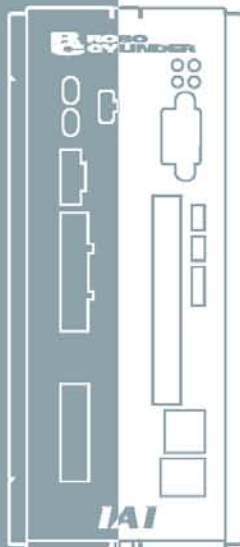
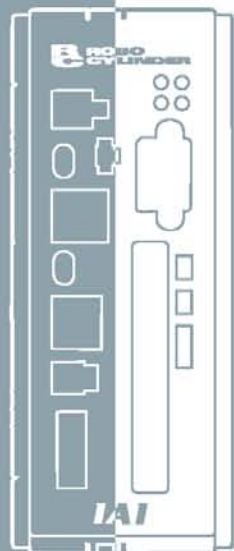




RCS Series ROBO Cylinder Controller RCS-C Type

Operation Manual 18th Edition



IAI America, Inc.

(1) Pause/servo ON signals

To operate the RCS (ROBO Cylinder), you must turn the PIO pause/servo ON input signals to ON.



Take note that if the PIO pause input signal remains OFF, the RCS will remain in pause and will not operate.

- (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. In the conditions listed below, the position complete signal will turn ON no matter where the actual position is. As a result, position 0 will be output.
1. When the power is turned on
 2. When an emergency stop is cancelled
 3. When an alarm is reset
 4. When a reset is performed after a pause

Pay due attention when using position 0.




- (4) With the absolute specification, an encoder reception 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.

Safety Precautions

Please read the information in “Safety Precautions” carefully before selecting a model and using the product.

The precautions described below are designed to help you use the product safely and avoid bodily injury and/or property damage.

Directions 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.

This product has been designed and manufactured as a component for use in general industrial machinery.

Devices must be selected and handled by a system designer, personnel in charge of the actual operation using the product or similar individual with sufficient knowledge and experience, who has read both the catalog and operation manual (particularly the “Safety Precautions” section). Mishandling of the product poses a risk.

Please read the operation manuals for all devices, including the main unit and controller.

It is the user’s responsibility to verify and determine the compatibility of this product with the user’s system, and to use them properly.

After reading the catalog, operation manual and other materials, be sure to keep them in a convenient place easily accessible to the personnel using this product.

When transferring or loaning this product to a third party, be sure to attach the catalog, operation manual and other materials in a conspicuous location on the product, so that the new owner or user can understand its safe and proper use.

The danger, warning and caution directions in this “Safety Precautions” do not cover every possible case. Please read the catalog and operation manual for the given device, particularly for descriptions unique to it, to ensure its safe and proper handling.



[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.

[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.



[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.
- The cables supplied with the product are flexible, but they are not robot cables. Do not store the cables in a movable cable duct (cable bearer, etc.) that bends more than the specified bending radius.
- 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.

- 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.



[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
- Install the main unit and controller in a place subject to as little dust as possible. Installing them in a dusty place may result in malfunction.
- 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.

- 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 insulation resistance test. Electric shock may result. (Do not perform any withstand voltage test on a product that uses DC power supply.)

Note

[General]

- If you are planning to use the product under a condition or environment not specified in the catalogs and operation manual, or in an application requiring strict safety such as aircraft facility, combustion system, entertainment machine, clean-room environment, safety device or other equipment having significant impact on human life or property, design operating ranges with sufficient margins from the ratings and design specifications or provide sufficient safety measures such as fail-safes. Whatever you do, always consult IAI's sales representative.

[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.
- The backup battery uses a nickel-cadmium battery. Before disposing of the product, remove the nickel-cadmium battery. Contact your nearest IAI sales office for a proper procedure to dispose of the removed battery.

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.

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. Note to the User

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.

* 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 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.

1-3 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.

1-4 Installation Environment and Noise Elimination

Pay due attention to the installation environment of the controller.

1-4-1 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.

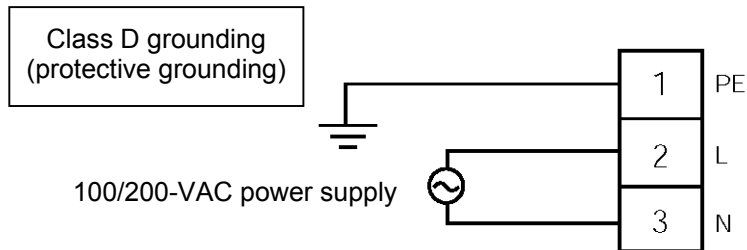
1-4-2 Power Supply

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

1-4-3 Noise Elimination and Grounding

- (1) Wiring and power supply

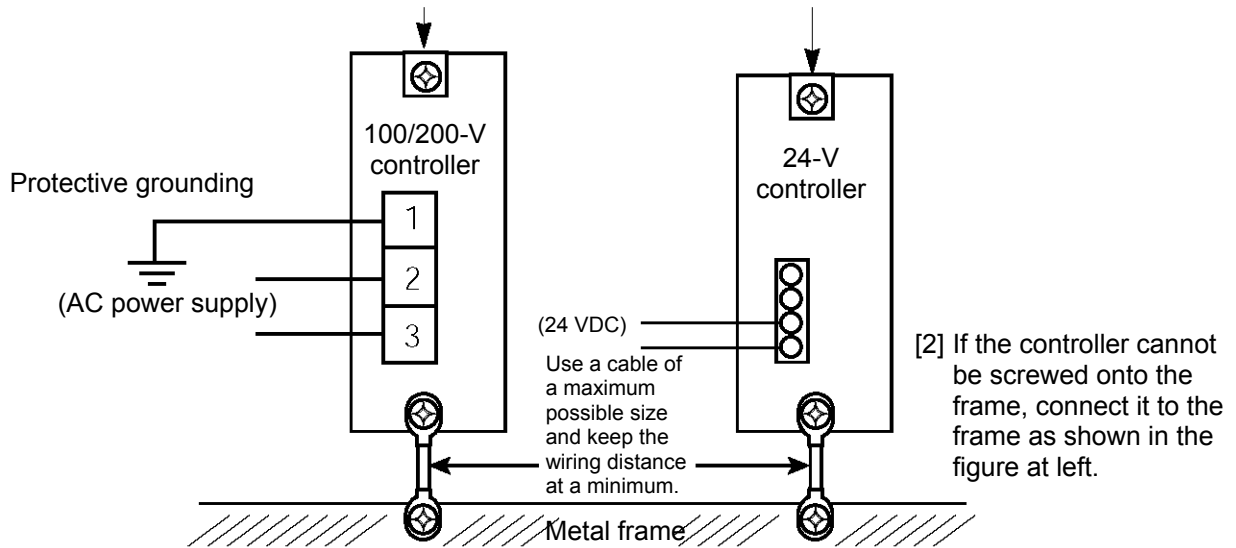
- [1] 100/200-VAC controller
PE on the power terminal block is a protective grounding terminal. Provide Class D grounding. Use a grounding cable of 0.75 mm² (AWG18) or larger. The grounding cable must be longer than the AC cable.



[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.



[3] Precautions regarding wiring method

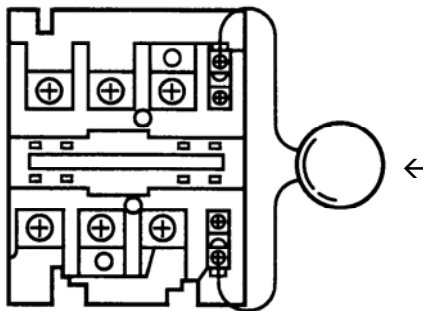
Use a twisted cable for connection to the 24-VDC external power supply.
 Separate the controller cables from high-power lines such as a cable connecting to a power circuit. (Do not bundle together the controller cables with high-power lines or place them in the same cable duct.)
 When extending the supplied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

(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.

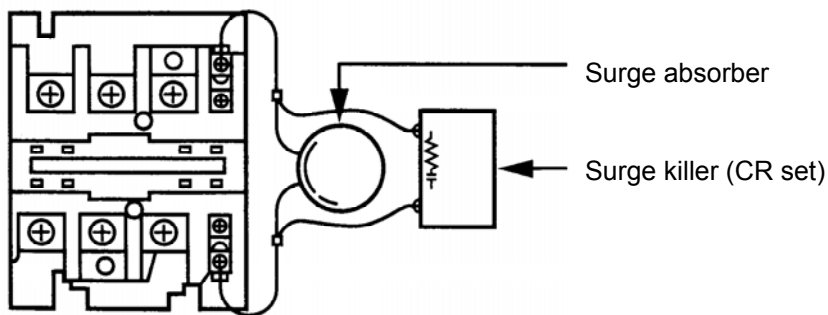
[1] AC solenoid valves, magnet switches and relays

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.

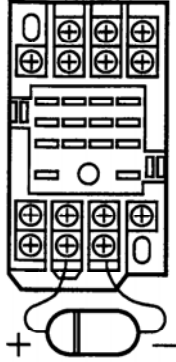
The most effective method is to connect a surge absorber and a surge killer in parallel.



This way, noise will be eliminated in the entire range.

[2] DC solenoid valves, magnet switches and relays

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



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

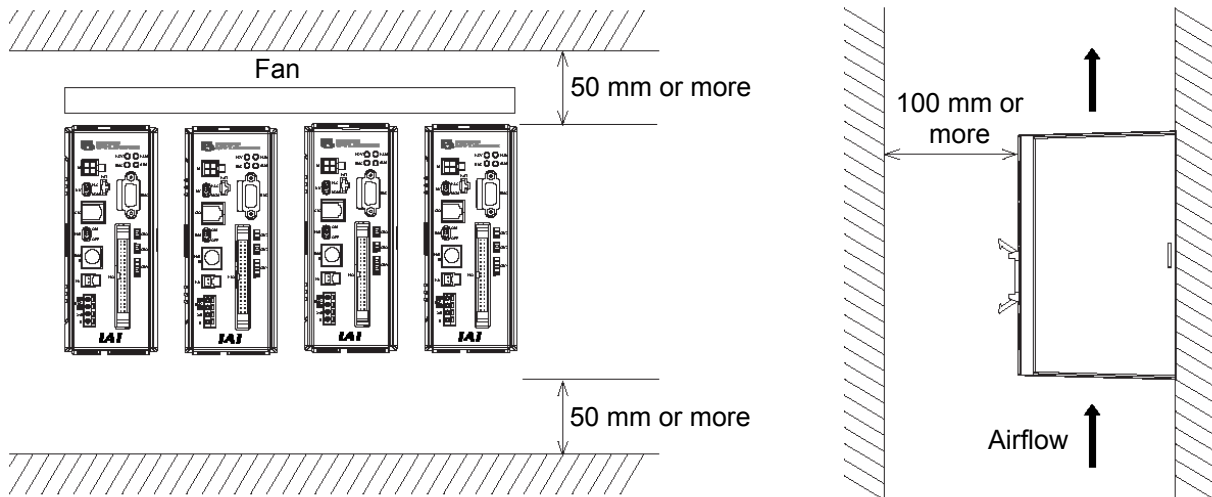
1-5 Heat Radiation and Installation

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

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

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

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

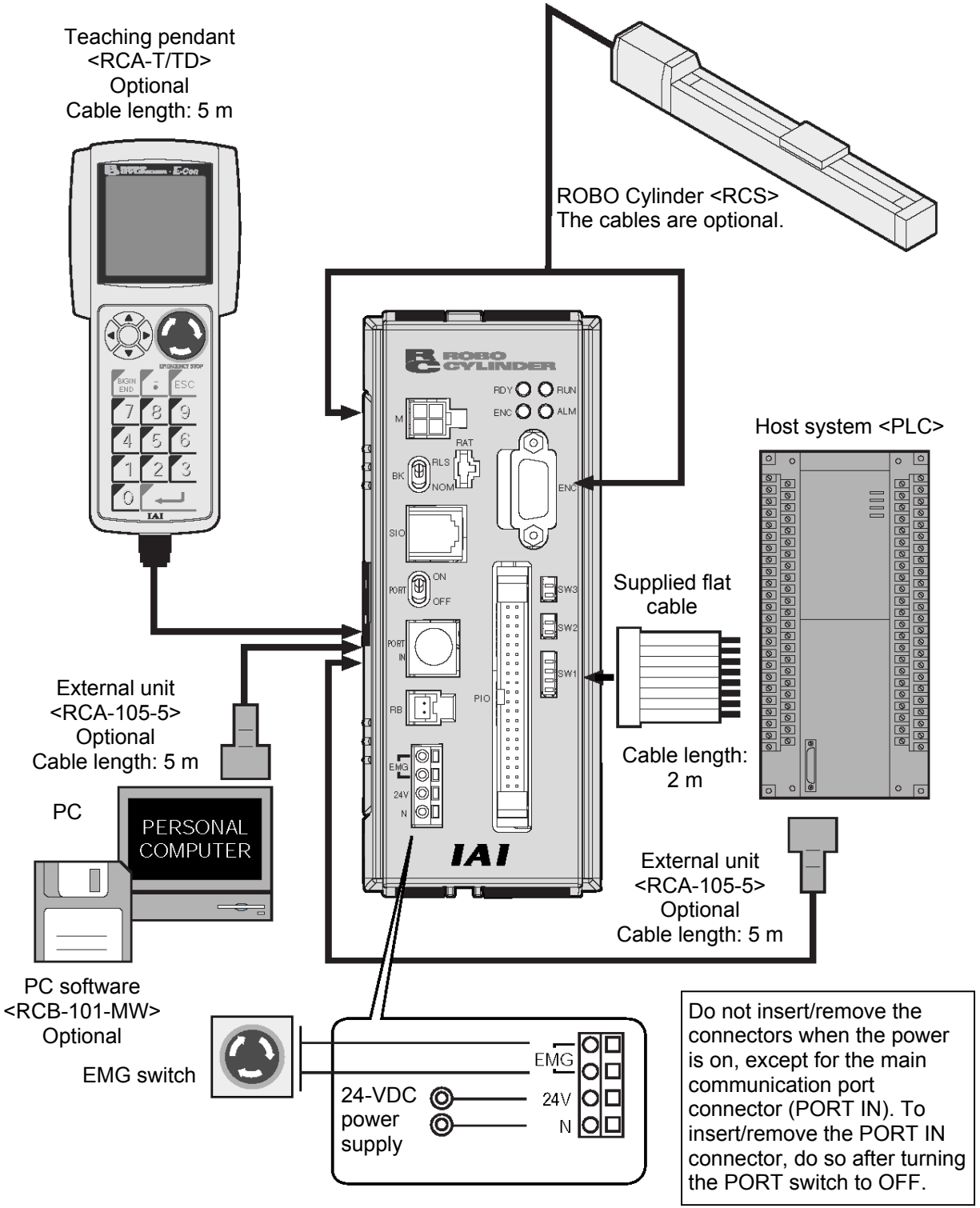


Regardless of whether your system consists of a single controller or multiple controllers, provide sufficient clearances around each controller so that it can be installed/removed easily.

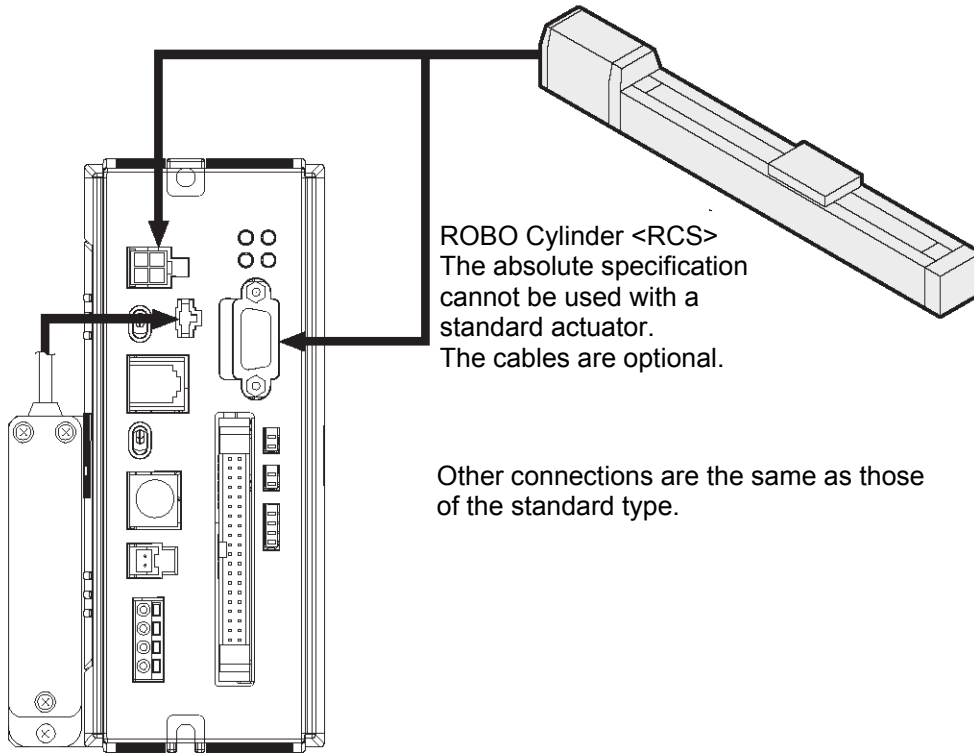
2. 24-V Specification

2-1 Connection Method

2-1-1 Standard Type

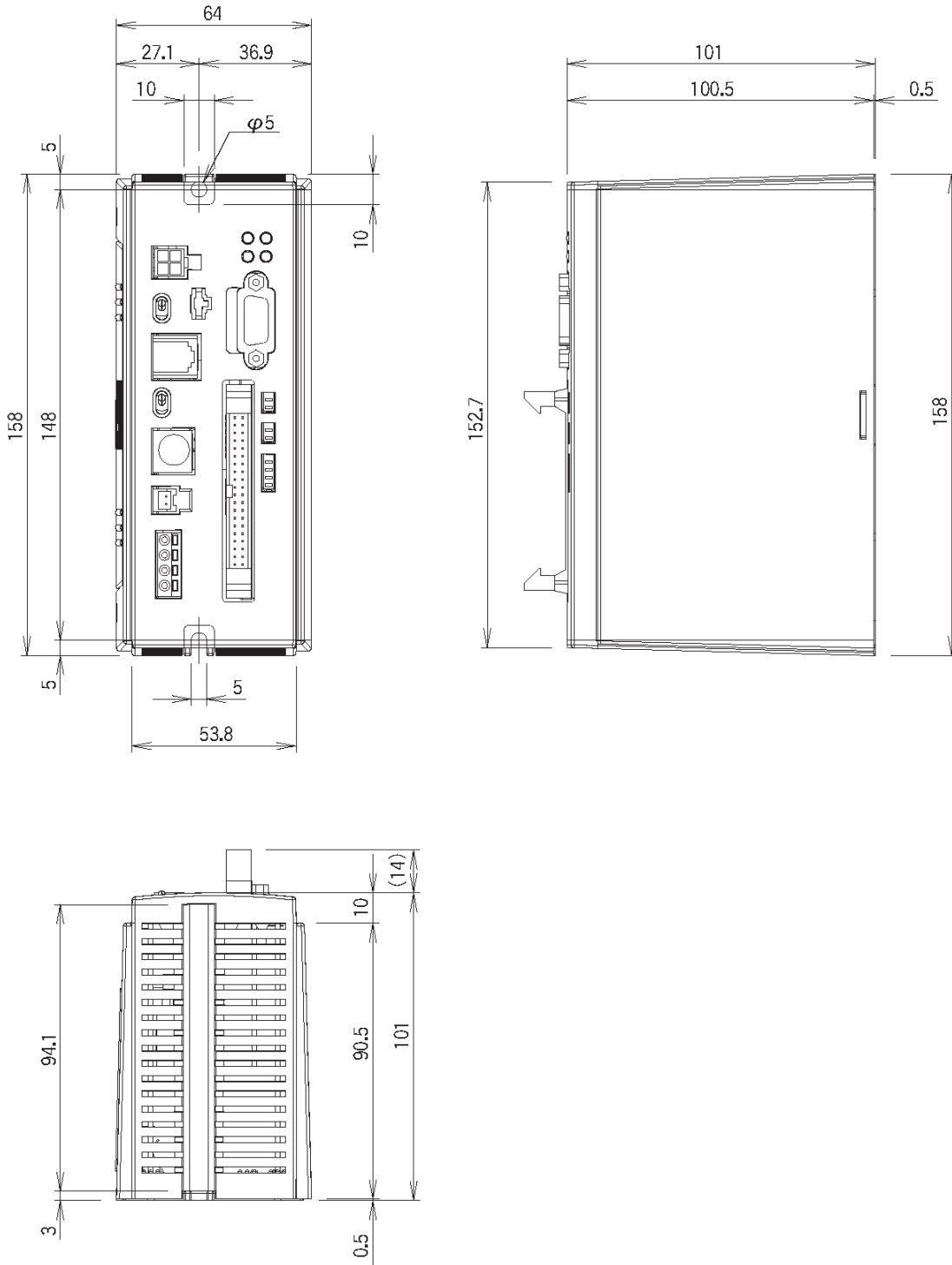


2-1-2 Absolute Specification

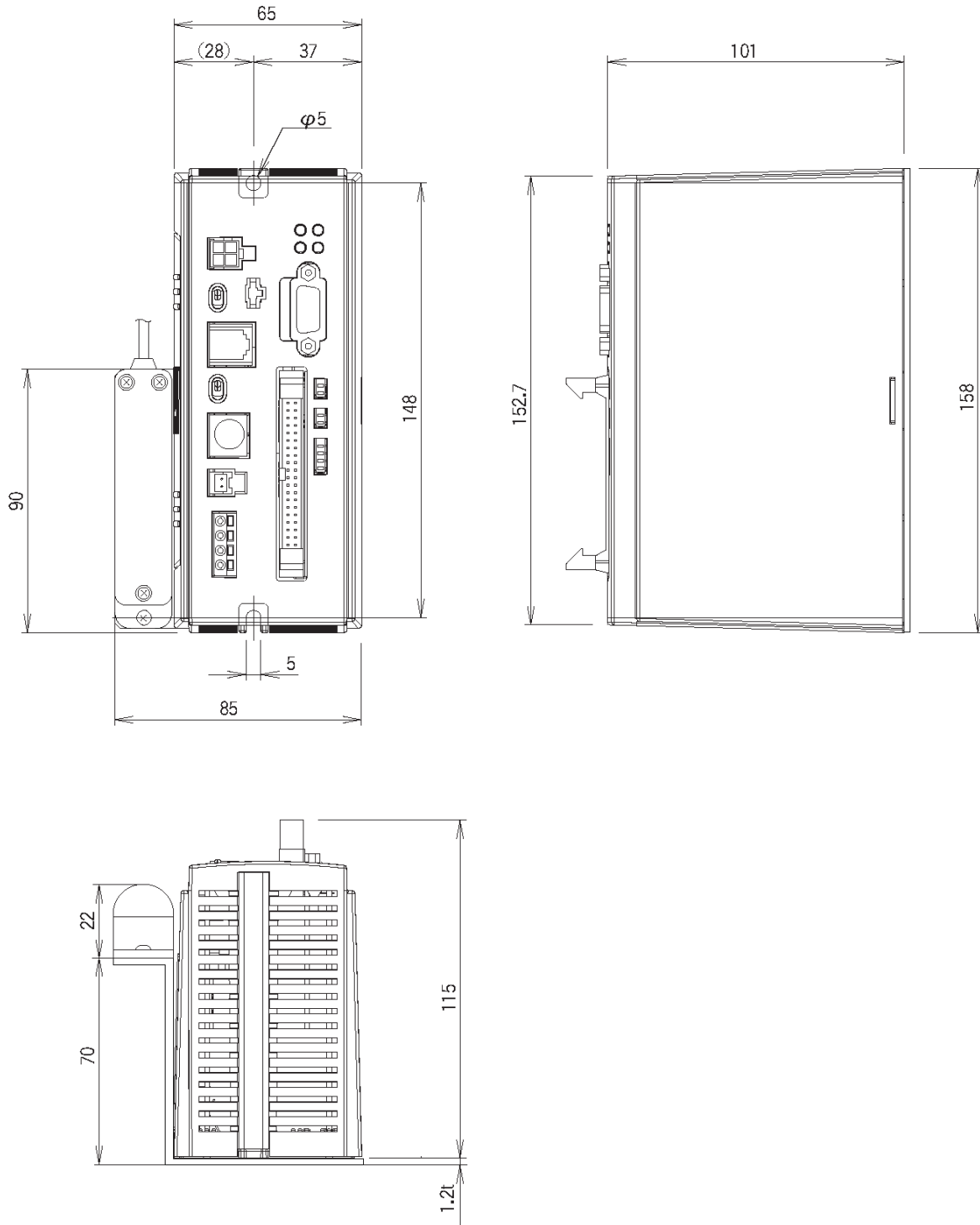


2-2 External Dimensions

2-2-1 Standard Type



2-2-2 Absolute Specification



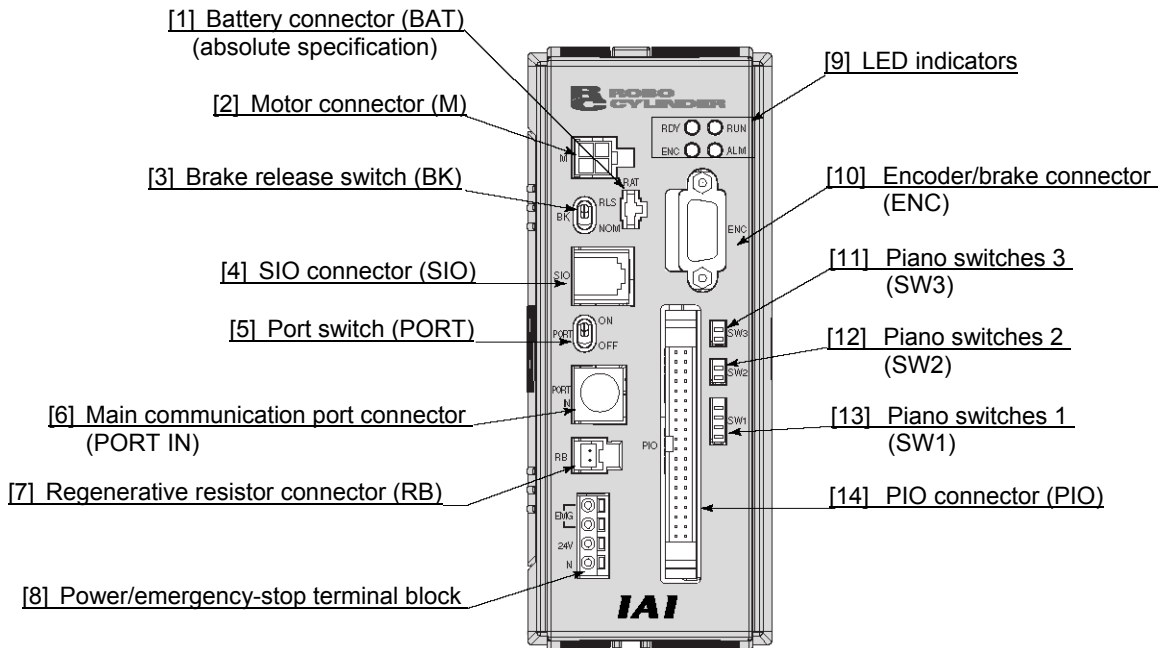
2-3 24-V Controller

Item		Specification															
		24-V type															
Supply voltage		24 VDC \pm 10%															
Supply current [A]		Type		RA35		RA45, F45		RB75 (30 W)		RB75 (60 W)		SA4, SA5		SA6			
		Rating	Peak	1.8	4.3	2.4	6.0	2.3	4.6	3.9	7.5	1.2	3.7	1.4	3.9		
Maximum motor output		60 W (Torque limit x 2) / Other (x 3)															
Operating temperature/humidity		0 to 40°C, 85%RH or less															
Operating environment		IP10, free from corrosive gases															
Weight		540 g															
Protective functions		Regenerative voltage error, motor overcurrent, power-stage overheat, encoder error, motor overload, overspeed															
LED indicators		RDY (ready), RUN, ALM (alarm), ENC (encoder error)															
DI/DO interface		24 VDC, insulated															
Input/output		8 dedicated input ports		Start Command position number (4-bit binary) Pause Reset Servo ON													
		10 dedicated output ports		Completed position number (4-bit binary) Position complete Home return completion Zone Alarm Emergency stop Moving													
				Serial interface input/output													
Number of positions		16															
Data entry method		Teaching pendant, PC software															
Storage device		EEPROM 8 kbytes, S-RAM 128 kbytes															

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

2-4 Names and Functions of Parts

2-4-1 Names



2-4-2 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.

[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 "OC9."

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

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

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

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

[9] **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.

[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 ~ 5 m
OFF	ON	5 ~ 10 m
ON	ON	10 ~ 15 m

Note: All piano switches are designated as Nos. 1, 2, etc., from the bottom.

[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**

[13] **Piano switches 1** (SW1)

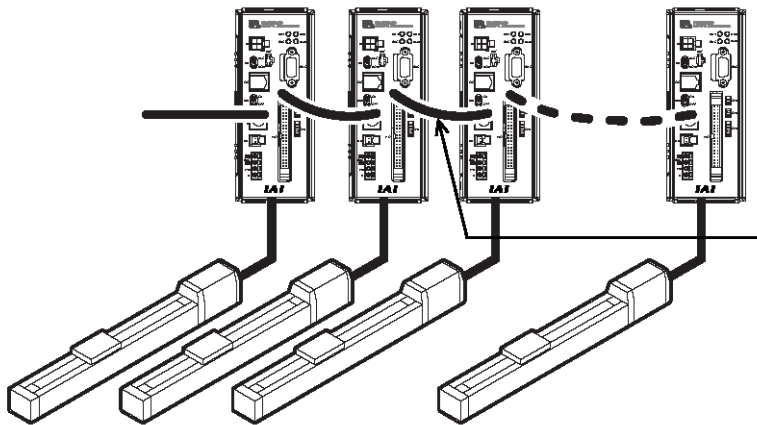
Nos. 1 to 4 --- Address switches

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.

2-4-3 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.

2-4-4 Pin Assignments of Each Connector, and Terminal Block Specifications

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)	

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

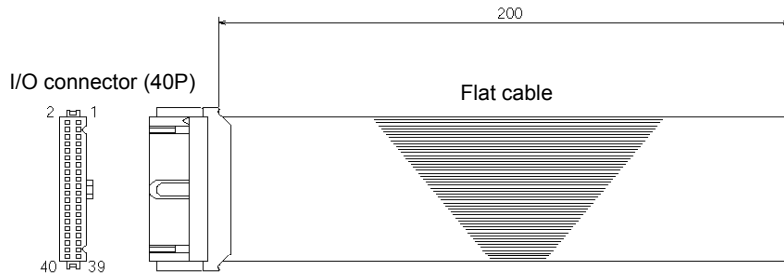
Power/emergency-stop terminal block [Sato ML-800S IH (4P)]

Pin No.	Signal name	Connected wire
1	N (0V)	Negative side of the 24-V power supply
2	24V	Positive side of the 24-V power supply
3	EMG (24V)	Emergency-stop switch (shorted before shipment)
4	EMG	

Pin Nos. 2 and 3 are connected internally.

2-4-5 I/O Flat Cable

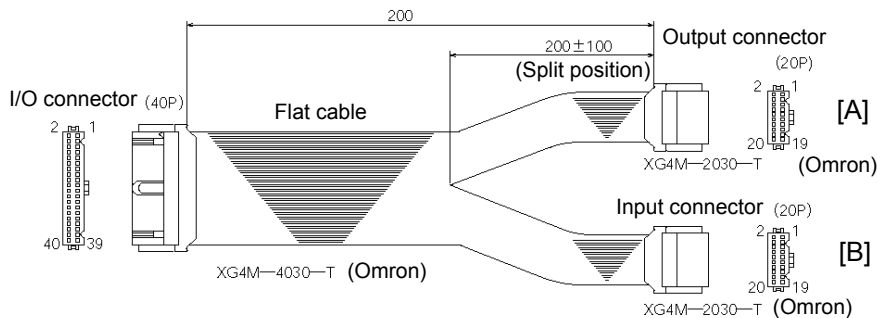
- Supplied with the Controller



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 supplied connector described above.

2-4-6 Backup Battery (Absolute Specification)

(1) Battery specifications

Item	Description
Model	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 ambient temperature of 20°C)

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

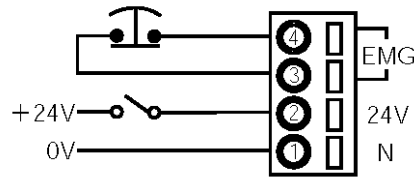
* Do not modify or extend the cable. It may result in controller failure.

* 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.

An absolute reset is required after the battery has been replaced.

2-5 Wiring

2-5-1 Wiring for Power Supply/Emergency Stop



Power/emergency-stop terminal block

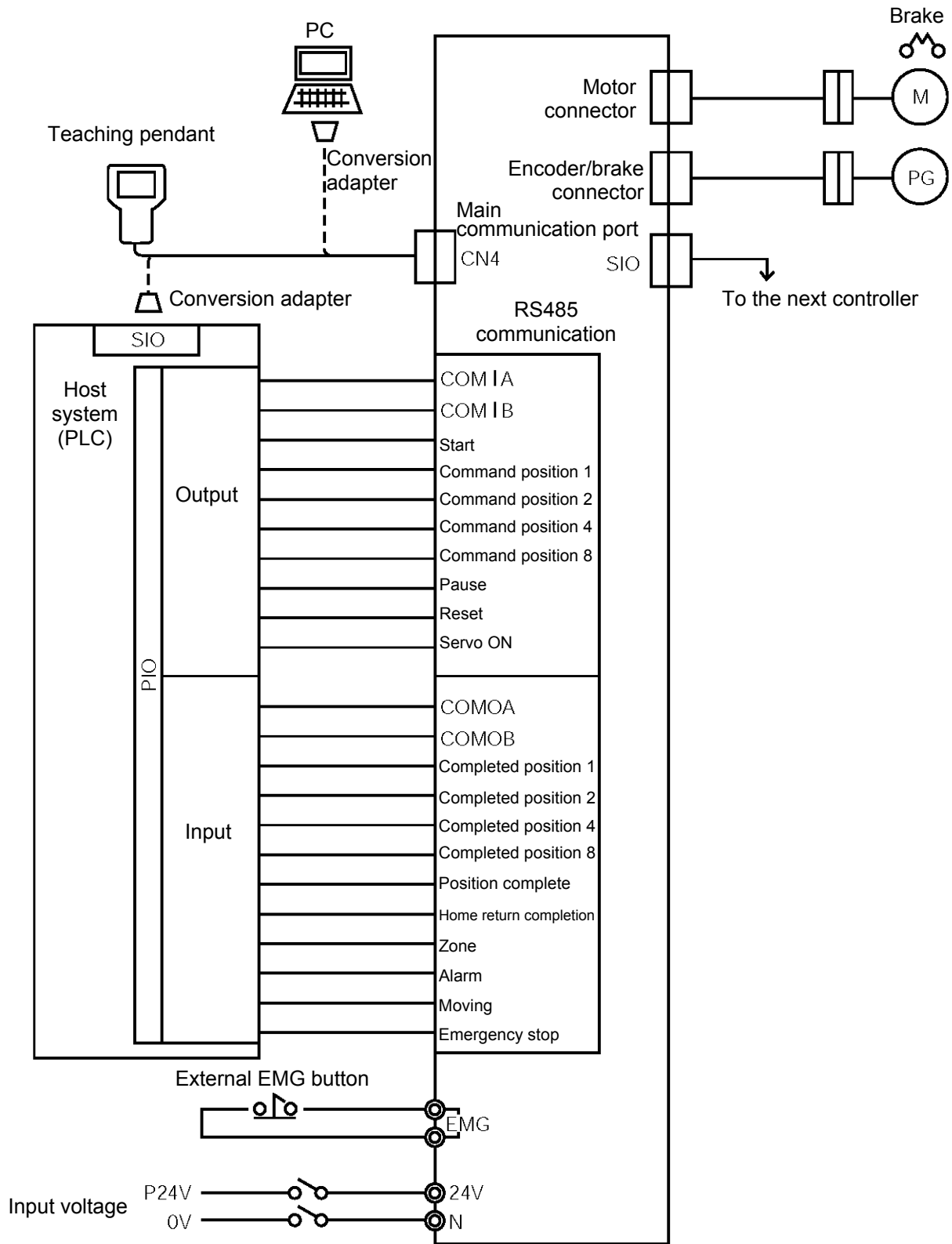
- * The two EMG terminals are contact-b inputs used for connecting an emergency-stop switch. The controller is shipped with these terminals shorted, so that an emergency stop will not be actuated. 24 VDC is output to EMG of pin No. 3.
The current consumption of the emergency-stop circuit is approx. 35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

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

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

Note: This controller has no power switch.

2-5-2 External Connection Diagram



2-5-3 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			18	Completed position 2	Gray-2
19				[9]	*Emergency stop			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.

- [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.
- [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.

- [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. (Only the overcurrent alarm (alarm code: 0C8) requires a power reconnection.)
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		
	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

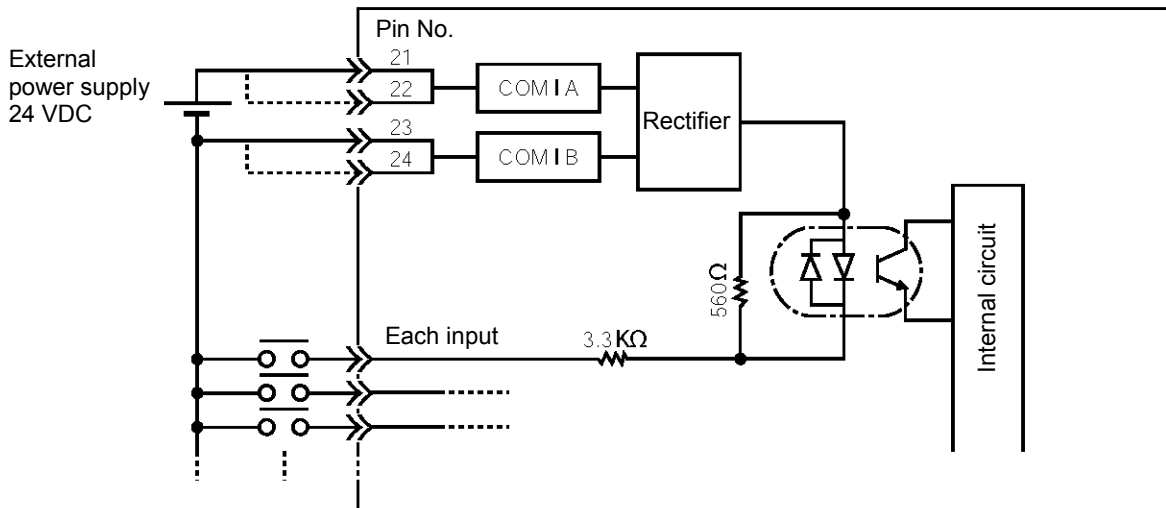
Note: The actuator will not operate if the start input is turned ON after selecting a position number for which no position data is entered. (A bank 31 error (alarm code: 0B1) will occur.)

2-5-4 24-V External I/O Specifications

Input Part

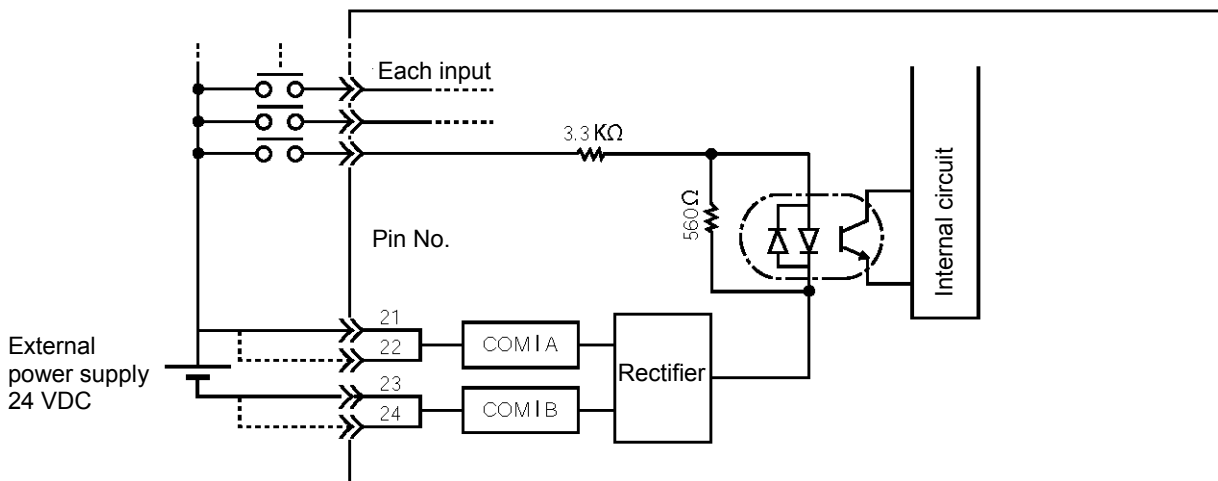
Item	Specification
Number of input points	8 points
Input voltage	24 VDC \pm 20 %
Input current	7 mA per circuit
Operating voltage	ON voltage --- 16 V min. (4.5 mA) OFF voltage --- 6 V max. (1.4 mA)
Insulation method	Photocoupler

Internal circuit configuration (Standard NPN specification)



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

Internal circuit configuration (Optional PNP specification)



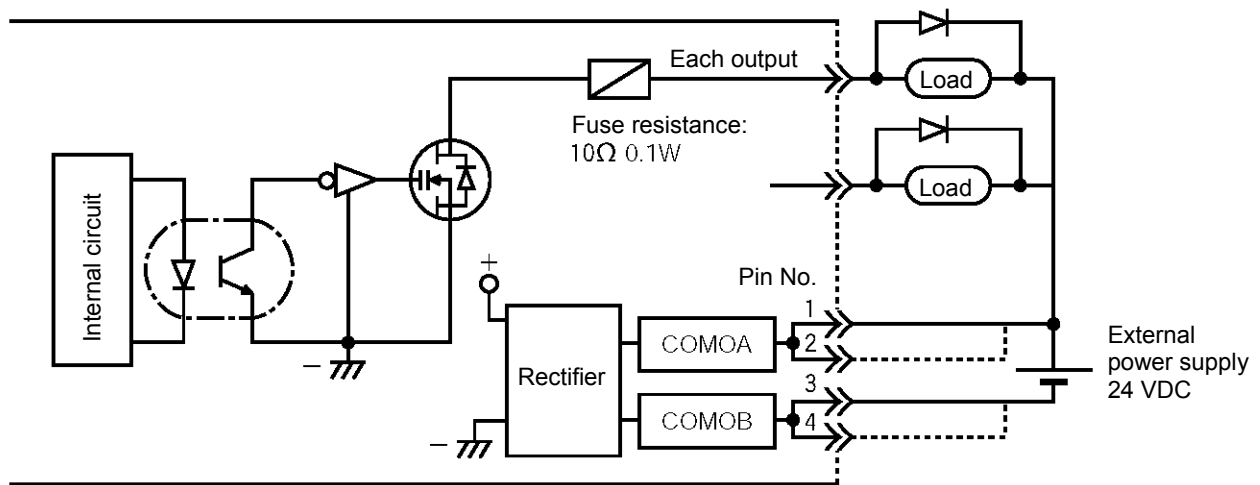
- Connect a 24-V power supply between COM I A and COM I B.
- Connect the input common to the positive side of the external power supply.
- Pin Nos. 21 and 22 of COM I A and 23 and 24 of COM I B are connected internally.

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
Insulation method	Photocoupler
Overcurrent protection	Fuse resistance: 10 Ω, 0.1 W

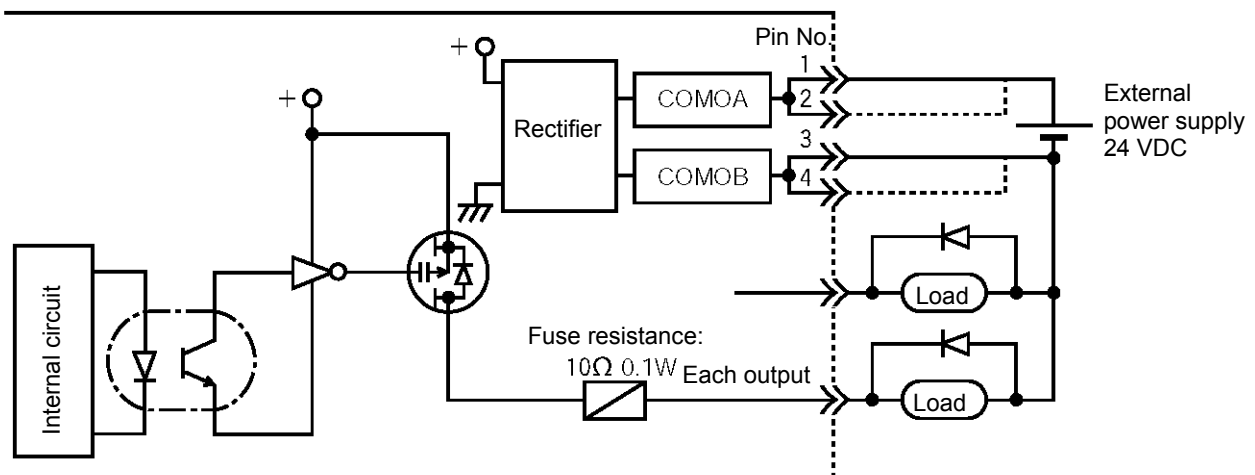
Internal circuit configuration (Standard NPN specification)



- 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).

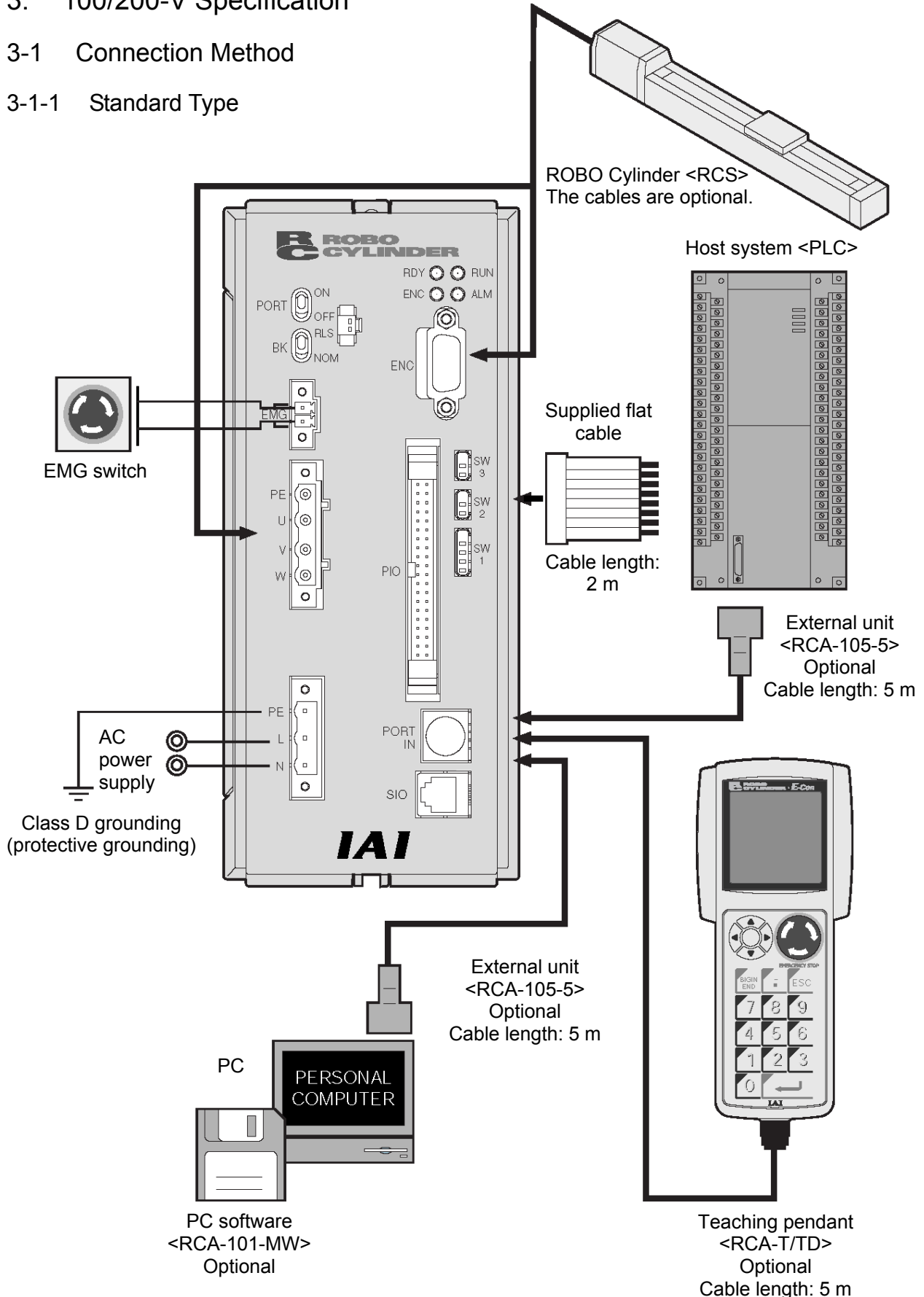
Internal circuit configuration (Optional PNP specification)



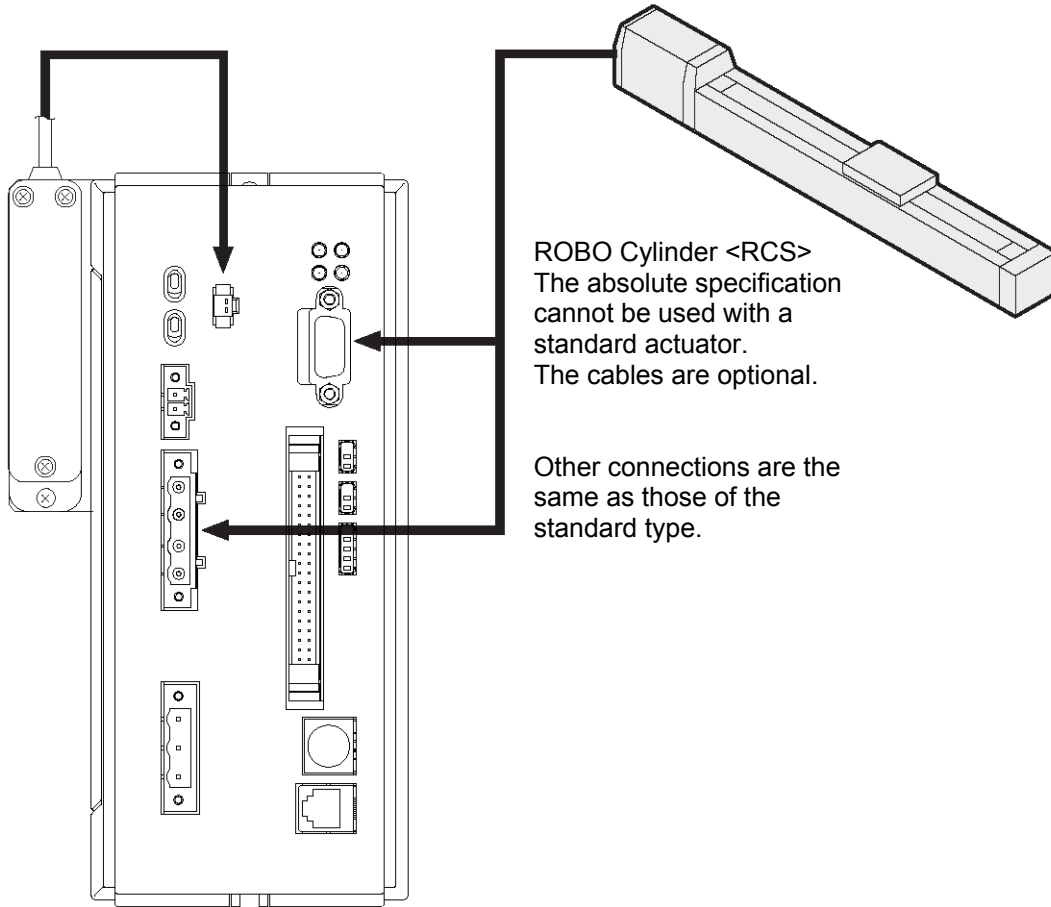
3. 100/200-V Specification

3-1 Connection Method

3-1-1 Standard Type

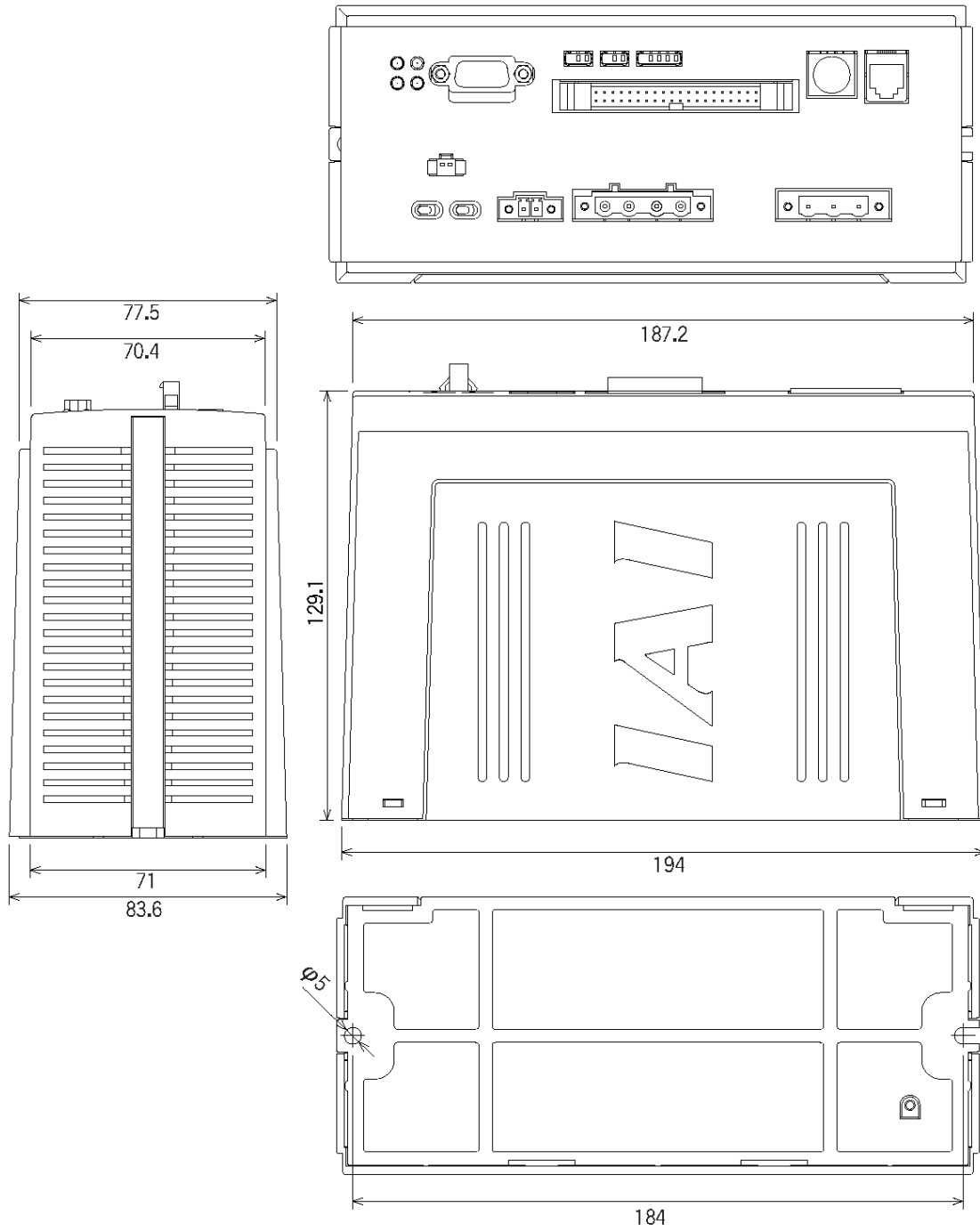


3-2-2 Absolute Specification

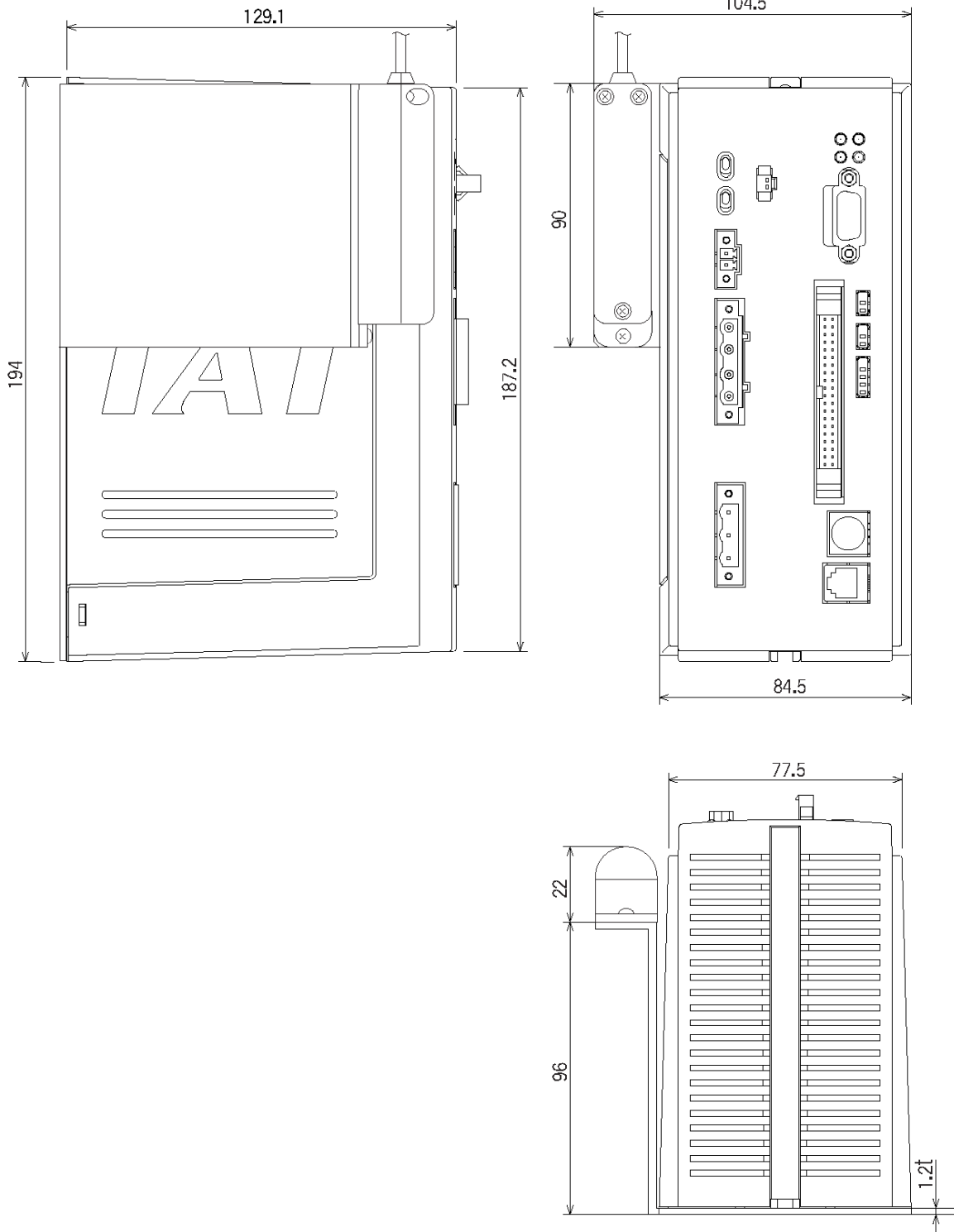


3-2 External Dimensions

3-2-1 Standard Type



3-2-2 Absolute Specification



3-3 100/200-V Controller

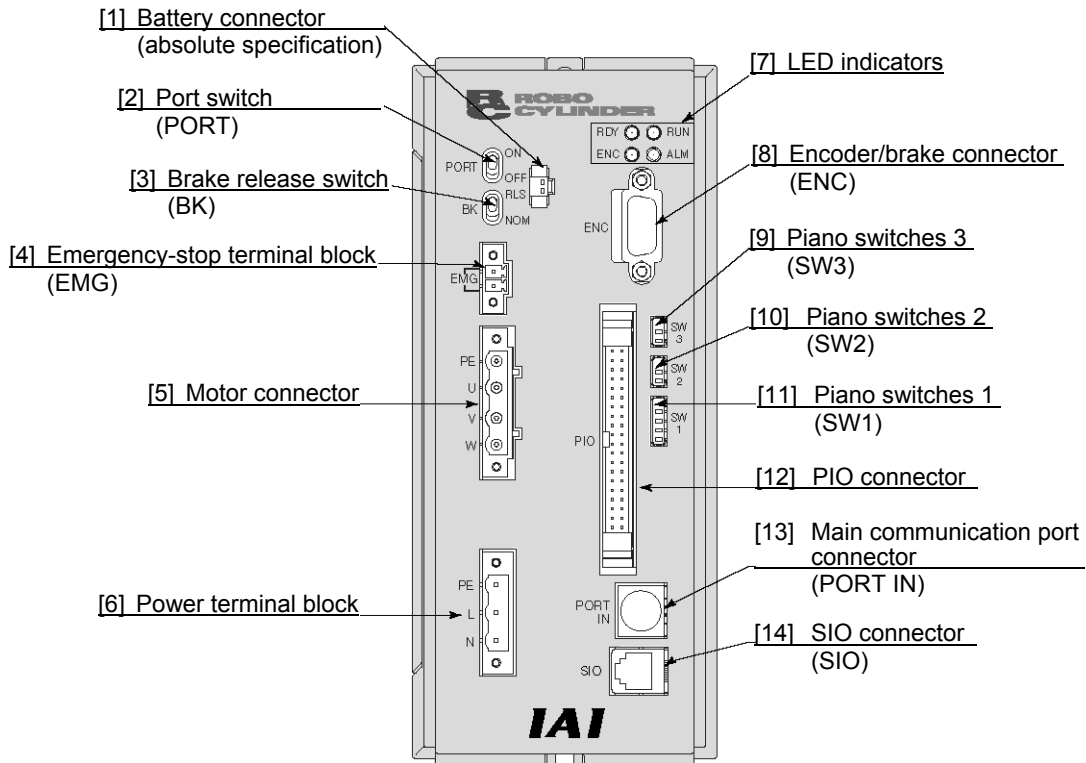
Item		Specification															
		100 / 200 VAC															
Supply voltage		90 ~ 125 / 180 ~ 250 VAC															
Supply current [VA]		Type		RB75 (60 W)		RB75 (100 W)		RB75 (150 W)		RA55 (60 W), SSR (60 W), F55 (60 W)		RA55 (100 W), SMR (100 W), F55 (100 W)		SMR (150 W)			
		Rating	Peak	152	487	246	700	333	1026	166	546	265	902	364	1285		
Maximum motor output		150 W (x 3)															
Operating temperature/humidity		0 to 40°C, 85%RH or less															
Operating environment		IP10, free from corrosive gases															
Weight		1320 g															
Protective functions		Regenerative voltage error, motor overcurrent, power-stage overheat, encoder error, motor overload, overspeed															
Withstand voltage (Note 2)		1500 VAC for 1 minute															
LED indicators		RDY (ready), RUN, ALM (alarm), ENC (encoder error)															
DI/DO interface		24 VDC, insulated															
Input/output (Note 1)		8 dedicated input ports		Start Command position number (4-bit binary) Pause Reset Servo ON													
		11 dedicated output ports		Completed position number (4-bit binary) Position complete Home return completion Zone Alarm Emergency stop Moving Battery alarm													
				Serial interface input/output													
Number of positions		16															
Data entry method		Teaching pendant, PC software															
Storage device		EEPROM 8 kbytes, S-RAM 128 kbytes															

(Note 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.

3-4 Names and Functions of Parts

3-4-1 Names



3-4-2 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.

[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 ~ 5 m
OFF	ON	5 ~ 10 m
ON	ON	10 ~ 15 m

Note: All piano switches are designated as Nos. 1, 2, etc., from the bottom.

[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**

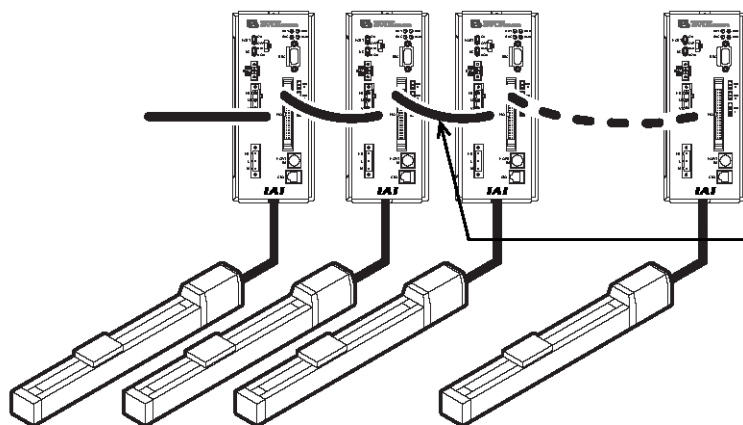
[11] Piano switches 1 (SW1)
Nos. 1 to 4 --- Address switches

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.

[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.

3-4-3 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.

3-4-4 Pin Assignments of Each Connector, and Terminal Block Specifications

Motor connector [Molex 5569-04A1]

Pin No.	Signal name	Connected wire
1	PE	Motor FG
2	U	Motor phase U
3	V	Motor phase V
4	W	Motor phase W

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]

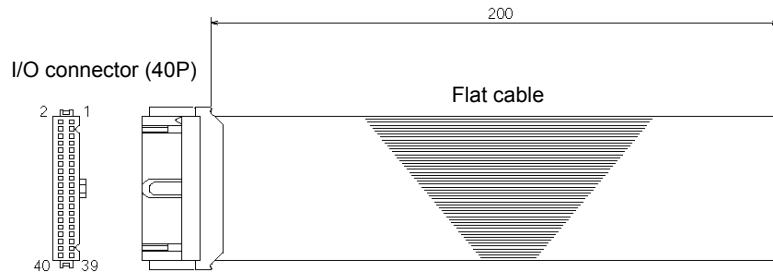
Pin No.	Connected wire
1	PE (Ground)
2	L (AC)
3	N (AC)

Emergency-stop terminal block

Pin No.	Connected wire
1	EMG 1 (24 V)
2	EMG 2

3-4-5 I/O Flat Cable

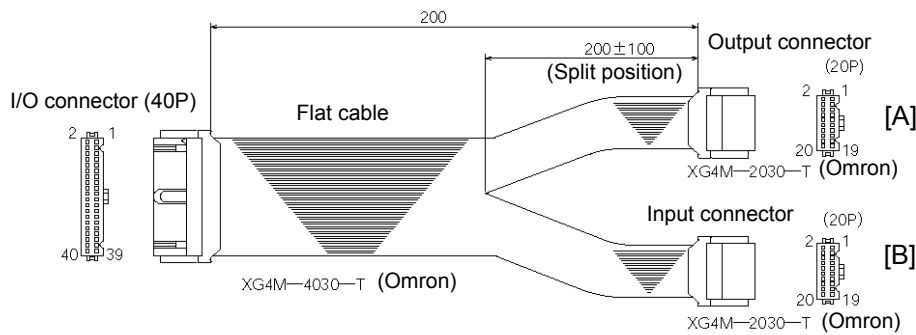
- Supplied with the Controller



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	*Battery alarm	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)

[B] Input 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	*Battery alarm	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

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 supplied connector described above.

3-4-6 Backup Battery (Absolute Specification)

(1) Battery specifications

Item	Description
Model	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 ambient temperature of 20°C)

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

* 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.

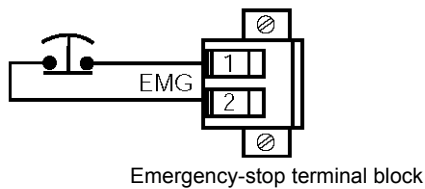
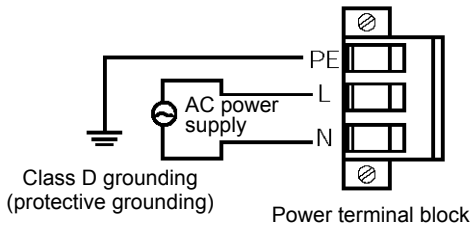
If the battery was replaced while the controller power was off, the position information (absolute data) may or may not be retained depending on how long the controller remained without battery.

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.

3-5 Wiring

3-5-1 Wiring for Power Supply/Emergency Stop



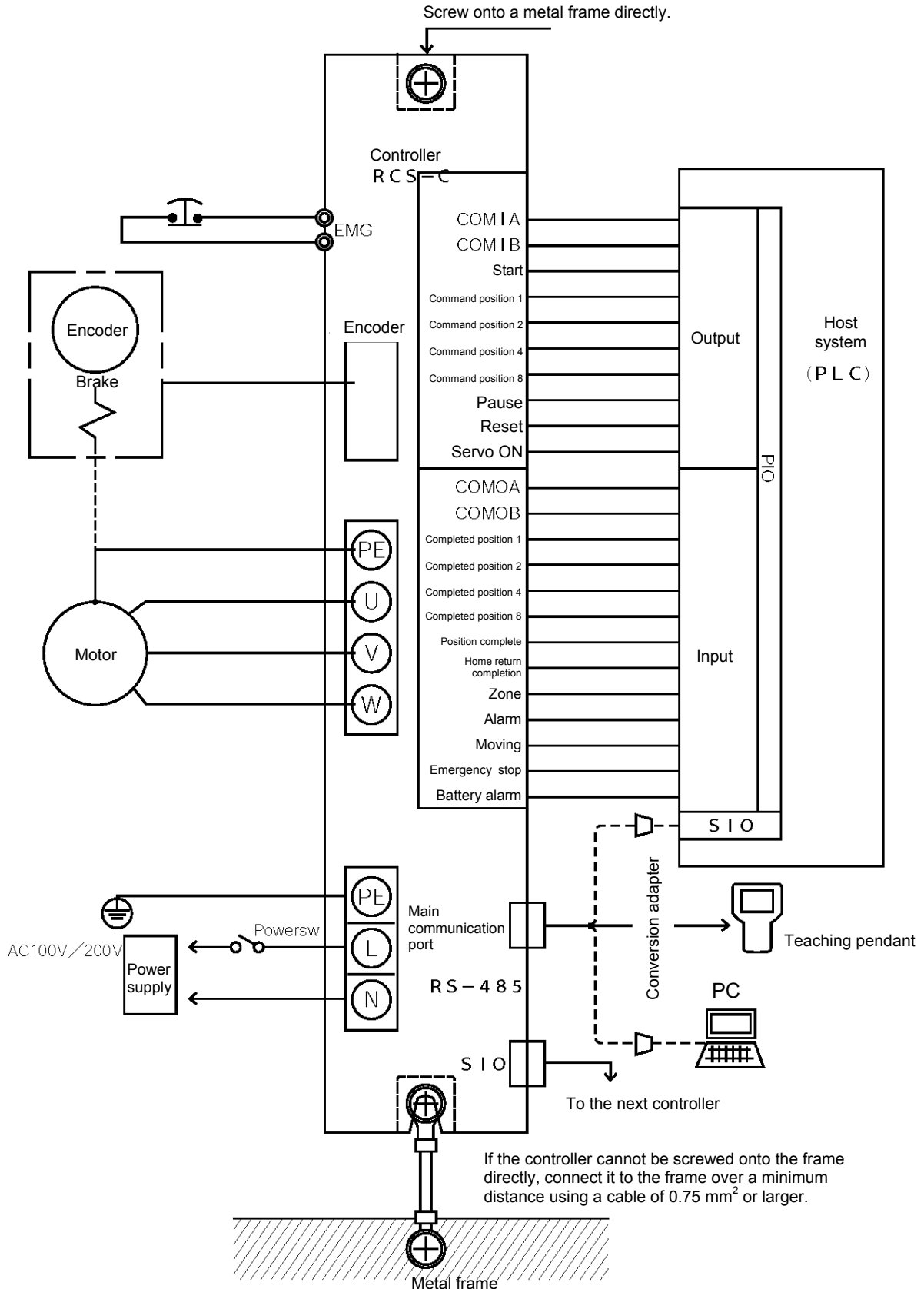
* The two EMG terminals are contact-b inputs used for connecting an emergency-stop switch. The controller is shipped with these terminals shorted, so that an emergency stop will not be actuated. 24 VDC is output to EMG of pin No. 1.
The current consumption of the emergency-stop circuit is approx. 15 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 --- ϕ 1.0 (AWG18) Stranded wire --- 0.75 mm ² (AWG18)
Allowable wire size	Single wire --- ϕ 0.4 (AWG26) to ϕ 1.2 (AWG16) Stranded wire --- 0.3 mm ² (AWG22) to 1.25 mm ² (AWG16) Element wire diameter --- ϕ 0.18 or larger
Standard stripped-wire length	11 mm
Button operation tool	Flathead screwdriver (shaft diameter ϕ 3, blade tip width 2.6)

Note: This controller has no power switch.

3-5-2 External Connection Diagram



3-5-3 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.

- [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.
- [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.

- [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.
When the emergency stop is cancelled, the signal will turn ON.
- [11] COMIA } Power supply for input ports
- [12] COMIB }
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. (Only the overcurrent alarm (alarm code: OC8) requires a power reconnection.)
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		
	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

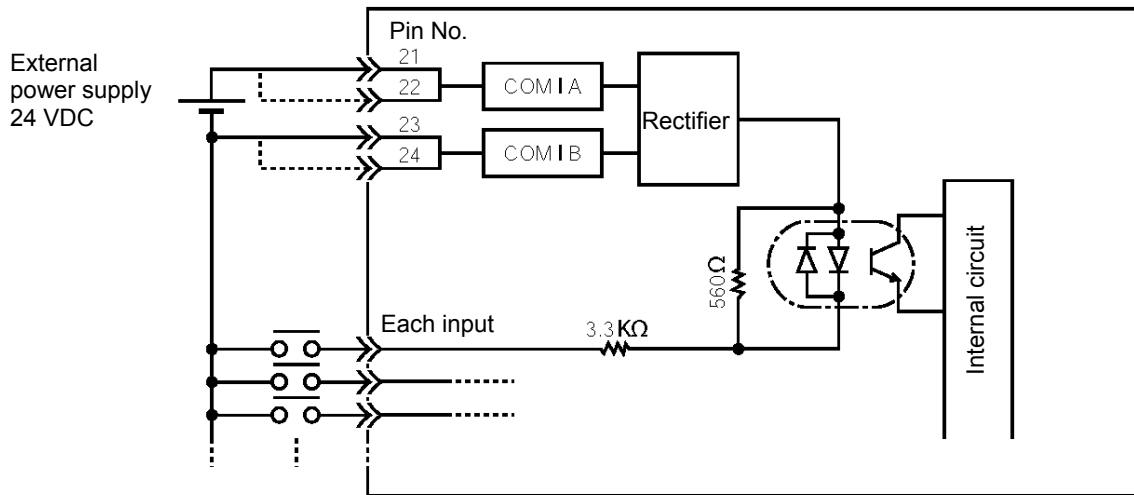
Note: The actuator will not operate if the start input is turned ON after selecting a position number for which no position data is entered. (A bank 31 error (alarm code: 0B1) will occur.)

3-5-4 100/200-V External I/O Specifications

Input Part

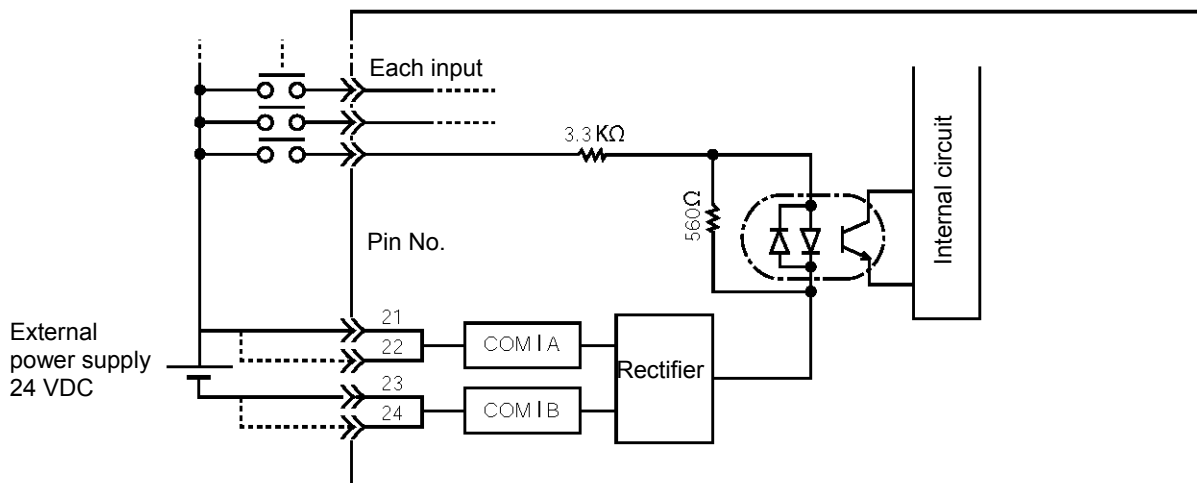
Item	Specification
Number of input points	8 points
Input voltage	24 VDC \pm 20 %
Input current	7 mA per circuit
Operating voltage	ON voltage --- 16 V min. (4.5 mA) OFF voltage --- 6 V max. (1.4 mA)
Insulation method	Photocoupler

Internal circuit configuration (Standard NPN specification)



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

Internal circuit configuration (Optional PNP specification)



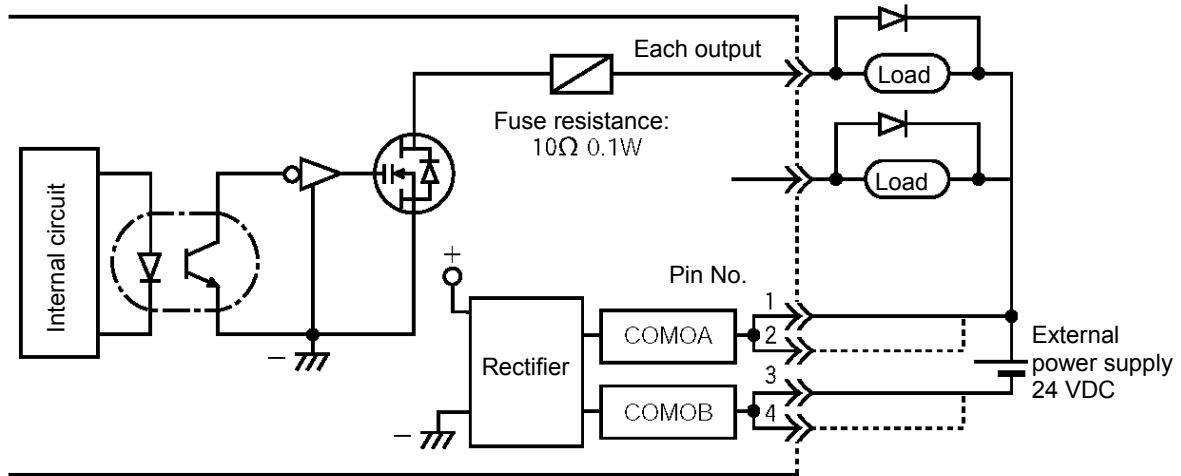
- Connect a 24-V power supply between COM I A and COM I B.
- Connect the input common to the positive side of the external power supply.
- Pin Nos. 21 & 22 of COM I A and 23 & 24 of COM I B are connected internally.

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
Insulation method	Photocoupler
Overcurrent protection	Fuse resistance: 10 Ω 0.1 W

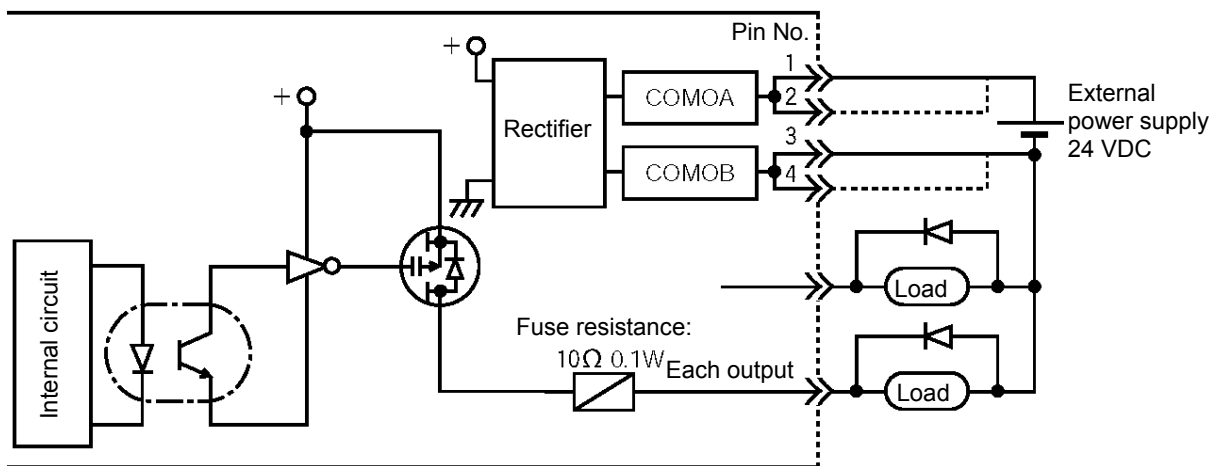
Internal circuit configuration (Standard NPN specification)



- 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 closest possible position to the coil).

Internal circuit configuration (Optional PNP specification)



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 <small>Note</small>	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	0	100	0.3	0	0.1	0
1	30	100	0.3	0	0.1	0
2	10	100	0.3	0	0.1	0
.
.
15	100	100	0.3	0	0.1	0

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

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

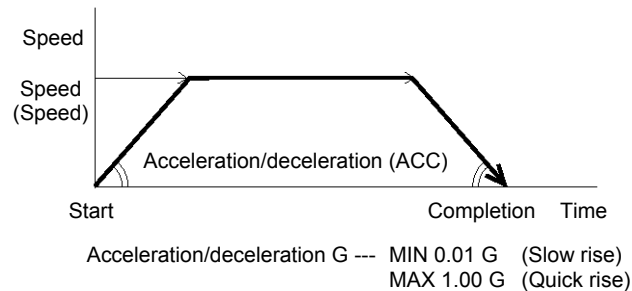
Note: Enter position data first. Any attempt to enter other data before position data will be rejected. You can enter position data containing two decimal places. However, the controller only recognizes position data as a multiple of its minimum resolution. The minimum resolution of the controller varies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

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.



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

The table on page 52 lists the push force at standstill for each controller type when the current-limiting value is set to 70%. Be sure to reference this table to set an appropriate value for your controller.

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

(6) Positioning band
(Pos. band)

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

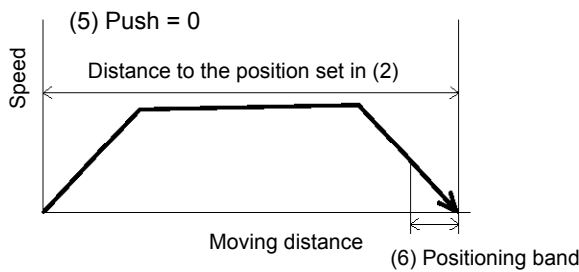


Fig. A

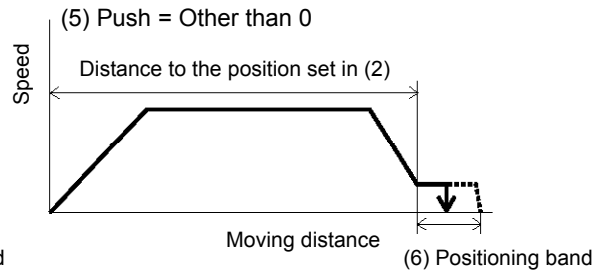
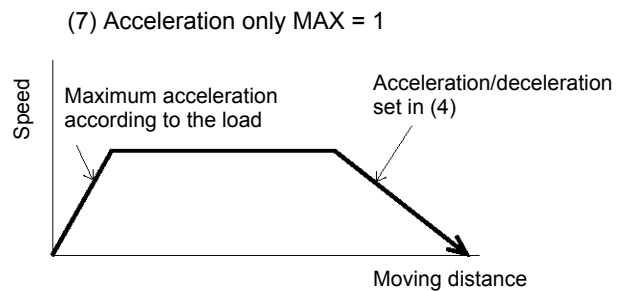
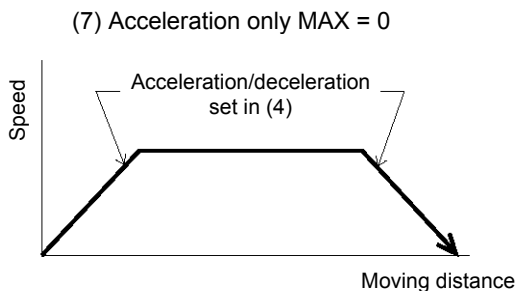


Fig. B

(7) Acceleration only MAX
(ACC MAX)

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



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.

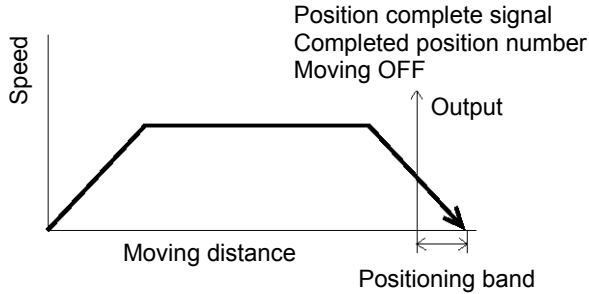
The table below lists the push force at standstill for each controller type when the current-limiting value is set to 70%.

	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
	M	118 (12.1)		
	H	59 (6.1)		
	100	M		198 (20.2)
H		99 (10.1)		
RB7535		100		L
	M		149 (15.2)	
	H		74 (7.6)	
	150	M	222 (22.7)	
		H	111 (11.4)	
		Flat type	F45	30
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.

4-2 Explanation of Modes

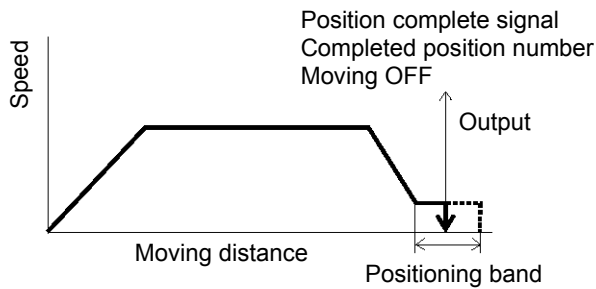
4-2-1 Positioning Mode Push = 0



- (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.

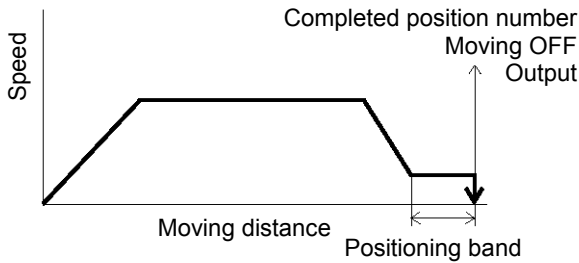
Warning

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:

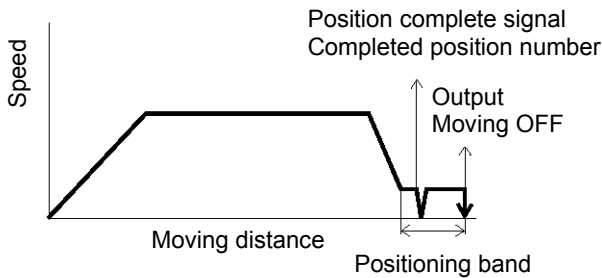
	Set speed	
	20 mm/sec or more	Less than 20 mm/sec
Push speed	20 mm/sec	Set speed

(2) Load was not contacted (missed)



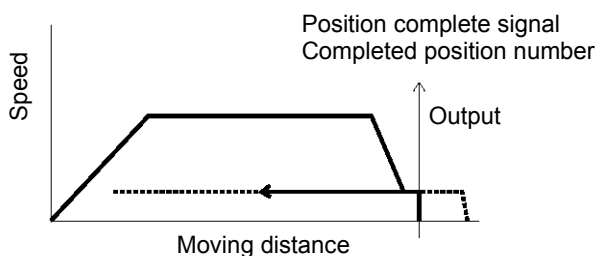
(1) After reaching the target position, the actuator will move at low speed. Even after contacting the load, the actuator will move to the end of the positioning band if the servo motor current is yet to reach the current-limiting value. The position complete output will not turn ON even when the end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

(3) Load moves during push & hold operation
 [1] Load moves in the pushed direction



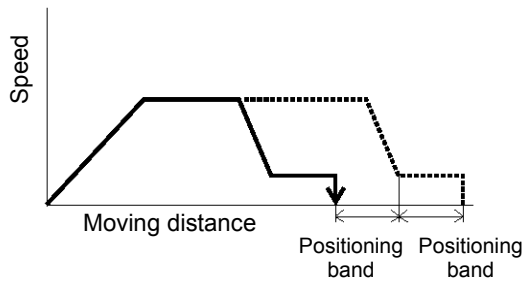
If the load moves in the pushed direction after the position complete output has turned ON (moving has turned OFF), the actuator will push the load within the positioning band. The moving output will turn ON. The position complete output will remain ON and the completed position number will be output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

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



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

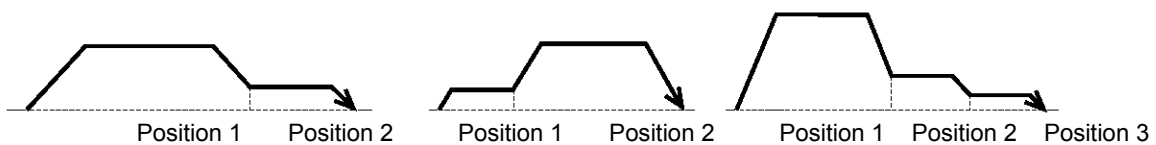
(4) Positioning band was entered with a wrong sign



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

4-2-3 Speed Change during Movement

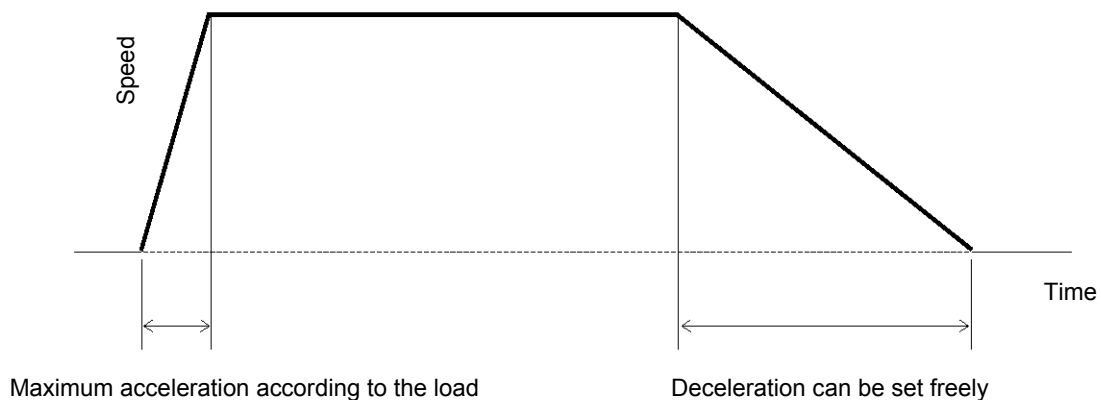
Speed control involving multiple speed levels is possible in a single operation. The actuator speed can be decreased or increased at a certain point during movement. However, the position at which to implement each speed change must be set.



4-2-4 Operation at Different Acceleration and Deceleration Settings

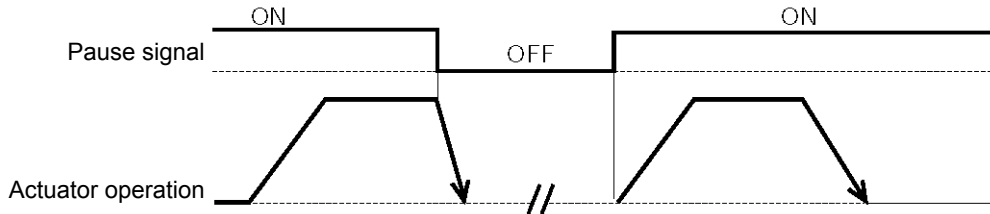
The actuator will accelerate and decelerate at different speeds if "1" is entered under "Acceleration only MAX" in the position data.

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.

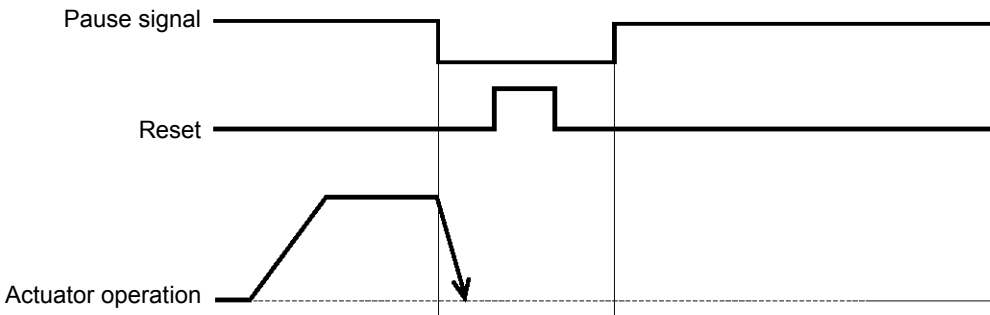


4-2-5 Pause

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.

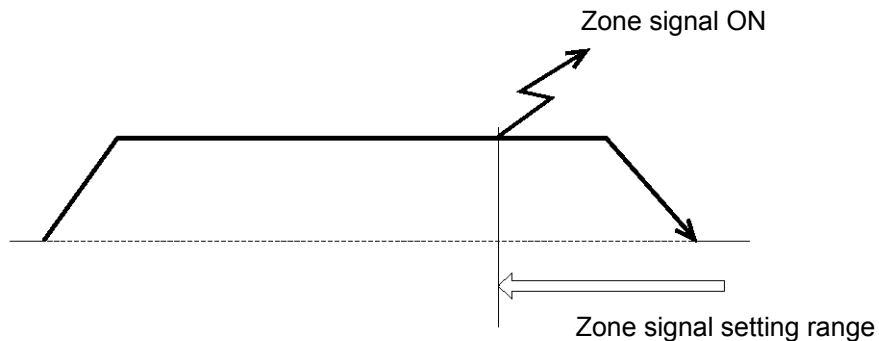


The remaining movement of the actuator can be cancelled by turning ON the reset input during pause (the movement will be cancelled upon rise of the reset input signal).



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).



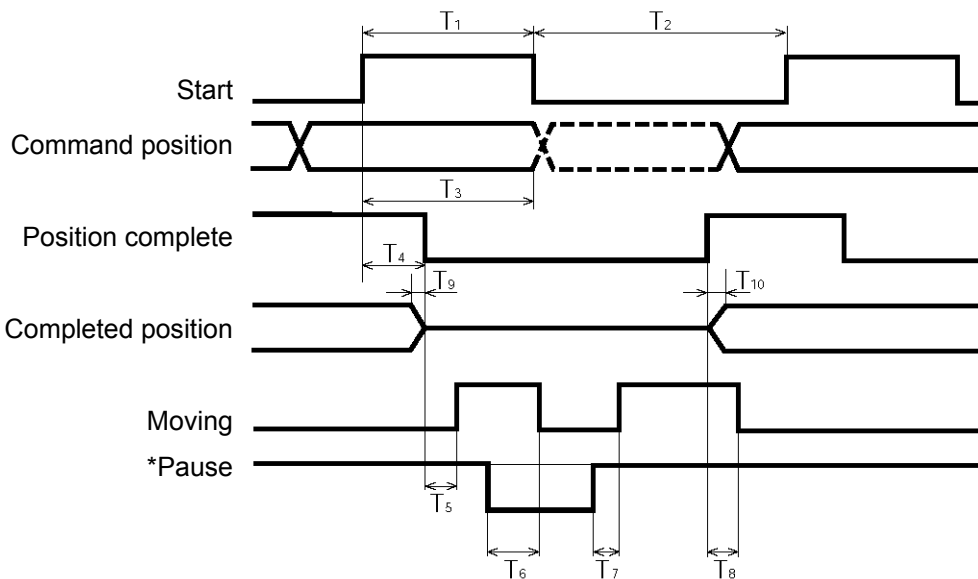
4-2-7 Home Return

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.

5. Using the Controller <Practical Steps>

5-1 How to Start (Standard Type)

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

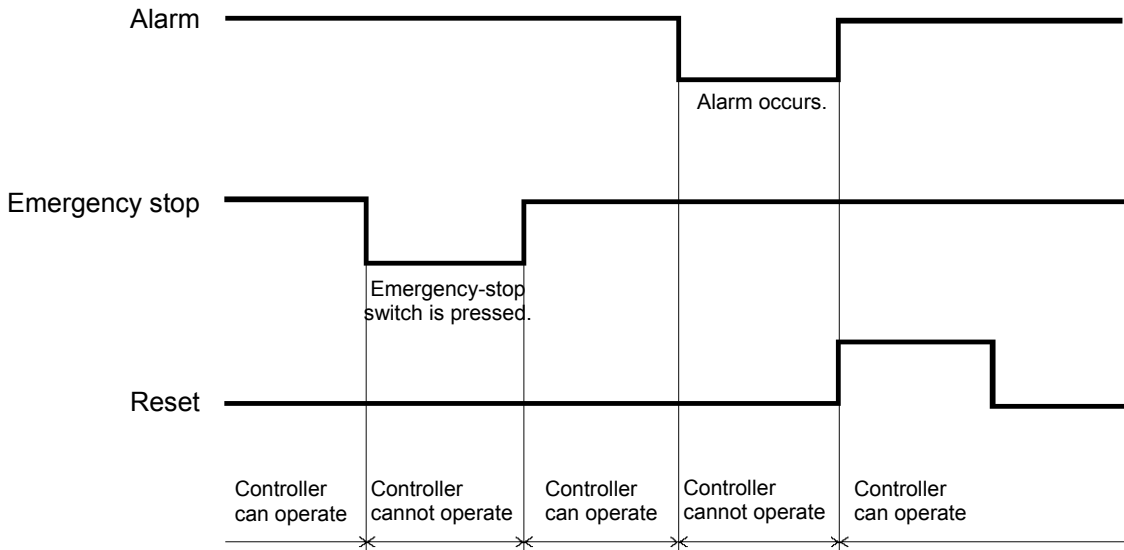
- (1) Connect the motor/brake cables and encoder cable to the controller.
- (2) Connect the host PLC to the PIO connector using the supplied flat cable.
- (3) If two or more axes are connected, set the necessary items using the piano switches. For details, refer to “Names and Functions of Parts.”
- (4)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

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

The controller is ready once the above operation is completed.

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.



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 2-4, “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.

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 "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.

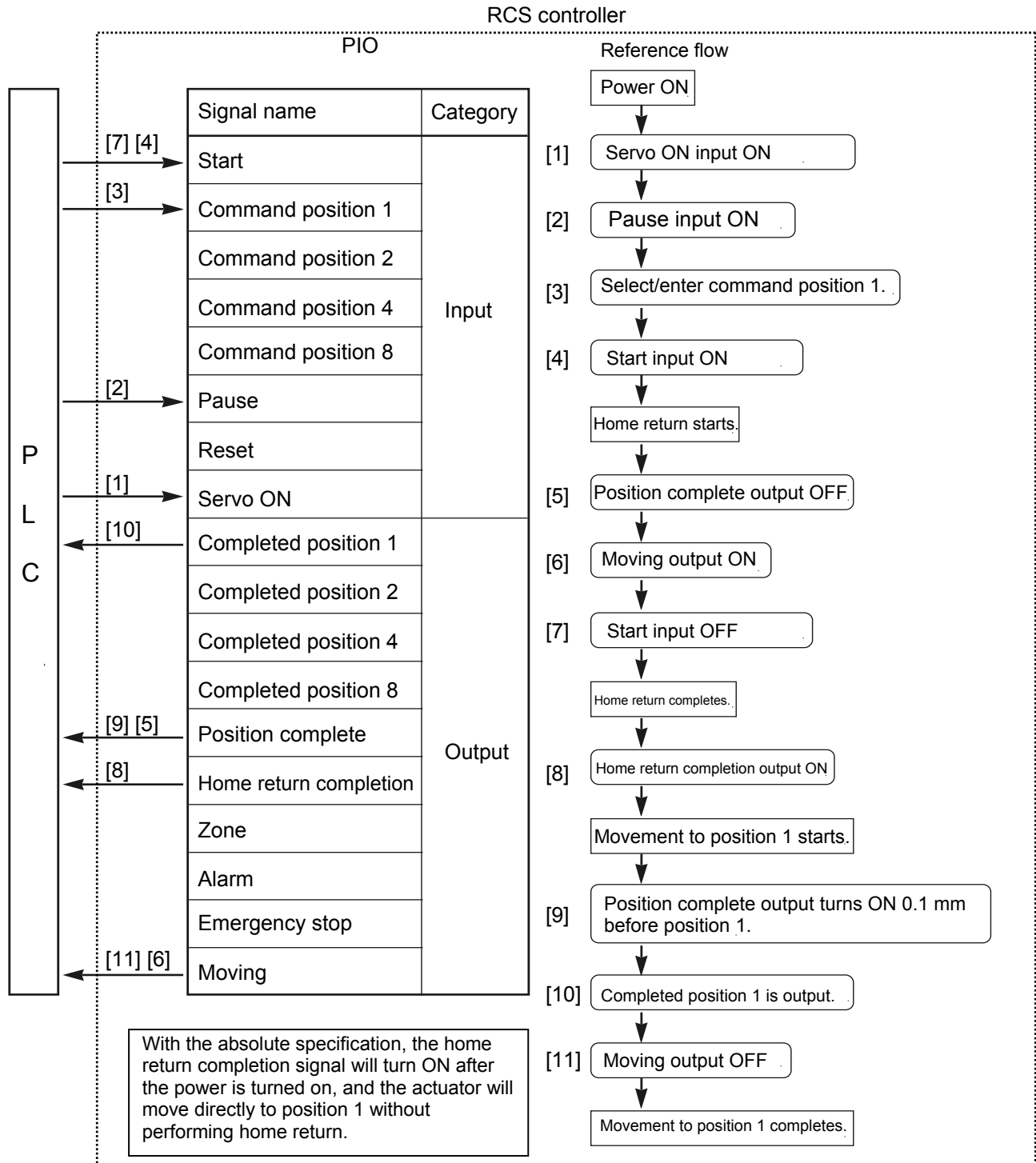
Note 1) The absolute RCS controller can be used only with absolute RCS actuators. It cannot be used with standard RCS actuators.

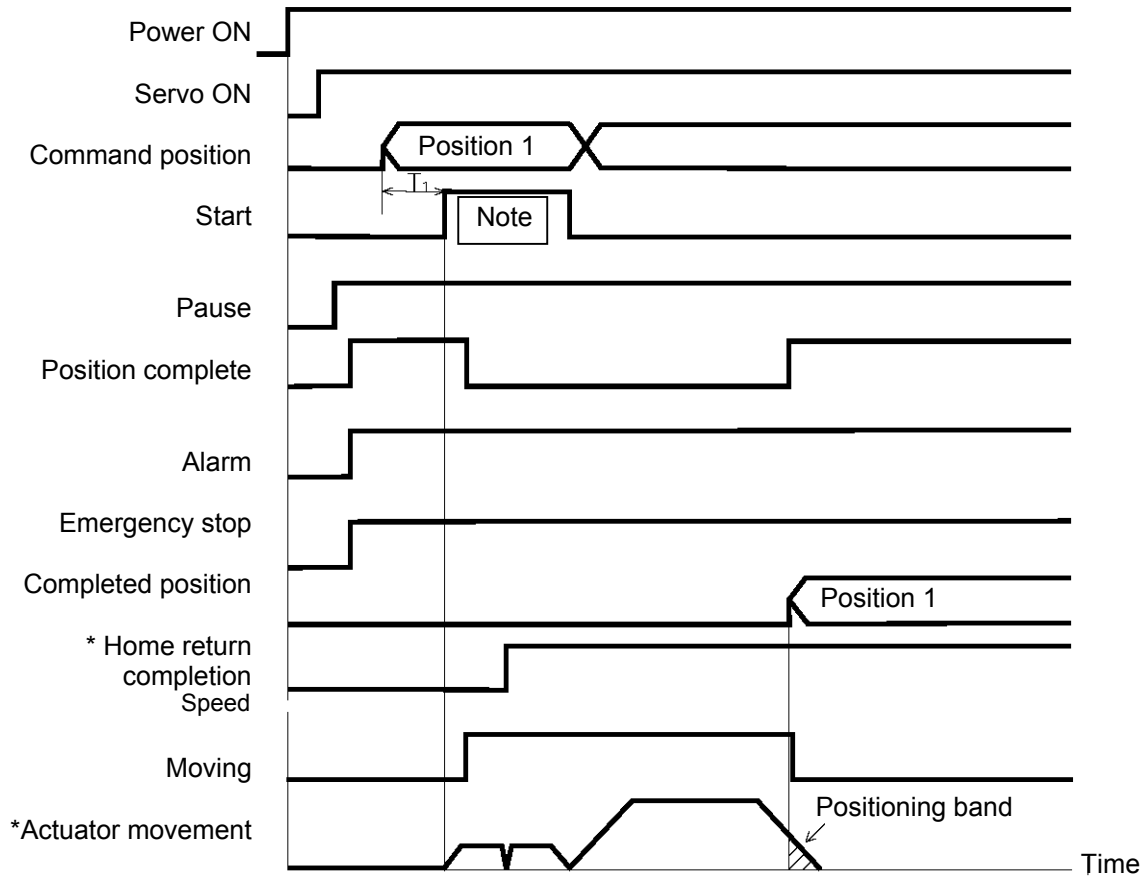
5-3 Movement after Power On (Standard Type)

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
⋮						





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.)

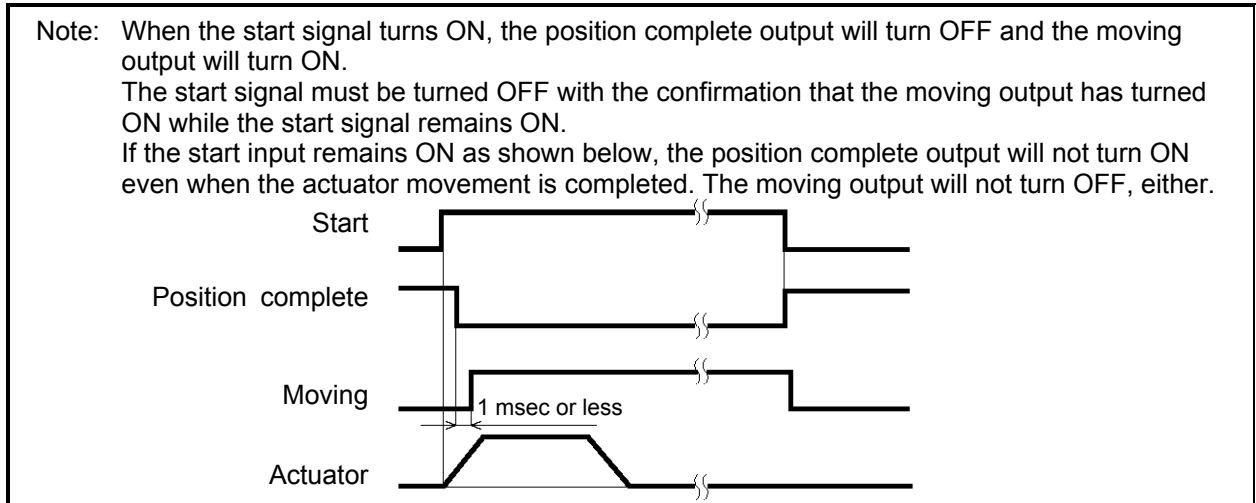
To check if the controller is ready, always check if the position complete output is ON.

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.

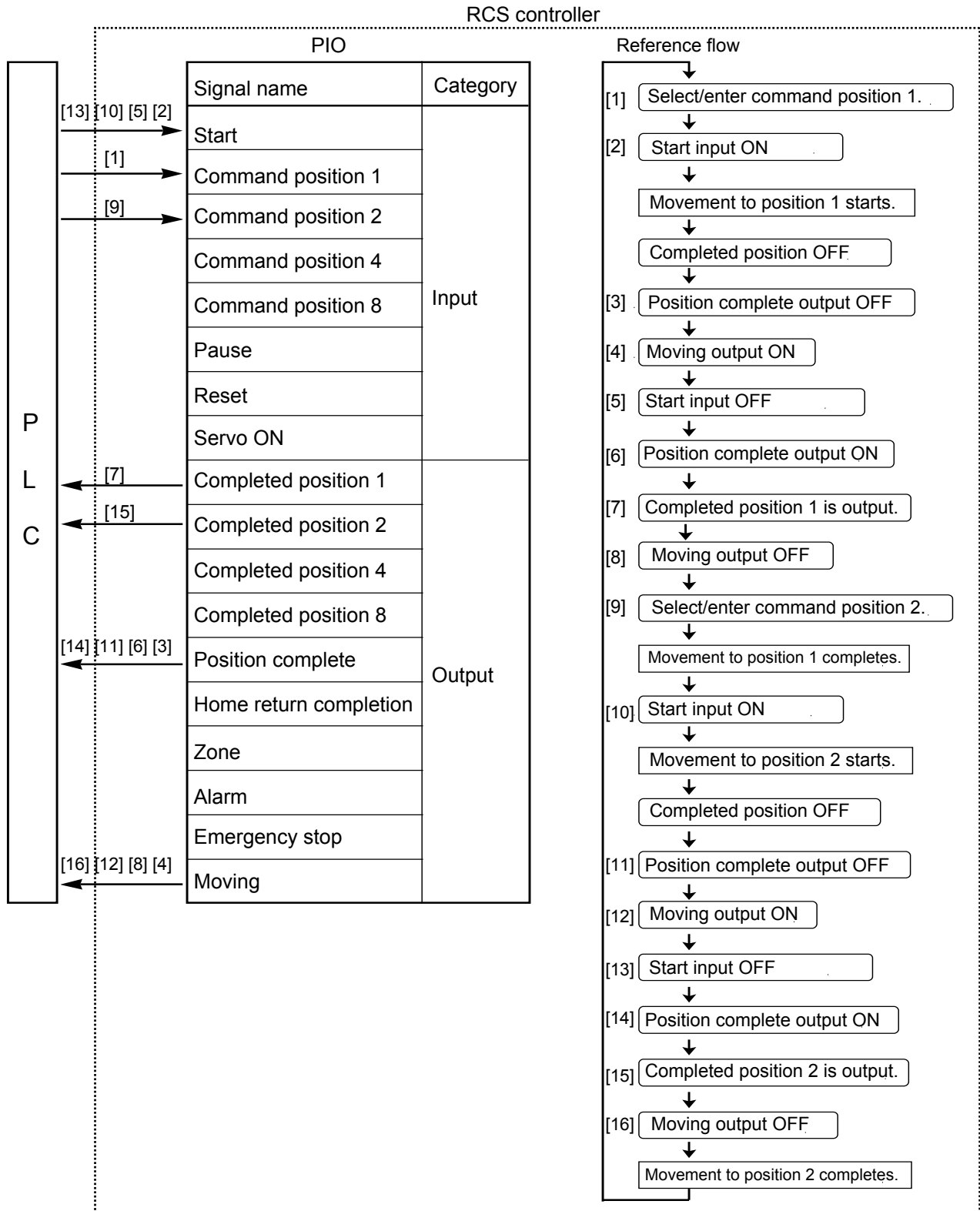
T_1 : 5 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

* 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.



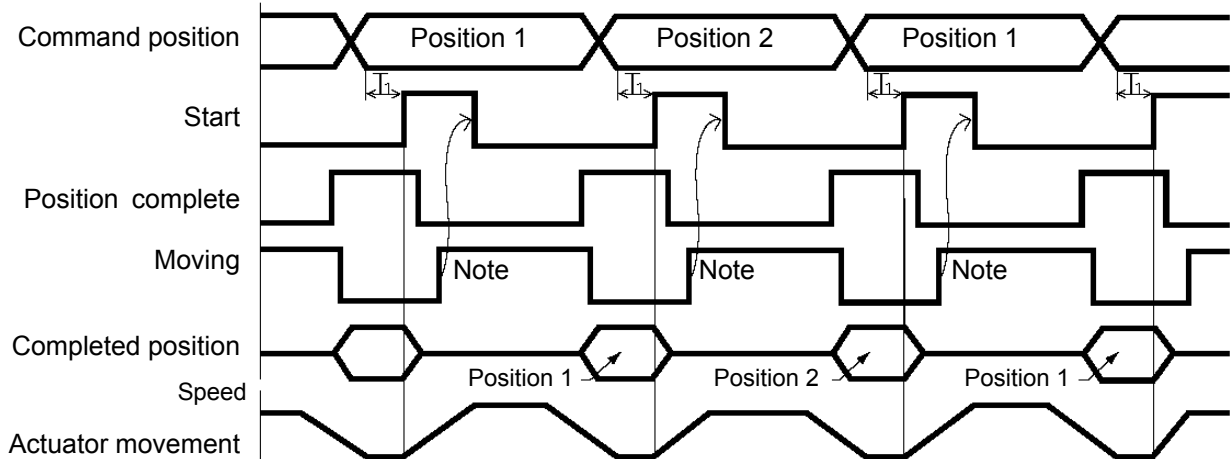
5-4 Positioning Mode (Back and Forth Movement between Two Points)

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.



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

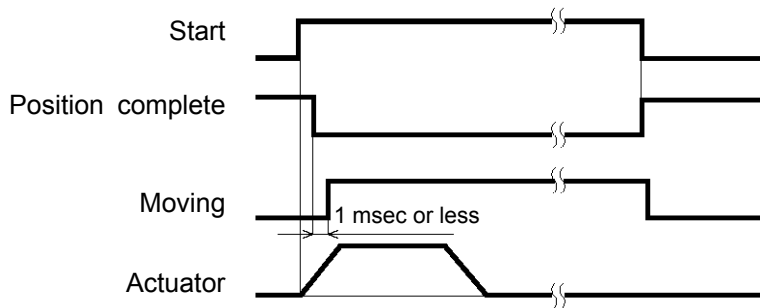
No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	250	200	0.3	0	0.1	0
2	100	100	0.3	0	0.1	0
⋮						



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.)

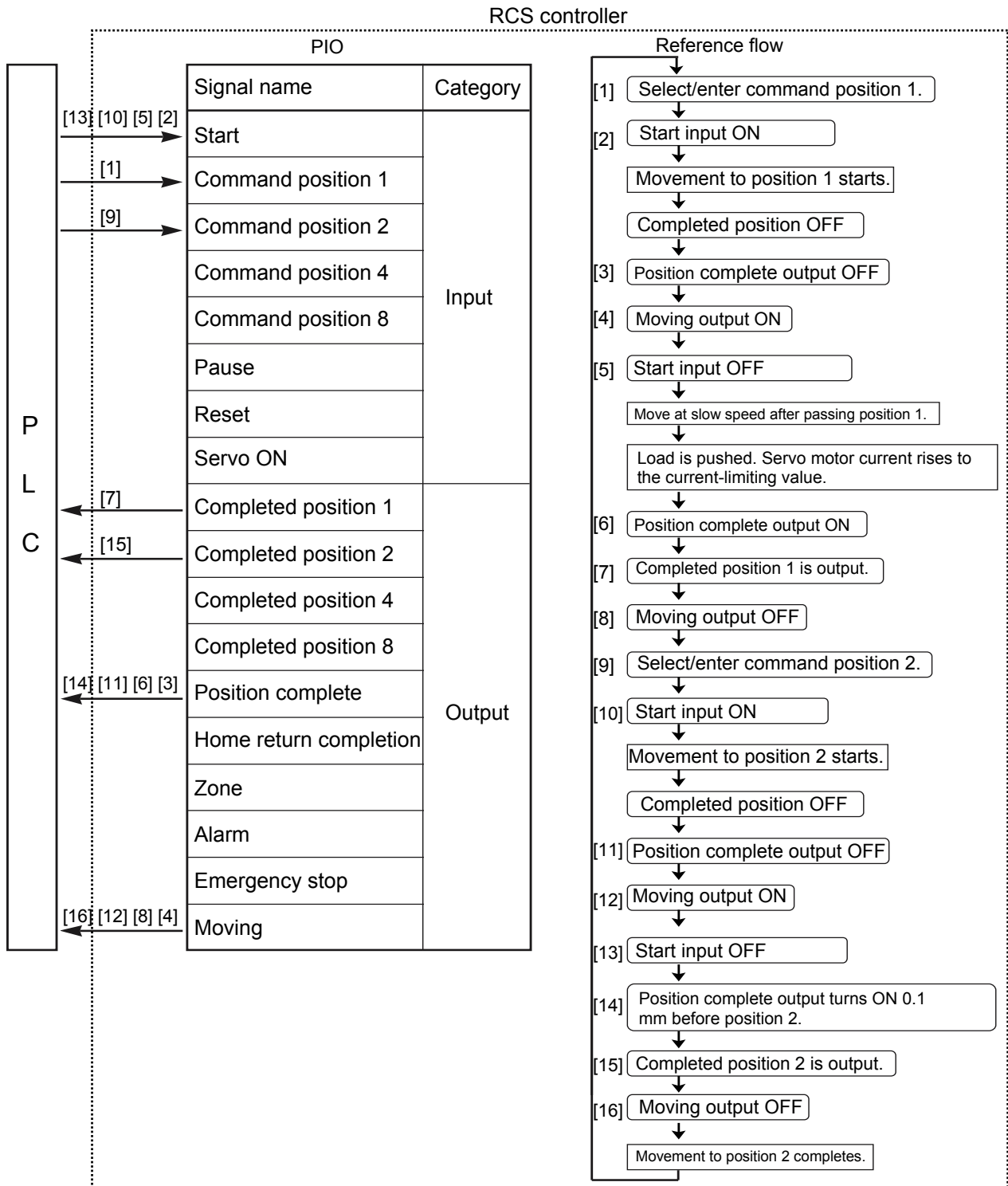
Each command position must be input after the position complete output has turned ON for the movement to the previous position.

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.



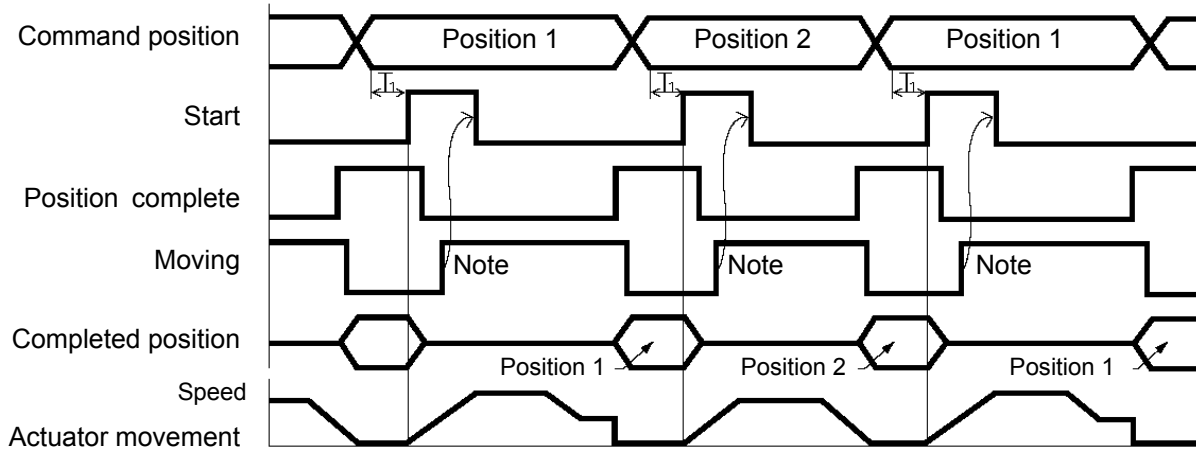
5-5 Push & Hold Mode

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.



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

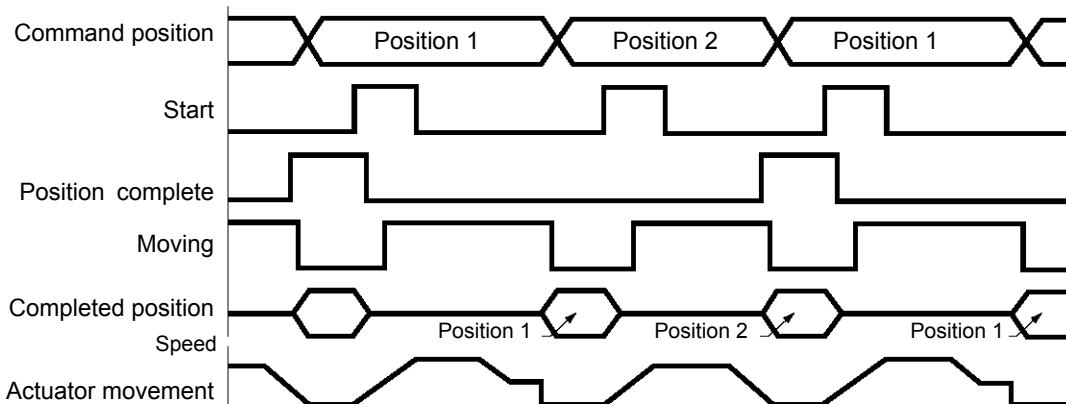
No.	Position	Speed	Acceleration/ deceleration	Push	Positioning band	Acceleration only MAX
0	*	*	*	*	*	*
1	280	200	0.3	50	15	0
2	40	100	0.3	0	0.1	0
⋮						



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.

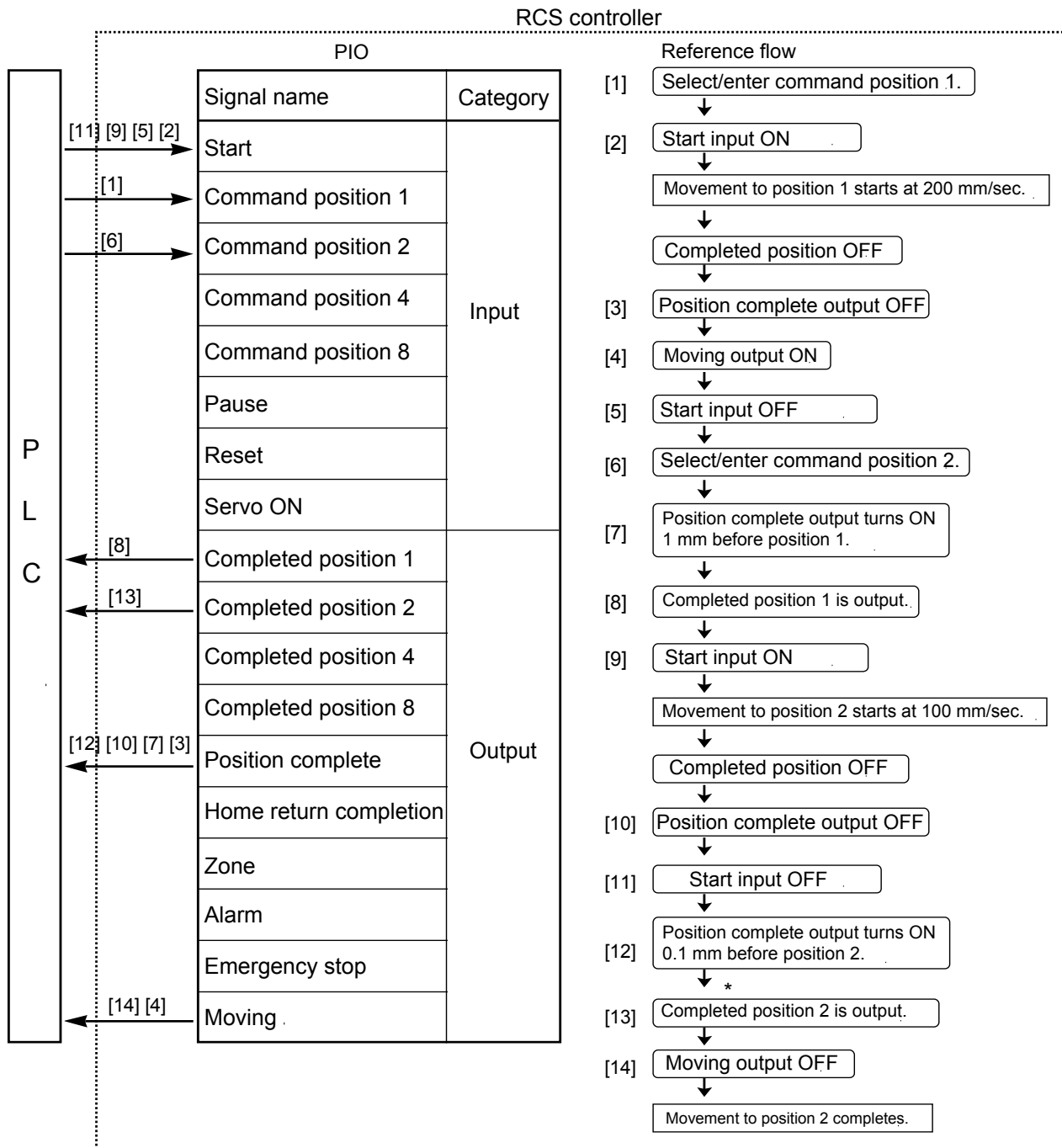
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON. The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON. If the actuator has missed the load, the position complete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



5-6 Speed Change during Movement

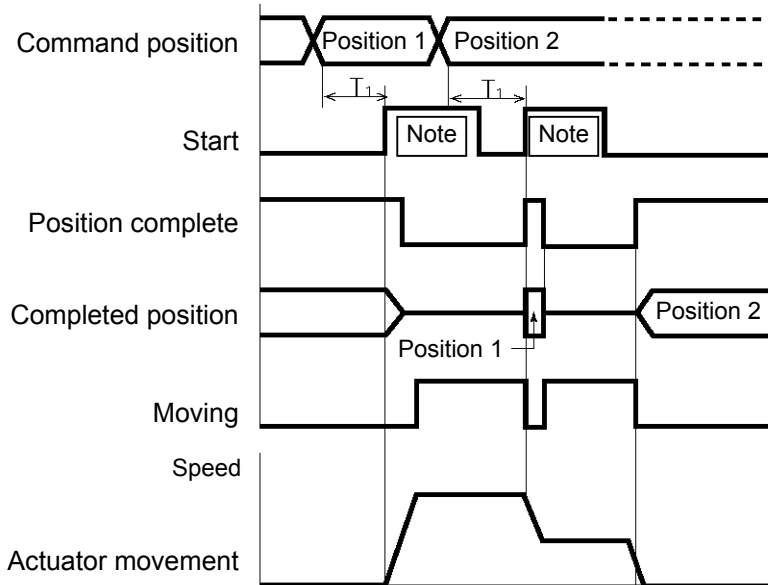
Example of use in operation) The actuator speed is reduced at a certain point during movement. The position 150 mm from the home is set as position 1, and the position 200 mm from the home is set as position 2. The actuator is initially located between the home and position 1. The actuator is moved to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



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
⋮						



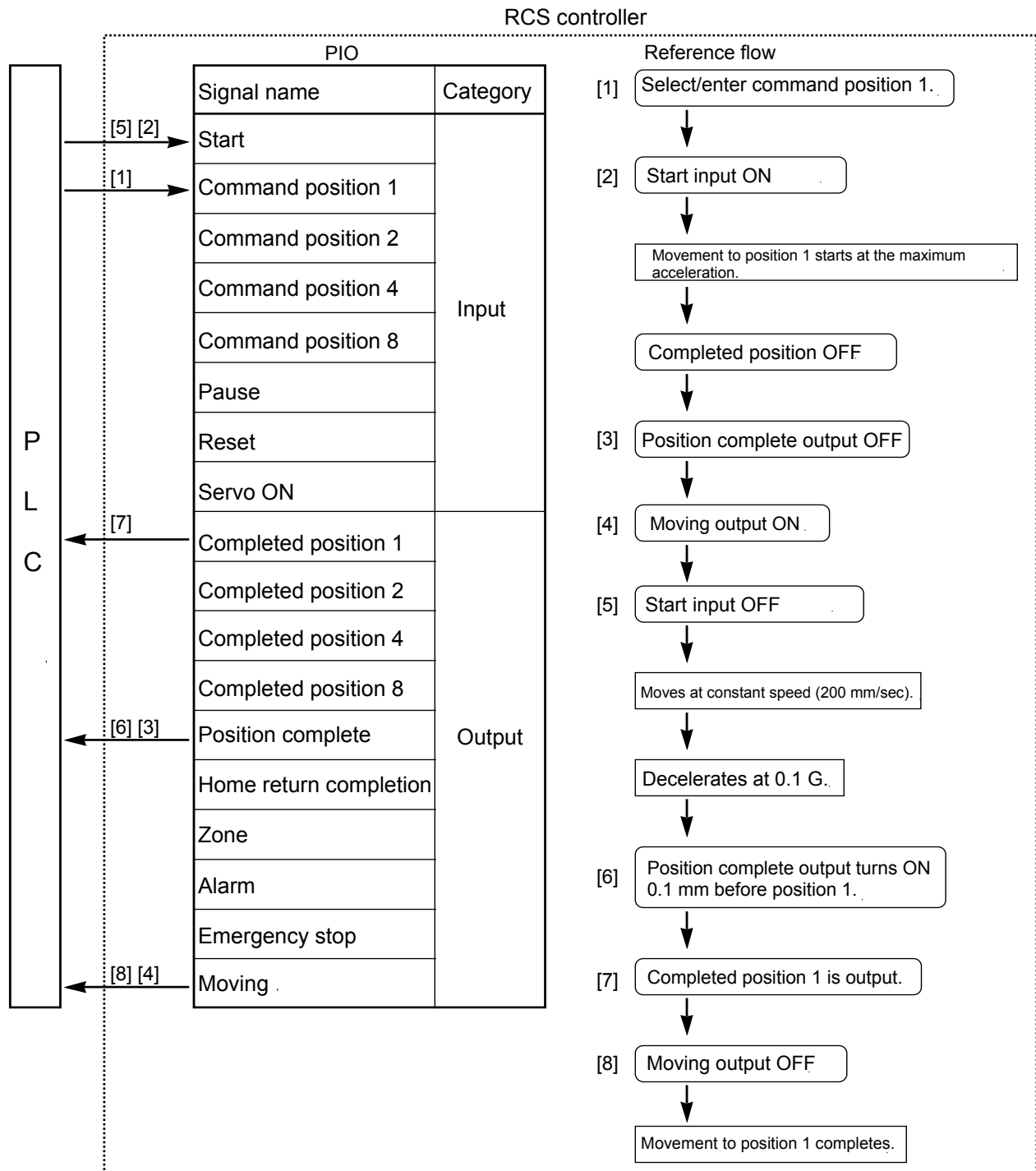
T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON
(The scan time of the host controller must be considered.)

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.

5-7 Operation at Different Acceleration and Deceleration Settings

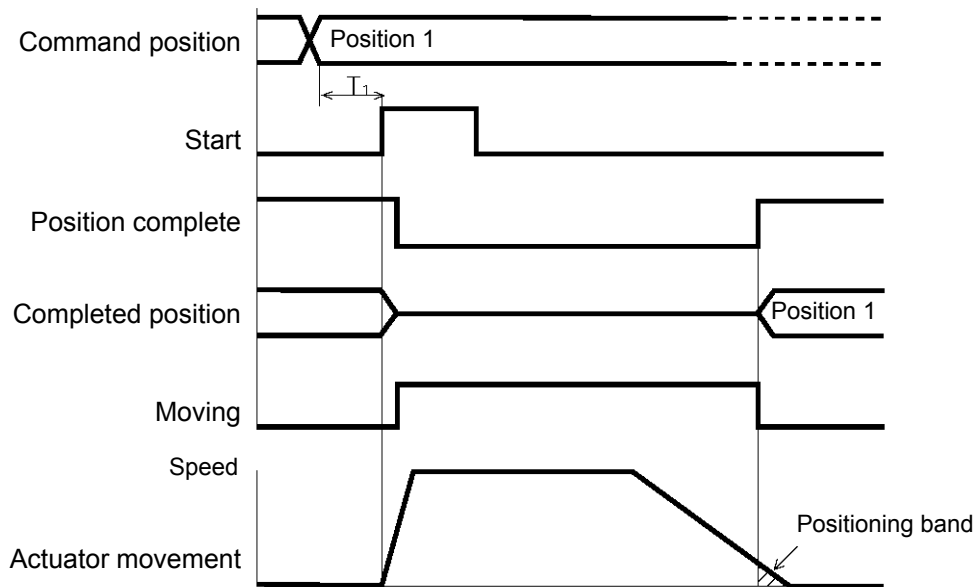
Example of use in operation) Positioning is performed to the position 150 mm from the home (position 1) at a speed of 200 mm/sec. The actuator will accelerate at the maximum acceleration set according to the load, and decelerate at 0.1 G.

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.



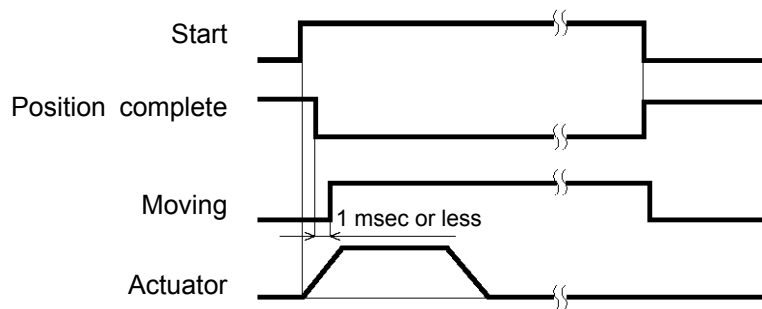
Position-data table (Field(s) within thick line must be entered.)

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



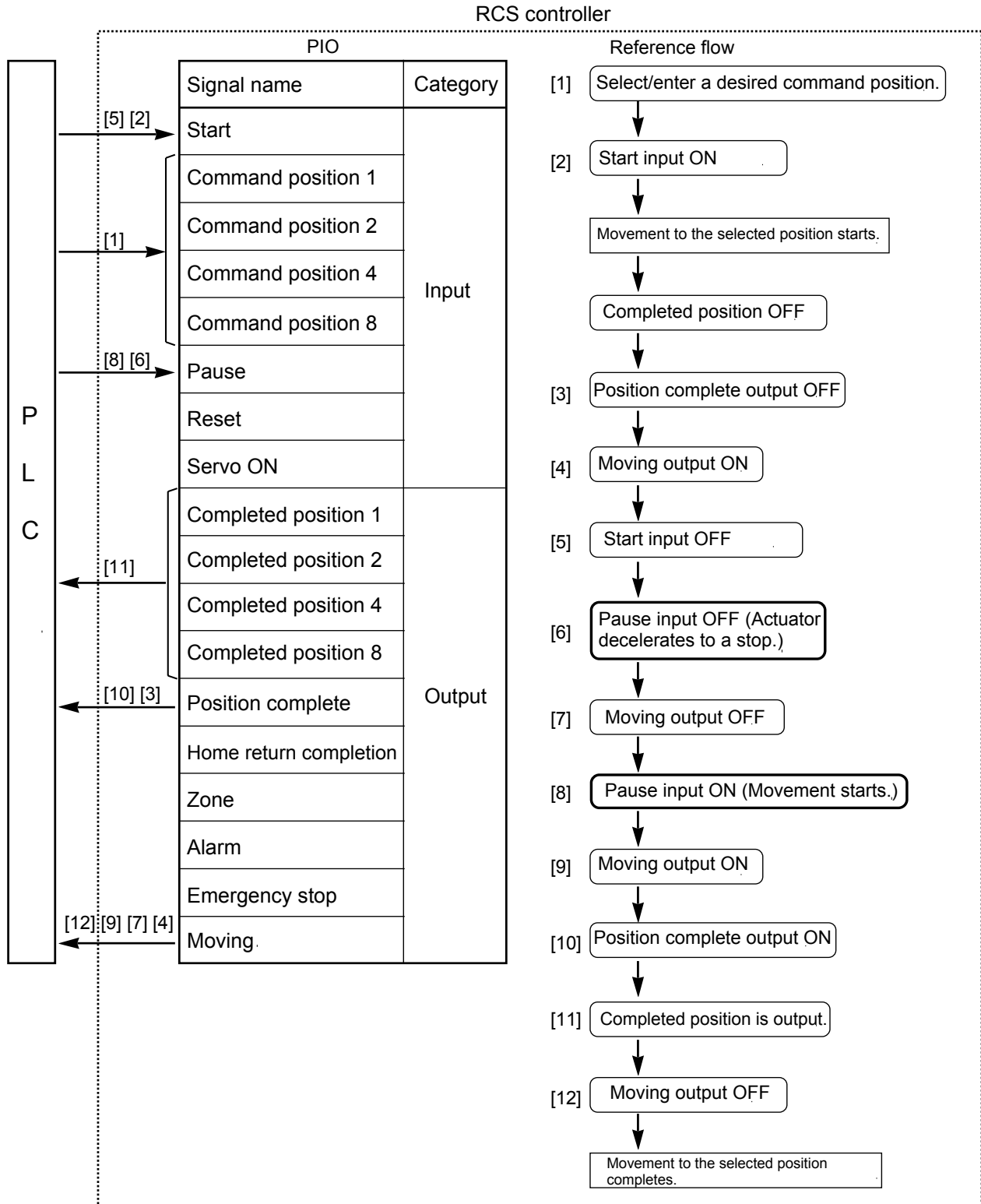
T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON
(The scan time of the host controller must be considered.)

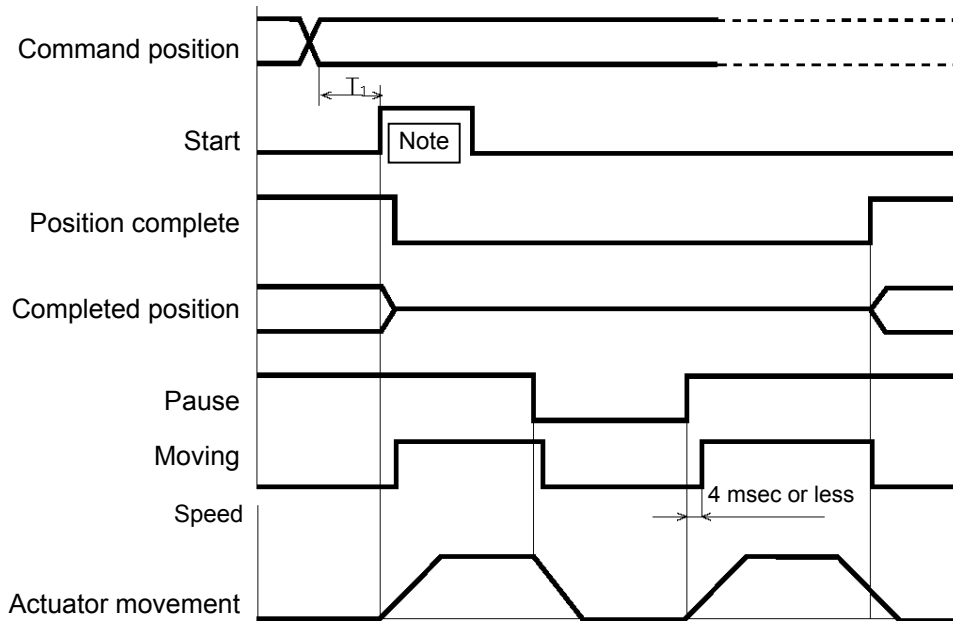
Note: When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON.
The start signal must be turned OFF with the confirmation that the moving output has turned ON while the start signal remains ON.
If the start input remains ON as shown below, the position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



5-8 Pause

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

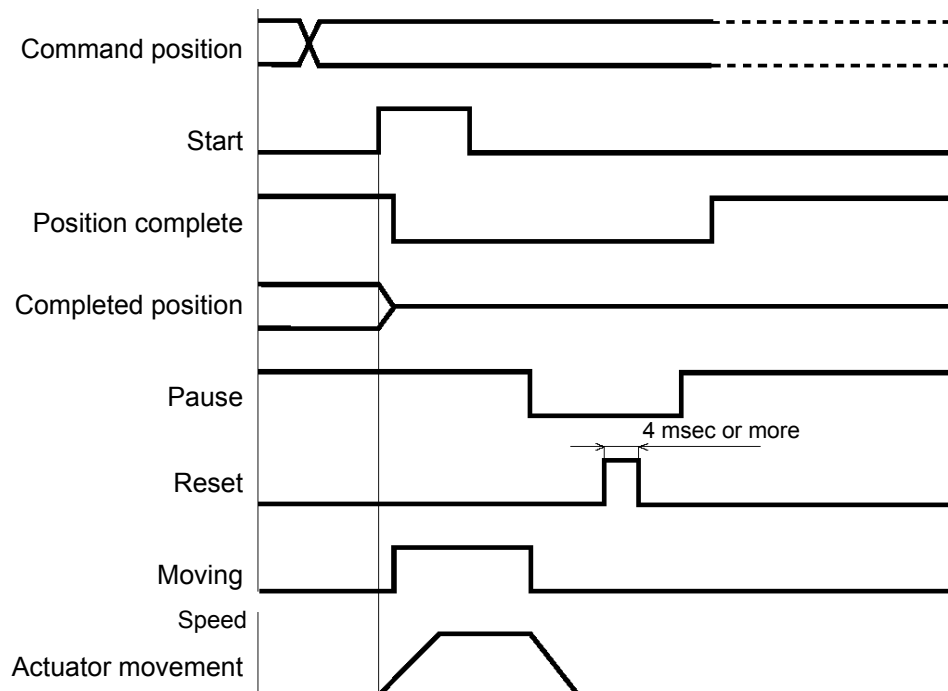




T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON
(The scan time of the host controller must be considered.)

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

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

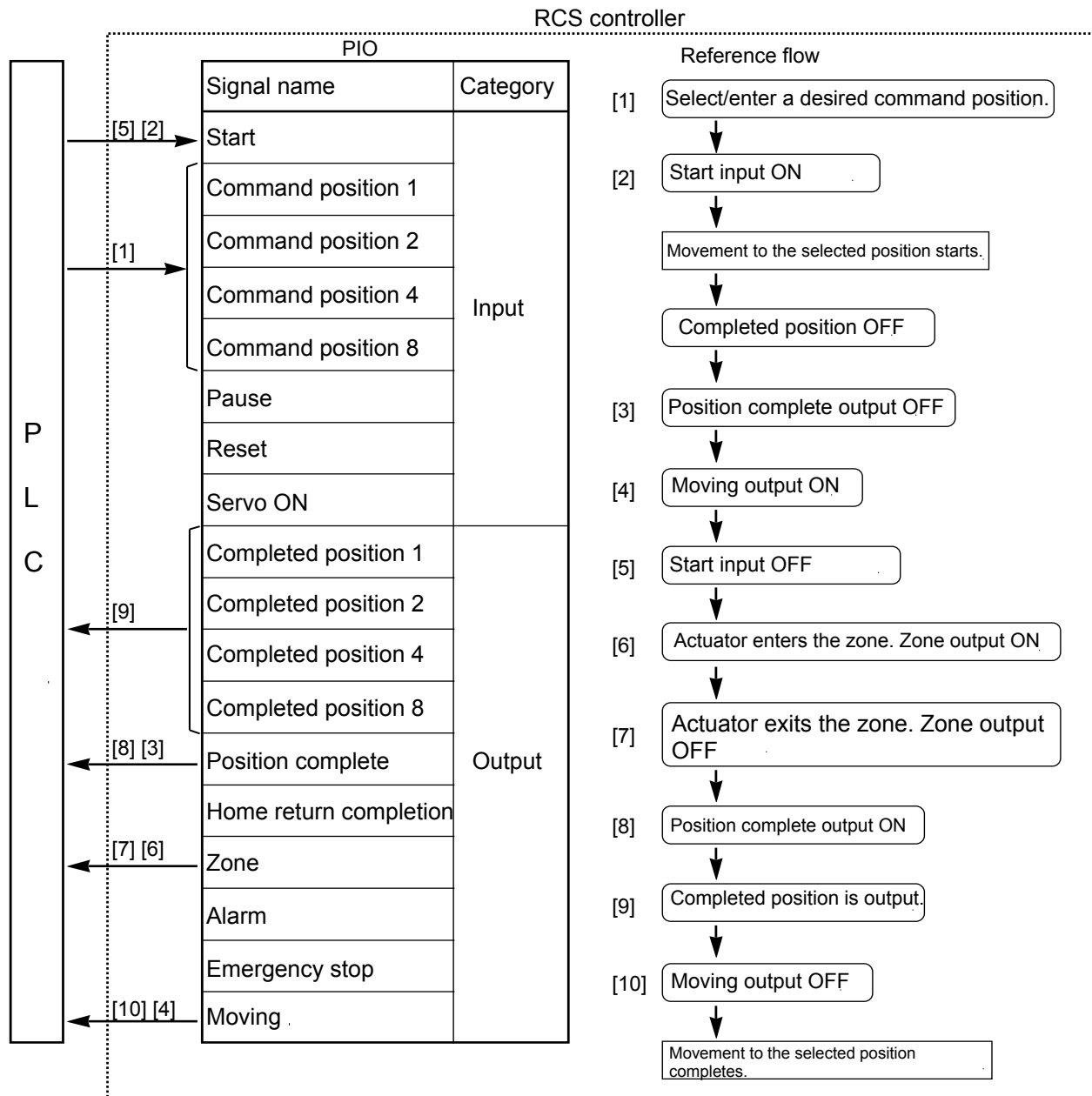


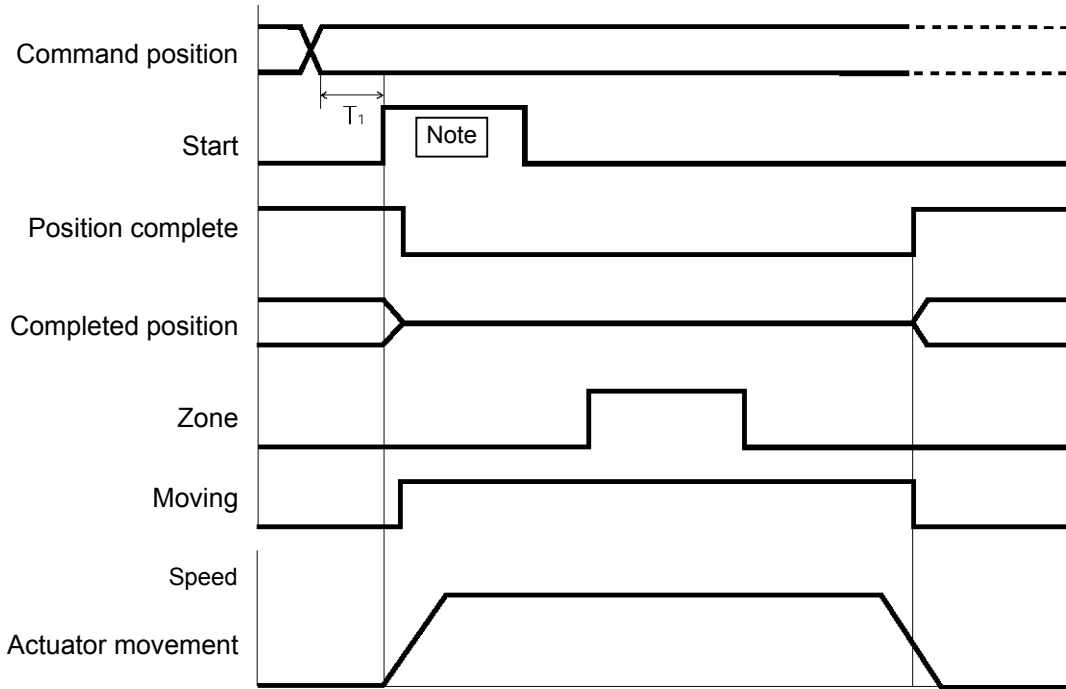
5-9 Zone Signal Output

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

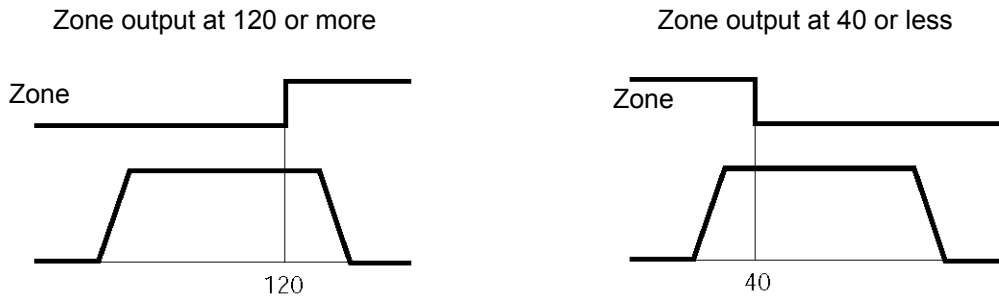




T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON (The scan time of the host controller must be considered.)

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

Example of other zone output)



Zone boundary+	Maximum stroke length
Zone boundary-	120

Zone boundary+	40
Zone boundary-	0

5-10 Returning Home

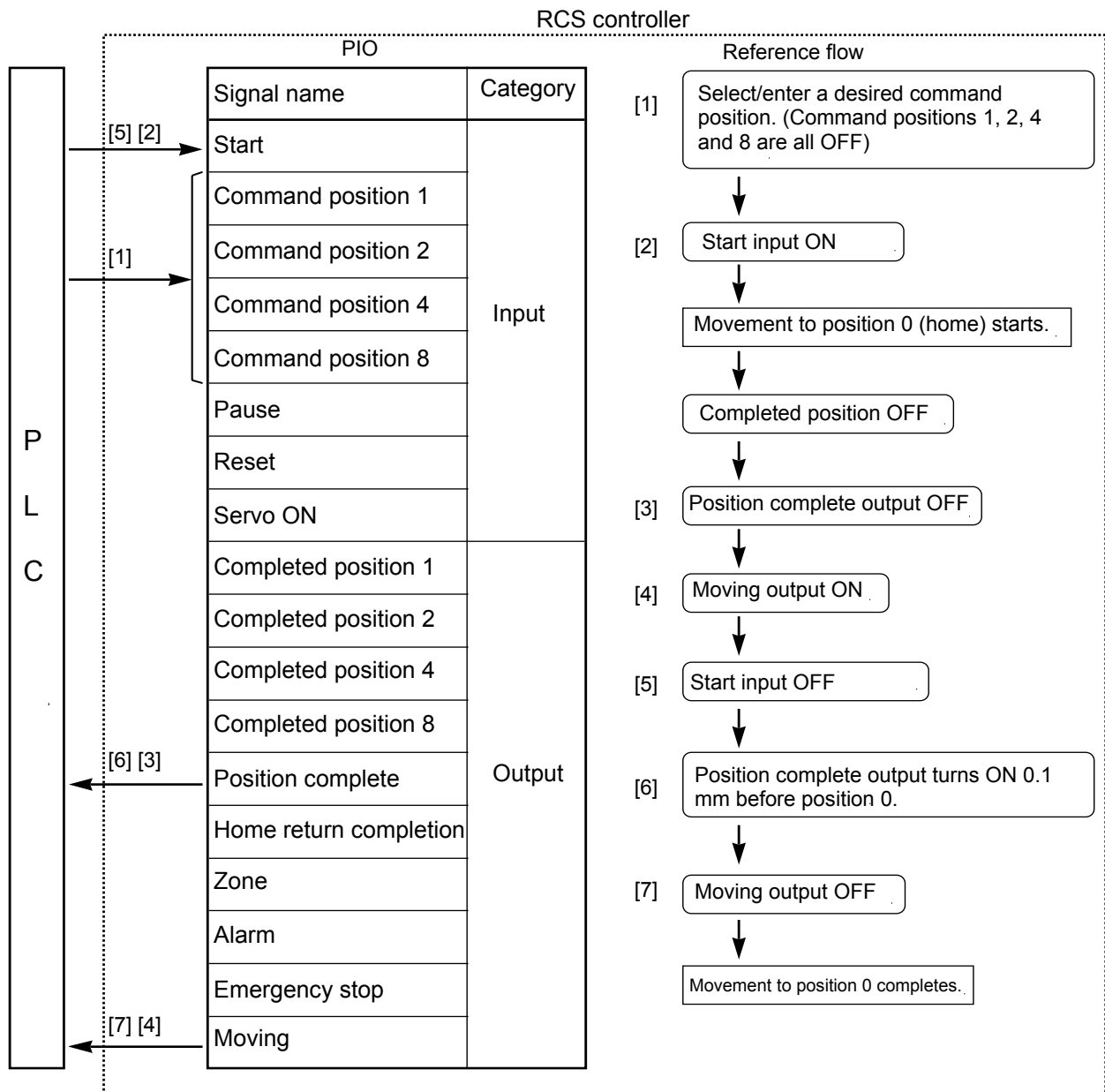
Example of use in operation) Home return alone cannot be performed using PIO.

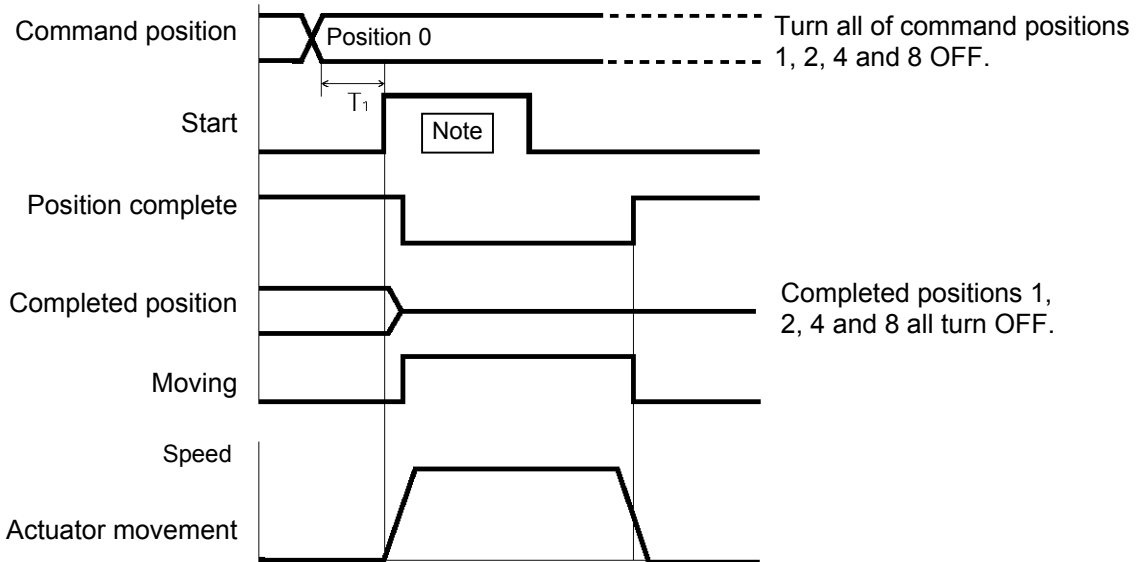
Method) Create point data of 0 distance from the home, and move the actuator to that position.

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	*	*	*	*	*	*
⋮						

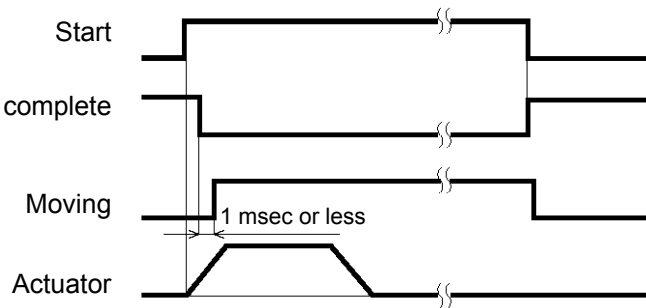




T1: 5 msec or more; time after selecting/entering a command position until the start input turns ON
(The scan time of the host controller must be considered.)

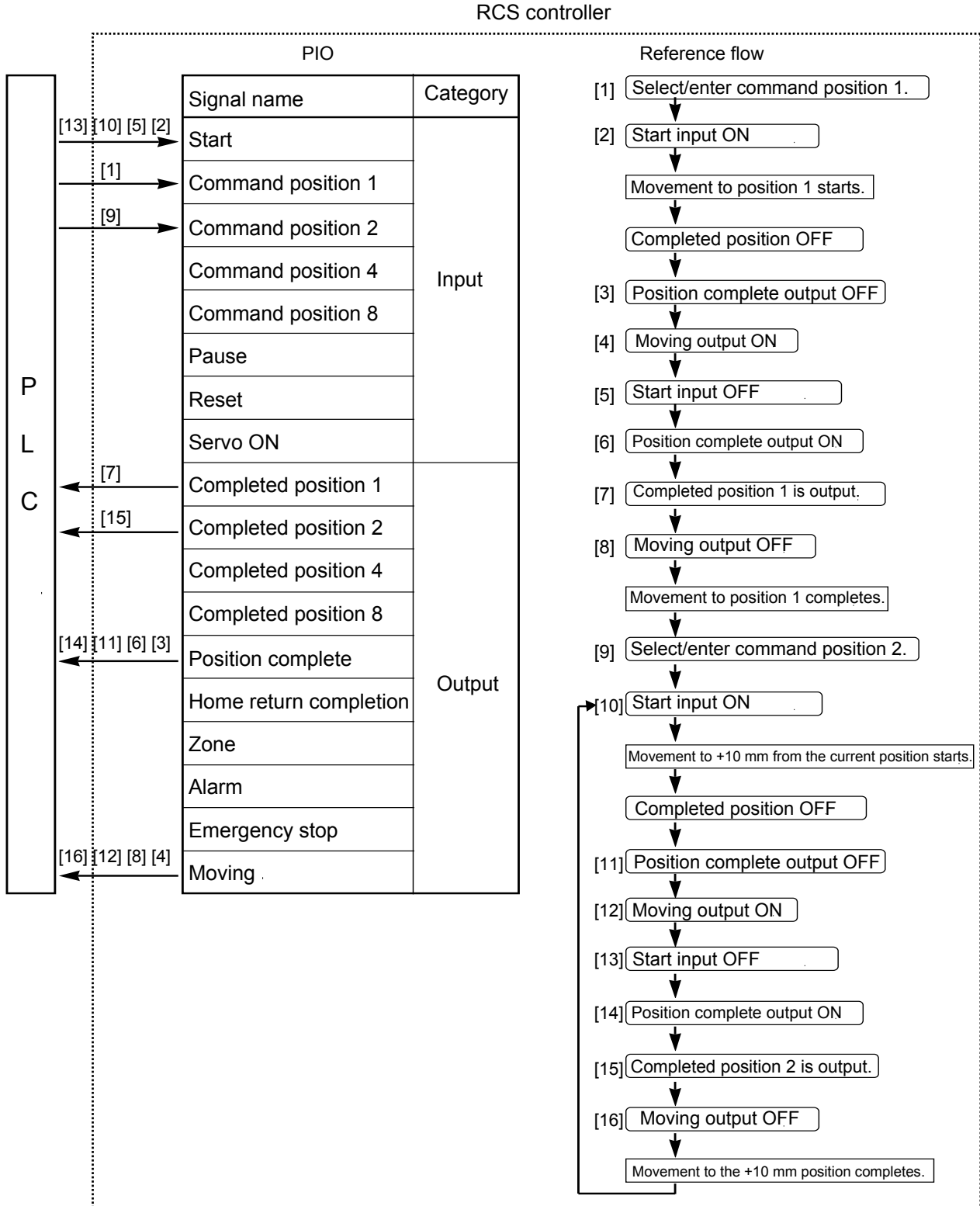
Data of 0 distance from the home need not be always entered in position 0.
In this example, data of 0 distance from the home was entered in position 0. Of course, such data can also be entered in any other position of 1 to 15.

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.



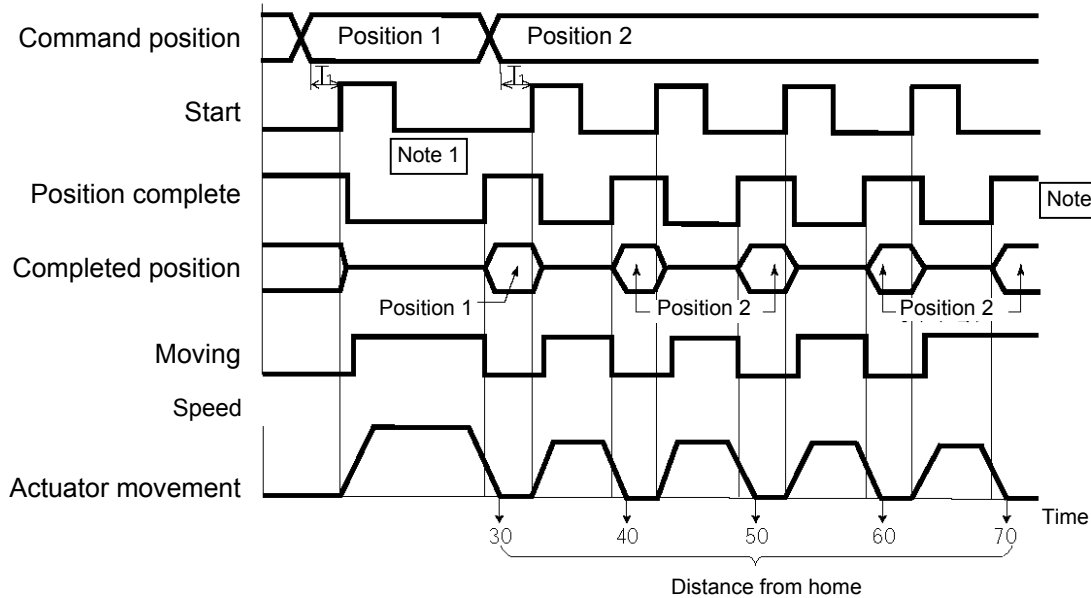
5-11 Incremental Moves

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.



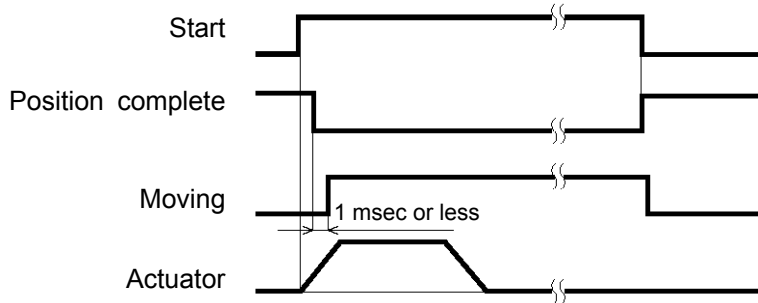
Position-data table (Field(s) within thick line must be entered.)

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.



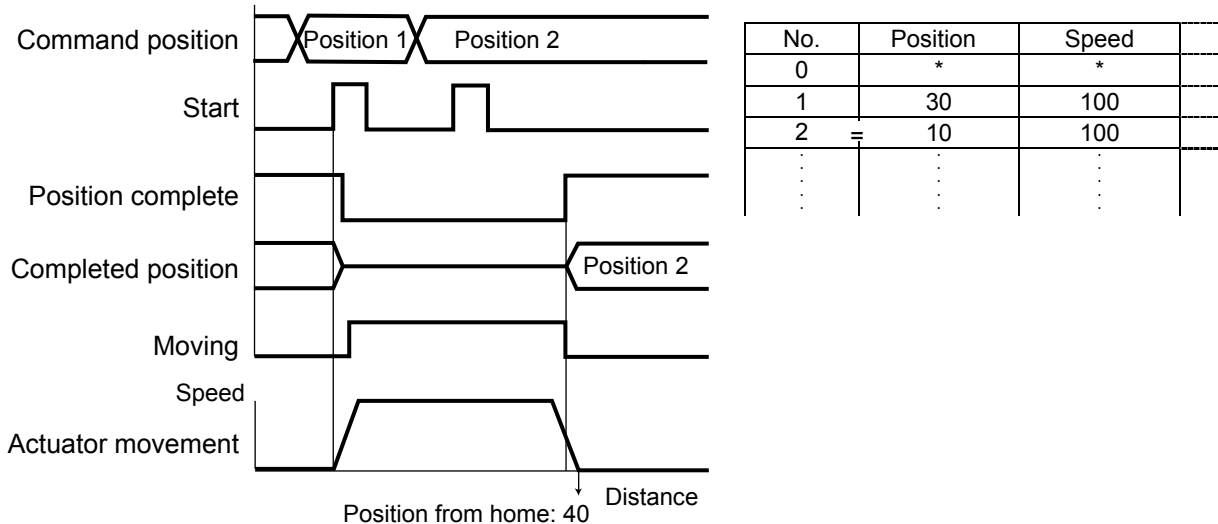
Note 2: When a soft limit is reached as a result of repeated incremental moves, the actuator will stop at that position and the position complete signal will be output.

5-12 Notes on Incremental Mode

(1) Notes on positioning operation

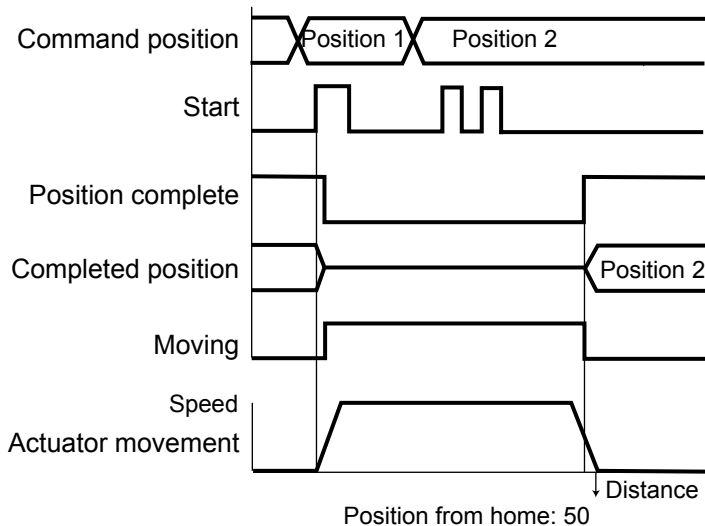
Selecting/entering a position number using relative coordinates during positioning will cause the actuator to move to the position corresponding to the initial position plus the increment. (If the increment is a negative value, the actuator will move to the position corresponding to the initial position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



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

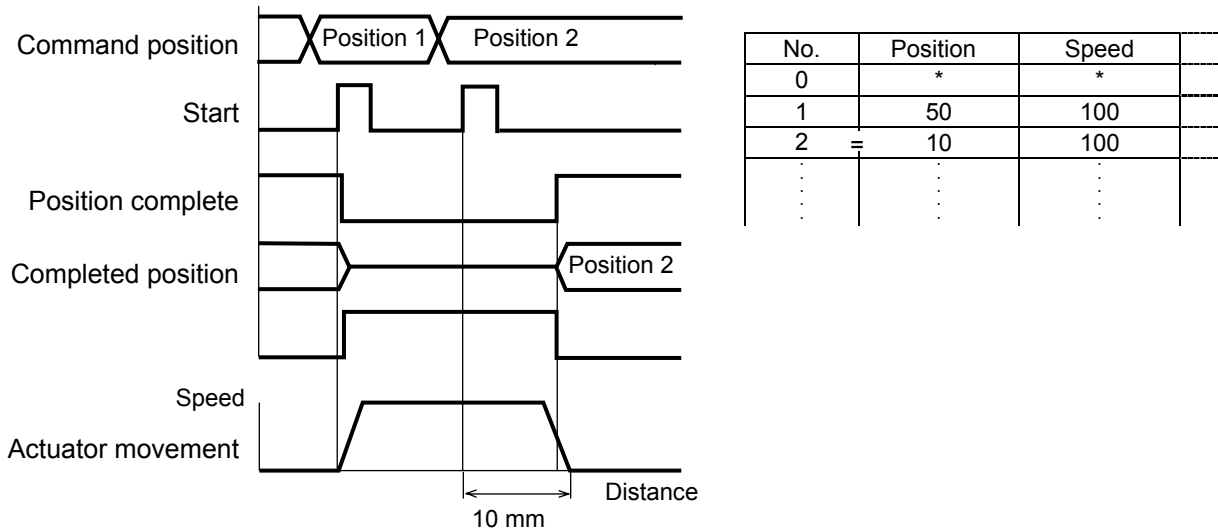
Example) If the start signal for movement to position 2 is input twice while the actuator is moving to position 1, the actuator will move to the position 50 mm from the home.



(2) Note on push & hold operation

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

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



(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
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	30	L	2.5	0.8
			M	5	1.6
			H	10	3.3
		60	M	5	1.6
			H	10	3.3
			L	3	1.0
RB7530	60	M	6	2.0	
		H	12	3.9	
		L	3	1.0	
	100	M	6	2.0	
		H	12	3.9	
		L	4	1.3	
RB7535	100	M	8	2.6	
		H	16	5.2	
		L	4	1.3	
	150	M	8	2.6	
		H	16	5.2	
		L	4	1.3	

6. Parameter Table

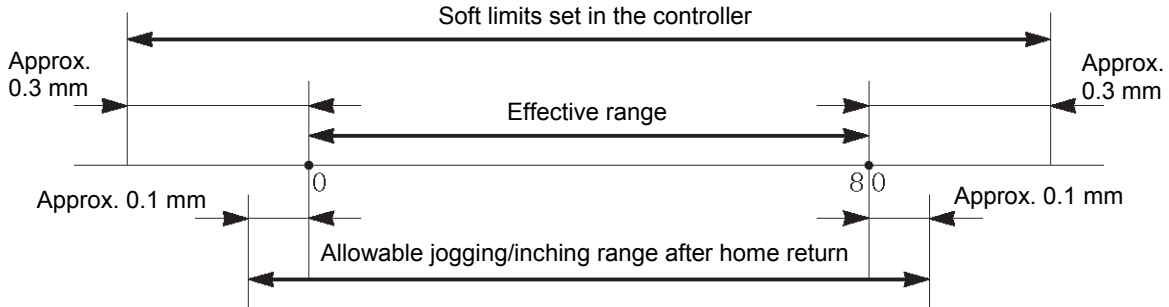
1	Zone boundary+ (mm)	Maximum limit of the zone output range	
2	Zone boundary- (mm)	Minimum limit of the zone output range	
3	Soft limit+ (mm)	Set the soft limit in the positive direction.	
4	Soft limit- (mm)	Set the soft limit in the negative direction.	
5	Home return direction (0: Reverse, 1: Forward)	Set the home return direction.	
6	Push & hold stop judgment period (msec)	In the push & hold mode, the position complete output will turn ON if the current remains equal to or above the current-limiting value for the time set here.	
7	Servo gain number	Set the servo gain number.	
8	Default speed (mm/sec)	Default speed in the position-data table	
9	Default acceleration/deceleration (G)	Default acceleration/deceleration in the position-data table	
10	Default positioning band (mm)	Default positioning band in the position-data table	
11	Default acceleration only MAX	Default acceleration only MAX in the position-data table	
12	Current-limiting value at standstill during positioning (%)	Determine the holding force at standstill after positioning operation.	*
13	Current-limiting value during home return (%)	Set the current-limiting value to be applied when the actuator contacts the mechanical end during home return (factory setting: 100%).	*
14	Operation-at-standstill flag	Set whether to enable or disable the dynamic brake at standstill. 0: Disable 1: Enable (factory setting: 1)	
15	Pause input disable selection	0: Enable, 1: Disable	
16	SIO communication speed	Select an appropriate speed from 9600, 19200, 28800, 38400, 57600 and 115200 [bps].	
17	Minimum delay time for slave transmitter activation	A delay until the RCS controller returns a response after receiving a command from the host PLC/PC. Note) Set to 5 msec or longer.	

Parameter Nos. 1 to 14 are editable using the teaching pendant or PC software.
Parameter Nos. 15 to 17 are editable using the PC software.

*: If you need to change the parameter values, please contact IAI.

- To change a soft limit, set a value corresponding to 0.3 mm outside of the effective range.

Example) Set the effective range to between 0 mm and 80 mm
 Soft limit+: 80.3
 Soft limit-: -0.3



- If the home return direction is changed, all position data that have been entered will be cleared. If necessary, back up the data before changing the home return direction.
- The home return direction cannot be reversed on a rod-type actuator.
- On a reversing-type actuator, the specified home return direction will be reversed (0: Forward, 1: Reverse).

Note: After changing any parameter, reconnect the controller power. The parameter will be rewritten simply by turning the emergency-stop switch or PORT switch OFF and then turning it ON again. However, the new value may not become effective depending on the parameter.

7. Alarm Table

When an alarm occurs, the ALM LED on the controller will illuminate.

The content of each alarm can be identified from the combination of the PIO alarm output and completed position output.

Alarm Table

○ = ON ● = OFF

Alarm	Completed position No.				Content of alarm	Alarm code*
	8	4	2	1		
○	/	/	/	/	Normal	/
●	●	○	●	○	CPU error	0FA
●	●	○	○	●	Nonvolatile memory data setting error	0B0, 0B1
●	●	○	○	○	Home return error	0BE
●	○	●	●	●	Alarm pertaining to servo error	0C0
●	○	●	●	○	Power conversion error	0B8 ~ 0CA
●	○	●	○	○	Excessive deviation	0D8, 0DC
●	○	○	●	●	Overload	0ED
●	○	○	●	○	Open encoder or low battery voltage	0E4 ~ 0E7
●	○	○	○	○	Corrupted nonvolatile memory data	0F8

[1] To reset an alarm, input a PIO reset signal.

[2] If the alarm cannot be reset by a reset signal, a faulty controller or open encoder cable is suspected.

* These alarm codes are displayed on the teaching pendant and PC software. PIO completed position signals will not be output if an alarm of any other code occurs.

If the teaching pendant or PC software is used, the detailed codes shown in the table below will be displayed. (The error names in the table are those displayed on the teaching pendant.)

Note: If the host is connected to the SIO connector, be sure to reference the error code table in "Communication Protocol Specification."

Alarm Code and Action Table

Code	Error name	Action
040	Emergency stop	(This is not an error.) An emergency stop was detected. (Whether an emergency stop is still active cannot be confirmed.)
05A	Reception overrun	Communication error. Check for noise and conflict between the SIO master and slave stations.
05B	Reception framing error	Communication error. Check for shorted cable, noise and conflict between the SIO master and slave stations.
05C	Reception timeout error	Communication error. Check for shorted cable, noise and conflict between the SIO master and slave stations.
05D	Header error	Communication error. Check for noise and conflict between the SIO master and slave stations.
05E	Delimiter error	Communication error. Check for noise and conflict between the SIO master and slave stations.
07F	BCC error	Communication error. Check for noise and conflict between the SIO master and slave stations.
061	FNCCHR, W address error	The command was rejected due to invalid data. This error also occurs when an address is assigned to a standalone controller using SIO (or the teaching pendant). (Address must be assigned using the switches.)
062	Operand 1 error	The command was rejected due to invalid data (or the operation is not supported by the applicable controller type).
063	Operand 2 error	The command was rejected due to invalid data (or the operation is not supported by the applicable controller type). If a standalone controller is used, the speed may have been initialized to a value exceeding 2000 rpm when SW7 and SW8 on the controller are set to ON and OFF, respectively.
064	Operand 3 error	The command was rejected due to invalid data (or the operation is not supported by the applicable controller type).
067	BCC error	The command was rejected due to invalid data. A character other than 0 to 9 and A to F is included in the BCC.
070	Movement command during RUN-OFF	The command was rejected because the execution condition was not satisfied. The command may have been issued via external PIO.
071	PTP before home return completion	The command was rejected because the execution condition was not satisfied. The command may have been issued via external PIO.
073	Error reset during servo ON	The command was rejected because the execution condition was not satisfied. The command may have been issued via external PIO.
074	Operation during excitation search	The command was rejected because the execution condition was not satisfied. The command may have been issued via external PIO.
075	Operation command during home return	The command was rejected because the execution condition was not satisfied. The command may have been issued via external PIO.
07A	ABS battery voltage low	The voltage of the absolute-data backup battery is low (battery alarm). This alarm can be temporarily reset, but replacement of the battery at the earliest convenience is recommended.

0B0	Bank 30 error (Parameter)	If the error persists after reconnecting the controller power, the common parameters must be edited or the controller must be initialized.
0B1	Bank 31 error (Point)	If the error persists after reconnecting the controller power, the common parameters/point data must be edited or the controller must be initialized.
0BE	Home return timeout	Check the physical connection between the motor and actuator. The motor/actuator may not be operating.
0C0	Overspeed	Decrease the load or lower the acceleration/deceleration.
0C8	Overcurrent	The main motor circuit may have shorted or an excessive load may have been received momentarily. This alarm cannot be reset unless the power is reconnected.
0C9	Overvoltage	The load is excessive. Also check if the operation is locked.
0CA	Overheating	The ambient temperature may be too high.
0CB	Current sensor error	The current sensor generated an offset error.
0D8	Deviation overflow	Check if the operation is locked.
0DC	Push-back error	The load was pushed back to a position outside the push range due to an external force, etc.
0E0	Overload	The load is excessive. Also check if the operation is locked.
0E4	Encoder send error	The encoder receive IC generated a send error. Noise or faulty receive IC board is suspected.
0E5	Encoder receive error	Absolute reset has not been executed yet. Battery error. Absolute reset must be executed after the absolute-data backup battery is replaced. The PG cable may be open or is not connected properly. The encoder receive IC generated a send error. Noise or faulty receive IC board is suspected.
0E6	Encoder count error	The encoder generated a count error. This error occurs when the speed exceeded 5000 rpm.
0E7	Open phase A/B/Z	Check the encoder cable.
0F8	Damaged nonvolatile memory	The controller must be initialized.
0FA	CPU error	The CPU is not operating properly. Noise may have entered the CPU circuit.
0FB	FPGA error	A FPGA error was detected.
101	Overrun error (S)	Check the baud rate. Also check for conflict between the SIO master and slave stations. (In update mode)
102	Framing error (S)	Check the baud rate. Also check for shorted cable and conflict between the SIO master and slave stations. (In update mode)
104	SCI R-QUE OV (S)	Excessive data is received from outside the controller. (In update mode)
105	SCI S-QUE OV (S)	The SCI send queue overflowed. (In update mode)
106	Termi R-BF OV (S)	Excessive data is received from outside the controller. (In update mode)
10A	Motorola S sum error	The update program file is invalid. (In update mode)
10B	Motorola S record error	The update program file is invalid. (In update mode)
10C	Motorola S address error	The update program file is invalid. (In update mode)

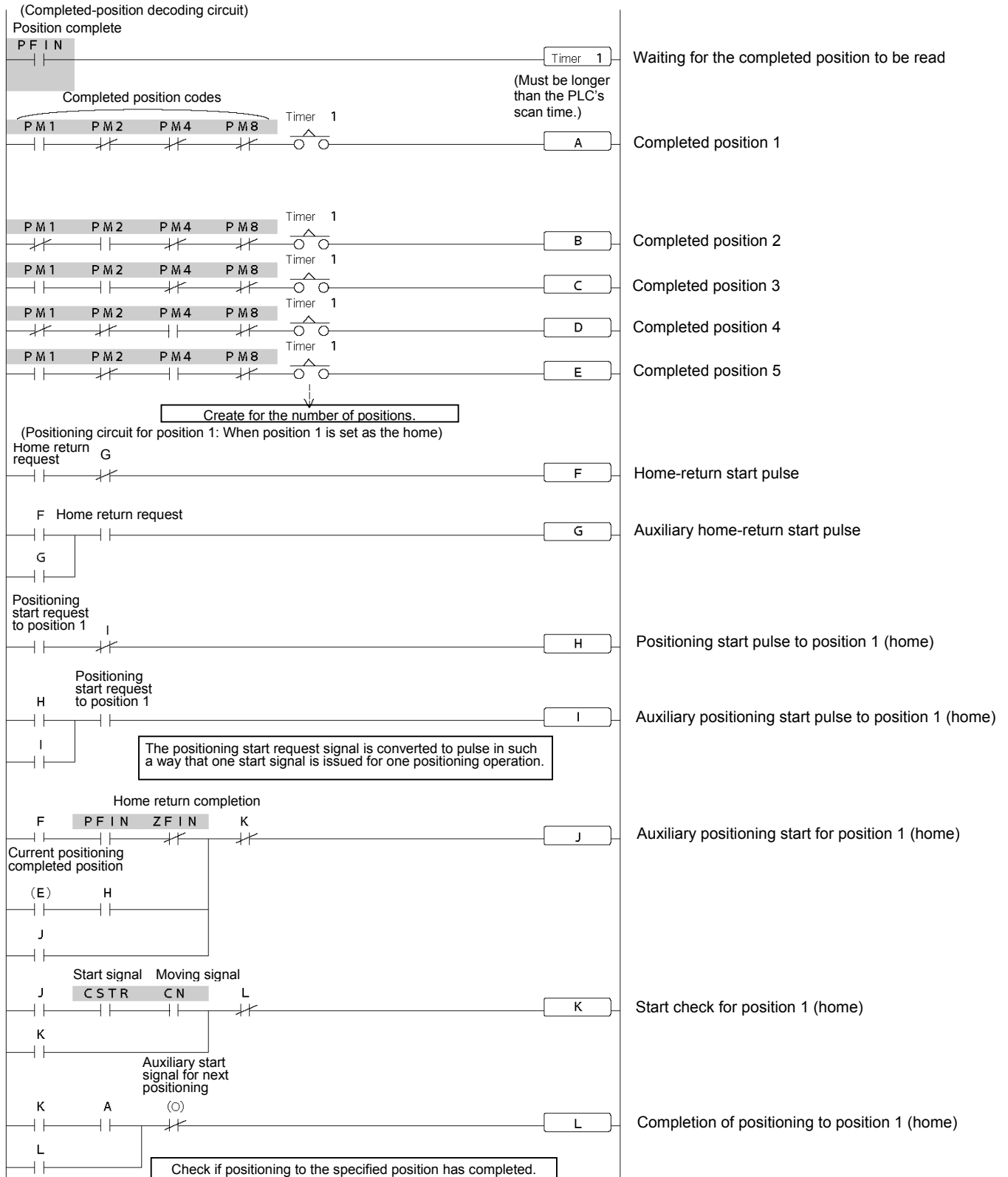
10D	Motorola S file name error	The update program file is invalid. (In update mode)
10E	Timing limit (W) (S)	Check the address dip-switches for the TP-CPU board's flash ROM. (In update mode)
10F	Timing limit (E) (S)	Check the address dip-switches for the TP-CPU board's flash ROM. (In update mode)
111	Timing limit (P) (S)	Check the address dip-switches for the TP-CPU board's flash ROM. (In update mode)
112	Input data error	The input value is invalid. Enter a data within the allowable range.
113	Input too small	The input value is too small. Enter a data within the allowable range.
114	Input too large	The input value is too large. Enter a data within the allowable range.
115	Home return incomplete	The operation is not permitted until home return is completed. Perform home return first.
116	Last position data	When adding a position, clear or delete the last position data first.
117	No moving data	Movement cannot be performed because no position data is available. Specify valid position data.
118	Selected axis not connected	The selected axis is not connected. (This is not an error.)
119	Too many TP parameter changes	The parameters in the teaching pendant were changed beyond the allowable limit after the update.
11A	Flash verify error: S	Check the address dip-switches for the TP-CPU board's flash ROM.
11B	Flash ACK timeout: S	Check the address dip-switches for the TP-CPU board's flash ROM.
11C	Flash verify error: M	Check the address dip-switches for the TP-CPU board's flash ROM.
11D	Flash ACK timeout: M	Check the address dip-switches for the TP-CPU board's flash ROM.
11E	Paired data mismatch error	Enter paired data by paying attention to the magnitude relationship of the two data.
11F	Absolute value too small	The absolute value of the input is too small. Enter a data within the allowable range.
120	Initialization factor error	The factor data entered when the controller was initialized is invalid. Enter a data within the allowable range.
121	Push search end over	The position at which the push & hold operation ended is outside the stroke range. Correct the position or positioning band.
122	Multiple axes connected during address assignment	Always assign an address with only one axis connected.
180	Address change OK	(This is not an error.)
181	Controller initialization OK	(This is not an error.)
182	All clear upon home change	(This is not an error.)
201	Emergency stop	(This is not an error.)
20A	Servo OFF during operation	The servo turned OFF during operation.
20C	Start ON during operation	The start input turned ON during operation.

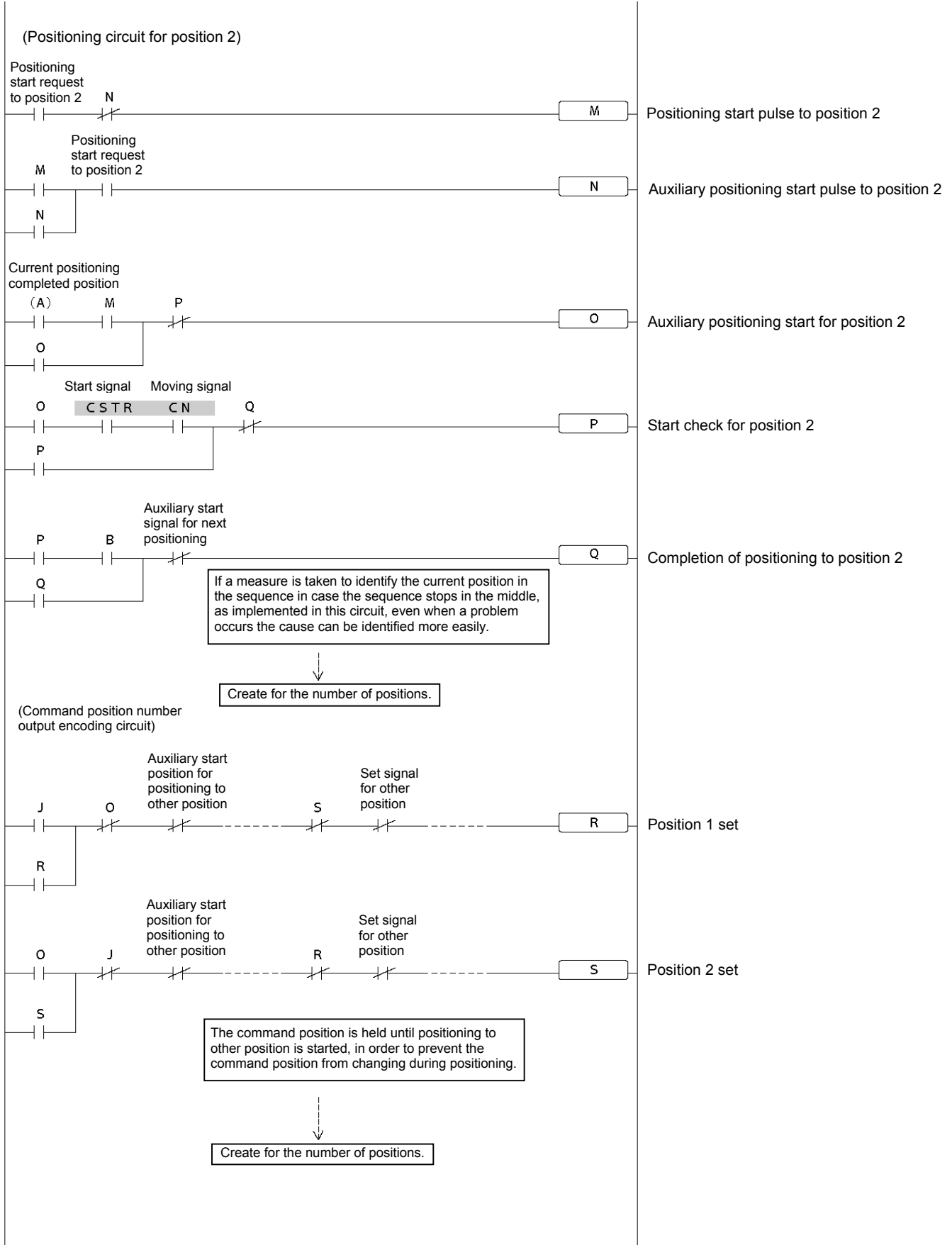
20D	STP OFF during operation	The STP turned OFF during operation.
20E	Soft limit over during operation	A soft limit was exceeded during operation.
301	Overrun error (M)	Check for noise and conflict between the SIO master and slave stations.
302	Framing error (M)	Check for shorted cable, noise and conflict between the SIO master and slave stations.
304	SCI R-QUE OV (M)	Excessive data is received from outside the controller.
305	SCI S-QUE OV (M)	The SCI send queue overflowed (in the master station mode).
306	Termi R-BF OV (M)	Excessive data is received from outside the controller.
307	Memory command rejected	The controller rejected the command. The cause of this error is unknown. Record the entire error list before turning off the TP power.
308	Response timeout (M)	Check the cable and controller power. Also check for conflict between the SIO master and slave stations.
309	Termi write address error	Indeterminable Termi write address.
30A	Packet R-QUE OV	Excessive data is received from outside the controller.
30B	Packet S-QUE OV	The packet send queue overflowed.
30C	No connected axis	Check the cable and controller power. Also check for conflict between the SIO master and slave stations.

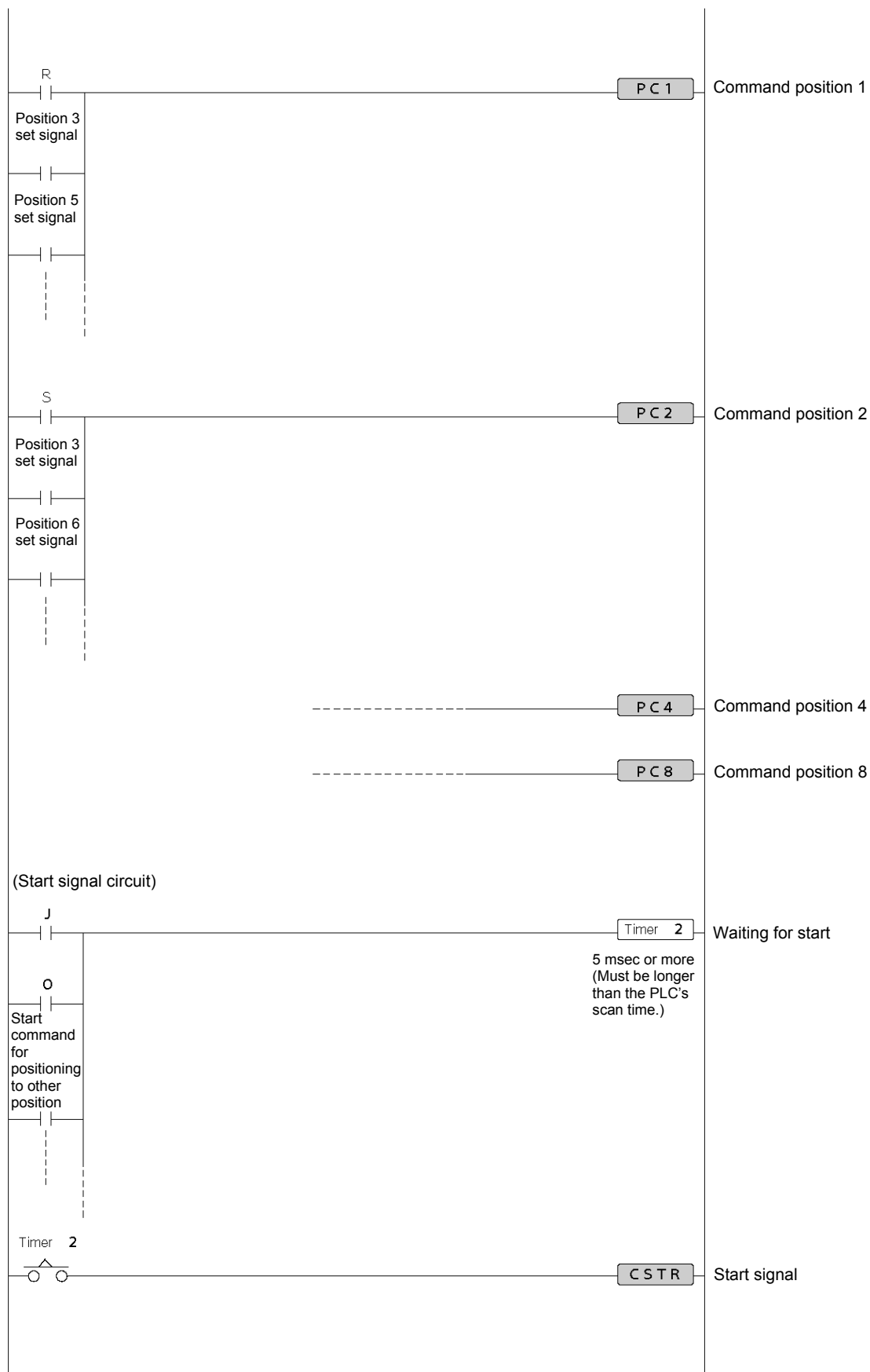
* Appendix

Example of Basic RCS Positioning Sequence

Given below is an example of basic sequence for creating a positioning sequence using the RCS.
 [Grey box] indicates PIO signals of the RCS controller.









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