of the alarm output signal.

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

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

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

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7.4 Alarms, Causes and Actions

(1) Message Alarms

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

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(2) Operation Cancellation Alarms

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

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

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(3) Cold Start Alarms

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

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

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

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7.5 Messages Displayed during Operations Using Teaching Pendant or PC Software

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

Code	Message	Description
112	Input data error	An inappropriate value was input as a user parameter setting. (Example) "9601" was input as the serial communication speed by mistake. Input an appropriate value again.
113 114	Input value too small Input value too large	The input value is under the setting range. The input value is over the setting range. Input an appropriate value again by referring to the actuator specifications and parameter list.
115	Homing not yet complete	The current position was written before homing was complete. Perform homing first.
116	Last position data available	When new data is added, data already exists in the last position of the position table. Clear or delete the data in the last position first.
117	No movement data	No target position is set under the selected position number. Input a target position first.
11E	Inconsistent data pair	The magnitude relationship of a pair of data is inappropriate. (Example) The same value is set in both the + and – soft limit parameters. Input appropriate values again.
11F	Absolute value too small	The minimum travel toward a target position is determined by the lead of the drive system and encoder resolution. This message indicates that the input target position is less than this minimum travel. (Example) With the RCS-R30, the lead is 90° and encoder resolution is 3,072 pulses. Therefore, the minimum travel is calculated as 0.029°/pulses (90 ÷ 3,072). If "0.02° is input as the target position, this message will be displayed.
121	Push search end over	The final position in push-motion operation exceeds a soft limit. No harm is done as long as the actuator contacts the work part. If it misses the work part, however, the actuator will reach the soft limit and this message will be displayed. Change either the target position or positioning band.
122	Multiple axes connected at assignment	An axis number was assigned when multiple axes were connected. Always assign an axis number when only one axis is connected.
180 181 182	Axis number change OK Controller initialization OK Home change all clear	This is an operation check message. (It does not indicate misoperation or error.)
201	Emergency stop	An emergency stop was actuated. (This is not an error.)
20A	Servo OFF during movement	The servo ON signal (SON) was turned OFF by the PLC while the actuator was moving. As a result, the servo turned OFF and the actuator stopped.

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Code	Message	Description
20C	CSTR-ON during operation	The start signal (CSTR) was turned ON by the PLC while the actuator was moving. As a result, duplication of movement commands occurred.
20D	STP-OFF during operation	The hold signal (*STP) was turned OFF by the PLC while the actuator was moving. As a result, the actuator stopped.
20E	Soft limit over	A soft limit was reached.
20F	Missed work part in push-motion operation	The actuator missed the work part in push-motion operation. Check the work part condition and review the target position/positioning band settings.
301 302 304 305 306 308 30A 30B	Overrun error (M) Framing error (M) SCIR-QUE OV (M) SCIS-QUE OV (M) R-BF OV Response timeout (M) Packet R-QUE OV Packet S-QUE OV	An error occurred in serial communication with the controller. Cause: [1] Garbage data due to noise [2] Duplicate slave numbers when multiple actuators are controlled via serial communication Action: [1] Revise the wiring, equipment layout, etc., to eliminate noise. [2] Change the slave numbers to eliminate duplication. If the message persists, please contact IAI.
307 309	Memory command denied Write address error	A command was denied in serial communication with the controller. An indeterminable write address error occurred in serial communication with the controller. These messages do not generate during normal operation. Should either of them occur, record the entire error list before turning off the power. The recorded error list will help us identify the cause of the problem. Also contact IAI.
30C	No connected axis	The controller axis number cannot be recognized. Cause: [1] The controller is not operating properly. [2] Only the communication line of the supplied cable (SGA/SGB) is open. [3] When RCP2 and ERC controllers are linked together via SIO converters, not all link cables are connected although 24 V is supplied to all converters. [4] The piano switches are set to the same number on multiple controllers being linked. Action: [1] Check if the RDY LED on the controller is lit. If this LED is not lit, the controller is faulty. [2] If you have a spare teaching pendant, change to the spare teaching pendant. Or, switch to the PC software mode and see if the message will disappear. [3] Connect all pairs of converter and controller using link cables, and then supply the power. [4] Do not set the piano switches to the same number on multiple linked controllers. If the message persists, please contact IAI.

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* Appendix

Specification List of Supported Actuators

	Model number	Stroke (mm), maximum speed (mm/sec) (Note 1)															Loading capacity (Note 2)		Rated acceleration	
		50	100	150	200	250	300	350	400	450	500	550	600	700	800	900	1000	Horizontal (kg)	Vertical (kg)	Horizontal (G)	Vertical (G)
Slider type	RCS-SA4-□-20-H-□□□	665																4	1	0.3	0.2
	RCS-SA4-□-20-M-□□□	330																5	2.5	0.3	
	RCS-SA4-□-20-L-□□□	165																	4.5	0.2	
	RCS-SA5-□-20-H-□□□	800									760							4	1	0.3	
	RCS-SA5-□-20-M-□□□	400									380							8	2	0.3	
	RCS-SA5-□-20-L-□□□	200									190								4	0.2	
	RCS-SA6-□-20-H-□□□	800									760	640	540					6	1.5	0.3	
	RCS-SA6-□-20-M-□□□	400									380	320	270					12	3	0.3	
	RCS-SA6-□-20-L-□□□	200									190	160	135						6	0.2	
	RCS-SS-□-60-H-□□□	600											470					15	4	0.3	0.2
	RCS-SS-□-60-M-□□□	300											230					30	8		
	RCS-SM-□-100-H-□□□	1000												960	765	625	515	20	4		
	RCS-SM-□-100-M-□□□	500												480	380	310	255	40	8		
	RCS-SM-□-150-H-□□□	1000												960	765	625	515	30	6		
	RCS-SM-□-150-M-□□□	500												480	380	310	255	60	12		
	RCS-SSR-□-60-H-□□□	600											470					15	4		
	RCS-SSR-□-60-M-□□□	300											230					30	8		
	RCS-SMR-□-100-H-□□□	1000												960	765	625	515	20	4		
	RCS-SMR-□-100-M-□□□	500												480	380	310	255	40	8		
	RCS-SMR-□-150-H-□□□	1000												960	765	625	515	30	6		
	RCS-SMR-□-150-M-□□□	500												480	380	310	255	60	12		
Rod type	RCS-RA35-I-20-H-□□□	500																4	1	0.3	0.2
	RCS-RA35-I-20-M-□□□	250																9	3		
	RCS-RA35-I-20-L-□□□	125																18	6.5	0.2	
	RCS-RA45-I-30-H-□□□	500																7	1.5	0.3	
	RCS-RA45-I-30-M-□□□	250																15	4		
	RCS-RA45-I-30-L-□□□	125																30	8.5	0.2	
	RCS-RA55-□-60-H-□□□	800						755										12	2	0.3	
	RCS-RA55-□-60-M-□□□	400						377										25	5		
	RCS-RA55-□-60-L-□□□	200						188										50	11.5	0.2	
	RCS-RA55-□-100-H-□□□	800						755										15	3.5	0.3	
	RCS-RA55-□-100-M-□□□	400						377										30	9		
	RCS-RA55-□-100-L-□□□	200						188										60	18	0.2	
	RCS-RA35R-I-20-H-□□□	500																4	1	0.3	0.2
	RCS-RA35R-I-20-M-□□□	250																9	3		
	RCS-RA35R-I-20-L-□□□	125																18	6.5	0.2	
	RCS-RA45R-I-30-H-□□□	500																7	1.5	0.3	
	RCS-RA45R-I-30-M-□□□	250																15	4		
	RCS-RA45R-I-30-L-□□□	125																30	8.5	0.2	
	RCS-RA55R-□-60-H-□□□	800						755										12	2	0.3	
	RCS-RA55R-□-60-M-□□□	400						377										25	5		
	RCS-RA55R-□-60-L-□□□	200						188										50	11.5	0.2	

(Note 1) The figure in each elongated circle represents the maximum speed for the applicable stroke(s).
(Note 2) The loading capacity is calculated by assuming actuator operation at the rated acceleration.

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	Model number	Stroke (mm), maximum speed (mm/sec) (Note 1)																Loading capacity (Note 2)		Rated acceleration	
																		Horizontal	Vertical	Horizontal	Vertical
		50	100	150	200	250	300	350	400	450	500	550	600	700	800	900	1000	(kg)	(kg)	(G)	(G)
Rod type	RCS-RB7525-I-60-H-□□□	500				485	350											25	4	0.1	0.1
	RCS-RB7525-I-60-M-□□□	250				245	175											45	7	0.08	0.08
	RCS-RB7530-I-60-H-□□□	600					505											10	2.5	0.15	0.15
	RCS-RB7530-I-60-M-□□□	300					250											20	7	0.1	0.1
	RCS-RB7530-I-60-L-□□□	150					125											40	15.5	0.05	0.05
	RCS-RB7530-I-100-H-□□□	600					505											15	5.5	0.2	0.2
	RCS-RB7530-I-100-M-□□□	300					250											30	12.5	0.1	0.1
	RCS-RB7535-I-100-H-□□□	800																10	3.5	0.25	0.25
	RCS-RB7535-I-100-M-□□□	400																22	9	0.17	0.17
	RCS-RB7535-I-100-L-□□□	200																40	19.5	0.1	0.1
	RCS-RB7535-I-150-H-□□□	800																15	6.5	0.3	0.3
	RCS-RB7535-I-150-M-□□□	400																35	14.5	0.2	0.2
Flat type	RCS-F45-□-30-H-□□□	500																	1.5	0.3	0.2
	RCS-F45-□-30-M-□□□	250																	4		
	RCS-F45-□-30-L-□□□	125																	9		
	RCS-F55-□-60-H-□□□	800																	2		
	RCS-F55-□-60-M-□□□	400																	5		
	RCS-F55-□-60-L-□□□	200																	11.5	0.2	
	RCS-F55-□-100-H-□□□	800																	3.5	0.3	
	RCS-F55-□-100-M-□□□	400																	9		
	RCS-F55-□-100-L-□□□	200																	18	0.2	

(Note 1) The figure in each elongated circle represents the maximum speed for the applicable stroke(s).
(Note 2) The loading capacity is calculated by assuming actuator operation at the rated acceleration.
(Note 3) Refer to the table on the next page.

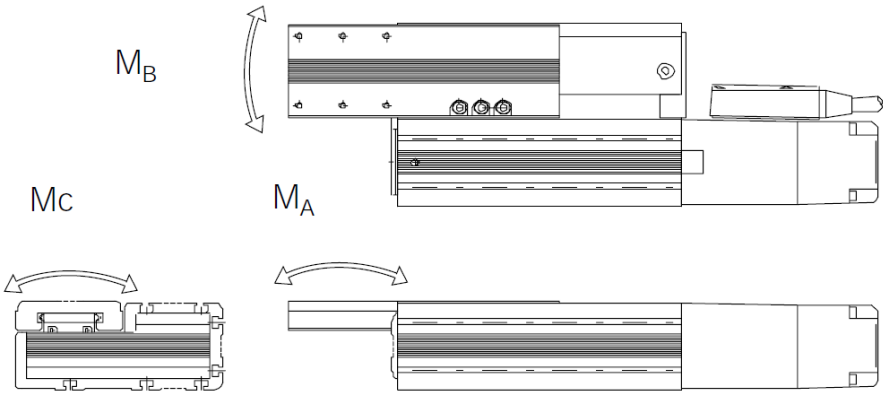
	Model name	Rated torque	Oscillation angle (deg)	Maximum speed (deg/sec)	Gear ratio	Rated acceleration
Rotary	RCS-R10-I-60-18-300-□□	2.4 N•m	300	500	18:1	2.76
	RCS-R20-I-60-18-300-□□	2.4 N•m	300	500	18:1	2.76
	RCS-R30-I-60-4-300-□□	0.76 N•m	300	500	4:1	2.76

	Model name	Stroke (mm)	Maximum return strokes (cpm)	Maximum gripping force (N)
Gripper	RCS-G20-I-60-5-□□	20, 40, 60, 80, 100, 120, 200	60	45.1 (Total of both fingers)

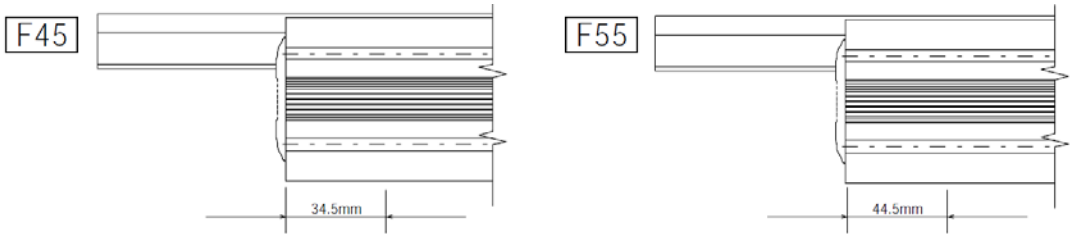
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Flat Type (F45, 55) - Moments and Loading Capacity

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

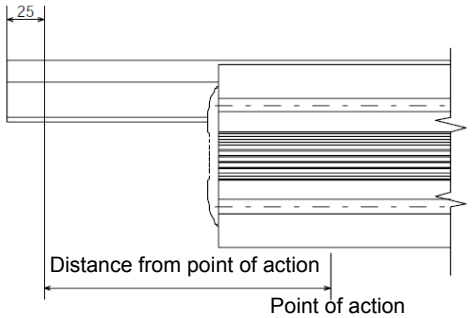


The points of action of Ma and Mb moments are shown in the figure below.



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

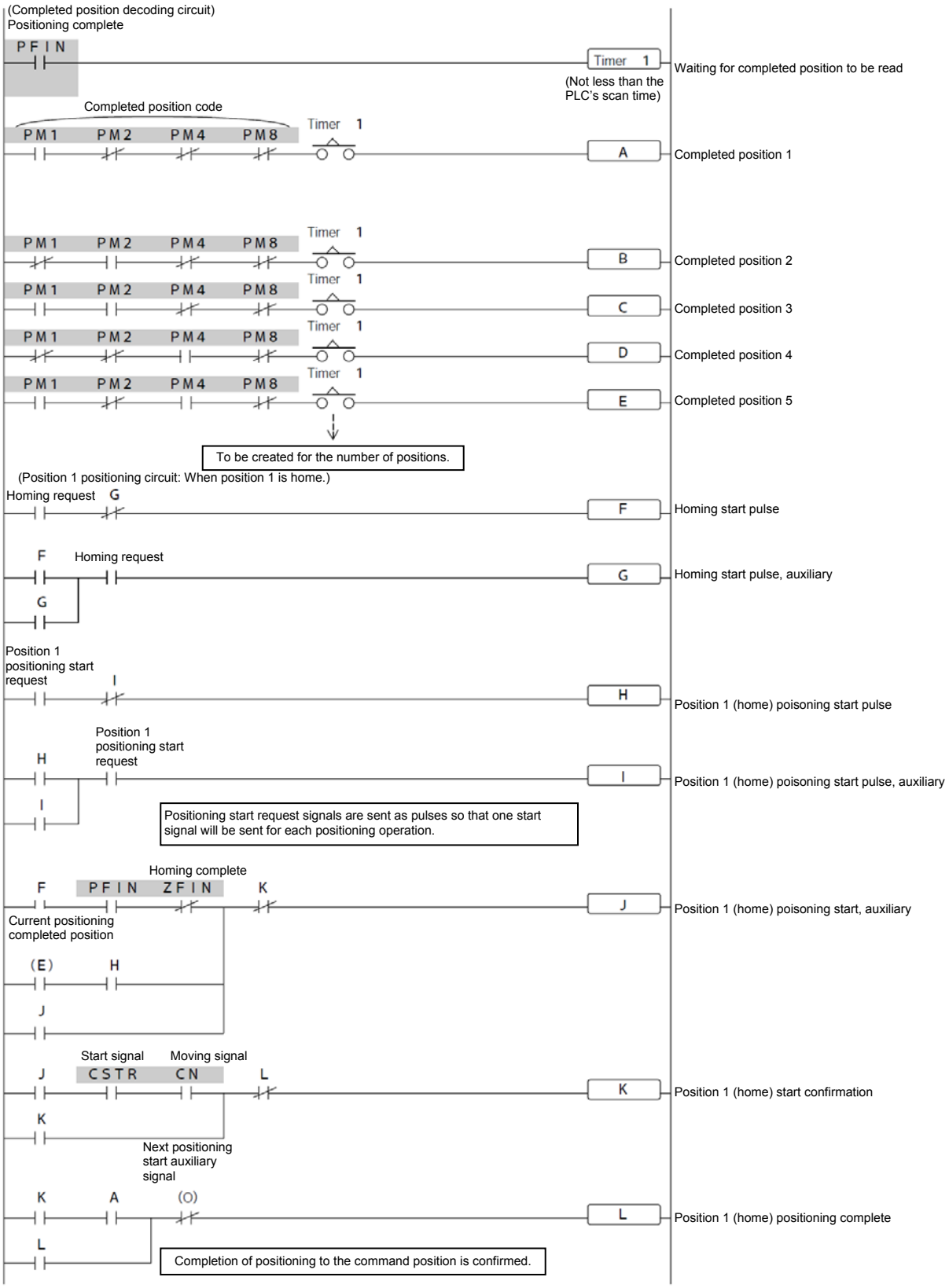
Stroke		50	100	150	200	250	300
F45 type	Distance from point of action (m)	0.06	0.11	0.16	0.21	0.26	0.31
	N	45.0	24.5	16.9	12.9	10.4	8.7
	(kgf)	4.59	2.50	1.72	1.31	1.06	0.89
F 55 type	Distance from point of action (m)	0.07	0.12	0.17	0.22	0.27	0.32
	N	64.3	37.5	26.5	20.5	16.7	14.1
	(kgf)	6.56	3.83	2.70	2.09	1.70	1.43



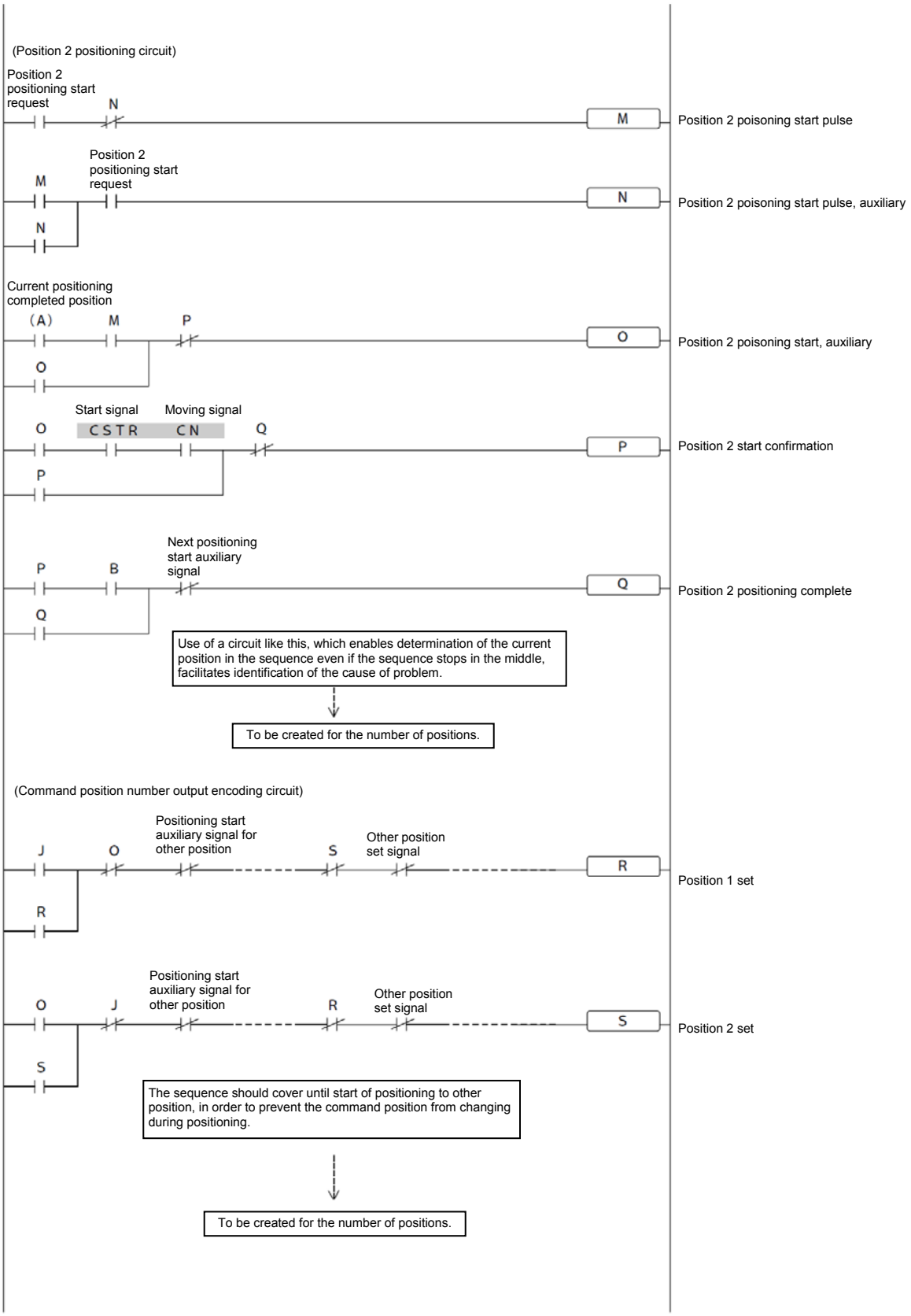
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Example of Basic RCS Positioning Sequence

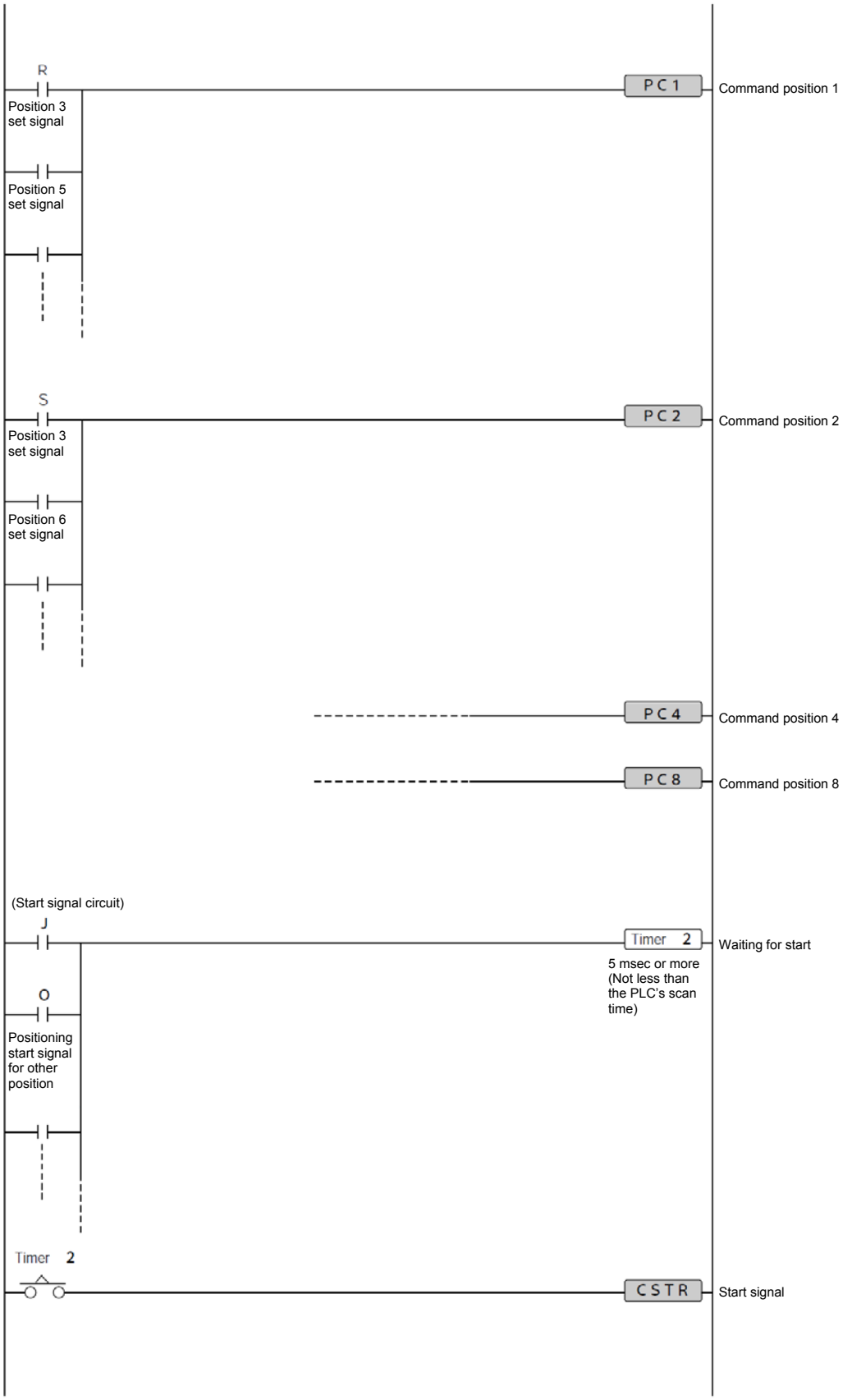
An example of basic sequence is given below for reference when creating an RCS positioning sequence.
indicates a PIO signal of the RCStroller.



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Position Table Record

Recorded date: _____

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

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Parameter Record

Recorded date: _____

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

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

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