ROBO NET

ROBONET

Operation Manual Eleventh Edition

IAI America, Inc.

Please Read Before Use

Thank you for purchasing our product.

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

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.
The CD/DVD that comes with the product contains operation manuals for IAI products.
When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

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

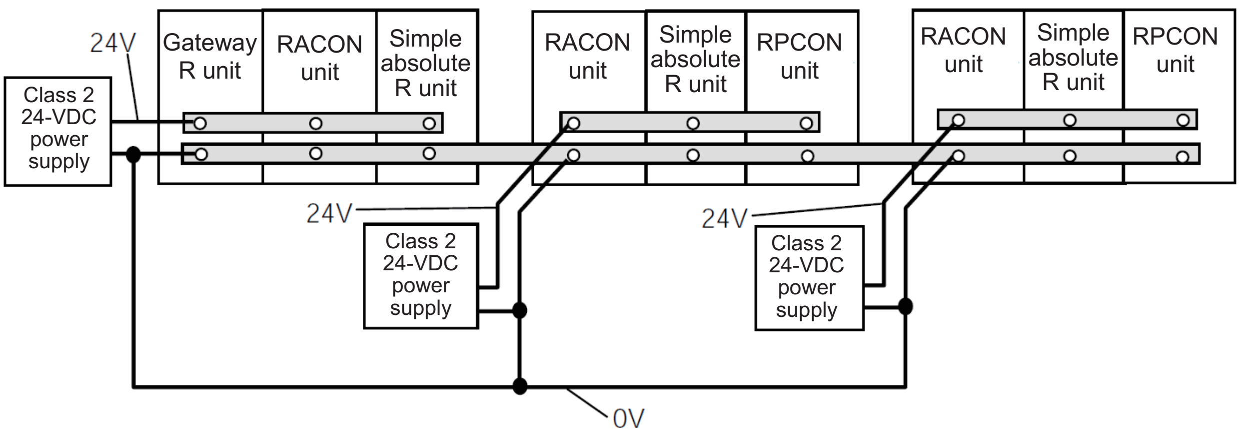
[Important]

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

24-V Power Supply for UL Certification

The 24-VDC power supply conditions for obtaining a UL certification are explained below.

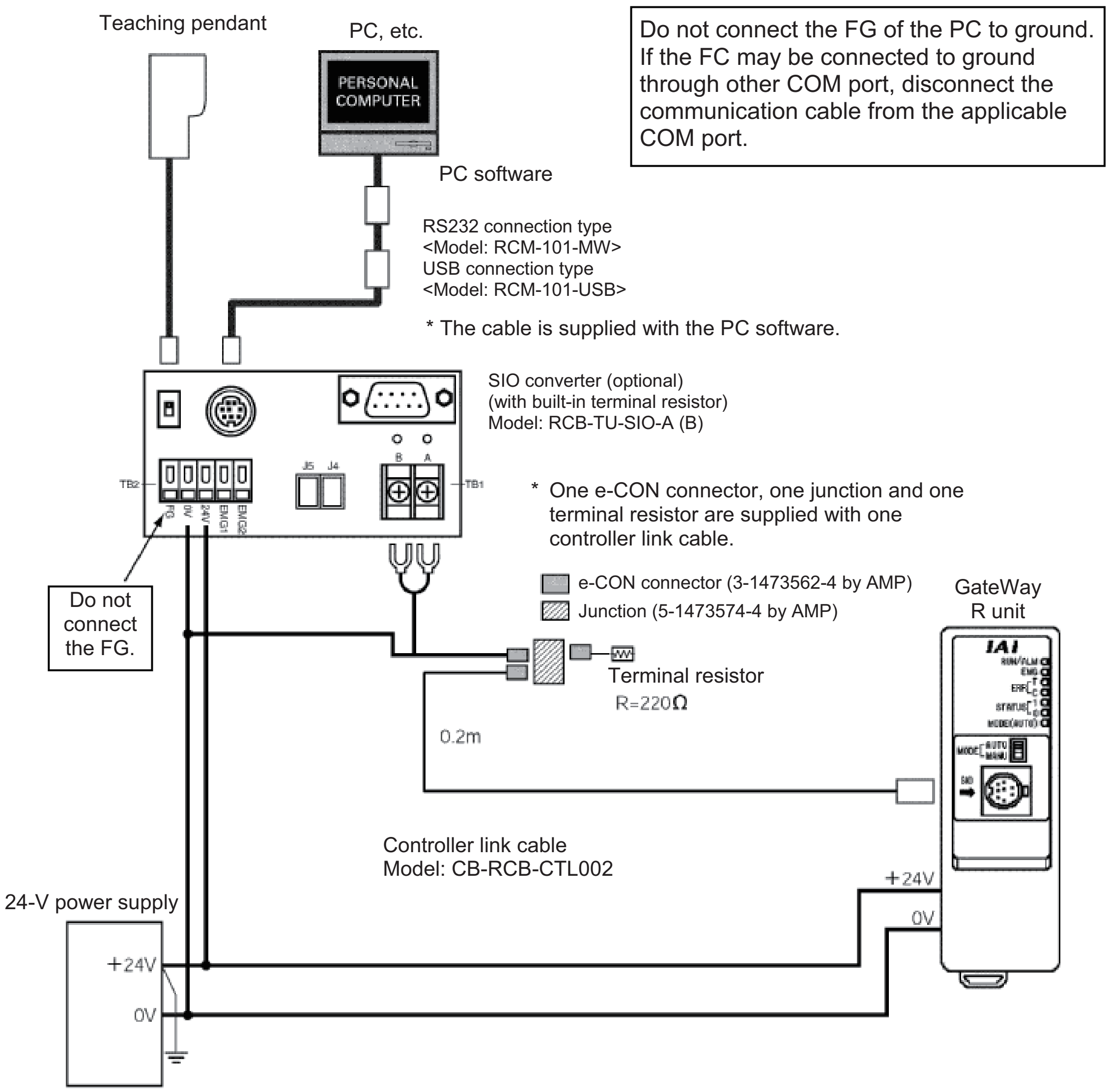
- To obtain a UL certification, use a Class 2 power supply conforming to all applicable U.S. electrical wiring regulations.
- If one Class 2 power supply cannot supply enough current, use two or more Class 2 power supplies. In this case, wire each power supply according to the figure below (example). Also make sure the 0-V terminals of all power supplies are connected with a common line.



IAI	CAUTION

Notes on Connecting PC and Teaching Pendant to ROBONET Whose 24-V Power Supply Is Grounded at Positive Terminal

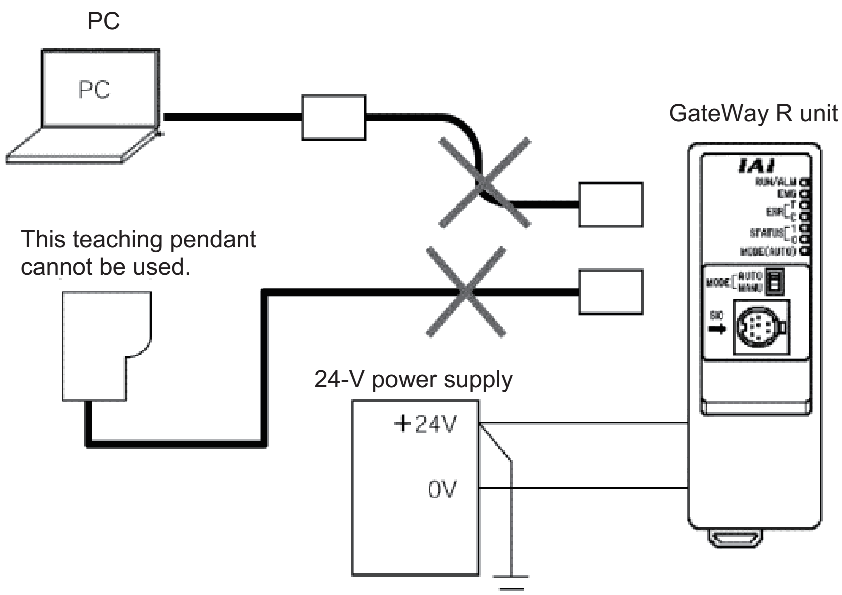
If the positive terminal of the ROBONET’s 24-V power supply is grounded, use a SIO converter as shown below to connect a teaching pendant or PC to the Gateway R unit.
At this time, do not connect the FG of the SIO converter.



CAUTION

If the positive terminal of the ROBONET's 24-V power supply is grounded, a teaching pendant or PC cannot be connected directly to the Gateway R unit.
If a teaching pendant or PC is connected directly to the Gateway R unit, the power supply may be short-circuited, causing the PC or teaching pendant to suffer damage.

<u>Cannot be connected directly.</u>



Introduction

Thank you for purchasing IAI's ROBONET. "ROBONET" is a general term for dedicated single-axis controllers used in a field network environment and characterized by their ultra-compact size, wire-saving features, and easy installation.
This manual provides the information you need to know to use the ROBONET. Before using your ROBONET, peruse this manual and understand its contents fully.

CE Marking

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

Warranty

(1) Warranty Period

One of the following periods, whichever is shorter:
- 18 months after shipment from our factory
- 12 months after delivery to a specified location

(2) Scope of Warranty

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

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

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

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

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

(3) Honoring the Warranty

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

(4) Limited Liability

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

(5) Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.
2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:
   [1] Medical equipment pertaining to maintenance or management of human life or health
   [2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
   [3] Important safety parts of mechanical equipment (such as safety devices)
   [4] Equipment used to handle cultural assets, art or other irreplaceable items
3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or operation manual.

(6) Other Items Excluded from Warranty

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

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

Table of Contents

Safety Guide

This "Safety Guide" is intended to ensure the correct use of this product and prevent dangers and property damage. Be sure to read this section before using your product.

Regulations and Standards Governing Industrial Robots

Safety measures on mechanical devices are generally classified into four categories under the International Industrial Standard ISO/DIS 12100, "Safety of machinery," as follows:

Safety measures
- Inherent safety design
- Protective guards --- Safety fence, etc.
- Additional safety measures --- Emergency stop device, etc.
- Information on use --- Danger sign, warnings, operation manual

Based on this classification, various standards are established in a hierarchical manner under the International Standards ISO/IEC. The safety standards that apply to industrial robots are as follows:

Type C standards (individual safety standards) → ISO10218 (Manipulating industrial robots – Safety)
→ JIS B 8433
(Manipulating industrial robots – Safety)

Also, Japanese laws regulate the safety of industrial robots, as follows:

Industrial Safety and Health Law Article 59
Workers engaged in dangerous or harmful operations must receive special education.

Ordinance on Industrial Safety and Health
Article 36 --- Operations requiring special education
- No. 31 (Teaching, etc.) --- Teaching and other similar work involving industrial robots (exceptions apply)
- No. 32 (Inspection, etc.) --- Inspection, repair, adjustment and similar work involving industrial robots (exceptions apply)

Article 150 --- Measures to be taken by the user of an industrial robot

Requirements for Industrial Robots under Ordinance on Industrial Safety and Health

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

Applicable Modes of IAI's Industrial Robot

Machines meeting the following conditions are not classified as industrial robots according to Notice of Ministry of Labor No. 51 and Notice of Ministry of Labor/Labor Standards Office Director (Ki-Hatsu No. 340):

(1) Single-axis robo with a motor wattage of 80 W or less
(2) Combined multi-axis robot whose X, Y and Z-axes are 300 mm or shorter and whose rotating part, if any, has the maximum movement range of within 300 mm^3 including the end of the rotating part
(3) Multi-joint robot whose movable radius and Z-axis are within 300 mm

Among the products featured in our catalogs, the following models are classified as industrial robots:

1. Single-axis ROBO Cylinders
   RCS2/RCS2CR-SS8☐ whose stroke exceeds 300 mm
2. Single-axis robots
   The following models whose stroke exceeds 300 mm and whose motor capacity also exceeds 80 W:
   ISA/ISPA, ISDA/ISPDA, ISWA/ISPWA, IF, FS, NS
3. Linear servo actuators
   All models whose stroke exceeds 300 mm
4. Cartesian robos
   Any robot that uses at least one axis corresponding to one of the models specified in 1 to 3
5. IX SCARA robots
   All models whose arm length exceeds 300 mm
   (All models excluding IX-NNN1205/1505/1805/2515, NNW2515 and NNC1205/1505/1805/2515)

Notes on Safety of Our Products

Common items you should note when performing each task on any IAI robot are explained below.

No.	Task	Note
1	Model selection	● This product is not planned or designed for uses requiring high degrees of safety. Accordingly, it cannot be used to sustain or support life and must not be used in the following applications: [1] Medical devices relating to maintenance, management, etc., of life or health [2] Mechanisms or mechanical devices (vehicles, railway facilities, aircraft facilities, etc.) intended to move or transport people [3] Important safety parts in mechanical devices (safety devices, etc.) ● Do not use this product in the following environments: [1] Place subject to flammable gases, ignitable objects, flammables, explosives, etc. [2] Place that may be exposed to radiation [3] Place where the ambient temperature or relative humidity exceeds the specified range [4] Place subject to direct sunlight or radiated heat from large heat sources [5] Place subject to sudden temperature shift and condensation [6] Place subject to corrosive gases (sulfuric acid, hydrochloric acid, etc.) [7] Place subject to excessive dust, salt or iron powder [8] Place where the product receives direct vibration or impact ● Do not use this product outside the specified ranges. Doing so may significantly shorten the life of the product or result in product failure or facility stoppage.
2	Transportation	● When transporting the product, exercise due caution not to bump or drop the product. ● Use appropriate means for transportation. ● Do not step on the package. ● Do not place on the package any heavy article that may deform the package. ● When using a crane of 1 ton or more in capacity, make sure the crane operators are qualified to operate cranes and perform slinging work. ● When using a crane, etc., never hoist articles exceeding the rated load of the crane, etc. ● Use hoisting equipment suitable for the article to be hoisted. Calculate the load needed to cut off the hoisting equipment and other loads incidental to equipment operation by considering a safety factor. Also check the hoisting equipment for damage. ● Do not climb onto the article while it is being hoisted. ● Do not keep the article hoisted for an extended period of time. ● Do not stand under the hoisted article.
3	Storage/ preservation	● The storage/preservation environment should conform to the installation environment. Among others, be careful not to cause condensation.
4	Installation/ startup	(1) Installing the robot, controller, etc. ● Be sure to firmly secure and affix the product (including its work part). If the product tips over, drops, malfunctions, etc., damage or injury may result. ● Do not step on the product or place any article on top. The product may tip over or the article may drop, resulting in injury, product damage, loss of/drop in product performance, shorter life, etc. ● If the product is used in any of the following places, provide sufficient shielding measures: [1] Place subject to electrical noise [2] Place subject to a strong electric or magnetic field [3] Place where power lines or drive lines are wired nearby [4] Place subject to splashed water, oil or chemicals

No.	Task	Note
4	Installation/ startup	(2) Wiring the cables ● Use IAI's genuine cables to connect the actuator and controller or connect a teaching tool, etc. ● Do not damage, forcibly bend, pull, loop round an object or pinch the cables or place heavy articles on top. Current leak or poor electrical continuity may occur, resulting in fire, electric shock or malfunction. ● Wire the product correctly after turning off the power. ● When wiring a DC power supply (+24 V), pay attention to the positive and negative polarities. Connecting the wires in wrong polarities may result in fire, product failure or malfunction. ● Be sure to connect the cable connectors without fail and firmly. Failing to do so may result in fire, electric shock or product malfunction. ● Do not cut and reconnect the cables of the product to extend or shorten the cables. Doing so may result in fire or product malfunction.
		(3) Grounding ● Be sure to provide class D (former class 3) grounding for the controller. Grounding is required to prevent electric shock and electrostatic charges, improve noise resistance and suppress unnecessary electromagnetic radiation.
		(4) Safety measures ● Implement safety measures (such as installing safety fences, etc.) to prevent entry into the movement range of the robot when the product is moving or can be moved. Contacting the moving robot may result in death or serious injury. ● Be sure to provide an emergency stop circuit so that the product can be stopped immediately in case of emergency during operation. ● Implement safety measures so that the product cannot be started only by turning on the power. If the product starts suddenly, injury or product damage may result. ● Implement safety measures so that the product will not start upon cancellation of an emergency stop or recovery of power following a power outage. Failure to do so may result in injury, equipment damage, etc. ● Put up a sign saying "WORK IN PROGRESS. DO NOT TURN ON POWER," etc., during installation, adjustment, etc. If the power is accidently turned on, electric shock or injury may result. ● Implement measures to prevent the work part, etc., from dropping due to a power outage or emergency stop. ● Ensure safety by wearing protective gloves, protective goggles and/or safety shoes, as necessary. ● Do not insert fingers and objects into openings in the product. Doing so may result in injury, electric shock, product damage, fire, etc. ● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc.
5	Teaching	● Whenever possible, perform teaching from outside the safety fences. If teaching must be performed inside the safety fences, prepare "work rules" and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying "WORK IN PROGRESS" in a conspicuous location.

No.	Task	Note
		● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc. * Safety fences --- Indicate the movement range if safety fences are not provided.
6	Confirmation operation	● After teaching or programming, carry out step-by-step confirmation operation before switching to automatic operation. ● When carrying out confirmation operation inside the safety fences, follow the specified work procedure just like during teaching. ● When confirming the program operation, use the safety speed. Failure to do so may result in an unexpected movement due to programming errors, etc., causing injury. ● Do not touch the terminal blocks and various setting switches while the power is supplied. Touching these parts may result in electric shock or malfunction.
7	Automatic operation	● Before commencing automatic operation, make sure no one is inside the safety fences. ● Before commencing automatic operation, make sure all related peripherals are ready to operate in the auto mode and no abnormalities are displayed or indicated. ● Be sure to start automatic operation from outside the safety fences. ● If the product generated abnormal heat, smoke, odor or noise, stop the product immediately and turn off the power switch. Failure to do so may result in fire or product damage. ● If a power outage occurred, turn off the power switch. Otherwise, the product may move suddenly when the power is restored, resulting in injury or product damage.
8	Maintenance/ inspection	● Whenever possible, work from outside the safety fences. If work must be performed inside the safety fences, prepare “work rules” and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, turn off the power switch, as a rule. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying “WORK IN PROGRESS” in a conspicuous location. ● Use appropriate grease for the guides and ball screws by checking the operation manual for each model. ● Do not perform a withstand voltage test. Conducting this test may result in product damage. ● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc. * Safety fences --- Indicate the movement range if safety fences are not provided.
9	Modification	● The customer must not modify or disassemble/assemble the product or use maintenance parts not specified in the manual without first consulting IAI. ● Any damage or loss resulting from the above actions will be excluded from the scope of warranty.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When disposing of the product, do not throw it into fire. The product may explode or generate toxic gases.

Indication of Cautionary Information

The operation manual for each model denotes safety precautions under “Danger,” “Warning,” “Caution” and “Note,” as specified below.

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

Part 1 Specification
Chapter 1 Overview of ROBONET

1.1 Overview

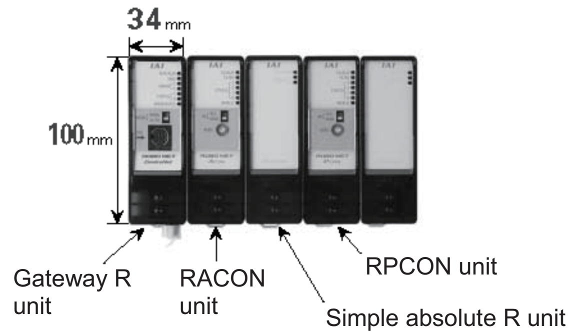
"ROBONET" is a general term for dedicated controllers used to operate ROBO Cylinders (RCA/RCA2/RCL/RCP2/RCP3) over a field network connected to a host programmable controller (hereinafter referred to as "PLC").
A ROBONET system can be configured with a desired combination of a Gateway R unit, which serves as a field network connection interface, and one or more RACON units (RCA/RCA2/RCL controller) and RPCON unit (RCP2/RCP3 controller).
Up to 16 axes can be controlled in one ROBONET system.
You can also configure an absolute system by connecting a simple absolute R unit to the controller of each axis.
The Gateway R unit is available in four types: DeviceNet type, CC-Link type, Profibus type, and RS485 SIO type.
The ROBONET is treated as a slave station in a field network.
RS485 SIO communication is implemented according to the Modbus-RTU protocol.
The ROBONET extension unit can be used to implement a ROBONET system of multi-stage layout and connect non-ROBONET controllers (SCON, PCON-CF, ERC2) (via external SIO link).

1.2 Features

(1) Five Types of Component Units

The five types of units specified below can be combined in a desired fashion to build a ROBONET system. The maximum number of component axes is 16.

[1] Gateway R unit
Four types—DeviceNet type, CC-Link type, Profibus type, and RS485 SIO communication type—are available.
[2] RACON unit --- RCA/RCA2/RX=CL controller
[3] RPCON unit --- RCP2/RCP3 controller
[4] Simple absolute R unit
[5] ROBONET extension unit

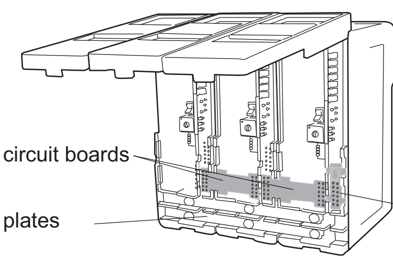


(2) Ultra-compact Size

Each unit has an ultra-compact design with external dimensions of 34 mm in width, 100 mm in height, and 73 mm in depth. Accordingly, you can reduce the control panel size for your ROBONET system.

(3) Wire-saving

Units are interconnected by dedicated power-supply connection plates and communication connection circuit boards, which substantially reduces the hassle of wiring.



(Interconnections of ROBONET units)

(4) Easy Installation

All units are installed on a DIN rail (35 mm), so installation to a control panel or equipment is easy.
Units can also be installed side by side with other components.

(5) Simple Absolute System

The axis-drive unit is either a RPCON unit for 24-V pulse motor actuators or RACON unit for 24-V servo motor actuators. Although both use an incremental encoder, they can be used as an absolute axis when a simple absolute R unit is connected.

(6) Four Types of Gateway R units

To support various field networks, the Gateway R unit (gateway function) is available in the following four types, each supporting a different field network.

- DeviceNet type
- CC-Link type
- Profibus type
- RS485 SIO communication type

(7) Six ROBONET operation modes

The ROBONET can operate ROBO Cylinders in one of the following four modes under the control of the Gateway R unit, regardless of the type of the host fieldbus.
The following three modes from [1] to [3] can be combined together. You can also combine the remaining three modes from [4] to [6].
However, [1] and [4] cannot be combined, and modes in the group of [1] to [3] cannot be combined with modes in the group of [4] to [6].

[1] Positioner mode (Number of positions: 768 points)
In this mode, the actuator is operated by specifying a position number. The position data, speed, acceleration/deceleration and other data are input in the position table beforehand. Up to 768 points can be registered as positions for each axis.
The various status signals of the controller unit can be monitored, and so can the current actuator position, but the alarm codes, speed and electrical current cannot be monitored. If an alarm occurs, however, a corresponding simple alarm code will be output to the completed position number area, so you can monitor simple alarm codes in this area.

[2] Simple direct mode (Number of positions: 768 points)
In this mode, the actuator is operated by specifying only the position data directly as a numerical value, and specifying all other data including the speed, acceleration/deceleration, positioning band and push-current limiting value using a position number. Up to 768 points can be registered as positions.
The various status signals of the controller unit can be monitored, and so can the current actuator position, but the alarm codes, speed and electrical current cannot be monitored. If an alarm occurs, however, a corresponding simple alarm code will be output to the completed position number area, so you can monitor simple alarm codes in this area.

[3] Direct numerical specification mode
In this mode, the actuator is operated by specifying the position data, speed, acceleration/deceleration, positioning band and push-current limiting value directly as numerical values. The various status signals of the controller unit, current actuator position, alarm codes and speed/electrical current can be monitored at all times.

[4] Positioner 2 mode (Number of positions: 768 points)
This mode is the same as the positioner 1 mode.
It cannot be combined with the positioner 1 mode, simple direct mode or direct numerical specification mode.
The positioner 2 mode can only be used alone. The positioner 2 mode can be combined with solenoid valve mode 1 or solenoid valve mode 2. This mode is supported by gateway units of firmware version 000B and later.

[5] Solenoid valve mode 1 (Number of positions: 7)
In this mode, the number of positioning points is limited to 7 to simplify operations.
Actuators can be operated simply by issuing a command with a target position number (no start signal is required).
Accordingly, PLC ladder sequence circuits can be created with ease.

[6] Solenoid valve mode 2 (Number of positions: 3)
Operations are also simplified in this mode, as with solenoid valve mode 1. You can operate actuators using the same control methods you normally use on solenoid valves.

In the positioner mode or simple direct mode, position table data can be read, written or otherwise manipulated using dedicated commands.
Even in the AUTO mode, the various information of each axis (alarm codes, speed, electrical current, etc.) can be monitored on the touch panel display (RCM-PM-01) connected to the TP connector.

List of ROBONET Operation Functions

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(Position table)</td><td colspan="2">X
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<tr><td colspan="2">Inching operation</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">X</td></tr>
<tr><td colspan="2">Various status signal monitor *1</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">X</td></tr>
<tr><td colspan="2">Current position monitor *1</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">X</td></tr>
<tr><td colspan="2">Alarm code monitor *1</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">X</td></tr>
<tr><td colspan="2">Speed/electrical current monitor *1</td><td>X</td><td>X</td><td>○</td><td>X</td><td colspan="2">X</td></tr>
<tr><td colspan="2">Axis monitor function in AUTO mode *2</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td rowspan="4">Command</td><td>Handshake</td><td>○</td><td>○</td><td>X</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Position table data read/write</td><td>○</td><td>○</td><td>X</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Current position read</td><td>X</td><td>X</td><td>X</td><td>X</td><td colspan="2">X</td></tr>
<tr><td>Broadcast</td><td>○</td><td>X</td><td>X</td><td>○</td><td colspan="2">○</td></tr>
<tr><td colspan="2">Maximum specifiable position data value</td><td>9999.99 mm
(When a command is used)</td><td>9999.99 mm</td><td>9999.99 mm</td><td>9999.99 mm
(When a command is used)</td><td colspan="2">9999.99 mm
(When a command is used)</td></tr>
<tr><td colspan="2">Number of connectable axes</td><td>16</td><td>16</td><td>8</td><td>16</td><td colspan="2">16</td></tr>
</table>

*1 Various status signals, current position, alarm codes and speed/electrical current can be monitored by accessing each address of the gateway unit from the PLC.
*2 Before, axis monitor was not possible in the AUTO mode. This has become possible with the ROBONET, even when the MODE switch is set to AUTO, by connecting a dedicated touch panel to the TP connector.
*3 Separate values cannot be set for acceleration and deceleration. The acceleration and deceleration are always the same.

(8) Easy Setting Using the ROBONET Gateway Parameter Setting Tool

With this tool, you can set the station number, baud rate, and operation mode of each axis, and also check the occupied areas.
Also, reserved axes can be set in consideration of expansion of axis configuration in the future.

[1] Station number setting ------------------------- Set the station number (node address) in the field network.
[2] Baud rate setting -------------------------------- Set the baud rate over the field network. The setting must be the same as the baud rate set on the master side.
[3] Operation mode setting for each axis
[4] Setting of reserved axes
[5] Checking of occupied area information --- The ROBONET-occupied area information set on the master side can be checked.
[6] Operation of parameter files

Setting of the positioner 2 mode, setting of reserved axes and operation of parameter files are supported when the version of the parameter setting tool is 1.0.3.0 or later and the firmware version of the Gateway R unit is 000B or later.
Correspondences with gateway firmware versions are shown below. (O: Supported, X: Not supported)
Solenoid valve mode 1, solenoid valve mode 2 and special parameter setting functions are supported by parameter setting tools of version 1.0.4.0 and later and Gateway R units of firmware version 000F and later.

(9) Multi-stage layout

The extension unit can be used to implement a ROBONET system of multi-stage layout.

(10) External SIO link

The extension unit can be used to connect non-ROBONET controllers (SCON, PCON-CF, ERC2).

Chapter 2 System Configuration and General Specifications

2.1 System Configuration

A ROBONET system is comprised of one Gateway R unit and up to 16 axes of controller units. The Gateway R unit is available in four types—DeviceNet specification, CC-Link specification, Profibus specification, and RS485 SIO specification—to support various field networks.
The controller unit may be a RPCON unit for 24-V pulse motor actuators or RACON unit for 24-V servo motor actuators.
When a simple absolute R unit is connected to the controller unit, the controller can be used as an absolute axis.
Also, the ROBONET extension unit can be used to implement a ROBONET system of multiple-row layout (multi-stage layout) and connect non-ROBONET controller units (SCON, PCON-CF, ERC2) to a ROBONET system (via external SIO link).
A ROBONET system configuration is shown on the next page.

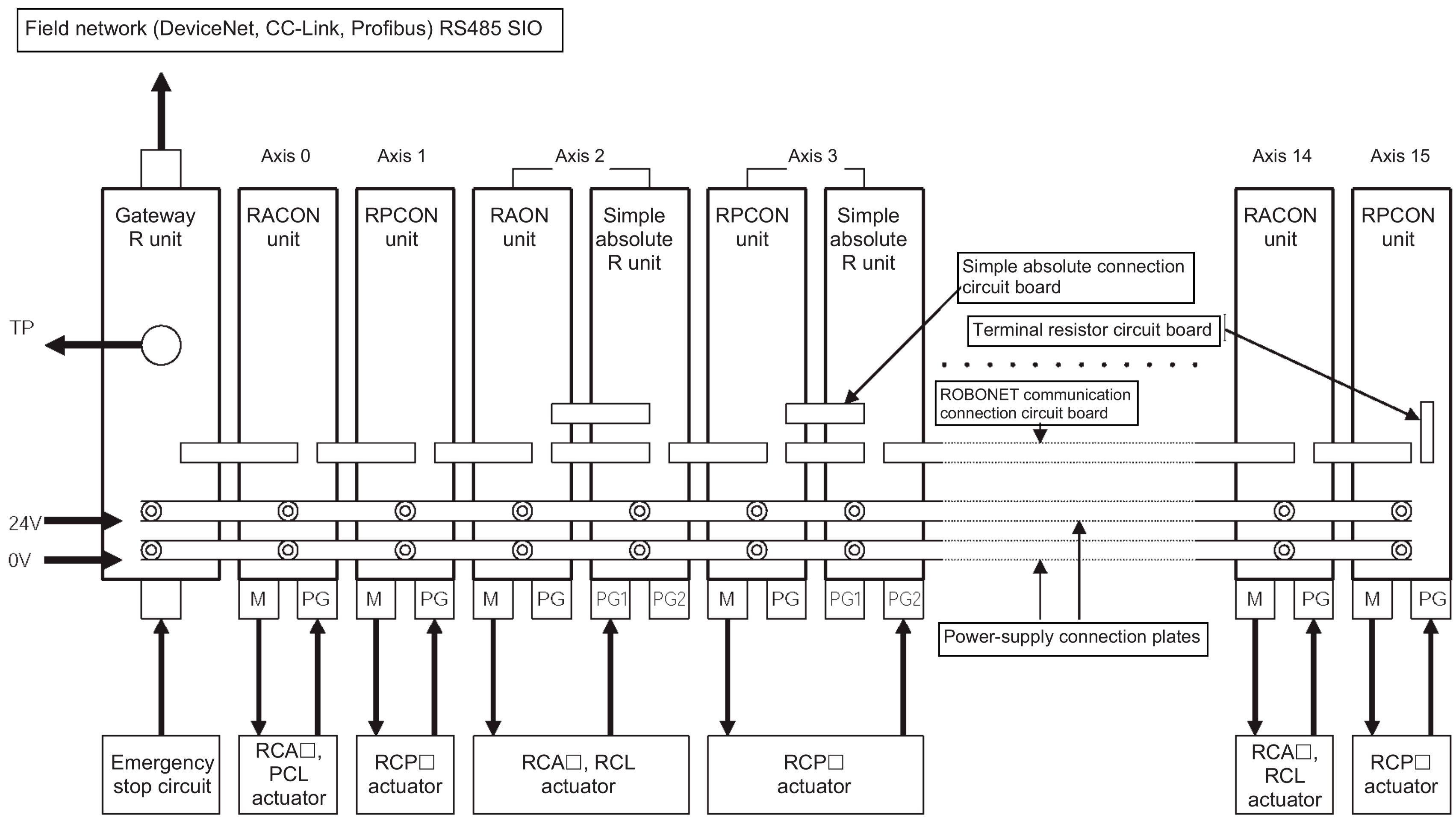
2.2 List of Component Units

The units comprising a ROBONET system are listed below.

Product name		Model
Gateway R unit	DeviceNet specification	RGW-DV
	CC-Link specification	RGW-CC
	Profibus specification	RGW-PR
	RS485SIO specification	RGW-SIO
Controller unit	RACON (for RCA☐,RCL actuators)	RACON-10I/20S/30 *
	RPCON (for RCP☐ actuators)	RACON-20P/28P/28SP/42P/56P *
Simple absolute R unit	Common to the RACON and RPCON	RABU
ROBONET extension	(Optional)	REXT

* If a simple absolute R unit is connected, "-ABU" is appended at the end of the model name.

ROBONET Configuration (1) (Basic)



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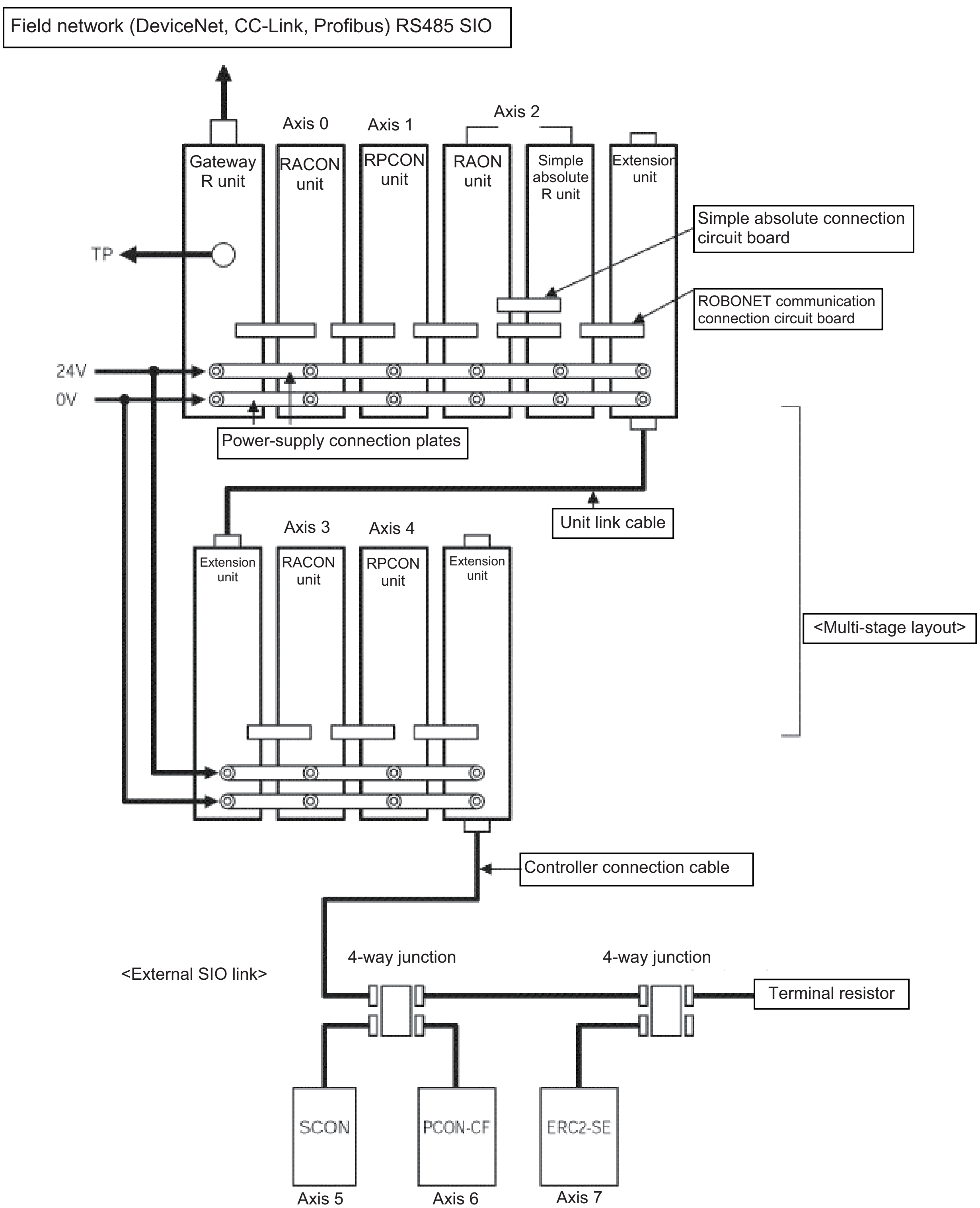
ROBONET Configuration (2) (Multi-stage layout and external SIO link)



2.3 General Specifications

The general specifications of a ROBONET system are listed below.

Item	Specification
Power-supply voltage	24 VDC ± 10 %
Power-supply current	Varies depending on the system configuration.
Maximum number of connectable axes	16 axes (Controller units can be combined freely.)
Supported field networks	CC-Link, DeviceNet, Profibus, RS485 SIO (slave station)
ROBONET communication protocol	Modbus protocol
Component units	Gateway R unit, controller unit, simple absolute R unit ROBONET extension (Refer to 2.2 for details.)
Emergency stop/enable operation	The entire system is stopped by the emergency stop input from the Gateway R unit. Each controller unit has a built-in drive-source cutoff relay.
Ambient operating temperature	0 to 40°C
Ambient operating humidity	95% RH max. (non-condensing)
Protection degree	IP20
External dimensions of each unit	34 W x 105 H x 73.3 D [mm] All units have the same dimensions.
Interconnection of units	Power-supply connection plate Unit link cable or controller connection cable when the ROBONET communication connection circuit board, simple absolute connection circuit board or ROBONET extension unit is used (multi-stage layout or external SIO link)
Installation method	Installation on a DIN rail (35 mm) (However, controllers corresponding to external SIO link axes are excluded.)

2.4 24-V Power Current Consumption of Each Unit

	Current consumption				
Gateway R unit	600 mA max. (Common to all four types)				
RACON unit	Actuator	Standard specification, high acceleration/deceleration type		Energy-saving type	
		Rating	Max. *1	Rating	Max. *1
	SA3 (10)	1.3 A	4.0 A	1.3 A	2.2 A
	SA4•SA5•RA4 (20)	1.3 A	4.4 A	1.3 A	2.5 A
	SA6•RA4 (30)	1.3 A	4.0 A	1.3 A	2.2 A
	RA3 (20S)	1.7 A	5.1 A	1.7 A	3.4 A
RPCON unit	Actuator	Rating		Max. *2	
	20P, 28P, 28SP motors	0.4 A		2.0 A	
	42P, 56P motors	1.2 A		2.0 A	
Simple absolute R unit	300 mA max.				
ROBONET extension	100 mA max.				

*1 The current becomes the maximum during the excited-phase detection of the servo motor performed when the servo is turned on for the first time following the power on. (Normal: Approx. 1 to 2 seconds, Maximum: 10 seconds)

*2 The current becomes the maximum during the excited-phase detection performed when the servo is turned on for the first time following the power on. (Normal: 100 msec)

<Selection of Power-supply Capacity>
The method to select an appropriate 24-VDC power supply to be used with your ROBONET system is explained below.

(1) Current consumption of controller units when the respective axes operate simultaneously

Rated RACON current x Number of RACON controllers operating simultaneously (≥ 1) + Rated RPCON current x Number of RPCON controllers operating simultaneously (≥ 1) --- [1]

(2) Current consumption of other units

= 0.6 A x Number of Gateway R units + 0.3 A x Number of simple absolute R units + 0.1 A x Number of extension units --- [2]

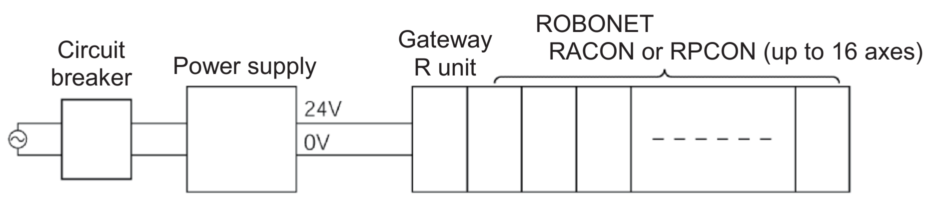
The current consumption is calculated by [1] + [2] in a steady state.

(3) Current consumption during excited-phase detection

Maximum RACON current x Number of RACON controllers performing excited-phase detection simultaneously (≥ 1) + Maximum RPCON current x Number of RPCON controllers performing excited-phase detection simultaneously (≥ 1) --- [3]

Normally a power supply whose rated current is equivalent to ([1] + [2]) x 1.3 or more is selected by considering 20 to 30% of allowance in addition to the above current consumption of [1] + [2].
However, make sure you select a power supply of “peak load accommodation” specification or having a sufficient allowance because the current of [3] will flow for a brief moment. In particular, exercise caution when the remote sensing function is provided.

<Reference>



(1) It is recommended that the ROBONET power be turned on/off on the AC power supply side (primary side of the 24-V power supply). If the ROBONET power is turned on/off on the output side of the 24-V power supply, the large current will flow for a brief moment when the power is turned on, as explained in (2).

Turning on the power on the AC power supply side causes a rush current (*1) to flow where the size of this rush current is determined by the 24-V power supply used. Accordingly, select a circuit breaker that will not trip when this rush current flows.

(Example) If the PS241 is used as the 24-V power supply, a rush current of approx. 50 to 60 A will flow through the power supply for approx. 3 ms. (Measured value)

*1 The specific value varies depending on the model of the 24-V power supply and impedance of the power-supply line.

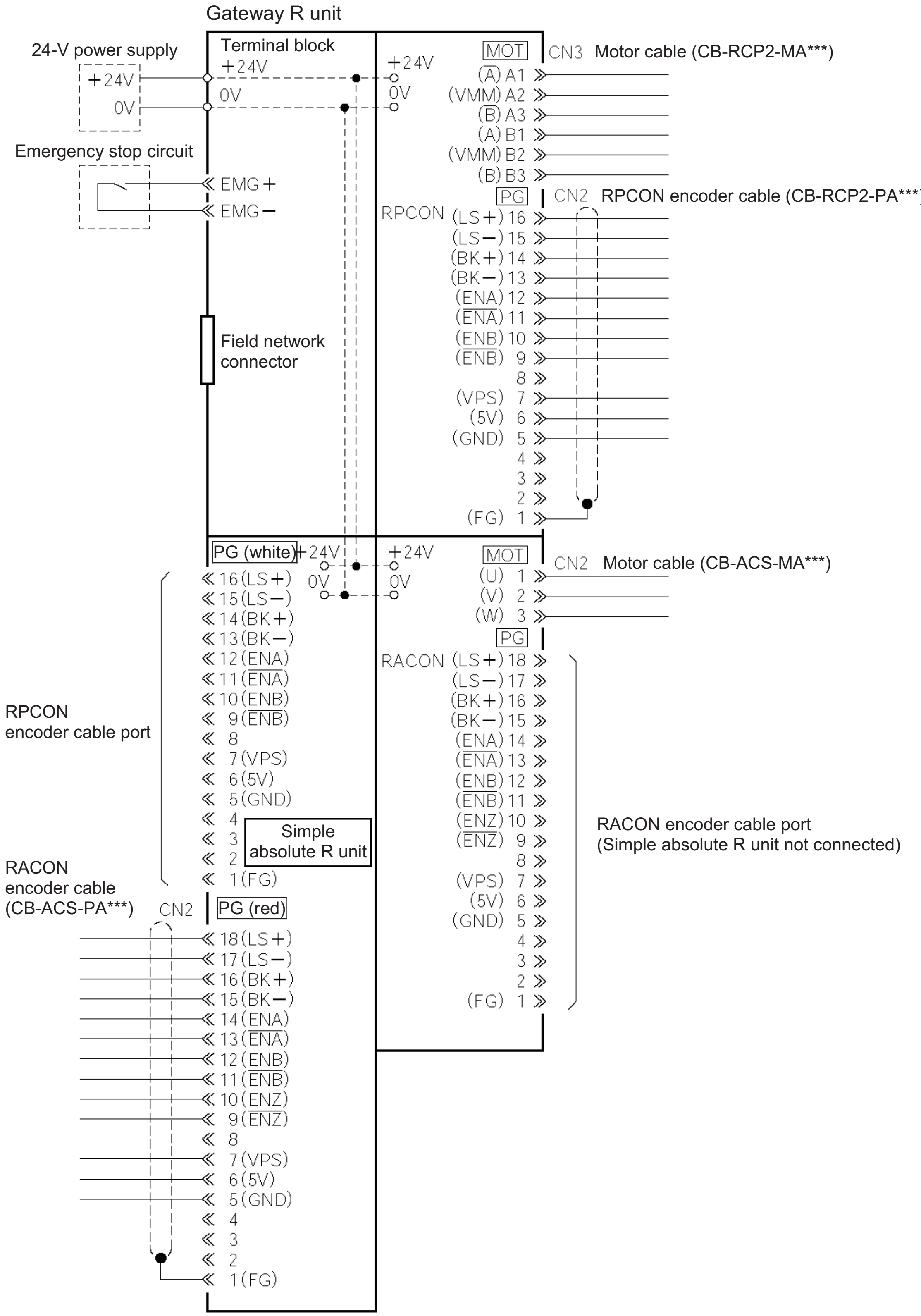
(2) The table below lists the measured ROBONET rush currents (*2) that generate when the ROBONET power is turned on/off on the DC side (secondary side of the 24-V power supply). (These values assume parallel connection of three PS241s as 24-V power supplies.)

Number of axes	1 to 3 axes	4 to 8 axes	9 to 12 axes	13 to 16 axes
ROBONET rush current	Approx. 50 to 60 A, 0.2 ms	Approx. 100 to 120 A, 0.2 to 0.5 ms	Approx. 12 to 130 A, 0.6 to 0.8 ms	Approx. 130 A 1.0 to 1.5 ms

*2 The specific ROBONET rush current varies depending on the model of the 24-V power supply and impedance of the power-supply line. The values in the above table are reference values only and not guaranteed.

2.5 Connection Diagram

Shown below is a connection diagram of a ROBONET system comprising of a RPCON and a RACON connected to a simple absolute R unit.



Chapter 3 Gateway R unit

3.1 Overview

The Gateway R unit is a slave station with gateway function for connecting ROBO Cylinders to a field network of a host PLC and operating the connected ROBO Cylinders.
The Gateway R unit is available in four types to support field networks of CC-Link, DeviceNet, Profibus and RS485 SIO communication types.
A total of up to 16 axes can be connected by combining dedicated ROBONET controller units (RACON/RPCON) and non-ROBONET controller units (SCON, PCON-CF, ERC2), and each axis can be monitored in the AUTO mode (only when the touch panel display RCM-PM-01 is connected).

3.2 How to Read the Model Name

RGW-CC

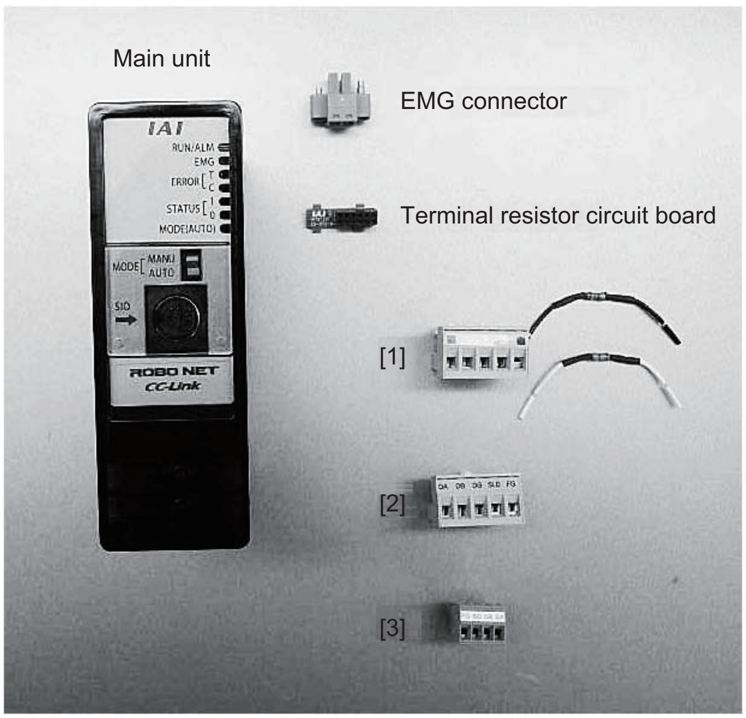
Base model: Dedicated Gateway R unit for ROBONET

Supported field network:

CC : CC-Link
DV : DeviceNet
PR : ProfiBus
SIO : RS485SIO

3.3 Gateway R unit and Accessories

The four types of units each come with a different set of accessories appropriate for the applicable field network.



Common accessories

Dedicated accessories for CC-Link type
Communication connector, terminal resistors

Dedicated accessory for DeviceNet type
Communication connector

Dedicated accessory for RS485 SIO communication type
Communication connector

CC-Link	DeviceNet	RS485 SIO communication	Profibus
Fig. [1]	Fig. [2]	Fig. [3]	-
EMG connector MC1.5/2-STF-3.81 (by Phoenix Contact)			
Terminal resistor circuit board (model TN-1)			
• CC-Link communication connector MSTB2.5/5-ST-5.08ABGYAU (by Phoenix Contact)	• DeviceNet communication connector MSTB2.5/5-ST-5.08ABGYAU (by Phoenix Contact)	• RS485 SIO communication connector MC1.5/4-ST-3.5 (by Phoenix Contact)	None
• Terminal resistors 110 Ω, 130 Ω (1/2 W)	None	None	None

3.4 General Specifications

3.4.1 CC-Link

This product is a maximum 4-station remote device station supporting CC-Link Version 2.00. (Its specifications vary depending on the extended cyclic setting.)
This product supports the following functions of CC-Link Version 2.00:

- Extended cyclic transmission
- Relaxed limitation on station link cable length

CC-Link Version 1.10 is also supported as long as the extended cyclic transmission setting of x1 (four stations occupied) can be used.

<table>
<tr><th colspan="2">Item</th><th colspan="6">Specification</th></tr>
<tr><td colspan="2">Power supply</td><td colspan="6">24 VDC ± 10%</td></tr>
<tr><td colspan="2">Current consumption</td><td colspan="6">600 mA max.</td></tr>
<tr><td rowspan="12">CC-Link specification</td><td>Communication protocol</td><td colspan="6">CC-Link Version 2.00 (Version 1.10)</td></tr>
<tr><td>Baud rate</td><td colspan="6">10M/5M/2.5M/625k/156k [bps] (Set by a ROBONET gateway parameter)</td></tr>
<tr><td>Communication method</td><td colspan="6">Broadcast polling method</td></tr>
<tr><td>Synchronization method</td><td colspan="6">Frame synchronization method</td></tr>
<tr><td>Encoding method</td><td colspan="6">NRZI</td></tr>
<tr><td>Transmission path type</td><td colspan="6">Bus type (Conforming to EIA RS485)</td></tr>
<tr><td>Transmission format</td><td colspan="6">Conforming to HDLC</td></tr>
<tr><td>Error control method</td><td colspan="6">CRC ($X^{16} + X^{12} + X^5 + 1$)</td></tr>
<tr><td>Number of occupiable stations</td><td colspan="6">Remote device stations: four x1 stations, two x4 stations or two x8 stations</td></tr>
<tr><td rowspan="2">Communication cable length (*1)</td><td>Baud rate (bps)</td><td>10M</td><td>5M</td><td>2.5M</td><td>625k</td><td>156k</td></tr>
<tr><td>Total cable length (m)</td><td>100</td><td>160</td><td>400</td><td>900</td><td>1200</td></tr>
<tr><td>Communication cable</td><td colspan="6">Dedicated CC-Link cable</td></tr>
<tr><td rowspan="8">SIO communication specification</td><td>Transmission path configuration</td><td colspan="6">IAI's dedicated multi-drop differential communication</td></tr>
<tr><td>Communication method</td><td colspan="6">Half-duplex</td></tr>
<tr><td>Synchronization method</td><td colspan="6">Asynchronous method</td></tr>
<tr><td>Transmission path type</td><td colspan="6">2-wire method corresponding to EIA RS485</td></tr>
<tr><td>Baud rate</td><td colspan="6">230.4k [bps]</td></tr>
<tr><td>Error control method</td><td colspan="6">CRC with no parity bit (*2)</td></tr>
<tr><td>Communication cable</td><td colspan="6">ROBONET communication connection circuit board (supplied), ROBONET extension cable (when an extension unit is used)</td></tr>
<tr><td>Number of connectable units</td><td colspan="6">16 axes max.</td></tr>
<tr><td rowspan="7">Environment conditions</td><td>Ambient operating temperature</td><td colspan="6">0 to 40°C</td></tr>
<tr><td>Ambient operating humidity</td><td colspan="6">95% RH max. (non-condensing)</td></tr>
<tr><td>Operating ambience</td><td colspan="6">Free from corrosive gases, flammable gases, oil mist or powder dust.</td></tr>
<tr><td>Storage temperature</td><td colspan="6">-25 to 70°C</td></tr>
<tr><td>Storage humidity</td><td colspan="6">95% RH max. (non-condensing)</td></tr>
<tr><td>Vibration resistance</td><td colspan="6">XYZ directions:
10 to 57 Hz, half amplitude – 0.035 mm (continuous) / 0.075 mm (intermittent)
57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)</td></tr>
<tr><td>Impact resistance</td><td colspan="6">XYZ directions: 147 mm/s^2, 11 ms, half-sine wave pulse</td></tr>
<tr><td colspan="2">Protection degree</td><td colspan="6">IP20</td></tr>
<tr><td colspan="2">Weight</td><td colspan="6">Approx. 140 g</td></tr>
<tr><td colspan="2">External dimensions</td><td colspan="6">34 W x 105 H x 73.3 D [mm]</td></tr>
</table>

*1: For T-branching communication, refer to the operation manuals of the master unit and the PLC installed in the master unit.
*2: CRC: Cyclic Redundancy Check
A data error detection method frequently used for synchronous transmission.

3.4.2 DeviceNet

	Item	Specification			
Power supply		24 VDC ± 10%			
Current consumption		600 mA max. (*1)			
DeviceNet specification	Communication protocol	An interface module certified under DeviceNet 2.0 is used.			
		Group 2 only server			
		Network-powered isolated node			
	Communication specification	Master-slave connection		Bit strobe	
				Polling	
				Cyclic	
	Baud rate	500k/250k/125k [bps] (Set by a ROBONET gateway parameter)			
	Communication cable length (*1)	Baud rate	Maximum network length	Maximum branch length	Total branch length
		500 kbps	100 m	6 m	39 m
		250 kbps	250 m		78 m
		125 kbps	500 m		156 m
		Note) When a thick DeviceNet cable is used.			
	Number of occupiable nodes	1 node			
	Communication power supply	Voltage: 24 VDC (Supplied from DeviceNet) Current consumption: 60 mA			
SIO communication specification	Transmission path configuration	IAI's dedicated multi-drop differential communication			
	Communication method	Half-duplex			
	Synchronization method	Asynchronous method			
	Transmission path type	2-wire method corresponding to EIA RS485			
	Baud rate	230.4k [bps]			
	Error control method	CRC with no parity bit (*2)			
	Communication cable	ROBONET communication connection circuit board (supplied), ROBONET extension cable (when an extension unit is used)			
	Number of connectable units	16 axes max.			
Environment conditions	Ambient operating temperature	0 to 40°C			
	Ambient operating humidity	95% RH max. (non-condensing)			
	Operating ambience	Free from corrosive gases, flammable gases, oil mist or powder dust.			
	Storage temperature	-25 to 70°C			
	Storage humidity	95% RH max. (non-condensing)			
	Vibration resistance	XYZ directions: 10 to 57 Hz, half amplitude – 0.035 mm (continuous) / 0.075 mm (intermittent) 57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)			
	Impact resistance	XYZ directions: 147 mm/s^2, 11 ms, half-sine wave pulse			
Protection degree		IP20			
Weight		Approx. 140 g			
External dimensions		34 W x 105 H x 73.3 D [mm]			

*1: For T-branching communication, refer to the operation manuals of the master unit and the PLC installed in the master unit.
*2: CRC: Cyclic Redundancy Check
A data error detection method frequently used for synchronous transmission.

3.4.3 Profibus

Item		Specification	
Power supply		24 VDC ± 10%	
Current consumption		600 mA max. (*1)	
Profibus specification	Communication protocol	Group 2 only server	
		Network-powered isolated node	
	Communication specification	Master-slave connection	Bit strobe
			Polling
			Cyclic
	Baud rate	9.6 kbps to 12 Mbps	
	Communication cable length (*1)	9.6 kbps	1500 m
		500 kbps	400 m
		1.5 Mbps	200 m
		3 Mbps	200 m
		12 Mbps	100 m
SIO communication specification	Transmission path configuration	IAI's dedicated multi-drop differential communication	
	Communication method	Half-duplex	
	Synchronization method	Asynchronous method	
	Transmission path type	2-wire method corresponding to EIA RS485	
	Baud rate	230.4k [bps]	
	Error control method	CRC with no parity bit (*2)	
	Communication cable	ROBONET communication connection circuit board (supplied), ROBONET extension cable (when an extension unit is used)	
	Number of connectable units	16 axes max.	
Environment conditions	Ambient operating temperature	0 to 40°C	
	Ambient operating humidity	95% RH max. (non-condensing)	
	Operating ambience	Free from corrosive gases, flammable gases, oil mist or powder dust.	
	Storage temperature	-25 to 70°C	
	Storage humidity	95% RH max. (non-condensing)	
	Vibration resistance	XYZ directions: 10 to 57 Hz, half amplitude – 0.035 mm (continuous) / 0.075 mm (intermittent) 57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)	
	Impact resistance	XYZ directions: 147 mm/s^2, 11 ms, half-sine wave pulse	
Protection degree		IP20	
Weight		Approx. 140 g	
External dimensions		34 W x 105 H x 73.3 D [mm]	

*1: For T-branching communication, refer to the operation manuals of the master unit and the PLC installed in the master unit.
*2: CRC: Cyclic Redundancy Check
A data error detection method frequently used for synchronous transmission.

3.4.4 RS485 SIO

Two modes are available: the Modbus gateway mode in which the unit operates as a Modbus/RTU slave station, and the SIO through mode in which the unit operates by means of serial communication per the Modbus/RTU and ASCII protocols.

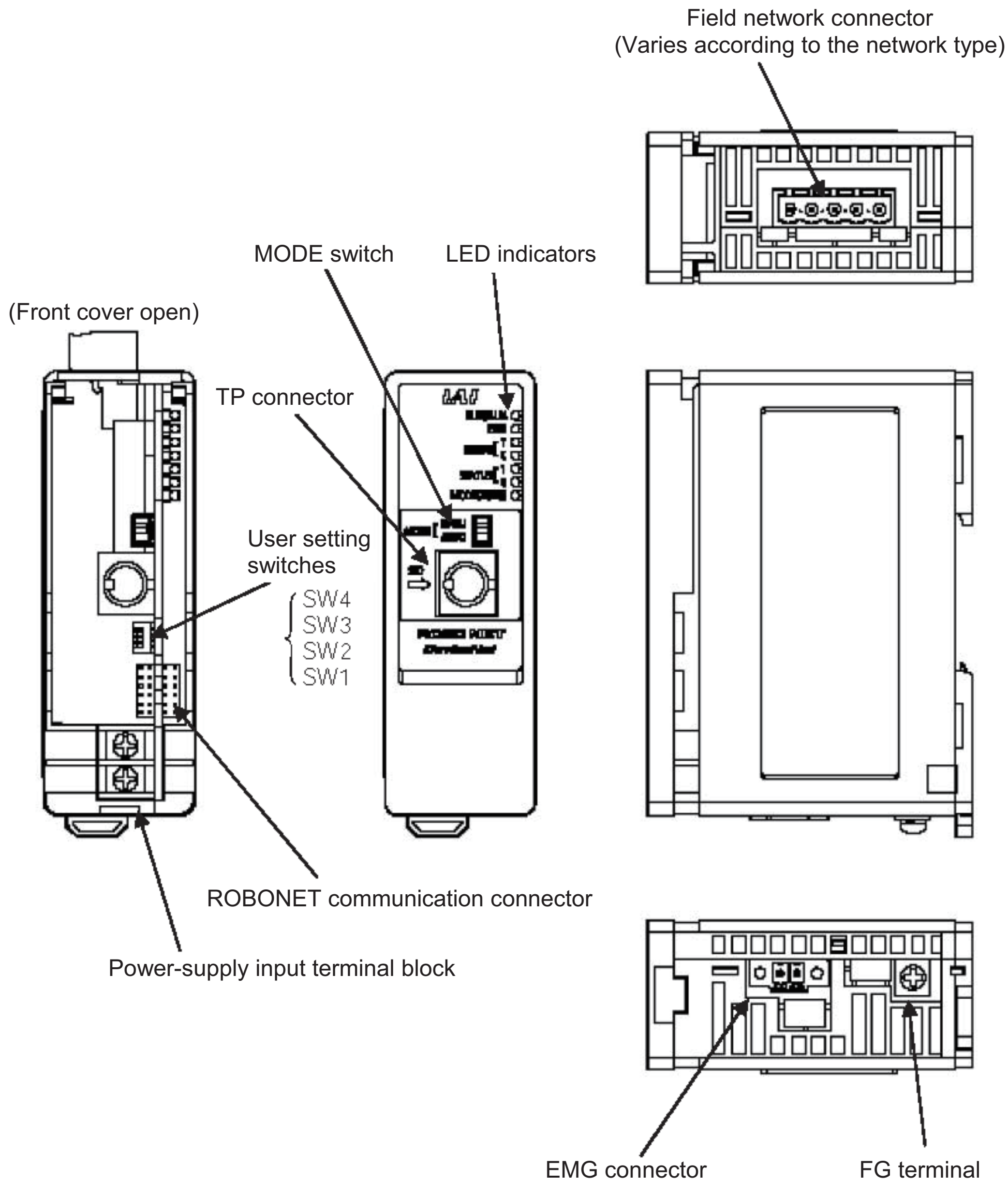
<table>
<tr><th colspan="2" rowspan="2">Item</th><th colspan="10">Specification</th></tr>
<tr><th colspan="6">Modbus gateway mode</th><th colspan="4">SIO through mode</th></tr>
<tr><td colspan="2">Power supply</td><td colspan="10">24 VDC ± 10%</td></tr>
<tr><td colspan="2">Current consumption</td><td colspan="10">600 mA max.</td></tr>
<tr><td rowspan="15">Host RS485 specifications</td><td>Communication format</td><td colspan="6">1:1 communication connection conforming to RS485</td><td colspan="4">1:N (1≤ N ≤ 16) communication connection conforming to RS485</td></tr>
<tr><td>Communication method</td><td colspan="10">Asynchronous half-duplex</td></tr>
<tr><td>Communication mode</td><td colspan="6">Modbus/RTU</td><td colspan="4">Modbus/RTU, ASCII</td></tr>
<tr><td>Baud rate [bps] *2</td><td>9600</td><td>19200</td><td>38400</td><td>57600</td><td>115200</td><td>230400</td><td>38400</td><td>57600</td><td>115200</td><td>230400</td></tr>
<tr><td>Frame delay time</td><td colspan="3">t3.5</td><td colspan="3">Fixed to 1.75 ms</td><td>t3.5</td><td colspan="3">Fixed to 1.75 ms</td></tr>
<tr><td>Slave address</td><td colspan="6">Fixed to 63 (3FH)</td><td colspan="4">Axis number + 1 (01H to 10H)</td></tr>
<tr><td rowspan="2">Register address</td><td colspan="3">Master ⇒ ROBONET</td><td colspan="3">F600H to F647H</td><td colspan="4" rowspan="2">Arbitrary</td></tr>
<tr><td colspan="3">ROBONET ⇒ Master</td><td colspan="3">F700H to F747H</td></tr>
<tr><td>Available function codes</td><td colspan="6">Read Holding Register (03H)
Preset Single Register (06H)
Preset Multiple Register (10H)</td><td colspan="4">01H to 07H
0FH, 10H, 11H, 17H</td></tr>
<tr><td>Maximum send/receive buffer size</td><td colspan="10">160 byte</td></tr>
<tr><td>Bit length</td><td colspan="10">8 bits</td></tr>
<tr><td>Start bit</td><td colspan="10">1 bit</td></tr>
<tr><td>Stop bit</td><td colspan="10">1 bit</td></tr>
<tr><td>Parity</td><td colspan="10">None</td></tr>
<tr><td>Cable length</td><td colspan="10">100 m max. (master ⇐⇒ RGW-SIO)</td></tr>
<tr><td rowspan="8">SIO communication specifications</td><td>Transmission path configuration</td><td colspan="10">IAI’s dedicated multi-drop differential communication</td></tr>
<tr><td>Communication method</td><td colspan="10">Half-duplex</td></tr>
<tr><td>Synchronization method</td><td colspan="10">Start-stop method</td></tr>
<tr><td>Transmission path format</td><td colspan="10">Conforming to EIA RS485, 2-wire type</td></tr>
<tr><td>Baud rate</td><td colspan="10">230.4 k [bps]</td></tr>
<tr><td>Error control method</td><td colspan="10">No parity bit, CRC *2</td></tr>
<tr><td>Communication cable</td><td colspan="10">ROBONET communication connection circuit board (supplied), ROBONET extension cable (when an extension unit is used)</td></tr>
<tr><td>Number of units that can be connected</td><td colspan="10">16 axes max.</td></tr>
<tr><td rowspan="11">Environment conditions</td><td>Ambient operating temperature</td><td colspan="10">0 to 40°C</td></tr>
<tr><td>Ambient operating humidity</td><td colspan="10">95% RH max. (non-condensing)</td></tr>
<tr><td>Operating ambience</td><td colspan="10">Free from corrosive gases, flammable gases, oil mist or powder dust.</td></tr>
<tr><td>Storage temperature</td><td colspan="10">-25 to 70°C</td></tr>
<tr><td>Storage humidity</td><td colspan="10">95% RH max. (non-condensing)</td></tr>
<tr><td>Vibration resistance</td><td colspan="10">XYZ directions:
10 to 57 Hz, half amplitude – 0.035 mm (continuous) / 0.075 mm (intermittent)
57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)</td></tr>
<tr><td>Impact resistance</td><td colspan="10">XYZ directions:
147 mm/s^2, 11 ms, half-sine wave pulse</td></tr>
<tr><td>Protection degree</td><td colspan="10">IP20</td></tr>
<tr><td>Weight</td><td colspan="10">Approx. 140 g</td></tr>
<tr><td>External dimensions [mm]</td><td colspan="10">34 W x 105 H x 73.3 D [mm]</td></tr>
</table>

*1: The baud rate is set by the gateway parameter selection tool.
2: If the host is a PLC, the PLC must have a RS485 or RS232C interface. If a RS232C interface is used, a SIO converter (RCB-TU-SIO-) is required.

3.5 Name/Function of Each Part and External Dimensions

The four types of Gateway R units are exactly the same, except for the field network connector provided on top of the unit.

3.5.1 Name of Each Part



3.5.2 LED Indicators

These LEDs are used to monitor the status of the gateway unit.

Symbol	Indicator color	Explanation
RUN/ALM	Green/orange	Steady green: Operating normally. Steady orange: An error is present.
EMG	Red	This LED is lit when an emergency stop is actuated.
ERROR T	Orange	This LED is lit when a communication error is present between the controller and internal bus.
ERROR C	Orange	This LED is lit when a communication error is present over the field network.
STATUS 1	Green/orange	The function of this LED varies according to the field network type. (Refer to the table below.)
STATUS 0	Green/orange	
AUTO	Green	This LED is lit in the AUTO (auto operation) mode.

STATUS 0 and 1 indicate the field network statuses. What these LEDs indicate vary according to the field network type, as shown in the table below.

(1) CC-Link

Name	Indicator color	Status	Explanation
STATUS 1	Orange	Steady	An error (CRC error, station number setting error or baud rate setting error) is present.
		Blinking	The station number or baud rate has changed from the set value due to a reset.
STATUS 0	Green	Steady	A refresh & polling command has been received successfully, or a refresh command has been received successfully, after joining the network.

(2) DiviceNet

Name	Indicator color	Status	Explanation
STATUS 1	Green	Steady	Online.
		Blinking	Online (Cnx not established).
	Orange	Steady	An error is present.
		Blinking	At least one Cnx has generated a timeout.
	Green/orange	Alternate	Self-diagnosis is in progress.
STATUS 0	Green	Steady	Operating normally.
		Blinking	No configuration information is available or the configuration information is incomplete.
	Orange	Steady	Failed (unrecoverable).
		Blinking	Failed (recoverable).
	Green/orange	Alternate	Self-diagnosis is in progress.

(3) Profibus

Name	Indicator color	Status	Explanation
STATUS 1	Green	Steady	Online.
		Blinking	Online (clear command executed).
	Orange	Blinking	An error (parameter error or Profibus configuration error) is present.
STATUS 0	Green	Steady	Initialization has completed.
		Blinking	Initialization has completed (diagnosis event has occurred).
	Orange	Steady	An error (exceptional error) is present.

(4) RS485SIO

Name	Indicator color	Status	Explanation
STATUS 1	Green	Steady	Sending data.
STATUS 0	Green	Steady	Receiving data.

3.5.3 MODE Switch

This switch is used to set the operation mode of the controller.

Status	Explanation
MANU	Manual operation: The ROBONET system can be operated using a teaching pendant or PC.
AUTO	Auto operation: The ROBONET system is controlled via field network communication.

3.5.4 TP Connector

A connector used exclusively for connecting a teaching pendant or PC.
Connector: TCS7587-0121077 (by Hosiden)

3.5.5 User Setting Switches

These switches are used to set the operation mode of the Gateway R unit.
Normally SW3 and SW4 should remain OFF (they should be in the left positions). Do not change the settings of these switches.

SW No.	Explanation			
	CC-Link	DeviceNet	Profibus	RS485SIO
SW4	Always OFF			
SW3	Always OFF			
SW2	Always OFF		Endian *2	ON: SIO through mode OFF: Modbus gateway mode
SW1	When this switch is set to ON, the TP enable switch signal is effective.			

*1 SW1 to SW4 are ON when set to the right side, and OFF when set to the left side.
*2 Remote I/O endian

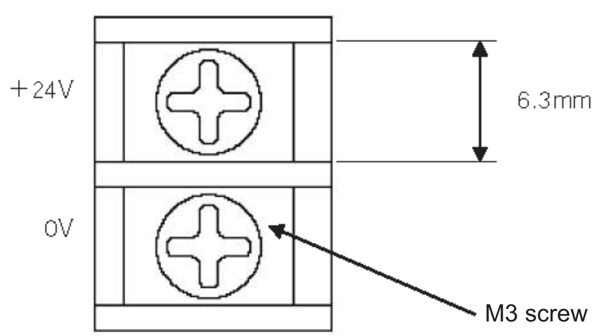
ON	Little endian (LSB first)	PLC by Mitsubishi, Omron, etc.
OFF	Big endian (MSB first)	PLC by Siemens

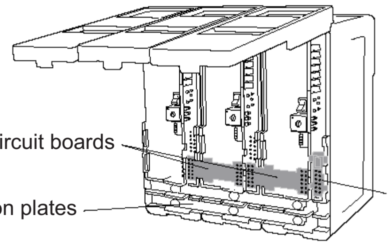
3.5.6 ROBONET Communication Connector

This connector is used to connect a Modbus communication line, emergency stop signal, etc., to the axis controller unit. Connection is made using the ROBONET communication connection circuit board supplied with the axis controller unit.

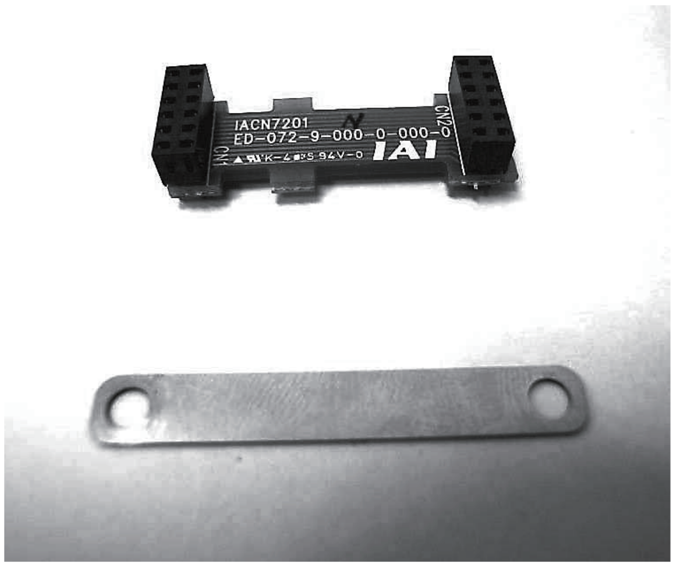
3.5.7 Power-supply Input Terminal Block

24-VDC power is input to this terminal block.
To supply power, connect the +24-V side and 0-V side to the power-supply input terminal block of the adjoining axis controller unit using the power-supply connection plate supplied with the controller.
11. M3 screw





(Interconnections of ROBONET units)



The photographs show the parts supplied with the axis controller unit or simple absolute R unit.

3.5.8 FG Terminal (Frame Ground)

This terminal is used to connect the Gateway R unit to ground. The thread size is M3.

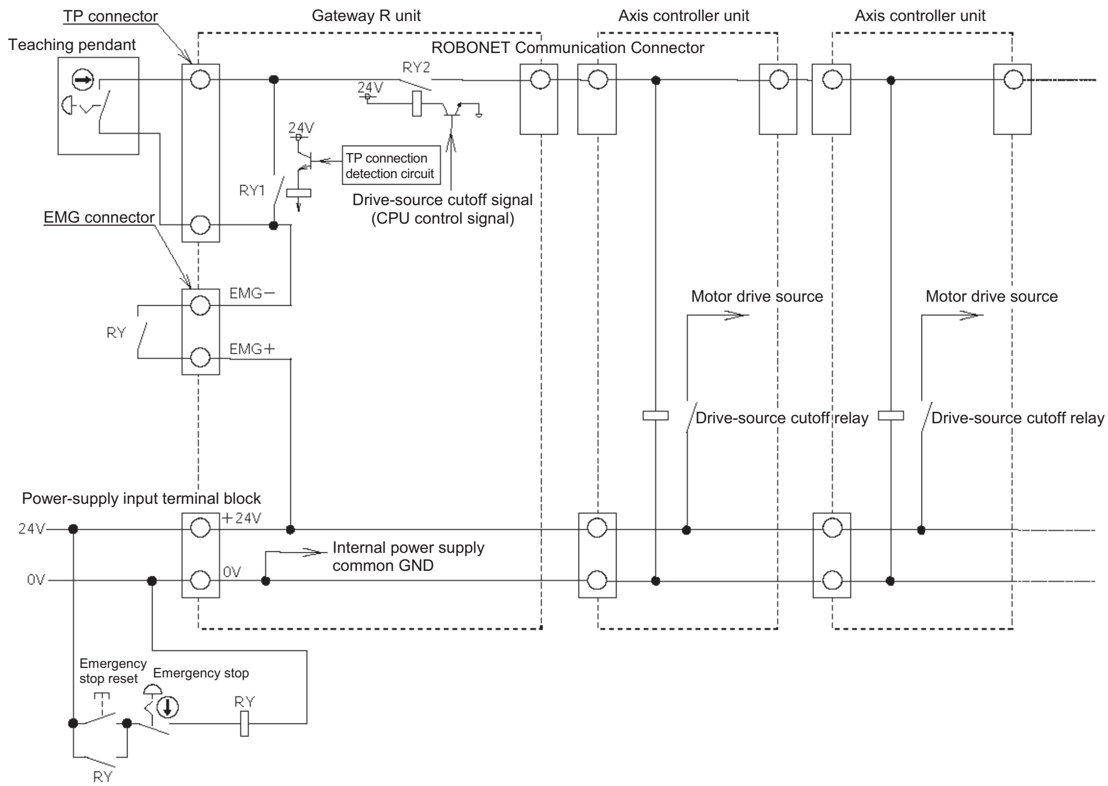
3.5.9 EMG Connector (Emergency Stop)

This connector is used to connect an emergency stop circuit. It turns ON/OFF the drive sources of all axes simultaneously.
Gateway-end connector: MC1.5/2-GF-3.81 (by Phoenix Contact)
Cable-end connector: MC1.5/2-STF-3.81 (by Phoenix Contact) = Standard accessory

Signal name	Explanation
EMG+	Emergency stop switch+
EMG-	Emergency stop switch-

Recommended Emergency Stop Circuit

Shown below is an example of an emergency stop circuit of a ROBONET system.
The built-in drive-source cutoff relays of all axis controller units are turned ON/OFF simultaneously using the emergency stop switch of the emergency stop circuit or teaching pendant connected to the Gateway R unit.



⚠ Caution

If an emergency stop is actuated with the emergency stop button, the emergency stop can be reset using the emergency stop reset switch. If an emergency stop is actuated with a teaching pendant, however, the emergency switch will be reset when the same emergency switch is turned and reset.

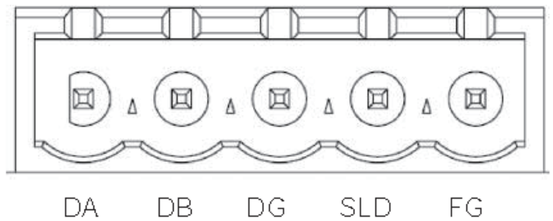
3.5.10 Field Network Connector

This connector is used to connect the master unit of each field network.
The connector varies according to the field network type.

(1) CC-Link (RGW-CC)

RGW-CC-end connector: MSTBA2.5/5-G-5.08AU (by Phoenix Contact)
Cable-end connector: MSTB2.5/5-ST-5.08ABGYAU (by Phoenix Contact) = Standard accessory

RGW-CC end



CC-Link communication connector

Signal name	Explanation
DA	Communication line A
DB	Communication line B
DG	Digital ground
SLD	Connect the shield of the shielded cable. This signal is internally connected to “FG” and the enclosure.
FG	Frame ground This signal is internally connected to “SLD” and the enclosure.

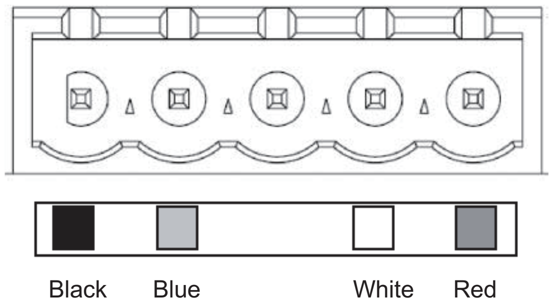
* The cable-end connector, “terminal resistor 110 Ω, 1/2 W” and “terminal resistor 130 Ω, 1/2 W” are supplied.
A terminal resistor must be connected to the units at both ends of the CC-Link system. If the RGW-CC is a terminal unit of the CC-Link system, connect the supplied terminal resistor between the DA and DB pins of the connector.
The applicable terminal resistor varies according to the type of the CC-Link cable used, as shown below. Use the terminal resistor appropriate for the cable.
For details, refer to the operation manual of the master unit.

Cable name	Terminal resistor
Dedicated CC-Link cable (Version 1.00, Version 1.10)	110 Ω, 1/2 W
Dedicated high-performance CC-Link cable (Version 1.00)	130 Ω, 1/2 W

(1) DeviceNet (RGW-DV)

RGW-DV-end connector: MSTBA2.5/5-G-5.08ABGYAU (by Phoenix Contact)
Cable-end connector: MSTB2.5/5-ST-5.08ABGYAU (by Phoenix Contact) = Standard accessory

RGW-DV end



DeviceNet communication connector

Pin color	Explanation
Black	Power-supply cable- *
Blue	Communication data low
-	Shield
White	Communication data high
Red	Power-supply cable+ *

* Current consumption of bus power supply = 60 mA

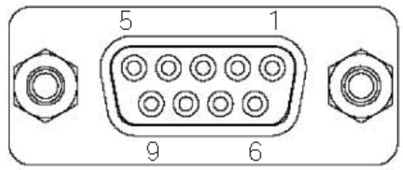
Applicable Wire for Cable-end Connector

Item	Description
Applicable wire size	Stranded wire: AWG24 to 12 (0.2 to 2.5 mm^2)
Cable stripping length	7 mm (stripping length of cable sheath)

* Although the RGW-DV does not come with terminal resistors, a terminal resistor must be connected to both ends of the main DeviceNet line. Use a T-branch tap with terminal resistor (121 Ω ± 1%, 1/4 W) or terminal-block type terminal resistor (121 Ω ± 1%, 1/4 W) at both ends of the main line.
Alternatively, connect a resistor of the same specification directly between the blue and white pins of the connector. For details, refer to the operation manual of the master unit.

(3) Profibus (RGW-PR)

RGW-PR connector: D-Sub, 9-pin connector (female)



Profibus communication connector

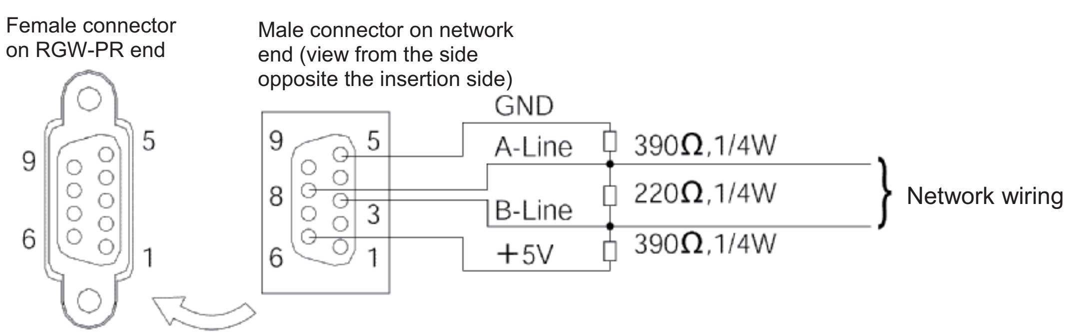
Pin number	Signal name	Explanation
1	NC	Not connected
2	NC	Not connected
3	B-Line	Communication line B (RS485)
4	RTS	Send request
5	GND	Signal ground (isolated)
6	+5 V	+5-V output (isolated)
7	NC	Not connected
8	A-Line	Communication line A (RS485)
9	NC	Not connected
Housing	Shield	Cable shield This signal is connected to the enclosure.

Caution

(1) The mating (cable-end) connector (D-sub, 9-pin connector) is not supplied.

(2) The RGW-PR does not have terminal resistor setting switches. If the RGW-PR is connected at the end of a network, connect a terminal resistor to the network connector or use a connector with terminal resistor, as specified below.

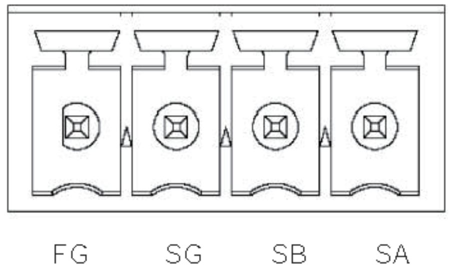
- Connecting a terminal resistor



- Profibus connector (with terminal resistor)
  (Example) SUBCON-PLUS-PROFIB/AX/SC (Phoenix Contact)
  For details, refer to the operation manual of the master unit.

(4) RS485SIO (RGW-SIO)

RGW-SIO connector: MC1.5/4-G-3.5 (by Phoenix Contact)
Cable-end connector: MC1.5/4-ST-3.5 (by Phoenix Contact) = Standard accessory



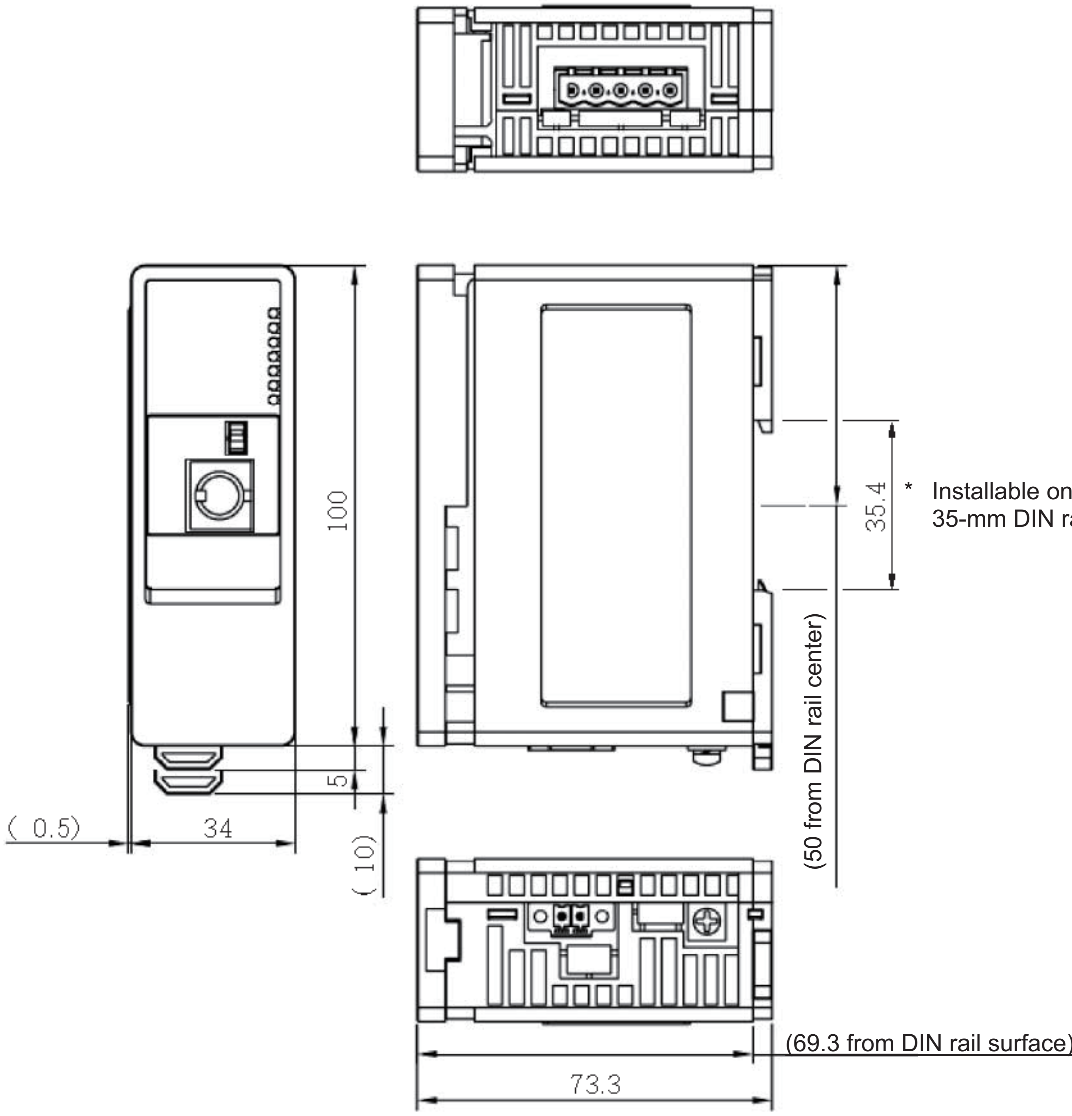
SIO communication connector

Signal name	Explanation	
SA	Communication line A (+)	Built-in terminal resistor (220 Ω) conforming to RS485
SB	Communication line B (-)	
SG	Signal ground	
FG	Frame ground This signal is connected to the enclosure.	

Applicable Wire for Cable-end Connector

Item	Description
Applicable wire size	Stranded wire: AWG28 to 16 (0.14 to 1.5 mm^2)
Cable stripping length	7 mm

3.5.11 External Dimensions



3.6 Operation Function List

RACON/RPCON Function List

	Positioner 1, 2 mode	Solenoid valve modes 1, 2
Home return operation	○	○ Solenoid valve mode 1 X Solenoid valve mode 2 (not required)
Positioning operation	△ Specify a position table number.	△ Specify a position table number.
Speed setting	△ Set in the position table.	△ Set in the position table.
Acceleration/deceleration setting	△ Set acceleration and deceleration in the position table separately.	△ Set acceleration and deceleration in the position table separately.
Operation at different acceleration and deceleration	△ Set acceleration and deceleration in the position table separately.	△ Set acceleration and deceleration in the position table separately.
Push operation	△ Set in the position table.	△ Set in the position table.
Speed change during movement	△ Combine two or more position numbers.	△ Combine two or more position numbers.
Pause	○	○ Solenoid valve mode 1 X Solenoid valve mode 2 (not required)
Zone signal	○ Set using the position table and user parameters. Outputs: PZONE, ZONE1, ZONE2	○ Set using the position table and user parameters. The following zone signals are output: • Solenoid valve mode 1: ZONE1, ZONE2 • Solenoid valve mode 2: PZONE, ZONE1
Teaching operation	○	X
Jogging operation	○	○ Solenoid valve mode 1 X Solenoid valve mode 2
Inching operation	○	○ Solenoid valve mode 1 X Solenoid valve mode 2
Power-saving mode	With the RPCON, set parameter No. 53 to “4” to implement full servo control.	○
Position table	Required	Required

○: Direct control △: Indirect control X: Not available

Simple direct mode	Direct numerical specification mode
○	○
○ Specify position data (32-bit signed integer).	○ Specify position data (32-bit signed integer).
△ Set in the position table.	○ Specify speed data (16-bit integer).
△ Set acceleration and deceleration in the position table separately.	○ Specify acceleration/deceleration data (16-bit integer).
△ Set acceleration and deceleration in the position table separately.	○ Since the acceleration/deceleration data is accepted when the positioning is started, change the acceleration/deceleration data while the actuator is moving and restart the operation in order to decelerate the actuator at a value different from the acceleration.
△ Set in the position table.	○ Specify the push-current limiting value (8-bit integer) and also specify the push direction (DIR) and push mode (PUSH).
△ Combine two or more position numbers.	○ Since the speed data is accepted when the positioning is started, change the speed data while the actuator is moving and restart the operation.
○	○
○ Set using the position table and user parameters. Outputs: PZONE, ZONE1, ZONE2	○ Set using user parameters. Outputs: ZONE1, ZONE2
X	X
○	○
○	○
With the RPCON, set parameter No. 53 to “4” to implement full servo control.	
Required	Not required

3.7 Address Configuration

ROBONET addresses are configured in the same manner with all four types of gateway units regardless of the type of field network.
The addresses occupied by the network consist of a fixed 8-word area and a data area that changes according to the operation mode and number of axes. The operation modes and occupied data areas are shown below.
The positioner 1 mode, simple direct mode and direct numerical specification mode can be combined, and a desired mode can be selected for each axis. Also note that the positioner 2 mode, solenoid valve mode 1 and solenoid valve mode 2 cannot be combined with the positioner 1 mode, simple direct mode or direct numerical specification mode.

Fixed area (8 words)
+
Data area
Positioner 1 mode (4 words) × Number of axes + Simple direct mode (4 words) × Number of axes + Direct numerical specification mode (8 words) × Number of axes

Fixed area (8 words)
+
Data area
Positioner 2 mode (2 words) × Number of axes + Solenoid valve mode 1, solenoid valve mode 2 (2 words) × Number of axes

(1) Configuration of Fixed Area

	PLC output ⇒ ROBONET			ROBONET ⇒ PLC input		
	Upper byte	Lower byte	Number of words	Upper byte	Lower byte	Number of words
Gateway control area	Gateway control signal 0		2	Gateway status signal 0		2
	Gateway control signal 1			Gateway status signal 1		
Command area	Request command		6	Response command		6
	Data 0			Data 0		
	Data 1			Data 1		
	Data 2			Data 2		
	Data 3			Data 3		
	Cannot be used.			Cannot be used.		

* In the direct numerical specification mode, the command area cannot be used, but this area is occupied as part of the data area.

(2) Data Area Configuration in the Positioner Mode and Simple Direct Mode

	PLC output ⇒ Axis input					Axis output ⇒ PLC input				
	Upper byte	Lower byte	Number of words	Positioner mode	Simple direct mode	Upper byte	Lower byte	Number of words	Positioner mode	Simple direct mode
Position data specification area	Position data specification (L)		2	X	○	Current position data (L)		2	○	○
	Position data specification (H)					Current position data				
Position specification area	Command position number		1	○	○	Completed position number		1	○	○
Control signal area	Control signal		1	○	○	Status signal		1	○	○

* In the positioner mode, the position data specification area (PLC ⇒ Axis input) is not used, but this area is occupied as part of the data area.

(3) Data Area Configuration in the Direct Numerical Specification Mode

	PLC output ⇒ Axis input			Axis output ⇒ PLC input		
	Upper byte	Lower byte	Number of words	Upper byte	Lower byte	Number of words
Direct numerical specification area	Position data specification (L)*		2	Current position data (L)*		2
	Position data specification (H)*			Current position data (H)*		
	Positioning band specification (L)*		2	Current electrical current (L)*		2
	Positioning band specification (H)*			Current electrical current (H)*		
	Speed specification		1	Current speed data		1
	Acceleration/deceleration specification		1	Cannot be used.		1
	Push-current limiting value		1	Alarm code		1
Control signal area	Control signal		1	Status signal		1

* (L) indicates the lower word of 2-word data, while (H) indicates the upper word of 2-word data.

(4) Structure of data fields in the positioner 2 mode, solenoid valve mode 1 and solenoid valve mode 2

	Upper byte	Lower byte	Number of words	Upper byte	Lower byte	Number of words
Position specification area	Command position number		1	Completed position number		1
Control signal area	Control signal		1	Status signal		1

3.7.1 Examples of Overall Address Configuration

Overall address configurations are shown based on a system where 12 4-word mode axes (positioner 1/simple direct mode) and two 8-word mode axes (direct numerical specification mode) are connected.
For your information, the CC-Link and DeviceNet types are assigned by word addressing, while the Profibus and RS485 SIO types are assigned by byte addressing.

(1) CC-Link

A configuration example using the CC-Link type is shown on the next page.
The eight words in the fixed area are assigned to bit registers (RX/RY), while the area of each axis is assigned to word registers (RWr/RWw).

■ Example of Overall CC-Link Address Configuration
(Positioner 1 mode/simple direct mode + Direct numerical specification mode)
An example of connecting 12 axes operating in the positioner 1 mode or simple direct mode and two axes operating in the direct numerical specification mode is shown.

PLC output ⇒ ROBONET / ROBONET⇒ PLC input

Output register	Upper byte / Lower byte	Input register	Upper byte / Lower byte	
RY0F to 00	Gateway control signal 0	RX0F to 00	Gateway status signal 0	8-word fixed area
RY1F to 10	Gateway control signal 1	RX1F to 10	Gateway status signal 1	
RY2F to 20	Request command	RX2F to 20	Response command	
RY3F to 30	Data 0	RX3F to 30	Data 0	
RY4F to 40	Data 1	RX4F to 40	Data 1	
RY5F to 50	Data 2	RX5F to 50	Data 2	
RY6F to 60	Data 3	RX6F to 60	Data 3	
RY7F to 70	(Cannot be used)	RX7F to 70	(Cannot be used)	

PLC master expanded cyclic setting *1	Output register		Input register		
16 words x1 setting, 4 stations *2	RWw 00H	(Axis 0) Position data specification (L)	RWr 00H	(Axis 0) Current position data (L)	4 words Positioner/ simple direct mode
	RWw 01H	(Axis 0) Position data specification (H)	RWr 01H	(Axis 0) Current position data (H)	
	RWw 02H	(Axis 0) Command position number	RWr 02H	(Axis 0) Completed position number	
	RWw 03H	(Axis 0) Control signal	RWr 03H	(Axis 0) Status signal	
	RWw 04H	(Axis 1) Position data specification (L)	RWr 04H	(Axis 1) Current position data (L)	4 words
	RWw 05H	(Axis 1) Position data specification (H)	RWr 05H	(Axis 1) Current position data (H)	
	RWw 06H	(Axis 1) Command position number	RWr 06H	(Axis 1) Completed position number	
	RWw 07H	(Axis 1) Control signal	RWr 07H	(Axis 1) Status signal	
	RWw 08H	(Axis 2) Position data specification (L)	RWr 08H	(Axis 2) Current position data (L)	4 words
	RWw 09H	(Axis 2) Position data specification (H)	RWr 09H	(Axis 2) Current position data (H)	
	RWw 0AH	(Axis 2) Command position number	RWr 0AH	(Axis 2) Completed position number	
	RWw 0BH	(Axis 2) Control signal	RWr 0BH	(Axis 2) Status signal	
	RWw 0CH	(Axis 3) Position data specification (L)	RWr 0CH	(Axis 3) Current position data (L)	4 words
	RWw 0DH	(Axis 3) Position data specification (H)	RWr 0DH	(Axis 3) Current position data (H)	
	RWw 0EH	(Axis 3) Command position number	RWr 0EH	(Axis 3) Completed position number	
	RWw 0FH	(Axis 3) Control signal	RWr 0FH	(Axis 3) Status signal	
32 words x4 setting, 2 stations	⋮	⋮	⋮	⋮	4 words
	RWw 1FH	(Axis 7) Control signal	RWr 1FH	(Axis 7) Status signal	
	⋮	⋮	⋮	⋮	
	RWw 2FH	(Axis 11) Control signal	RWr 2FH	(Axis 11) Status signal	
	RWw 30H	(Axis 12) Position data specification (L)	RWr 30H	(Axis 12) Current position data (L)	8 words Direct numerical specification mode
	RWw 31H	(Axis 12) Position data specification (H)	RWr 31H	(Axis 12) Current position data (H)	
	RWw 32H	(Axis 12) Positioning band specification (L)	RWr 32H	(Axis 12) Current electrical current (L)	
	RWw 33H	(Axis 12) Positioning band specification (H)	RWr 33H	(Axis 12) Current electrical current (H)	
	RWw 34H	(Axis 12) Speed specification	RWr 34H	(Axis 12) Current speed data	
	RWw 35H	(Axis 12) Acceleration/deceleration specification	RWr 35H	(Cannot be used)	
	RWw 36H	(Axis 12) Push-current limiting value	RWr 36H	(Axis 12) Alarm code	
	RWw 37H	(Axis12) Control signal	RWr 37H	(Axis 12) Status signal	
64 words x8 setting, 2 stations	RWw 38H	(Axis 13) Position data specification (L)	RWr 38H	(Axis 13) Current position data (L)	8 words
	RWw 39H	(Axis 13) Position data specification (H)	RWr 39H	(Axis 13) Current position data (H)	
	RWw 3AH	(Axis 13) Positioning band specification (L)	RWr 3AH	(Axis 13) Current electrical current (L)	
	RWw 3BH	(Axis 13) Positioning band specification (H)	RWr 3BH	(Axis 13) Current electrical current (H)	
	RWw 3CH	(Axis 13) Speed specification	RWr 3CH	(Axis 13) Current speed data	
	RWw 3DH	(Axis 13) Acceleration/deceleration specification	RWr 3DH	(Cannot be used)	
	RWw 3EH	(Axis 13) Push-current limiting value	RWr 3EH	(Axis 13) Alarm code	
	RWw 3FH	(Axis13) Control signal	RWr 3FH	(Axis 13) Status signal	

*1 The extended cyclic setting is based on the occupied area information displayed using the gateway parameter setting tool.
*2 CC-Link Version 1.10 is also supplied as long as the expanded cyclic setting of x1 (four stations occupied) can be used.

■ Example of Overall CC-Link Address Configuration (positioner 2 mode and solenoid valve modes 1 and 2)
An example of connecting 16 axes in the positioner 2 mode or solenoid valve mode 1 or 2 is shown below.

PLC output ⇒ ROBONET / ROBONET⇒ PLC input

Output register	Upper byte / Lower byte	Input register	Upper byte / Lower byte	
RY0F to 00	Gateway control signal 0	RX0F to 00	Gateway status signal 0	8-word fixed area
RY1F to 10	Gateway control signal 1	RX1F to 10	Gateway status signal 1	
RY2F to 20	Request command	RX2F to 20	Response command	
RY3F to 30	Data 0	RX3F to 30	Data 0	
RY4F to 40	Data 1	RX4F to 40	Data 1	
RY5F to 50	Data 2	RX5F to 50	Data 2	
RY6F to 60	Data 3	RX6F to 60	Data 3	
RY7F to 70	(Cannot be used)	RX7F to 70	(Cannot be used)	

*1 PLC master expanded cyclic setting	Output register		Input register		
	R**W**w 00H	(Axis 0) Command position number	R**W**r 00H	(Axis 0) Completed position number	2 words
16 words x1 setting, 4 stations *2	R**W**w 01H	(Axis 0) Control signal	R**W**r 01H	(Axis 0) Status signal	
	R**W**w 02H	(Axis 1) Command position number	R**W**r 02H	(Axis 1) Completed position number	
	R**W**w 03H	(Axis 1) Control signal	R**W**r 03H	(Axis 1) Status signal	
	R**W**w 04H	(Axis 2) Command position number	R**W**r 04H	(Axis 2) Completed position number	
	R**W**w 05H	(Axis 2) Control signal	R**W**r 05H	(Axis 2) Status signal	
	R**W**w 06H	(Axis 3) Command position number	R**W**r 06H	(Axis 3) Completed position number	
	R**W**w 07H	(Axis 3) Control signal	R**W**r 07H	(Axis 3) Status signal	
	R**W**w 08H	(Axis 4) Command position number	R**W**r 08H	(Axis 4) Completed position number	
	R**W**w 09H	(Axis 4) Control signal	R**W**r 09H	(Axis 4) Status signal	
	R**W**w 0AH	(Axis 5) Command position number	R**W**r 0AH	(Axis 5) Completed position number	
	R**W**w 0BH	(Axis 5) Control signal	R**W**r 0BH	(Axis 5) Status signal	
	R**W**w 0CH	(Axis 6) Command position number	R**W**r 0CH	(Axis 6) Completed position number	
	R**W**w 0DH	(Axis 6) Control signal	R**W**r 0DH	(Axis 6) Status signal	
	R**W**w 0EH	(Axis 7) Command position number	R**W**r 0EH	(Axis 7) Completed position number	
	R**W**w 0FH	(Axis 7) Control signal	R**W**r 0FH	(Axis 7) Status signal	
32 words x4 setting, 2 stations	RWw 10H	(Axis 8) Command position number	R**W**r 10H	(Axis 8) Completed position number	
	RWw 11H	(Axis 8) Control signal	R**W**r 11H	(Axis 8) Status signal	
	RWw 12H	(Axis 9) Command position number	R**W**r 12H	(Axis 9) Completed position number	
	RWw 13H	(Axis 9) Control signal	R**W**r 13H	(Axis 9) Status signal	
	RWw 14H	(Axis 10) Command position number	R**W**r 14H	(Axis 10) Completed position number	
	RWw 15H	(Axis 10) Control signal	R**W**r 15H	(Axis 10) Status signal	
	RWw 16H	(Axis 11) Command position number	R**W**r 16H	(Axis 11) Completed position number	
	RWw 17H	(Axis 11) Control signal	R**W**r 17H	(Axis 11) Status signal	
	RWw 18H	(Axis 12) Command position number	R**W**r 18H	(Axis 12) Completed position number	
	RWw 19H	(Axis 12) Control signal	R**W**r 19H	(Axis 12) Status signal	
	RWw 1AH	(Axis 13) Command position number	R**W**r 1AH	(Axis 13) Completed position number	
	RWw 1BH	(Axis 13) Control signal	R**W**r 1BH	(Axis 13) Status signal	
	RWw 1CH	(Axis 14) Command position number	R**W**r 1CH	(Axis 14) Completed position number	
	RWw 1DH	(Axis 14) Control signal	R**W**r 1DH	(Axis 14) Status signal	
	RWw 1EH	(Axis 15) Command position number	R**W**r 1EH	(Axis 15) Completed position number	
	RWw 1FH	(Axis 15) Control signal	R**W**r 1FH	(Axis 15) Status signal	

*1 The extended cyclic setting is based on the occupied area information displayed using the gateway parameter setting tool.
*2 CC-Link Version 1.10 is also supplied as long as the expanded cyclic setting of x1 (four stations occupied) can be used.

(2) DeviceNet

■ Example of Overall DeviceNet Address Configuration
(Positioner 1 mode/simple direct mode + Direct numerical specification mode)
An example of connecting 12 axes operating in the positioner 1 mode or simple direct mode and two axes operating in the direct numerical specification mode is shown.

Relative channel*	PLC output ⇒ ROBONET (Upper byte / Lower byte)	ROBONET⇒ PLC input (Upper byte / Lower byte)	
0	Gateway control signal 0	Gateway status signal 0	8-word fixed area
1	Gateway control signal 1	Gateway status signal 1	
2	Request command	Response command	
3	Data 0	Data 0	
4	Data 1	Data 1	
5	Data 2	Data 2	
6	Data 3	Data 3	
7	(Cannot be used)	(Cannot be used)	
8	(Axis 0) Position data specification (L)	(Axis 0) Current position data (L)	4 words Positioner/ simple direct mode
9	(Axis 0) Position data specification (H)	(Axis 0) Current position data (H)	
10	(Axis 0) Command position number	(Axis 0) Completed position number	
11	(Axis 0) Control signal	(Axis 0) Status signal	
12	(Axis 1) Position data specification (L)	(Axis 1) Current position data (L)	4 words
13	(Axis 1) Position data specification (H)	(Axis 1) Current position data (H)	
14	(Axis 1) Command position number	(Axis 1) Completed position number	
15	(Axis 1) Control signal	(Axis 1) Status signal	
16	(Axis 2) Position data specification (L)	(Axis 2) Current position data (L)	4 words
17	(Axis 2) Position data specification (H)	(Axis 2) Current position data (H)	
18	(Axis 2) Command position number	(Axis 2) Completed position number	
19	(Axis 2) Control signal	(Axis 2) Status signal	
20	(Axis 3) Position data specification (L)	(Axis 3) Current position data (L)	4 words
21	(Axis 3) Position data specification (H)	(Axis 3) Current position data (H)	
22	(Axis 3) Command position number	(Axis 3) Completed position number	
23	(Axis 3) Control signal	(Axis 3) Status signal	
⋮	⋮	⋮	4 words
39	(Axis 7) Control signal	(Axis 7) Status signal	
⋮	⋮	⋮	
55	(Axis 11) Control signal	(Axis 11) Status signal	
56	(Axis 12) Position data specification (L)	(Axis 12) Current position data (L)	8 words Direct numerical specification mode
57	(Axis 12) Position data specification (H)	(Axis 12) Current position data (H)	
58	(Axis 12) Positioning band specification (L)	(Axis 12) Current electrical current (L)	
59	(Axis 12) Positioning band specification (H)	(Axis 12) Current electrical current (H)	
60	(Axis 12) Speed specification	(Axis 12) Current speed data	
61	(Axis 12) Acceleration/deceleration specification	(Cannot be used)	
62	(Axis 12) Push-current limiting value	(Axis 12) Alarm code	
63	(Axis12) Control signal	(Axis 12) Status signal	
64	(Axis 13) Position data specification (L)	(Axis 13) Current position data (L)	8 words
65	(Axis 13) Position data specification (H)	(Axis 13) Current position data (H)	
66	(Axis 13) Positioning band specification (L)	(Axis 13) Current electrical current (L)	
67	(Axis 13) Positioning band specification (H)	(Axis 13) Current electrical current (H)	
68	(Axis 13) Speed specification	(Axis 13) Current speed data	
69	(Axis 13) Acceleration/deceleration specification	(Cannot be used)	
70	(Axis 13) Push-current limiting value	(Axis 13) Alarm code	
71	(Axis13) Control signal	(Axis 13) Status signal	

* The relative channel indicates the relative channel number from the first gateway channel.

■ Example of Overall DeviceNet Address Configuration (positioner 2 mode and solenoid valve modes 1 and 2)
An example of connecting 16 axes in the positioner 2 mode or solenoid valve mode 1 or 2 is shown below.

Relative channel*	PLC output ⇒ ROBONET Upper byte / Lower byte	ROBONET⇒ PLC input Upper byte / Lower byte	
0	Gateway control signal 0	Gateway status signal 0	8-word fixed area
1	Gateway control signal 1	Gateway status signal 1	
2	Request command	Response command	
3	Data 0	Data 0	
4	Data 1	Data 1	
5	Data 2	Data 2	
6	Data 3	Data 3	
7	(Cannot be used)	(Cannot be used)	
8	(Axis 0) Command position number	(Axis 0) Completed position number	2 words
9	(Axis 0) Control signal	(Axis 0) Status signal	
10	(Axis 1) Command position number	(Axis 1) Completed position number	
11	(Axis 1) Control signal	(Axis 1) Status signal	
12	(Axis 2) Command position number	(Axis 2) Completed position number	
13	(Axis 2) Control signal	(Axis 2) Status signal	
14	(Axis 3) Command position number	(Axis 3) Completed position number	
15	(Axis 3) Control signal	(Axis 3) Status signal	
16	(Axis 4) Command position number	(Axis 4) Completed position number	
17	(Axis 4) Control signal	(Axis 4) Status signal	
18	(Axis 5) Command position number	(Axis 5) Completed position number	
19	(Axis 5) Control signal	(Axis 5) Status signal	
20	(Axis 6) Command position number	(Axis 6) Completed position number	
21	(Axis 6) Control signal	(Axis 6) Status signal	
22	(Axis 7) Command position number	(Axis 7) Completed position number	
23	(Axis 7) Control signal	(Axis 7) Status signal	
24	(Axis 8) Command position number	(Axis 8) Completed position number	
25	(Axis 8) Control signal	(Axis 8) Status signal	
26	(Axis 9) Command position number	(Axis 9) Completed position number	
27	(Axis 9) Control signal	(Axis 9) Status signal	
28	(Axis 10) Command position number	(Axis 10) Completed position number	
29	(Axis 10) Control signal	(Axis 10) Status signal	
30	(Axis 11) Command position number	(Axis 11) Completed position number	
31	(Axis 11) Control signal	(Axis 11) Status signal	
32	(Axis 12) Command position number	(Axis 12) Completed position number	
33	(Axis 12) Control signal	(Axis 12) Status signal	
34	(Axis 13) Command position number	(Axis 13) Completed position number	
35	(Axis 13) Control signal	(Axis 13) Status signal	
36	(Axis 14) Command position number	(Axis 14) Completed position number	
37	(Axis 14) Control signal	(Axis 14) Status signal	
38	(Axis 15) Command position number	(Axis 15) Completed position number	
39	(Axis 15) Control signal	(Axis 15) Status signal	

* The relative channel indicates the relative channel number from the first gateway channel.

(3) Profibus

■ Example of Overall Profibus Address Configuration
(Positioner 1 mode/simple direct mode + Direct numerical specification mode)
An example of connecting 12 axes operating in the positioner 1 mode or simple direct mode and two axes operating in the direct numerical specification mode is shown.

Relative byte*	PLC output ⇒ ROBONET (Upper byte / Lower byte)	ROBONET⇒ PLC input (Upper byte / Lower byte)	
0	Gateway control signal 0	Gateway status signal 0	8-word fixed area
2	Gateway control signal 1	Gateway status signal 1	
4	Request command	Response command	
6	Data 0	Data 0	
8	Data 1	Data 1	
10	Data 2	Data 2	
12	Data 3	Data 3	
14	(Cannot be used)	(Cannot be used)	
16	(Axis 0) Position data specification (L)	(Axis 0) Current position data (L)	4 words Positioner/ simple direct mode
18	(Axis 0) Position data specification (H)	(Axis 0) Current position data (H)	
20	(Axis 0) Command position number	(Axis 0) Completed position number	
22	(Axis 0) Control signal	(Axis 0) Status signal	
24	(Axis 1) Position data specification (L)	(Axis 1) Current position data (L)	4 words
26	(Axis 1) Position data specification (H)	(Axis 1) Current position data (H)	
28	(Axis 1) Command position number	(Axis 1) Completed position number	
30	(Axis 1) Control signal	(Axis 1) Status signal	
31	(Axis 2) Position data specification (L)	(Axis 2) Current position data (L)	4 words
34	(Axis 2) Position data specification (H)	(Axis 2) Current position data (H)	
36	(Axis 2) Command position number	(Axis 2) Completed position number	
38	(Axis 2) Control signal	(Axis 2) Status signal	
40	(Axis 3) Position data specification (L)	(Axis 3) Current position data (L)	4 words
42	(Axis 3) Position data specification (H)	(Axis 3) Current position data (H)	
44	(Axis 3) Command position number	(Axis 3) Completed position number	
46	(Axis 3) Control signal	(Axis 3) Status signal	
⋮	⋮	⋮	
78	(Axis 7) Control signal	(Axis 7) Status signal	4 words
⋮	⋮	⋮	
110	(Axis 11) Control signal	(Axis 11) Status signal	
112	(Axis 12) Position data specification (L)	(Axis 12) Current position data (L)	8 words Direct numerical specification mode
114	(Axis 12) Position data specification (H)	(Axis 12) Current position data (H)	
116	(Axis 12) Positioning band specification (L)	(Axis 12) Current electrical current (L)	
118	(Axis 12) Positioning band specification (H)	(Axis 12) Current electrical current (H)	
120	(Axis 12) Speed specification	(Axis 12) Current speed data	
122	(Axis 12) Acceleration/deceleration specification	(Cannot be used)	
124	(Axis 12) Push-current limiting value	(Axis 12) Alarm code	
126	(Axis12) Control signal	(Axis 12) Status signal	
128	(Axis 13) Position data specification (L)	(Axis 13) Current position data (L)	8 words
130	(Axis 13) Position data specification (H)	(Axis 13) Current position data (H)	
132	(Axis 13) Positioning band specification (L)	(Axis 13) Current electrical current (L)	
134	(Axis 13) Positioning band specification (H)	(Axis 13) Current electrical current (H)	
136	(Axis 13) Speed specification	(Axis 13) Current speed data	
138	(Axis 13) Acceleration/deceleration specification	(Cannot be used)	
140	(Axis 13) Push-current limiting value	(Axis 13) Alarm code	
142	(Axis13) Control signal	(Axis 13) Status signal	

* The relative byte indicates the relative byte address from the beginning of the gateway.

■ Example of Overall Profibus Address Configuration (positioner 2 mode and solenoid valve modes 1 and 2)
An example of connecting 16 axes in the positioner 2 mode or solenoid valve mode 1 or 2 is shown below.

Relative channel*	PLC output ⇒ ROBONET (Upper byte / Lower byte)	ROBONET⇒ PLC input (Upper byte / Lower byte)	
0	Gateway control signal 0	Gateway status signal 0	8-word fixed area
2	Gateway control signal 1	Gateway status signal 1	
4	Request command	Response command	
6	Data 0	Data 0	
8	Data 1	Data 1	
10	Data 2	Data 2	
12	Data 3	Data 3	
14	(Cannot be used)	(Cannot be used)	
16	(Axis 0) Command position number	(Axis 0) Completed position number	2 words
18	(Axis 0) Control signal	(Axis 0) Status signal	
20	(Axis 1) Command position number	(Axis 1) Completed position number	
22	(Axis 1) Control signal	(Axis 1) Status signal	
24	(Axis 2) Command position number	(Axis 2) Completed position number	
26	(Axis 2) Control signal	(Axis 2) Status signal	
28	(Axis 3) Command position number	(Axis 3) Completed position number	
30	(Axis 3) Control signal	(Axis 3) Status signal	
32	(Axis 4) Command position number	(Axis 4) Completed position number	
34	(Axis 4) Control signal	(Axis 4) Status signal	
36	(Axis 5) Command position number	(Axis 5) Completed position number	
38	(Axis 5) Control signal	(Axis 5) Status signal	
40	(Axis 6) Command position number	(Axis 6) Completed position number	
42	(Axis 6) Control signal	(Axis 6) Status signal	
44	(Axis 7) Command position number	(Axis 7) Completed position number	
46	(Axis 7) Control signal	(Axis 7) Status signal	
48	(Axis 8) Command position number	(Axis 8) Completed position number	
50	(Axis 8) Control signal	(Axis 8) Status signal	
52	(Axis 9) Command position number	(Axis 9) Completed position number	
54	(Axis 9) Control signal	(Axis 9) Status signal	
56	(Axis 10) Command position number	(Axis 10) Completed position number	
58	(Axis 10) Control signal	(Axis 10) Status signal	
60	(Axis 11) Command position number	(Axis 11) Completed position number	
62	(Axis 11) Control signal	(Axis 11) Status signal	
64	(Axis 12) Command position number	(Axis 12) Completed position number	
66	(Axis 12) Control signal	(Axis 12) Status signal	
68	(Axis 13) Command position number	(Axis 13) Completed position number	
70	(Axis 13) Control signal	(Axis 13) Status signal	
72	(Axis 14) Command position number	(Axis 14) Completed position number	
74	(Axis 14) Control signal	(Axis 14) Status signal	
76	(Axis 15) Command position number	(Axis 15) Completed position number	
78	(Axis 15) Control signal	(Axis 15) Status signal	

* The relative byte indicates the relative byte address from the beginning of the gateway.

(4) RS485SIO

■ Example of Overall RS485 SIO (Modbus Gateway Mode) Address Configuration
(Positioner 1 mode/simple direct mode + Direct numerical specification mode)
An example of connecting 12 axes operating in the positioner 1 mode or simple direct mode and two axes operating in the direct numerical specification mode is shown.

Register address	PLC output ⇒ ROBONET (Upper byte / Lower byte)	Relative byte	ROBONET⇒ PLC input (Upper byte / Lower byte)	Register address
F600*	Gateway control signal 0	0	Gateway status signal 0	F700*
F601	Gateway control signal 1	2	Gateway status signal 1	F701
F602	Request command	4	Response command	F702
F603	Data 0	6	Data 0	F703
F604	Data 1	8	Data 1	F704
F605	Data 2	10	Data 2	F705
F606	Data 3	12	Data 3	F706
F607	(Reserved)	14	(Reserved)	F707
F608	(Axis 0) Position data specification (L)	16	(Axis 0) Current position data (L)	F708
F609	(Axis 0) Position data specification (H)	18	(Axis 0) Current position data (H)	F709
F60A	(Axis 0) Command position number	20	(Axis 0) Completed position number	F70A
F60B	(Axis 0) Control signal	22	(Axis 0) Status signal	F70B
F60C	(Axis 1) Position data specification (L)	24	(Axis 1) Current position data (L)	F70C
F60D	(Axis 1) Position data specification (H)	26	(Axis 1) Current position data (H)	F70D
F60E	(Axis 1) Command position number	28	(Axis 1) Completed position number	F70E
F60F	(Axis 1) Control signal	30	(Axis 1) Status signal	F70F
F610	(Axis 2) Position data specification (L)	32	(Axis 2) Current position data (L)	F710
F611	(Axis 2) Position data specification (H)	34	(Axis 2) Current position data (H)	F711
F612	(Axis 2) Command position number	36	(Axis 2) Completed position number	F712
F613	(Axis 2) Control signal	38	(Axis 2) Status signal	F713
F614	(Axis 3) Position data specification (L)	40	(Axis 3) Current position data (L)	F714
F615	(Axis 3) Position data specification (H)	42	(Axis 3) Current position data (H)	F715
F616	(Axis 3) Command position number	44	(Axis 3) Completed position number	F716
F617	(Axis 3) Control signal	46	(Axis 3) Status signal	F717
⋮	⋮	⋮	⋮	⋮
F627	(Axis 7) Control signal	78	(Axis 7) Status signal	F727
⋮	⋮	⋮	⋮	⋮
F637	(Axis 11) Control signal	110	(Axis 11) Status signal	F737
F638	(Axis 12) Position data specification (L)	112	(Axis 12) Current position data (L)	F738
F639	(Axis 12) Position data specification (H)	114	(Axis 12) Current position data (H)	F739
F63A	(Axis 12) Positioning band specification (L)	116	(Axis 12) Current electrical current (L)	F73A
F63B	(Axis 12) Positioning band specification (H)	118	(Axis 12) Current electrical current (H)	F73B
F63C	(Axis 12) Speed specification	120	(Axis 12) Current speed data	F73C
F63D	(Axis 12) Acceleration/deceleration specification	122	(Reserved)	F73D
F63E	(Axis 12) Push-current limiting value	124	(Axis 12) Alarm code	F73E
F63F	(Axis12) Control signal	126	(Axis 12) Status signal	F73F
F640	(Axis 13) Position data specification (L)	128	(Axis 13) Current position data (L)	F740
F641	(Axis 13) Position data specification (H)	130	(Axis 13) Current position data (H)	F741
F642	(Axis 13) Positioning band specification (L)	132	(Axis 13) Current electrical current (L)	F742
F643	(Axis 13) Positioning band specification (H)	134	(Axis 13) Current electrical current (H)	F743
F644	(Axis 13) Speed specification	136	(Axis 13) Current speed data	F744
F645	(Axis 13) Acceleration/deceleration specification	138	(Reserved)	F745
F646	(Axis 13) Push-current limiting value	140	(Axis 13) Alarm	F746
F647	(Axis13) Control signal	142	(Axis 13) Status signal	F747

* With the RS485 SIO type, the initial address is F600H (PLC ⇒ ROBONET) or F700H (ROBONET ⇒ PLC).

■ Example of Overall RS485 SIO (Modbus Gateway Mode) Address Configuration (positioner 2 mode and solenoid valve modes 1 and 2)
An example of connecting 16 axes in the positioner 2 mode or solenoid valve mode 1 or 2 is shown below.

Register address	PLC output ⇒ ROBONET (Upper byte / Lower byte)	Relative byte	ROBONET⇒ PLC input (Upper byte / Lower byte)	Register address
F600*	Gateway control signal 0	0	Gateway status signal 0	F700*
F601	Gateway control signal 1	2	Gateway status signal 1	F701
F602	Request command	4	Response command	F702
F603	Data 0	6	Data 0	F703
F604	Data 1	8	Data 1	F704
F605	Data 2	10	Data 2	F705
F606	Data 3	12	Data 3	F706
F607	(Reserved)	14	(Reserved)	F707
F608	(Axis 0) Command position number	16	(Axis 0) Completed position number	F708
F609	(Axis 0) Control signal	18	(Axis 0) Status signal	F709
F60A	(Axis 1) Command position number	20	(Axis 1) Completed position number	F70A
F60B	(Axis 1) Control signal	22	(Axis 1) Status signal	F70B
F60C	(Axis 2) Command position number	24	(Axis 2) Completed position number	F70C
F60D	(Axis 2) Control signal	26	(Axis 2) Status signal	F70D
F60E	(Axis 3) Command position number	28	(Axis 3) Completed position number	F70E
F60F	(Axis 3) Control signal	30	(Axis 3) Status signal	F70F
F610	(Axis 4) Command position number	32	(Axis 4) Completed position number	F710
F611	(Axis 4) Control signal	34	(Axis 4) Status signal	F711
F612	(Axis 5) Command position number	36	(Axis 5) Completed position number	F712
F613	(Axis 5) Control signal	38	(Axis 5) Status signal	F713
F614	(Axis 6) Command position number	40	(Axis 6) Completed position number	F714
F615	(Axis 6) Control signal	42	(Axis 6) Status signal	F715
F616	(Axis 7) Command position number	44	(Axis 7) Completed position number	F716
F617	(Axis 7) Control signal	46	(Axis 7) Status signal	F717
F618	(Axis 8) Command position number	48	(Axis 8) Completed position number	F718
F619	(Axis 8) Control signal	50	(Axis 8) Status signal	F719
F61A	(Axis 9) Command position number	52	(Axis 9) Completed position number	F71A
F61B	(Axis 9) Control signal	54	(Axis 9) Status signal	F71B
F61C	(Axis 10) Command position number	56	(Axis 10) Completed position number	F71C
F61D	(Axis 10) Control signal	58	(Axis 10) Status signal	F71D
F61E	(Axis 11) Command position number	60	(Axis 11) Completed position number	F71E
F61F	(Axis 11) Control signal	62	(Axis 11) Status signal	F71F
F620	(Axis 12) Command position number	64	(Axis 12) Completed position number	F720
F621	(Axis 12) Control signal	66	(Axis 12) Status signal	F721
F622	(Axis 13) Command position number	68	(Axis 13) Completed position number	F722
F623	(Axis 13) Control signal	70	(Axis 13) Status signal	F723
F624	(Axis 14) Command position number	72	(Axis 14) Completed position number	F724
F625	(Axis 14) Control signal	74	(Axis 14) Status signal	F725
F626	(Axis 15) Command position number	76	(Axis 15) Completed position number	F726
F627	(Axis 15) Control signal	78	(Axis 15) Status signal	F727

* With the RS485 SIO type, the initial address is F600H (PLC ⇒ ROBONET) or F700H (ROBONET ⇒ PLC).

3.7.2 Gateway Control/Status Signals

In the address configuration of the Gateway R unit, the first two input words and output words are used to control the Gateway R unit.
These signals can be used to perform ON/OFF control of ROBONET communication (SIO control) and monitor the communication status as well as the status of the Gateway R unit.

PLC output

									Address*		
									CC-Link	DeviceNet	PROFIBUS RS485SIO
									—	Relative channel	Relative byte
Gateway control signal 0	b15	b14	b13	b12	b11	b10	b9	b8	RY 0*	+0	+0
	MON	—	RTE	RMOD	ECE	—	—	—			
	b7	b6	b5	b4	b3	b2	b1	b0			+1
	—	—	—	—	—	—	—	—			
Gateway control signal 1	b15	b14	b13	b12	b11	b10	b9	b8	RY 1*	+1	+2
	—	—	—	—	—	—	—	—			
	b7	b6	b5	b4	b3	b2	b1	b0			+3
	—	—	—	—	—	—	—	—			

PLC input

									Address*		
									CC-Link	DeviceNet	PROFIBUS RS485SIO
									—	Relative channel	Relative byte
Gateway status signal 0	b15	b14	b13	b12	b11	b10	b9	b8	RX 0*	+0	+0
	RUN	LERC	ERRT	MOD	—	—	W8B16	W8B8			
	b7	b6	b5	b4	b3	b2	b1	b0			+1
	W8B4	W8B2	W8B1	W4B16	W4B8	W4B4	W4B2	W4B1			
Gateway status signal 1	b15	b14	b13	b12	b11	b10	b9	b8	RX 1*	+1	+2
	LNK15	LNK14	LNK13	LNK12	LNK11	LNK10	LNK9	LNK8			
	b7	b6	b5	b4	b3	b2	b1	b0			+3
	LNK7	LNK6	LNK5	LNK4	LNK3	LNK2	LNK1	LNK0			

* Each address is a relative address from the beginning of the gateway.
Word addresses are used by the CC-Link and DeviceNet types, while byte addresses are used by the Profibus and RS485 SIO types.
With the CC-Link type, the asterisk (*) in bit register addresses is a value between 0 and F.
With the CC-Link type, b10 to b15 are indicated as bA to b7 (due to hexadecimal notation).
With the Profibus and RS485 SIO types, b8 to b15 are indicated as b0 to b7 (due to use of byte addresses).

I/O Signal List

Signal type		Bit	Signal name	Description	
PLC output	Control signal 0	15	MON	When this signal is ON ("1"), control outputs from the PLC are effective (outputs from the PLC are reflected in the controller unit). When the signal is OFF ("0"), the outputs are ineffective.	
		14	-	Cannot be used. Always keep this signal OFF (0).	
		13	RTE	If an ERR-T or ERR-C error has generated, free the locked bit by setting it to "1" (level input).	
		12	RMOD	AUTO/MANU Mode (ON : MANU, OFF : AUTO) It functions under the combination with AUTO/MANU Switch on the front panel of Gateway R Unit. The mode turns to AUTO Mode with the both are on AUTO while it is MANU Mode when one of them is on MANU. (Note) This signal is not linked to Fieldbus, thus it would not turn OFF even if Fieldbus turns offline.	
		11	ECE	Control is activated even during emergency stop when this signal is ON. (Those including operation are excluded.)	
		10-0	-		
	Control signal 1	15-0	RTE	Cannot be used.	
PLC input	Status signal 0	15	RUN	Gateway unit operation normal output	This signal is ON while the gateway unit is operating normally. The signal is synchronized with the LED (RUN) on the front panel of the unit.
		14	LERC	-	If an ERR-C error generates, this bit will be locked to the current status.
		13	ERRT	ROBONET communication error output	This signal turns ON upon detection of a ROBONET communication (SIO communication) error. The signal is synchronized with the ERROR-T LED on the front panel of the unit.
		12	MOD	MODE switch output	This signal is ON when the MODE switch on the front panel of the unit is set to MANU.
		11-10	-	-	Cannot be used.
		9 8 7 6 5	W8B16 W8B8 W8B4 W8B2 W8B1	Number-of-axes setting in direct numerical specification mode	The number of axes in the direct numerical specification mode is output as a 5-bit binary code.
		4 3 2 1 0	W4B16 W4B8 W4B4 W4B2 W4B1	Positioner mode or simple direct mode	The number of axes in the positioner mode or simple direct mode is output as a 5-bit binary code.
	Status signal 1	15	LNK15	Linked axis No. 15	The signal of each linked axis turns ON ("1").
		14	LNK14	14	
		13	LNK13	13	
		12	LNK12	12	
		11	LNK11	11	
		10	LNK10	10	
		9	LNK9	9	
		8	LNK8	8	
		7	LNK7	7	
		6	LNK6	6	
		5	LNK5	5	
		4	LNK4	4	
		3	LNK3	3	
		2	LNK2	2	
		1	LNK1	1	
		0	LNK0	0	

3.7.3 Command Area

The eight input words and eight output words from the initial address of the gateway unit are fixed areas. With both output and input, six words in this fixed area are assigned as a command area where various commands can be used to read/write the position table, among others.
Note that commands cannot be used in the direct numerical specification mode.

(1) Address Configuration

The request command area and response command area consist of six input words and six output words, respectively.

[1] CC-Link

*1	PLC output ⇒ Gateway ⇒ Axis input: b15 Upper byte b8	b7 Lower byte b0	Axis output ⇒ Gateway ⇒ PLC input: b15 Upper byte b8	b7 Lower byte b0	*1
RY 2F to 20	Request command		Response command		RX 2F to 20
RY 3F to 30	Data 0		Data 0		RX 3F to 30
RY 4F to 40	Data 1		Data 1 *2 (error code)		RX 4F to 40
RY 5F to 50	Data 2		Data 2		RX 5F to 50
RY 6F to 60	Data 3		Data 3		RX 6F to 60
RY 7F to 70	Cannot be used.		Cannot be used.		RX 7F to 70

*1) Bit register address
*2) If a command error occurs, the most significant bit (b15) of the response command will turn ON and an error code will be set in response data 1.

[1] DeviceNet, Profibus, RS485SIO

*1 Address Word	Byte	PLC output ⇒ Gateway ⇒ Axis input: b15 Upper byte b8	b7 Lower byte b0	Axis output ⇒ Gateway ⇒ PLC input: b15 Upper byte b8	b7 Lower byte b0
+2	+4/+5	Request command		Response command	
+3	+6/+7	Data 0		Data 0	
+4	+8/+9	Data 1		Data 1 *2 (error code)	
+5	+10/+11	Data 2		Data 2	
+6	+12/+13	Data 3		Data 3	
+7	+13/+14	Cannot be used.		Cannot be used.	

*1 Each address is a relative address from the beginning of the gateway, and word addresses are used by the DeviceNet type. With the Profibus and RS485 SIO types, byte addresses are used and b8 to b15 comprising the upper word are indicated as b0 to b7.
*2 If a command error occurs, the most significant bit (b15) of the response command will turn ON and an error code will be set in response data 1.

(2) Command List

The available command and command codes are listed below.

Function classification	Code	Explanation	Positioner 1 mode	Simple direct mode	Direct numerical specification mode	Positioner 2 mode	Solenoid valve modes 1, 2
Handshake	0000H	Clear request command	○	○	X	○	○
Position table data write *1	1000H	Write target position	○	○	X	○	○
	1001H	Write positioning band					
	1002H	Write speed					
	1003H	Write individual zone boundary+					
	1004H	Write individual zone boundary-					
	1005H	Write acceleration					
	1006H	Write deceleration					
	1007H	Write push-current limiting value					
	1008H	Write load current threshold					
Position table data read	1040H	Read target position	○	○	X	○	○
	1041H	Read positioning band					
	1042H	Read speed					
	1043H	Read individual zone boundary+					
	1044H	Read individual zone boundary-					
	1045H	Read acceleration					
	1046H	Read deceleration					
	1047H	Read push-current-limiting value					
	1048H	Read load current threshold					
Group-specific broadcast operation	0D03H	Simultaneous start to same POS number position	○	X	X	○	○

○: Available X: Not available

(3) Commands and Data Formats

The rewrite life of the position table memory is approx. 100,000 times. Accordingly, do not rewrite the position table constantly.

[1] Position table data write commands

Command name	Relative address from beginning			PLC output (request)	PLC input (response)
	CC-Link*8	DeviceNet	Profibus RS485SIO *1		
Write target position	RY 2*/RX 2*	+2	+4/+5	1000H	If the command has been successful, the same value set in the request is returned as a response. For error responses, refer to (4), "Error Responses."
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Position data *2	
	RY 5*/RX 5*	+5	+10/+11		
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH *3	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write positioning band	RY 2*/RX 2*	+2	+4/+5	1001H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Positioning band data *4	
	RY 5*/RX 5*	+5	+10/+11		
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write speed	RY 2*/RX 2*	+2	+4/+5	1002H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Speed data *5	
	RY 5*/RX 5*	+5	+10/+11		
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write individual zone boundary+	RY 2*/RX 2*	+2	+4/+5	1003H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Position data *2	
	RY 5*/RX 5*	+5	+10/+11		
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write individual zone boundary-	RY 2*/RX 2*	+2	+4/+5	1004H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Position data *2	
	RY 5*/RX 5*	+5	+10/+11		
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write acceleration	RY 2*/RX 2*	+2	+4/+5	1005H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Acceleration data *6	
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	

Command name	Relative address from beginning			PLC output (request)	PLC input (response)
	CC-Link	DeviceNet	Profibus RS485SIO *1		
Write deceleration	RY 2*/RX 2*	+2	+4/+5	1006H	If the command has been successful, the same value set in the request is returned as a response. For error responses, refer to (4), “Error Responses.”
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	Deceleration data *6	
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write push-current limiting value *7	RY 2*/RX 2*	+2	+4/+5	1007H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0000 to 00FFH (00FFH, maximum current)	
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Write load current threshold	RY 2*/RX 2*	+2	+4/+5	1008H	
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0000 to 00FFH (00FFH, maximum current)	
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	

*1 In byte address specification, the smaller byte address on the left corresponds to the upper byte of 1-word data, while the larger byte address on the right corresponds to the lower byte of 1-word data.

*2
- Set as a hexadecimal number using a 32-bit signed integer (unit: 0.01 mm).
  Example) To set +25.4 mm, specify “0009ECH” (decimal number: 2540).
- The maximum settable value is +9999.99 mm = 999999 (decimal number) = 0F423FH (hexadecimal number).
- Since a negative value is indicated as a 2’s complement, the most significant bit becomes “1.”
- Set position data within the soft stroke range.

*3 Axis numbers (0) to (15) correspond to data 00 to 0FH.

*4
- Set as a hexadecimal number using a 32-bit signed integer (unit: 0.01 mm).
  Example) To set +25.4 mm, specify “0009ECH” (decimal number: 2540).
- Set within the soft stroke range.

*5
- Set as a hexadecimal number using a 32-bit integer (unit: 0.01 mm/sec).
  Example) To set 200 mm/sec, specify “000000C8H” (decimal number: 200).

*6
- Set as a hexadecimal number using a 16-bit integer (unit: 0.01 G).
  Example) To set 0.2 G, specify “0014H” (decimal number: 20).
- The maximum settable value is 2G, specifying “00C8H” (decimal number: 200)

*7 If push-current limiting value is not set in the position table before the write command is executed, the data will not be rewritten.

*8 The asterisk (*) in CC-Link addresses is a value between 0 and F.

[2] Position table data read commands

Command name	Relative address from beginning			PLC output (request)	PLC input (response)
	CC-Link*6	DeviceNet	Profibus RS485SIO *1		
Read target position	RY 2*/RX 2*	+2	+4/+5	1040H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	Target position data *2
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH*1	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read positioning band	RY 2*/RX 2*	+2	+4/+5	1041H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	Positioning band data *3
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read speed	RY 2*/RX 2*	+2	+4/+5	1042H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	Speed data *4
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read individual zone boundary+	RY 2*/RX 2*	+2	+4/+5	1043H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	Individual zone boundary+ data *2
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read individual zone boundary-	RY 2*/RX 2*	+2	+4/+5	1044H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	Individual zone boundary- data *2
	RY 5*/RX 5*	+5	+10/+11	0	
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read acceleration	RY 2*/RX 2*	+2	+4/+5	1045H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	Acceleration data *5
	RY 5*/RX 5*	+5	+10/+11	0	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	

Command name	Relative address from beginning			PLC output (request)	PLC input (response)
	CC-Link*6	DeviceNet	Profibus RS485SIO *1		
Read deceleration	RY 2*/RX 2*	+2	+4/+5	1046H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Deceleration read POS number	
	RY 4*/RX 4*	+4	+8/+9	0	Deceleration data *5
	RY 5*/RX 5*	+5	+10/+11	0	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read push-current-limiting value	RY 2*/RX 2*	+2	+4/+5	1047H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	0000 to 00FFH (00FFH, maximum current)
	RY 5*/RX 5*	+5	+10/+11	0	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	
Read load current threshold	RY 2*/RX 2*	+2	+4/+5	1048H	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 3*/RX 3*	+3	+6/+7	Position number	
	RY 4*/RX 4*	+4	+8/+9	0	0000 to 00FFH (00FFH, maximum current)
	RY 5*/RX 5*	+5	+10/+11	0	If the command has been successful, the value returned in the response is the same as the value set in the request.
	RY 6*/RX 6*	+6	+12/+13	Axis number 0 to FH	
	RY 7*/RX 7*	+7	+14/+15	Cannot be used.	

*1 Axis numbers (0) to (15) correspond to data 00 to 0FH.
*2 32-bit signed integer data. The details are the same as described in *2 under [1].
*3 32-bit integer data. The details are the same as described in *4 under [1].
*4 32-bit integer data. The details are the same as described in *5 under [1].
*5 16-bit integer data. The details are the same as described in *6 under [1].
*6 The asterisk (*) in addresses is a value between 0 and F.

[3] Group-specific broadcast operation commands
These operations can be used in the positioner mode.
The axes specified by the group number are started simultaneously to the position specified by the POS number. Since these commands implement broadcast communication between the gateway and controllers, no response is returned from the controllers.
The response result indicated by the PLC input means that the command has been successfully sent to the controllers; it does not indicate the status of each controller. position complete, etc., based on the status signal of each axis.

Relative address from beginning			PLC output (request)	PLC input (response)
CC-Link*3	DeviceNet	Profibus RS485SIO *1		
RY 2*/RX 2*	+2	+4/+5	0D03H	If the command has been successful, the value returned in the response is the same as the value set in the request.
RY 3*/RX 3*	+3	+6/+7	Target POS number	
RY 4*/RX 4*	+4	+8/+9	Group ID number *1	
RY 5*/RX 5*	+5	+10/+11	0	
RY 6*/RX 6*	+6	+12/+13	0	
RY 7*/RX 7*	+7	+14/+15	Cannot be used.	

*1 If this value is “0,” all linked axes will move regardless of the group specification.
The group number is set using a system parameter in the PC software.
*2 If a move command is issued using an axis-specific control word while any axis is currently moving by this command, the movement by the original command will be cancelled and the axis specified by the latest move command will operate according to the command. In other words, each axis has two interfaces for move commands.
Provide an interlock to prevent two commands from being issued simultaneously.
*3 The asterisk (*) in addresses is a value between 0 and F.

(4) Error Responses

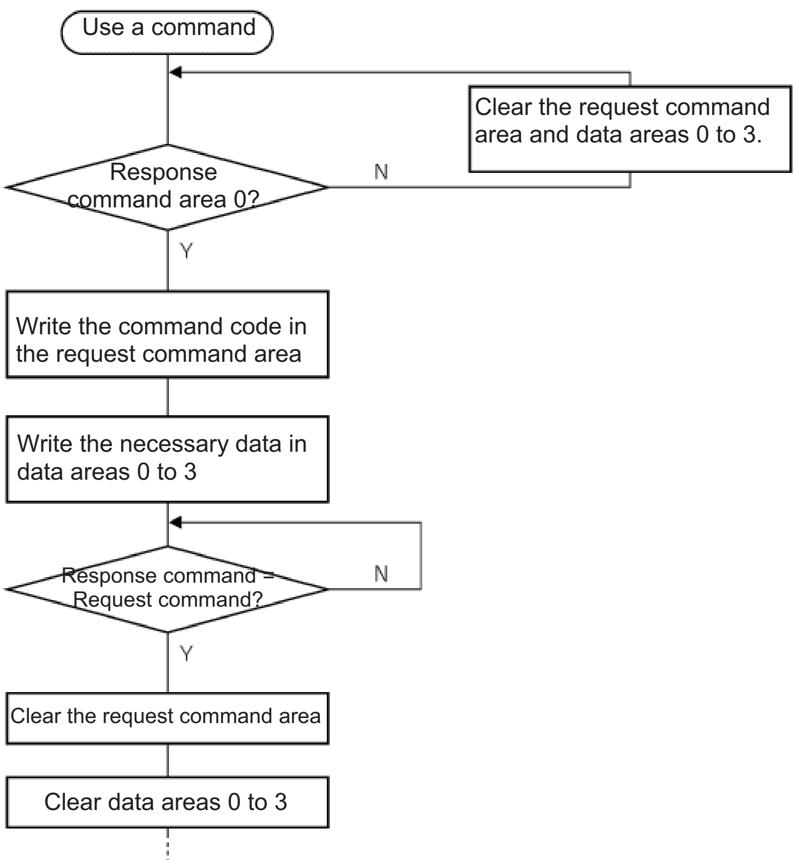
If a command error occurs, the most significant bit (b15) of the response command will turn ON and an error code will be set in response data 1.

Code	Explanation
0101H	Invalid axis number *1
0102H	Invalid position number *1
0103H	Invalid request command *1
0201H	Communication failed
0202H	Controller could not execute the command

*1 If an error is found in the data from the PLC as a result of check, the data will not be sent to the controller, but an error code will be set in the response data instead.
*2 If no link is established yet, nothing will be shown in the response command.

(5) How to Use Commands

To use various commands, process the data in command areas according to the flow shown below. In this flow, only one command is processed.



3.7.4 Position Table

RACON and RPCON controllers can be operated in one of six modes—positioner mode 1, 2, simple direct mode, direct numerical specification mode and solenoid valve mode 1, 2—using one of four types of Gateway R units.
To perform positioning operation in the positioner mode or simple direct mode, a position table must be created beforehand using a teaching tool. For details on how to set a position table, refer to "PC Software RCM-101-** Operation Manual" or "CON-T Teaching Pendant Operation Manual."
As explained in the previous section, the position table can also be read or written from the host PLC using various commands. Take note, however, that the position table can be written only 100,000 times or so.

The position table is explained using the screen of the PC software as an example.
(The display is different on the teaching pendant.)

No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]	Threshold [%]	Positioning band [mm]	Zone+ [mm]	Zone- [mm]	Acceleration /deceleration mode	Incremental	Command mode	Stop mode	Comment
0	5.00	300.00	0.30	0.30	0	0	0.10	100.00	0.00	0	0	0	0	
1	380.00	300.00	0.30	0.10	0	0	0.10	400.00	300.00	0	0	0	0	
2	200.00	300.00	0.30	0.10	0	0	0.10	250.00	150.00	0	0	0	0	

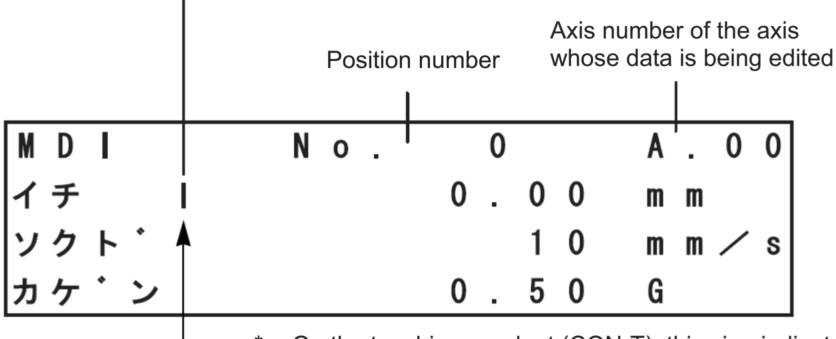
(1) No. • A position data number is indicated.

(2) Position • Input the target position to which to move the actuator [mm].
Absolute coordination specification: Input the distance from the actuator home.
Relative coordination specification: Constant pitch feed is assumed. The specified value represents a relative distance from the current position.

No.	Position [mm]	
0	5.00	Absolute coordination specification: The target position is 5 mm from the home.
1	= 10.00	Relative coordination specification: The target position is 10 mm plus the current position.
2	= −10.00	Relative coordination specification: The target position is 10 mm minus the current position.

* On the teaching pendant (RCM-T), this sign indicates that the position is specified in relative coordinates.

A: Absolute coordinate specification (ABS)
I: Relative coordinate specification (INC)

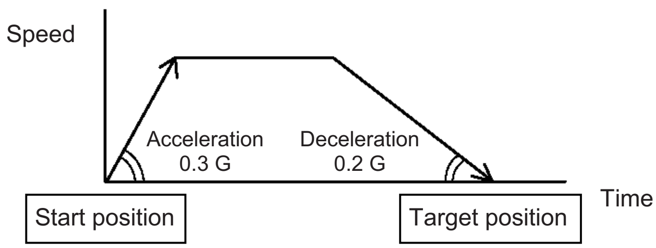


* On the teaching pendant (CON-T), this sign indicates that the position is specified in relative coordinates.

(3) Speed • Input the speed at which to move the actuator [mm/sec].
The default varies according to the actuator type.

(4) Acceleration/Deceleration

- Input the acceleration/deceleration at which to move the actuator (unit: [G]). Input a value within the rated range.
  (Refer to Appendix, "Specification List of Supported Actuators.")
  Exercise caution when setting the acceleration/deceleration, because the input range is greater than the rated range in the catalog.
  If the transferring load vibrates during acceleration/deceleration to cause problems, decrease the set value.



Increasing the value will make the acceleration/deceleration curve sharper, while decreasing the value will make the curve more gradual.

⚠ Caution

Refer to Appendix, "Specification List of Supported Actuators" and input appropriate values for speed and acceleration/deceleration by considering the installation conditions and the shape of the transferring load, so that the actuator will not receive excessive impact or vibration.
Take note that increasing this value will significantly affect the allowable transferring mass, or may even cause a system failure.

(5) Push

- Select "positioning operation" or "push operation."
  The factory setting is "0."
  0: Normal positioning operation
  Other than 0: The set value indicates a current-limiting value. The push operation mode is selected when a current-limiting value is set.

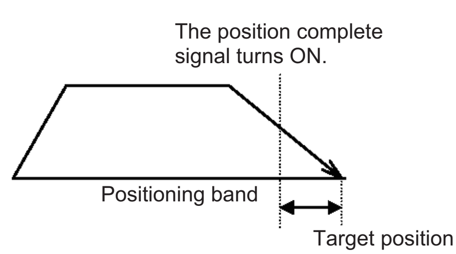
(6) Threshold

- This field is not used with this controller.
  The factory setting is "0."

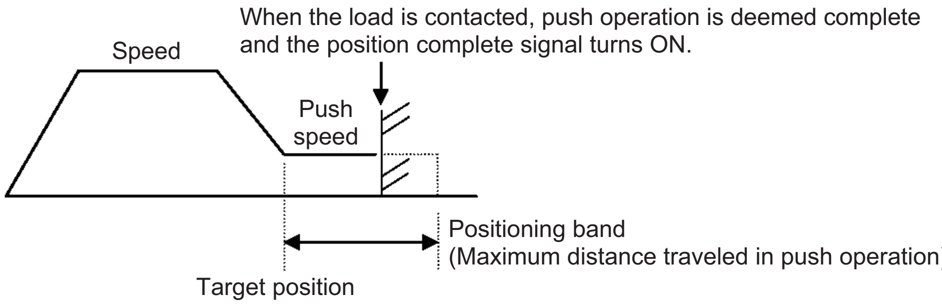
(7) Positioning Band

- How the set value is handled varies between "positioning operation" and "push operation."

"Positioning operation"
This field defines how much before the target position the position complete signal is turned ON.
Even after the position complete signal turns ON, the actuator will continue to move toward the target position.
Increasing the positioning band will quicken the start of the next sequence, which helps reduce the tact time. Set an optimal value by considering the balance of the entire system.



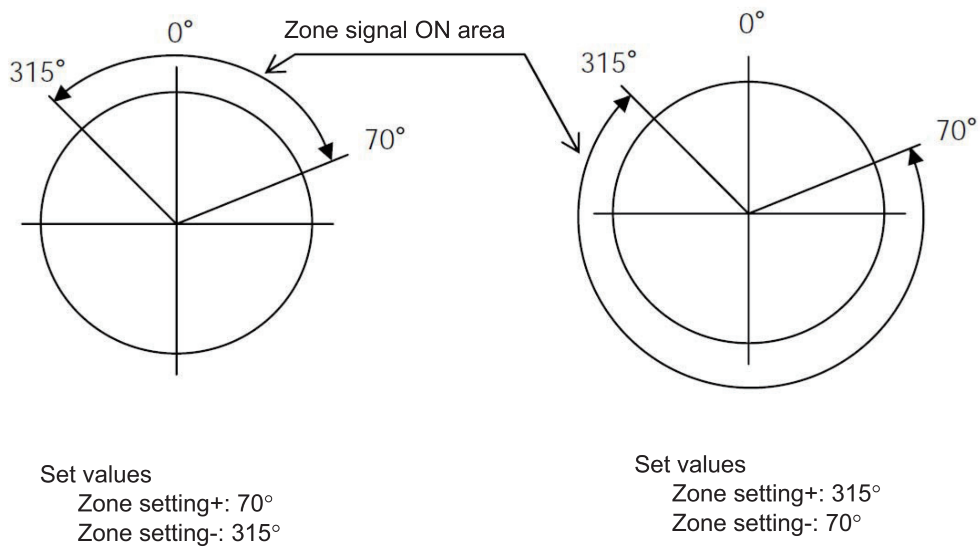
"Push operation"
This field defines the maximum distance traveled from the target position in push operation.
Consider the mechanical variation of the work part and set an appropriate positioning band so that the positioning will not complete before the actuator contacts the work part.



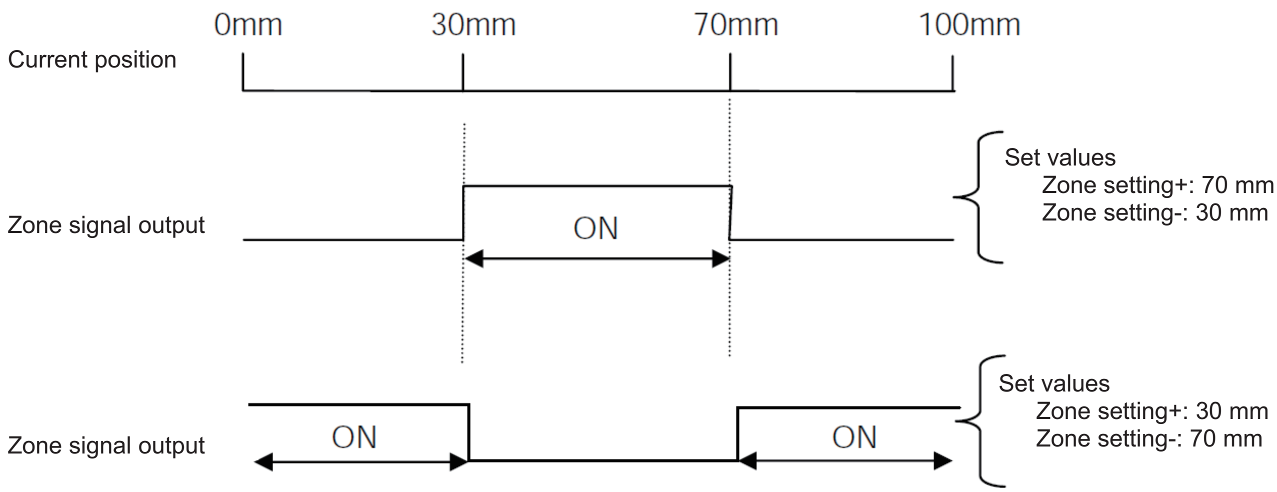
(8) Zone+/-

- These fields define the zone within which the zone output signal turns ON.
  A separate zone can be set for each target position.
  Only the zone setting for the currently executed position number becomes effective, and the zone settings for all other position numbers remain ineffective.

[Rotary actuator in the index mode]



[Linear axis]



Caution

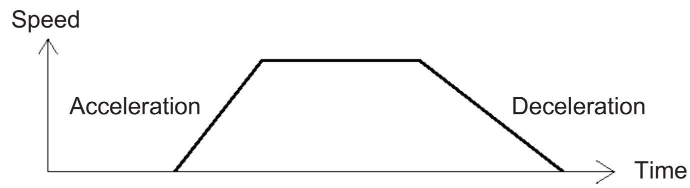
The specifics of the zone function vary depending on the application version.

- In applications of version 0015 and older, zone signals will not be output if the parameters are set as follows:
  Zone setting+ ≤ Zone setting-
- In applications of version 0016 and later, zone signals will not be output if the parameters are set as follows:
  Zone setting+ = Zone setting-

(9) Acceleration/Deceleration Mode

- This field defines the acceleration/deceleration pattern characteristics.
  The factory setting is "0."
  0: Trapezoid pattern
  1: S-motion
  2: Primary delay filter

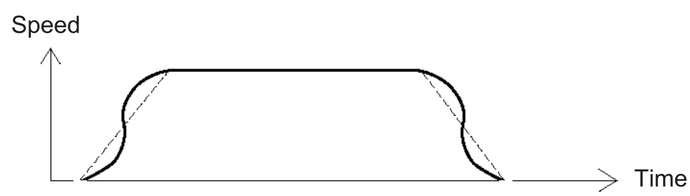
Trapezoid Pattern



The acceleration and deceleration are set in the "Acceleration" and "Deceleration" fields of the position table, respectively.

S-motion

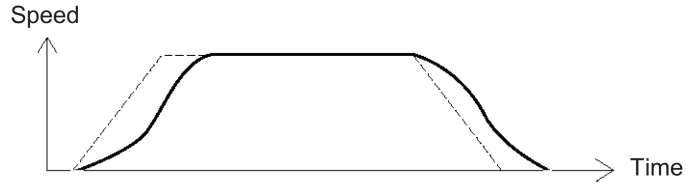
The actuator accelerates over a curve that increases gradually at first and then rises sharply in the middle.
Use this pattern if you want to set the acceleration/deceleration high to meet the tact time requirement, but still want the actuator to accelerate and decelerate gradually immediately after starting and before stopping.



The S-motion level is set in parameter No. 56, "S-motion ratio setting." The setting unit is %, and the setting range is 0 to 100.
(The above graph assumes a ratio of 100%.)
When this parameter is set to "0," the S-motion mode will be disabled.
Note, however, that the parameter will not be reflected in jogging or inching feed operated from a PC or teaching pendant.
Although the acceleration/deceleration time does not change, the value of acceleration/deceleration becomes greater than the acceleration/deceleration set in the position table (by up to twice), as shown in the above graph.

Primary Delay Filter

The actuator accelerates/decelerates over a curve that is more gradual than in linear acceleration/deceleration (trapezoid pattern). Use this pattern if you don't want the work part to receive micro-vibration during acceleration/deceleration.



The primary delay level is set in parameter No. 55, "Position-command primary filter time constant." The setting unit is msec, and a desired value can be set in a range of 0.0 to 100.0 in 0.1-msec steps.
If this parameter is set to "0," the primary delay filter will be disabled.
Note, however, that the parameter will not be reflected in jogging or inching feed operated from a PC or teaching pendant.

(10) Incremental

- This field defines either absolute coordinate specification or relative coordinate specification.
  The factory setting is "0."
  0: Absolute coordinate specification
  1: Relative coordinate specification

(11) Command Mode

- This field is not used with this controller.
  The factory setting is "0."

(12) Stop mode

- This field is invalid with RACON controllers.
- With RPCON controllers, define the power-saving method to be applied during the standby period after completion of positioning to the target position set in the "Position" field of the position number table.
  0: Disable the power-saving mode
  4: Full-servo control method

Full-servo control method

The holding current can be reduced by servo-controlling the pulse motor.
Although the degree of reduction varies depending on the actuator model, load condition, etc., the holding current will drop to approx. 1/2 to 1/4.
Under this method, the servo remains on and therefore position deviation will not occur.
The actual holding current can be checked on the current monitor screen of the PC software.

3.7.5 Assignments in the Positioner 1 Mode or Simple Direct Mode

Assignments in the positioner 1 mode or simple direct mode are shown below.

PLC output = Axis control signal

1 word = 16 bits

Address* CC-Link	Address* DeviceNet	Address* PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	Position data specification (Signed integer)															
RWw (m+1)	n+1	n+2 n+3	Position data specification (Signed integer)															
RWw (m+2)	n+2	n+4 n+5	–	–	–	–	–	–	PC512	PC256	PC128	PC64	PC32	PC16	PC8	PC4	PC2	PC1
			Command position Number (Signed integer)															
RWw (m+3)	n+3	n+6 n+7	BKRL	–	–	–	–	MODE	PWRT	JOG+	JOG–	JVEL	JISL	SON	RES	STP	HOME	CSTR
			Control signal															

PLC input = Axis status signal

Address* CC-Link	Address* DeviceNet	Address* PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	Current position data (Signed integer)															
RWr (m+1)	n+1	n+2 n+3	Current position data (Signed integer)															
RWr (m+2)	n+2	n+4 n+5	–	–	–	–	–	–	PM512	PM256	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1
			Completed position Number															
RWr (m+3)	n+3	n+6 n+7	EMGS	CRDY	ZONE2	ZONE1	PZONE	MODES	WEND	–	–	–	PSFL	SV	ALM	MOVE	HEND	PEND
			Status signal															

* m indicates the initial register address of each axis.
n indicates the relative address at the beginning of each address.
The CC-Link and DeviceNet types use word addresses, while the Profibus and RS485 SIO types use byte addresses.

I/O Signal List

Signal type		Bit	Signal name	Description	Positioner	Simple direct	Details
PLC output	Position data specification	32-bit data	-	Set as a hexadecimal number using a 32-bit signed integer (unit: 0.01 mm) Example) To set +25.4 mm, specify "0009EC" (decimal number: 2540). ● The maximum settable value is +9999.99 mm = 999999 (decimal number) = 0F423FH (hexadecimal number). ● If the applicable data is a negative value, specify it as a complement of 2.	X	○	3.8.3 (4)
	Command position number	b9-b0	PC***	Set the command position number as a binary number.	○	X	3.8.2 (11)
				Move data other than the specified position data is set in the position table. Specify the position number as a binary number.	X	○	3.8.3 (3)
	Control signal	b15	BKRL	Forced brake release	○	○	3.8.2 (19)
		b10	MODE	Teaching mode command	○	X	3.8.2 (17)
		b9	PWRT	Position data load command	○	X	3.8.2 (18)
		b8	JOG+	Jog+ command	○	○	3.8.2 (14)
		b7	JOG-	Jog- command	○	○	
		b6	JVEL	Jogging speed/inching distance switching	○	○	3.8.2 (15)
		b5	JISL	Jogging/inching switching	○	○	3.8.2 (16)
		b4	SON	Servo ON command	○	○	3.8.2 (5)
		b3	RES	Reset command	○	○	3.8.2 (4)
		b2	STP	Pause command	○	○	3.8.2 (10) 3.8.4 (2)
		b1	HOME	Home return command	○	○	3.8.2 (6)
		b0	CSTR	Start command	○	○	3.8.2 (7)

○: Available X: Not available

I/O Signal List

Signal type		Bit	Signal name	Description	Positioner	Simple direct	Details
PLC input	Current position data	32-bit data	-	Output as a hexadecimal number using a 32-bit signed integer (unit: 0.01 mm). Example) To set +25.4 mm, specify "0009EC" (decimal number: 2540). ● The maximum settable value is +9999.99 mm = 999999 (decimal number) = 0F423FH (hexadecimal number). ● If the applicable data is a negative value, a complement of 2 is displayed.	○	○	3.8.3 (4)
	Completed position number	b9-b0	PM***	The completed position number is read as a binary number. A simple alarm code is output while an alarm is present.	○	○	3.8.2 (12) 3.8.3 (3)
	Control signal	b15	EMGS	Emergency stop status	○	○	3.8.2 (2)
		b14	CRDY	Controller ready	○	○	3.8.2 (1)
		b13	ZONE2	Zone output monitor 1	○	○	3.8.2 (13)
		b12	ZONE1	Zone output monitor 2	○	○	
		b11	PZONE	Position zone output monitor	○	X	
		b10	MODES	Teaching mode status	○	X	3.8.2 (18)
		b9	WEND	Position data load command status	○	X	3.8.2 (18)
		b8	-	Can not be used.	-	-	-
		b7	LOAD	Load output judgement	○	○	3.8.2 (24)
		b6	TRQS	Torque level	○	○	3.8.2 (25)
		b5	PSFL	Missed work part in push operation	○	○	3.8.4 (1)
		b4	SV	Ready (servo ON)	○	○	3.8.2 (5)
		b3	ALM	Alarm present	○	○	3.8.2 (3)
		b2	MOVE	Moving	○	○	3.8.2 (8)
		b1	HEND	Home return complete	○	○	3.8.2 (6)
		b0	PEND	Position complete	○	○	3.8.2 (9)

○: Available X: Not available

[Alarm List]
Listed below are simple alarm codes that will be output when the respective alarms generate.
For details, refer to Part 3, "Maintenance."
Simple alarm codes and alarm codes are given as hexadecimal numbers.
* Simple alarm codes are indicated by the STATUS0 to 3 LEDs on the controller unit.

●: ON X: OFF ○: Available X: Not available

PM 512	PM 256	PM 128	PM 64	PM 32	PM 16	PM 8	PM 4	PM 2	PM 1	Simple* alarm code	Alarm code	Alarm name	RPCON	RACON
X	X	X	X	X	X	X	X	●	X	2	90	Software reset command with servo ON	○	○
											91	Position number error during teaching	○	○
											92	PWRT signal detection during movement	○	○
											93	PWRT signal detection before home return	○	○
X	X	X	X	X	X	X	X	●	●	3	80	Move command with servo OFF	○	○
											82	Position command before home return	○	○
											83	Absolute position move command before home return	○	○
											84	Move command during home return	○	○
											85	Position number error during movement	○	○
											A7	Command deceleration error	○	○
X	X	X	X	X	X	X	●	X	X	4	F4	PCB mismatch error	○	○
X	X	X	X	X	X	X	●	●	X	6	A1	Parameter data error	○	○
											A2	Position data error	○	○
											A3	Position command information data error	○	○
X	X	X	X	X	X	X	●	●	●	7	B6	Phase-Z detection timeout	X	○
											B7	Indeterminable magnetic pole	X	○
											B8	Excited phase detection error	○	X
											BA	Home sensor not detected	○	○
											BE	Home return timeout	○	○
X	X	X	X	X	X	●	X	X	X	8	C0	Excessive actual speed	○	○
X	X	X	X	X	X	●	X	X	●	9	C8	Overcurrent	X	○
											C9	Overvoltage	○	○
											CA	Overheat	○	○
											CB	Current sensor offset adjustment error	X	○
											CC	Control power-supply voltage error	○	○
											CE	Control power-supply voltage low	○	○
X	X	X	X	X	X	●	X	●	●	B	D8	Deviation overflow	○	○
											D9	Software stroke limit over error	○	○
											DC	Push operation range over error	○	○
											A4	Command counter overflow	○	○
X	X	X	X	X	X	●	●	X	X	C	C1	Servo error	○	X
											D2	Motor power-supply overvoltage	X	○
											E0	Overload	X	○
											F0	Driver logic error	X	○
X	X	X	X	X	X	●	●	X	●	D	E5	Encoder receive error	○	○
											E8	Phase A/B open	○	○
											E9	Phase A open	○	X
											EA	Phase B open	○	X
											ED	Absolute encoder error detection 1	○	○
											EE	Absolute encoder error detection 2	○	○
											EF	Absolute encoder error detection 3	○	○
X	X	X	X	X	X	●	●	●	X	E	FA	CPU error	○	○
											FC	Logic error	○	○
X	X	X	X	X	X	●	●	●	●	F	F5	Nonvolatile memory write verification error	○	○
											F6	Nonvolatile memory write timeout	○	○
											F8	Nonvolatile memory data damage	○	○

3.7.6 Assignments in the Direct Numerical Specification Mode

Assignments in the direct numerical specification mode are shown below.
Set the push-current limiting value, acceleration/deceleration and speed within the ranges specified for the applicable actuator, and set the target position data within the soft stroke range.

Setting units:	Current-limiting value = 1%, Acceleration/deceleration = 0.01 G, Speed = 1.0 mm/sec or 0.1 mm/sec Position data/positioning band = 1/100 mm,

PLC output = Axis control signal

Address*

1 word = 16 bits

CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1																	Position data specification (Signed integer)
RWw (m+1)	n+1	n+2 n+3																	Position data specification (Signed integer)
RWw (m+2)	n+2	n+4 n+5	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1	Positioning band
RWw (m+3)	n+3	n+6 n+7	–	–	–	–	–	–	–	–	–	–	–	–	524,288	262,144	131,072	65,536	Positioning band
RWw (m+4)	n+4	n+8 n+9	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1	Speed
RWw (m+5)	n+5	n+10 n+11	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1	Acceleration/deceleration
RWw (m+6)	n+6	n+12 n+13	–	–	–	–	–	–	–	256	128	64	32	16	8	4	2	1	Push-current limiting value
RWw (m+7)	n+7	n+14 n+15	BKRL	–	DIR	PUSH	–	–	–	JOG+	JOG–	JVEL	JISL	SON	RES	STP	HOME	CSTR	Control signal

* m indicates the initial register address of each axis.
n indicates the relative address at the beginning of each address.
The CC-Link and DeviceNet types use word addresses, while the Profibus and RS485 SIO types use byte addresses.

PLC input = Axis status signal

1 word = 16 bits

Address* CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1																	Current position data (Signed integer)
RWr (m+1)	n+1	n+2 n+3																	Current position data (Signed integer)
RWr (m+2)	n+2	n+4 n+5																	Actual motor current (Signed integer)
RWr (m+3)	n+3	n+6 n+7																	Actual motor current (Signed integer)
RWr (m+4)	n+4	n+8 n+9	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1	Current speed
RWr (m+5)	n+5	n+10 n+11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	(Cannot be used.)
RWr (m+6)	n+6	n+12 n+13																	Alarm code
RWr (m+7)	n+7	n+14 n+15	EMGS	CRDY	ZONE2	ZONE1	–	–	–	MEND	–	–	PSFL	SV	ALM	MOVE	HEND	PEND	Status signal

* m indicates the initial register address of each axis.
n indicates the relative address at the beginning of each address.
The CC-Link and DeviceNet types use word addresses, while the Profibus and RS485 SIO types use byte addresses.

I/O Signal List

Signal type		Bit	Signal name	Description	Details
PLC output	Position data specification	32-bit data	-	Set as a hexadecimal number using a 32-bit signed integer (unit: 0.01 mm) Example) To set +25.4 mm, specify "0009ECH" (decimal number: 2540). ● The maximum settable value is +9999.99 mm = 999999 (decimal number) = 0F423FH (hexadecimal number). ● If the applicable data is a negative value, specify it as a complement of 2. ● Set the position data within the soft stroke range.	3.8.3 (5)
	Positioning band	32-bit data	-	Set as a hexadecimal number using a 32-bit integer (unit: 0.01 mm). Example) To set +25.4 mm, specify "0009ECH" (decimal number: 2540). ● Set the position data within the soft stroke range. ● Set the direction of push operation using the DIR. ● Take note that if positioning band specification data is not set, the setting of parameter No. 10, "Default positioning band" will not be applied.	3.8.3 (5)
	Speed	16-bit data	-	Set as a hexadecimal number using a 16-bit integer (unit: 1.0 mm/sec or 0.1 mm/sec). Example) To set 200 mm/sec, specify "00C8H" (decimal number: 200). ● If speed is not set, or the set speed is "0," the actuator will remain stopped and no alarm will generate. If the speed setting is changed to "0" while the actuator is moving, the actuator will decelerate to a stop. ● Change the unit on the special parameter setting screen of the ROBONET gateway parameter setting tool. (The unit change function is supported by applications of version 1.0.4.0 and later.) (The factory setting is 1.0 mm/sec.)	3.8.3 (5)
	Acceleration/ deceleration	16-bit data	-	Set as a hexadecimal number using a 16-bit integer (unit: 0.01 G). Example) To set 0.2 G, specify "0014H" (decimal number: 20). The maximum value is 2 G, corresponding to "00C8H" (decimal number: 200). ● Take note that if acceleration/deceleration is not set, the setting of parameter No. 9, "Default acceleration/deceleration" will not be applied. ● Separate values cannot be set for acceleration and deceleration. The acceleration and deceleration are always the same.	3.8.3 (5)

I/O Signal List

Signal type		Bit	Signal name	Description	Details
PLC output	Push-current limiting value	8-bit data	-	Set the push-current limiting value as a hexadecimal number (unit: %) to set the push force. The setting range is 00H to FFH, where FFH and 1FFH correspond to 100% and 200%, respectively. Example) To set 50%, specify FFH x 50% = 255 x 50% = 127 (decimal number) = “7FH.”	3.8.3 (5)
	Control signal	b15	BKRL	Forced brake release	3.8.2 (19)
		b14	-	Cannot be used.	-
		b13	DIR	Push direction specification (0 = Home return direction, 1 = Opposite home return direction)	3.8.3 (5) 3.8.4 (1)
		b12	PUSH	Push operation mode specification	
		b11	-	Cannot be used.	-
		b10	-	Cannot be used.	-
		b9	-	Cannot be used.	-
		b8	JOG+	Jog+ command	3.8.2 (14)
		b7	JOG-	Jog- command	
		b6	JVEL	Jogging speed/inching distance switching	3.8.2 (15)
		b5	JISL	Jogging/inching switching	3.8.2 (16)
		b4	SON	Servo ON command	3.8.2 (5)
		b3	RES	Reset command	3.8.2 (4)
		b2	STP	Pause command	3.8.2 (10) 3.8.4 (2)
		b1	HOME	Home return command	3.8.2 (6)
		b0	CSTR	Start command	3.8.2 (7)

I/O Signal List

	Signal type	Bit	Signal name	Description	Details
PLC input	Current position data	32-bit data	-	The current position data is output as a hexadecimal number using a 32-bit signed integer (unit: 0.01 mm). Example) If the data is +25.4 mm, "000009ECH" (decimal number: 2540) is output. ● Since a negative value is indicated as a 2' s complement, the most significant bit becomes "1."	3.8.3 (5)
	Actual motor current	32-bit data	-	The actual motor current data is output as a hexadecimal number using a 32-bit signed integer (unit: mA). Example) If the data is +1 A (1000 mA), "000003EH8 (decimal number: 1000) is output. ● Since a negative value is indicated as a 2' s complement, the most significant bit becomes "1."	3.8.3 (5)
	Current speed	16-bit data	-	Output as a hexadecimal number using a 16-bit integer (unit: 1.0 mm/sec). Example) If the data is 200 mm/sec, "00C8H" (decimal number: 200) is output.	3.8.3 (5)
	Alarm code	16-bit data	-	The present alarm code is output. (The ALM is turned ON.) Refer to the list in 3.7.5 for the alarm details. Take note that these are not simple alarm codes.	3.7.5
	Status signal	b15	EMGS	Emergency stop mode	3.8.2 (2)
		b14	CRDY	Controller ready	3.8.2 (1)
		b13	ZONE2	Zone output monitor 2	3.8.2 (13)
		b12	ZONE1	Zone output monitor 1	
		b11	-	Cannot be used.	-
		b10-b9	-	Cannot be used.	-
		b8	MEND	Movement command complet	3.8.2 (26)
		b7-b6	-	Cannot be used.	-
		b5	PSFL	Missed work part in push operation	3.8.3 (5) 3.8.4 (1)
		b4	SV	Ready (servo ON)	3.8.2 (5)
		b3	ALM	Alarm present	3.8.2 (3)
		b2	MOVE	Moving	3.8.2 (8)
		b1	HEND	Home return complete	3.8.2 (6)
		b0	PEND	Position complete	3.8.2 (9)

3.7.7 Assignment in Positioner 2 Mode

Assignment in the positioner 2 mode is explained below.

PLC output = Axis control signal

1 word = 16 bits

Address* CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	–	–	–	–	–	–	PC512	PC256	PC128	PC64	PC32	PC16	PC8	PC4	PC2	PC1	Command position number
RWw (m+1)	n+1	n+2 n+3	BKRL	–	–	–	–	MODE	PWRT	JOG+	JOG–	JVEL	JISL	SON	RES	STP	HOME	CSTR	Control signal

PLC input = Axis status signal

Address* CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
RWr (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	–	–	–	–	–	–	PM512	PM256	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1	Completed position number
RWr (m+1)	n+1	n+2 n+3	EMGS	CRDY	ZONE2	ZONE1	PZONE	MODES	WEND	–	–	–	PSFL	SV	ALM	MOVE	HEND	PEND	Status signal

* m indicates the initial register address of each axis.
n indicates the relative address at the beginning of each address.
The CC-Link and DeviceNet types use word addresses, while the Profibus and RS485 SIO types use byte addresses.
The I/O signal list and alarm list are the same as those of the positioner 1 mode. Refer to 3.7.5.

3.7.8 Signal Assignments in Solenoid Valve Mode 1

Signal assignments in solenoid valve mode 1 are shown below.

PLC output = Axis control signal

1 word = 16 bits

Address* CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	–	–	–	–	–	–	–	–	–	ST6	ST5	ST4	ST3	ST2	ST1	ST0
			Command position number															
RWw (m+1)	n+1	n+2 n+3	BKRL	–	–	–	–	–	–	–	–	–	–	SON	RES	STP	HOME	–
			Control signal															

PLC input = Axis status signal

Address* CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RWr (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	–	–	–	–	–	–	–	–	–	PE6	PE5	PE4	PE3	PE2	PE1	PE0
			Completed position number															
RWr (m+1)	n+1	n+2 n+3	EMGS	–	–	ZONE1	PZONE	–	–	–	–	–	–	SV	ALM	–	HEND	PEND
			Status signal															

* m indicates the first register address of each axis.
n indicates the relative address at the beginning of each axis.
Word addresses are used for CC-Link and DeviceNet networks, while byte addresses are used for Profibus and RS485SIO networks.

I/O Signal List

Signal type		Bit	Signal	Description	Details
PLC output	Command position number	b15-b7	-	Cannot be used.	-
		b6	ST6	Start position command 6	3.8.2. (20)
		b5	ST5	Start position command 5	
		b4	ST4	Start position command 4	
		b3	ST3	Start position command 3	
		b2	ST2	Start position command 2	
		b1	ST1	Start position command 1	
		b0	ST0	Start position command 0	
	Control signal	b15	BKRL	Forced brake release	3.8.2. (19)
		b14-b5	-	Cannot be used.	-
		b4	SON	Servo ON command	3.8.2. (5)
		b3	RES	Reset command	3.8.2. (4)
		b2	STP	Pause command	3.8.2. (2) 3.8.2. (10)
		b1	HOME	Home return command	3.8.2. (6)
		b0	-	Cannot be used.	-
PLC input	Completed position number	b15-b7	-	Cannot be used.	-
		b6	PE6	Current position number signal 6	3.8.2. (22)
		b5	PE5	Current position number signal 5	
		b4	PE4	Current position number signal 4	
		b3	PE3	Current position number signal 3	
		b2	PE2	Current position number signal 2	
		b1	PE1	Current position number signal 1	
		b0	PE0	Current position number signal 0	
	Status signal	b15	EMGS	Emergency stop	3.8.2. (2)
		b14-b13	-	Cannot be used.	-
		b12	ZONE1	Zone output 1 monitor	3.8.2. (13)
		b11	PZONE	Position zone output monitor	3.8.2. (13)
		b10-b5	-	Cannot be used.	-
		b4	SV	Ready (servo ON)	3.8.2. (5)
		b3	ALM	Alarm	3.8.2. (3)
		b2	-	Cannot be used.	-
		b1	HEND	Home return complete	3.8.2. (6)
		b0	PEND	Position complete	3.8.2. (9)

3.7.9 Signal Assignments in Solenoid Valve Mode 2

Signal assignments in solenoid valve mode 2 are shown below.

PLC output = Axis control signal

Address* — 1 word = 16 bits

CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RWw (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	-	-	-	-	-	-	-	-	-	-	-	-	-	ST2	ST1	ST0
			Command position number															
RWw (m+1)	n+1	n+2 n+3	BKRL	-	-	-	-	-	-	-	-	-	-	SON	RES	-	-	-
			Control signal															

PLC input = Axis status signal

Address*

CC-Link	DeviceNet	PROFIBUS RS485SIO	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RWr (m+0)	n+0	(Upper byte) n+0 (Lower byte) n+1	-	-	-	-	-	-	-	-	-	-	-	-	-	LS2	LS1	LS0
			Completed position number															
RWr (m+1)	n+1	n+2 n+3	EMGS	-	-	ZONE1	PZONE	-	-	-	-	-	-	SV	ALM	-	HEND	-
			Status signal															

* m indicates the first register address of each axis.
n indicates the relative address at the beginning of each axis.
Word addresses are used for CC-Link and DeviceNet networks, while byte addresses are used for Profibus and RS485SIO networks.

I/O Signal List

Signal type		Bit	Signal	Description	Details
PLC output	Command position number	b15-b3	-	Cannot be used.	-
		b2	ST2	Intermediate point movement command	3.8.2. (21)
		b1	ST1	Front end movement command	
		b0	ST0	Rear end movement command	
	Control signal	b15	BKRL	Forced brake release	3.8.2. (19)
		b14-b5	-	Cannot be used.	-
		b4	SON	Servo ON command	3.8.2. (5)
		b3	RES	Reset command	3.8.2. (4)
		b2-b0	-	Cannot be used.	-
PLC input	Completed position number	b15-b3	-	Cannot be used.	-
		b2	LS2	Intermediate point position detection	3.8.2. (23)
		b1	LS1	Front end position detection	
		b0	LS0	Rear end position detection	
	Status signal	b15	EMGS	Emergency stop	3.8.2. (2)
		b14-b13	-	Cannot be used.	-
		b12	ZONE1	Zone output 1 monitor	3.8.2. (13)
		b11	PZONE	Position zone output monitor	3.8.2. (13)
		b10-b5	-	Cannot be used.	-
		b4	SV	Ready (servo ON)	3.8.2. (5)
		b3	ALM	Alarm	3.8.2. (3)
		b2	-	Cannot be used.	-
		b1	HEND	Home return complete	3.8.2. (6)
		b0	-	Cannot be used.	-

3.8 I/O Signals

3.8.1 I/O Signal Timings

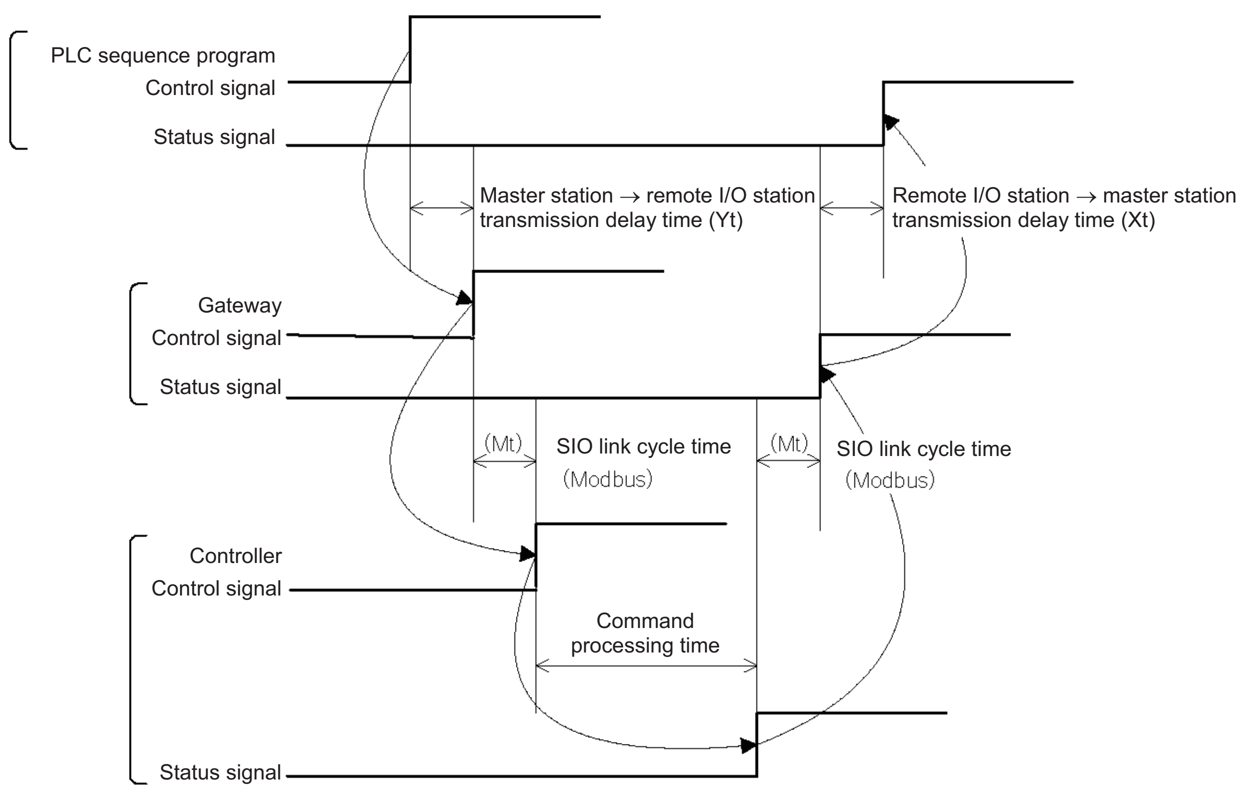
To operate the ROBO Cylinder using the PLC's sequence program, a given control signal is turned ON. The maximum response time after the signal turns ON until the response (status) signal is returned to the PLC is calculated by the formula below:

Maximum response time (msec) = Yt + Xt + 2 x Mt + Command processing time (operation time, etc.)

Mt = 10 (msec) x (n + 1) : SIO link (Modbus) cycle time
n: Number of controlled axes
Yt: Master station → remote I/O station transmission delay time
Xt: Remote I/O station → master station transmission delay time

(Yt and Xt: Field network transmission delay time)

For the master station → remote I/O station transmission delay time (Yt) and remote I/O station → master station transmission delay time (Xt), refer to the operation manuals of the CC-Link master unit and the PLC installed in the master unit.



(Note) If a communication error occurred due to a problem along the transmission path, etc., communication will be retried (by up to three times) and consequently the SIO link cycle time (Mt) may become longer than normal.

3.8.2 I/O Signal Functions

(1) Controller Ready (CRDY) PLC Input Signal

This signal turns "1" (ON) when the controller has become ready to perform control after the power is turned ON.

■ Function
This signal turns "1" (ON) when the controller has been successfully initialized and become ready to perform control after the power is turned ON, regardless of the alarm status, servo status, etc.
Even when an alarm is present, this signal is always "1" (ON) whenever the controller is ready.

(2) Emergency Stop (EMGS) PLC Input Signal

This signal turns "1" (ON) when the controller has actuated an emergency stop.

■ Function
This signal turns "1" (ON) when the controller generates an alarm or actuates an emergency stop (= the motor driver power is cut off). It will turn "0" (OFF) once the emergency stop is cancelled. The applicable alarms are operation-cancellation alarms and cold-start alarms.

(3) Alarm (ALM) PLC Input Signal

This signal turns "1" (ON) when the controller's protective circuit (function) has detected an alarm.

■ Function
This signal turns "1" (ON) when a protective circuit (function) is activated due to detection of an error.
When the cause of the alarm is removed and the reset (RES) signal is turned "1" (ON), the signal will turn "0" (OFF). (With cold-start alarms, the power must be reconnected.)
When an alarm is detected, the ALM LED (red) on the front panel of the controller illuminates. This LED remains unlit in a normal condition.

(4) Reset (RES) PLC Output Signal

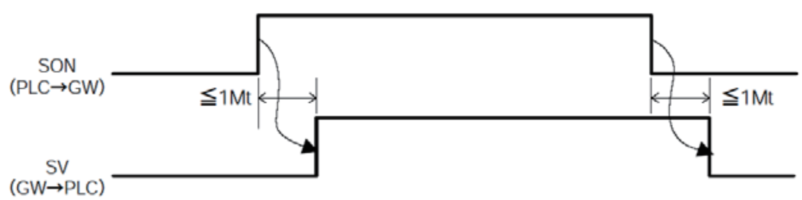
This signal has two functions. It can be used to reset controller alarms or to cancel the remaining travel distance during a pause.

■ Function
[1] While an alarm is present, remove the cause of the alarm and change this signal from "0" (OFF) to "1" (ON), and the alarm signal will be reset. (With cold-start alarms, the power must be reconnected.)
[2] Change this signal from "0" (OFF) to "1" (ON) while the actuator is paused, and the remaining travel distance will be cancelled.

(5) Servo ON Command (SON) PLC Output Signal
Ready (SV) PLC Input Signal

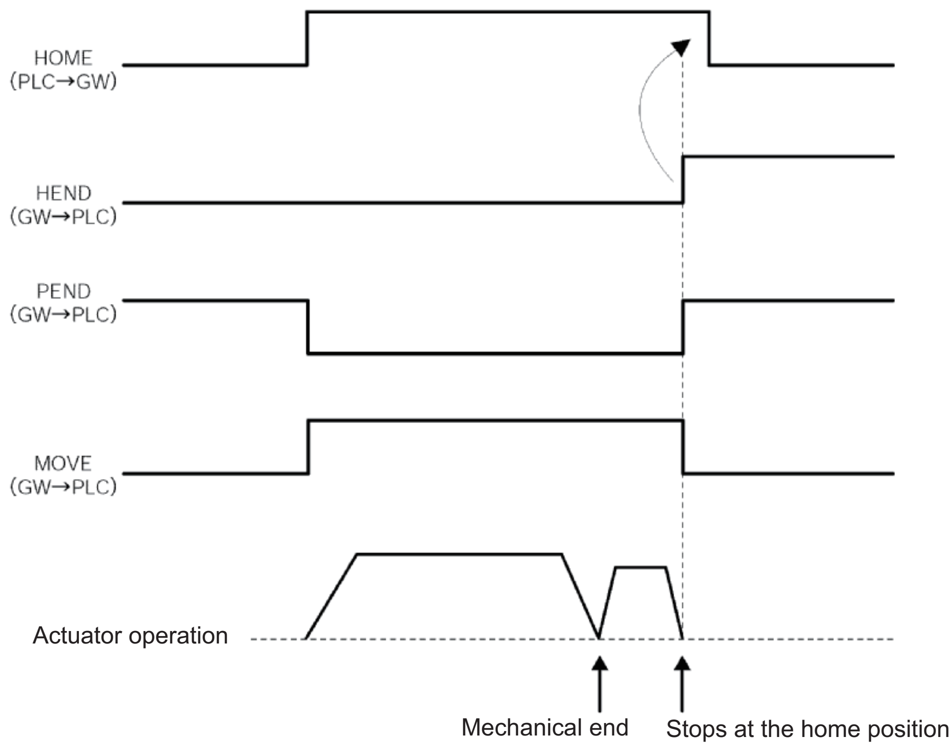
Turn the SON signal “1” (ON), and the servo will turn on. When the servo is turned ON, the SV LED (green) on the front panel of the controller will illuminate.
The SV signal is synchronized with this LED indicator.

■ Function
The SON signal can be used to turn ON/OFF the controller servo.
The controller servo remains on and thus the controller can be operated while the SV signal is “1” (ON).
The relationship of SON and SV signals is shown below.



(6) Home Return Command (HOME) PLC Output Signal
Home Return Complete (HEND) PLC Input Signal

Home return operation will start at the "0" (OFF) → "1" (ON) leading edge of the HOME signal.
When home return is complete, the HEND (home return complete) signal will turn "1" (ON).
Turn the HOME signal "0" (OFF) after the HEND signal has turned "1" (ON). Once it turns "1," the HEND signal will not turn "0" (OFF) until the power is turned OFF or the HOME signal is input again. After home return has been completed once, home return can be performed as many times as desired using the HOME signal.
An absolute reset must be performed for each axis (controller unit) connected to a simple absolute R unit, when the system is started.
To perform an absolute reset from the host PLC, output the home return signal (HOME).
For details, refer to the section on starting up the simple absolute R unit in Part 2, "Startup."



Caution

1. If a positioning command is issued in the positioner mode immediately after the power has been turned ON, without performing home return, home return will be performed automatically, but only if no home return has been performed after the power ON, and then the positioning will be executed.
2. <u>Take note that in any other mode, an alarm "Error 83: ALARM HOME ABS (absolute position move command before home return)" will generate</u>.

(7) Positioning Start (CSTR) PLC Output Signal

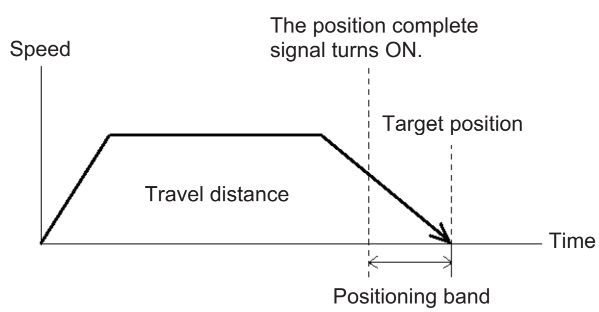
Upon detection of the “0” (OFF) → “1” (ON) leading edge of this signal, the controller will read the target position number consisting of a 10-bit binary code from PC1 to PC512, and perform positioning to the target position specified by the corresponding position data. The same procedure is followed when the target position is specified directly as a numerical value in the position data specification area.
Before executing a start command, the operation data such as target position and speed must be set in the position table using a PC/teaching pendant.
If this command is issued when no home return has been performed after the power ON (= when the HEND output signal is “0” (OFF)), home return will be performed automatically and then the positioning will be executed.
Turn this signal “0” (OFF) after confirming that the PEND signal has turned “0” (OFF).

(8) Moving (MOVE)

This signal is “1” (ON) while the actuator is moving with the servo turned ON (and also during home return, push operation and jogging operation).
Use the MOVE signal together with the PEND signal for status judgment on the PLC side.
This signal will turn “0” (OFF) once the actuator completes positioning, home return or push operation, or is paused.

(9) Position complete (PEND) PLC Input Signal

This signal turns “1” (ON) when the actuator has moved to the target position and entered the positioning band, or push operation has completed (the work part has not been missed).
When the servo status changes from OFF to ON, the applicable position is set as the target position and accordingly this signal turns “1” (ON). When positioning operation is subsequently started via the HOME signal or CSTR signal, this signal will turn “0” (OFF).



⚠ Caution

If the servo turns OFF or an emergency stop is actuated while the actuator is stopped at the target position, the PEND will turn “0” (OFF).
If the current position is within the positioning band when the servo turns ON again, the signal will return to “1” (ON). If the CSTR remains “1” (ON), the PEND will not turn “1” (ON) even when the current position is within the positioning band. It will turn “1” (ON) only after the CSTR signal has turned “0” (OFF).

(10) Pause (STP) PLC Output Signal

Turn this signal “1” (ON), and the axis movement will pause (the axis will decelerate to a stop). Turn the signal “0” (OFF), and the axis movement will resume.

(11) Command Position Number (PC1 to PC512) PLC Output Signal

The command position number is read as a 10-bit binary number.
Upon detecting the “0” (OFF) → “1” (ON) edge of the CSTR signal, the controller will read the 10-bit binary number consisting of PC1 to PC512 signals as the command position number.

(12) Completed Position Number (PM1 to PM512) PLC Input Signal

The position complete number is output as a 10-bit binary number.
When the power is turned ON or while the actuator is moving, all of PM1 to PM512 signals are “0” (OFF).
All signals will turn “0” (OFF) once the servo turns OFF or an emergency stop is actuated. The signals will return to “1” (ON) if the current position is within the positioning band (INP) with respect to the target position when the servo turns ON again. If the positioning band (INP) is exceeded, the signals will remain “0” (OFF).
These signals also turn “1” (ON) when push operation has completed or the work part has been missed.

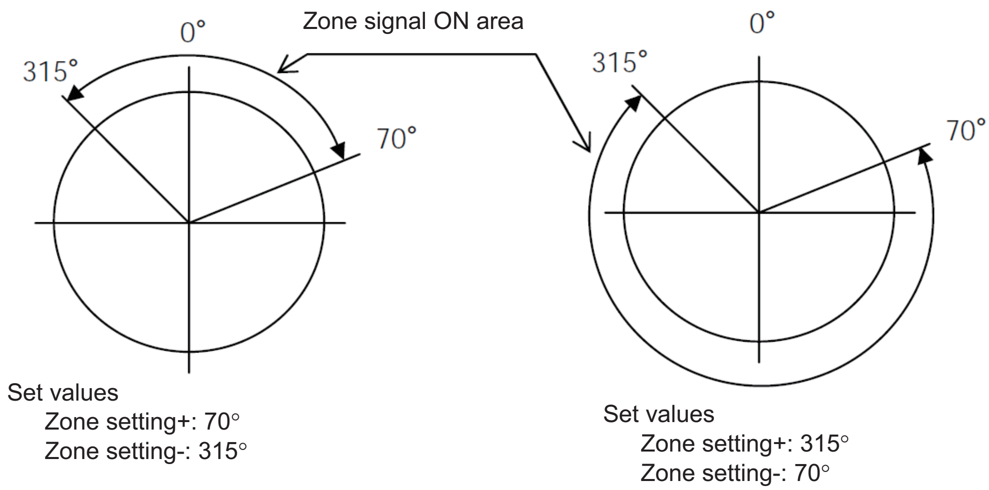
(13) Zone (PZONE, ZONE1, ZONE2) PLC Input Signal

These signals remain “1” (ON) while the current actuator position is inside the specified zone.
Zones are set using the position table or user parameters.
This signal becomes effective after completion of home return. It will remain effective, even while the servo is turned off, once home return has completed.

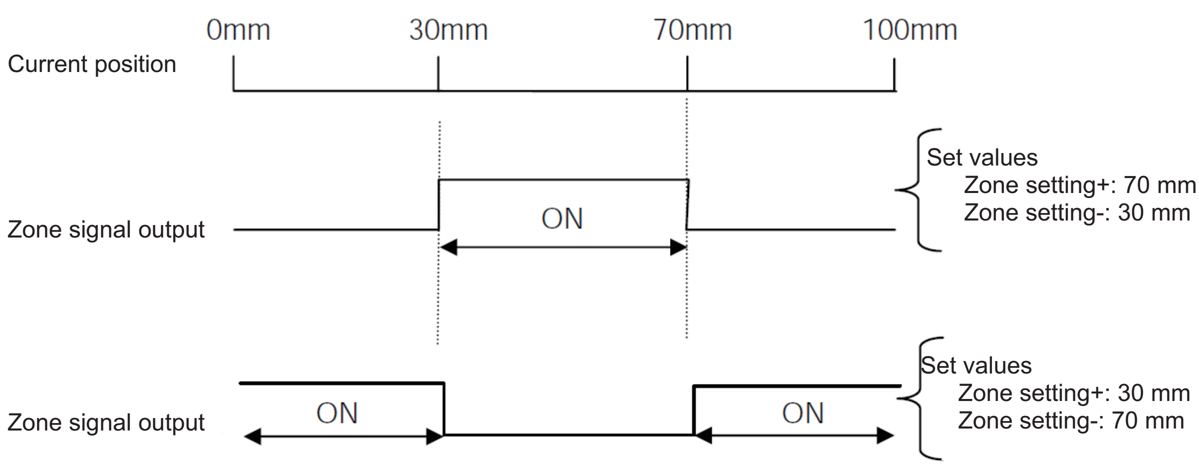
Setting	Zone signal	Positioner mode, simple direct mode	Direct numerical specification mode	Solenoid valve mode 1 Solenoid valve mode 2
Individual zone boundaries in the position table	Position zone output PZONE	○	X	○
User parameters for zone boundary 1 (Parameter No. 1 = + side, No. 2 = - side)	Zone output 1 ZONE1	○	○	○
User parameters for zone boundary 2 (Parameter No. 23 = + side, No. 24 = - side)	Zone output 2 ZONE2	○	○	X

Examples are shown below.

[Rotary actuator in the index mode]



[Linear axis]



Caution

The specifics of the zone function vary depending on the application version.

- In applications of version 0015 and older, zone signals will not be output if the parameters are set as follows:
  Zone setting+ ≤ Zone setting-
- In applications of version 0016 and later, zone signals will not be output if the parameters are set as follows:
  Zone setting+ = Zone setting-

(14) Jog+ Command/Jog- Command (JOG+/JOG-) PLC Output Signal

These signals function as start commands for jogging operation or inching operation.
The + command starts operation in the direction opposite home, while the – command starts operation in the home direction.
Jogging operation or inching operation is specified by a combination of this signal and the JISL signal (jogging/inching switching signal) and JVEL signal (jogging/inching speed and inching distance parameter switching signal).

[1] Jogging operation

The actuator can be jogged when the jogging/inching switching signal (JISL) is “0” (OFF).
The actuator will operate in the direction opposite home while the JOG+ is “1” (ON), and decelerate to a stop when the signal turns “0” (OFF).
The actuator will operate in the direction of home while the JOG- is “1” (ON), and decelerate to a stop when the signal turns “0” (OFF).
The operation is set by the following parameters:

- Speed: Jogging speed in the parameter specified by the jogging speed/inching distance switching (JVEL) signal
  JVEL signal = “0” (OFF)→ Parameter No. 26 (PIO jogging speed)
  JVEL signal = “1” (ON)→ Parameter No. 47 (PIO jogging speed 2)
- Acceleration/deceleration: Rated acceleration/deceleration (The specific value varies depending on the actuator.)

To stop the jogging operation (cause the actuator to decelerate to a stop), change the active JOG signal from “1” (ON) to “0” (OFF) or turn both the JOG+ and JOG- “1” (ON).

[2] Inching operation

The actuator can be inched when the jogging/inching switching signal (JISL) is “1” (ON).
The actuator moves by the inching distance every time the JOG signal changes from “0” (OFF) to “1” (ON).
The JOG+ signal causes the actuator to inch in the direction opposite home, while the JOG- signal causes the actuator to inch in the direction of home.
The operation is set by the following parameters:

- Speed: Jogging speed set in the parameter specified by the JVEL signal
  JVEL signal = “0” (OFF)→ Parameter No. 26 (PIO jogging speed)
  JVEL signal = “1” (ON)→ Parameter No. 47 (PIO jogging speed 2)
- Travel distance: Travel distance set in the parameter specified by the JVEL signal
  JVEL signal = “0” (OFF)→ Parameter No. 48 (PIO inching distance)
  JVEL signal = “1” (ON)→ Parameter No. 49 (PIO inching distance 2)
- Acceleration/deceleration: Rated acceleration/deceleration (The specific value varies depending on the actuator.)

Normally while the actuator is operating, the actuator will continue to operate even when the JOG+ or JOG- signal is turned “1” (ON) (= the JOG signal will be ignored). Also while the actuator is paused, turning the JOG+ or JOG- signal “1” (ON) will not cause the actuator to operate (= the JOG signal will be ignored).

⚠ Caution

Exercise caution that until home return is completed, the software stroke limits are ineffective and therefore the actuator may collide with a mechanical end.

(15) Jogging Speed/Inching Distance Switching (JVEL) PLC Output Signal

This signal switches between the parameter for specifying the jogging speed when jogging operation is selected and the parameter for specifying the inching distance when inching operation is selected.
The relationships are summarized in the table below.

JVEL signal	Jogging operation: JISL = "0" (OFF)	Inching operation: JISL = "1" (ON)
"0" (OFF)	Parameter No. 26 (Jogging speed)	Parameter No. 26 (Jogging speed) Parameter No. 48 (Inching distance)
"1" (ON)	Parameter No. 47 (Jogging speed 2)	Parameter No. 47 (Jogging speed 2) Parameter No. 49 (Inching distance 2)

(16) Jogging/Inching Switching (JISL) PLC Output Signal

This signal is used to switch jogging operation and inching operation.
JISL = "0" (OFF): Jogging operation
JISL = "1" (ON): Inching operation
If the JISL signal switches to "1" (ON) during jogging operation, the actuator will decelerate to a stop and the inching function will become effective. If the JISL signal switches to "0" (OFF) during inching operation, the actuator will complete the inching operation and then the jogging function will become effective.

Jogging and inching operation commands are based on a combination of JISL, JVEL and JOG+/JOG- signals. The relationships of these signals are summarized in the table below.

		Jogging operation	Inching operation
JISL		"0" (OFF)	"1" (ON)
JVEL= "0" (OFF)	Speed	Parameter No. 26 (Jogging speed)	Parameter No. 26 (Jogging speed)
	Travel distance	-	Parameter No. 48 (Inching distance)
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
JVEL= "1" (ON)	Speed	Parameter No. 47 (Jogging speed 2)	Parameter No. 47 (Jogging speed 2)
	Travel distance	-	Parameter No. 49 (Inching distance 2)
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
Operation		When the JOG+/JOG- is "1"	When the JOG+/JOG- changes from "0" from "1"

(17) Teaching Mode Command (MODE) PLC Output Signal (Effective only in the positioner mode)
Teaching Mode Status (MODES) PLC Input Signal

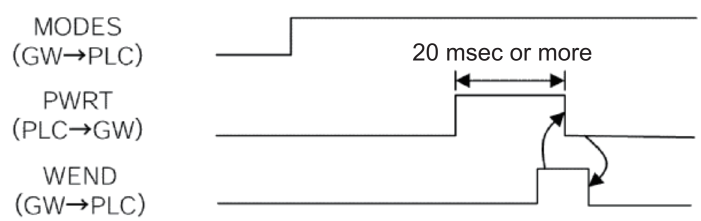
When this signal is turned "1," the controller will switch from the normal operation mode to the teaching mode. After switching to the teaching mode, each axis controller will output the teaching mode status (MODES) signal.
Turning the MODE signal "1" (ON) switches the normal operation mode to the teaching mode.
When the teaching mode becomes effective, the MODES signal for each controller axis turns "1" (ON).
Teaching should be performed on the PLC side after confirming that the MODES signal has turned "1" (ON).
Switching from the normal operation mode to the teaching mode is permitted in the following conditions:

- The actuator (motor) is stopped
- The JOG+ signal and JOG- signal are "0" (OFF)
- The position data load command (PWRT) signal and positioning start (CSTR) signal are "0" (OFF)

(18) Position Data Load Command (PWRT) PLC Output Signal (Effective only in the positioner mode)
Position Data Load Complete (WEND) PLC Input Signal

The PWRT signal is effective when the MODES signal is "1" (ON).
When the PWRT signal remains "1" (ON) for 20 msec or more (*1), the current position data will be written to the "Position" field under the position number (PC1 to PC512) currently specified by the PLC. (*2)
When the writing is complete, the WEND signal turns "1" (ON).
The host PLC should turn the PWRT signal "0" (OFF) after the WEND signal has turned "1" (ON).
If the PWRT signal is turned "0" (OFF) before the WEND signal turns "1" (ON), the WEND signal will not turn "1" (ON).
When the PWRT signal is turned "0" (OFF), the WEND signal turns "0" (OFF).

*1 If the signal only remains "1" (ON) for less than 20 msec, the data may not be written.
*2 If any data other than position is not yet defined, the default value of the corresponding parameter will be written.



(19) Forced Brake Release (BKRL) PLC Output Signal

The brake can be forcibly released by turning this signal "1" (ON).

(20) Start position commands (ST0 to ST6) [Solenoid valve mode 1] PLC output signal

Upon detection of the OFF → ON leading edge of any of these signals or an ON level signal for such signal, the actuator starts positioning to the target position specified by corresponding position data.
Before issuing a start position command, the target position, speed and other operation data must be set in the position table using a PC or teaching pendant.
Also note that if an ON signal is detected for two or more start position commands at the same time, the detected position command of the youngest number will be executed. (Example: If an ON signal is detected for ST0 and ST1 at the same time, the actuator will start moving to ST0.)
Although each command is executed based on detection of an ON signal for the applicable signal, priority is given to the command whose ON signal is detected first, meaning that a signal input while the actuator is moving will not affect the current actuator operation. Even if the signal for a different position is turned ON while the actuator is moving, the actuator will not start moving to the applicable position after reaching the target position.

Correspondence table of input signals and command positions

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

If any of these commands is issued when the actuator has not yet completed a single home return operation following the power on, the actuator will automatically perform a home return operation and then move to the target position.

(21) Front end movement command (ST1)
Rear end movement command (ST0)
Intermediate point movement command (ST2) [Solenoid valve mode 2] PLC output signal

While any of these signals is ON, the actuator continues to move to the applicable target position.
If the signal turns OFF during movement, the actuator will decelerate to a stop.
Before executing any of these commands, enter the target position in the “Position” field of the position table for position No. 0, 1 or 2.

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

(22) Current position number signals (PE0 to PE6) [Solenoid valve mode 1] PLC input signal

When positioning is complete, a signal for the position number corresponding to the movement command (0 to 6) is output separately.

Correspondence table of output signals and completed positions

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

Note) These signals turn OFF when the servo turns OFF or an emergency stop is executed. If the actuator is inside the positioning band relative to the target position when the servo turns ON again, each current position number signal will turn ON again. If the actuator is outside the positioning band, however, the signal will remain OFF.

(23) Position detection output (LS0 to LS2) [Solenoid volume mode 2] PLC input signal

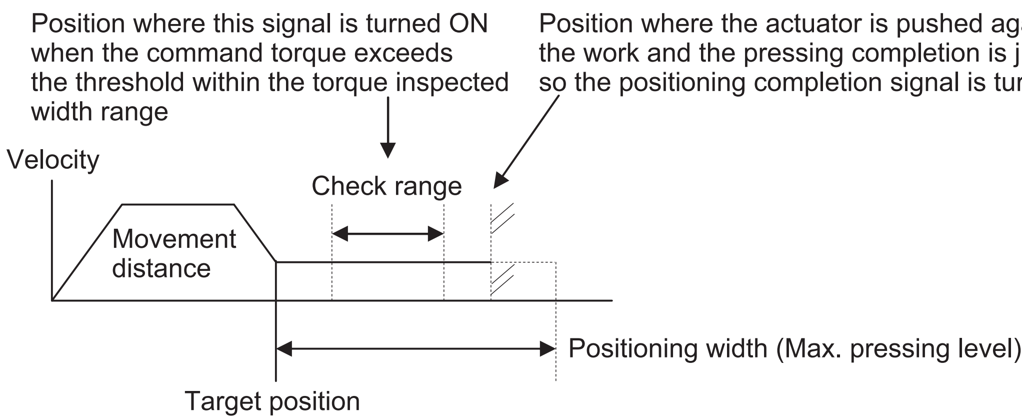
Similar to the air cylinder LS system, these signals turn ON when the current position is inside the positioning band relative to each target position.

(Note) Even when the servo turns OFF or an emergency stop is executed while the actuator is stopped at the target position, the applicable current position number signal will remain ON as long as the actuator is inside the positioning band.

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

(24) Load output judgment (LOAD) PLC Input Signal Dedicated Function for RPCON

This signal is available only in the pressing operation.
When this signal is used for pressing-in purpose, it should be know whether if the set load threshold is reached during the pressing operation.
The load threshold and inspected width range are set using the PLC's register. When the command torque (motor current) exceeds the threshold within the inspected width range, this signal is turned “ON”.
This signal judges the load output based on the fact that the command torque excesses the threshold for the specified time period.
This processing procedure is the same as for the pressing judgment. The judgment time period can be changed freely using the parameter No. 50 “Load Output Judgment Time Period”.
This signal is continued until the next movement command is received.

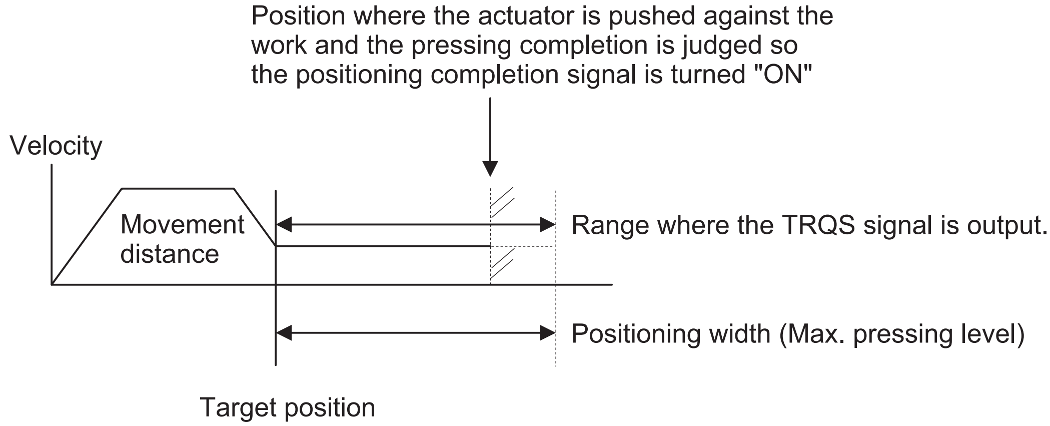


- Set the pressing speed using the parameter No. 34 “Pressing Speed”.
  When the machine is delivered, it has been individually set depending on the actuator characteristics.
  Set an appropriate speed considering the work material and shape.
- Set the parameter No. 50 “Load Output Judgment Time Period”.
- Set the parameter No. 51 “Torque Inspected Range” to “0” (enabled).
- Set the threshold inspected width using the PLC's Zone Boarder Value + Register or Zone Boarder Value - Register.
- Set the threshold using the PLC's Load Current Threshold Register.
- Set the positioning width using the PLC's Positioning Width Register.
  Set it a bit longer from the backmost position considering the mechanical dispersion of the work.

Warning:
- If the actuator pushes against the work before the target position, it is regarded as a servo-motor error.
  Take care of the positional relationship between the target position and the work position.
- The actuator continues to push the work with the pressing current at the stop time decided with the current limit value.
  It is not the stop condition, so take the greatest care to deal with it.

(25) Torque level (TRQS) PLC Input Signal | Dedicated Function for RPCON

This signal is available only in the pressing operation.
When the motor current reaches the load threshold during the pressing operation (moving up to the positioning width), this signal is turned "ON".
Because the current level is monitored, when the current level is changed, this signal is turned "ON".
The speed available for the pressing varies depends on the motor and leads, it is required to adjust the parameters.



- Set the pressing speed using the parameter No. 34 "Pressing Speed".
  When the machine is delivered, it has been individually set depending on the actuator characteristics.
  Set an appropriate speed considering the work material and shape.
- Set the parameter No. 50 "Load Output Judgment Time Period".
- Set the parameter No. 51 "Torque Inspected Range" to "1" (disable).
- Set the threshold using the PLC's Load Current Threshold Register.
- Set the positioning width using the PLC's Positioning Width Register.
  Set it a bit longer from the backmost position considering the mechanical dispersion of the work.

⚠ Warning:
- If the actuator pushes against the work before the target position, it is regarded as a servo-motor error.
  Take care of the positional relationship between the target position and the work position.
- The actuator continues to push the work with the pressing current at the stop time decided with the current limit value.
  It is not the stop condition, so take the greatest care to deal with it.

(26) Movement command complete (MEND) PLC Input Signal

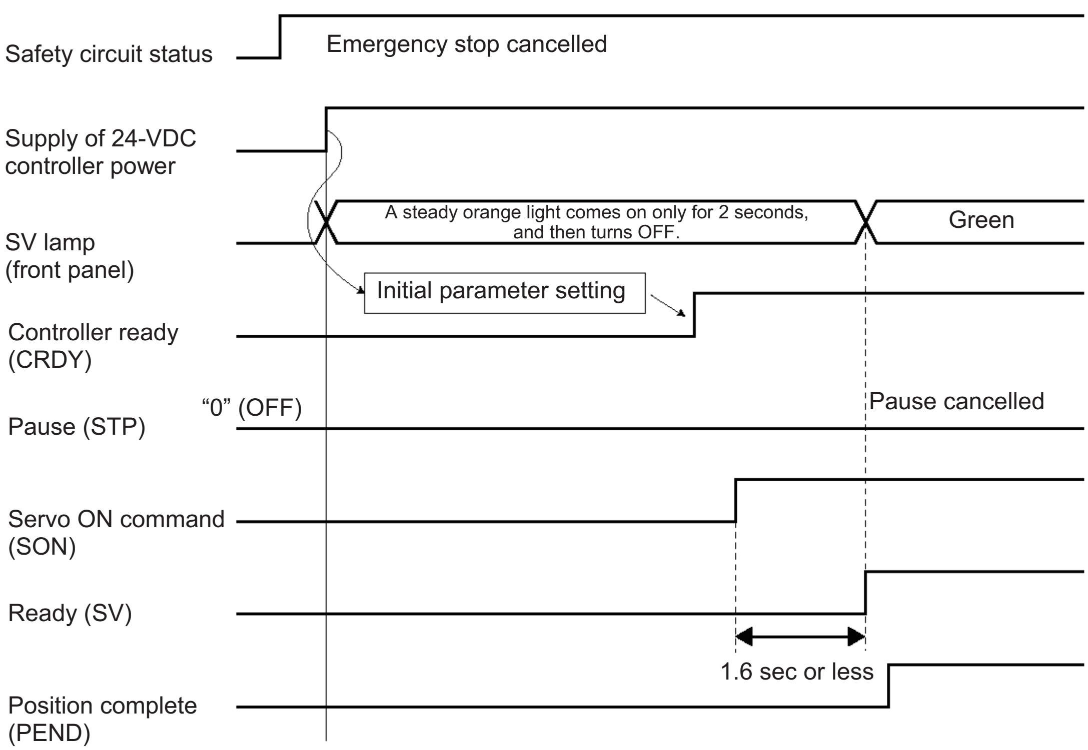
They are all set to "0" (OFF) when the power is turned ON and while in operation.
It turns OFF when servo is "0" (OFF) or at an emergency stop.
They turn to "1" (ON) when pressing is complete, and even when the pressing operation was missed.
Output would not be made when CSTR signal is ON.

3.8.3 Basic Operation Timings

(1) Ready

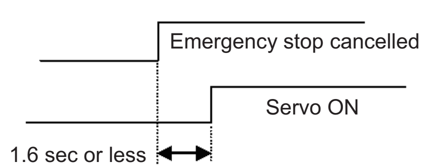
Follow the steps bellow to start the system after confirming that the slider or rod is not contacting a mechanical end and the transferring load is not contacting any peripherals, either:

[1] Cancel the emergency stop or enable the motor drive power.
[2] Supply the 24-VDC controller power (24-V terminal and 0-V terminal on the power-supply terminal block).
[3] Initialize the minimum parameter(s) required.
(Example) • To change the feed speed during teaching:
Change the value of parameter No. 35, "Safety speed."
[4] In the positioner mode or simple direct mode, set optimal values in the "Position," "Speed," "Acceleration," "Deceleration" and other fields of the position table.



⚠ Caution

If the power is turned ON while an emergency stop is actuated and then the emergency stop is cancelled (SON signal "1" (ON)), it will take a maximum of 1.6 seconds after the cancellation of emergency stop for the servo to turn ON.



Warning

The RACON controller performs magnetic-pole phase detection operation during the first servo ON processing after the power has been turned ON. During this detection operation, the actuator will generally move by approx. 0.5 to 2 mm, although the specific dimension varies depending on the ball screw lead.
(On rare occasions, the actuator may move by up to around one-half the ball screw lead depending on the position at which the power is turned ON.)
If the power is turned ON while the actuator is positioned near a mechanical end, the actuator may contact the mechanical end during the detection operation and reverse its direction.
Exercise due caution not to let the work part or hand contact any surrounding structure because of this movement and sustain damage as a result.

(2) Home Return Operation

This controller unit uses an incremental position detector (encoder) and therefore its mechanical coordinates will be lost once the power is cut off.
After the power is turned ON, therefore, home return must be performed to establish mechanical coordinates.
To perform home return operation, input the home return command signal (HOME).
Home return operation is not required if a simple absolute R unit is connected to the controller unit to make the controller an absolute axis.

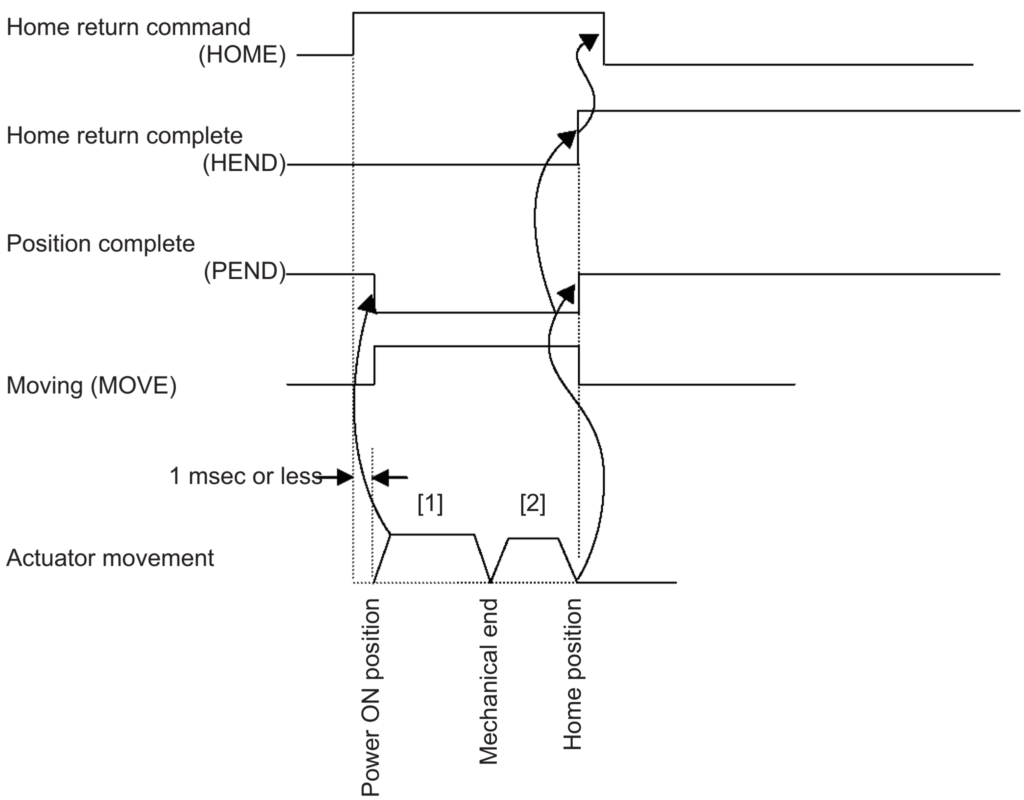
Operation timings

PLC processing 1: As the start button is pressed, the home return command signal (HOME) turns "1" (ON).

Operation: [1] The actuator starts moving toward the mechanical end on the home side.
[2] After contacting the mechanical end, the actuator reverses its direction and moves to the home position, upon reaching, which the actuator stops.
→ The home return complete signal (HEND) turns "1" (ON).

PLC processing 2: Turn the home return command (HOME) signal “0” (OFF) after confirming that the HEND signal has turned “1” (ON).

PLC processing 3: The actuator starts continuous operation.



Caution

Take heed of the following points when performing home return:
[1] Confirm that no obstacles are present in the direction of home return.
[2] If any obstacle is present in the direction of home return, move the actuator in the direction opposite home and remove the obstacle.
[3] When the HOME signal is turned “1” (ON), the PEND signal turns “0” (OFF) and MOVE signal turns “1” (ON).
Return the HOME signal to “0” (OFF) after confirming that the HEND signal has turned “1” (ON) while the HOME signal is still “1” (ON).

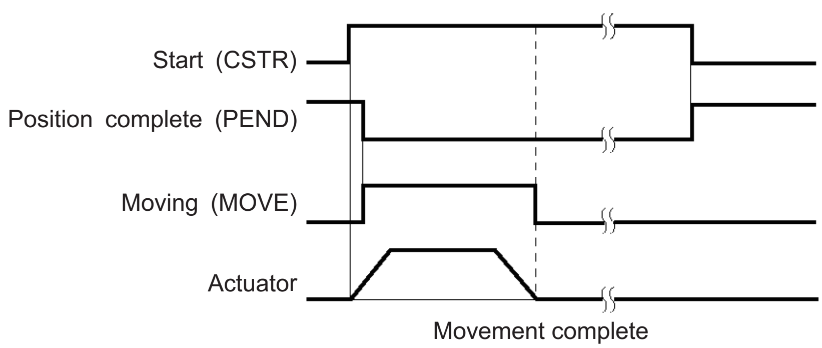
(3) Operation in the Positioner 1 Mode and Positioner 2 Mode

Input position data in the controller's position table beforehand, and specify a desired position number using a link register of the PLC.

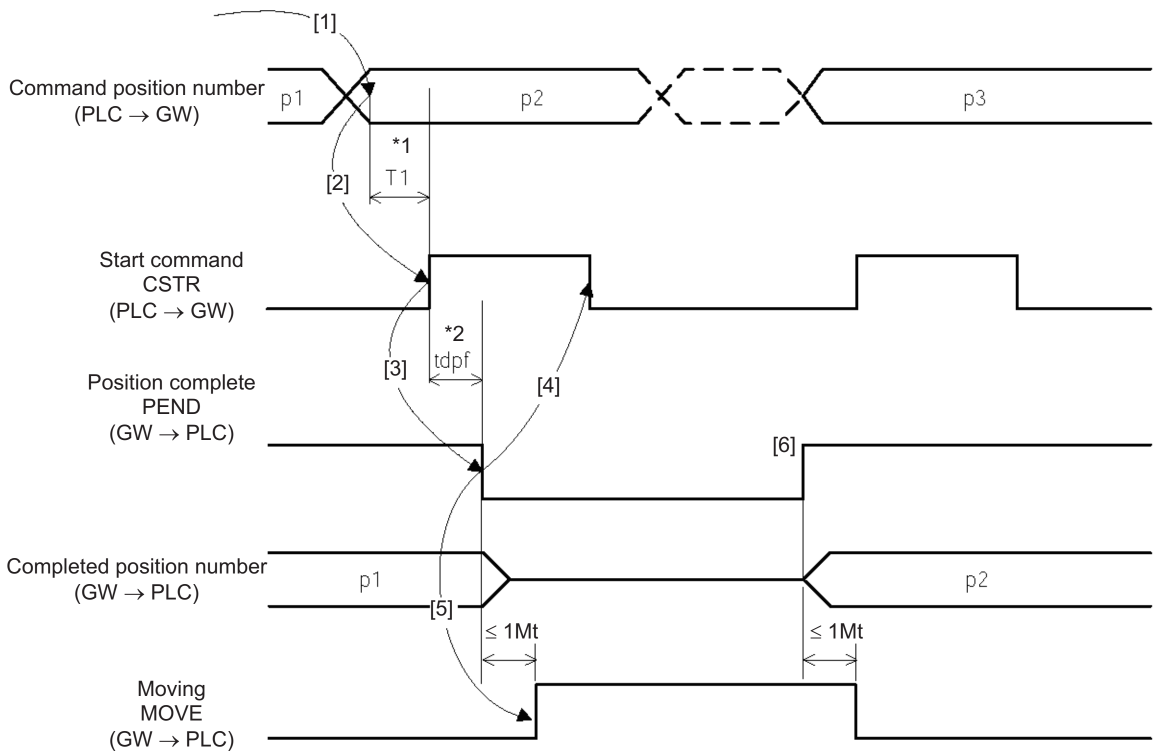
■ Operation
[1] Set the position number in the command position number register.
[2] Next, turn the start command signal (CSTR) "1" (ON) after confirming that the position complete signal (PEND) is "1" (ON).
[3] The PEND turns "0" (OFF) tdpf after the CSTR has turned "1" (ON).
[4] Turn the CSTR "0" (OFF) after confirming that the PEND has turned "0" (OFF).
[5] The MOVE turns "1" (ON) the moment the PEND turns "0" (OFF) or within 1 Mt thereafter.
[6] When the remaining travel distance has become within the specified positioning band (INP), the PEND turns "1" (ON) if the CSTR is "0" (OFF) and the completed position number is output.
Accordingly, check the completed position number following the completion of positioning after waiting for an appropriate time after the PEND has turned "1" (ON) (time needed to travel the remaining distance).

Caution

- When the start signal turns ON, the position complete output will turn OFF and the moving output will turn ON. Always turn the start signal OFF after confirming that the position complete output has turned OFF. <u>If the start input remains ON, the position complete output will not turn ON after the actuator completes its movement</u>, as shown below.



- If a move command specifying the same position is issued, the position complete output will turn OFF but the moving output will not turn ON.
- Even though the actuator is moving, the moving output turns OFF the moment the position complete output turns ON. Therefore, although increasing the positioning band in the position data will cause the moving output to turn OFF the moment the position complete output turns ON, the actuator may still be moving.
- When a soft limit is reached through repeated incremental moves, the actuator will stop at that position and the position complete signal will be output.



*1 T1: Set an appropriate time so that “T1 ≥ 0 ms” is satisfied, by considering the scan time of the host controller.
*2 Yt + 2Mt + Xt ≤ tdpf ≤ Yt + 2Mt + Xt + 7 (ms)

(4) Operation in the Simple Direct Mode

In this mode, position data is written to a link register of the PLC and other data such as speed, acceleration/deceleration, positioning band and push current-limiting value are specified by a position table.

■ Preparation

Set in the position table all position data (speed, acceleration/deceleration, positioning band, push-current limiting value, etc.) other than the target position.

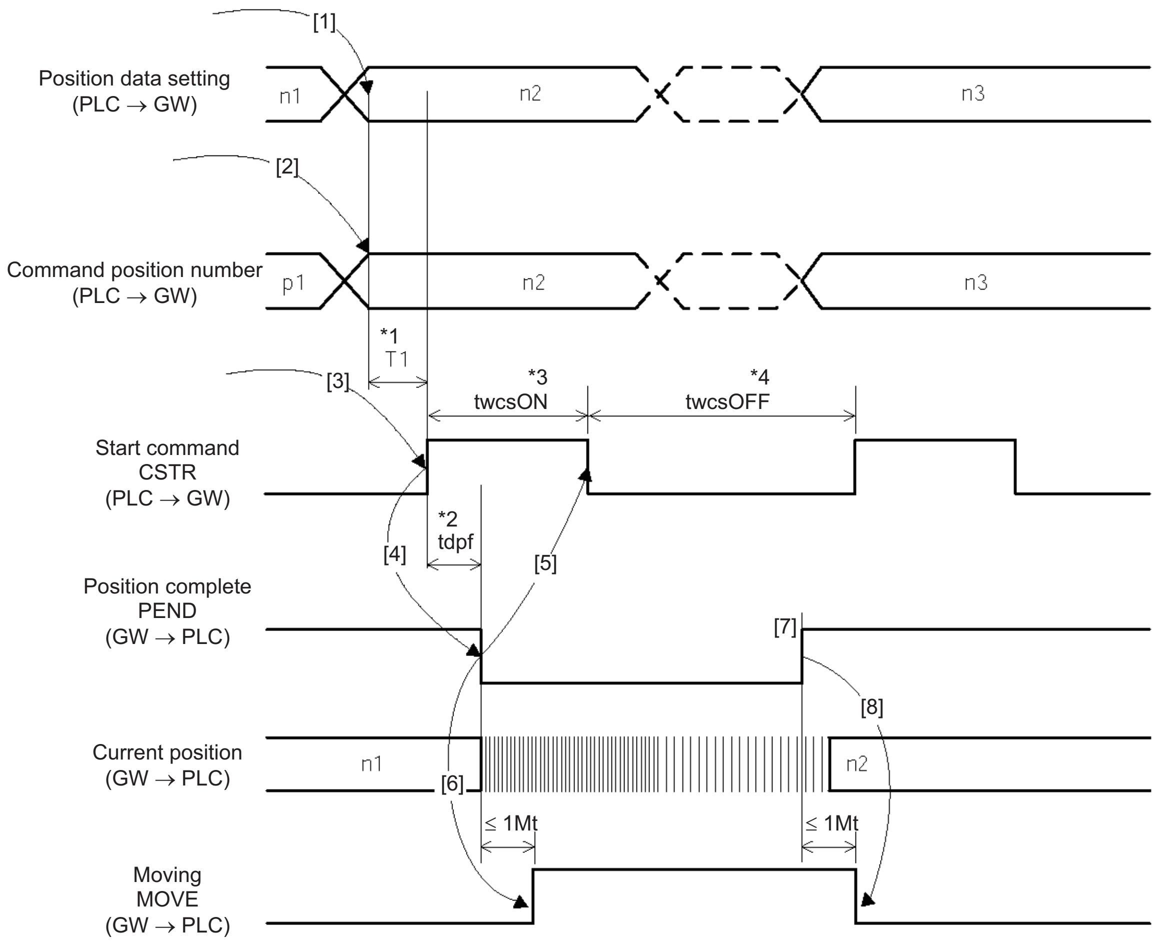
■ Operation

[Normal positioning operation]

[1] Set the target position data in the position data specification register.
[2] Set the position number in the command position number register.
[3] Turn the start command signal (CSTR) "1" (ON) after confirming that the position complete signal (PEND) is "1" (ON) or moving signal (MOVE) is "0" (OFF).
The target position data will be read by the controller at the "0" (OFF) → "1" (ON) edge of the CSTR (leading edge of the signal).
[4] The PEND turns "0" (OFF) tdpf after the CSTR has turned "1."
[5] Turn the CSTR "0" (OFF) after confirming that the PEND signal has turned "0" (OFF) or MOVE signal has turned "1" (ON).
Do not change the target position data until CSTR turns "0" (OFF)
[6] The MOVE turns "1" the moment the PEND turns "0" (OFF) or within 1 Mt thereafter.
[7] The current position data is constantly updated. When the remaining travel distance has become within the specified positioning band (INP), the PEND turns "1" (ON) if the CSTR is "0" (OFF).
Accordingly, check the completed position number following the position complete after waiting for an appropriate time after the PEND has turned "1" (ON) (time needed to travel the remaining distance).
Also note that the current position data may vary slightly due to variation, etc., even when the actuator is stopped.
[8] The MOVE turns "0" (OFF) the moment the PEND turns "1" (ON) or within 1 Mt thereafter.
[9] The target position data can be changed while the actuator is moving.
To change the target position data while the actuator is moving, change the target position data and then wait for at least the scan time of the PLC before turning the CSTR "1" (ON).
In this case, keep the CSTR "1" (ON) for tdpf or more. Also provide an interval of 1 Mt or more after the CSTR is turned "0" (OFF) until it is turned "1" (ON) again.

[Push operation]

Push operation is performed by setting the push-current limiting value in the Push field of the position table in the preparation stage and then performing positioning to the applicable position number.



*1 Set an appropriate time so that "T1 ≥ 0 ms" is satisfied, by considering the scan time of the host controller.
*2 Yt + 2Mt + Xt ≤ tdpf ≤ Yt + 2Mt + Xt + 7 (msec)
*3 twcsON ≥ 1Mt
*4 twcsOFF ≥ 1Mt

(5) Operation in the Direct Numerical Specification Mode

In this mode, the actuator is operated by writing the target position data, acceleration/deceleration data, speed data, push-current limiting value data and positioning band data to link registers in the PLC, without using the position table of the controller.
With push operation, set all of the above data.
With normal positioning operation, the push-current limiting value data, PUSH signal and DIR signal are not required among the data set for push operation.
Take note that with either operation, the actuator will not operate unless all necessary data are set.

■ Operation

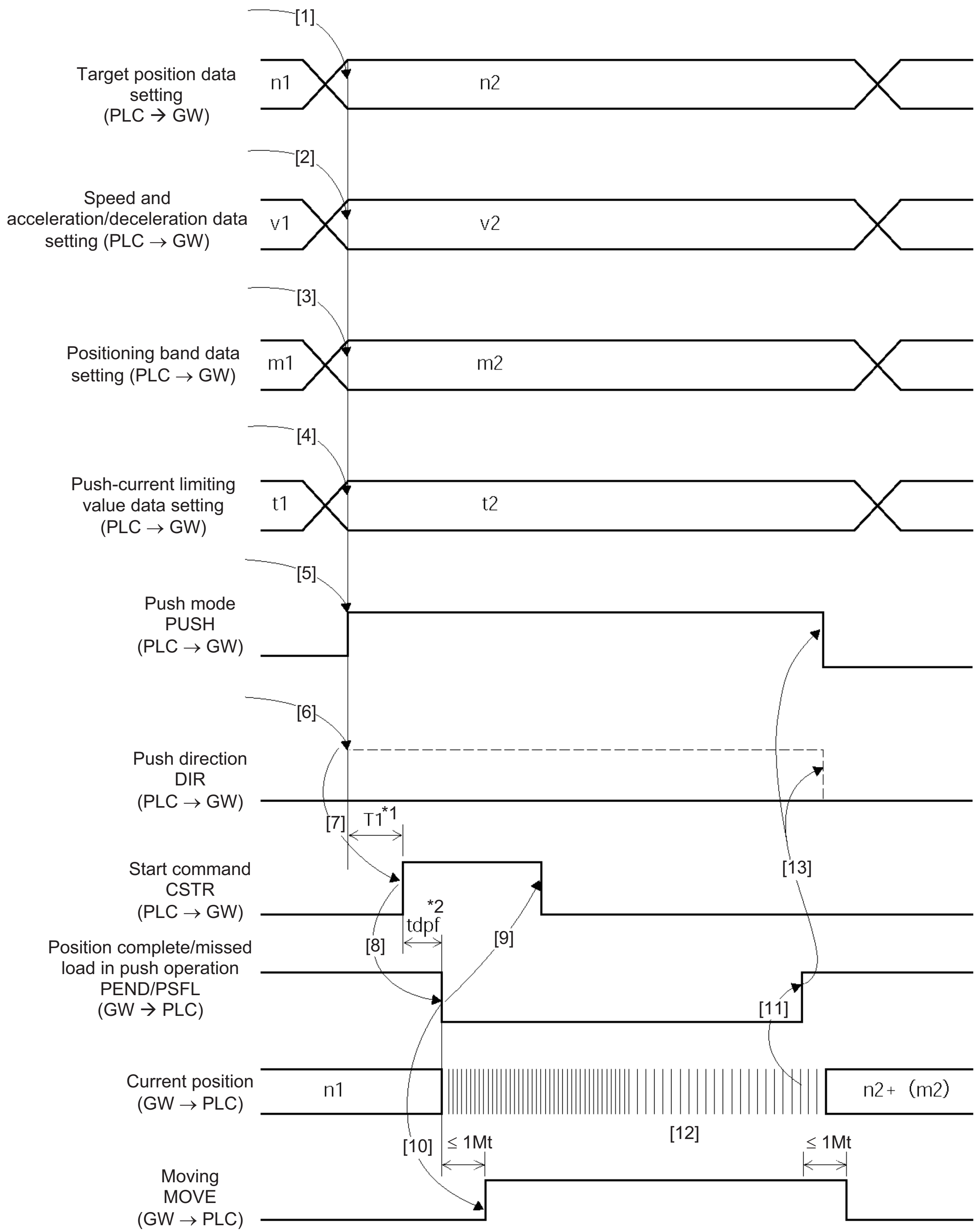
[Push operation]

[1] Set the push start position data in the position data specification register.
[2] Set the speed data until the push start position in the speed specification register, and set the applicable acceleration/deceleration data in the acceleration/deceleration register. Take note that if acceleration/deceleration is not set, the setting of parameter No. 9, “Default acceleration/deceleration” will not be applied.
[3] Set the distance traveled in push operation in the positioning band specification register. *
[4] Set in the push-current limiting value register the push-current limiting data for setting the push force.
[5] Turn the PUSH (push operation mode specification) signal “1” (ON).
[6] Select the push direction using the DIR (push direction specification) signal.
Push operation is performed in the direction opposite home return direction when the DIR signal is “1” (ON), or in the home return direction when the DIR signal is “0” (OFF).
[7] Next, turn the start command signal (CSTR) “1” (ON) after confirming that the position complete signal (PEND) is “1” (ON).
The data set in [1] to [4] is loaded to the controller at the “0” (OFF) → “1” (ON) edge (leading edge) of the CSTR.
[8] The PEND turns “0” (OFF) tdpf after the CSTR has turned “1” (ON).
[9] Turn the CSTR “0” (OFF) after confirming that the PEND signal has turned “0” (OFF) or MOVE signal has turned “1” (ON).
[10] The MOVE turns “1” (ON) the moment the PEND turns “0” (OFF) or within 1 Mt thereafter.
[11] When the motor current reaches the push-current limiting value set in [4] during push operation while the CSTR is “0” (OFF), the PEND will turn “1” (ON). (Push operation is completed.)
If the motor current does not reach the push-current limiting value set in [4] even after the actuator has reached the positioning band set in [3], the PSFL (missed work part in push operation) signal will turn “1” (ON). In this case, the PEND will not turn “1” (ON). (The work part was missed.)
[12] The current position data is constantly updated.
[13] Turn the PUSH “0” (OFF) after the PEND or PSFL has turned “1” (ON).

* Take note that if positioning band specification data is not set, the setting of parameter No. 10, “Default positioning band” will not be applied.

[Normal positioning operation]

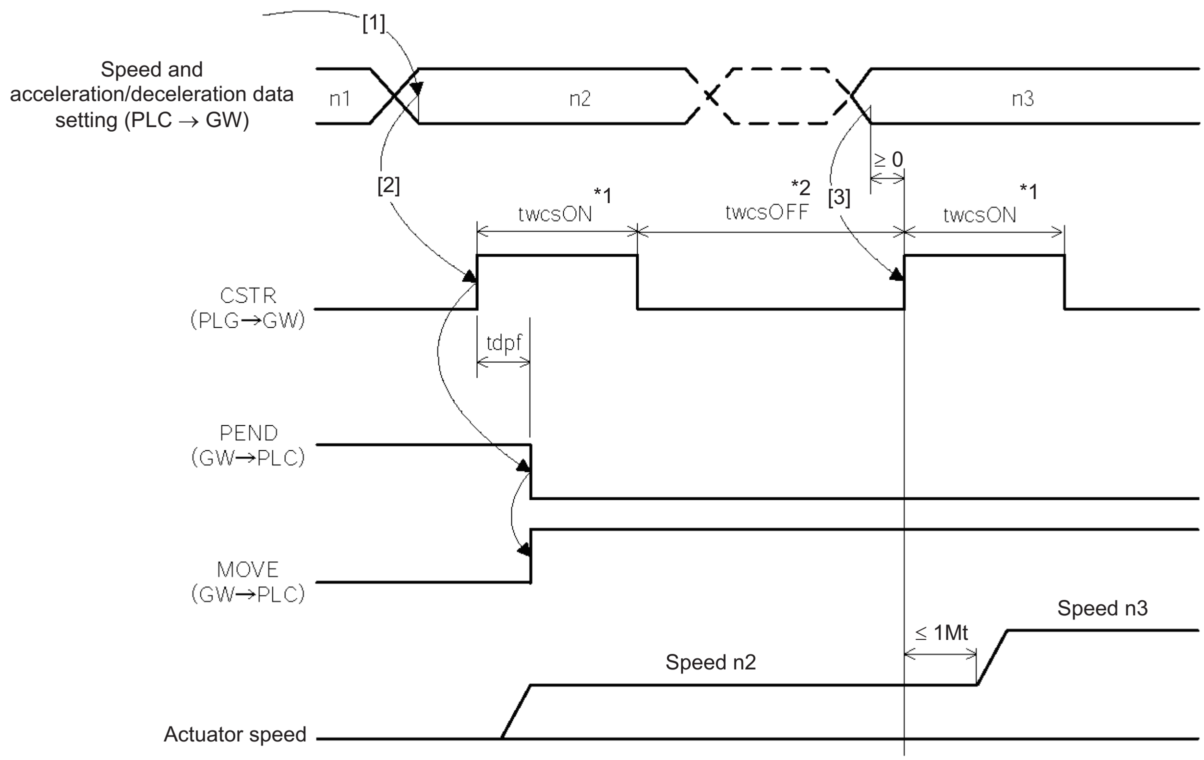
With normal positioning operation, the PUSH signal remains “0” (OFF) in [5] above. The setting of push-current limiting value in [4] is not required, either.The PEND turns “1” (ON) once the remaining travel distance has become the data range set in [3] as the positioning band while the CSTR is “0” (OFF).



*1 Set an appropriate time so that "T1 ≥ 0 ms" is satisfied, by considering the scan time of the host controller.

*2 $Yt + 2Mt + Xt \leq tdpf \leq Yt + 2Mt + Xt + 7$ (msec)

The target position data, acceleration/deceleration data, speed data, positioning band data and push-current limiting value data can be changed while the actuator is moving. To do so, turn the CSTR “1” (ON) and keep it “1” (ON) for tdpf or more after the data has been changed.
Also provide an interval of 1 Mt or more after the CSTR is turned “0” (OFF) until it is turned “1” (ON) again.
An example of changing the speed and acceleration/deceleration is shown below.



*1 twcsON ≥ 1Mt
*2 twcsOFF ≥ 1Mt

Caution

1. If speed data is not set, or the set speed is “0,” the actuator will remain stopped and no alarm will generate.
2. f the speed data setting is changed to “0” while the actuator is moving, the actuator will decelerate to a stop.
3. Target position data must be set even if you only want to change the acceleration/deceleration or speed data.
4. Acceleration/deceleration and speed data must be set even if you only want to change the target position data.

(6) Operation in solenoid valve mode 1

Enter position data beforehand in the position table of the controller, and specify each desired position number using the corresponding link register on the PLC.

■ Operation

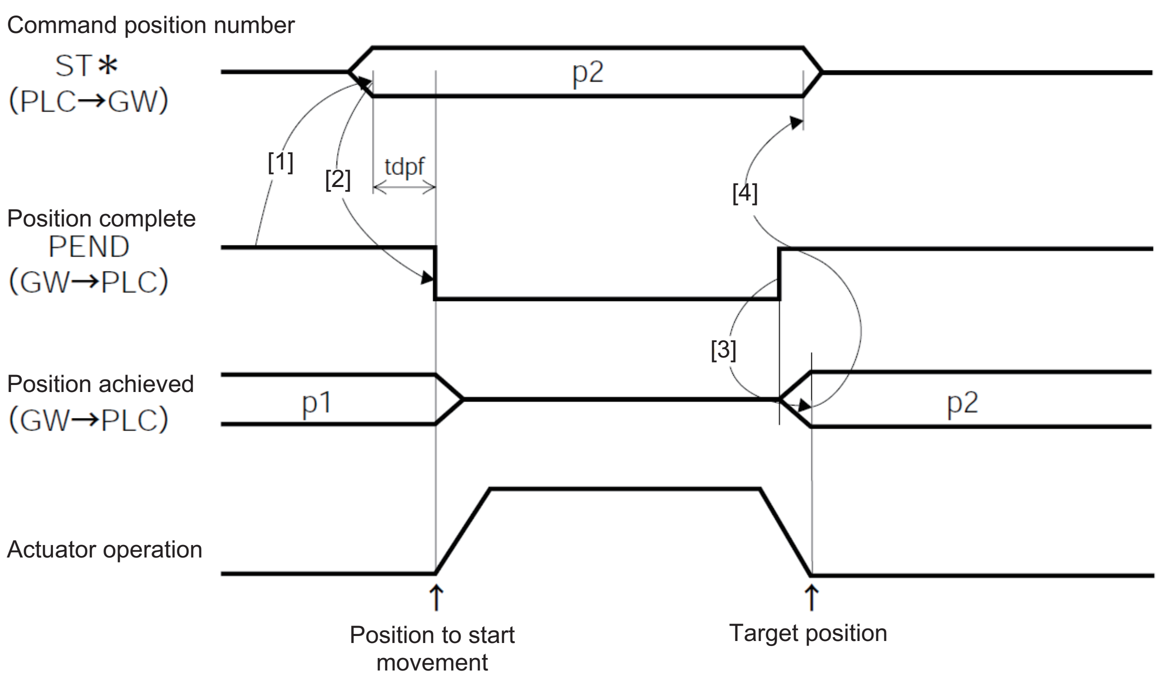
[1] After confirming that the position complete (PEND) signal is “1” (ON), turn the ST* signal corresponding to the position number under which the target position you want to move the actuator to, which is currently stored in a command position number register, from “0” (OFF) to “1” (ON).

[2] The actuator starts moving, and then PEND turns “0” (OFF) tdpf thereafter.

[3] When the remaining travel becomes within the specified positioning band (INP), PEND turns “1” (ON) and the position achieved (PE*) signal is output.

Accordingly, when checking if the position achieved (PE*) signal has been output following the completion of positioning, do so by waiting for an appropriate time (time to move remaining travel) after PEND has turned “1” (ON).

[4] After confirming that the position achieved (PE*) signal has been output, rewrite the command position number register to “0” or to the next command position number.



*1 $Yt + 2Mt + Xt \leq tdpf \leq Yt + 2Mt + Xt + 7$ (ms)

(7) Operation in solenoid valve mode 2

Enter position data beforehand in the position table of the controller, and specify each desired position number using the corresponding link register on the PLC.

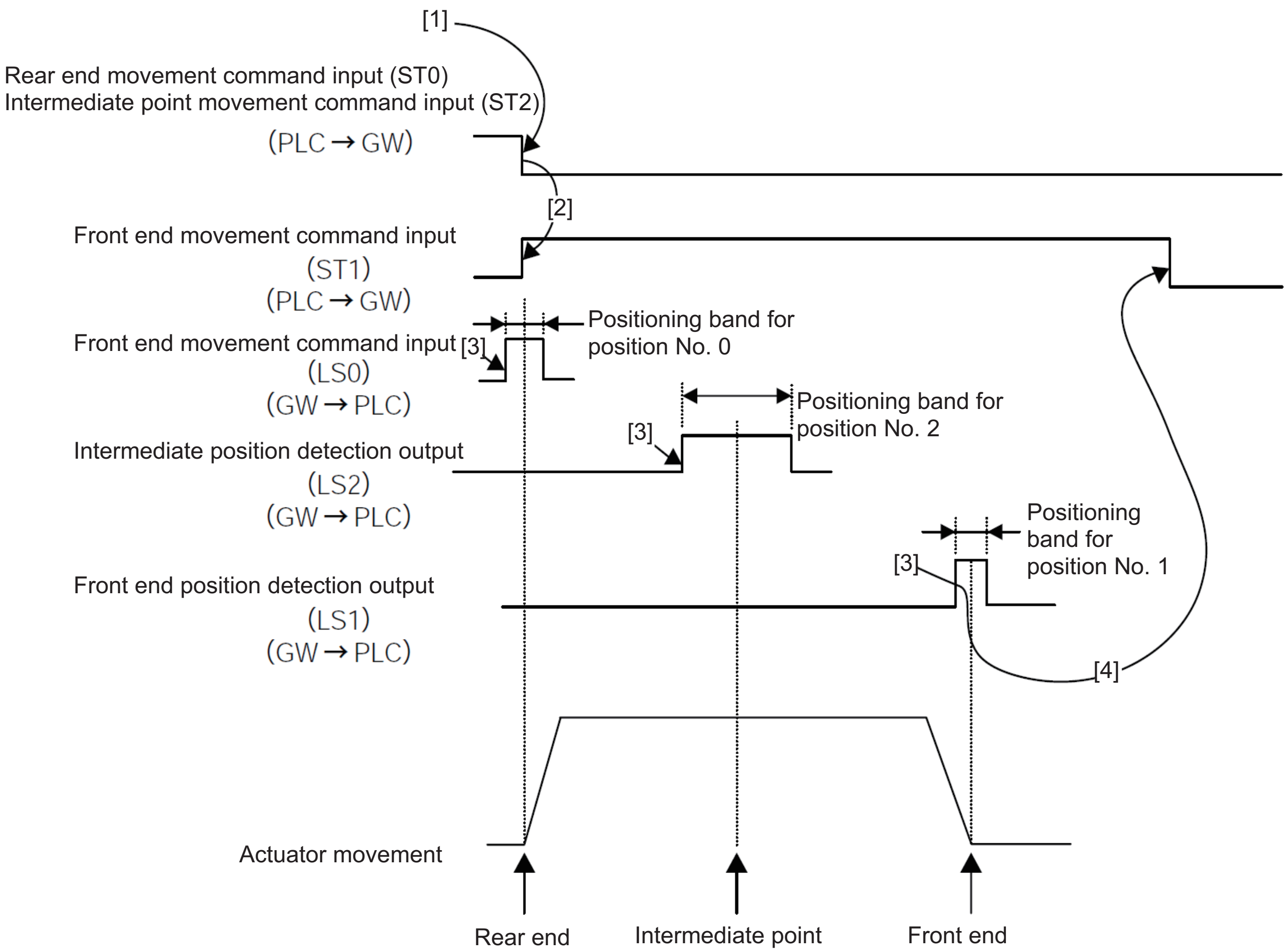
■ Operation

[1] Set all movement command bits to "0" (turn all movement command signals OFF).

[2] Set the movement command bit (front end movement command in the example below) to "1" (turn the signal ON).

[3] When the current position of the actuator enters the range of the value set in the position table ± positioning band (INP), each position detection is output.

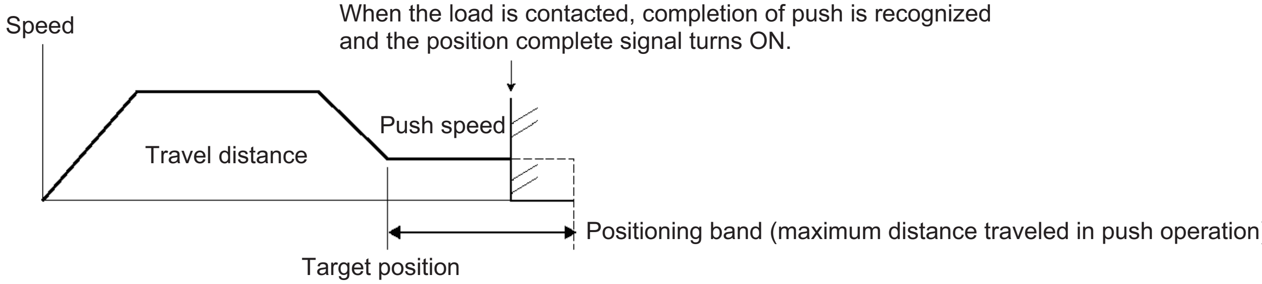
[4] Set the movement command bit to "0" (turn the signal OFF) after confirming that the position detection output bit for the target position (front end position detection output in the example below) has changed to "1" (the signal has turned ON).



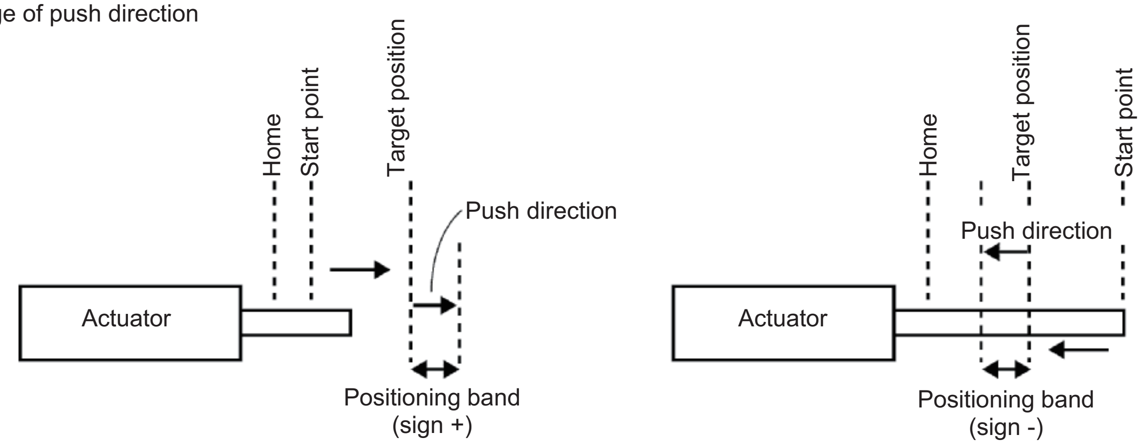
3.8.4 Other Basic Operations

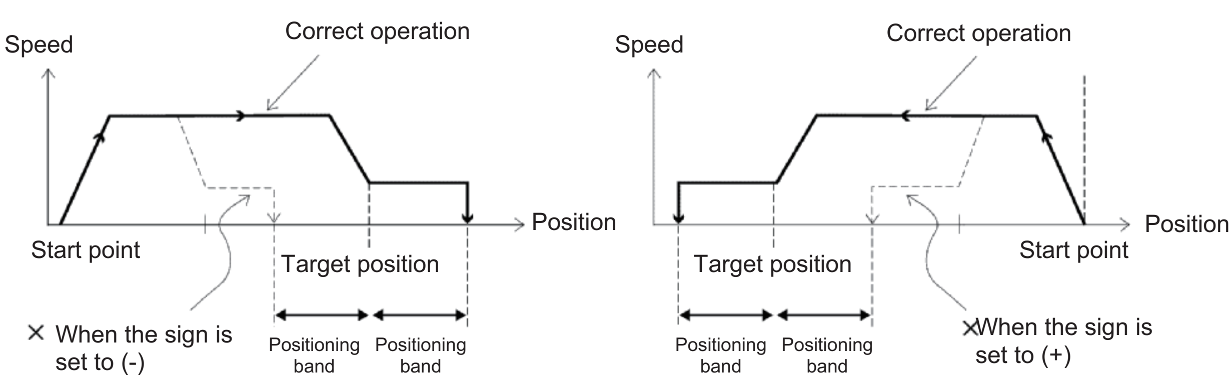
(1) Push operation

[1] Basic operation
As shown below, the actuator moves to the specified target position, and then moves at the specified push speed by up to the specified positioning band while pushing the work part.
The moment the push force reaches a certain value during push movement, completion of push is recognized and the position complete signal turns “1” (ON).



• Image of push direction





As shown above, when the actuator pushes from the start point to the target position the direction in which the coordinate increases is defined as the positive (+) direction, while the direction in which the coordinate decreases is defined as the negative (-) direction. Exercise caution because if the push direction is set incorrectly, the actuator will not operate correctly and push the work part at a position offset toward the start point by the distance of “positioning band x 2.”

- Push Mode Specification
  - In the positioner 1, 2 mode, simple direct mode and solenoid valve mode 1, 2, set a value other than “0” (push-current limiting value) in the “Push” field of the position table.
  - I In the direct numerical specification mode, set a value in the push-current limiting value area (bit 8) and set “1” (ON) in the control signal PUSH (bit 12).

- Push Speed
  Set the push speed using parameter No. 34, “Push speed.”
  (Before shipment, this parameter has been set individually in accordance with the actuator characteristics.)

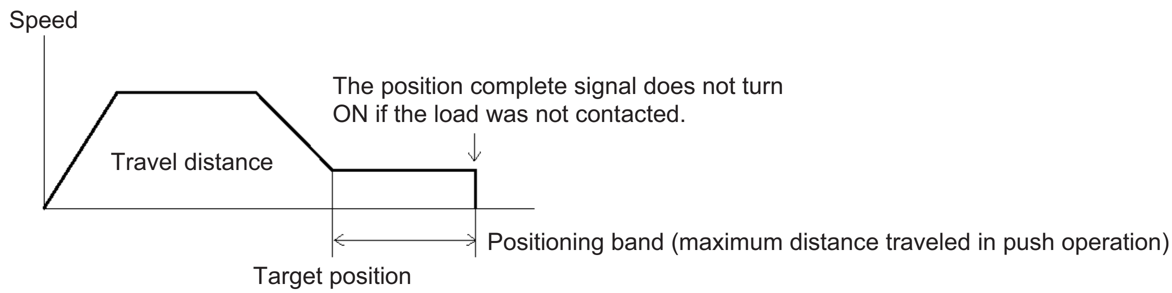
- Maximum Distance Traveled in Push operation
  - In the positioner 1, 2 mode, simple direct mode and solenoid valve mode 1, 2, set in the “Positioning band” field of the position table.
  - In the direct numerical specification mode, set in the positioning band area.
    (Consider the position error generated when the work part was installed, and also consider the amount of deflection if the work part is made of elastic material).

- Push Direction
  - In the positioner 1, 2 mode, simple direct mode and solenoid valve mode 1, 2, the sign in the “Positioning band” field of the position table specifies the push direction.
  - In the direct numerical specification mode, set “0” (OFF) or “1” (ON) in the control signal DIR (bit 13).

- Push Completion Judgment
  - Push completion judgment is based on the motor generated torque (push force) and push time.
  - To set the push force, set a push-current limiting value (%) in the “Push” field of the position table. In the direct numerical specification mode, set an applicable value in the push-current-limiting value register.
    Determine an appropriate push force based on the characteristics (shape, material, etc.) of the work part, and determine a corresponding push-current-limiting value by referring to the correlation diagram of “push force and current-limiting value” of the actuator.
  - Set the push stop judgment time in parameter No. 6.
    (The factory setting is “255” [msec].)

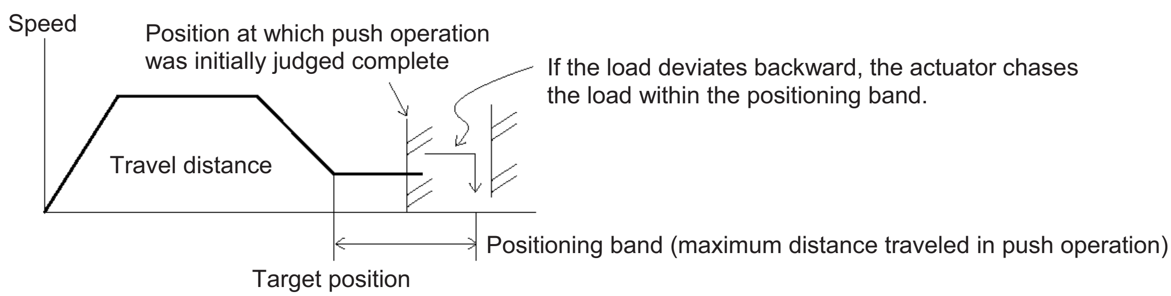
- Continuous Push
  - Once push operation is judged complete, the position complete signal will turn “1” (ON). However, the actuator will continue to push the work part until the next move command (command position number and positioning start signal) is issued.

[2] When the work part was missed in push operation
If the work part is not contacted (= the motor current does not reach the push-current limiting value) after the actuator has moved the distance corresponding to the specified positioning band, the position complete signal is not output. However, the completed position number is output.
In this case, status signal bit 5, or the PSFL, turns "1" (ON).

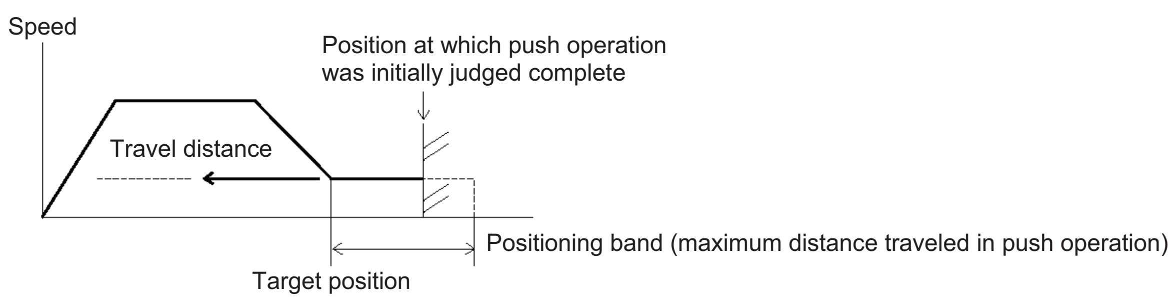


[3] When the work part moves after contact

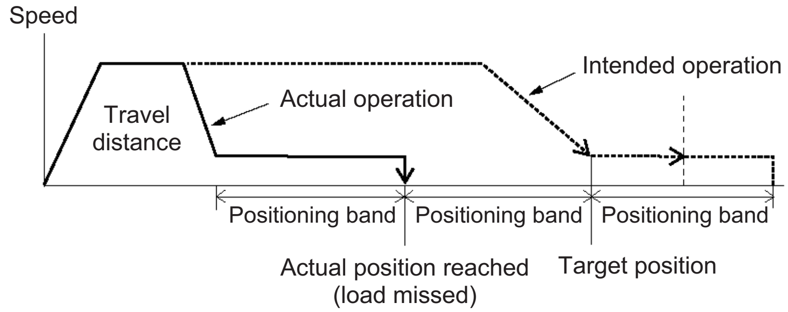
■ The work part moves in the push direction
If the work part moves in the push direction after completion of push operation, the actuator will continue to chase the work part within the positioning band.
If the current becomes smaller than the push-current limiting value during this movement, the position complete signal will turn "0" (OFF). When the current-limiting value is reached again, the signal will turn "1" (ON).



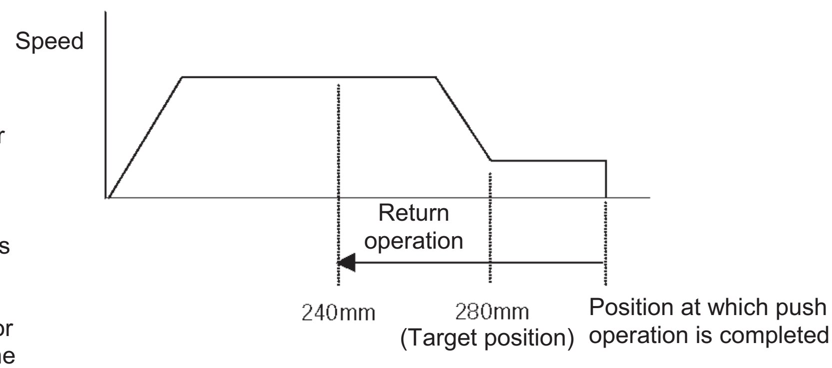
■ When the work part moves in the direction opposite push direction
(The work part is pushed back because the reactive force of the work part is too strong.)
If the reactive force of the work part exceeds the push force and the work part is pushed back after completion of push operation, the actuator will be pushed back continuously until the push force balances with the reactive force of the work part.
The position complete signal remains "1" (ON).
If the actuator is pushed back to the target position, an alarm will generate.



[4] When the push direction is set incorrectly
If the push direction is set incorrectly, the actuator position will deviate by "positioning band x 2," as shown below. Exercise caution.

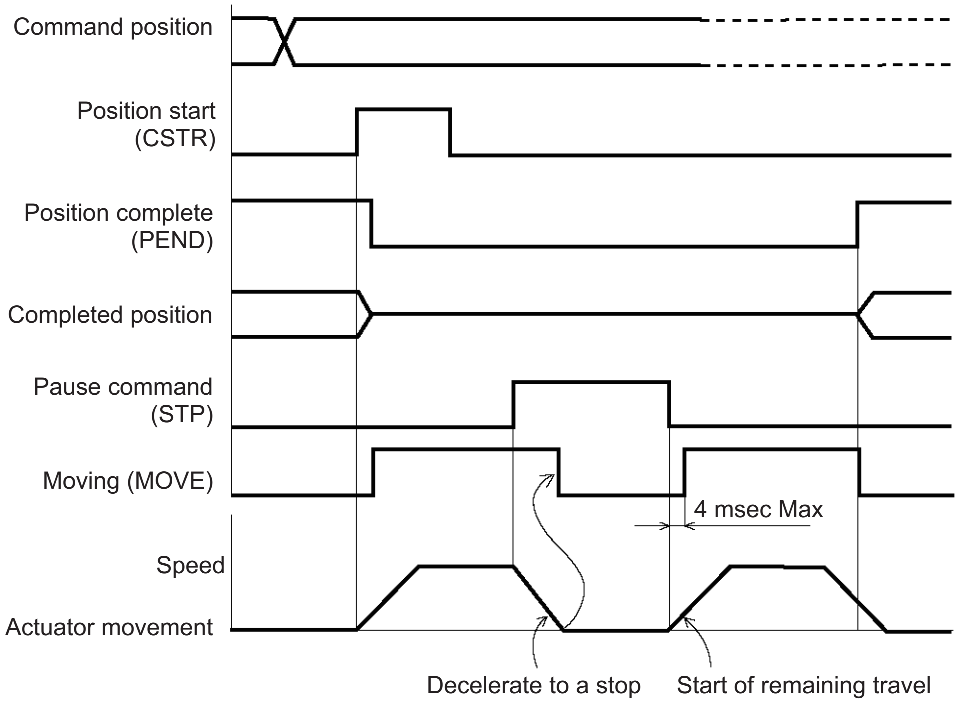


[5] When the return operation after push is specified in relative coordinates
Take note that when relative coordinate specification is used, the reference position is not the current position at which the actuator is stopped after completing the push operation, but the target position under the position number based on which the push operation was executed.
In this example, setting the position number as -40 mm in relative coordinates will cause the actuator to move to the position at 240 mm (280 – 40).
If the push mode is specified, the actuator will execute an incremental move from the stopped position.

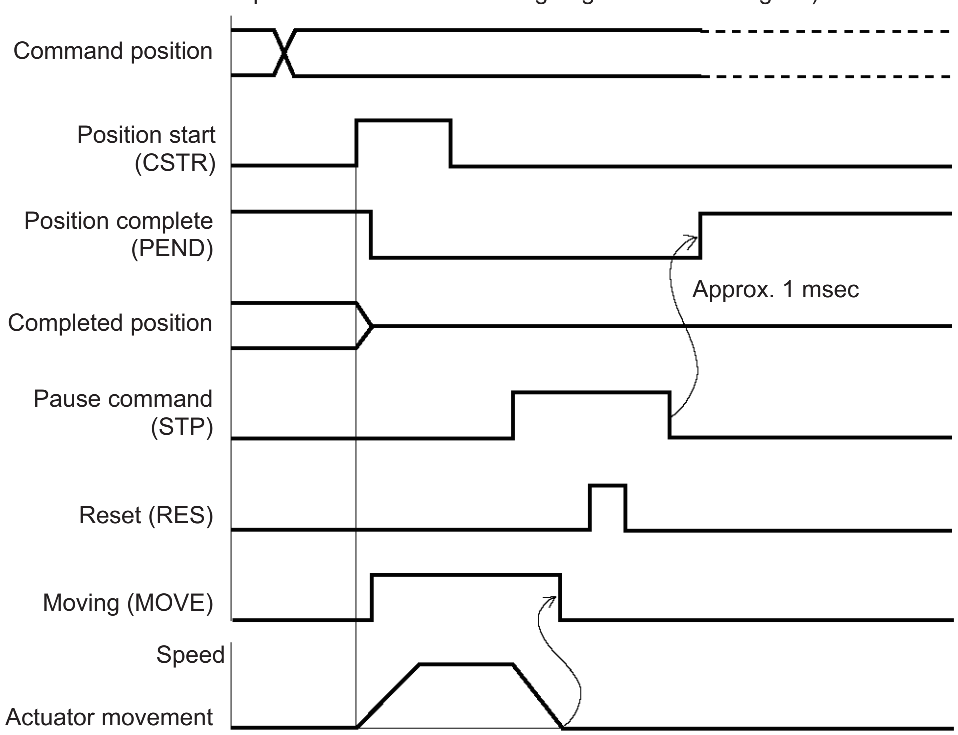


(2) Pause

When the pause command signal (STP) is turned "1" (ON) while the actuator is moving, the actuator will decelerate to a stop.
Since the remaining travel distance is retained, the remaining travel can be resumed by turning the SPT "0" (OFF) again.

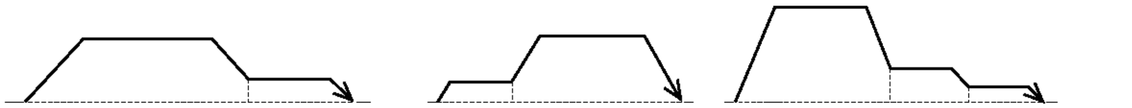


The remaining travel can be cancelled by turning the reset signal (RES) "1" (ON) while the actuator is paused. When the cancellation of the pause command (STP) is recognized thereafter, the position complete signal (PEND) will turn "1" (ON) within approx. 1 msec.
(The command is cancelled upon detection of the leading edge of the reset signal.)



(3) Speed Change during Movement

The actuator can be controlled at multiple speeds in a single operation. In other words, the speed can be decreased or increased at a given point.
However, a position data must be set for every point at which the speed is changed.

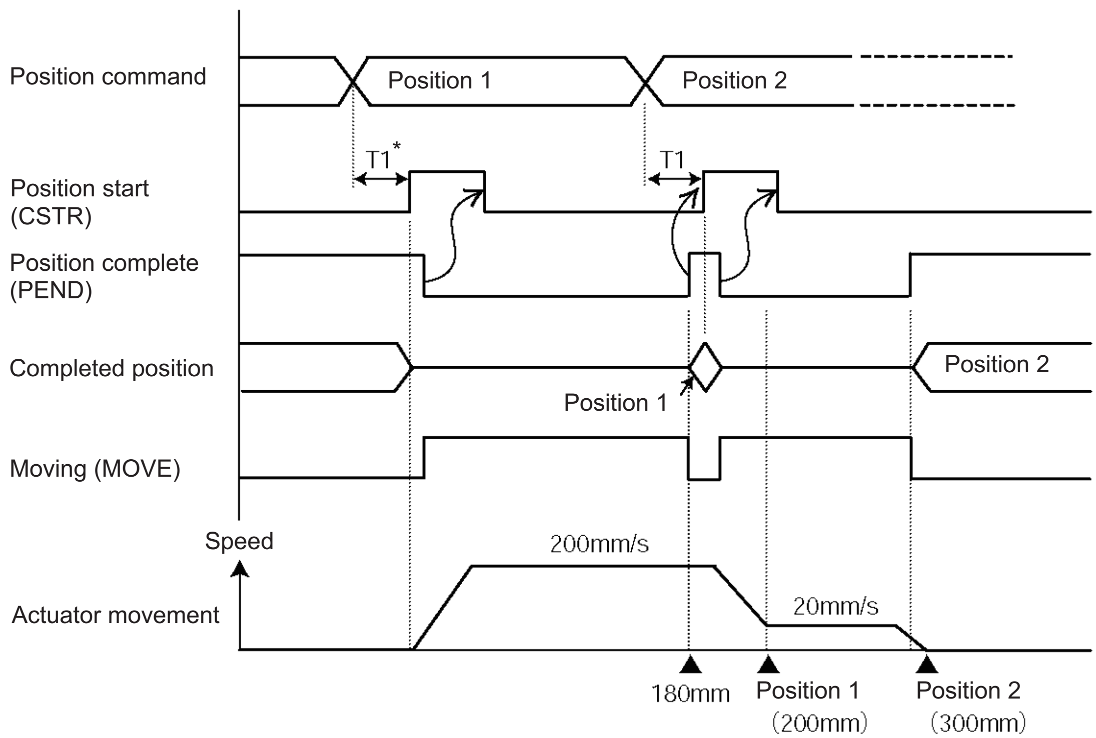


This function can be used in situations where the work part is made of soft material or is a bottle or has other easy-to-topple shape and you don't want the work part to receive vibration or impact upon stopping.

(Example) Positioning to position 2 (300 mm from the home), where the actuator is moved at a speed of 200 mm/sec to intermediate position 1 (200 mm from the home) and at a speed of 20 mm/sec thereafter.

Example of Position Table

No.	Position [mm]	Speed [mm/s]	Acceleration [G]	Deceleration [G]	Push [%]		Positioning band [mm]		Comment
0	*	*	*	*	*		*		
1	200.00	200.00	0.30	0.30	0		20.00		
2	300.00	20.00	0.30	0.30	0		0.10		



* Set an appropriate time so that "T1 ≥ 0 ms" is satisfied, by considering the scan time of the host controller.

Caution

[1] When the start signal (CSTR) is turned “1” (ON), the position complete signal (PEND) will turn “0” (OFF) and the moving signal (MOVE) will turn “1” (ON).
Turn the start signal (CSTR) “0” (OFF) after confirming that the position complete signal (PEND) has turned “0” (OFF) when CSTR is turned “1” (ON).
[2] By setting a large positioning band for position 1, speed change can be implemented smoothly without causing the actuator to stop.

Caution

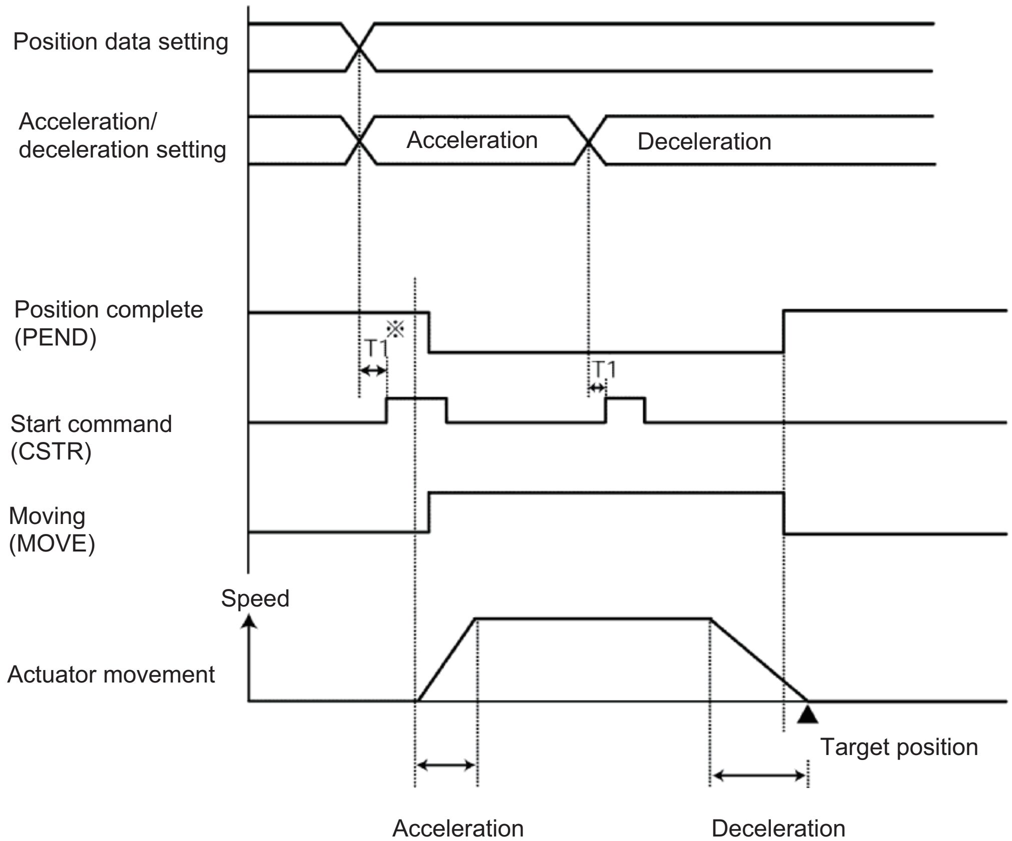
If a pause command is issued during home return, the move command will be retained if the actuator has not yet contacted a mechanical end. If the actuator has already reversed its direction after contacting a mechanical end, however, home return will be repeated from the beginning.

(4) Operation at Different Acceleration and Deceleration

[1] When the controller is used in the positioner 1, 2 mode or simple direct mode, separate values can be set for acceleration and deceleration using the position table.

[2] Direct numerical specification mode
In this mode, separate values cannot be set for acceleration and deceleration. The acceleration and deceleration are always the same.
The acceleration/deceleration data (16-bit data) becomes effective when the data is received by the axis controller (at the "0" (OFF) → "1" (ON) leading edge of the CSTR signal). To cause the actuator to decelerate at a different value than the acceleration, change the acceleration/deceleration data while the actuator is moving.

(Example)



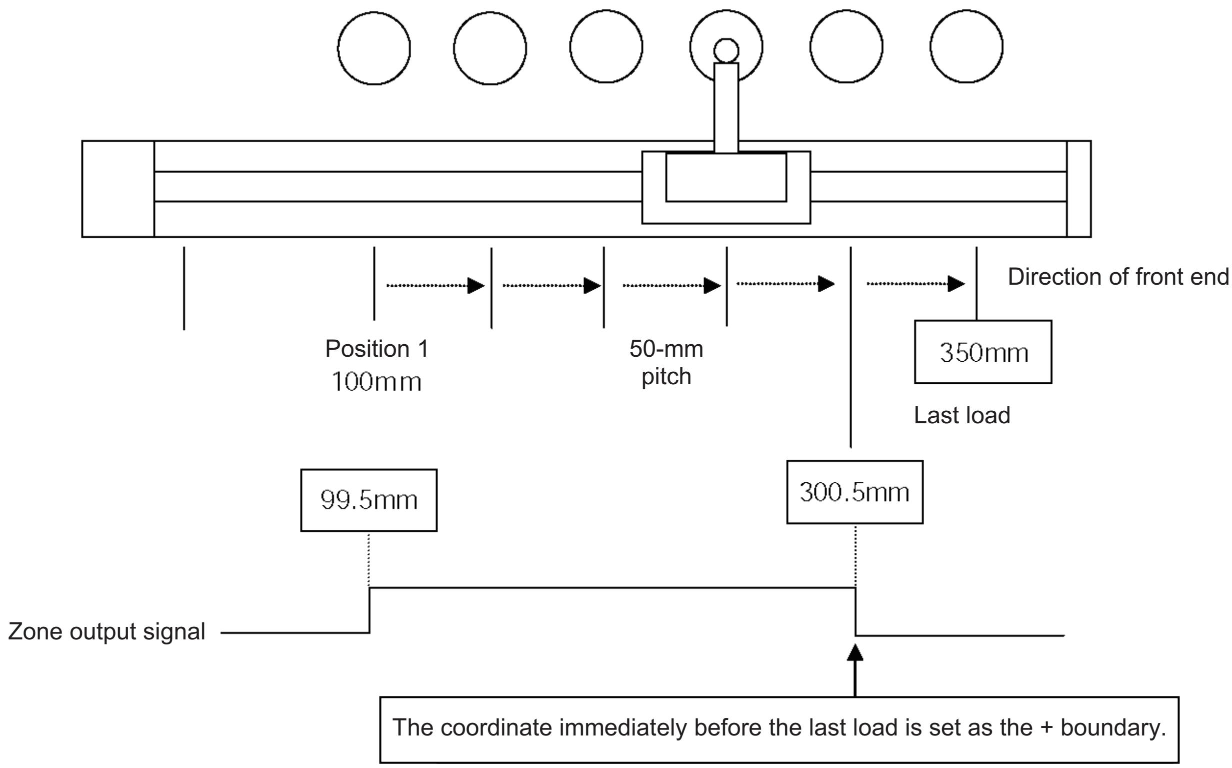
* Make sure "T1 ≥ 0 ms" is satisfied by considering the scan time of the host controller.

(5) Operation by Relative Coordinate Specification

The target position in the position table can also be specified in relative coordinates. This function can be used to repeat positioning operations at equal pitches.

[1] Example of operation in the positioner 1, 2 mode

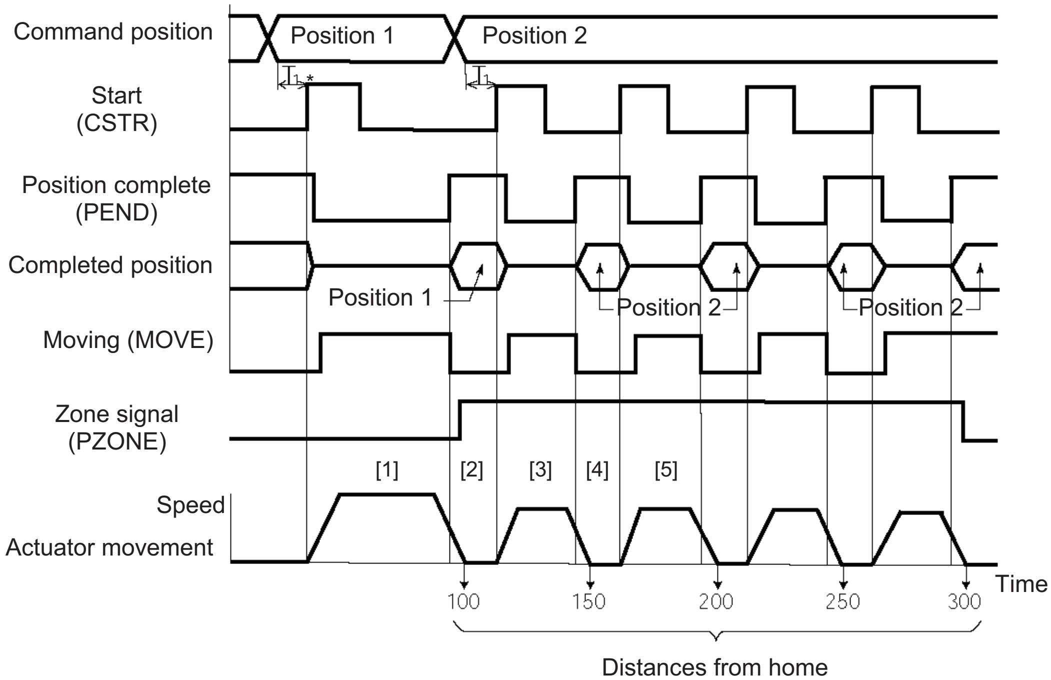
The following explains an example of positioning operation repeated at a 50-mm pitch, starting from position No. 1. The position table shown below is created. End of operation is determined based on the count managed by the PLC. The zone signal can be used to doubly confirm that operation has ended.



Example of Position Table

No.	Position [mm]	Zone+ [mm]	Zone- [mm]	Incremental	Comment
0	*	*	*	0	
1	100.00	300.50	99.50	0	
2	= 50.00	300.50	99.50	1	

On the teaching pendant, this sign indicates that the position is specified in relative coordinates.



* Set an appropriate time so that "T1 ≥ 0 ms" is satisfied, by considering the scan time of the host controller.

[Explanation of Operation]

[1] Positioning operation to position 1 (100.00 mm) is performed.

[2] Upon completion of positioning to position 1, the position complete signal (PEND) turns "1" (ON). The zone signal (PZONE) also turns "1" (ON).
The position number is changed from 1 to 2, and the start signal (CSTR) is turned "1" (ON).

[3] Once the actuator starts moving, the position complete signal (PEND) changes from "1" (ON) to "0" (OFF) and the moving signal (MOVE) changes from "0" (OFF) to "1" (ON). Turn the start signal (CSTR) "0" (OFF) after confirming that the PEND has turned "0" (OFF).

[4] After the actuator has moved by 50 mm, the position complete signal (PEND) turns "1" (ON) and the moving signal (MOVE) turns "0" (OFF) again. At this time, the PLC registers the first count in the movement counter.
Next, the start signal (CSTR) is turned "1" (ON) to start the next 50-mm movement.

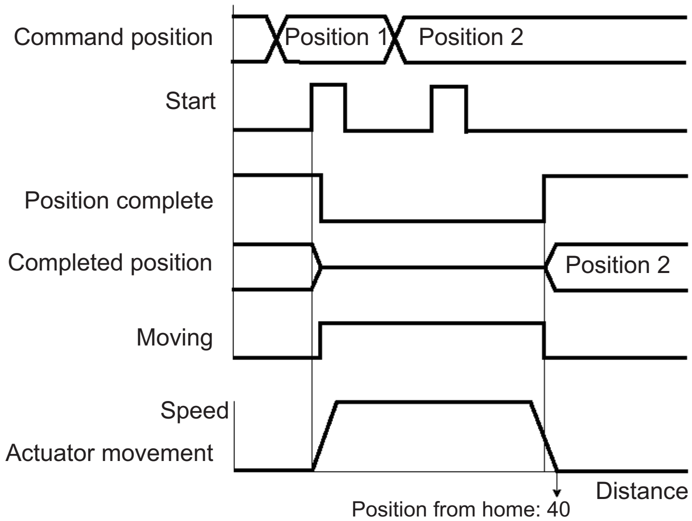
[5] Steps [3] and [4] are repeated hereafter.

The PLC checks the status of the zone signal (PZONE) upon completion of positioning. If the signal is "0" (OFF), the PLC determines that this is the last work part.
If the count in the PLC does not match the zone signal status, the signal timings may not be synchronized.

[2] Notes on positioning operation

If a position number specified in relative coordinates is selected/entered and a start signal is input during positioning operation, the actuator will move to the initial target position plus the relative travel distance. (If the relative travel distance is a negative value, the actuator will move to the initial target position less than the relative travel distance.)

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

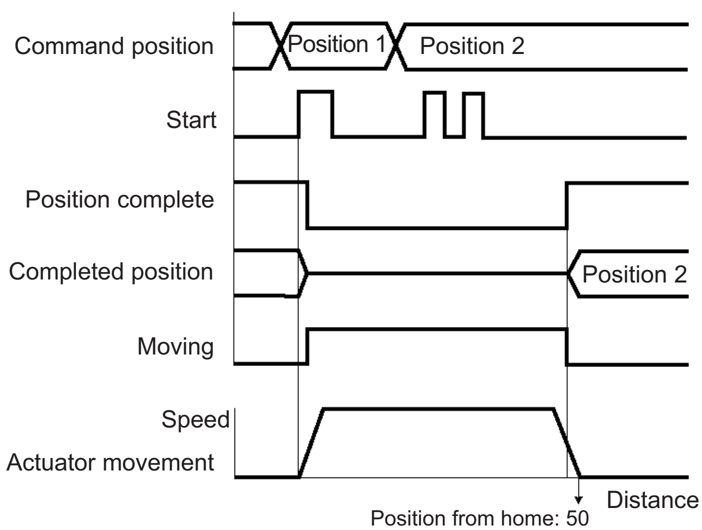


<Position Table of Teaching Pendant>

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

If during positioning operation a start signal is input multiple times for a position number specified in relative coordinates, the actuator will move to the initial target position plus "relative travel distance x number of times the signal is input."

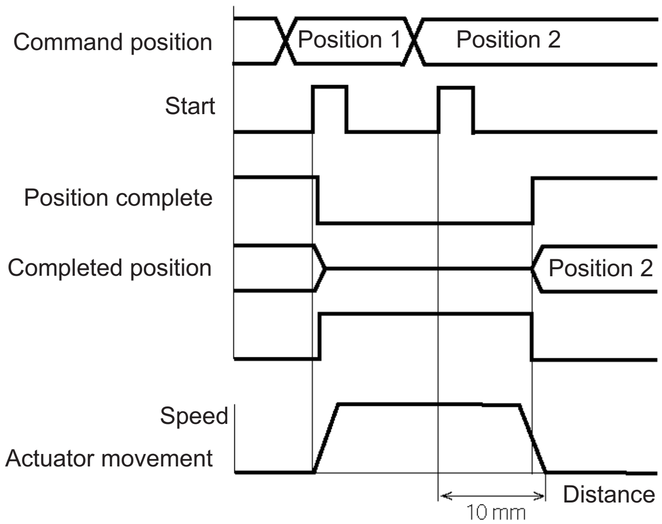
Example) If a start signal is input twice while the actuator is moving to position 1, the actuator will travel to a position 50 mm from home.



[3] Notes on push operation

If a position number specified in relative coordinates (for which the push mode is specified) is selected/input and a start signal is input while the actuator is moving in the push mode, the actuator will move to the position at which the start signal was input, plus the relative travel distance. Therefore, the end position becomes indeterminable.

Example) If a start signal for positioning to position 2 is input while the actuator is moving to position 1 in the push mode, the actuator will travel to a position 10 mm from the position at which the start signal was input.



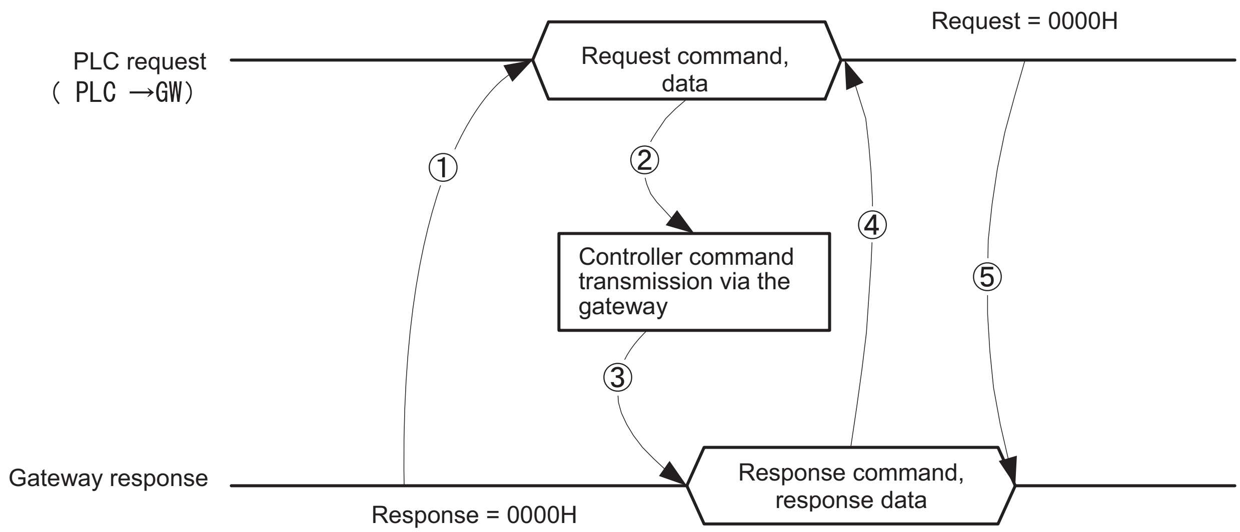
<Position Table of Teaching Pendant>

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

3.8.5 Command Transmission

A command transmission chart is shown below.
The Gateway R unit analyzes each request command and returns a response every time the replacement of control/status data of all axes, which is performed constantly, is completed.
The PLC and Gateway R unit perform the following actions:

[1] Upon detecting a response command with zero set in it, the PLC application sets the necessary request command and data.
[2] Upon detecting the change of the request command to a value other than zero, the gateway sends the request data to the applicable axis.
[3] Upon receiving a response from the applicable axis, the gateway outputs the response result.
[4] Upon confirming the response result, the PLC application clears the request command.
[5] Upon detecting the clearing of the request command, the gateway clears the response command and waits for the next command.
[1] to [5] are repeated if commands are used consecutively.



3.9 Modbus Gateway Mode of RS485 SIO

3.9.1 Overview

With the RS485 SIO Gateway R unit, the Modbus gateway mode in which the unit operates as a Modbus/RTU slave station, and the SIO through mode in which the unit operates by means of serial communication per the Modbus/RTU and ASCII protocols, are available.
For the operation in the SIO through mode, refer to the operation manual "ROBO CYLINDER Series – Serial Communication (Modbus Version)."

This section explains the Modbus gateway mode.
Modbus/RTU is the only applicable communication protocol in this mode, and the unit must be connected to a serial port that supports the Modbus/RTU protocol.
Axes are operated by sending communication messages under the Modbus/RTU protocol to the Gateway R unit (RGW-SIO) and accessing the gateway's registers (addresses F600 onward and F700 onward in the PLC).
Normally communication messages must be created using a PLC ladder sequence. If the number of communications increases, however, the required ladder sequence will become large and complex and creating an appropriate sequence will require a longer time.
Accordingly, the "Modbus cyclic communication FBL" is provided as a dedicated communication function block. This function block is very useful because the user can use it to create a ladder sequence without a need to consider serial communication.
To use this function block, the PLC must meet the following conditions:

[1] CPU unit	CS/CJ Series by Omron (If the function block is to be used, the CS/CJ Series unit must be Version 4.0 or later.)
[2] Serial communication unit	CS/CJ Series by Omron CS: CS1W-SCU**-V1 (Version 1.2 or later) CJ: CS1W-SCU**-V1 (Version 1.2 or later)
[3] CX Programmer	Version 7.0 or later

Caution

Switch between the Modbus gateway mode and SIO through mode using the user setting switch (SW2) on the Gateway R unit.

SW2 ON: SIO through mode
OFF: Modbus gateway mode

3.9.2 Modbus/RTU Protocol Specification

The RS485 SIO Gateway R unit has an asynchronous serial bus interface conforming to EIA RS485 for interfacing with the host.
The Modbus protocol is used for communication to receive commands from the host or reference internal information in the host.
The Modbus protocol is a communication protocol developed by Modicon Inc. (AEG Schneider Automation International S.A.S.) for PLCs, and its specification is open to the world. For the detailed specifications of this protocol, refer to the specification document (Modbus Application Protocol Specification V1.1a) published by Modbus-IDA (http://www.modbus-ida.org/), along with this specification.

(1) Basic Specifications

The basic specifications were explained in 3.4.4. Key items are summarized below.

Item	Method/condition
Interface	Conforming to EIA RS485
Communication method	Half-duplex communication
Synchronization method	Asynchronous method
Connection pattern	1:1 differential connection
Transmission mode	Modbus/RTU
Baud rate (bps)	Selectable from the following by a parameter: 9600, 19200, 38400, 57600, 115200, 230400
Bit length	8 bits
Stop bit	1 bit
Parity	None

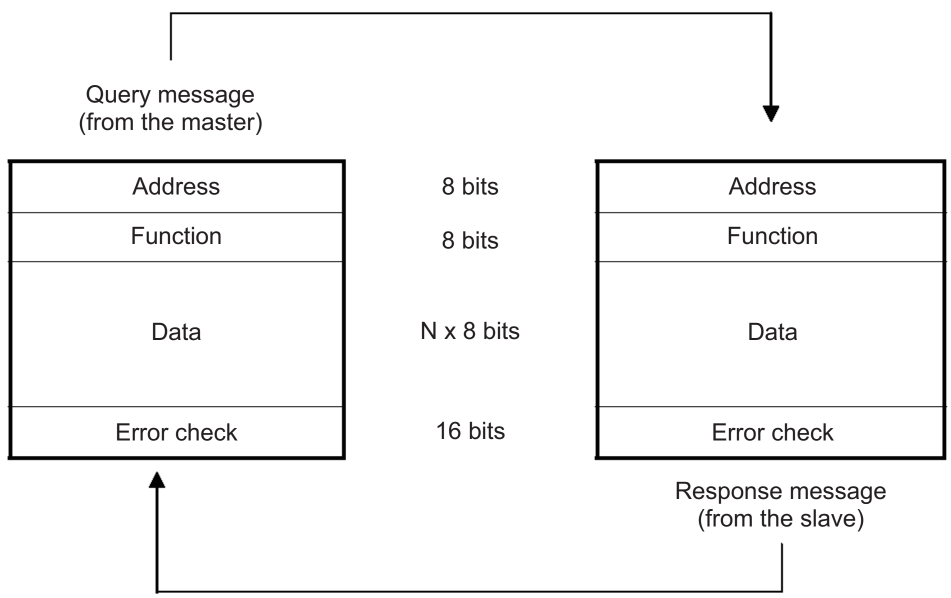
Caution

In the SIO through mode, 9600 bps and 19200 bps cannot be selected.

(2) Communication Method

The Modbus protocol uses the single-master/multiple-slave communication method. Only the master can issue a query (to start communication). The slave receives a query, performs the specified function, and returns a response message. The master can issue a query to a specific slave or broadcast a query to all slaves.
In the case of a broadcast query, the slaves only performs the specified function and do not return a response message. Each slave returns a response message only after receiving a query addressed specifically to the slave. The query transmission format consists of the slave address (or broadcast specification), function code defining the request, and data/error check fields.
The response message transmission format consists of the request check field and data/error check fields. The transmission formats of query and response messages are shown below.

Query and response communication cycle



(3) Serial Transfer Mode

The serial transfer mode in the Modbus gateway mode is the RTU (Remote Terminal Unit) mode.
In the RTU mode, 1-byte (8-bit) data is transmitted directly, which results in greater transmission efficiency.

(4) Message Frame

Query and response messages use the following message frame.

Header	Address	Function	Data	Error check	Trailer
T1-T2-T3-T4	8 bits	8 bits	N x 8 bits	16 bits	T1-T2-T3-T4

* "T1-T2-T3-T4" represents a silent interval.

[1] Header field
The frame starts with a silent interval of 3.5 characters or more.

[2] Address field
The address in the message frame. Fixed to 3FH for the RS485 SIO gateway.

[3] Function field
The following three functions can be used in the Modbus gateway mode.

Code (Hex)	Name	Function	Broadcast support
03H	Read Holding Registers	Read holding registers	
06H	Preset Single Register	Write holding register	○
10H	Preset Multiple Registers	Write multiple holding registers simultaneously	○

[4] Data field
This field is used to append data relating to the function code. The data field has a variable length and it can be omitted.

[5] Error check field
16-bit data is indicated by two bytes of eight-bit data.
The error check result is calculated by the method called "CRC (Cyclical Redundancy Check)."

[6] Trailer field
The frame ends with a silent interval of 3.5 characters or more.

(5) Error Check

CRC check

Each message contains an error check field based on the CRC method.
The CRC field is used to check the content of the entire message. This check is independent of the parity check of individual characters comprising the message.
The CRC field consists of two bytes of 16-bit binary data. The CRC value is calculated by the sender who appends the CRC to the message. The recipient recalculates the CRC value while the message is being received, and compares the calculated result against the actual value received in the CRC field. If the two values do not match, an error will be recognized.
In CRC calculation, first the register is preloaded with all 16 bits set to "1." Next, the successive 8-bit bytes are applied to the current content of the register. Among the characters, only eight bits are used to generate a CRC. The start, stop and parity bits are not used in CRC.
While a CRC is generated, each 8-bit character is compared against the register content based on the exclusive OR gate.
The result is shifted toward the least significant digit, and zero is inserted in the most significant digit. Thereafter, the least significant digit is taken out and checked. If the least significant digit is "1," the register is again compared based on the exclusive OR gate. If the least significant digit is "0," the exclusive OR gate is not applied.
This process is repeated until the data is shifted eight times. After the last (eighth) shift, the next 8-bit byte is compared against the current register value based on the exclusive OR gate. Then, this process is repeated eight times as explained above. After the process has been applied to all message bytes, the last content of the register provides the CRC value.

The generation polynomial is shown below (CRC-16 method)

x16 + x15 + x2 +1

When a CRC is appended to the message, the lower byte is appended first, followed by the upper byte.

(6) Send/Receive Buffers

With the RS485 SIO Gateway R unit, the sizes of send/receive buffers are 160 bytes, respectively. Calculate the message size to make sure the receive buffer is not exceeded in the case of messages sent from the host, and the send buffer is not exceeded in the case of data request messages.

3.9.3 Protocol Format

3.9.3.1 Gateway Address Map

The slave address is fixed to "63 (3FH)" for the RS485 SIO gateway.
As for gateway registers, inputs (PLC ⇒ ROBONET) are assigned to word addresses F600 H onward in the PLC, while outputs (ROBONET ⇒ PLC) are assigned to word addresses F700 H onward in the PLC.
These word addresses are the register addresses used in communication messages.
Take note that these addresses vary depending on the gateway parameter settings (assignment of each axis). The address map on the next page assumes that 12 axes of positioner mode or simple direct mode and two axes of direct numerical specification mode are connected.

In the sample protocol format explained in this section, axis (0) is operated in the positioner mode, while axis (1) is operated in the direct numerical specification mode. The gateway address map is as follows.

Register address	PLC output ⇒ ROBONET (Upper byte / Lower byte)	ROBONET⇒ PLC input (Upper byte / Lower byte)	Register address
F600	Gateway control signal 0	Gateway status signal 0	F700
F601	Gateway control signal 1	Gateway status signal 1	F701
F602	Request command	Response command	F702
F603	Data 0	Data 0	F703
F604	Data 1	Data 1	F704
F605	Data 2	Data 2	F705
F606	Data 3	Data 3	F706
F607	Cannot be used.	Cannot be used.	F707
F608	(Axis 0) Position data specification (L)	(Axis 0) Current position data (L)	F708
F609	(Axis 0) Position data specification (H)	(Axis 0) Current position data (H)	F709
F60A	(Axis 0) Command position number	(Axis 0) Completed position number	F70A
F60B	(Axis 0) Control signal	(Axis 0) Status signal	F70B
F60C	(Axis 1) Position data specification (L)	(Axis 1) Current position data (L)	F70C
F60D	(Axis 1) Position data specification (H)	(Axis 1) Current position data (H)	F70D
F60E	(Axis 1) Positioning band specification (L)	(Axis 1) Current electrical current (L)	F70E
F60F	(Axis 1) Positioning band specification (H)	(Axis 1) Current electrical current (H)	F70F
F610	(Axis 1) Speed specification	(Axis 1) Current speed data	F710
F611	(Axis 1) Acceleration/deceleration specification	(Reserved)	F711
F612	(Axis 1) Push-current limiting value	Axis (1) Alarm	F712
F613	(Axis1) Control signal	(Axis 1) Status signal	F713

Example of Overall RS485SIO Gateway Address Configuration

An example of connecting 12 axes operating in the positioner 1 mode or simple direct mode and two axes operating in the direct numerical specification mode is shown.

Register address	PLC output ⇒ ROBONET (Upper byte / Lower byte)	Relative byte	ROBONET⇒ PLC input (Upper byte / Lower byte)	Register address
F600*	Gateway control signal 0	0	Gateway status signal 0	F700*
F601	Gateway control signal 1	2	Gateway status signal 1	F701
F602	Request command	4	Response command	F702
F603	Data 0	6	Data 0	F703
F604	Data 1	8	Data 1	F704
F605	Data 2	10	Data 2	F705
F606	Data 3	12	Data 3	F706
F607	(Cannot be used.)	14	(Cannot be used.)	F707
F608	(Axis 0) Position data specification (L)	16	(Axis 0) Current position data (L)	F708
F609	(Axis 0) Position data specification (H)	18	(Axis 0) Current position data (H)	F709
F60A	(Axis 0) Command position number	20	(Axis 0) Completed position number	F70A
F60B	(Axis 0) Control signal	22	(Axis 0) Status signal	F70B
F60C	(Axis 1) Position data specification (L)	24	(Axis 1) Current position data (L)	F70C
F60D	(Axis 1) Position data specification (H)	26	(Axis 1) Current position data (H)	F70D
F60E	(Axis 1) Command position number	28	(Axis 1) Completed position number	F70E
F60F	(Axis 1) Control signal	30	(Axis 1) Status signal	F70F
F610	(Axis 2) Position data specification (L)	32	(Axis 2) Current position data (L)	F710
F611	(Axis 2) Position data specification (H)	34	(Axis 2) Current position data (H)	F711
F612	(Axis 2) Command position number	36	(Axis 2) Completed position number	F712
F613	(Axis 2) Control signal	38	(Axis 2) Status signal	F713
F614	(Axis 3) Position data specification (L)	40	(Axis 3) Current position data (L)	F714
F615	(Axis 3) Position data specification (H)	42	(Axis 3) Current position data (H)	F715
F616	(Axis 3) Command position number	44	(Axis 3) Completed position number	F716
F617	(Axis 3) Control signal	46	(Axis 3) Status signal	F717
⋮	⋮	⋮	⋮	⋮
F627	(Axis 7) Control signal	78	(Axis 7) Status signal	F727
⋮	⋮	⋮	⋮	⋮
F637	(Axis 11) Control signal	110	(Axis 11) Status signal	F737
F638	(Axis 12) Position data specification (L)	112	(Axis 12) Current position data (L)	F738
F639	(Axis 12) Position data specification (H)	114	(Axis 12) Current position data (H)	F739
F63A	(Axis 12) Positioning band specification (L)	116	(Axis 12) Current electrical current (L)	F73A
F63B	(Axis 12) Positioning band specification (H)	118	(Axis 12) Current electrical current (H)	F73B
F63C	(Axis 12) Speed specification	120	(Axis 12) Current speed data	F73C
F63D	(Axis 12) Acceleration/deceleration specification	122	(Cannot be used)	F73D
F63E	(Axis 12) Push-current limiting value	124	(Axis 12) Alarm	F73E
F63F	(Axis12) Control signal	126	(Axis 12) Status signal	F73F
F640	(Axis 13) Position data specification (L)	128	(Axis 13) Current position data (L)	F740
F641	(Axis 13) Position data specification (H)	130	(Axis 13) Current position data (H)	F741
F642	(Axis 13) Positioning band specification (L)	132	(Axis 13) Current electrical current (L)	F742
F643	(Axis 13) Positioning band specification (H)	134	(Axis 13) Current electrical current (H)	F743
F644	(Axis 13) Speed specification	136	(Axis 13) Current speed data	F744
F645	(Axis 13) Acceleration/deceleration specification	138	(Cannot be used.)	F745
F646	(Axis 13) Push-current limiting value	140	(Axis 13) Alarm	F746
F647	(Axis13) Control signal	142	(Axis 13) Status signal	F747

* With the RS485 SIO unit, the initial address is “0xF600H” for PLC ⇒ ROBONET messages, and “0xF700H” for ROBONET ⇒ PLC messages.

3.9.3.2 Query List

The table below lists queries that can be used.

FC	Function	Remarks (Performable operation)	Positioner mode axis	Simple direct mode axis	Direct numerical mode axis	Details
03H	Read multiple registers	[1] Read gateway status signal 0, 1	1 each	1 each	1 each	3.9.3.3 (2) [1]
		[2] Read response command data 0 to 3	1 each	1 each	X	3.9.3.3 (2) [2]
		[3] Monitor current position (unit: 0.01 mm, 2 words)	2	2	2	3.9.3.3 (2) [3]
		[4] Monitor current electrical current (unit: 1 mA, 2 words)	X	X	2	3.9.3.3 (2) [4]
		[5] Monitor current speed (unit: 1 mm/s, 1 word)	X	X	1	3.9.3.3 (2) [5]
		[6] Monitor alarm information (1 word)	X	X	1	3.9.3.3 (2) [6]
		[7] Read completed position number status PM1/PM2/PM4/PM8/PM16/PM32/PM64/PM128/ PM256/PM512	1	1	X	3.9.3.3 (2) [7]
		[8] Read status signal status	1	1	1	3.9.3.3 (2) [8]
		• Position complete (PEND)	○	○	○	
		• Home return complete (HEND)	○	○	○	
		• Moving (MOVE)	○	○	○	
		• Alarm (ALM)	○	○	○	
		• Ready (SV)	○	○	○	
		• Missed work part in push operation (PSFL)	○	○	○	
		• Position data load command status (WEND)	○	X	X	
		• Teaching mode status (MODES)	○	X	X	
		• Position zone output monitor (PZONE)	○	X	X	
		• Zone output monitor 1 (ZONE1)	○	○	○	
		• Zone output monitor 2 (ZONE2)	○	○	○	
		• Controller ready (CRDY)	○	○	○	
		• Emergency stop status (EMGS)	○	○	○	
06H	Write register	[1] Write gateway control signal 0, 1	1 each	1 each	1 each	3.9.3.4 (2) [1]
		[2] Output command position number	1	X	X	3.9.3.4 (2) [2]
		[3] Output control signals	1	1	1	3.9.3.4 (2) [3]
		• Start command (CSTR)	○	○	○	
		• Home return command (HOME)	○	○	○	
		• Pause command (STP)	○	○	○	
		• Reset command (RES)	○	○	○	
		• Servo ON command (SON)	○	○	○	
		• Jogging/inching switching (JISL)	○	○	○	
		• Jogging speed/inching distance switching (JVEL)	○	○	○	
		• Jog- command (JOG-)	○	○	○	
		• Jog+ command (JOG+)	○	○	○	
		• Position data load command (PWRT)	○	X	X	
		• Teaching mode command (MODE)	○	X	X	

FC	Function	Remarks (Performable operation)	Positioner mode axis	Simple direct mode axis	Direct numerical mode axis	Details
06H	Write register	• Forced brake release (BKRL)	○	○	○	3.9.3.4 (2) [3]
		• Push operation mode specification	X	X	○	
		• Push direction specification	X	X	○	3.9.3.4 (2) [4]
10H	Write multiple registers simultaneously	With a move command by direct numerical specification, the following data is sent in one message:				3.9.3.5 (2) 3.9.3.5 (3)
		[1] Position data specification (2 words)	X	X	2	
		[2] Positioning band (2 words)	X	X	2	
		[3] Speed command (1 word)	X	X	1	
		[4] Acceleration/deceleration command (1 word)	X	X	1	
		[5] Push-current limiting value (1 word)	X	X	1	
		[6] Control signal output (1 word) (The content is the same as when the applicable register is written.)	X	X	1	
		[7] Send request command data 0 to 3, if a gateway command is used.	1 each	1 each	X	3.9.3.5 (4)

- Positioner mode axes include positioner 1 mode axes and positioner 2 mode axes.
- The value indicates the number of registers (register size: 1 word).
  A field that contains a value or “○” indicates that the function is available, while one that contains “X” indicates that the function is not available.

3.9.3.3 Read Holding Registers (Query using FC = 03H)

This query reads the contents of holding registers in the slave. Broadcast is not supported.
The basic query/response structures and examples of queries are shown below.

(1) Basic Query/Response Structures

[1] Query format

The query message specifies the address of the holding register (gateway register) from which to start reading data, and the number of registers.
Data length of 1 holding register = 1 word = 2 bytes = 16 bits

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Starting address (upper)	Arbitrary	2	The address varies depending on the axis arrangement.
Starting address (lower)	Arbitrary		
Number of registers (upper)	Arbitrary	2	Refer to the query list.
Number of registers (lower)	Arbitrary		
Error check	CRC (16 bits)	2	
Trailer	None	-	
Total bytes		8	

[2] Response format

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Data bytes	Arbitrary	1	Number of registers specified in the query format x 2
Data 1 (upper)	Arbitrary	1 each for upper and lower words 2	Data corresponding to the data bytes (number of specified registers x 2)
Data 1 (lower)	Arbitrary		
Data 2 (upper)	Arbitrary	Same as above	
Data 2 (lower)	Arbitrary		
:	:	:	
Error check	CRC (16 bits)	2	
Trailer	None	-	
Total bytes			

(2) Examples of Queries/Responses

Queries are implemented by reading a 1-word register and thus the basic pattern is the same with all queries. The only differences are the starting address and data.

[1] Read gateway status signal 0, 1
The configuration of the completed position number register of axis (0) is shown below.

	b15							b8	b7							b0	
Address F700H	RUN	—	ERRT	MOD	—	—	W8B16	W8B8	W8B4	W8B2	W8B1	W4B16	W4B8	W4B4	W4B2	W4B1	Gateway status signal 0
Address F701H	LNK15	LNK14	LNK13	LNK12	LNK11	LNK10	LNK9	LNK8	LNK7	LNK6	LNK5	LNK4	LNK3	LNK2	LNK1	LNK0	Gateway status signal 1

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Starting address (upper)	F7 H	2	Initial address of gateway status signal 0, 1
Starting address (lower)	00 H		
Number of registers (upper)	00 H	2	Number of registers (1 register = 1 word): 2
Number of registers (lower)	02 H		
Error check (CRC)	Based on calculation result	2	(F2 A1)
Trailer	None	-	
Total bytes		**8**	

● Response

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Data bytes	04 H	1	1-word register x 2 = 4 bytes
Data 1 (upper)	Arbitrary	1 each for upper and lower words 2	Data of gateway status signal 0, 1
Data 1 (lower)	Arbitrary		
Data 2 (upper)	Arbitrary	Same as above	
Data 2 (lower)	Arbitrary		
Error check (CRC)	Based on calculation result	2	
Trailer	None	-	
Total bytes		Arbitrary	

● Actual Example
- ■ Sent Query: 3F03F7000002F2A1
- ■ Received Response: 3F0304802100031C3B

Gateway status signal 0 is “8021H,” while status signal 1 is “0003H.” In other words, the RUN, W8B1, W4B1, LNK1 and LNK0 signals are ON.

[2] Read response command data 0 to 3

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Starting address (upper)	F7 H	2	Initial address of the response command
Starting address (lower)	02 H		
Number of registers (upper)	00 H	2	Number of registers (1 register = 1 word): 5
Number of registers (lower)	05 H		
Error check (CRC)	Based on calculation result	2	(12 A3)
Trailer	None	-	
Total bytes		8	

● Response

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Data bytes	0A H	1	1-word register x 5 = 10 bytes
Data 1 (upper) (lower)	Response command	2	Position number specified in the request command
Data 2 (upper) (lower)	Data 0	2	
Data 3 (upper) (lower)	Data 1	2	
Data 4 (upper) (lower)	Data 2	2	
Data 5 (upper) (lower)	Data 3	2	Address
Error check (CRC)	Based on calculation result	2	
Trailer	None	-	
Total bytes			

● Actual Example (Example of reading the response data after issuing a command to read the table position for position No. 2 of axis 0)

■ Sent Query: 3F03F702000512A3

■ Received Response: 3F030A <u>1040</u> [1] <u>0002</u> [2] <u>2710</u> [3] <u>0000</u> [4] <u>0000</u> [5] A74A

(Explanation)
[1] The response command is “1040H,” meaning that this is a target position read command.
[2] Position number: 2
[3] Lower word of position data that has been read: 2710H
[4] Upper word of position data that has been read: 0000H
2710H = 10000 (decimal) → 100.00 mm
[5] Axis number: 0

[3] Monitor current position – Axis (0)

● Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		03 H	1	
Starting address	(upper)	F7 H	2	The addresses of current position data of axis (0) are F708H and F709H for the lower word and upper word, respectively.
Starting address	(lower)	08 H		
Number of registers	(upper)	00 H	2	Number of registers (1 register = 1 word): 2
Number of registers	(lower)	02 H		
Error check	(CRC)	Based on calculation result	2	(73 63)
Trailer		None	-	
Total bytes			8	

● Response

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		03 H	1	
Data bytes		04 H	1	1-word register x 2 = 4 bytes
Data 1	(upper)	Arbitrary	1 each for upper and lower words 2	Lower word of the current position
Data 1	(lower)	Arbitrary		
Data 2	(upper)	Arbitrary	Same as above	Upper word of the current position
Data 2	(lower)	Arbitrary		
Error check	(CRC)	Based on calculation result	2	
Trailer		None	-	
Total bytes				

● Actual Example
- ■ Sent Query: 3F03F70800027363
- ■ Received Response: 3F0304<u>38A50000</u>38B3

(Explanation)
- Lower word: 38A5H
- Upper word: 0000H

The current position data is indicated in units of 0.01 mm.
In other words, 000038A5 H = 14501 (decimal) → 145.01 mm

[4] Monitor current electrical current – Axis (1)

● Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		03 H	1	
Starting address	(upper)	F7 H	2	Address of the current electrical current of axis (1)
Starting address	(lower)	0E H		
Number of registers	(upper)	00 H	2	Number of registers (1 register = 1 word): 2
Number of registers	(lower)	02 H		
Error check	(CRC)	Based on calculation result	2	(93 62)
Trailer		None	-	
Total bytes			8	

● Response

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		03 H	1	
Data bytes		04 H	1	1-word register x 2 = 4 bytes
Data 1	(upper)	Arbitrary	1 each for upper and lower words 2	Lower word of the current electrical current
Data 1	(lower)	Arbitrary		
Data 2	(upper)	Arbitrary	Same as above	Upper word of the current electrical current
Data 2	(lower)	Arbitrary		
Error check	(CRC)	Based on calculation result	2	
Trailer		None	-	
Total bytes				

● Actual Example
- ■ Sent Query: 3F03F70E00029362
- ■ Received Response: 3F0304<u>00260000</u>C43B

(Explanation)
- • Lower word: 0026 H
- • Upper word: 0000 H

The electrical current data is indicated in unit of 1mA.
In other words, 00000026 H = 38 (decimal) → 38 mA

[5] Monitor current speed – Axis (1)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Starting address (upper)	F7 H	2	Address of the current speed data of axis (1)
Starting address (lower)	10 H		
Number of registers (upper)	00 H	2	Number of registers (1 register = 1 word): 1
Number of registers (lower)	01 H		
Error check (CRC)	Based on calculation result	2	(B3 65)
Trailer	None	-	
Total bytes		8	

● Response

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Data bytes	02 H	1	1-word register x 1 = 2 bytes
Data 1 (upper)	Arbitrary	1 each for upper and lower words 2	Current speed data
Data 1 (lower)	Arbitrary		
Error check (CRC)	Based on calculation result	2	
Trailer	None	-	
Total bytes			

● Actual Example
- ■ Sent Query: 3F03F7100001B365
- ■ Received Response: 3F03020000 9181

(Explanation) The current speed data is “0000H.”
In other words, the current speed is “0” in this example.
The current speed is indicated in units of 1.0 mm/sec.
The current speed is set as a multiple of 1.0 mm/sec or 0.1 mm/sec.
The unit is changed on the special parameter setting screen of the ROBONET gateway parameter creation tool. (The unit change function is supported by tools of version 1.0.4.0 and later.)

[6] Monitor alarm information – Axis (1)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Starting address (upper)	F7 H	2	Alarm address of axis (1)
Starting address (lower)	12 H		
Number of registers (upper)	00 H	2	Number of registers (1 register = 1 word): 2
Number of registers (lower)	01 H		
Error check (CRC)	Based on calculation result	2	(12 A5)
Trailer	None	-	
Total bytes		8	

● Response

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Data bytes	02 H	1	1-word register x 1 = 2 bytes
Data 1 (upper)	Arbitrary	1 each for upper and lower words 2	
Data 1 (lower)	Arbitrary		
Error check (CRC)	Based on calculation result	2	
Trailer	None	-	
Total bytes			

● Actual Example
- ■ Sent Query: 3F03F762000112A5
- ■ Received Response: 3F030200009181

(Explanation Alarm code is 0000H. Accordingly, no alarm has generated.

[7] Read completed position number status – Axis (0)
The configuration of the completed position number register of axis (0) is shown below.

	b15							b8	b7							b0
Address F70AH	—	—	—	—	—	—	PM512	PM256	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1

● Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		03 H	1	
Starting address	(upper)	F7 H	2	Address of the completed position number of axis (0)
Starting address	(lower)	0A H		
Number of registers	(upper)	00 H	2	Number of registers (1 register = 1 word): 1
Number of registers	(lower)	01 H		
Error check	(CRC)	Based on calculation result	2	(92 A2)
Trailer		None	-	
Total bytes			8	

● Response

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		03 H	1	
Data bytes		02 H	1	1-word register x 1 = 2 bytes
Data 1	(upper)	Arbitrary	1 each for upper and lower words 2	Completed position number data
Data 1	(lower)	Arbitrary		
Error check	(CRC)	Based on calculation result	2	
Trailer		None	-	
Total bytes			7	

● Actual Example
- Sent Query: 3F03F70A000192A2
- Received Response: 3F03020003D180

(Explanation) The completed position number is “3.”

[8] Read status signal status – Axis (0)
The configuration of the status signal register of axis (0) is shown below.

	b15							b8	b7							b0
Address F70BH	EMGS	CRDY	ZONE1	ZONE2	PZONE	MODES	WEND	—	—	—	PSFL	SV	ALM	MOVE	HEND	PEND

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Starting address (upper)	F7 H	2	Address of the status signal of axis (0)
Starting address (lower)	0B H		
Number of registers (upper)	00 H	2	Number of registers (1 register = 1 word): 1
Number of registers (lower)	01 H		
Error check (CRC)	Based on calculation result	2	(C3 62)
Trailer	None	-	
Total bytes		8	

● Response

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	03 H	1	
Data bytes	02 H	1	1-word register x 1 = 2 bytes
Data 1 (upper)	Arbitrary	1 each for upper and lower words 2	Status signal data
Data 1 (lower)	Arbitrary		
Error check (CRC)	Based on calculation result	2	
Trailer	None	-	
Total bytes		7	

- Actual Example After axis (0) servo ON
  - Sent Query: 3F03F70B0001C362
  - Received Response: 3F0302<u>4011</u>604D

  (Explanation) The CRDY, SV and PEND signals are ON.
- Actual Example After axis (0) home return
  - Sent Query: 3F03F70B0001C362
  - Received Response: 3F0302<u>7013</u>F58C

  (Explanation) The CRDY, ZONE1, ZONE2, SV, HEND and PEND signals are ON.

3.9.3.4 Preset Single Register (Query using FC = 06H)

Data is written to (changed in) a holding register in the slave.
The basic query/response structures and examples of queries are shown below.

(1) Basic Query/Response Structures

[1] Query format
The query message specifies the address of the holding register (gateway register) from which to start writing (changing) data, and the data.
Data length of 1 holding register = 1 word = 2 bytes = 16 bits

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	Arbitrary	2	The address varies depending on the axis arrangement.
Starting address (lower)	Arbitrary		
New data (data written) (upper)	Arbitrary	2	
New data (data written) (lower)	Arbitrary		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

[2] Response format
If the data has been changed (written) successfully, the response is the same as the query.
If invalid data has been sent, no response is returned.

(2) Examples of Queries/Responses

Queries are implemented by changing (writing) a 1-word register and thus the basic pattern is the same with all queries. The only differences are the starting address and data. The following explanations use axis (0) or axis (12) in the example.

[1] Write gateway control signals 0, 1
MON (bit 15 of control signal 0) is the only applicable control signal. Always turn this signal ON to enable the applicable control.

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of gateway control signal 0 register
Starting address (lower)	00 H		
New data (data written) (upper)	80 H	2	
New data (data written) (lower)	00 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
- ■ Sent Query: 3F06F6008000DF5C
- ■ Received Response: 3F06F6008000DF5C

[2] Output command position number
A position number (= 1) is specified for axis (0).
The configuration of the command position number register of axis (0) is shown below.

	B15							b8	b7							b0
Address F60AH	—	—	—	—	—	—	PC 512	PC 256	PC 128	PC 64	PC 32	PC 16	PC 8	PC 4	PC 2	PC 1

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the command position number register of axis (0)
Starting address (lower)	0A H		
New data (data written) (upper)	00 H	2	A position number (= 1) is specified.
New data (data written) (lower)	01 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
- Sent Query: 3F06F60A00015F5E
- Received Response: 3F06F60A00015F5E

[3] Output control signals (Axis 0 = Positioner mode or simple direct mode)
An example of control signals of axis (0) is explained.
The configuration of the control signal register of axis (0) is shown below.

	B15							b8	b7							b0
Address F60BH	BKRL	—	—	—	—	MODE	PWRT	JOG+	JOG−	JVEL	JISL	SON	RES	STP	HOME	CSTR

◆ Servo ON Command (SON)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	00 H	2	
New data (data written) (lower)	10 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
- Sent Query: 3F06F60B0010CE92
- Received Response: 3F06F60B0010CE92

◆ Home Return Command (HOME)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	00 H	2	
New data (data written) (lower)	12H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example

- ■ Sent Query: 3F06F60B00124F53
- ■ Received Response: 3F06F60B00124F53

Be sure to turn on the servo before executing the home return command.

◆ Start Command (CSTR)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	00 H	2	The SON and CSTR signals are “1.”
New data (data written) (lower)	11 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example

■ Sent Query: 3F06F60B00110F52

■ Received Response: 3F06F60B00110F52

[Function]

Upon detection of the signal edge for executing the position command when the new data is in normal state, the content of the position number register will be read and positioning will be performed to the target position of the corresponding position data.

If the position start command for the new data remains ON, the position complete signal (PEND) will not be output even when the actuator enters the positioning band. However, the completed position number signal (PM***) will be output.

If this command is executed when no home return operation has been performed after the power on (when HEND = “0”), the actuator will perform home return operation and then start moving to the target position.

◆ Pause Command (STP)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	00 H	2	The SON and STP signals are “1.”
New data (data written) (lower)	14 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example

■ Sent Query: 3F06F60B0014CF51

■ Received Response: 3F06F60B0014CF51

◆ Reset Command (RES)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	00 H	2	The SON and RES signals are “1.”
New data (data written) (lower)	08 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example

- ■ Sent Query: 3F06F60B0008CE98
- ■ Received Response: 3F06F60B0008CE98

◆ Jogging/Inching Switching Command (JISL)
This signal is used to switch jogging operation and inching operation.
JISL = “0”: Jogging operation
JISL = “1”: Inching operation

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	Arbitrary	2	Used in combination with the JOG+/-, JVEL and SON signals.
New data (data written) (lower)	Arbitrary		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
■ Sent Query: 3F06F60B -----
■ Received Response: 3F06F60B -----

◆ Jogging Speed/Inching Distance Switching Command (JVEL)
In jogging operation and inching operation, the jogging speed and inching distance are determined by referencing the applicable control parameters. This signal is used to switch these parameters.

JVEL	Jogging speed of jogging operation (JISL = "0")	Inching distance of inching operation (JISL = "1")
"0"	Parameter No. 26 (Jogging speed)	Parameter No. 48 (Inching distance)
"1"	Parameter No. 47 (Jogging speed 2)	Parameter No. 49 (Inching distance 2)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	Arbitrary	2	Used in combination with the JISL, JOG+/- and SON signals.
New data (data written) (lower)	Arbitrary		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
■ Sent Query: 3F06F60B -----
■ Received Response: 3F06F60B -----

◆ Jog+ Command (JOG+)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	Arbitrary	2	Used in combination with the JISL and JVEL signals.
New data (data written) (lower)	Arbitrary		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

[Function] This signal is used to start jogging operation or inching operation.

■ Jogging Operation in + Direction

When the JOG+ signal is turned “1” while the JISL signal is “0” (jogging mode), the actuator will jog in the direction opposite home. The speed corresponds to the jogging speed of the parameter specified by the JVEL signal, while the acceleration/deceleration corresponds to the rated acceleration/deceleration (the specific value varies depending on the actuator).

■ How to Stop Jogging Operation in + Direction

- Change the JOG+ signal from “1” to “0” during operation.
- Change the JOG- signal from “0” to “1” during operation.

■ Inching Operation

The actuator will inch in the direction opposite home every time the JOG+ signal changes from “0” to “1” while the JISL signal is “1” (inching mode). The speed and travel distance correspond to the jogging speed and inching distance of the parameters specified by the JVEL signal, while the acceleration/deceleration corresponds to the rated acceleration/deceleration (the specific value varies depending on the actuator).

◆ Jog- Command (JOG-)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	Arbitrary	2	Used in combination with the JISL and JVEL signals.
New data (data written) (lower)	Arbitrary		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

[Function] This signal is used to start jogging operation or inching operation.

■ Jogging Operation in - Direction

When the JOG- signal is turned “1” while the JISL signal is “0” (jogging mode), the actuator will jog in the direction home. The speed corresponds to the jogging speed of the parameter specified by the JVEL signal, while the acceleration/deceleration corresponds to the rated acceleration/deceleration (the specific value varies depending on the actuator).

■ How to Stop Jogging Operation in - Direction

- Change the JOG- signal from “1” to “0” during operation.
- Change the JOG+ signal from “0” to “1” during operation.

■ Inching Operation

The actuator will inch in the direction home every time the JOG- signal changes from “0” to “1” while the JISL signal is “1” (inching mode). The speed and travel distance correspond to the jogging speed and inching distance of the parameters specified by the JVEL signal, while the acceleration/deceleration corresponds to the rated acceleration/deceleration (the specific value varies depending on the actuator).

[Summary of Jogging Operation and Inching Operation]
With both jogging operation and inching operation, the JISL, JVEL, JOG+ and JOG- signals are used in combination. The relationships of these signals are summarized in the table below.

		Jogging operation	Inching operation
JISL		"0"	"1"
JVEL = "0"	Speed	Parameter 26	Parameter 26
	Travel distance	-	Parameter 48
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
JVEL = "1"	Speed	Parameter 47	Parameter 47
	Travel distance	-	Parameter 49
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
Condition for operation		Either the JOG+ or JOG- is "1"	Either the JOG+ or JOG- changes from "0" to "1"

- Actual Example of Jogging Operation (JOG+) (Axis 0)
  - Sent Query: 3F06F60B0110CF02 (JVEL = "0", JISL = "0")
  - Received Response: 3F06F60B0110CF02

- Actual Example of Jogging Operation (JOG-) (Axis 0)
  - Sent Query: 3F06F60B0090CF32 (JVEL = "0", JISL = "0")
  - Received Response: 3F06F60B0090CF32

- Actual Example of Inching Operation (JOG+) (Axis 0)
  - Sent Query: 3F06F60B0130CEDA (JVEL = "0", JISL = "1")
  - Received Response: 3F06F60B0030CF4A

◆ Teaching Mode Command (MODE)
The controller will switch to the teaching mode when the MODE signal turns “1.”

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	04 H	2	The MODE and SON signals are “1.”
New data (data written) (lower)	10 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
■ Sent Query: 3F06F60B0410CC52
■ Received Response: 3F06F60B0410CC52

◆ Position Data Load Command (PWRT)

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	06 H	2	The MODE, PWRT and SON signals are "1."
New data (data written) (lower)	10 H		
Error check (CRC)	16 bits	2	(CD32) Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response

If the data has been changed (written) successfully, the response is the same as the query.

[Function]

When the PWRT signal changes from "0" to "1" while in the teaching mode (MODE = "1") and this condition is maintained for 20 msec or more after it is recognized by the controller, the current position data will be written to the target position corresponding to the position number in the command position number register effective at the time of detection.

If the position table is empty, the default parameters will be written together in the data fields other than the target position (positioning band, speed, acceleration/deceleration).

● Actual Example (Axis 0)

Load the teaching position into No. 8 of the axis (0) position table.

Inching operation in the teaching mode (MODE = "1")	3F06F60B0530CC1A
	↕ (Repeated inching operations)
Specification of command position number (Ex: 8)	3F06F60B0430CD8A 3F06F60A00089F58
Position data load command	3F06F60B0610CD32

◆ Forced Brake Release Command (BKRL)
Normally brake control is linked to the servo ON/OFF operations. However, the brake can be forcibly released while the servo is ON, by using this command.

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (0)
Starting address (lower)	0B H		
New data (data written) (upper)	10 H	2	The BKRL signals are “1.”
New data (data written) (lower)	00 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
■ Sent Query: 3F06F60B1000C29E
■ Received Response: 3F06F60B1000C29E

[4] Output control signals (Axis 1 = Direct numerical specification mode)
An example of control signals of axis (1) is explained.
The configuration of the control signal register of axis (1) is shown below.

	B15							b8	b7							b0
Address F613H	BKRL	—	DIR	PUSH	—	—	—	JOG+	JOG−	JVEL	JISL	SON	RES	STP	HOME	CSTR

The method of use is the same as in [3], except for the DIR and PUSH.
The DIR and PUSH signals are used as a set when performing push operation in the direct numerical specification mode.

- PUSH signal: The push mode is effective when this signal is "1."
- DIR signal: This signal specifies the push direction.
  "0" = Home return direction "1" = Opposite home return direction

In other conditions, the push speed corresponds to the specification of parameter No. 34, while the maximum push amount corresponds to the specified positioning band.

A query in the push operation mode is described below.

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	06 H	1	
Starting address (upper)	F6 H	2	Address of the control signal register of axis (1)
Starting address (lower)	13 H		
New data (data written) (upper)	30 H	2	Set DIR, PUSH and SON to "1."
New data (data written) (lower)	10 H		
Error check (CRC)	16 bits	2	Based on calculation result (5A95)
Trailer	None	-	
Total bytes		8	

● Response
If the data has been changed (written) successfully, the response is the same as the query.

● Actual Example
- ■ Sent Query: 3F06F61330105A95
- ■ Received Response: 3F06F61330105A95

3.9.3.5 Preset Multiple Registers (Query using FC = 10H)

Data is changed in (written to) multiple successive holding registers in the slave.
The basic query/response structures and examples of queries are shown below.

(1) Basic Query/Response Structures

[1] Query format

The query message specifies the address of the holding register (gateway register) from which to start changing (writing) data, and the data.
Data length of 1 holding register = 1 word = 2 bytes = 16 bits

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	Arbitrary	2	The address varies depending on the axis arrangement.
Starting address (lower)	Arbitrary		
Number of registers (upper)	Arbitrary	2	
Number of registers (lower)	Arbitrary		
Bytes	Arbitrary	1	
New data 1 (upper) New data 1 (lower)	Arbitrary Arbitrary	1 each for upper and lower words 2	
New data 2 (upper) New data 2 (lower)	Arbitrary Arbitrary	1 each for upper and lower words 2	
New data 3 (upper) New data 3 (lower)	Arbitrary Arbitrary	1 each for upper and lower words 2	
: :			
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		15	

[2] Response format
If the data has been changed (written) successfully, the response returned is a copy of the query excluding the number of bytes and new data.

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	Arbitrary	2	The address varies depending on the axis arrangement.
Starting address (lower)	Arbitrary		
Number of registers (upper)	Arbitrary	2	
Number of registers (lower)	Arbitrary		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		8	

(2) Basic Axis Operations

[1] Axis area in the direct numerical specification mode

Assignments of axis control signals for axis (1) (direct numerical specification mode) are shown below.

Address	b15							b8	b7							b0
F60CH	Position data specification (lower word)															
F60DH	Position data specification (upper word)															
F60EH	Positioning Band (lower word)															
F60FH	Positioning Band (upper word)															
F610H	Speed															
F611H	Acceleration/deceleration															
F612H									Push-current limiting value							
F613H	BKRL	–	DIR	PUSH	–	–	–	JOG+	JOG–	JVEL	JISL	SON	RES	STP	HOME	CSTR

Refer to the section on gateway specifications for the detailed explanation of signals. An overview is given below.

■ Position Data Specification
- 32-bit signed integer
- Register size: 2 (4 bytes)
- Unit: 0.01 mm
- Settable range: -9999.99 mm to 9999.99 mm (0F423F H)

■ Positioning Band
- 32-bit integer
- Register size: 2 (4 bytes)
- Unit: 0.01 mm
- Maximum settable value: 9999.99 mm (0F423F H)
- In normal positioning operation, the allowable difference between the target position and current position upon detection of position completion is set.
- In push operation, the push band is set.
- Whether to perform normal positioning or push operation is specified by the control signal PUSH.

■ Speed
- 16-bit integer
- Register size: 1 (2 bytes)
- The unit is 1.0 mm/sec or 0.1 mm/sec. Set either unit as deemed appropriate using the ROBONET Gateway parameter setting tool.
- Settable range: 0 to 9999 mm/sec
  If a value exceeding the maximum actuator speed is set, an alarm will generate when a movement start command is issued.

■ Acceleration/Deceleration
- 16-bit integer
- Register size: 1 (2 bytes)
- Unit: 0.01 G
- The maximum settable value corresponds to the maximum actuator acceleration/deceleration.
  If a value exceeding the maximum actuator acceleration/deceleration is set, an alarm will generate when a movement start command is issued.

■ Push-current Limiting Value
- 8-bit integer
- Register size: 1 (1 byte)
- Unit: %
- Although the settable range is 0 to 100% (FF H = 255), the actual setting range varies depending on the actuator. Refer to the catalog or operation manual.

[1] Procedure
In the direct numerical specification mode, the actuator is operated by writing data to the axis control signal registers (position data, positioning band, speed, acceleration/deceleration, push-current limiting value, control signals). Operation is started when the start (CSTR) signal changes from “0” to “1.” Items to note regarding this process are listed below.

- The control signal register has been cleared to zero after the initialization following the power on.
- The default controller parameters are not referenced.
- In normal operation, the axis will not operate unless position data, positioning band, speed and acceleration/deceleration are all written to the registers. (If any one of these data is missing, an alarm 085 will generate.)
- In push operation, push-current limiting value must also be written in addition to the above data.
- Even after all data has been written, the axis will not operate unless the CSTR signal is changed from “0” to “1.”
- Once all data has been written to the registers, you can change desired data only and change the CSTR signal from “0” to “1” to operate the axis based on the new data.
  Even if the above change is made while the axis is operating, the axis will start operating based on the new data the moment the CSTR signal is changed from “0” to “1.”

(3) Examples of Queries/Responses (Axis 1, direct numerical specification mode)

[1] Query format for normal operation
Write all data required for axis operation (position, positioning band, speed, acceleration/deceleration, push-current limiting value) to the registers.

● Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		10 H	1	
Starting address	(upper)	F6 H	2	Initial control signal register address of axis (1)
Starting address	(lower)	0C H		
Number of registers	(upper)	00 H	2	The number of registers is “8” corresponding to new data 1 to 8.
Number of registers	(lower)	08 H		
Bytes		10 H	1	Number of registers x 2 = 16 (10H)
New data 1	(upper)	3A H	1 each for upper and lower words 2	Position data specification 150.00 mm = 15000 = 00003A98 H
New data 1	(lower)	98 H		
New data 2	(upper)	00 H	1 each for upper and lower words 2	
New data 2	(lower)	00 H		
New data 3	(upper)	00 H	1 each for upper and lower words 2	Positioning Band 0.1 mm = 10 = 000A H
New data 3	(lower)	0A H		
New data 4	(upper)	00 H	1 each for upper and lower words 2	
New data 4	(lower)	00 H		
New data 5	(upper)	00 H	1 each for upper and lower words 2	Speed 50 mm/sec = 50 = 0032 H
New data 5	(lower)	32 H		
New data 6	(upper)	00 H	1 each for upper and lower words 2	Acceleration/deceleration 0.30 G = 30 = 001E H
New data 6	(lower)	1E H		
New data 7	(upper)	00 H	1 each for upper and lower words 2	Push-current limiting value 0% = 0000 H
New data 7	(lower)	00 H		
New data 8	(upper)	00 H	1 each for upper and lower words 2	Control signal Set SON and CSTR to “1.”
New data 8	(lower)	11 H		
Error check	(CRC)	16 bits	2	Based on calculation result
Trailer		None	-	
Total bytes				

■ Sent Query: 3F10F60C0008103A980000000A0000
0032001E00000011406C

■ Received Response: 3F10F60C0008369A

[2] Query format for normal operation where only the position is changed
Use the same format in [1] by changing only the position data, to operate the axis.

● Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	F6 H	2	Initial control signal register address of axis (1)
Starting address (lower)	0C H		
Number of registers (upper)	00 H	2	The number of registers is “2” corresponding to new data 1 to 2.
Number of registers (lower)	02 H		
Bytes	04 H	1	Number of registers x 2 = 4 (04 H)
New data 1 (upper)	03 H	1 each for upper and lower words 2	Position data specification 10.00 mm = 1000 = 000003E8 H
New data 1 (lower)	E8 H		
New data 2 (upper)	00 H	1 each for upper and lower words 2	
New data 2 (lower)	00 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes		13	

■ Sent Query: 3F10F60C00020403E80000976C
■ Received Response: 3F10F60C0002B69D

Thereafter, turn the CSTR signal from “0” to “1.”

[3] Query format for normal operation where the position and speed are changed.
In this example, the same format in [2] is used by changing only the position data and speed, to operate the axis. The following two queries are transmitted.

● Query (Position data change)

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	F6 H	2	Initial position data specification register address of axis (1)
Starting address (lower)	0C H		
Number of registers (upper)	00 H	2	The number of registers is “2” corresponding to new data 1 to 2.
Number of registers (lower)	02 H		
Bytes	04 H	1	Number of registers x 2 = 4 (04 H)
New data 1 (upper)	3A H	1 each for upper and lower words 2	Position data specification 150.00 mm = 15000 = 00003A98 H
New data 1 (lower)	98 H		
New data 2 (upper)	00 H	1 each for upper and lower words 2	
New data 2 (lower)	00 H		
Error check (CRC)	16 bits	2	Based on calculation result (9A81)
Trailer	None	-	
Total bytes		13	

● Query (Speed change)

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	F6 H	2	Initial speed register address of axis (1)
Starting address (lower)	10 H		
Number of registers (upper)	00 H	2	The number of registers is “1” corresponding to new data 1.
Number of registers (lower)	01 H		
Bytes	02 H	1	Number of registers x 2 = 2 (02 H)
New data 1 (upper)	00 H	1 each for upper and lower words 2	Speed 200 mm/sec = 200 = 00C8 H
New data 1 (lower)	C8 H		
Error check (CRC)	16 bits	2	Based on calculation result (2B38)
Trailer	None	-	
Total bytes		11	

Thereafter, turn the CSTR signal from “0” to “1.”

[4] Query format for push operation
Write all data required for axis operation (position, positioning band, speed, acceleration/deceleration, push-current limiting value) to the registers.

● Query (Position data change)

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	F6 H	2	Initial control signal register address of axis (1)
Starting address (lower)	0C H		
Number of registers (upper)	00 H	2	The number of registers is "8" corresponding to new data 1 to 8.
Number of registers (lower)	08 H		
Bytes	10 H	1	Number of registers x 2 = 16 (10H)
New data 1 (upper)	36 H	1 each for upper and lower words 2	Position data specification 140.00 mm = 14000 = 000036B0 H
New data 1 (lower)	B0 H		
New data 2 (upper)	00 H	1 each for upper and lower words 2	
New data 2 (lower)	00 H		
New data 3 (upper)	01 H	1 each for upper and lower words 2	Positioning Band 5.0 mm = 500 = 01F4 H
New data 3 (lower)	F4 H		
New data 4 (upper)	00 H	1 each for upper and lower words 2	
New data 4 (upper)	00 H		
New data 5 (upper)	00 H	1 each for upper and lower words 2	Speed 50 mm/sec = 50 = 0032 H
New data 5 (upper)	32 H		
New data 6 (upper)	00 H	1 each for upper and lower words 2	Acceleration/deceleration 0.30 G = 30 = 001E H
New data 6 (upper)	1E H		
New data 7 (upper)	00 H	1 each for upper and lower words 2	Push-current limiting value 0% = 007F H
New data 7 (upper)	7F H		
New data 8 (upper)	30 H	1 each for upper and lower words 2	Control signal Set DIR, PUSH and CSTR to "1."
New data 8 (upper)	11 H		
Error check (CRC)	16 bits	2	Based on calculation result
Trailer	None	-	
Total bytes			

■ Sent Query: 3F10F60C00081036B0000001F40000
0032001E007F30118287
■ Received Response: 3F10F60C0008369A

(4) Use of Gateway Commands

The position table can be read/written by writing request commands and data in the command area of the gateway unit.
For details, refer to the specifications of the gateway unit.
An address map of the command area is shown below.

Register address			Register address
F602	Request command	Response command	F702
F603	Data 0	Data 0	F703
F604	Data 1	Data 1	F704
F605	Data 2	Data 2	F705
F606	Data 3	Data 3	F706

The table below lists the data that can be handled with these commands.

Data name	Register size	Data size	Unit	Data range
Target position	2 words	32-bit signed integer	0.01 mm	-999999 ~ 999999
Positioning band	2 words	32-bit integer	0.01 mm	Up to 999999
Speed (Note)	2 words	32-bit integer	0.01 mm/sec	0 ~ 999999
Individual zone boundary+	2 words	32-bit integer	0.01 mm	Within the actuator stroke
Individual zone boundary-	2 words	32-bit integer	0.01 mm	Within the actuator stroke
Acceleration	1 word	16-bit integer	0.01 G	Within the maximum actuator acceleration/deceleration
Deceleration	1 word	16-bit integer	0.01 G	
Push-current limiting value	1 word	8-bit integer	%	100% corresponds to FFH.
Load current threshold	1 word	8-bit integer	%	0 ~ 100 (00H ~ FFH)

Caution

When writing to the position table, the speed is specified in units of 0.01 mm/sec. Take note that in the direct numerical specification mode, the speed is specified in units of 1.0 mm/sec.

[1] Write position table data
An example of writing the target position, positioning band and speed data one by one to the position table under No. 10 corresponding to positioner mode axis (0) is explained.

- Target position 100 m → 10000 = 2710H
- Positioning band 0.3 mm → 30 = 001EH
- Speed 2 mm/sec → 200 = 00C8H

● Target Position Write Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		10 H	1	
Starting address	(upper)	F6 H	2	Initial request command register address of axis (0)
Starting address	(lower)	02 H		
Number of registers	(upper)	00 H	2	The number of registers is 5.
Number of registers	(lower)	05 H		
Bytes		0A H	1	Number of registers x 2 = 10 (0AH)
New data 1	(upper)	10 H	1 each for upper and lower words 2	Request command (position write)
New data 1	(lower)	00 H		
New data 2	(upper)	00 H	1 each for upper and lower words 2	Data 0: Position No. 10 is specified.
New data 2	(lower)	0A H		
New data 3	(upper)	27 H	1 each for upper and lower words 2	Data 1: Lower word of target position data
New data 3	(lower)	10 H		
New data 4	(upper)	00 H	1 each for upper and lower words 2	Data 2: Upper word of target position data
New data 4	(upper)	00 H		
New data 5	(upper)	00 H	1 each for upper and lower words 2	Data 3: An axis number is specified (axis 0).
New data 5	(upper)	00 H		
Error check	(CRC)	16 bits	2	Based on calculation result (6891)
Trailer		None	-	
Total bytes			19	

■ Sent Query: 3F10F60200050A1000000A27100000
00006891
■ Received Response: 3F10F6020005969C

⚠ Caution

Each gateway command must be cleared after use. If the command area is not cleared, the next command cannot be accepted.
Query sent in this example: 3F 06 F602 0000 1F5C

Request command clear code

Request command area address

● Positioning Band Write Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	F6 H	2	Initial request command register address of axis (0)
Starting address (lower)	02 H		
Number of registers (upper)	00 H	2	The number of registers is 5.
Number of registers (lower)	05 H		
Bytes	0A H	1	Number of registers x 2 = 10 (0AH)
New data 1 (upper) New data 1 (lower)	10 H 01 H	1 each for upper and lower words 2	Request command (positioning band write)
New data 2 (upper) New data 2 (lower)	00 H 0A H	1 each for upper and lower words 2	Data 0: Position No. 10 is specified.
New data 3 (upper) New data 3 (lower)	00 H 1E H	1 each for upper and lower words 2	Data 1: Lower word of positioning band data
New data 4 (upper) New data 4 (upper)	00 H 00 H	1 each for upper and lower words 2	Data 2: Upper word of positioning band data
New data 5 (upper) New data 5 (upper)	00 H 00 H	1 each for upper and lower words 2	Data 3: An axis number is specified (axis 0).
Error check (CRC)	16 bits	2	Based on calculation result (0A17)
Trailer	None	-	
Total bytes		19	

■ Sent Query: 3F10F60200050A1001000A001E0000
00000A17
■ Received Response: 3F10F6020005969C

⚠ Caution

Each gateway command must be cleared after use. If the command area is not cleared, the next command cannot be accepted.
Query sent in this example: 3F 06 F602 0000 1F5C

Request command clear code

Request command area address

● Speed Write Query

Field name	RTU mode data (8 bits)	Data length (bytes)	Remarks
Header	None	-	
Slave address	3F H	1	Fixed.
Function code	10 H	1	
Starting address (upper)	F6 H	2	Initial request command register address of axis (0)
Starting address (lower)	02 H		
Number of registers (upper)	00 H	2	The number of registers is 5.
Number of registers (lower)	05 H		
Bytes	0A H	1	Number of registers x 2 = 10 (0AH)
New data 1 (upper) New data 1 (lower)	10 H 02 H	1 each for upper and lower words 2	Request command (speed write)
New data 2 (upper) New data 2 (lower)	00 H 0A H	1 each for upper and lower words 2	Data 0: Position No. 10 is specified.
New data 3 (upper) New data 3 (lower)	00 H C8 H	1 each for upper and lower words 2	Data 1: Lower word of speed data
New data 4 (upper) New data 4 (upper)	00 H 00 H	1 each for upper and lower words 2	Data 2: Upper word of speed data
New data 5 (upper) New data 5 (upper)	00 H 00 H	1 each for upper and lower words 2	Data 3: An axis number is specified (axis 0).
Error check (CRC)	16 bits	2	Based on calculation result (5735)
Trailer	None	-	
Total bytes		19	

- Sent Query: 3F10F60200050A1002000A00C80000
00005735
- Received Response: 3F10F6020005969C

⚠ Caution

Each gateway command must be cleared after use. If the command area is not cleared, the next command cannot be accepted.

Query sent in this example: 3F 06 F602 0000 1F5C

Request command clear code

Request command area address

[2] Read position table data
In [1], the target position, positioning band and speed were written one by one to the position table under No. 10 corresponding to positioner mode axis (0). Next, an example of reading data from this position table is explained.

Query Send Procedure
[1] Send a position table data read query
(Write command data to the request command area)
[2] Send a response command area read query.

When a position table data read command is received, the gateway unit will output response data to the response command area.

● Target Position Read Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		10 H	1	
Starting address	(upper)	F6 H	2	Initial request command register address of axis (0)
Starting address	(lower)	02 H		
Number of registers	(upper)	00 H	2	The number of registers is 5.
Number of registers	(lower)	05 H		
Bytes		0A H	1	Number of registers x 2 = 10 (0AH)
New data 1	(upper)	10 H	1 each for upper and lower words 2	Request command (read target position)
New data 1	(lower)	40 H		
New data 2	(upper)	00 H	1 each for upper and lower words 2	Data 0: Position No. 10 is specified.
New data 2	(lower)	0A H		
New data 3	(upper)	00 H	1 each for upper and lower words 2	Data 1: 0
New data 3	(lower)	00 H		
New data 4	(upper)	00 H	1 each for upper and lower words 2	Data 2: 0
New data 4	(upper)	00 H		
New data 5	(upper)	00 H	1 each for upper and lower words 2	Data 3: An axis number is specified (axis 0).
New data 5	(upper)	00 H		
Error check	(CRC)	16 bits	2	Based on calculation result (9E46)
Trailer		None	-	
Total bytes			19	

■ Sent Query: 3F10F60200050A 1040 000A 00000000
0000 9E46
■ Received Response: 3F10F6020005969C

<Reading of Response Command Area>
Send a register read (FC = 03H) query.
- Sent Query: 3F03F702000512A3
- Received Response: 3F030A 1040 000A 27100000 0000 2E8A

Position data
The position data (2710H) written to the position table in [1] has been read.

Caution

Each gateway command must be cleared after use.

● Positioning Band Read Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		10 H	1	
Starting address	(upper)	F6 H	2	Initial request command register address of axis (0)
Starting address	(lower)	02 H		
Number of registers	(upper)	00 H	2	The number of registers is 5.
Number of registers	(lower)	05 H		
Bytes		0A H	1	Number of registers x 2 = 10 (0AH)
New data 1	(upper)	10 H	1 each for upper and lower words 2	Request command (read positioning band)
New data 1	(lower)	41 H		
New data 2	(upper)	00 H	1 each for upper and lower words 2	Data 0: Position No. 10 is specified.
New data 2	(lower)	0A H		
New data 3	(upper)	00 H	1 each for upper and lower words 2	Data 1: 0
New data 3	(lower)	00 H		
New data 4	(upper)	00 H	1 each for upper and lower words 2	Data 2: 0
New data 4	(upper)	00 H		
New data 5	(upper)	00 H	1 each for upper and lower words 2	Data 3: An axis number is specified (axis 0).
New data 5	(upper)	00 H		
Error check	(CRC)	16 bits	2	Based on calculation result (93D6)
Trailer		None	-	
Total bytes			19	

- Sent Query: 3F10F60200050A 1041 000A 00000000 0000 9D36
- Received Response: 3F10F6020005969C

<Reading of Response Command Area>
Send a register read (FC = 03H) query.

- Sent Query: 3F03F702000512A3
- Received Response: 3F030A 1041 000A 001E0000 0000 4C0C

Positioning band data
The data (001EH) written to the position table in [1] has been read.

Caution

Each gateway command must be cleared after use.

- Speed Read Query

Field name		RTU mode data (8 bits)	Data length (bytes)	Remarks
Header		None	-	
Slave address		3F H	1	Fixed.
Function code		10 H	1	
Starting address	(upper)	F6 H	2	Initial request command register address of axis (0)
Starting address	(lower)	02 H		
Number of registers	(upper)	00 H	2	The number of registers is 5.
Number of registers	(lower)	05 H		
Bytes		0A H	1	Number of registers x 2 = 10 (0AH)
New data 1	(upper)	10 H	1 each for upper and lower words 2	Request command (read speed)
New data 1	(lower)	42 H		
New data 2	(upper)	00 H	1 each for upper and lower words 2	Data 0: Position No. 10 is specified.
New data 2	(lower)	0A H		
New data 3	(upper)	00 H	1 each for upper and lower words 2	Data 1: 0
New data 3	(lower)	00 H		
New data 4	(upper)	00 H	1 each for upper and lower words 2	Data 2: 0
New data 4	(upper)	00 H		
New data 5	(upper)	00 H	1 each for upper and lower words 2	Data 3: An axis number is specified (axis 0).
New data 5	(upper)	00 H		
Error check	(CRC)	16 bits	2	Based on calculation result (8726)
Trailer		None	-	
Total bytes			19	

- Sent Query: 3F10F60200050A 1042 000A 00000000 0000 8726
- Received Response: 3F10F6020005969C

<Reading of Response Command Area>

Send a register read (FC = 03H) query.

- Sent Query: 3F03F702000512A3
- Received Response: 3F030A 1042 000A 00C80000 0000 4C0C

Speed data

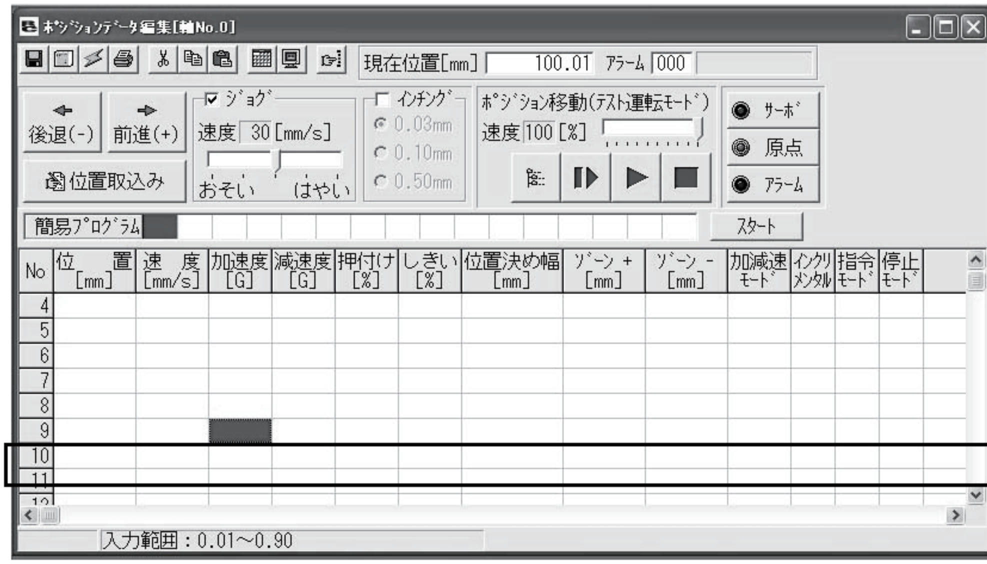
The data (00C8H) written to the position table in [1] has been read.

Caution

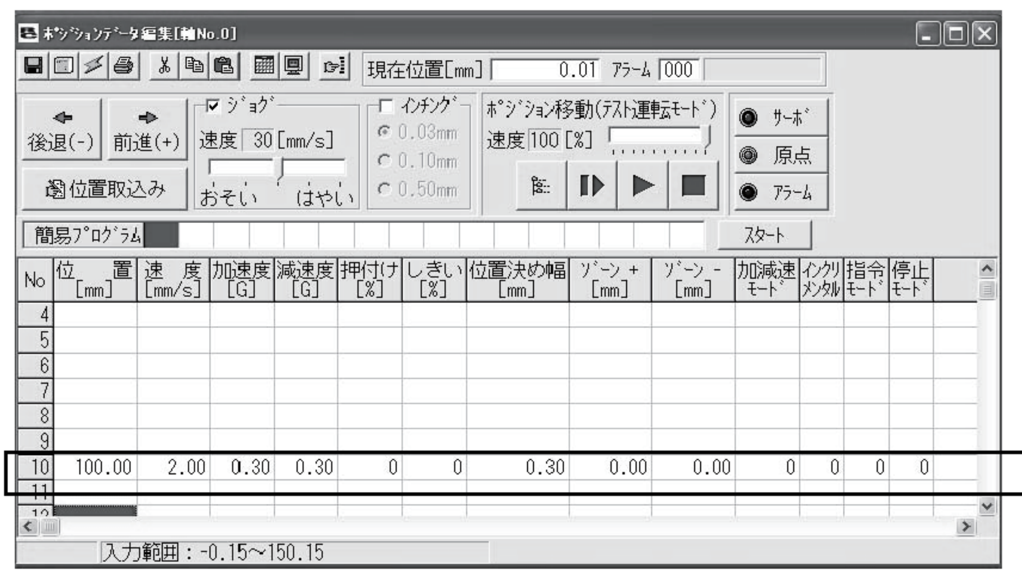
Each gateway command must be cleared after use.

In [1] and [2], the target position, positioning band and speed data were written to the position table and the write results were checked.
The applicable position table in the RC PC software is shown as follows.

■ Before Sending the Write Query



■ After Sending the Write Query



* Although acceleration/deceleration was not written, the default parameter value has been applied and written.

3.9.4 Function Block

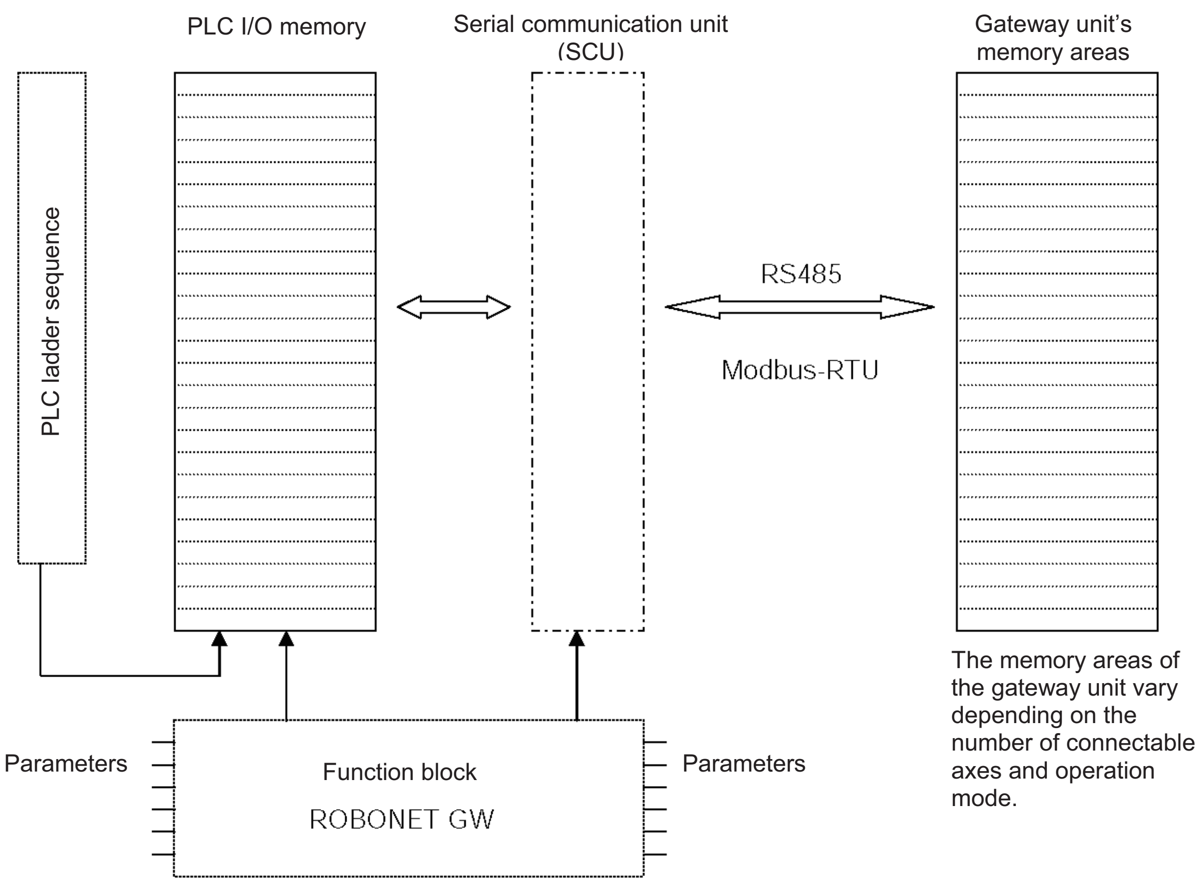
3.9.4.1 Dedicated ROBONET Function Block

(1) Overview

IAI provides a dedicated function block for ROBONET systems.
It is called "ROBONET Gateway Modbus Cyclic Communication FBL" (ROBONET GW).
This function block performs the following operations between the PLC and ROBONET gateway (Modbus gateway mode):

- Read gateway status signals, response commands and axis data cyclically
- Write gateway control signals, request commands and axis data

A conceptual diagram of data exchange between the PLC and ROBONET gateway is shown below.



Function block parameters are set to associate the memory areas of the gateway unit with the I/O memory of the PLC based on 1:1 address correspondence. The function block constantly performs data exchange, but only between the PLC I/O memory and gateway unit memory whose addresses have been associated.
Accordingly, the ladder sequence only needs to access the PLC's I/O memory associated with the gateway unit memory, as if accessing the gateway unit memory directly.
Since there is no need to use a ladder sequence to create communication messages to be sent, a desired ladder sequence can be created without a need to consider serial communication.

The function block parameters are used to specify the following addresses of the PLC's I/O memory to be linked with the gateway unit's memory areas:

- Initial gateway control signal address
- Initial request command area address
- Initial axis data specification area address
- Initial gateway status signal address
- Initial response command area address
- Initial axis status area address

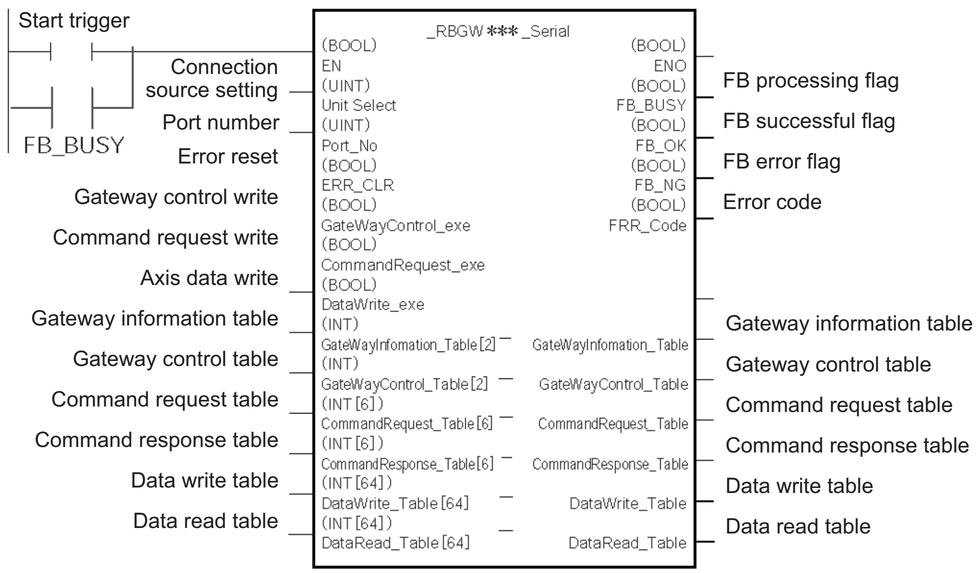
The PLC's I/O memory areas that can be set by parameters include W (internal auxiliary relays), D (data memory), A (special auxiliary relays), E (extended data memory), H (holding relays), and CIO (channel I/Os).

The function block is able to exchange data between the specified I/O memory areas and the gateway unit's memory areas linked to these I/O memory areas, via serial communication.

The conditions under which this function block can be used are as follows:

[1] CPU unit	CS/CJ Series by Omron, Version 4.0 or later
[2] Serial communication unit (SCU)	CS/CJ Series by Omron CS: CS1W-SCU**-V1 (Version 1.2 or later) CJ: CJ1W-SCU**-V1 (Version 1.2 or later)
[3] CX Programmer	Version 7.0 or later

(2) Specifications

<table>
<tr><td>Name</td><td colspan="2">ROBONET Gateway Modbus Cyclic Communication FBL</td></tr>
<tr><td>Function overview</td><td colspan="2">• Read gateway information, command responses and axis data cyclically from the ROBONET gateway.
• Write gateway control information, command requests and axis data to the ROBONET gateway via bit operation.</td></tr>
<tr><td>Symbols</td><td colspan="2">
</td></tr>
<tr><td>File name</td><td colspan="2">ROBONET_RW.cxf</td></tr>
<tr><td rowspan="3">Applicable models</td><td>CPU unit</td><td>CS/CJ Series Version 4.0 or later</td></tr>
<tr><td>SCU unit</td><td>CS/CJ Series Version 1.2 or later *</td></tr>
<tr><td>CX-Programmer</td><td>Version 7.0 or later</td></tr>
<tr><td>Use conditions</td><td colspan="2">■ CPU Unit Settings
PC system settings “Common settings for FB internal communication commands”
• Communication command response monitor time: 5 seconds or more (default: 2 seconds)
• Resend count [default: 2 times]
■ SCU Unit Settings
• Serial communication mode, serial gateway (default: host link)
• Communication settings: Aligned with the ROBONET gateway
Baud rate: 115200 bps/Character length: 8 bits/Parity: None
(default: 9.6 kbps/7 bits/2 bits / Even)

The serial port communication settings can be specified using the serial gateway mode settings of the smart FBL (SCx604_SetPortGATEWAY).

■ Shared Resource
• Communication port [internal logical port]</td></tr>
</table>

* Serial communication port
Only the port on the serial communication unit (SCU) can be used.
The serial port on the CPU unit cannot be used, because it does not support the Modbus-RTU protocol.

■ Variable Table (Parameter Settings)
The variables and parameter settings of the function block (FB) are described.

[Inputs] (Input Variables)

Name	Variable name	Data type	Default	Explanation of variable and parameter settings
EN	EN	BOOL	False	1 (ON): Start the FB 2 (OFF): Do not start the FB
Connection source setting	Unit_Select	UNIT	0	Unit number &0 to &15 Set the high-function CPU unit number of the connected SCU.
Port number	Port_No	UNIT	0	Set the SCU port number to be used. &1: SCU port 1 &2: SCU port 2
Error reset	ERR_CLR	BOOL	False	The error output is cleared at the leading edge of this signal. Set the bit address of the I/O memory to be used by this signal.
Gateway control write	GateWayControl _exe	BOOL	False	Gateway control information is sent at the leading edge of this signal. Set the bit address of the I/O memory to be used by this signal.
Command request write	CommandRequest _exe	BOOL	False	A command request is sent at the leading edge of this signal. Set the bit address of the I/O memory to be used by this signal.
Axis data write	DataWrite_exe	BOOL	False	Axis data specification is sent at the leading edge of this signal. Set the bit address of the I/O memory to be used by this signal.

[Outputs] (Output Variables)

Name	Variable name	Data type	Explanation of variable and parameter settings
ENO (May be omitted)	ENO	BOOL	1 (ON): The FB operated normally. 0 (OFF): The FB is not started or was terminated abnormally.
Processing flag	FB_BUSY	BOOL	This signal remains ON while processing is in progress, and will turn OFF automatically when the processing is completed. Set the bit address of the I/O memory to be used by this signal.
Successful flag	FB_OK	BOOL	This signal turns ON for only one cycle if the command was successful. Set the bit address of the I/O memory to be used by this signal.
Error flag	FB_NG	BOOL	This signal turns ON when the command generated an error. Set the bit address of the I/O memory to be used by this signal.
Error code	ERR_Code	INT	The present FINS command error code is returned. Set the bit address of the I/O memory to be used by this signal.

* For the FINS command error codes, refer to the operation manual of Omron's PLC (CS/CJ Communication Command Reference Manual).

[VER-IN/OUT] (Input/Output Variables)

Name	Variable name	Data type	Explanation of variable and parameter settings
Gateway information table	Gateway Information _Table	INT [2]	Gateway information data is returned. Set the I/O memory address to be assigned to the initial status signal address of the gateway.
Gateway control table	Gateway Control _Table	INT [2]	Gateway control data is placed. Set the I/O memory address to be assigned to the initial control signal address of the gateway.
Command request table	Command Request _Table	INT [6]	Request command data is placed. Set the I/O memory address to be assigned to the initial request command area address of the gateway.
Command response table	Command Response _Table	INT [6]	Command response data is returned. Set the I/O memory address to be assigned to the initial response command area address of the gateway.
Axis data write table	DataWrite _Table	INT [64]	A command for each axis is placed. Set the I/O memory address to be assigned to the initial axis input area (PLC output) address of the gateway.
Axis data read table	DataRead _Table	INT [64]	A monitored value of each axis is returned. Set the I/O memory address to be assigned to the initial axis output area (PLC input) address of the gateway.

⚠ Caution

Before setting the parameters or creating a ladder sequence, create an association matrix of SIO gateway addresses as explained later.

(Supplement) [Internal] (Internal Variables)

Internal variables are not output to outside the FB.

Name	Variable name	Data type	Explanation of variable and parameter settings
Modbus Error code	MODBUS_ ErrorCode	WORD	A Modbus error code is output. “#0000” is output if the command was successful.
Continuation-upon-error setting flag	ERR _Setting	BOOL	Whether to continue or stop the read operation upon communication error is set. 0: Stop the read operation when a communication error occurs. 1: Retry continuously even after a communication error occurs.

■ Explanation of Function

[1] When the “start trigger” signal is turned ON, gateway information, command responses and axis data will be read cyclically. (Constant read mode)

[2] When data is set in the gateway control table and the gateway control write signal is turned ON, the gateway control data (2 words) will be written to the gateway unit at the leading edge of the signal.
When writing data to the request command area or axis data specification area of the gateway, bit 15 of gateway control dada 0 (MON signal) must be turned “1” (ON) to enable the remote operation.

[3] When data is set in the command request table and the command request write signal is turned ON, the command request data (6 words) will be written to the gateway unit at the leading edge of the signal.

[4] When data is set in the axis data write table and the axis data write signal is turned ON, the axis control data (64 words) will be written to the gateway unit at the leading edge of the signal.

[5] If an error occurs during the communication, the FB abort flag turns ON and an error code (FINS command error) is output to the error code table. When the error reset signal is turned ON, the error will be cleared.

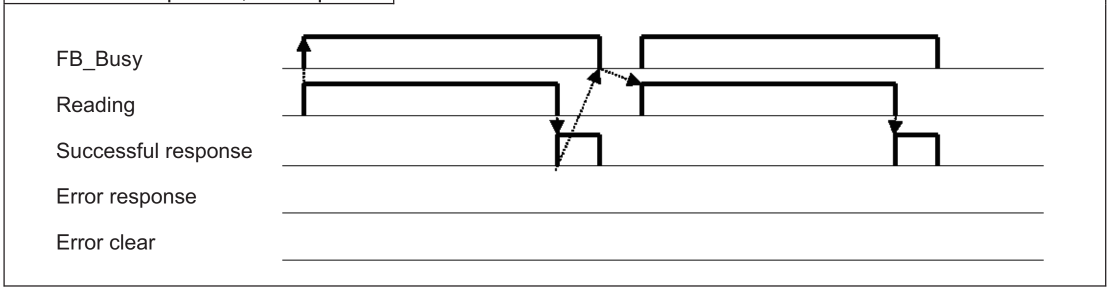
⚠ Caution

Do not issue position data write commands successively, because these commands are written to the flash memory area. The flash memory can be written only so many times (100,000 times).

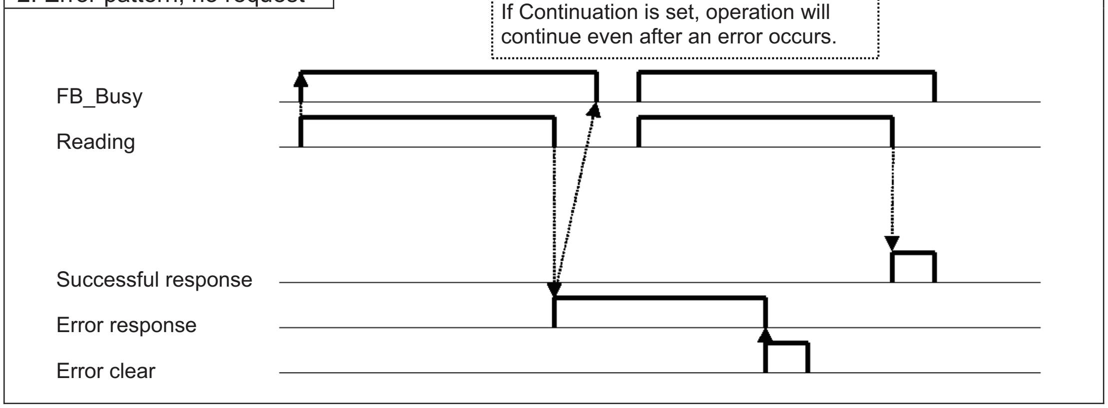
■ Operation Timing Chart

Timing chart	Successful pattern of read-only operation Data is read from the gateway unit in each cycle.

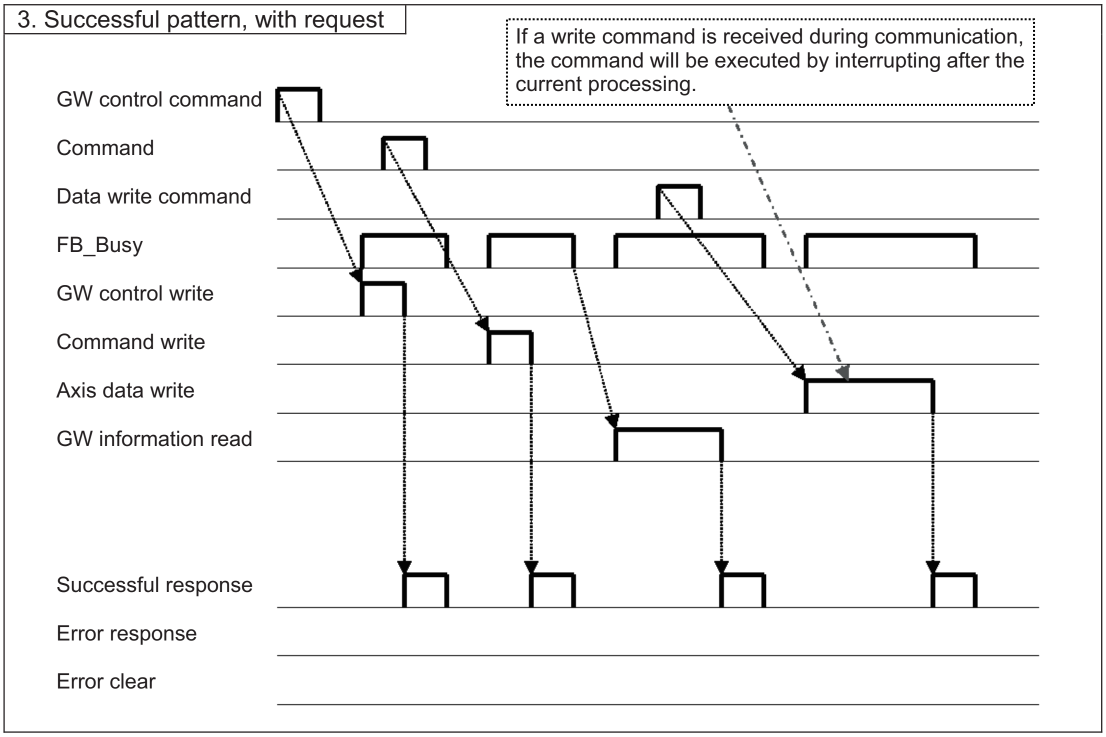
1. Successful pattern, no request



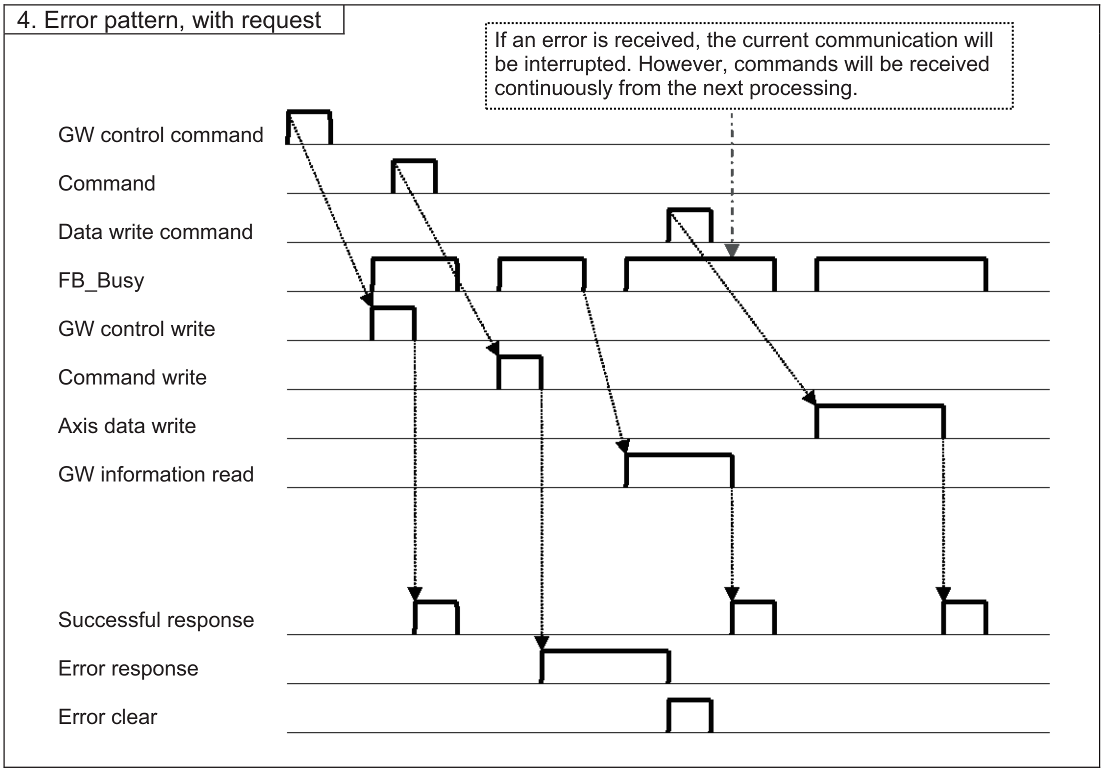
2. Error pattern, no request



3. Successful pattern, with request



4. Error pattern, with request



⚠ Caution

Notes on using the FB	• Do not issue position data write commands successively, because these commands are written to the flash memory area. The flash memory can be written only so many times. • If communication is cut off while the axis is moving (during jogging operation, etc.), the axis will continue to operate. To prevent danger, provide a measure to allow the axis to be stopped externally. • Do not use multiple instances of the same name. Duplication of assigned addresses will inhibit normal operation.
EN input condition	Connect the FB start condition input to the “start trigger” signal. This FB is of constant execution type.
Limitation - Input variables	• If the value of any input variable is out of range, the ENO will be turned OFF and the FB will not be executed.
- Output variables	• Do not turn ON/OFF the output variable FB_BUSY from outside the FB.

(3) Address Association Matrix

As explained in (1), "Overview," the PLC's I/O memory is associated with the gateway unit's memory. Before setting the parameters or creating a ladder sequence, therefore, create an association matrix of SIO gateway addresses.
An example is shown on the next page.
This example assumes the following conditions:

- Gateway Address Assignments
  - Axis (0) – Positioner mode
  - Axis (1) – Numerical specification mode
- PLC I/O Memory
  Use W (internal auxiliary relays) and D (data memory).

SIO Gateway FB Address Association Matrix (PLC Output) (Example)

Function Block		Gateway register																	
Variable name	Set address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Description	Address
GateWay Contorol Table	W200	MON	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	GW control 0	F600
	W201	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	GW control 1	F601
Command Request Table	W202																	Request command	F602
	W203																	Data 0	F603
	W204																	Data 1	F604
	W205																	Data 2	F605
	W206																	Data 3	F606
	W207																	Cannot be used.	F607
Data Write Table	W208																	(Axis 0) Position data specification (L)	F608
	W209																	(Axis 0) Position data specification (H)	F609
	W210																	(Axis 0) Position number	F60A
	W211	BKRL	—	—	—	—	MODE	PWRT	JOG+	JOG−	JVEL	JISL	SON	RES	STP	HOME	CSTR	(Axis 0) Control signal	F60B
	W212																	(Axis 1) Position data specification (L)	F60C
	W213																	(Axis 1) Position data specification (H)	F60D
	W214																	(Axis 1) Positioning band specification (L)	F60E
	W215																	(Axis 1) Positioning band specification (H)	F60F
	W216																	(Axis 1) Speed specification	F610
	W217																	(Axis 1) Acceleration/deceleration specification	F611
	W218																	(Axis 1) Push-current limiting value	F612
	W219	BKRL	—	DIR	PUSH	—	—	—	JOG+	JOG−	JVEL	JISL	SON	RES	STP	HOME	CSTR	(Axis 1) Control signal	F613

ERRCLR	W100.1
GateWay Contorol exe	W100.2
Command Request exe	W100.3
Data Write exe	W100.4

SIO Gateway FB Address Association Matrix (PLC Input) (Example)

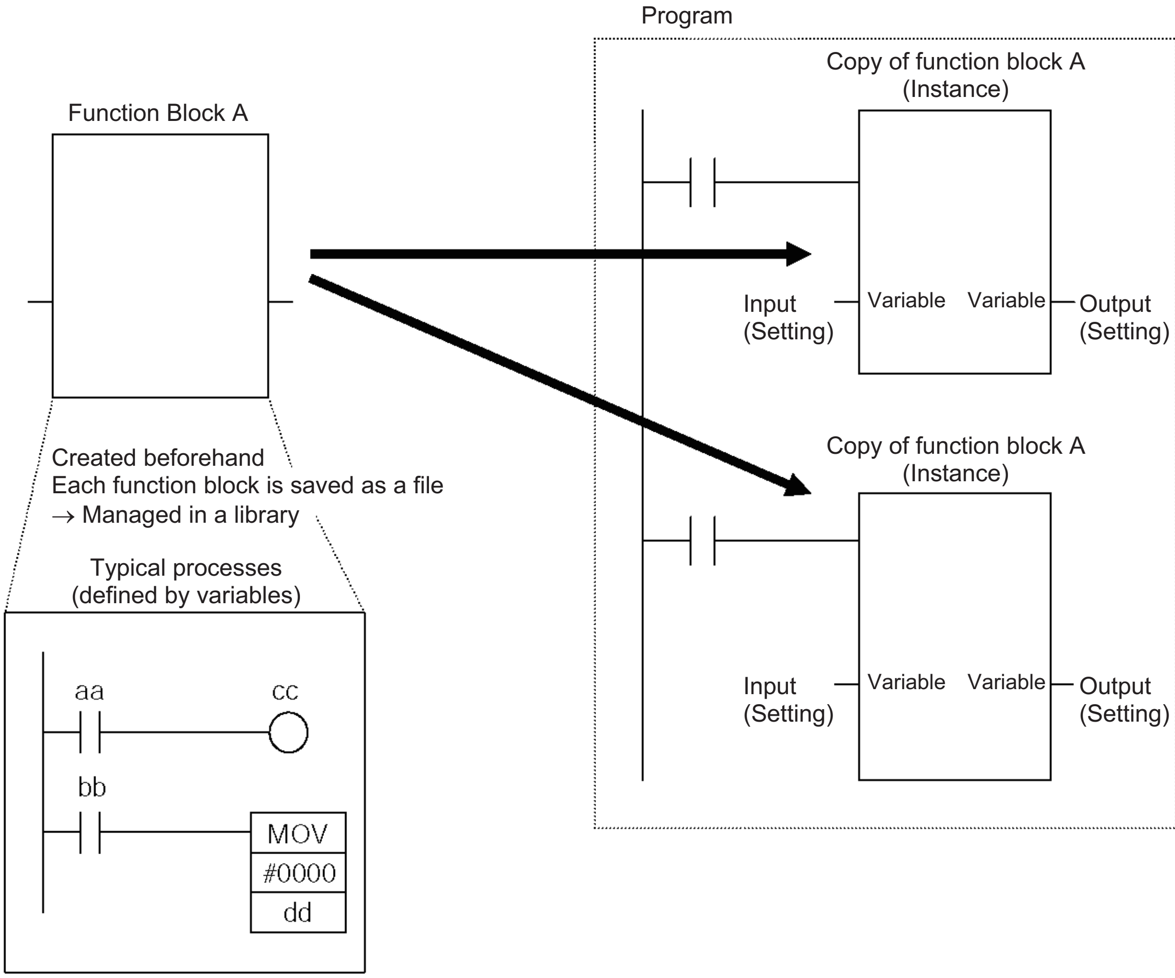
Function Block		Gateway register																	
Variable name	Set address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Description	Address
GateWay Infomation Table	W300	RUN	—	ERRT	MOD	—	—	W8B16	W8B8	W8B4	W8B2	W8B1	W4B16	W4B8	W4B4	W4B2	W4B1	GW control 0	F700
	W301	LNK15	LNK14	LNK13	LNK12	LNK11	LNK10	LNK9	LNK8	LNK7	LNK6	LNK5	LNK4	LNK3	LNK2	LNK1	LNK0	GW control 1	F701
Command Response Table	W302																	Response command	F702
	W303																	Data 0	F703
	W304																	Data 1	F704
	W305																	Data 2	F705
	W306																	Data 3	F706
	W307																	Cannot be used.	F707
Data Read Table	W308																	(Axis 0) Current position data (L)	F708
	W309																	(Axis 0) Current position data (H)	F709
	W310	—	—	—	—	—	—											(Axis 0) Completed position number	F70A
	W311	EMGS	CRDY	ZONE2	ZONE1	PZONE	MODES	WEND	—	—	—	PSFL	SV	ALM	MOVE	HEND	PEND	(Axis 0) Status signal	F70B
	W312																	(Axis 1) Current position data (L)	F70C
	W313																	(Axis 1) Current position data (H)	F70D
	W314																	(Axis 1) Current electrical current (L)	F70E
	W315																	(Axis 1) Current electrical current (H)	F70F
	W316																	(Axis 1) Current speed data	F710
	W317																	Cannot be used.	F711
	W318																	(Axis 1) Alarm	F712
	W319	EMGS	CRDY	ZONE2	ZONE1	—	—	—	—	—	—	PSFL	SV	ALM	MOVE	HEND	PEND	(Axis 1) Status signal	F713

FB BUSY	W101.2
FB OK	W101.3
FB NG	W101.4
ERR Code	D300

3.9.4.2 What Is Function Block?

(1) Overview

A function block is a graphical program language for PLCs. It is one of the five program languages for PLCs defined by the IEC standard (IEC 61131-3).
Ladder logic (or ladder language) currently adopted by the largest number of PLCs is also one of the above five program languages.
A function block is a program element that allows a group (block) of typical processes (functions) to be created beforehand, so that they can be used simply by placing the function block in a program and setting the inputs and outputs.
Basically all typical processes are defined by "variables" instead of actual addresses. When the block is placed and used in a program, a parameter (address or value) is set for each of these "variables."
As explained above, a function block is a function having one or more input parameters and one output parameter. It performs calculation based on the values given to each input parameter and outputs the result to the output parameter.
Use of function blocks allows for modular program design and reuse of programs, thereby reducing the hassle of creating PLC programs.



(2) Function Block Configuration

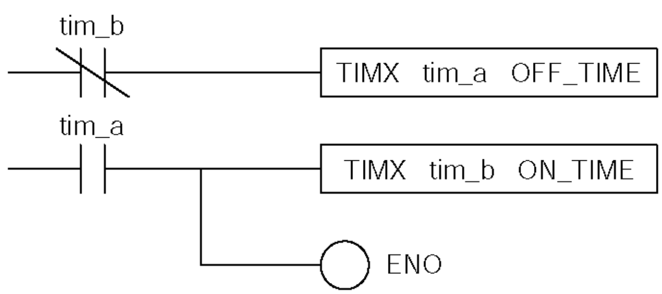
A function block consists of a predetermined function block definition and an instance that actually places the function block definition in a program.

[1] Function block definition
A program described in a function block. An algorithm is described along with a variable definition.

- Algorithm
  A typical circuit defined by variable names (not actual addresses).
- Variable definition
  A table describing the types (input, output or internal) and attributes (data type, etc.) of variables.

<Example of Function Block Definition>

1. Algorithm



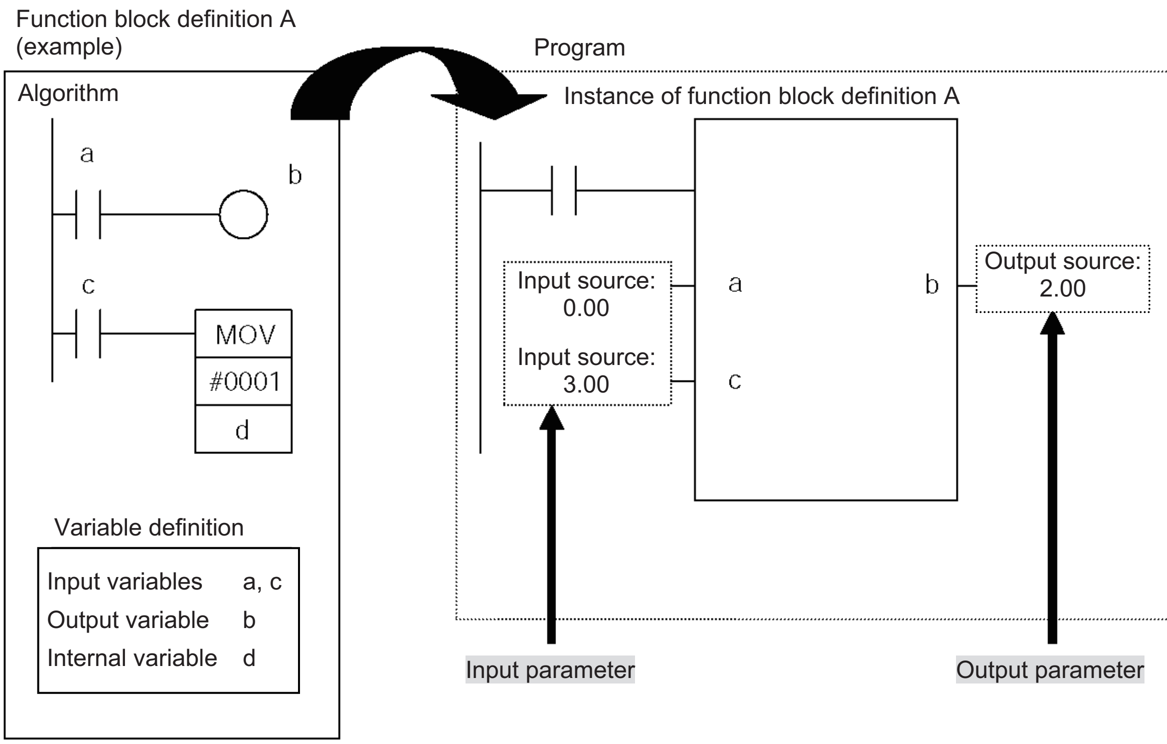
2. Variable definition

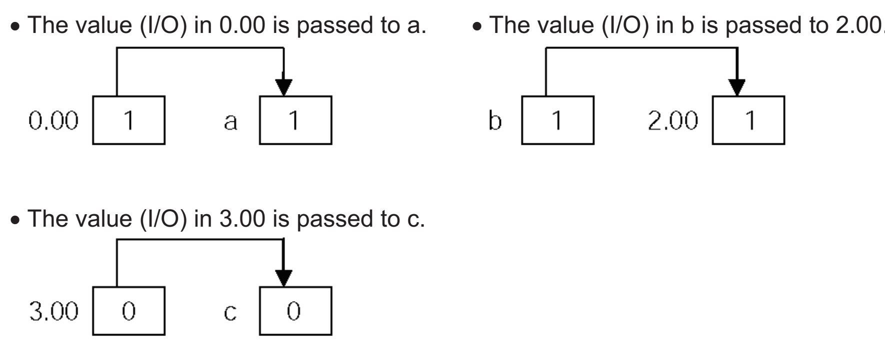
Type	Variable name	Type
Internal	tim_a	TIMER
Internal	tim_b	TIMER
Input	ON_TIME	INT
Input	OFF_TIME	INT

[2] Instance
To actually use a function block in a program, a copy of its function block definition must be created and placed in the program.
An instance is a function block definition placed in a program.
A function block definition represents a function block not yet placed in a program and therefore not yet assigned to a memory (still in an abstract form). Once the function block is placed in a program and assigned to a memory (in a tangible form), it is called an instance.
Instances are managed by their names. Use the same internal variables for instances of the same name, and use different internal variables for those of different names.

[3] Parameter

Every time an instance is created, actual I/O memory addresses (or constants) must be set for data exchange with input/output variables. These set addresses (or constants) are called parameters.





- What is exchanged between the parameters and function block is the data of the size specified by the variable data type. Take note that the parameter (address) information itself cannot be exchanged.
- The I/O memory addresses that can be used as parameters are limited to CIO (channel I/Os), A (special auxiliary relays), D (data memory), E (extended data memory), H (holding relays) and W (internal auxiliary relays).

[4] Variable

Addresses are not described as actual I/O memory addresses, but they are all described as variable names. The basic items you should know about variables are explained below.

■ Variable Types

[1] Internal variable (internals): Used only in an instance.

[2] Input variables (inputs): Variables to which data can be input from parameters outside the instance. "EN" (Enable) for inputting input conditions is generated by default.

[3] Output variables (outputs): Variables that can output data to parameters outside the instance. "ENO" (EnableOut) for outputting instance execution status is generated by default.

[4] External variables (externals): System definition variables pre-registered in CX Programmer, or user-defined global variables.

■ Variable Attributes (Data Types)

Data type	Description	Bit	How to input value to parameter	Value range
BOOL	Bit data	1	P-Off, P-On	0 (FALSE), 1 (TRUE)
INT	Integer	16	Positive value: & or +, followed by an integer Negative value: -, followed by an integer	-32768 to +32767
DINT	Double-precision integer	32		-2147483648 to +2147483647
LINT	Quadruple-precision integer	64		-9223372036854775808 to +9223372036854775807
UINT	Unsigned integer	16	Positive value: & or +, followed by an integer	&0 to 65535 &0 to 4294967295 &0 to 18446744073709551615
UDINT	Unsigned double-precision integer	32		
ULINT	Unsigned quadruple-precision integer	64		
WORD	16-bit data	16	#, followed by a hexadecimal number (4 digits or less) Or, &, followed by a decimal number	#0000 to #FFFF Or, &0 to &65535
DWORD	32-bit data	32	#, followed by a hexadecimal number (8 digits or less) Or, &, followed by a decimal number	#00000000 to #FFFFFFFF Or, &0 to &4294967295
LWORD	64-bit data	64	#, followed by a hexadecimal number (16 digits or less) Or, &, followed by a decimal number	#0000000000000000 to #FFFFFFFFFFFFFFFF Or, &0 to &18446744073709551615
REAL	Real number	32	Positive value: +, followed by a real number Negative value: -, followed by a real number	0, -3.402823×10^{38} to $-1.175494 \times 10^{-38}$ $+1.175494 \times 10^{-38}$ to $+3.402823 \times 10^{38}$
LREAL	Double-precision real number	64		0, $-1.79769313486232 \times 10^{308}$ to $-2.22507385850720 \times 10^{-308}$ $+2.22507385850720 \times 10^{-308}$ to $+1.79769313486232 \times 10^{308}$

Chapter 4 Controller Unit

4.1 Overview

The RACON and RPCON controllers are dedicated ROBONET controllers that drive RCA actuators (24-V servo motor type) and RCP2 actuators (24-V pulse motor type), respectively. Their basic functions and performance are the same as those of the ACON/PCON controllers. The RACON/RPCON controllers are operated by the Gateway R unit explained in Chapter 3, by means of field bus/Modbus communication.

4.1.1 Features

(1) Both controllers are operated by the dedicated Gateway R unit for ROBONET.
(2) Although these controllers are of incremental specifications, they can operate as absolute controllers by connecting a simple absolute R unit.
(3) The status LEDs on the front panel can be used to monitor the controller output current and read simple alarm codes.
(4) Since multiple controllers are interconnected using dedicated connection plates, the hassle of wiring can be reduced substantially.
(5) Both controllers are installed on a DIN rail, which makes installation to a control panel, etc., easy.

4.1.2 How to Read the Model Name

RACON－20－HA－ABU

- RACON — Base model: Dedicated ROBONET controller
- 20 — Actuator motor wattage
  - 2: 2 W
  - 5: 5 W
  - 10I: 10 W
  - 20: 20 W
  - 20S: 20 W
  - 30: 30 W
- HA — Actuator operation type
  - HA: High acceleration/deceleration type
  - LA: Energy-saving type
  - Blank: Standard specification
- ABU — Use the simple absolute R unit (Leave this field blank if the simple absolute R unit is not used.)

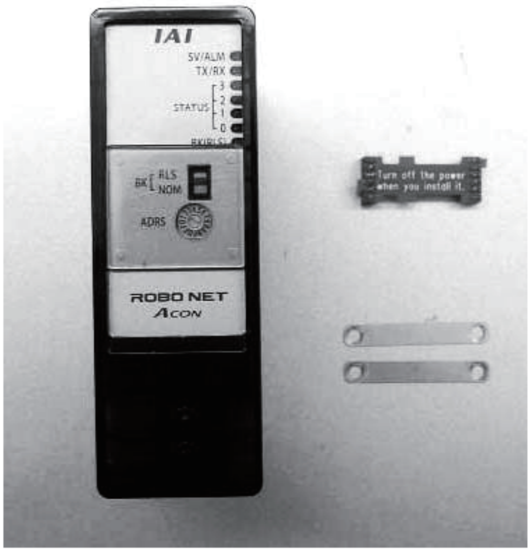
RPCON－20PI－ABU－H

- RPCON — Base model: Dedicated ROBONET controller
- 20PI — Actuator type
  - [Motor flange size]
    - 20P: 20, square
    - 28P: 28, square
    - 28P: 28, square
    - 35P: 35, square
    - 42P: 42, square
    - 56P: 56, square
  - [Encoder type]
    - I: Incremental
- ABU — Use the simple absolute R unit (Leave this field blank if the simple absolute R unit is not used.)
- H — High-acceleration transport specification

<RACON Unit Configuration>

RACON controller: 1 unit
ROBONET communication connection circuit board (model JB-1): 1 pc
Power-supply connection plate (model PP-1): 2 pcs
} Standard accessory

Main unit



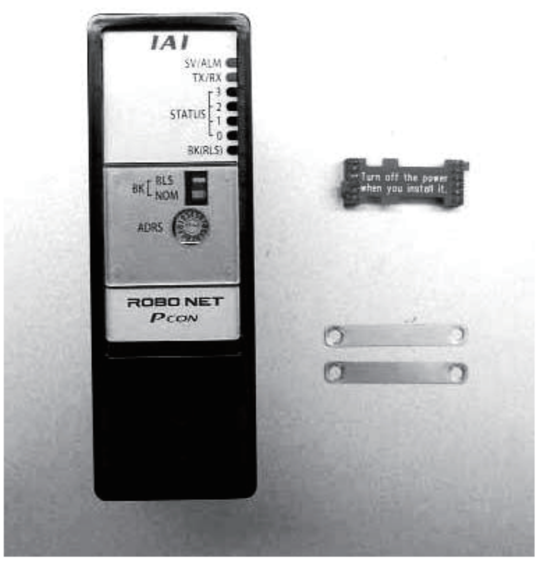
ROBONET communication connection circuit board

Power-supply connection plate

<RPCON Unit Configuration>

RPCON controller: 1 unit
ROBONET communication connection circuit board (model JB-1): 1 pc
Power-supply connection plate (model PP-1): 2 pcs
} Standard accessory

Main unit



ROBONET communication connection circuit board

Power-supply connection plate

4.2 Basic Specifications

The basic specifications are the same between the RACON and RPCON.

Item			Specification						
Number of controllable axes			1 axis						
Power-supply voltage			24 VDC ± 10%						
Power-supply current			RACON unit		Actuator	Standard specification, high acceleration/deceleration type		Energy-saving type	
						Rating	Max. *1	Rating	Max. *1
				RCA	SA4•SA5•RA4 (20W) type	1.3 A	4.4 A	1.3 A	2.5 A
				RCA	SA6•RA4 (30W) type	1.3 A	4.0 A	1.3 A	2.2 A
				RCA	RA3 (20W) type	1.7 A	5.1 A	1.7 A	3.4 A
				RCA2	SA3 (10W) type SA5•TA6 (20W) type	1.3 A	4.4 A	1.3 A	2.5 A
				RCA2	SA6•TA7 (30W) type	1.3 A	4.0 A	1.3 A	2.2 A
				RCA2	RA4•TA5 (20W) type	1.7 A	5.1 A	1.7 A	3.4 A
				RCL	RA1L•SA1L	0.8 A	4.6 A		
				RCL	RA2L•SA2L	1.0 A	6.4 A		
				RCL	RA3L•SA3L	1.3 A	6.4 A		
			RPCON unit	Actuator		Rating		Max. *2	
				20P, 28P, 28SP motors		0.4 A		2.0 A	
				42P, 56P motors		1.2 A		2.0 A	
Positioning commands			Position number specification, numerical specification						
Number of positioning points			768 points						
Serial communication			RS485, 1 channel (dedicated connector)						
Communication protocol			Modbus protocol						
Encoder resolution	RCP*, RCA*		800 pulses/rev						
	RCL	RA1L•SA1L	715 pulses/rev						
	RCL	RA2L•SA2L	855 pulses/rev						
	RCL	RA3L•SA3L	1145 pulses/rev						
Encoder interface			Incremental specification conforming to EIA RS-422A/423A						
Backup memory			Position table data and parameters are saved in the nonvolatile memory. Serial EEPROM rewrite life: 100,000 times max.						
LED indicators			Servo ON indicator, alarm indicator, communication status indicator, status indicator						
Forced release of electromagnetic brake			Brake release switch on the front panel						
Emergency stop circuit			Built-in drive-source cutoff relay						
Environment	Ambient operating temperature		0 to 50°C (*3)						
Environment	Ambient operating humidity		95% RH max. (non-condensing)						
Environment	Operating ambience		Free from corrosive gases						
Environment	Surrounding storage temperature		-25 to 70°C						
Environment	Surrounding storage humidity		95% RH max. (non-condensing)						
Environment	Vibration resistance		XYZ directions: 10 to 57 Hz, half amplitude – 0.035 mm (continuous) / 0.075 mm (intermittent) 57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)						
Environment	Impact resistance		XYZ directions: 147 mm/s^2, 11 ms, half-sine wave pulse						
Protection degree			IP20						
Cooling			Forced air cooling (built-in fan)						
Weight			200 g						
External dimensions			34 W x 105 H x 73.3 D mm						

*1 The current becomes the maximum during the excited-phase detection of the servo motor performed when the servo is turned on for the first time following the power on. (Normal: Approx. 1 to 2 seconds, Maximum: 10 seconds)

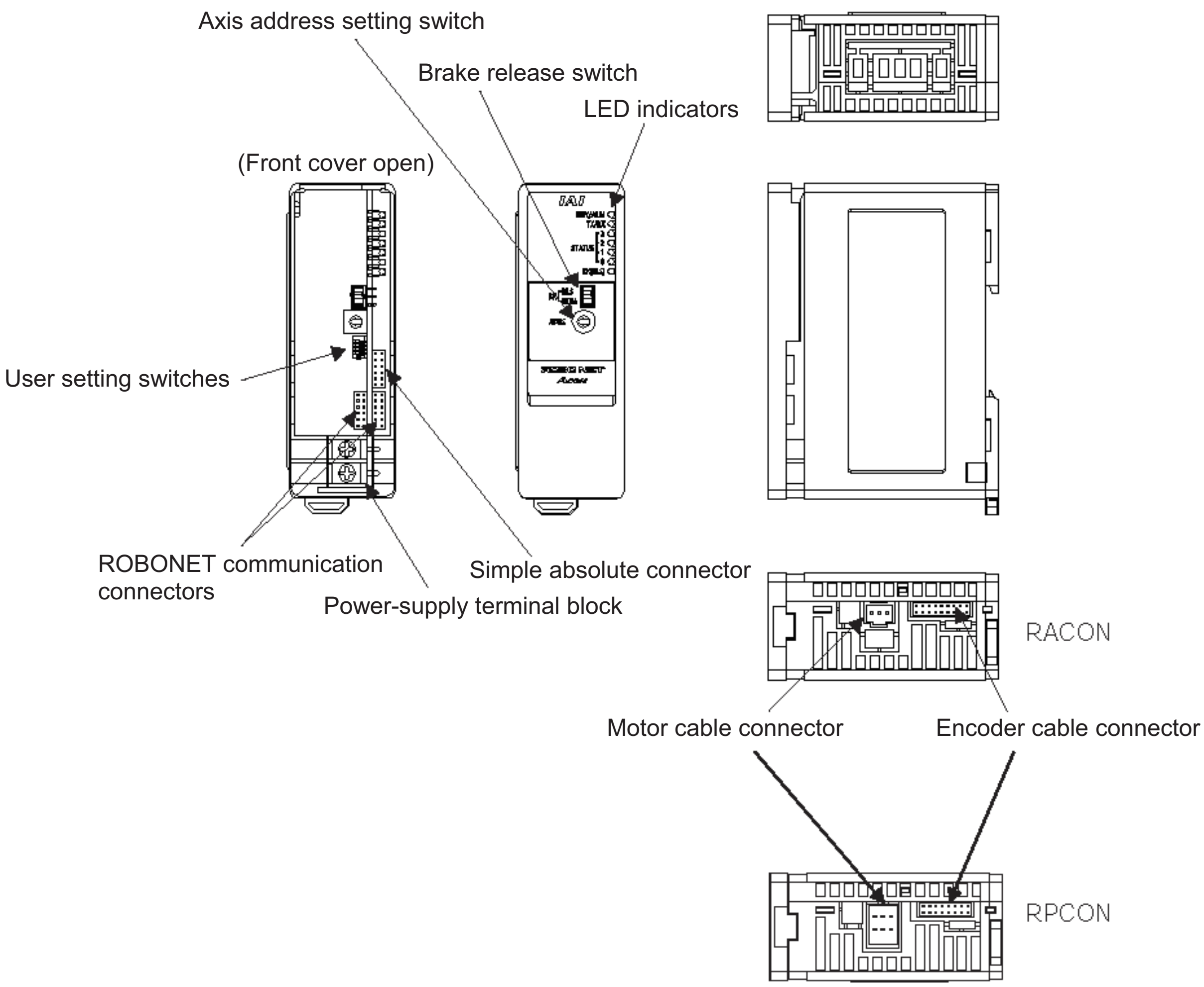
*2 The current becomes the maximum during the excited-phase detection performed when the servo is turned on for the first time following the power on. (Normal: 100 msec)

*3 The ambient operating temperature of a ROBONET system is 0 to 40°C.

4.3 Name/Function of Each Part and External Dimensions.

The name/function of each part and external dimensions are exactly the same with both the RACON and RPCON. However, the connector is different between the RACON and RPCON.

4.3.1 Name of Each Part



4.3.2 LED Indicators

These LEDs are used to monitor the status of the RACON/RPCON.

Symbol	Indicator color	Explanation
SV/ALM	Green/red	A steady green light comes on when the servo is ON, and changes to a steady read light when an alarm is present.
TX/RX	Green /yellow	A steady green light comes on while data is being sent over the communication line, and a steady yellow light comes on while data is being received.
STATUS 3	Green	• When the servo is ON → Indicate the monitored current • When an alarm is present → Indicate a simple alarm code Details are explained below.
STATUS 2	Green	
STATUS 1	Green	
STATUS 0	Green	
BK (RLS)	Yellow	A steady yellow light comes on while the brake is released, and the LED is off while the brake is actuated.

Description of STATUS indicators
What these indicators indicate varies depending on whether or not the servo is ON and an alarm is present.

(1) When the servo is ON
When the servo is ON, the STATUS LEDs on the front panel can be used to roughly monitor the motor current. The command current ratios (percentage ranges of the rated current) and corresponding LED indicator statuses are shown below.

STATUS				Command current ratio	
3	2	1	0	RPCON	RACON
○	○	○	○	0.00% to 6.24%	0.00% to 18.74%
○	○	○	●	6.25% to 24.99%	18.75% to 74.99%
○	○	●	●	25.00% to 49.00%	5.00% to 131.24%
○	●	●	●	50.00% to 74.99%	31.25% to 187.74%
●	●	●	●	75.00% to 100.00%	187.75% to 300.00%

○ indicates that the LED is off, while ● indicates a steady green light.

(2) When the ALM signal is ON (an alarm is present)
When the ALM signal turns ON, the statuses of STATUS LEDs can be used to check the cause of the alarm. Since there are only four LEDs, however, several causes are indicated by one indication pattern. Accordingly, you must connect the PC software or teaching pendant to check the exact cause. Refer to “Alarm Indicator List” on the next page for the alarm details, alarm codes and corresponding indicator statuses.

Alarm Indicator List

STATUS 3	STATUS 2	STATUS 1	STATUS 0	Simple alarm code	Alarm code	Alarm name	RPCON	RACON
○	○	●	○	2	90	Software reset command with servo ON	○	○
					91	Position number error during teaching	○	○
					92	PWRT signal detection during movement	○	○
					93	PWRT signal detection before home return	○	○
○	○	●	●	3	80	Move command with servo OFF	○	○
					82	Position command before home return	○	○
					83	Absolute position move command before home return	○	○
					84	Move command during home return	○	○
					85	Position number error during movement	○	○
					A7	Command deceleration error	○	○
○	●	○	○	4	F4	PCB mismatch error	○	○
○	●	●	○	6	A1	Parameter data error	○	○
					A2	Position data error	○	○
					A3	Position command information data error	○	○
○	●	●	●	7	B6	Phase-Z detection timeout	X	○
					B7	Indeterminable magnetic pole	X	○
					B8	Excited phase detection error	○	X
					BA	Home sensor not detected	○	○
					BE	Home return timeout	○	○
●	○	○	○	8	C0	Excessive actual speed	○	○
●	○	○	●	9	C8	Overcurrent	X	○
					C9	Overvoltage	○	○
					CA	Overheat	○	○
					CB	Current sensor offset adjustment error	X	○
					CC	Control power-supply voltage error	○	○
					CE	Control power-supply voltage low	○	○
●	○	●	●	B	D8	Deviation overflow	○	○
					D9	Software stroke limit over error	○	○
					DC	Push operation range over error	○	○
					A4	Command counter overflow	○	○
●	●	○	○	C	C1	Servo error	○	X
					D2	Motor power-supply overvoltage	X	○
					E0	Overload	X	○
					F0	Driver logic error	X	○
●	●	○	●	D	E5	Encoder receive error	○	○
					E8	Phase A/B open	○	○
					E9	Phase A open	○	X
					EA	Phase B open	○	X
					ED	Absolute encoder error detection 1	○	○
					EE	Absolute encoder error detection 2	○	○
					EF	Absolute encoder error detection 3	○	○
●	●	●	○	E	FA	CPU error	○	○
					FC	Logic error	○	○
●	●	●	●	F	F5	Nonvolatile memory write verification error	○	○
					F6	Nonvolatile memory write timeout	○	○
					F8	Nonvolatile memory data damage	○	○

○: Off ●: Steady light ○: Available X: Not available

4.3.3 Brake Release Switch

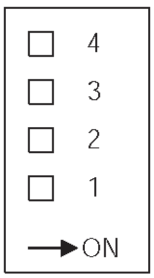
When an actuator with brake is used, this switch is used to forcibly release the brake when adjusting the actuator assembly, etc. Normally this switch is kept in the bottom (NOM) position.

Switch name	Status	Explanation
BK	Top (RLS) position	The brake is forcibly released.
	Bottom (NOM) position	Normal operation mode. The brake is always effective and can be released only while the servo is ON.

⚠ Caution

After forcibly releasing the brake, be sure to return the switch to the bottom (NOM) position before the next operation.

4.3.4 User Setting Switches



No.	Explanation
1	Keep this switch in the “OFF” position.
2	Keep this switch in the “OFF” position.
3	Keep this switch in the “OFF” position.
4	This switch is used to set the flash ROM update mode. ON (right) position: Update mode *

* Keep this user setting switch in the “OFF” (left) position.

4.3.5 Axis Number Setting Switch

The axis number is set using this rotary switch as a slave station number on the SIO link.
The axis number is set as a hexadecimal value of 0 to F, where “0” indicates the first axis and “F” indicates the 16th axis.

4.3.6 ROBONET Communication Connector

This connector is used to connect RACON/RPCON controllers via SIO link below the Gateway R unit. It connects to the SIO communication (Modbus) signal and emergency stop signal.
RACON/RPCON controllers are connected using the ROBONET communication connection circuit boards supplied with the controllers.

The photograph below shows the ROBONET communication connection circuit board supplied with the controller. The same board is used for connecting the simple absolute R unit.

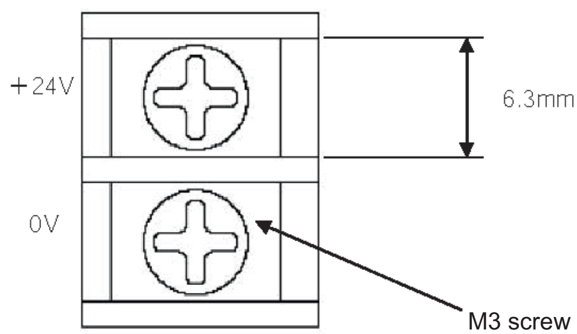
ROBONET communication connection circuit board
(model JB-1)

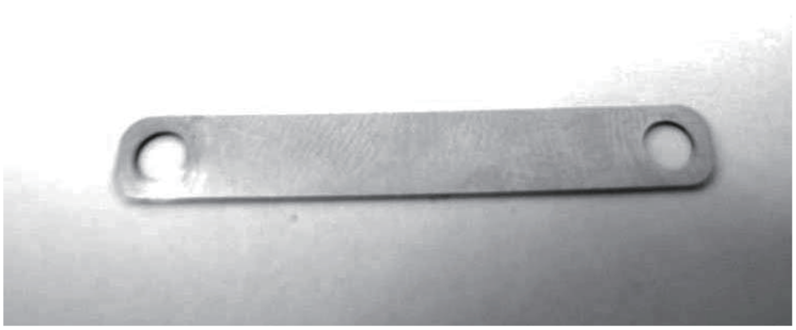
4.3.7 Simple Absolute R Unit Connector

The RACON/RPCON can be operated as an absolute controller by connecting a simple absolute R unit. This connector is used to connect the simple absolute R unit, and the connection uses the ROBONET communication connection circuit board (same board used for SIO communication) supplied with the simple absolute R unit.

4.3.8 Power-supply Input Terminal Block

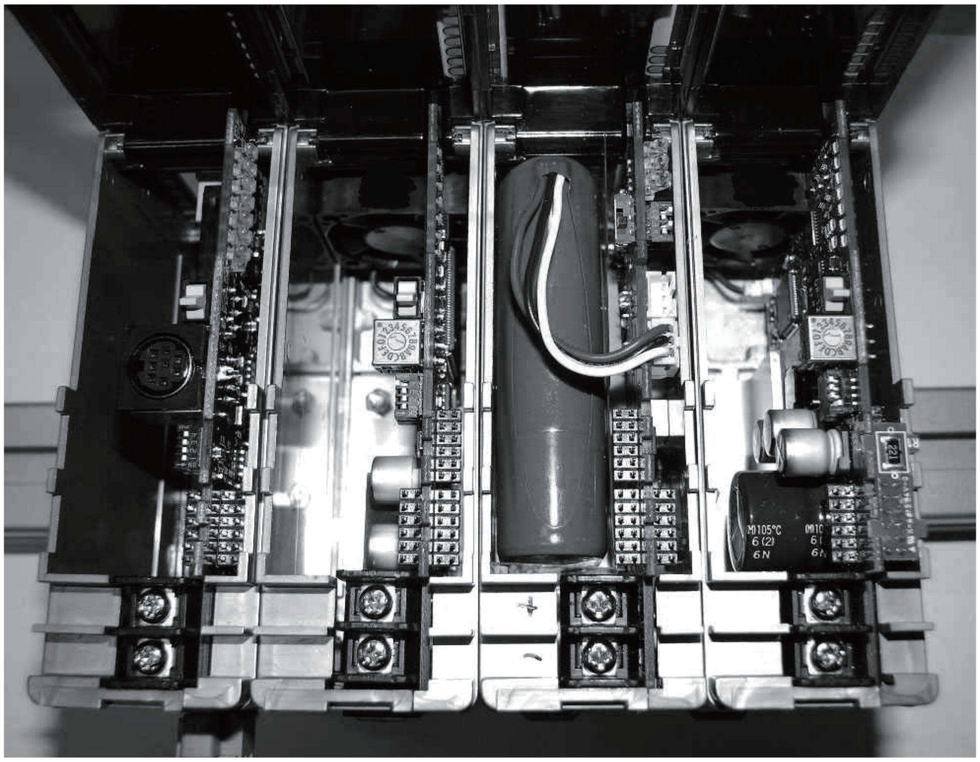
24-VDC power-supply input terminals for the RACON/RPCON. Multiple units are interconnected using the supplied power-supply connection plates.





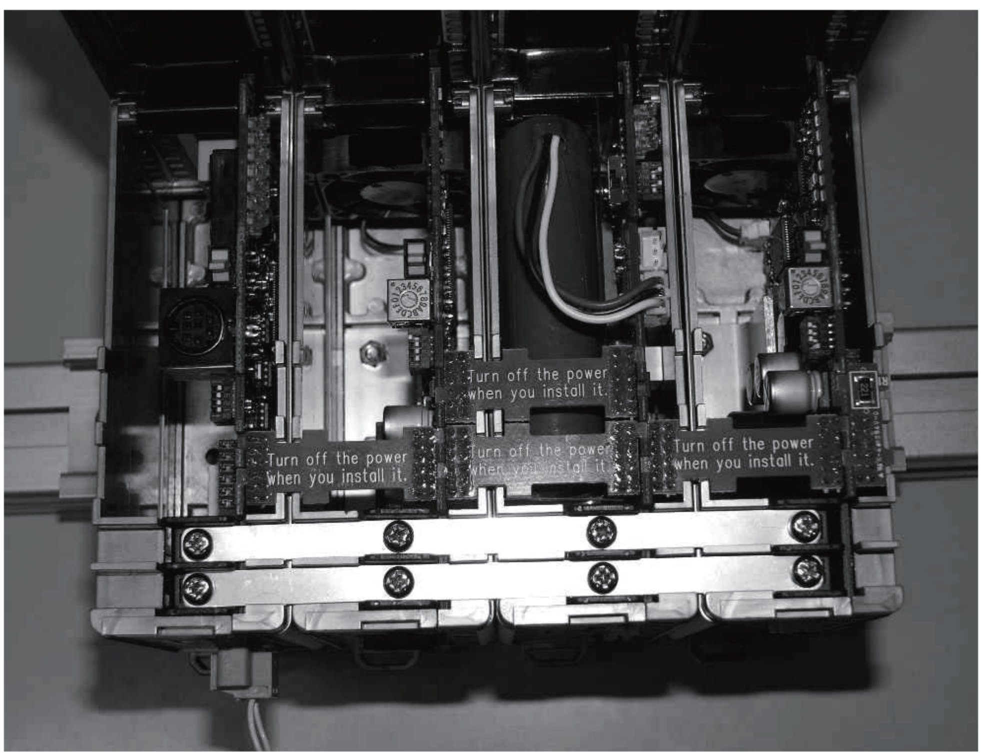
Power-supply connection plate
(model PP-1)

The photographs below show the condition before and after interconnection of units.



Before connection

Gateway R unit RPCON controller Simple absolute R unit RACON controller



After connection

4.3.9 Motor Cable Connector

This connector is used to connect the dedicated actuator motor cable. The connector is different between the RACON and RPCON.

Item	Specification					
	RACON			RPCON		
Connector name	MOT			MOT		
Applicable connector	DF1E-3P-2.5DS (Hirose) (Cable end) DF1E-3S-2.5C (Hirose) Contact: DF1E-2022SC			0-1376136-1 (AMP) (Cable end) 1-1318119-3 (AMP)		
Maximum connection length	20 m			20 m		
Terminal assignments	No.	Name	Function	No.	Name	Function
	1	U	Motor phase U	A1	$\overline{A}$	Motor drive line (phase A-)
	2	V	Motor phase V	A2	VMM	Motor power line
	3	W	Motor phase W	A3	$\overline{B}$	Motor drive line (phase B-)
				B1	A	Motor drive line (phase A+)
				B2	VMM	Motor power line
				B3	B	Motor drive line (phase B+)
Applicable cable	CB-ACS-MA***			CB-RCP2-MA***		

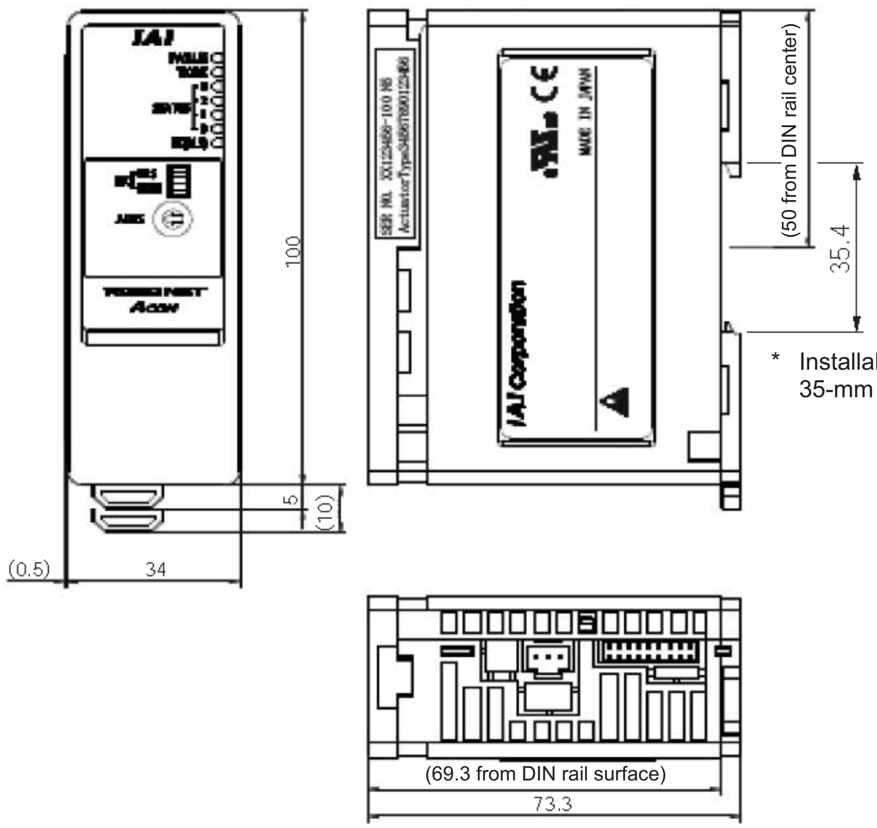
4.3.10 Encoder Cable Connector

This connector is used to connect the dedicated actuator encoder cable. The connector is different between the RACON and RPCON.

Item	Specification					
	RACON			RPCON		
Connector name	PG			PG		
Applicable connector	S18B-PHDRS (JST) (Cable end) PHDR-18VS (JST) Contact: SPHD-001T-P0.5 (JST)			S16B-PHDRS (JST) (Cable end) PHDR-16VS (JST) Contact: SPHD-001T-P0.5 (JST)		
Maximum connection length	20 m			20 m		
Terminal assignments	No.	Name	Function	No.	Name	Function
	1	FG	Shield round	1	FG	Shield round
	2	NC	Not connected	2	NC	Not connected
	3	NC	Not connected	3	NC	Not connected
	4	NC	Not connected	4	NC	Not connected
	5	GND	Ground	5	GND	Ground
	6	5V	Encoder power supply	6	5V	Encoder power supply
	7	VPS	Encoder control signal	7	VPS	Encoder control signal
	8	NC	Not connected	8	NC	Not connected
	9	$\overline{\text{ENZ}}$ $\overline{\text{(SD)}}$	Phase Z differential input- (Simple absolute transmission differential-)	9	$\overline{\text{ENB}}$	Phase-B differential input-
	10	ENZ (SD)	Phase Z differential input+ (Simple absolute transmission differential+)	10	ENB	Phase-B differential input+
	11	$\overline{\text{ENB}}$	Phase-B differential input-	11	$\overline{\text{ENA}}$	Phase-A differential input-
	12	ENB	Phase-B differential input+	12	ENA	Phase-A differential input+
	13	$\overline{\text{ENA}}$	Phase-A differential input-	13	BK-	Brake output ground
	14	ENA	Phase-A differential input+	14	BK+	Brake output
	15	BK-	Brake output ground	15	LS-	Limit sensor input
	16	BK+	Brake output	16	LS+	Limit-sensor 24-V power supply output
	17	LS-	Limit sensor input	-	-	-
	18	LS+	Limit-sensor 24-V power supply output	-	-	-
Applicable cable	CB-ACS-PA***			CB-RCP2-PB***		

4.3.11 External Dimensions

The external dimensions are exactly the same between the RACON and RPCON.
Take note that the motor cable connector and encoder cable connector are different.



* Installable on a 35-mm DIN rail

4.4 Parameters

4.4.1 Parameter List

The parameters are classified into the following four types depending on their function.
Types:
- a: Parameter relating to actuator stroke
- b: Parameter relating to actuator operating characteristic
- c: Parameter relating to external interface
- d: Parameter relating to servo gain adjustment

*2

No.	Type	Symbol	RPCON	RACON	Name	Unit	Factory default
1	a	ZONM	○	○	Zone boundary 1+	mm	Effective length of the actuator
2	a	ZONL	○	○	Zone boundary 1-	mm	Effective length of the actuator
3	a	LIMM	○	○	Soft limit+	mm	Effective length of the actuator
4	a	LIML	○	○	Soft limit-	mm	Effective length of the actuator
5	a	ORG	○	○	Home return direction [0: Reverse / 1: Forward]	-	(As specified at the time of order)
6	b	PSWT	○	○	Push stop judgment time	msec	255
7	d	PLGO	○	○	Servo gain number	-	Set individually in accordance with the actuator characteristics.
8	b	VCMD	○	○	Default speed	mm/sec	Set individually in accordance with the actuator characteristics.
9	b	ACMD	○	○	Default acceleration/deceleration	G	Set individually in accordance with the actuator characteristics.
10	b	INP	○	○	Default positioning band (in-position)	mm	0.1
12	b	SPOW	○	X	Current-limiting value at standstill after positioning	%	35
13	b	ODPW	○	○	Current-limiting value during home return	%	Set individually in accordance with the actuator characteristics.
18	b	LS	○	○	Home sensor input polarity	-	Set individually in accordance with the actuator characteristics.
22	a	OFST	○	○	Home return offset	mm	Set individually in accordance with the actuator characteristics.
23	a	ZNM2	○	○	Zone boundary 2+	mm	Effective length of the actuator
24	a	ZNL2	○	○	Zone boundary 2-	mm	Effective length of the actuator
26	b	JOGV	○	○	PIO jogging speed	mm/sec	100
28	b	PDIR1	○	○	Default direction of excited phase signal detection [0: Reverse / 1: Forward]	-	Set individually in accordance with the actuator characteristics.
29	b	PDIR2	○	○	Excited phase signal detection time	msec	Set individually in accordance with the actuator characteristics.
30	b	PDIR3	X	○	Pole sensing type [0: Current suppression / 1: Distance suppression]	-	1 [Distance suppression 1]
31	d	VLPG	○	○	Speed loop proportional gain	-	Set individually in accordance with the actuator characteristics.
32	d	VLPT	○	○	Speed loop integral gain	-	Set individually in accordance with the actuator characteristics.
33	d	TRQF	○	○	Torque filter time constant	-	Set individually in accordance with the actuator characteristics.
34	b	PSHV	○	○	Push speed	mm/sec	Set individually in accordance with the actuator characteristics.
35	b	SAFV	○	○	Safety speed	mm/sec	Set individually in accordance with the actuator characteristics.
39	c	PEND	○	○	Position complete signal output mode [0: PEND / 1: INP]	-	0 [PEND]

*1

*1 ○: Available X: Not available
*2 The parameter numbers are displayed in the PC software, but not on the teaching pendant. Missing numbers are not used and are thereby omitted. Types are indicated solely for the purpose of convenience and are not displayed.

*2

No.	Type	Symbol	RPCON	RACON	Name	Unit	Factory default
43	b	HMC	○	○	Home check sensor input polarity	-	(As specified at the time of order)
46	b	OVRD	○	○	Speed override	%	100
47	b	IOV2	○	○	PIO jogging speed 2	mm/sec	100
48	b	IOID	○	○	PIO inching distance	mm	0.1
49	b	IOD2	○	○	PIO inching distance 2	mm	0.1
52	b	HSTP1	X	○	Default acceleration/deceleration mode	-	0 [Trapezoid]
53	b	HSTP2	○	X	Default stop mode	-	0 [Complete stop]
54	d	CLPF	X	○	Current control band number	-	Set individually in accordance with the actuator characteristics.
55	b	PLPF	X	○	Position-command primary filter time constant	msec	0
56	b	SCRV	X	○	S-motion ratio setting	%	0
71	b	PLFG	X	○	Position feed-forward gain	-	0
77	b	LEAD	○	○	Ball screw lead	mm	Set individually in accordance with the actuator characteristics.
78	b	ATYP	○	○	Axis operation type	-	Set individually in accordance with the actuator characteristics.
79	b	ATYP	○	○	Rotational axis mode selection	-	Set individually in accordance with the actuator characteristics.
80	b	ATYP	○	○	Rotational axis shortcut selection	-	Set individually in accordance with the actuator characteristics.
83	b	ETYP	○	○	Use absolute unit [0: Do not use / 1: Use]	-	Set individually in accordance with the actuator characteristics.
91	B	PSFC	○	○	Current-limiting value at standstill after missing work part in push operation [0: Current-limiting value during movement / 1: Push-current limiting value]	-	0: Current-limiting value during movement

*1

*1 ○: Available X: Not available
*2 The parameter numbers are displayed in the PC software, but not on the teaching pendant. Missing numbers are not used and are thereby omitted. Types are indicated solely for the purpose of convenience and are not displayed.

⚠ Caution

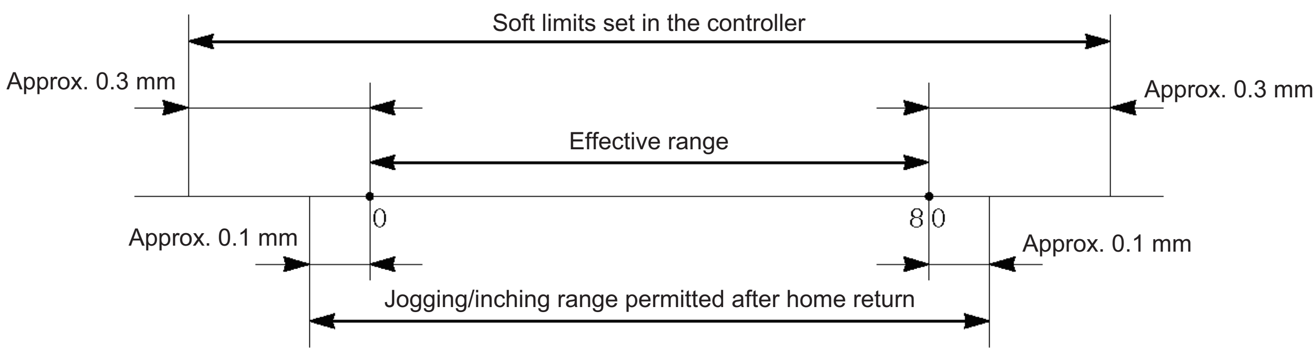
If you have changed any parameter, be sure to restart the controller via a software reset or reconnect the controller power.

4.4.2 Parameters Relating to Actuator Stroke

● Soft Limits (Nos. 3/4, LIMM/LIML)
Set the + soft limit in parameter No. 3 and – soft limit in parameter No. 4.
Both parameters have been set to the effective actuator length at the factory. Change the parameter settings if necessary, such as when an obstacle is present and collision between the actuator and obstacle must be prevented.
Exercise due caution when setting these parameters, as wrong settings will cause collision with the mechanical end.
The minimum setting unit is 0.01 mm.

⚠ Caution

To change these parameters, set values corresponding to positions that are 0.3 mm wider than the desired effective range.
Example) Set the effective range to between 0 and 80 mm
Parameter No. 3 (+): 80.3
Parameter No. 4 (–): -0.3



● Home Return Direction (No. 5, ORG)
If not specified by the customer, the home return direction is set to the motor side before shipment.
If you must change the home direction after the actuator has been assembled to your equipment, change the setting of parameter No. 5.
Also change the parameters for home return offset and soft limits, if necessary.

⚠ Caution

Even after the home return direction is reversed, stored position data will be retained.
Rod-type actuators must be used with its home on the motor side. (Do not reverse the factory-set home return direction.)

● Home Return Offset (No. 22, OFST)

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

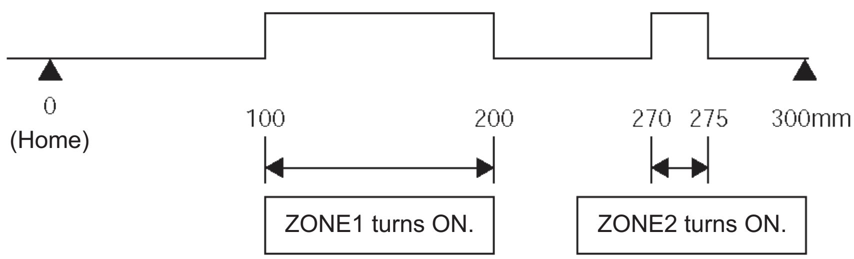
Caution

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

● Zone Boundaries (1: Nos. 1/2, ZONM/ZONL; 2: Nos. 23/24, ZNM2/ ZNL2)

Set the zone within which the zone output signal (ZONE1 or ZONE2) turns ON.
The zone signal turns ON when the actuator coordinate is inside the range set by the (-) boundary and (+) boundary.
For the ZONE1 signal, set the + boundary in parameter No. 1 and – boundary in parameter No. 2.
For the ZONE2 signal, set the + boundary in parameter No. 23 and – boundary in parameter No. 24.
The minimum setting unit is 0.01 mm.

Example) Use ZONE1 as an intermediate LS actuating in a range of 100 to 200 mm, and ZONE2 as a simple ruler actuating in a range of 270 to 275 mm, for a 300 mm stroke actuator.
Parameter No. 1 (+): 200, Parameter No. 2 (-): 100
Parameter No. 23 (+): 275, Parameter No. 24 (-): 270



4.4.3 Parameters Relating to Actuator Operating Characteristics

● Default Speed (No. 8, VCMD)
The factory setting is the rated speed of the actuator.
This value is treated as the speed data corresponding to the applicable position number when a target position has been written to the unregistered position table or the current position read into the table in the teaching mode.
To decrease the default speed from the rated speed, change the value set in parameter No. 8.

● Default Acceleration/Deceleration (No. 9, ACMD)
The factory setting is the rated acceleration/deceleration of the actuator.
This value is treated as the acceleration/deceleration data corresponding to the applicable position number when a target position has been written to the unregistered position table or the current position read into the table in the teaching mode.
To decrease the default acceleration/deceleration from the rated acceleration/deceleration, change the value set in parameter No. 9.

● Default Positioning Band (In-position) (No. 10, INP)
The factory setting is “0.10” [mm].
This value is treated as the positioning band data corresponding to the applicable position number when a target position has been written to the unregistered position table or the current position read into the table in the teaching mode.
Increasing this parameter value causes the position complete signal to output more quickly. If necessary, change the value set in parameter No. 10.

● Current-limiting Value during Home Return (No. 12, SPOW) <Effective only on the RPCON>
This parameter is effective only on the RPCON.
Before shipment, this parameter has been set to a current level appropriate for the standard specification of the actuator.
Increasing this parameter value increases the holding torque at standstill.
This parameter need not be changed in normal conditions of use. However, hunting will occur if the actuator receives a large external force at standstill. In this case, the value set in parameter No. 12 must be increased.
(As a guide, the setting should not exceed 70%.)

● Current-limiting Value at Standstill after Home Return (No. 13, ODPW)
In the case of the RPCON, this parameter has been set to a value appropriate for the standard specification of the actuator before shipment.
In the case of the RACON, this parameter has been set to 120% for the slider type and 100% for the rod type.
Increasing this parameter value increases the home return torque, but this parameter need not be changed in normal conditions of use.

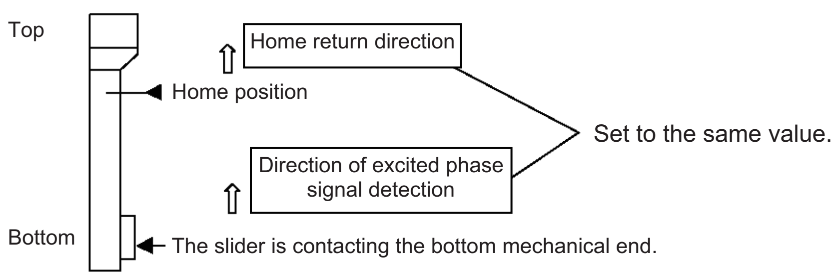
- Speed Override (No. 46, OVRD)

This parameter is used if you want to move the actuator at a slower speed to prevent danger during trial operation or at startup.
When issuing a move command from the PLC, you can override the travel speed set in the "Speed" field of the position table by multiplying it with the value set in parameter No. 46.
Actual travel speed = [Speed set in the position table] x [Value of parameter No. 46] / 100
Example) Value in the "Speed" field of the position table: 500 (mm/s)
Value of parameter No. 46: 20 (%)
In this case, the actual travel speed becomes 100 mm/s.
The minimum setting unit is 1%, and the input range is 1 to 100 (%). The factory setting is "100" (%).
This parameter is not effective on the move commands issued from a PC or teaching pendant, or the move commands by direct numerical specification.
If a PC or teaching pendant is used, you can set a speed ratio in each tool to operate the actuator accordingly.

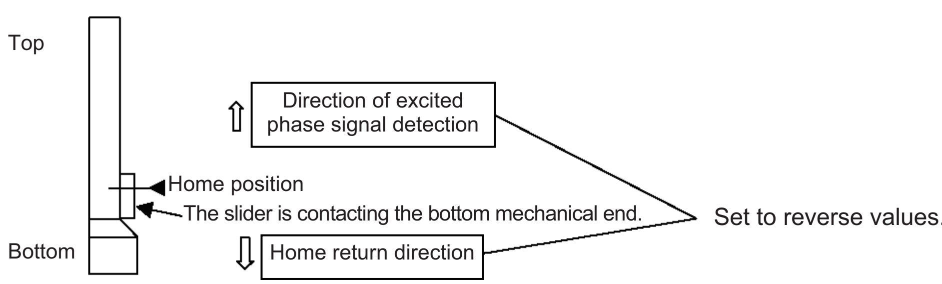
- Default Direction of Excited Phase Signal Detection (No. 28, PDIR1)

The excited phase is detected when the servo is turned ON for the first time after turning on the power. This parameter defines the direction of this detection.
This parameter need not be changed in normal conditions of use. However, if the actuator is contacting a mechanical end or any obstacle when the power is turned on and cannot be moved by hand, change the direction of detection to one in which the motor can be driven easily.
To do this, set the value of parameter No. 28 to either "0" or "1." If the direction of detection is to be the same as the home return direction, specify the same value currently set in parameter No. 5, "Home return direction."
To set the direction opposite home return direction, specify the value different from the one currently set in parameter No. 5, "Home return direction."
This parameter is effective only when the pole sensing type is set to the current suppression mode.

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



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



● Excited Phase Signal Detection Time (No. 29, PDIR2)
The excited phase is detected when the servo is turned ON for the first time after turning on the power. This parameter defines the time of this detection (excitation switching period).
Before shipment, this parameter has been set to a detection time appropriate for the standard specification of the actuator, and thus the setting need not be changed in normal conditions of use.
Should an excitation detection error or abnormal operation occur when the servo is turned ON for the first time after turning on the power, you can try changing the detection time set in parameter No. 29 as a possible countermeasure.
Before changing this parameter, contact IAI.

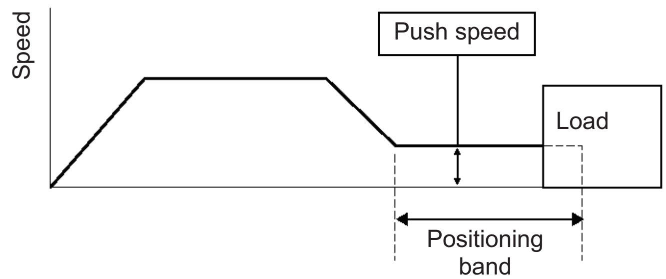
● Pole Sensing Type (No. 30, PDIR3) <Effective only on the RACON>
The excited phase is detected when the servo is turned ON for the first time after turning on the power. Parameter No. 30 defines the mode of this operation.
This parameter need not be changed in normal conditions of use, so the customer is advised not to change the setting.
Definition of settings: 0 (Current suppression mode)
1 (Distance suppression mode)
The factory setting is “1 [Distance suppression mode].”

● Safety Speed (No. 35, SAFV)
This parameter defines the feed speed in manual operation.
Before shipment, this parameter has been set individually in accordance with the actuator characteristics.
To change the speed, set an optimal value in parameter No. 35.
Since the maximum speed is limited to “250” [mm/sec], set the safety speed to below this level.

● Default Acceleration/Deceleration Mode (No. 52, HSTP1) <Effective only on the RACON>
This value is treated as the data in the “Acceleration/deceleration mode” field corresponding to the applicable position number when a target position has been written to the unregistered position table.
The factory setting is “0 [Trapezoid pattern].”
To change the default acceleration/deceleration pattern, set the value of parameter No. 52 as follows.

	Setting value
Trapezoid pattern	0
S-motion	1
Primary delay filter	2

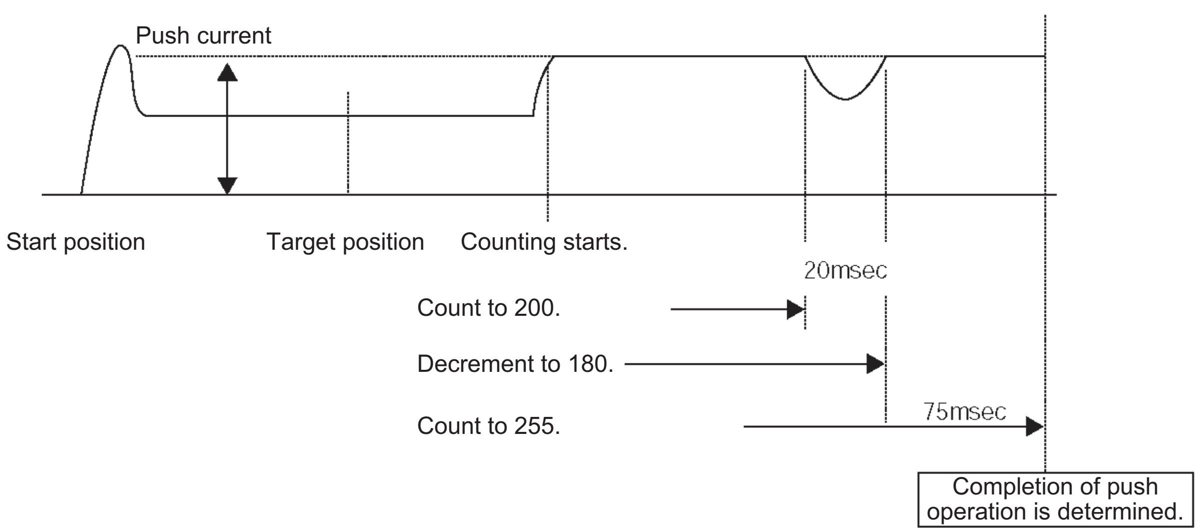
● Push Speed (No. 34, PSHV)
This parameter defines the push speed to become effective after the target position is reached in push operation.
Before shipment, this parameter has been set to a value appropriate for the characteristics of the actuator.
Set an appropriate speed in parameter No. 34 by considering the material and shape of the work part, etc.
Take note that although the maximum speed varies depending on the actuator, it is limited to “20” [mm/sec] even with high-speed types. Accordingly, set the push speed lower than this level.



Caution

It is recommended that the push speed be set to 5 mm/s or above to reduce the effect of push force fluctuation.

● Push-motion Completion Judgment Time (No. 6, PSWT)
This parameter is used as a condition for determining if the work part is contacted and push operation is completed.
Specifically, push operation is deemed complete if the current-limiting value set in the position table has been maintained for the time set in parameter No. 6.
Depending on the material and shape of the work part, etc., set an optimal value in combination with the current-limiting value.
The minimum setting unit is 1 msec, and the maximum value is 9999 msec. The factory setting is “255” [msec].
The following shows a case in which the work part has shifted and current has changed during push completion judgment. In this example, the judgment time is set to 255 msec.



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

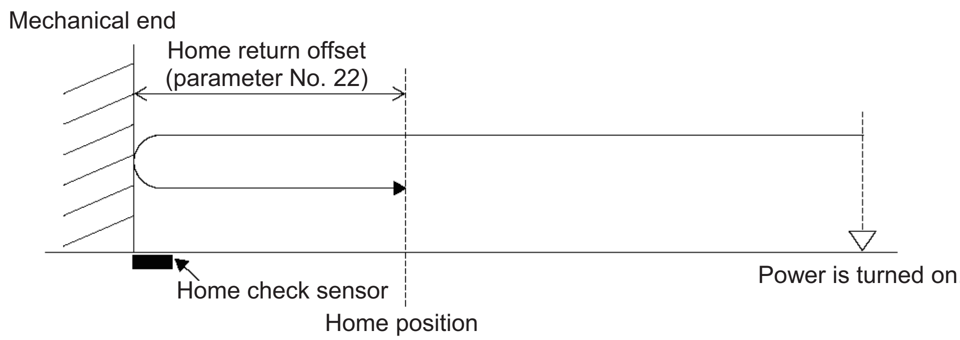
● Home Check Sensor Input Polarity (No. 43, HMC)

Although not equipped on the standard specification, the home check sensor can be added as an option.
This parameter need not be changed in normal conditions of use. If the customer wishes to change the mode after shipment, change the value in parameter No. 43.

Definition of settings: 0 (Standard specification/No sensor)
1 (The home check sensor is used based on the sensor polarity conforming to the contact-a logic)
2 (The home check sensor is used based on the sensor polarity conforming to the contact-b logic)

[Explanation of Operation]
[1] When a home return command is issued, the actuator contacts a mechanical end, upon which the home check sensor outputs a detection signal.
[2] Next, the actuator reverses its direction, moves to the home position, and stops.
[3] If the home check sensor signal has been detected, the controller determines that the home return has completed successfully.

If the signal has not been detected, the controller recognizes a “position deviation.” Accordingly, it generates a “home sensor not detected” error and outputs an alarm signal.



● Home Sensor Input Polarity (No. 18, LS)

The input polarity of the home sensor is defined by parameter No. 18.
Since the current RCA actuators do not adopt the home sensor method, the factory setting of this parameter is “0 [No sensor]” when these actuators are used.
On the RCP2-RTB/RTC of home sensor specification, this parameter is set before shipment.
This parameter is reserved for future actuator development, so the customer is advised not to change the setting.

Definition of settings: 0 (No sensor)
1 (The home sensor is used based on the sensor polarity conforming to the contact-a logic)
2 (The home sensor is used based on the sensor polarity conforming to the contact-b logic)

● PIO Jogging Speed (No. 26, JOGV)
PIO JOG Speed 2 (No. 47, IOV2)

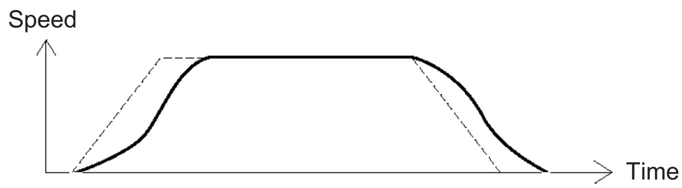
These parameters set the speeds of jogging operation or inching operation.
The jogging speed parameter is switched according to the jogging speed/inching distance switching signal (JVEL), as follows:
JVEL = “0” → Parameter No. 26 (PIO jogging speed)
JVEL = “1” → Parameter No. 47 (PIO jogging s peed 2)
Set an optional value according to the specific purpose. The maximum limit is “250” [mm/sec].

● PIO Inching Distance (No. 48, IOID)
PIO Inching Distance 2 (No. 49, IOD2)

These parameters set the inching distances for inching operation.
The inching distance parameter is switched according to the jogging speed/inching distance switching signal (JVEL), as follows:
JVEL = “0” → Parameter No. 48 (PIO inching distance)
JVEL = “1” → Parameter No. 49 (PIO inching distance 2)
Set an optional value according to the specific purpose. The maximum limit is “1” [min].

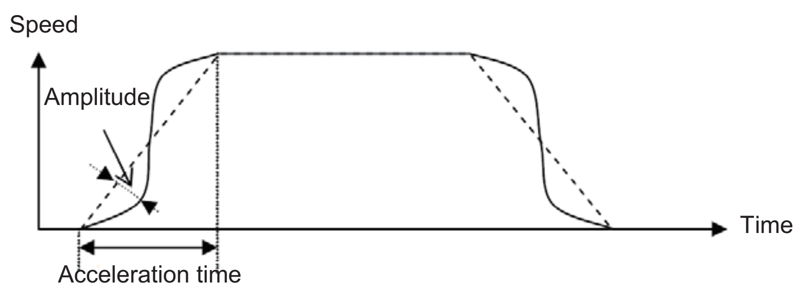
● Position-command Primary Filter Constant (No. 55, PLPF) <Effective only on the RACON>

Parameter No. 55 defines the delay level to be applied when “1 [Primary delay filter]” is set in the “Acceleration/deceleration mode” field of the position table.
The setting unit is [msec], and the minimum input unit is 0.1 msec. The setting range is 0.0 to 100.0.
The factory setting is “0” [msec].
If this parameter is set to “0,” the primary delay filter will be disabled.
The greater the setting value, the greater the delay level becomes.



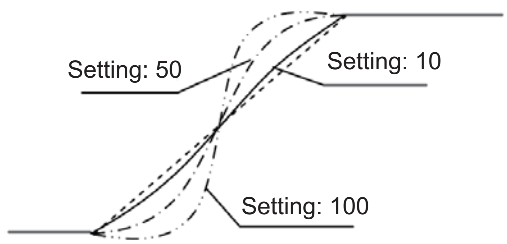
● S-motion Ratio Setting (No. 56, SCRV) <Effective only on the RACON>

Parameter No. 56 defines the slope of S-motion acceleration/deceleration to be applied when the value set in the “Acceleration/deceleration mode” field of the position table is “1 (S-motion).”
The setting unit is %, and the setting range is 0 to 100.
The factory setting is “0%” (S-motion is disabled).



In the S-motion mode, a sine wave is drawn where the acceleration time corresponds to one cycle.
Specify a desired amplitude level using parameter No. 56.

Setting of parameter No. 56 [%]	Amplitude level	
0 [Factory setting]	No S-motion	(dotted line in the figure below)
100	Sine wave amplitude x 1	(two-dot chain line in the figure below)
50	Sine wave amplitude x 0.5	(one-dot chain line in the figure below)
10	Sine wave amplitude x 0.1	(solid line in the figure below)



● Position Feed-Forward Gain (no. 71, PLFG) <Effective only on the RACON>

Parameter No.	Unit	Input range	Default
71	-	0 to 100	0

This parameter sets the feed-forward gain of the position control system.
When this parameter is set, the servo gain will increase and the response of the position control loop will improve.
Use this parameter if you want to improve the response of a system of low mechanical rigidity or mechanical system with a large load inertia ratio.
As a guide, set a value between 10 and 80. Increasing the setting value reduces the deviation and improves the response.
If an excessively large value is set, however, vibration or noise may occur.

● Default Stop Mode (No. 53, HSTP2) <Effective only on the RPCON>

This parameter defines the power-saving mode to be applied when the actuator stands by for a long period while the facility is operating.
This parameter is effective only on the RPCON.
Whether or not to use the power-saving mode is defined by parameter No. 53.

	Setting value
Disable the power-saving mode	0
Full-servo control mode	4

The factory setting is “0 [Disable].”

Full-servo Control Method

The holding current can be reduced by servo-controlling the pulse motor.
Although the specific level varies according to the actuator model, load condition, etc., the holding current will decrease to approx. one-half to one-fourth.
Since the servo remains ON with this method, position deviation does not occur.
The actual holding current can be checked on the current monitor screen of the PC software.

- Current-limiting Value at Standstill after Missing Work Part in Push Operation (No. 91, PSFC)

This parameter defines the current-limiting value to be applied while the actuator is at standstill after missing the work in push operation.
The definition varies between RACON and RPCON controllers as shown below.

	RACON	RPCON	
		Standstill mode = Power-saving mode disabled	Standstill mode = Full-servo control
0	Current-limiting value during movement (3 times the rated motor current)	Current-limiting value at standstill in positioning operation (Value of parameter No .12)	Current-limiting value during movement (3 times the rated motor current)
1	Push-current limiting value	Push-current limiting value	Push-current limiting value

- Ball Screw Lead (No. 77, LEAD)

This parameter defines the ball screw lead.
Before shipment, this parameter has been set to a value appropriate for the characteristics of the actuator.
* Do not change the setting.

- Axis Operation Type (No. 78, ATYP)

This parameter sets whether the actuator is a linear operation axis or rotational operation axis.
0: Linear operation axis
1: Rotational operation axis

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

This parameter sets the rotational operation mode when the axis operation type is set to “rotational operation axis” (Parameter No. 78 = 1).
0: Normal mode
1: Index mode

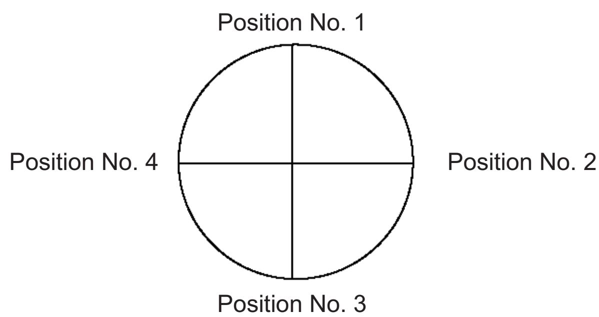
[Normal Mode]
Multi-rotational operation can be performed in a range of -9999.99 deg to 9999.99 deg.

[Index Mode]
Rotational operation can be performed in a range of 0 to 359.99 deg.

⚠ Caution

Push operation cannot be performed in the index mode. Even if push data is input in the position table, the data will be ignored and the actuator will perform normal movement. The positioning band will conform to the setting of the default positioning band parameter.

● Rotational Axis Shortcut Selection (No. 80, ATYP)
Select the shortcut mode if the actuator is a rotational axis operating in the index mode and you want to rotate the actuator in the direction closer to the target position.
0: Do not select
1: Select
By selecting the shortcut mode, you can rotate the rotational axis in a specific direction.
This is explained using an example of position table operation.



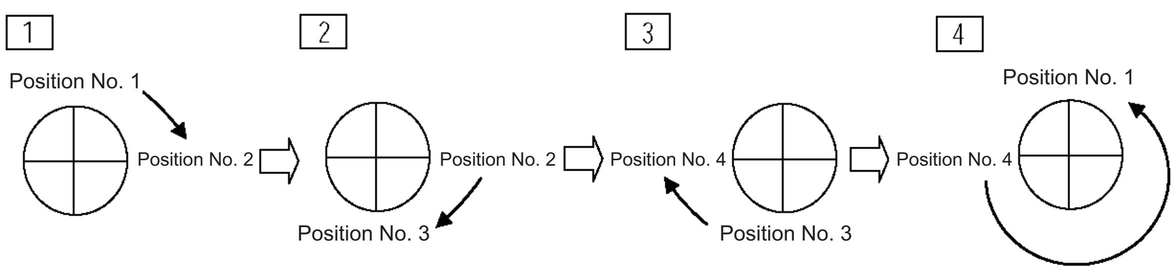
Position table

Position No.	Position data
1	0
2	90
3	180
4	270

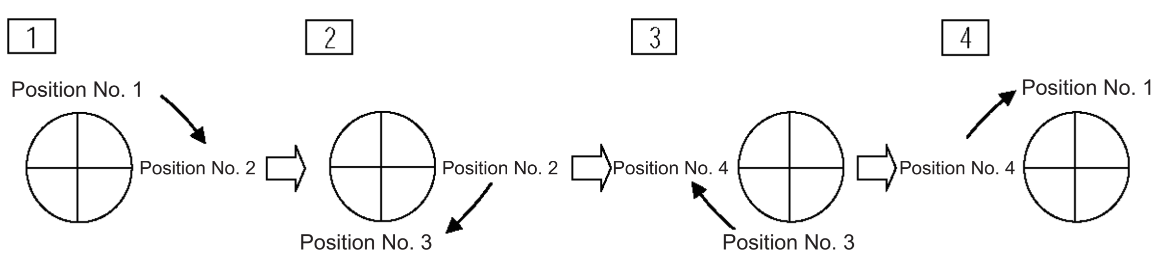
With position data, 1° corresponds to 1 mm.

If the actuator is moved sequentially from position No. 1 to Nos. 2, 3 and 4, the operation will differ as follows depending on whether or not the shortcut mode is selected. To be specific, while the actuator will reverse its direction to move from position No. 4 to No. 1 when the shortcut mode is not selected, it will move in the same direction from the 270° position to 360° (0°) position when the shortcut mode is selected.

When the shortcut mode is not selected



When the shortcut mode is selected



● Use Absolute Unit (No. 83, ETYP)
This parameter is set when a simple absolute R unit is connected.
0: Do not use
1: Use

[Various Settings for Rotational Operation Axis and Operation Details]

The list below summarizes the operation details of a rotational operation axis.

Axis operation type (No. 78)	Rotational axis mode selection (No. 79)	Rotational axis shortcut selection (No. 80)	Encoder system		Current position display range	Absolute position command range	Relative position command range	Soft limits (+, -)	Push operation
			ABS	INC					
0 Linear operation axis	Disable	Disable	○	○	-9999.99° to +9999.99°	0.15° to +9999.5°	-9999.30° to +9999.30°	Enable	○ Possible
1 Rotational operation axis	0 Normal mode	Disable	○	○	-9999.99° to +9999.99°	-0.15° to +9999.15°	-9999.30° to +9999.30°	Enable	○ Possible
	1 Index mode	0 Do not select	○	○	0° to +359.99°	0° to +359.99°	-360.00° to +360.00°	Disable	X Not possible
		1 Select							

⚠ Caution

[1] When the controller unit is started, the soft limits are automatically set to 0° for the – soft limit and +359.99° for the + soft limit in the controller, and accordingly the parameter settings will be ignored. A soft limit error will not occur.
[2] With relative position commands, the actuator will not perform rotational operation by shortcut even when the shortcut mode is selected.
[3] Push operation cannot be performed. Even if push operation is set by position data, the actuator will still perform normal rotational operation. In this case, the positioning band will conform to the default positioning band.
[4] In jogging and inching operations, the maximum rotation angle supported in each command is one revolution (up to 360°).
[5] The encoder resolution (deg/pulse) is determined by the gear ratio (or ball screw lead) and encoder pulse count, and may reach or exceed 0.01 deg/pulse. If the encoder resolution is 0.01 deg/pulse or more, an error will generate between the position complete position and target position.

4.4.4 Parameters Relating to External Interface

● Position complete Signal Output Mode (No. 39, PEND)

This parameter defines the status of the position complete signal when the servo is turned OFF or a "position deviation" occurs while the actuator is stopped after position complete.
The parameter considers the following two conditions:
[1] The actuator position has deviated beyond the specified value of "positioning band" due to an external force applied when the servo was ON.
[2] The actuator position has deviated beyond the specified value of "positioning band" due to an external force applied when the servo was OFF.
This is to provide flexibility as to how the "position complete status" should be monitored according to the characteristics of the equipment or configuration of the PLC's sequence circuit.
In particular, it is recommended that this parameter be set to "1 [INP]" if the actuator is operated like an air cylinder and you want to use the position complete signal as an auto switch.
The ON/OFF status of the position complete signal varies as follows depending on the setting of parameter No. 39.

Setting value of parameter No. 39	Description
0 [PEND]	[1] When the servo is ON The position complete signal will remain ON even after the current position exits the range of the "positioning band" set for the target position. [2] When the servo is OFF The position complete signal is always OFF unconditionally, regardless of the current position.
1 [INP]	Regardless of whether the servo is ON or OFF, the position complete signal is ON when the current position is inside the range of the "positioning band" set for the target position, and OFF when the current position is outside the range. This parameter functions like an auto switch for an air cylinder.

The factory setting is "0 [PEND]."

4.4.5 Parameters Relating to Servo Gain Adjustment

Since the servo has been adjusted at the factory to stabilize positioning operation at the maximum payload capacity of the actuator, the servo gain need not be changed in normal conditions of use.
In actual use, however, the load condition may not be always ideal (where there is no resonance, vibration, load fluctuation, etc.)
Accordingly, vibration or noise may occur depending on how the actuator is affixed, load condition, and so on, in which case servo adjustment will become necessary.
Particularly with custom models (whose ball screw lead or stroke is longer than that of the standard model), vibration/noise may occur due to external conditions.
In this case, the following parameters must be changed. Contact IAI for details.

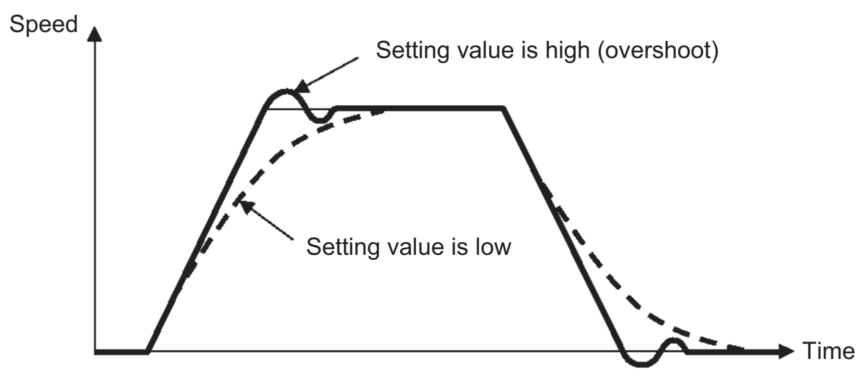
Note

Check the following items before performing servo adjustment:
1. Is the load installed in a manner free from looseness, play, etc., and is the load rigidity maximally maintained?
2. Is the actuator installed firmly?
3. Is the actuator mounting surface free from distortion?

● Servo Gain Number (No. 7, PLG0)

Parameter number	Unit	Input range	Default
7	5 rad/sec	0 to 15	Set individually in accordance with the actuator characteristics.

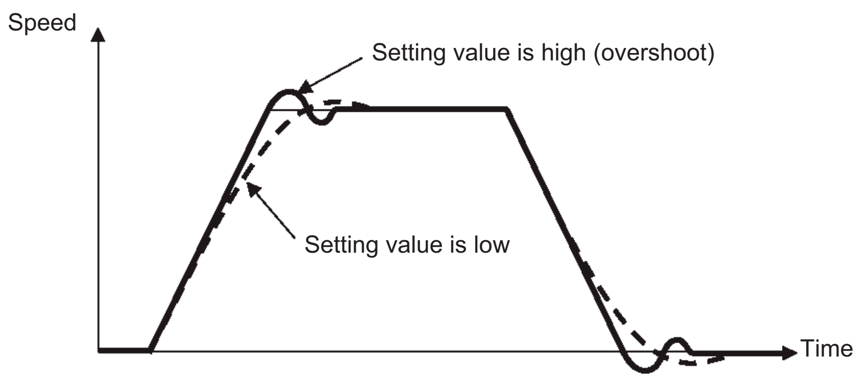
This parameter determines the level of response with respect to a position control loop.
Increasing the setting value improves compliance with the position command.
However, increasing the setting value too much increases the tendency of the actuator to overshoot.
If the setting value is low, compliance with the position command drops and the positioning time increases as a result.



- Speed Loop Proportional Gain (No. 31, VLPG)

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

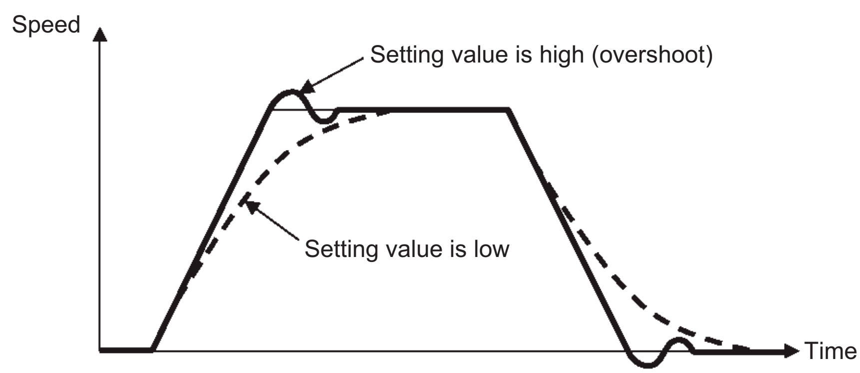
This parameter determines the level of response with respect to a speed control loop.
Increasing the setting value improves compliance with the speed command (i.e., servo rigidity increases).
The greater the load inertia, the higher the setting value should be.
However, increasing the setting value too much increases the tendency of the actuator to overshoot or oscillate, resulting in increased mechanical vibration.



- Speed Loop Integral Gain (No. 32, VLPT)

Parameter number	Unit	Input range	Default
32	-	1 to 217270	Set individually in accordance with the actuator characteristics.

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



- Torque Filter Time Constant (No. 33, TRQF)

Parameter number	Unit	Input range	Default
33	-	1 to 2500	Set individually in accordance with the actuator characteristics.

This parameter determines the filter time constant applicable to the torque command.
If the mechanical resonance frequency is equal to or lower than the servo loop response frequency, the motor will vibrate.
This mechanical resonance can be suppressed by increasing the setting of this parameter.
It should be noted, however, that increasing the setting too much may affect the stability of the control system.

- Current Control Band Number (No. 54, CLPF) <Effective only on the RACON>

Parameter number	Unit	Input range	Default
54	-	0 to 7	Set individually in accordance with the actuator characteristics.

This parameter sets the control band of the PI current control system.

⚠ Caution

This parameter need not be changed in normal conditions of use, so the customer is advised not to change the setting.
If the setting is changed carelessly, the stability of the control system may be affected and a very dangerous condition may result.
If the actuator generates resonance noise, the noise can be suppressed by changing this parameter. Even in this case, however, always follow IAI’s instruction when changing this parameter.

4.5 Notes on ROBO Rotary

(1) Home Return Direction

The moving end of the output axis in counterclockwise direction becomes the home position.
Actuators of multi-rotational specification can be ordered with their rotating direction reversed. On these reverse rotation models, the home return direction corresponds to the clockwise direction.

Caution

If the home return direction of the delivered actuator is changed by a parameter, the home return direction will be reversed, but the home position will deviate due to the structure of the actuator.
Do not change the home return direction parameter.

(2) Operation (Position Setting) Range

The position value is determined by the angle of movement from the home position.

- 330°-rotation Specification: The position specification range is 0 to 330°.

- Multi-rotational Specification: The position specification range is as follows.

Mode	Absolute position specification	Relative position specification
Rotational axis, normal mode	-0.15 to +9999.15	-9999.30 to +9999.30
Rotational axis, index mode	0 to 359.99	-360.00 to +360.00

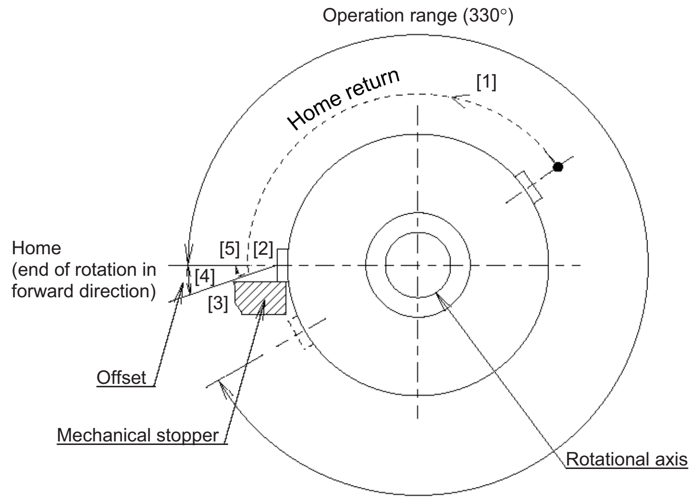
(3) Angular Velocity and Acceleration/Deceleration Command

The rotational angle command is based on angular velocity (deg/sec).
In programs, acceleration/deceleration is specified in “G.”
Rated angular acceleration/deceleration: 0.3 G = 2940 deg/sec.

(4) Home Return Operation

■ 330°-rotation Specification

[1] Start of home return → [2] Detection of a mechanical stopper → [3] Reversing → [4] Movement by the offset → [5] Home position

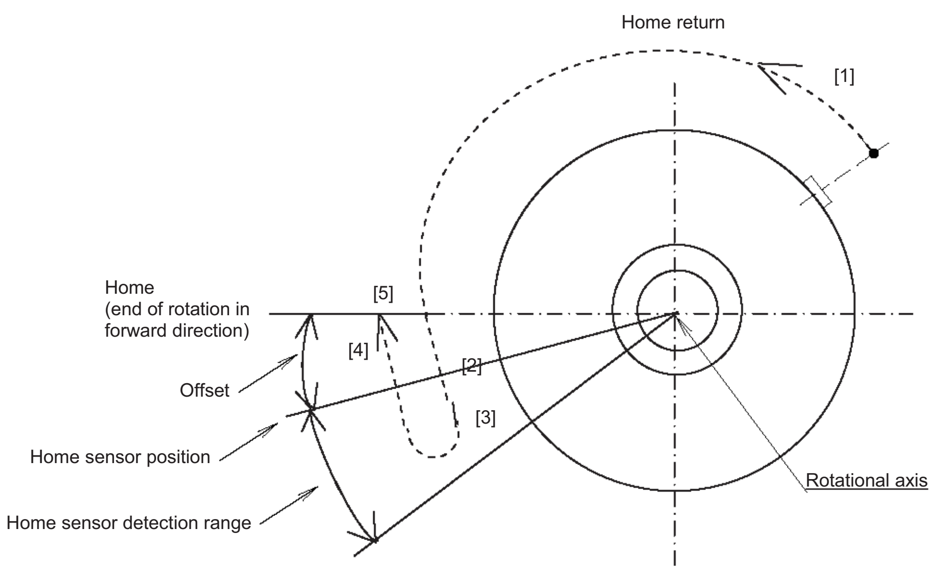


330°-rotation specification RTB/RTC

■ Multi-rotational Specification

[1] Start of home return → [2] Detection of a home sensor signal (Contact B: Leading edge of the signal or detection of the signal ON status) → [3] Reversing → [4] Detection of a home sensor signal (Contact B: Leading edge of the signal or detection of the signal OFF status) → [5] Movement by the offset → [5] Home position

* If home return operation is started within the home sensor detection range, the actuator will move out of the home sensor detection range and then perform home return operation.



Multi-rotational specification RTBL/RTCL

4.6 Notes on ROBO Gripper

(1) Finger Operation

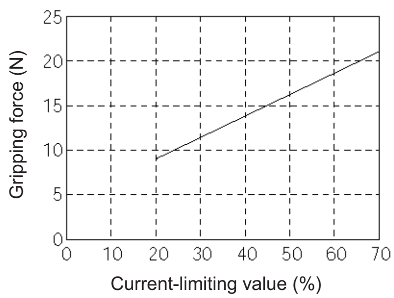
[1] Definition of position
The home of each finger is where the finger is open. The position command specifies the travel distance of each finger from its home position toward the closing side.
Accordingly, the maximum command value is 5 mm for the GRS type and 7 mm for the GRM type.
With the 2-finger type, the specified stroke indicates the sum of travel distances of both fingers.
In other words, the travel distance per finger is one-half the stroke.

[2] Definition of speed and acceleration
Both the speed and acceleration commands apply to one finger.
With the 2-finger type, the relative speed and acceleration are twice the command values.

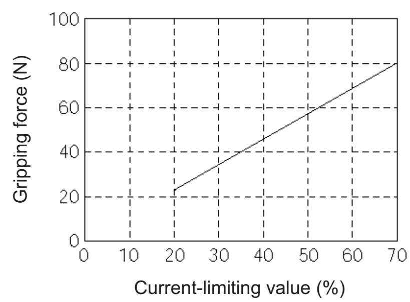
[3] Gripper operation mode
In applications where the work part is gripped using the ROBO Gripper, be sure to use the actuator in the "push mode."
(Note) If the actuator is used in the "positioning mode," a servo error may generate while the work part is gripped.

[Diagram of gripping force and current-limiting value]

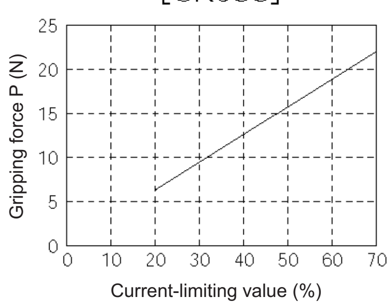
[GRS]



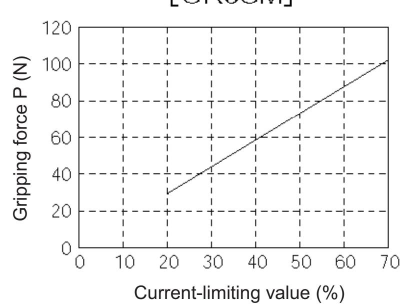
[GRM]



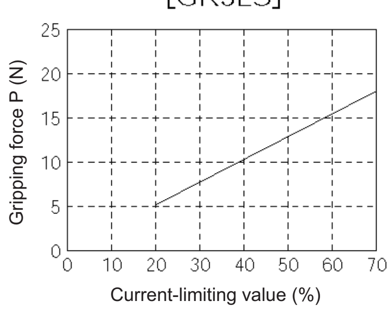
[GR3SS]



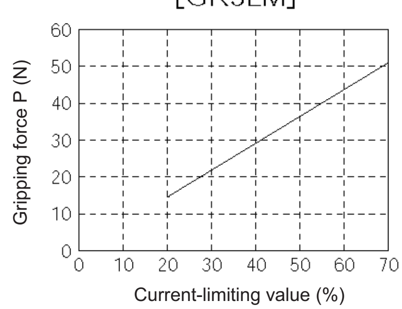
[GR3SM]



[GR3LS]



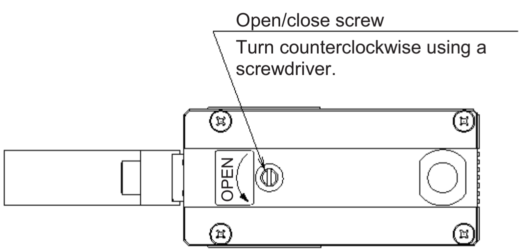
[GR3LM]

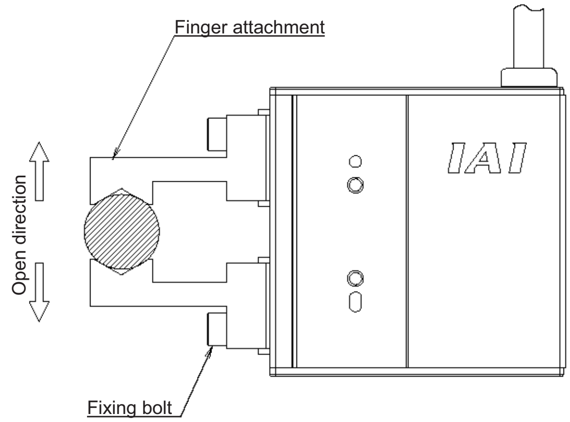


(2) Removing the Gripped Work Part

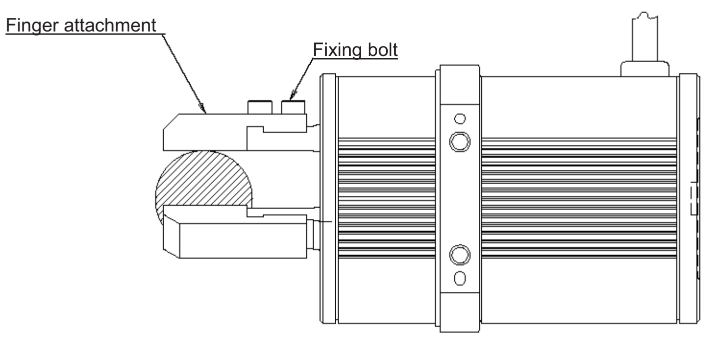
This gripper is structured so that the work part-gripping force will be maintained by a self-lock function even after the servo is turned OFF or the controller power is cut off.
If the gripped work part must be removed while the power is cut off, turn the open/close screw or take out one finger attachment to remove the work part.

[2-finger Type]
Turn the open/close screw or take out one finger attachment.





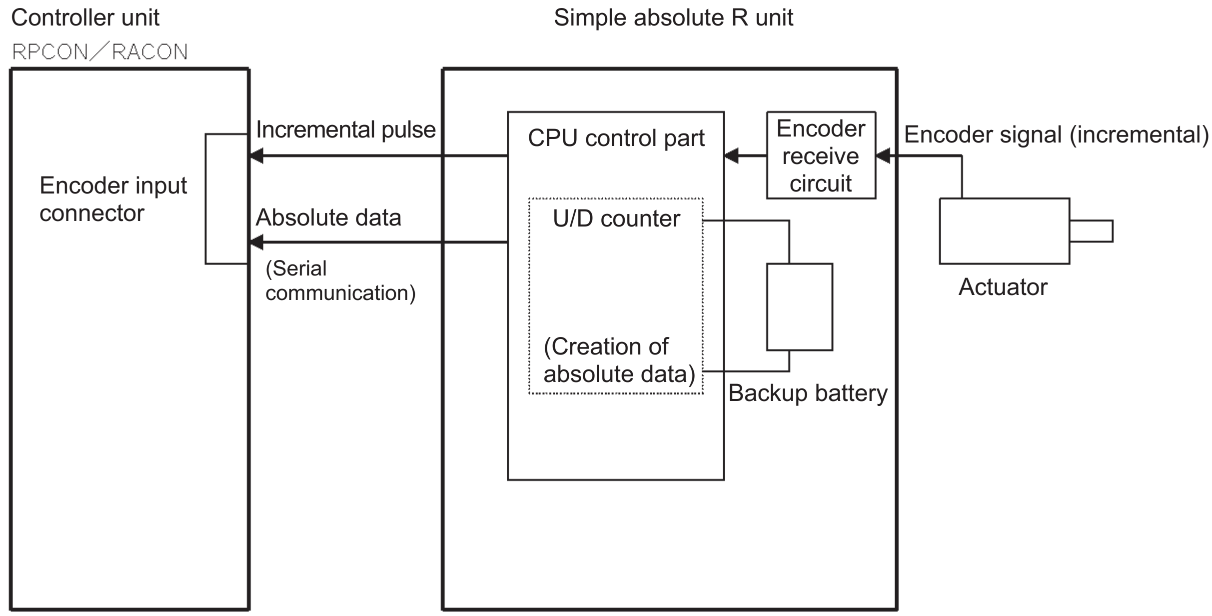
[3-finger Type]
Take out one finger attachment.



Chapter 5 Simple Absolute R Unit

5.1 Overview

RPCON and RACON controller units can be used as absolute axes by connecting a simple absolute R unit. If the controller unit is used as an absolute axis, home return will not be necessary once an absolute reset is performed, even after the controller unit power is turned OFF.



5.2 How to Read the Model Name

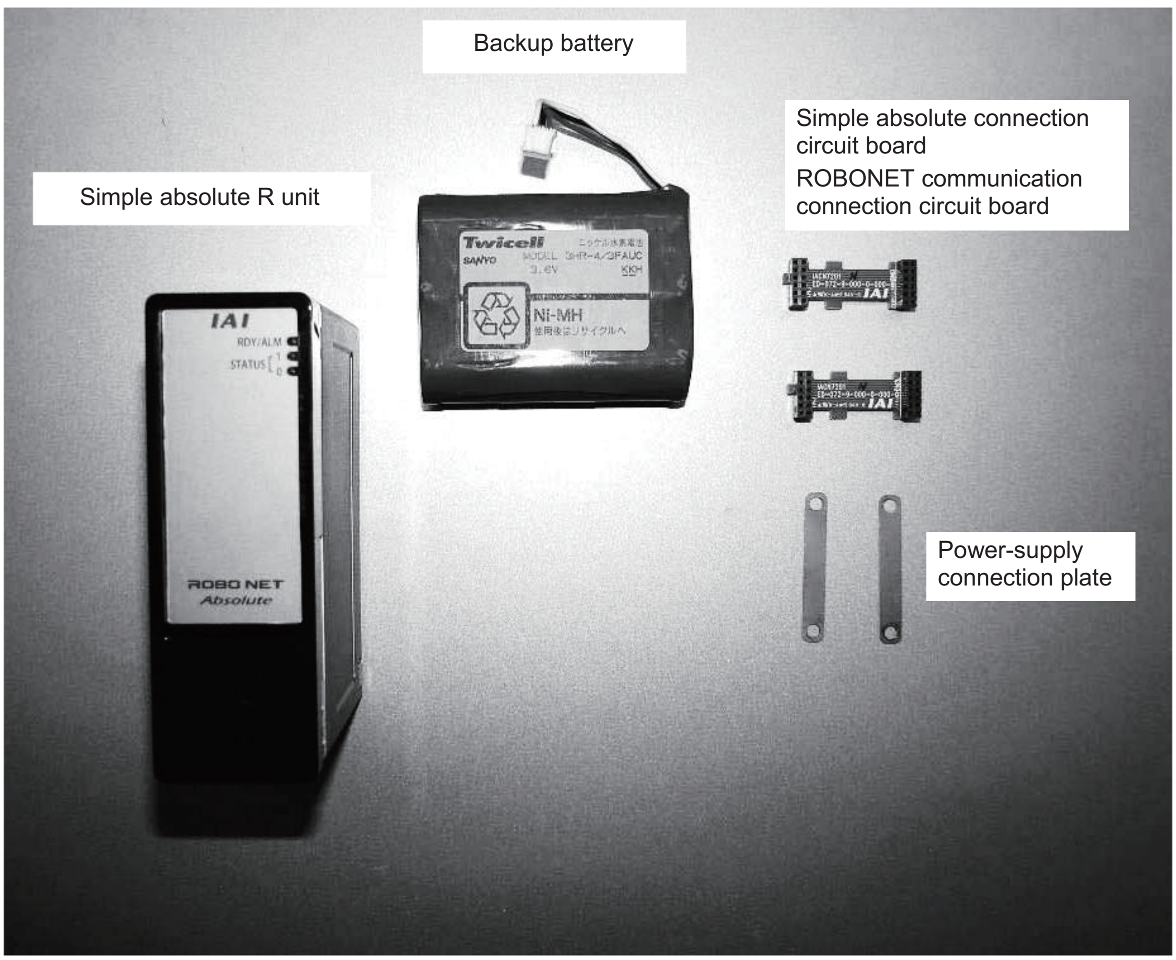
RABU

<Base model>
Simple absolute R unit (common to the RPCON and RACON)

<Configuration of Simple Absolute R Unit>

Simple absolute R unit:	RABU (backup battery included)	
Backup battery:	Model AB-7, 1 unit	Supplied
(Simple absolute connection circuit board), ROBONET communication connection circuit board:	Common model JB-1, 2 units	Supplied
Power-supply connection plate:	Model PP-1, 2 pcs	Supplied

The simple absolute connection circuit board is used to connect the simple absolute R unit to the controller unit.
The simple absolute connection circuit board is the same as the ROBONET communication connection circuit board (JB-1).



5.3 Specifications

5.3.1 General Specifications

Model	RABU	
Power-supply voltage	24 VDC ± 10%	
Power-supply current	MAX 300 mA	
Environment	Ambient operating temperature	0 to 40°C
	Ambient operating humidity	95% RH max. (non-condensing)
	Operating ambience	Free from corrosive gases and dust.
	Surrounding storage temperature	0 to 40°C (If a battery is included, approx. 20°C is desired.)
	Surrounding storage humidity	95% RH max. (non-condensing)
	Vibration resistance	XYZ directions: 10 to 57 Hz, half amplitude – 0.035 mm (continuous) 0.075 mm (intermittent) 57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)
Impact resistance	XYZ directions: 147 mm/s^2, 11 ms, half-sine wave pulse	
Protection degree	IP20	
Weight	330 g (including the backup battery)	
Outer diameter	34 W x 105 H x 73.3 D [mm]	

5.3.2 Backup Battery

The absolute specification uses a secondary battery (nickel hydrogen battery) to retain absolute counter data in the FPGA and supply power to the encoder drive circuit even when the power is cut off.

(1) Battery Specifications

Item	Description
Classification	Cylindrical sealed nickel hydrogen battery
Manufacturer	Sanyo Electric Co., Ltd.
Model	AB-7
Nominal voltage	3.6 V (1.2 V x 3)
Rated capacity	3300 mAh
Average life	3 years
Weight	190 g
Charge time	Approx. 72 hours (continuous)

(2) Charging the Battery
Always charge the battery when starting the delivered unit and after replacing the battery.
The battery is charged automatically when the controller power is supplied, so keep the main power supply on for at least 72 hours.
The actuator can be moved and the position table changed while the battery is charging. Also charge the battery continuously for at least 72 hours after the power has been cut off for a prolonged period (but within the specified battery retention time).
For the specified battery retention time, refer to "Setting switches" in 5.4.2.

(3) Replacing the Battery
The battery is a consumable part. Repeated charges will cause the battery characteristics to deteriorate. If you notice that the battery becomes low very quickly, the battery has probably reached its life. In this case, replace the battery.
Although the replacement interval varies depending on the ambient temperature and discharge condition, as a guide the battery should be replaced after approx. 3 years of connecting to the controller.
The battery unit has a label that specifies the date three years from the shipment date. Use this date as a guide.

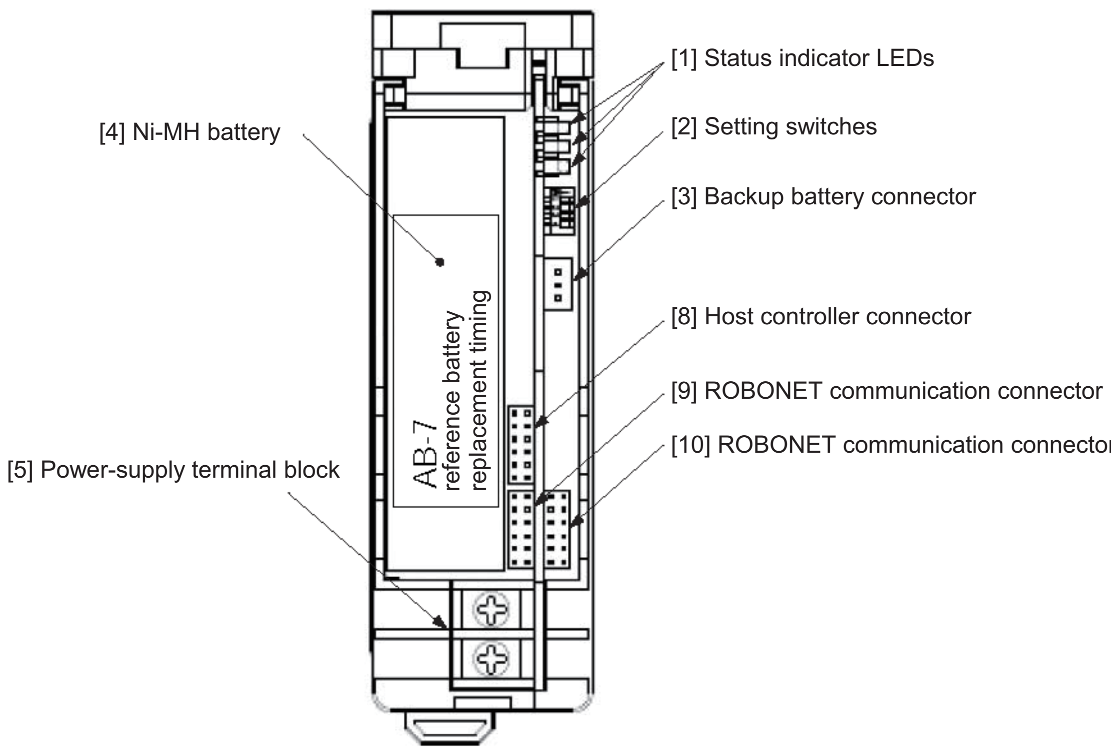
⚠ Caution

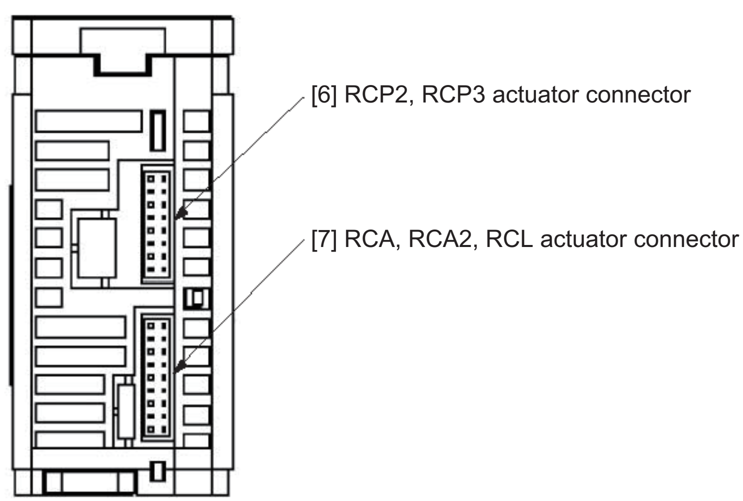
(1) Applying vibration, impact, etc., to the actuator or moving the slider, etc., while the power is cut off may cause loss of absolute data.
If the RDY/ALM LED and STATUS 1 LED on the front panel of the simple absolute R unit illuminate in green and red, respectively, the next time the power is turned on, an absolute encoder error has occurred. In this case, an alarm reset and home return must be performed.
Do not move the slider or rod while the power is cut off.
(2) Since the charge efficiency is particularly affected by the ambient temperature during charge, it is recommended that the unit be used at normal temperature (+10 to +30°C).
If the ambient temperature exceeds 45°C, the charge efficiency will drop and the battery will not be charged fully. What is worse, lower battery performance or leakage of battery fluid may also occur.

5.4 Name/Function of Each Part and External Dimensions

5.4.1 Name of Each Part

Front view





Down view

5.4.2 Functions

[1] Status indicator LEDs

RDY/ALM		Indicator color
Steady green	Steady red	System normal
○	-	
-	○	System error (alarm)
Blinking green	Blinking red	Update mode
○	○	

STATUS 1		Operation
Steady green	Steady red	
○	-	Absolute reset completed (RDY: steady green light)
-	○	Absolute reset not yet completed (RDY: steady green light)
-	○	FPGA communication error (RDY: steady red light)

STATUS 0			Operation
Steady green	Steady orange	Steady red	
○	-	-	Battery is fully charged *
-	○	-	Battery charging
-	-	○	Battery not connected

* A green LED comes on when the battery has been charged continuously for 72 hours or the battery voltage exceeds 4.25 V.
If the simple absolute R unit is connected to the controller unit, a steady green light will come on when the battery is fully charged.
If the simple absolute R unit is not connected to the controller unit, a steady green light will not come on even when the battery is fully charged.

[2] Setting switches

These switches are used to switch the speed setting and update mode.
(The switches are arranged in the order of 1, 2, 3 and 4, from the top.)

Switch	Function
1	Speed setting switch 1
2	Speed setting switch 2
3	Update mode selector switch (Keep this switch in the “OFF” position.)
4	Model selector switch (Keep this switch in the “ON” position.)

[Speed Selector Switch Settings]
The maximum motor speed at which absolute data can be detected is set as one of four levels while the controller power is turned OFF.

Setting Switch		Encoder Max. Rotation Speed [rpm]		Battery Retention Time (reference)
1	2	When the connected actuator is a model other than RCA2-***N;	When the connected actuator is RCA2-***N;	
OFF	OFF	100	75	20 days
ON	OFF	200	150	15 days
OFF	ON	400	300	10 days (Default setting)
ON	ON	800	600	5 days

⚠ Caution

1. The above backup battery retention times are reference values based on use of the supplied battery at normal temperature and when operations within the specified speed are performed only sporadically and for a short period of time or when the actuator is not operated at all.
   Even if the specified speed is not exceeded, the battery will be consumed faster if the actuator is operated continuously.
2. If the motor is turned at the specified speed or above when the controller power is OFF, absolute data will be lost.

[Update Mode Selector Switch]

Switch	Function
3	
ON	Update mode
OFF	Normal

Normally the setting need not be changed. Keep this switch in the OFF position.

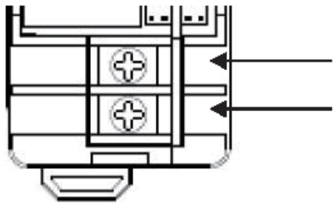
[Model Selector Switch]

Switch	Function
4	
ON	Keep this switch in the ON position (default setting).
OFF	-

[3] Backup battery connector
This connector is used to connect the absolute-data backup battery.

[4] Ni-MH battery
A space is provided to store the absolute-data backup battery.

[5] Power-supply terminal block



Use the supplied power-supply connection plate to connect to the power-supply terminal block of the paired controller.

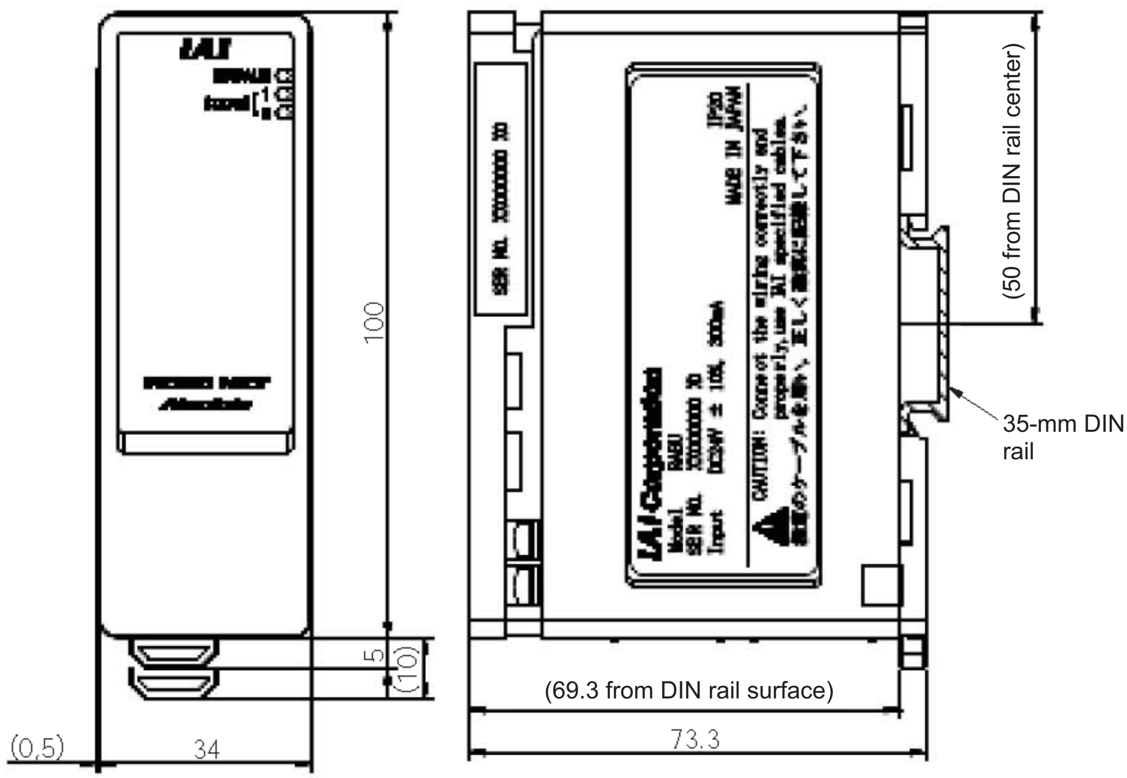
[6] RCP2 connector (white)
This connector is used to connect the PG cable of the RCP2 actuator.

[7] RCA connector (red)
This connector is used to connect the PG cable of the RCA actuator.

[8] Host controller connector
This connector enables encoder feedback to the host controller and serial communication of absolute data.

[9], [10] ROBONET communication connectors
These connectors are used to connect ROBONET communication (RS485 SIO) signals by the multi-drop method.
Although the simple absolute unit does not use communication signals, it exchanges signals with the adjoining controllers.
The supplied ROBONET communication connection circuit board is used to connect to the controller.

5.4.3 External Dimensions



5.5 Notes

(1) Notes on Changing Parameters
If the following parameters are changed, an absolute error will occur. Accordingly, an absolute reset must be performed after changing any of these parameters:
[1] Parameter No. 5, “Home return direction”
[2] Parameter No. 22, “Home return offset”
[3] Parameter No. 77, “Ball screw lead”
[4] Parameter No. 78, “Axis operation type”

(2) Handling of the Backup Battery
Strictly observe the following safety precautions:

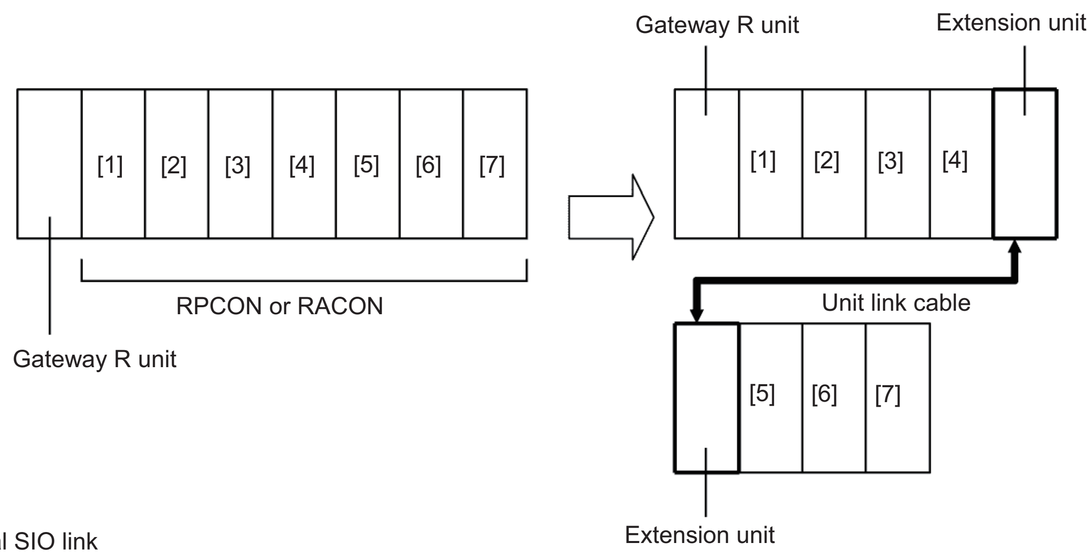
[1] Never disassemble the battery. The electrolyte in the battery is a strong alkaline fluid that may damage the skin or clothes.
[2] Never short the battery (by causing the + terminal and – terminal to directly contact each other). Doing so may damage the equipment or cause burns due to generated heat.
[3] Never throw the battery into fire because the battery may explode.
Also avoid immersing the battery in water because the battery function may be lost.
[4] Do not solder the battery directly.
If the safety valve in the battery cap is damaged, the battery may explode.
[5] If the power to the battery is cut off for a prolonged period and the battery undergoes deep discharge while the connector remains plugged, battery fluid may leak or the battery performance or life may drop significantly.
If the power to the battery will be cut off for a prolonged period due to relocation or modification of the equipment, etc., unplug the connector.
[6] When disposing of the battery, take an appropriate course of action such as dropping it into the collection box at a recycle shop.

Chapter 6 Extension unit

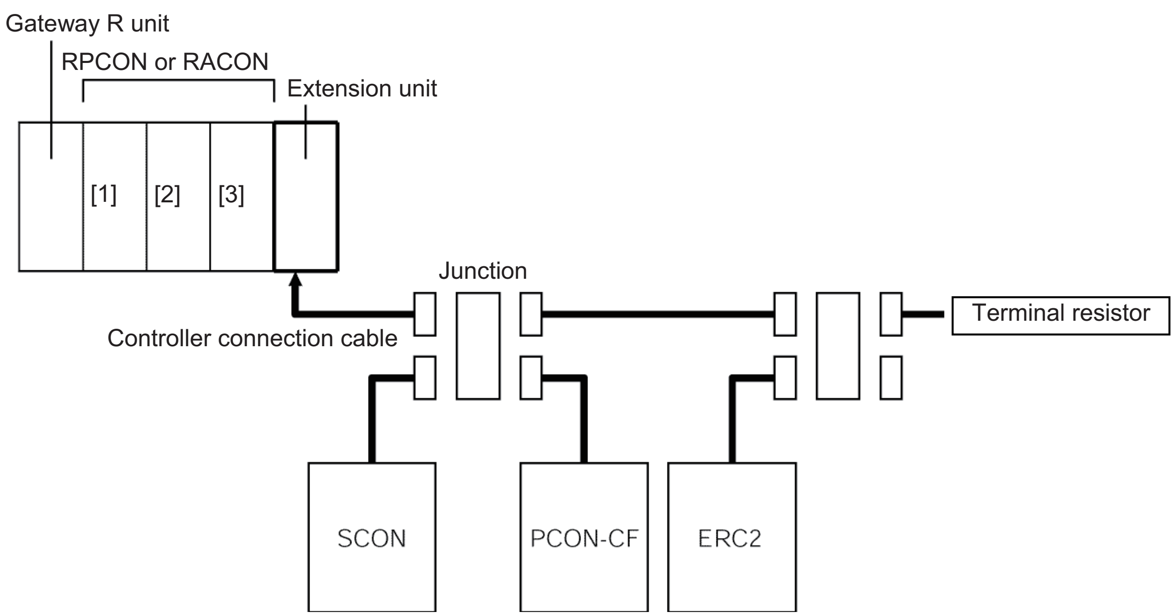
6.1 Overview

Basically, a ROBONET system is used by installing a Gateway R unit in the far left position and arranging RPCON and/or RACON controller units along a single line to its right. However, the controllers may not be arranged in a single line due to physical limitations such as the width of the control panel. In this case, you can use extension units (optional) to arrange the controllers in multiple lines (= multi-stage layout).
Also note what while the RPCON and RACON are specified as the standard controller units that can be used in ROBONET systems, you can use extension units to also configure a ROBONET system combining SCON (positioner mode), PCON-CF and/or ERC2 controller units (= external SIO link).

(1) Multi-stage layer of ROBONET system



(2) External SIO link



6.2 Specifications

Model	REXT (main unit)	
Power-supply voltage	24 VDC ± 10%	
Power-supply current	MAX 100 mA	
Environment	Ambient operating temperature	0 to 40°C
	Ambient operating humidity	95% RH max. (non-condensing)
	Operating ambience	Free from corrosive gases and dust.
	Surrounding storage temperature	0 to 40°C
	Surrounding storage humidity	95% RH max. (non-condensing)
	Vibration resistance	XYZ directions: 10 to 57 Hz, half amplitude – 0.035 mm (continuous) 0.075 mm (intermittent) 57 to 150 Hz – 4.9 m/s^2 (continuous) / 9.8 m/s^2 (intermittent)
	Impact resistance	XYZ directions: 147 mm/s^2, 11 ms, half-sine wave pulse
Protection degree	IP20	
Weight	140 g (main unit only)	
Outer diameter	34 W x 100 H x 73.3 D [mm]	

⚠ Caution

The total distance from the Gateway R unit to the downstream SIO link must not exceed 30 m.
When selecting the unit link cables and controller connection cables, make sure the total distance of SIO link does not exceed 30 m.

6.3 Product Configuration

Name	Model	Description	Application	Figure
ROBONET Extension unit	REXT	• Main unit x 1 • Power-supply connection plate x 2 • Communication connection circuit board x 1	• For ROBONET multi-stage layout • For external SIO link	Figure 1
Unit reversing set	REXT-SIO	• Main unit x 2 • Power-supply connection plate x 2 • Communication connection circuit board x 1 • Unit link cable (standard, 1 m)	Setting of multi-stage layout	Figure 2
Controller connection set	REXT-CTL	• Main unit x 1 • Power-supply connection plate x 2 • Communication connection circuit board x 1 • Controller connection cable (standard, 1 m)	Setting of external SIO link	Figure 3
Unit link cable	CB-REXT-SIO□□□		Cable for interconnecting ROBONET extension units	Figure 4
Controller connection cable	CB-REXT-CTL□□□		SIO link connection cable	Figure 5

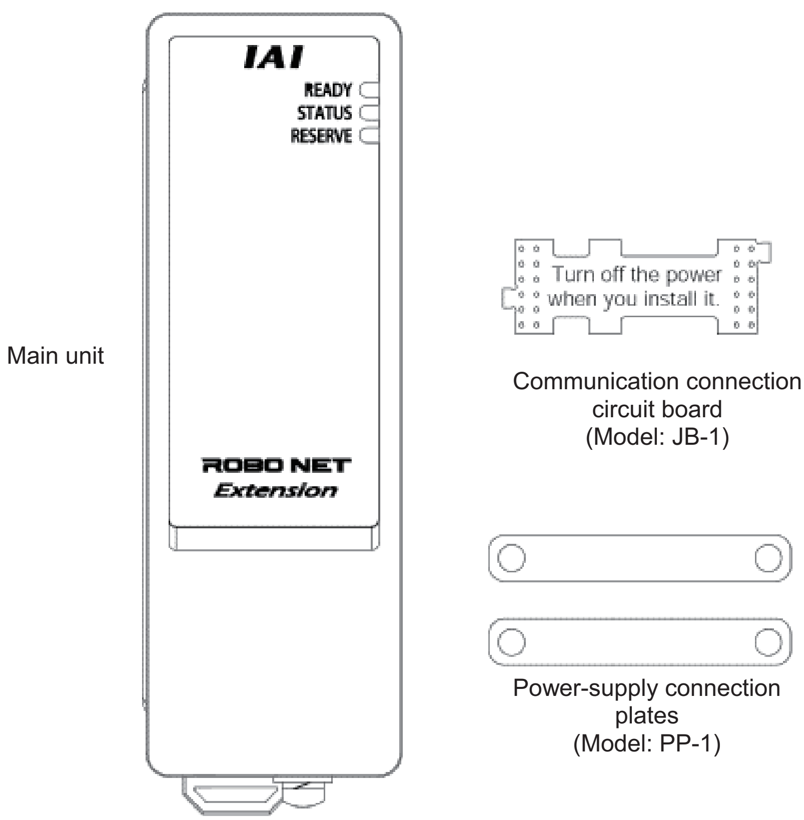


Fig.1 ROBONET Extension unit (REXT)

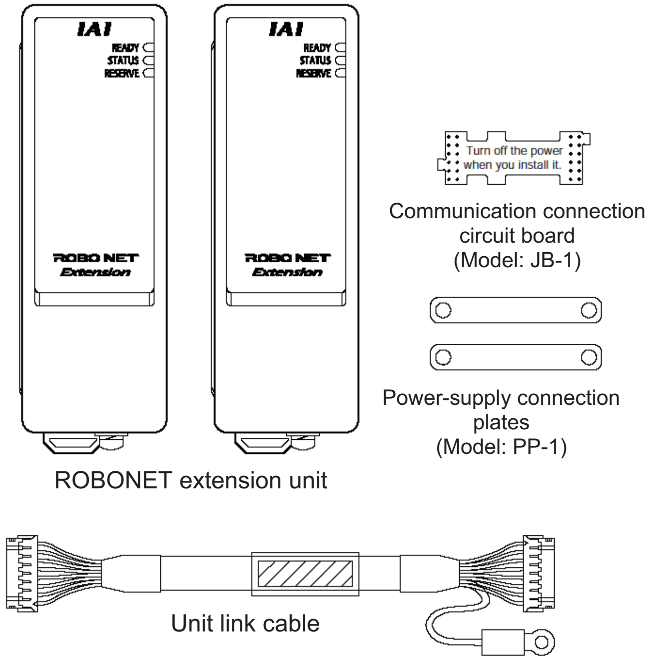


Fig 2 Controller connection set (REXT-SIO)

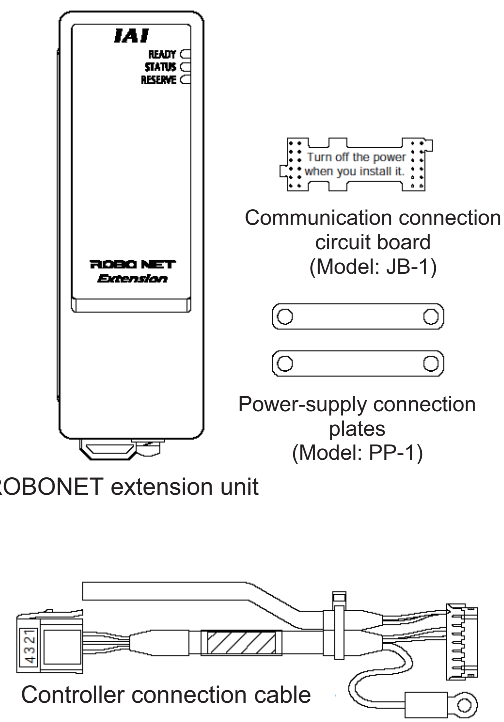
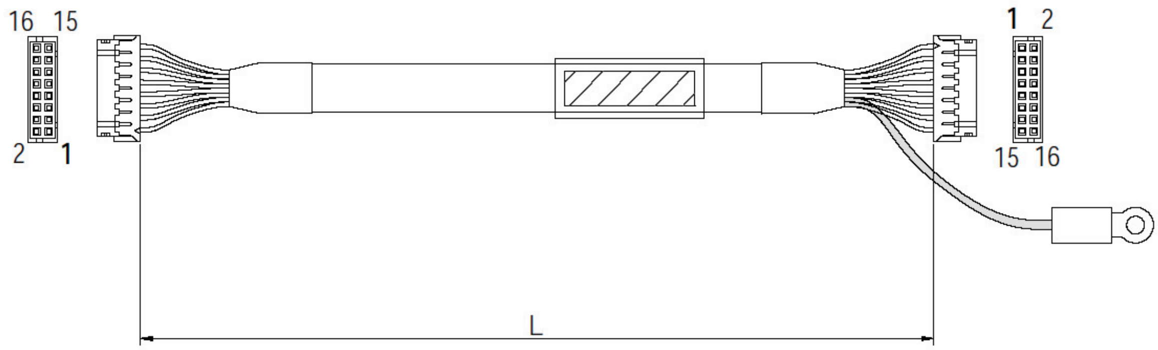
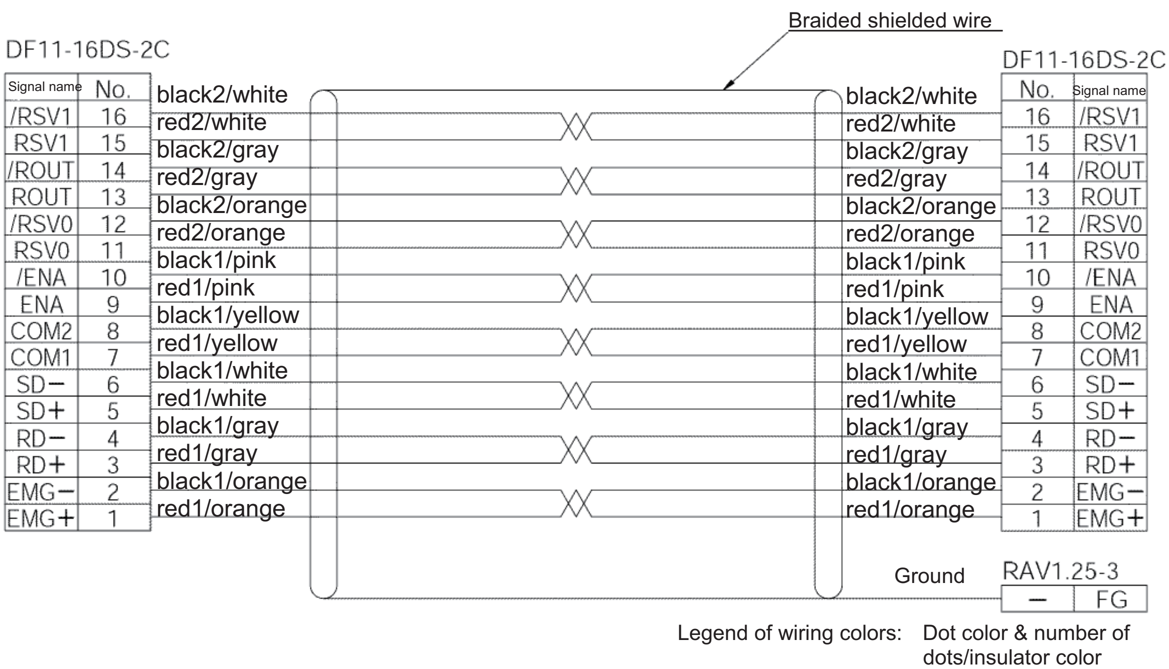


Fig 3 Controller connection set (REXT-CTL)



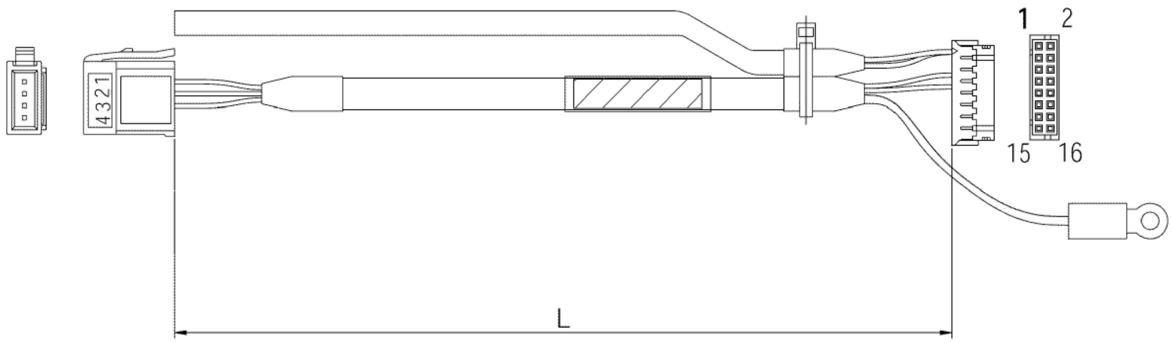
Harness Connection View



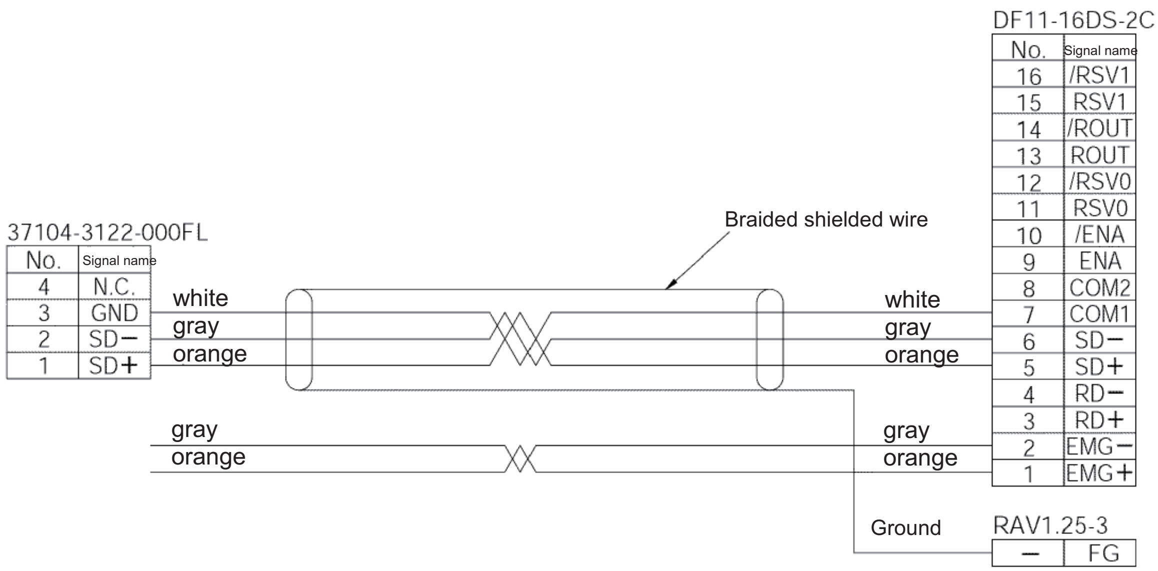
Connection Diagram

□□□ indicates the cable length (L).
Example) 010 = 1 m

Fig. 4 Unit link cable (CB-REXT-SIO□□□)



Harness Connection View



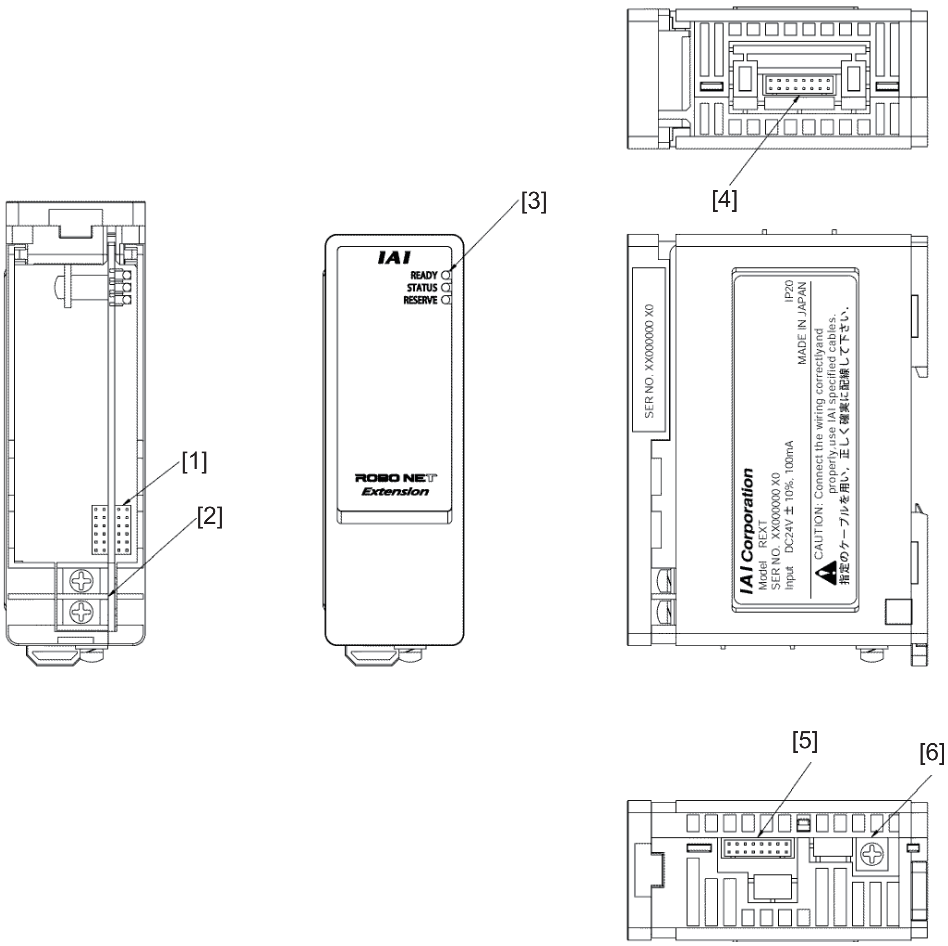
Connection Diagram

☐☐☐ indicates the cable length (L).
Example) 010 = 1 m

Fig. 5 Controller connection cable (CB-REXT-CTL☐☐☐)

6.4 Name of Each Part and External Dimensions

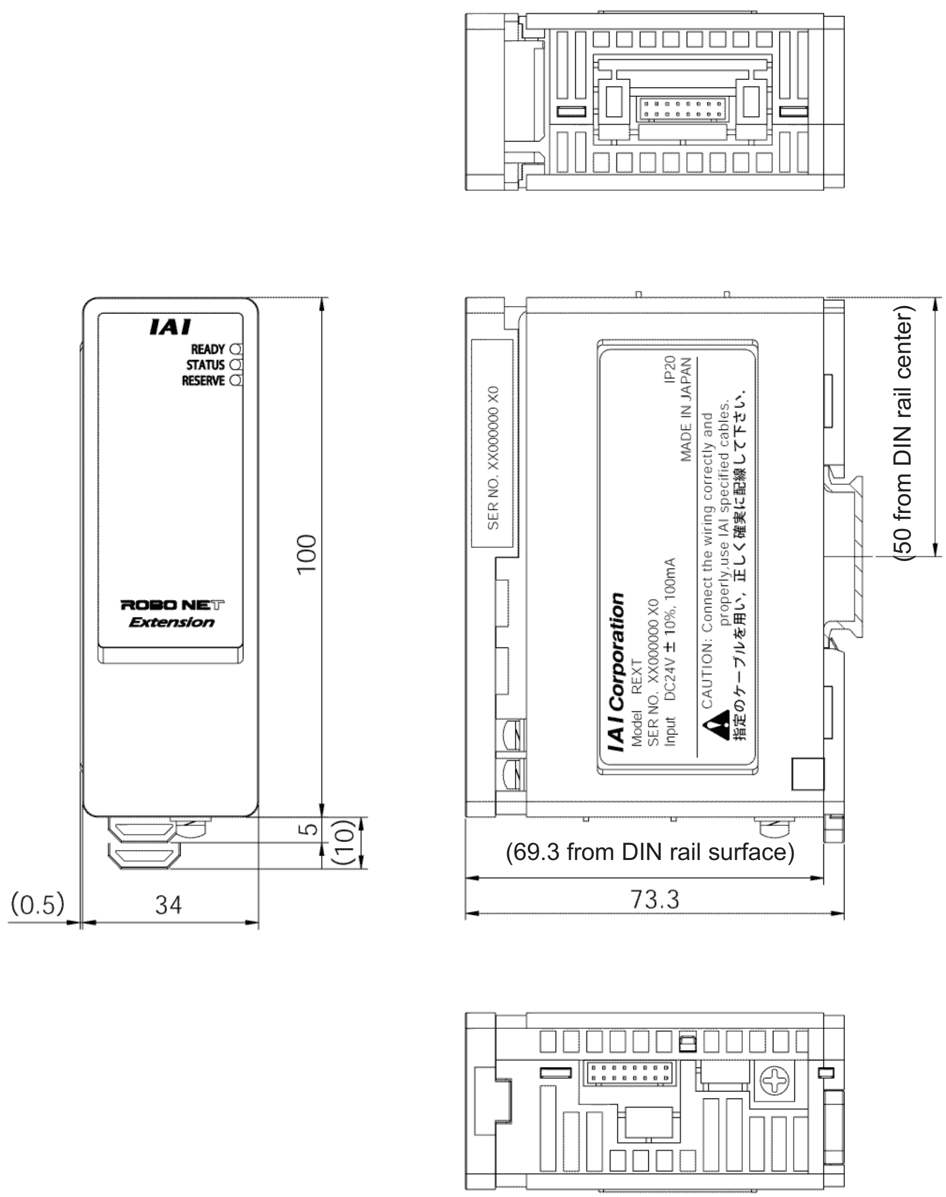
6.4.1 Name of Each Part



No.	Name	Description
[1]	ROBONET communication connector	This communication connector is used to connect a unit in the same row (same stage). It is connected using a ROBONET communication connection circuit board (JB-1).
[2]	Power-supply terminal block	These are 24-VDC input terminals for the unit. The top terminal is +24 V, while the bottom terminal is 0 V. To connect a power-supply wire, use a M3 round terminal of 6 mm or less in width. Connection with a unit in the same row (same stage) uses a power-supply connection plate (PP-1).
[3]	Indicator LEDs READY	This LED indicates the status of the internal power supply (5 V) of the unit. • Green light: Normal • Unlit: Internal power supply error
	STATUS	This LED indicates the connection statuses of connectors [4] and [5]. • Green light: Normal (Only one connector is connected.) • Red light: Abnormal (Both connectors are connected.) • Unlit: Abnormal (Neither connector is connected.) When used in the external SIO link connection, this LED is unlit.
	RESERVE	This LED is not used and remains unlit at all times.

No.	Name	Description
[4]	Upstream unit connector	This connector is used to connect a group of upstream units (units in the upper stage) using a unit link cable (CB-REXT-SIO).
[5]	Downstream unit connector	This connector is used to connect a group of downstream units (units in the lower stage) using a unit link cable (CB-REXT-SIO). To establish connection via external SIO link, use a controller connection cable (CB-REXT-CTL).
[6]	FG terminal block	This terminal block is used to connect grounding wires (M3 round terminals). It functions as a terminal block for connecting the shielded wire of the unit link cable (CB-REXT-SIO) or controller connection cable (CB-REXT-CTL).

6.4.2 External Dimensions



Part 2 Startup Chapter
Chapter 1 Overview

1.1 Required Tools

The tools needed to configure a ROBONET system and start the system include the PC software, teaching pendant, and ROBONET gateway parameter setting tool, as specified below.

[1] PC software RCM-101-** Version 6.00.04.00 or later
[2] Teaching pendant
- RCM-T/TD Version 2.06 or later
- RCM-E/P Version 2.08 or later
- CON-T/TD Version 1.00 or later

[3] ROBONET gateway parameter setting tool Version 1.0.2.0 or later
Setting of the positioner 2 mode, setting of the reserved axes and operation of files are supported when the version of the parameter setting tool is 1.0.3.0 or later. However, the firmware version of the Gateway R unit must be .000B or later at the same time.
Solenoid valve mode 1, solenoid valve mode 2 and special parameter functions are supported by parameter setting tools of version 1.0.4.0 and later. However, the firmware version of the Gateway R unit must be 000F or later.

This tool is provided in the CD-ROM containing PC software (Control No. CDCON00006 or later). You can also download the tool from our website.

1.2 Startup Procedure

The basic startup procedure for a ROBONET system is shown below.

(1) Installation (Refer to 2.1)
Mount on a DIN rail the Gateway R unit, controller unit and/or simple absolute R unit as required, interconnect the units, and install the units in a control panel.

↓

(2) Wiring (Refer to 2.2)
Wire the ROBONET 24-V power supply, field network, actuator drive line and encoder line.

↓

(3) Set the address of the controller unit (Refer to Chapter 3)

↓

(4) Perform an absolute reset (when the simple absolute R unit is used) (Refer to 4.2 to 4.5)
Perform an absolute reset to establish an absolute system.

↓

(5) Set up the ROBONET (Refer to 5.2)
Use the ROBONET gateway parameter setting tool to set the station number, baud rate, operation mode of each axis, etc.

↓

(6) Set up the master in the field network (Refer to 5.3)
Set various items using a dedicated tool appropriate for each field network.

↓

(7) Create a controller position table (Refer to 5.4)
(Positioner mode or simple direct mode)

↓

(8) Create a PLC ladder sequence

↓

(9) Trial operation

↓

(10) Full-scale operation

Chapter 2 Mounting and Installation

2.1 Installation

2.1.1 Important Information and Items to Note

To enhance the reliability of your ROBONET and allow it to demonstrate its functions fully, consider the following items before installing the ROBONET.

(1) Installation location

Do not install the ROBONET in any of the following locations:

[1] Where the ambient temperature drops below 0°C or rises above 40°C
[2] Where the relative humidity exceeds 95%RH
[3] Where condensation may occur due to sudden temperature shift
[4] Exposed to corrosive or flammable gases
[5] Exposed to a large amount of dust, salt or iron powder
[6] Exposed to splashes or mist of water, oil or chemicals
[7] Where the ROBONET may receive direct vibration or impact
[8] Exposed to direct sunlight, or radiant heat from a large heat source such as a heat treatment furnace

If the ROBONET is to be used in any of the following locations, provide sufficient shielding measures:

[1] Where noise generates due to electrostatic, etc.
[2] Where a strong electric or magnetic field generates
[3] Where power or drive lines are running nearby

(2) Installation location in a panel

Consider factors that affect the environmental resistance of the ROBONET when installing it in a control panel.

[1] Considerations to the ambient temperature
The ambient temperature of the ROBONET is 0°C to 40°C. Accordingly, give consideration to the following items:

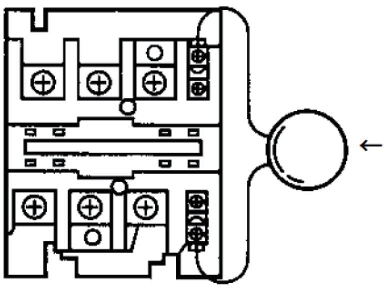
- Provide a sufficient ventilation space. (Refer to 2.1.4.)
- Avoid installing the ROBONET directly above any equipment that generates a large amount of heat (such as a heater, large-capacity resistor or transformer).
- If the ambient temperature exceeds 40°C, install a forced fan or cooler.

[2] Consideration to improvement of noise resistance

- Avoid installing the ROBONET in a panel that also houses high-voltage equipment.
- Install the ROBONET as far away as possible from drive lines
- Properly ground any intermediate plate used for mounting.
- Implement noise elimination measures appropriate for each noise source.
  There are many sources that generate noise. When building a system, the noise sources you should pay particular attention to are solenoid valves, magnet switches and relays. Noise from these devices can be prevented using the measures described on the following page.

a. AC solenoid valves, magnet switches and relays

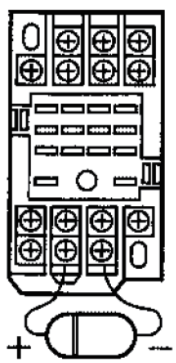
Measure --- Install a surge killer in parallel with the coils.



Surge killer
Keep the wiring length from each coil to a minimum.
If the surge killer is installed on a terminal block, etc., an extra distance from the coils will reduce the noise elimination effect.

b. DC solenoid valves, magnet switches and relays

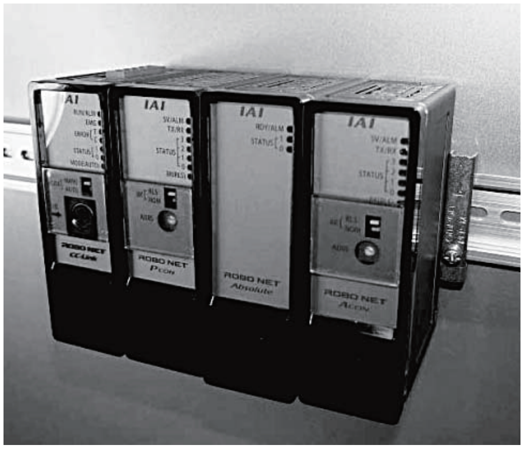
Measure --- Install a diode in parallel with the coils. Determine an appropriate diode capacity according to the load capacity.



In a DC system, connecting the diode in reverse polarities may damage the diode, internal controller parts and DC power supply. Exercise due caution.

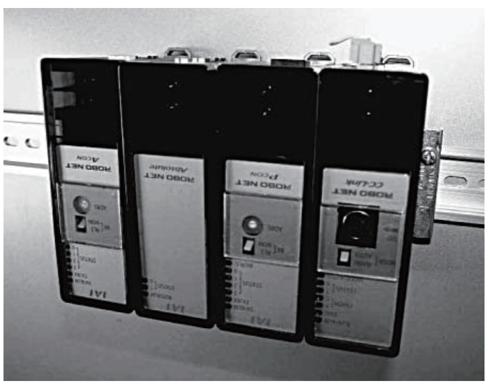
[3] Installation in a panel

- The ROBONET should be installed only in the manner shown below.



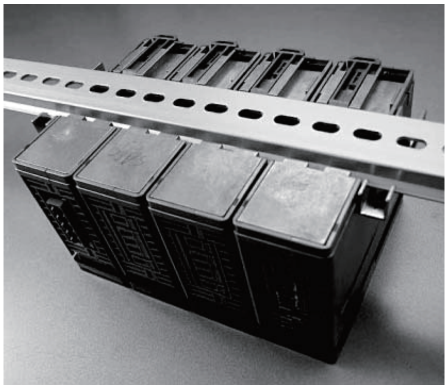
○ Installed correctly

- Never install the ROBONET in the manners shown below.

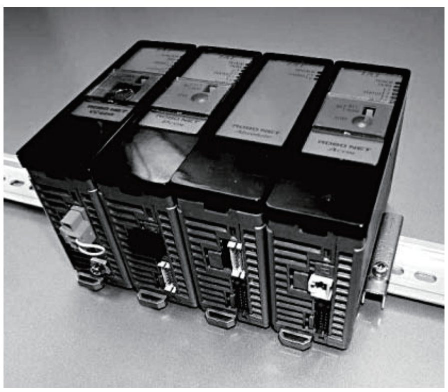


X Installed upside down

X Installed sideways



X Installed face down

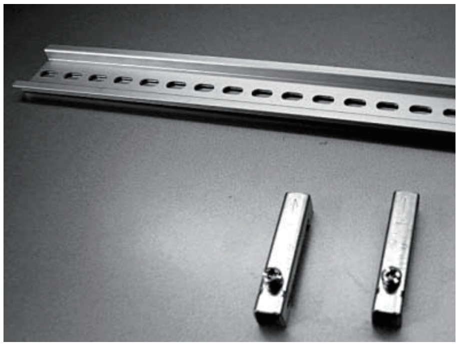


X Installed face up

2.1.2 Mounting on a DIN Rail

Affixing equipment

Install the ROBONET using a 35-mm DIN rail.



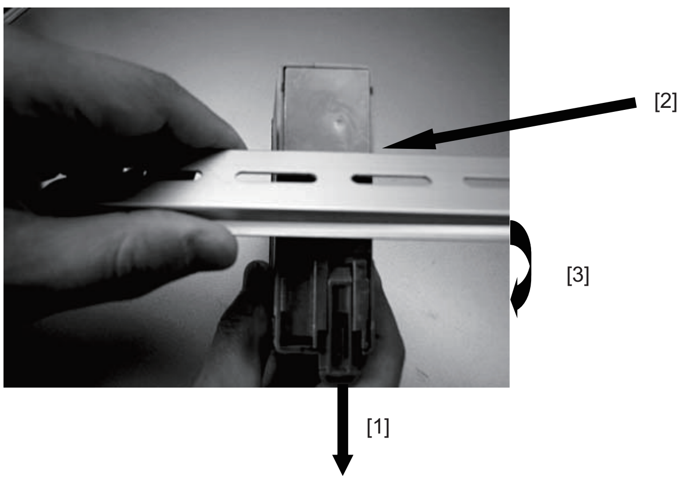
35-mm DIN rail

Affixing equipment (2 pieces)

* The DIN rail and affixing equipment are provided by the customer.

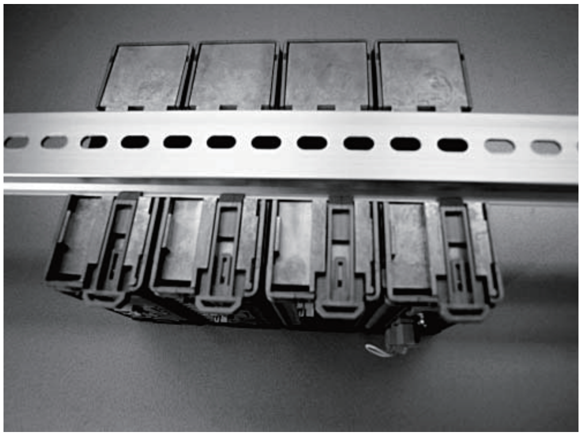
Procedure

(1) "Release" the DIN-rail mounting pin provided at the back of the unit ([1]), hook the tabs on the upper side of the DIN rail ([2]), and push in the bottom side of the rail ([3]).

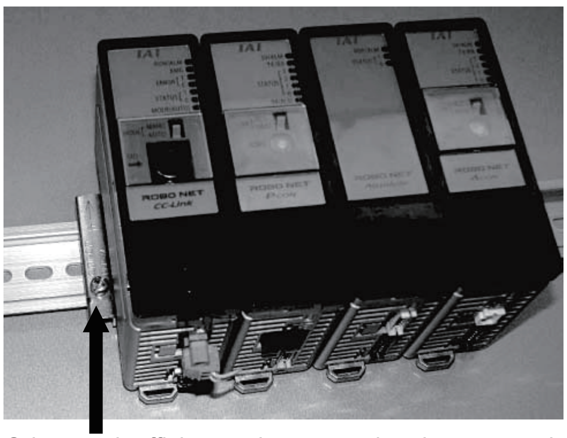


(2) Lock the bottom side with the DIN-rail mounting pin.

(3) Mount all necessary units on the DIN rail.



(4) After the necessary units have been installed, be sure to set two affixing equipments on both ends to affix the units.

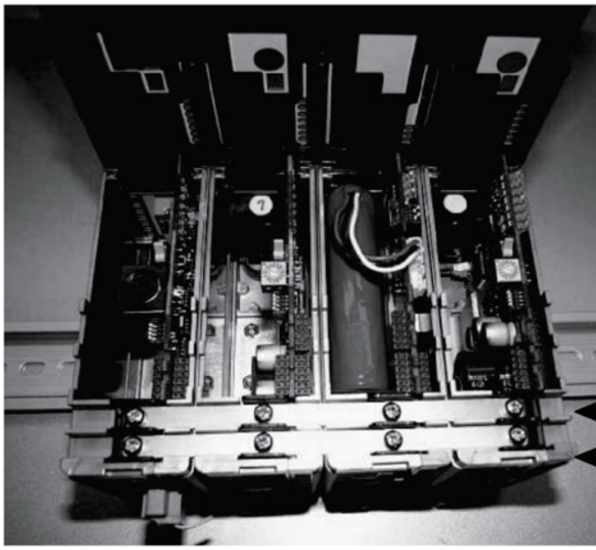


Orient each affixing equipment so that the arrow points upward. Hook the bottom of the end plate on the DIN rail, hook the top, and then pull down the plate. Tighten the screws to affix the end plate in place.

2.1.3 Interconnecting Multiple Units

(1) Connecting 24-V power supply terminal blocks

Connect the power-supply terminal blocks (24 V, 0 V) of adjacent units using power connection plates, as shown below. All units other than the Gateway R unit come with power connection plates.



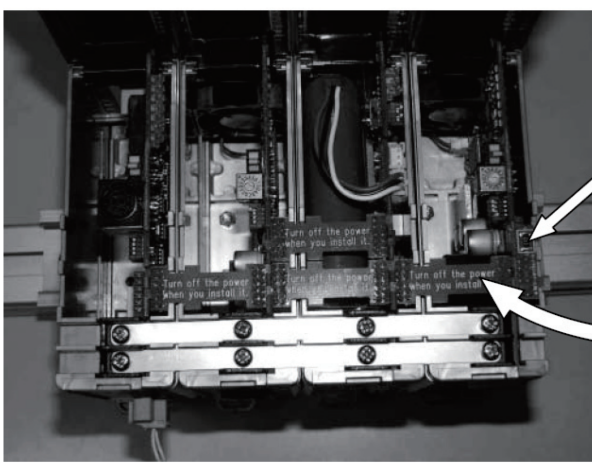
+24V

0V

Power connection plates

(2) Connecting ROBONET communication connection boards

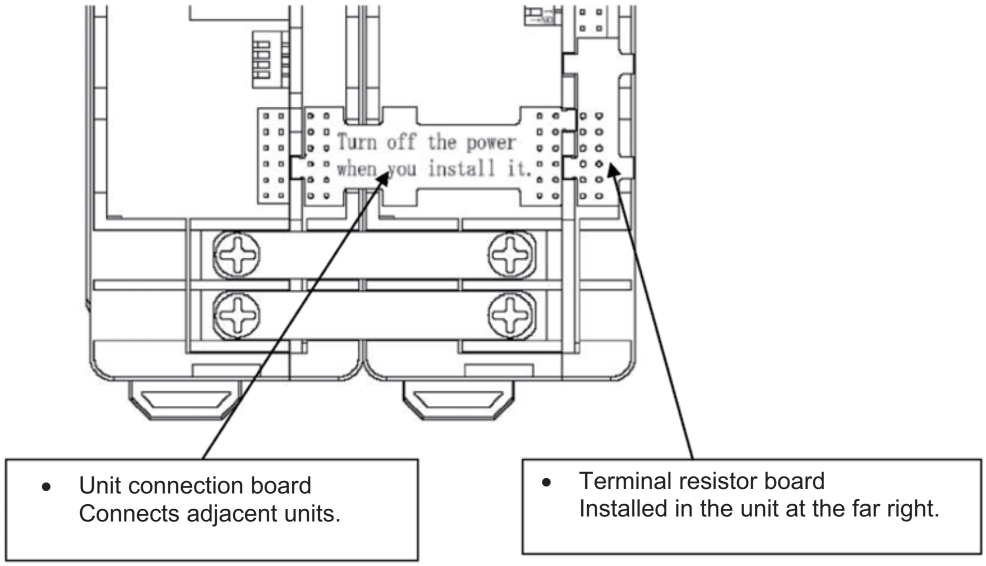
Connect the adjacent units using ROBONET communication connection boards as shown below. All units other than the Gateway R unit come with ROBONET communication connection boards.



Terminal resistor circuit board

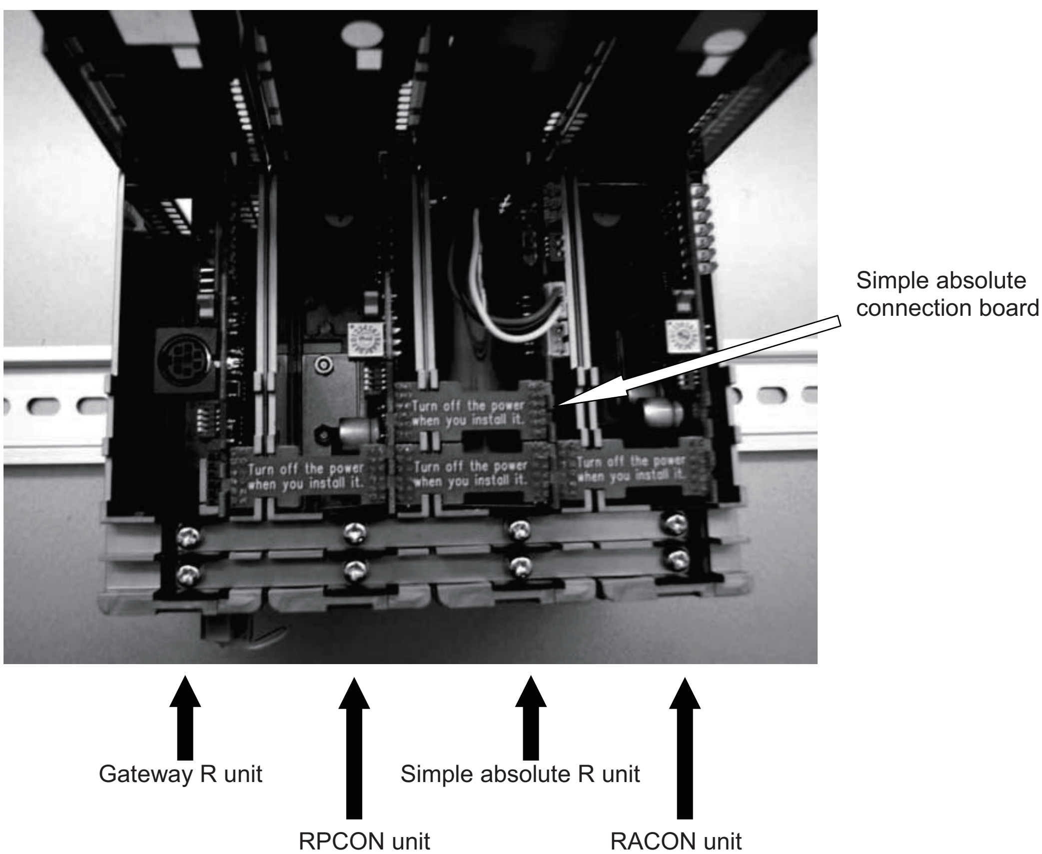
ROBONET communication connection boards

On the unit installed at the far right, also install the terminal resistor board supplied with the gateway unit.



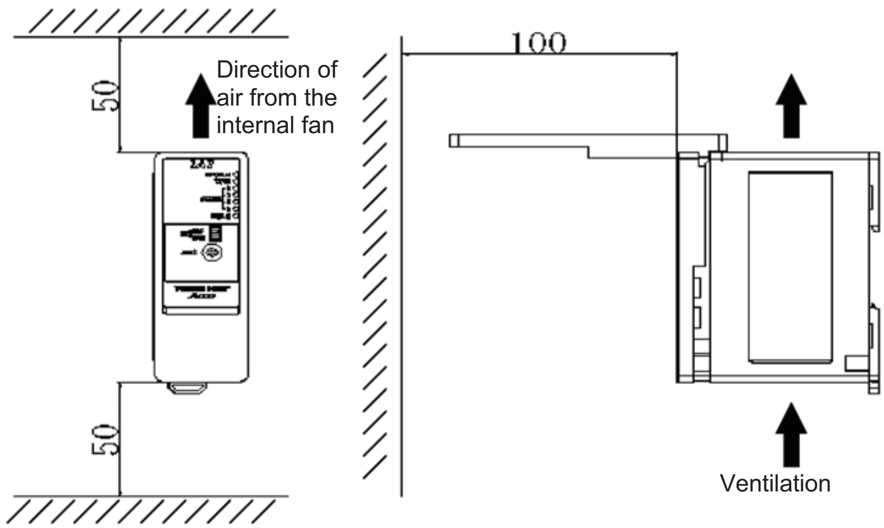
(3) Connecting a simple absolute connection board

As shown below, place the simple absolute unit on the immediate right of the applicable controller unit and connect the two using a simple absolute connection board (same as the ROBONET communication connection board). The simple absolute R unit comes with a simple absolute connection board.



2.1.4 Installing in a Control Panel

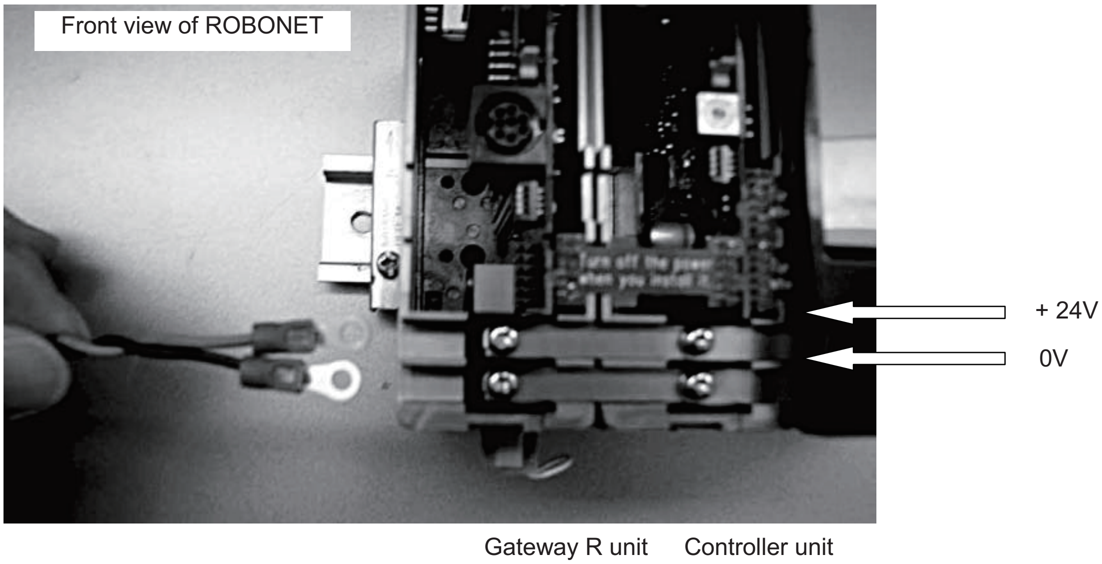
The ROBONET must be installed using a DIN rail.
Since the ROBONET adopts natural convection cooling, provide a clearance of 50 mm or more above and below the unit, and 100 mm or more in front of the unit, by following the correct installation method explained in 2.1.1. Take note that the above dimensions do not include wiring space. Increase the clearances by the required wiring space.
The field network cable and emergency-stop circuit cable will be connected to the top and bottom of the Gateway R unit, respectively. The motor cable and encoder cable will be connected to the bottom of the RPCON or RACON unit, and the encoder cable will also be connected to the bottom of the simple absolute R unit.



2.2 Wiring

2.2.1 Wiring the Power Supply

Wire the 24-VDC power supply as shown below.

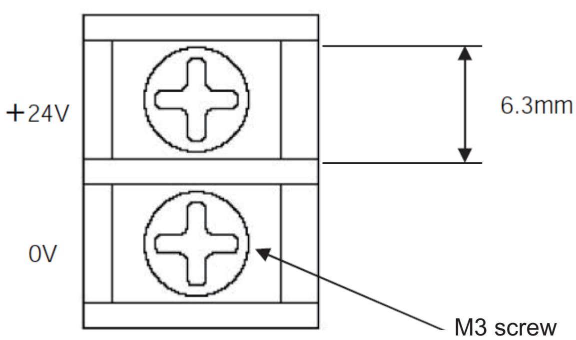


Use the following parts for wiring:

- Wire ∅1.0 single wire or 0.8-mm^2 stranded wire (AWG18)
- Terminal M3 round terminal of 6 mm or less in width
  (Example) V1.25-3 (AWG22 to 16) V2-MS3 (AWG16 to 14) Manufactured by JST
- Temperature rating of isolation sheath: 60°C or above

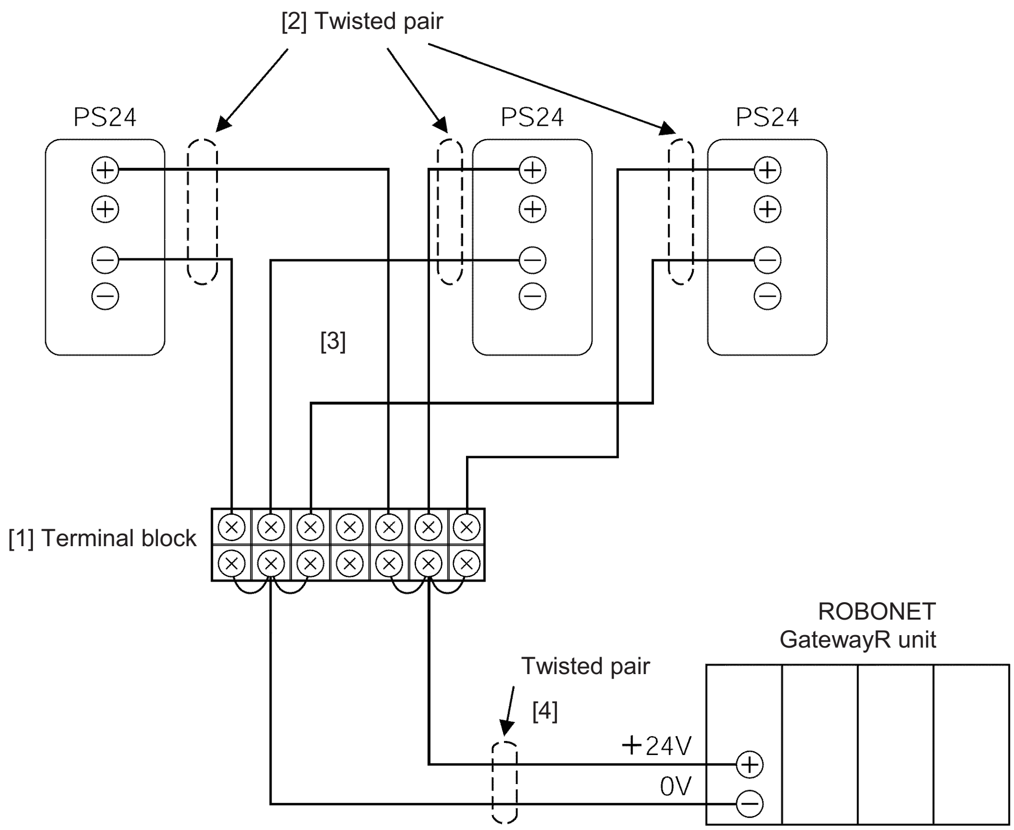
Use a twisted pair cable and wire it separately from high-power lines such as those of drive circuits, etc. (Do not bundle them together or place them in the same cable duct.)

The shape of the power-supply terminal block is shown below.



⚠ Caution

If multiple units of IAI's PS24 are connected in parallel (up to five PS24s can be connected) to supply power to the ROBONET, wire them as shown below.

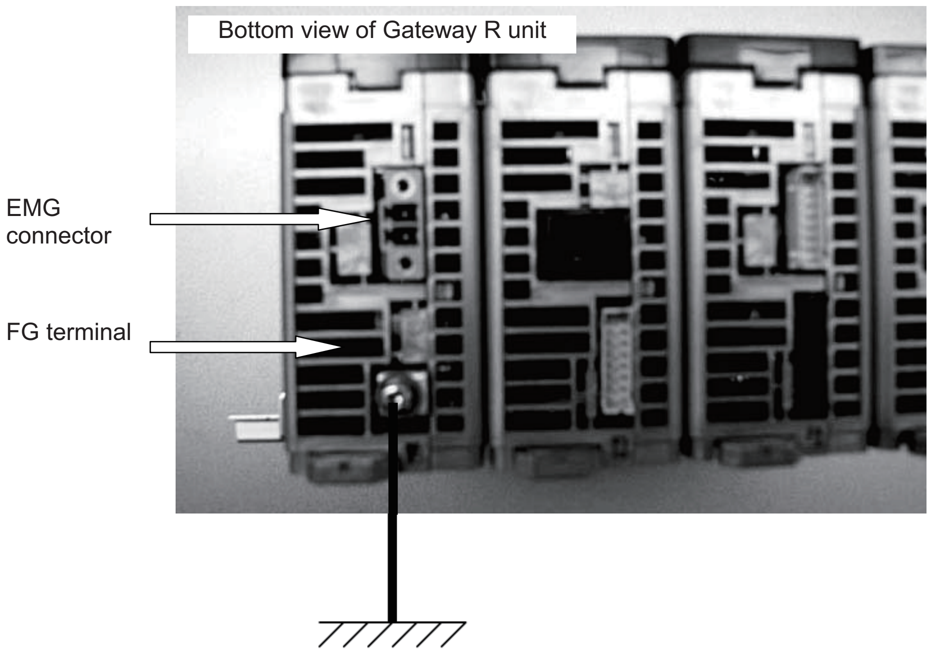


[1] As shown above, connect all PS24s in parallel at the terminal block.
[2] Use a twisted pair cable to wire each power supply to the terminal block.
[3] The twisted pair cables connecting the respective power supplies to the terminal block should be of the same wire size (recommended: AWG16 to 18) and same length whenever possible.
[4] Use a twisted pair cable to wire the ROBONET to the terminal block and also minimize the cable length. A recommended wire size is AWG18.

2.2.2 Grounding Wire

Connect the FG terminal of the Gateway R unit to the copper grounding bar inside the control panel, or other appropriate part, using a grounding wire over the shortest possible distance.

- Class D grounding (former class 3 grounding)
- Wire 2.0 to 5.5 mm^2
- Screw M3



2.2.3 EMG Connector

Connect the emergency-stop circuit (refer to 3.5.9 in Part 1, “Specifications”) to the EMG connector plug (MC1.5/2-STF-3.81, manufactured by Phoenix Contact) supplied with the Gateway R unit, and insert the plug into the EMG connector receptacle shown above.
Wire compatible with EMG connector

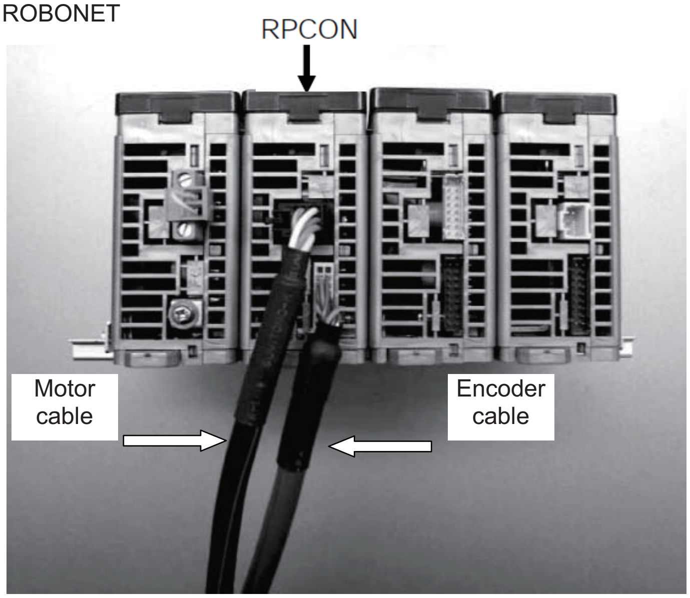
- Wire size Stranded wire AWG28 to 16 (0.14 mm^2 to 1.5 mm^2)
- Wire stripping length 7 mm

2.2.4 Motor Cable and Encoder Cable

(1) When the RPCON controller is of incremental specification

Plug the motor cable and encoder cable into the respective connectors on the RPCON controller, as shown below.

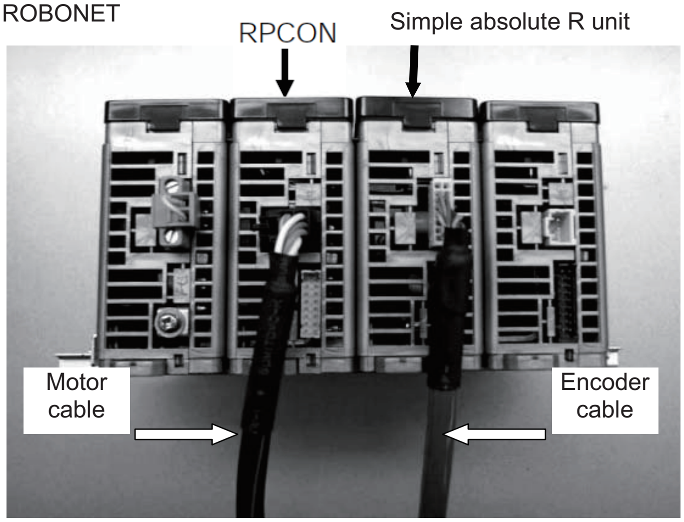
Bottom view of ROBONET



(2) When the simple absolute R unit is connected to the RPCON controller

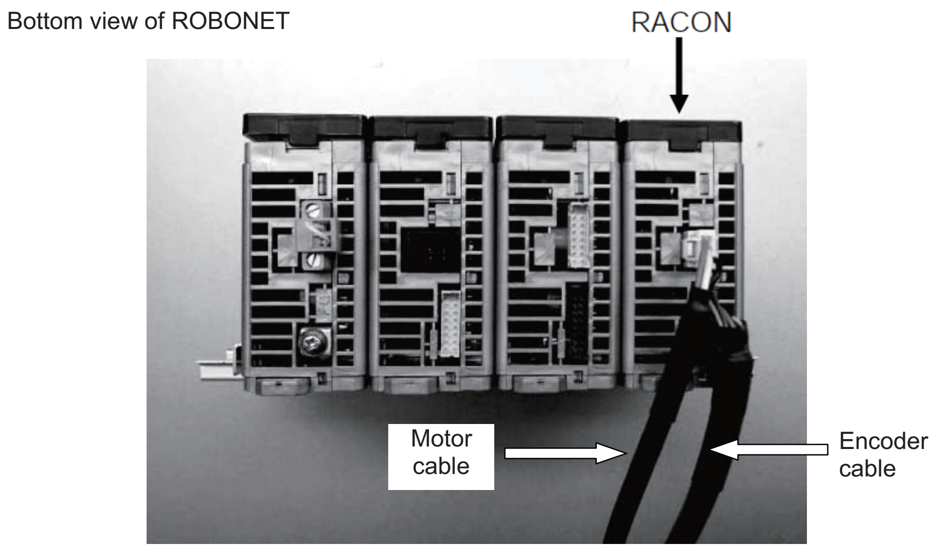
Plug the motor cable into the connector on the RPCON, and encoder cable into the connector on the simple absolute R unit, as shown below.

Bottom view of ROBONET



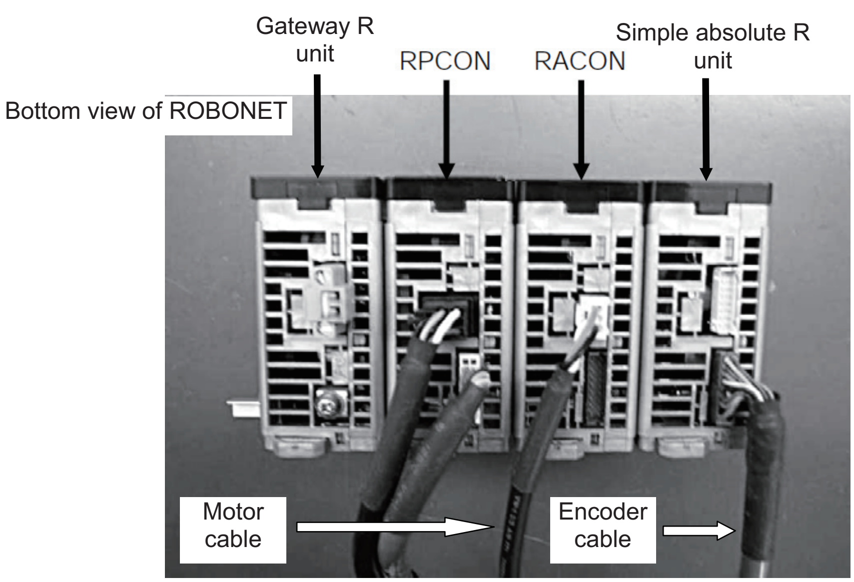
(3) When the RACON controller is of incremental specification

Plug the motor cable and encoder cable into the respective connectors on the RACON controller, as shown below.



(4) When the simple absolute R unit is connected to the RACON controller

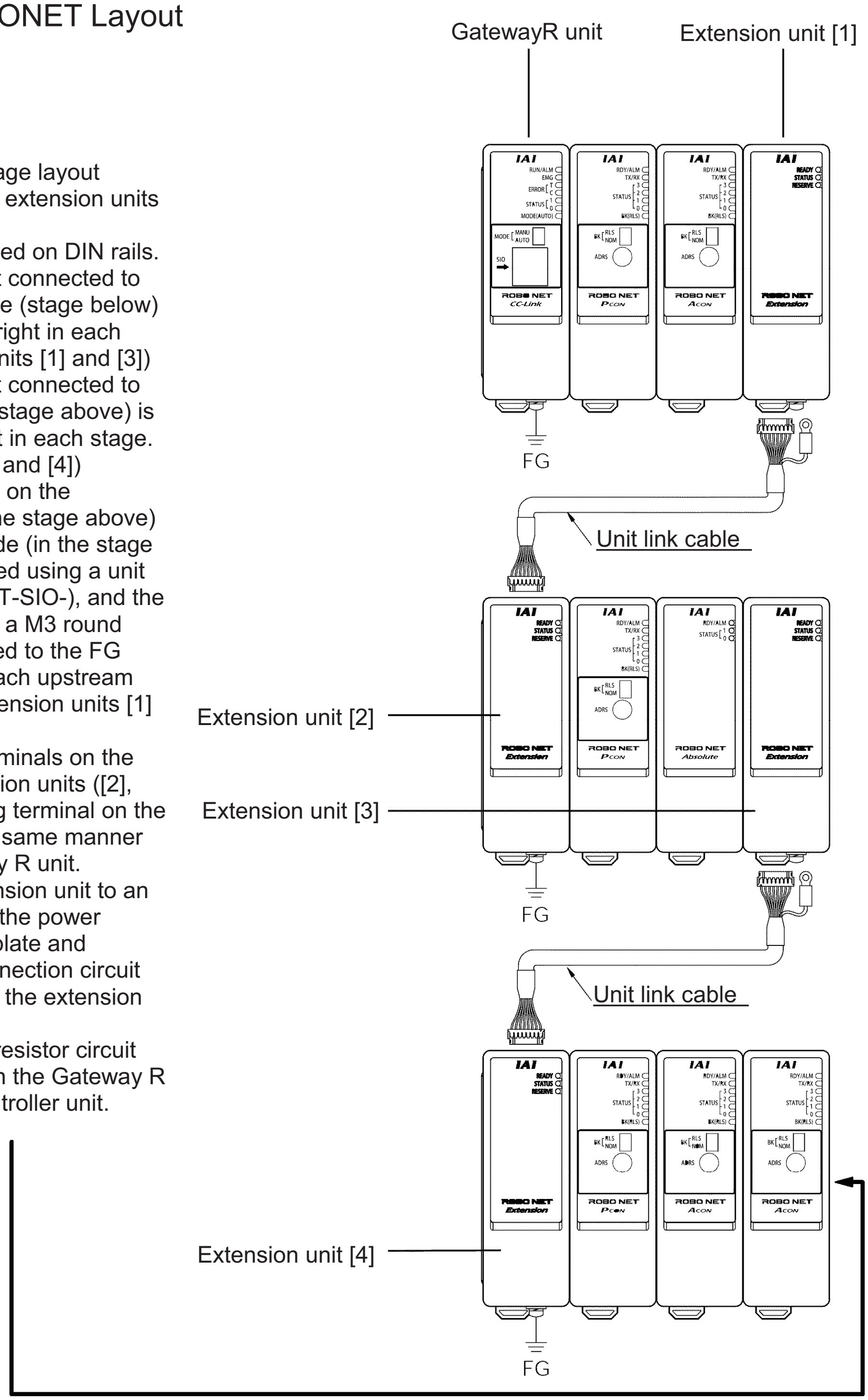
Plug the motor cable into the connector on the RACON, and encoder cable into the connector on the simple absolute R unit, as shown below.



2.2.5 Multi-stage ROBONET Layout

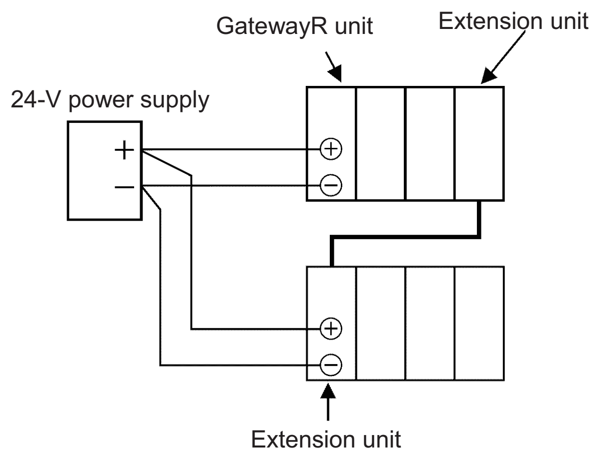
An example of a multi-stage layout achieved by using REXT extension units is shown to the right.

(1) The units are installed on DIN rails.
(2) Each extension unit connected to the downstream side (stage below) is placed at the far right in each stage. (Extension units [1] and [3])
(3) Each extension unit connected to the upstream side (stage above) is placed at the far left in each stage. (Extension units [2] and [4])
(4) The extension units on the upstream side (in the stage above) and downstream side (in the stage below) are connected using a unit link cable (CB-REXT-SIO-), and the grounding wire with a M3 round terminal is connected to the FG terminal block on each upstream extension unit. (Extension units [1] and [3])
Connect the FG terminals on the downstream extension units ([2], [4]) to the grounding terminal on the control panel in the same manner as with the Gateway R unit.
(5) Connect each extension unit to an adjacent unit using the power supply connection plate and communication connection circuit board supplied with the extension unit.
(6) Install the terminal resistor circuit board (supplied with the Gateway R unit) on the last controller unit.

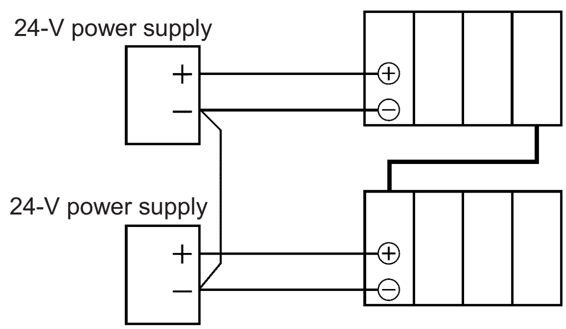


(7) Connect the power supply (+24 V, 0 V) to the unit positioned at the far left in each stage using a twisted pair cable. The power rise timing should be the same for all stages.

[1] Example of supplying power from one power supply



[2] Example of supplying power from multiple power supplies



⚠ Caution

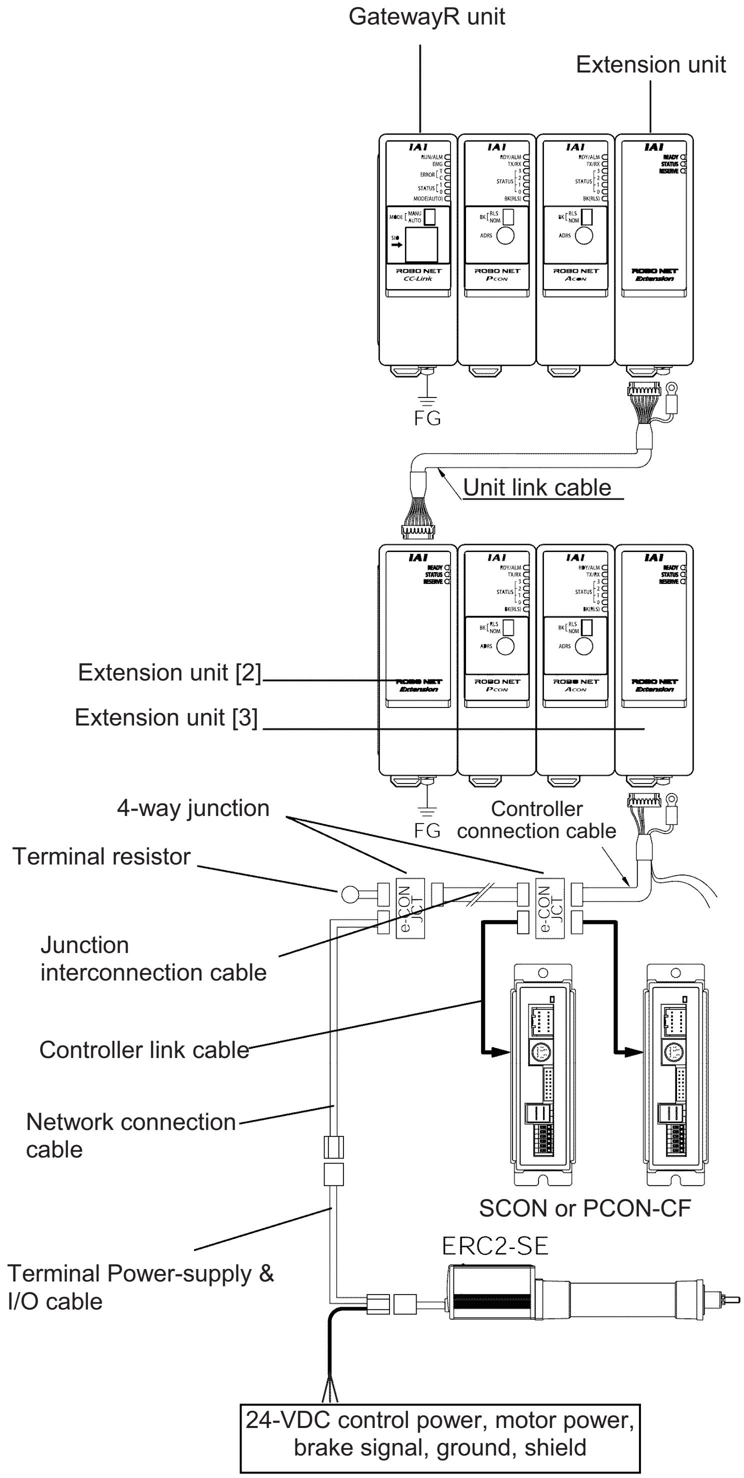
1. Use a common 0-V line for the power supply connected to each stage.
2. Be sure to install the RABU unit (simple absolute R unit) paired with each RPCON unit or RACON unit in the same row (stage) as the applicable controller unit.
3. Keep the total distance of internal SIO communication lines of the ROBONET system (distance from the Gateway R unit to the terminal resistor of the last controller) to 30 m or less.

2.2.6 External SIO Link of ROBONET

An example of implementing an external SIO link using REXT extension units is shown to the right.
In this example, the first stage and second stage comprise a multi-stage layout, while the last extension unit [3] in the second stage is linked to a SCON or PCON-CF via SIO link.

(1) The units are installed on DIN rails.
(2) The multi-stage layout of the first stage and second stage is the same as in 2.2.5. Refer to 2.2.5.
(3) Connect each extension unit to an adjacent unit using the power supply connection plate and communication connection circuit board supplied with the extension unit.
(4) Place the extension unit for SIO link at the end of the lowermost stream (bottom stage) (extension unit [3]) and connect the controller connection cable (CB-REXT-CTL-) to the downstream unit connector on the extension unit. Connect the grounding wire with a M3 round terminal to the FG terminal block.
(5) Connect the e-CON connector end of the controller connection cable to a 4-way junction.
(6) Connect the SCON or PCON-CF and 4-way junction using an optional controller link cable (CB-RCB-CTL002). The controller link cable CB-RCB-CTL002 comes with the following accessories. Use them to make the connection as shown to the right:
   - 4-way junction (5-1473574-4 by AMP) x 1
   - e-CON connector (4-1473562-4) x 1
   - Terminal resistor 220 Ω (with e-CON connector) x 1

   The customer must fabricate a junction interconnection cable using the above e-CON connector supplied with the controller link cable.
   Connect the ERC2-SE and 4-way junction using the power-supply & I/O cable (CB-ERC2-PWBIO) and network connection cable (CB-ERC2-CTL001) supplied with the ERC2-SE.

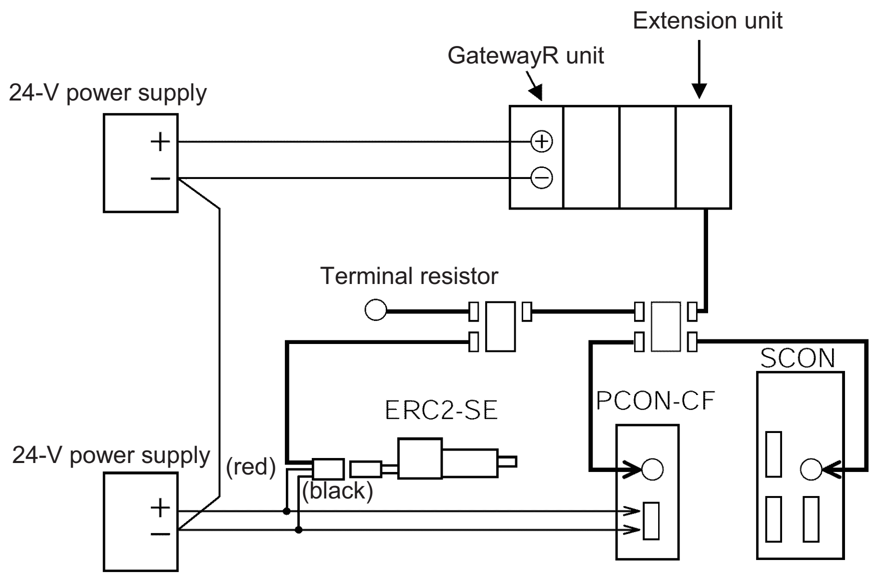


(7) The terminal resistor supplied with the Gateway R unit is not used (not installed to the ROBONET controller). Install the 220-Ω terminal resistor supplied with the controller link cable to the 4-way junction at the end of the SIO link.

(8) Use twisted pair cables to connect the power supply (+24 V, 0 V) to the unit positioned at the far left in each ROBONET stage and also to the controller connected via the external SIO link (ERC2-SE or PCON-CF). The power rise timing should be the same for each ROBONET stage and the controller connected via the external SIO link.

*1 The SCON power supply is specification single-phase 100 or 200 V.

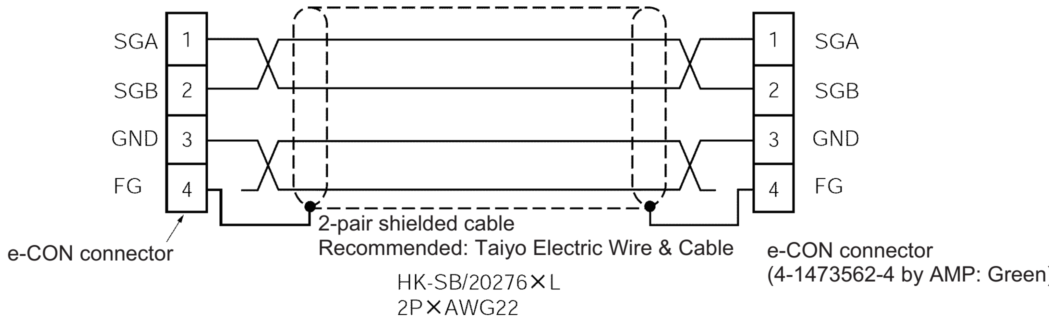
Example of supplying power from multiple power supplies



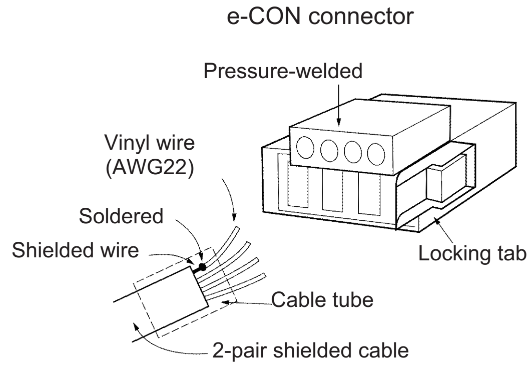
⚠ Caution

1. Use a common 0-V line for the power supply connected to each ROBONET stage and the controller connected via the external SIO link.
2. Keep the total distance of internal SIO communication lines of the ROBONET system (distance from the Gateway R unit to the terminal resistor of the last controller) (including the external SIO link) to 30 m or less.

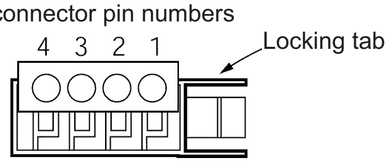
<Fabrication of Junction Interconnection Cable>



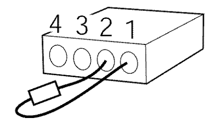
[1] Strip the sheath of the 2-pair shielded cable by 15 to 20 mm.
[2] Strand the shielded wires and solder them to vinyl wires of AWG22 or equivalent.
[3] Slide a cable protection tube onto the cable.
[4] Insert the four core wires into the cable insertion holes in the connector without stripping the wires. (SDA, SDB, GND, FG)
[5] With the cable inserted, pressure-weld the press-fit cable housing from above.
[6] Heat and shrink the cable protection tube.



e-CON connector pin numbers

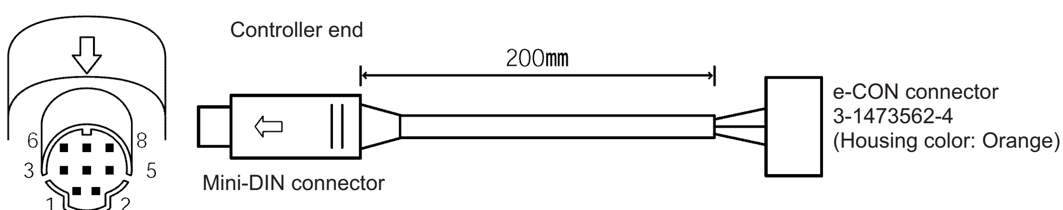


Be sure to insert a terminal resistor (220 Ω, 1/4 W) at each end of the main communication line (between Nos. 1 and 2 on the e-CON connector).



<Controller Link Cable> (CB-RCB-CTL002)

This cable is an option for each controller and must be purchased separately.



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

yellow
orange
blue

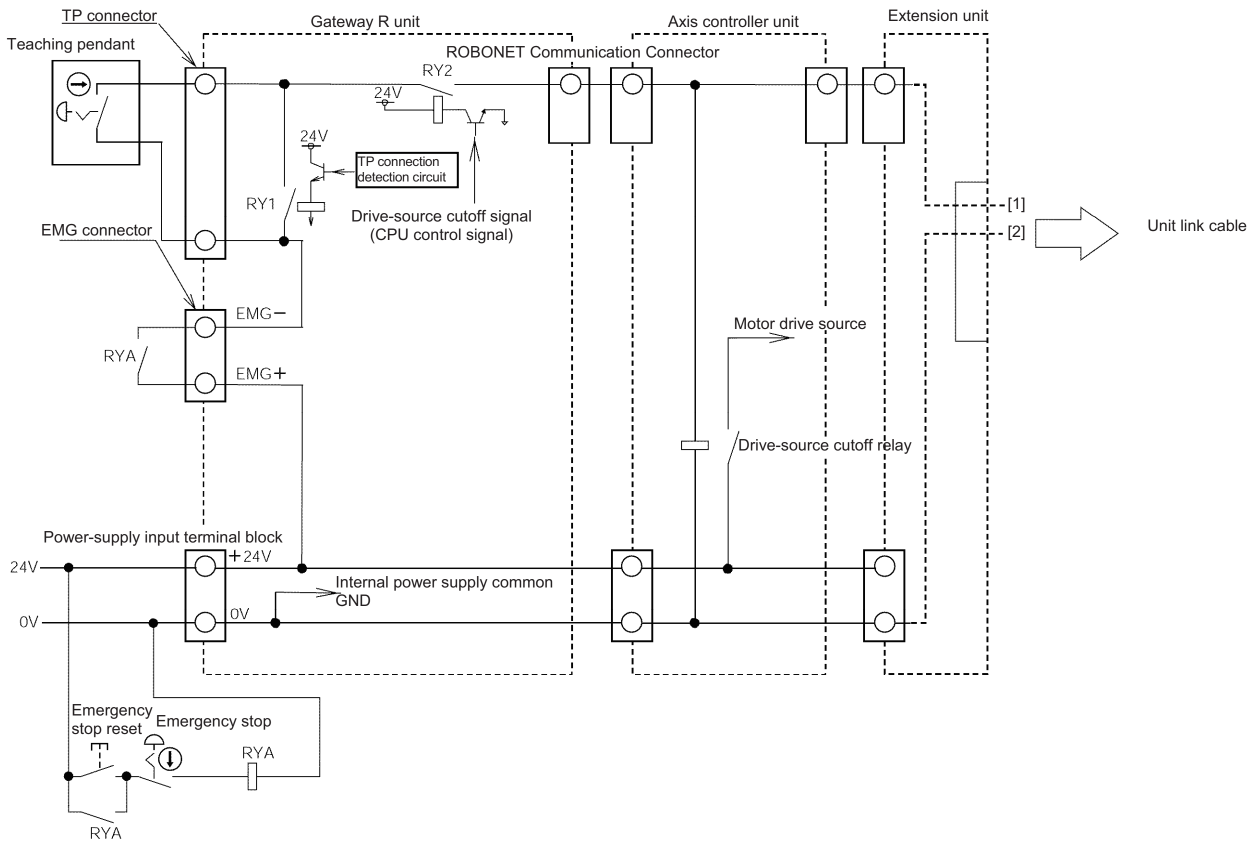
No	Signal
1	SGA
2	SGB
3	GND
4	

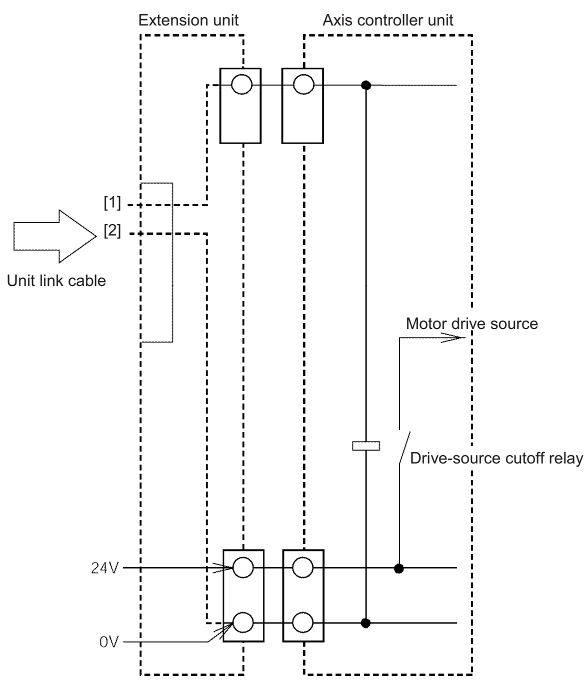
The following parts are supplied.

[1] 4-way junction	Model: 5-1473574-4	Manufacturer: AMP	Quantity: 1
[2] e-CON connector	4-1473562-4 Outer sheath size of applicable wire	Manufacturer: AMP 1.35 to 1.6 mm	Quantity: 1
[3] Terminal resistor	220 Ω 1/4 W	With e-CON connector	Quantity: 1

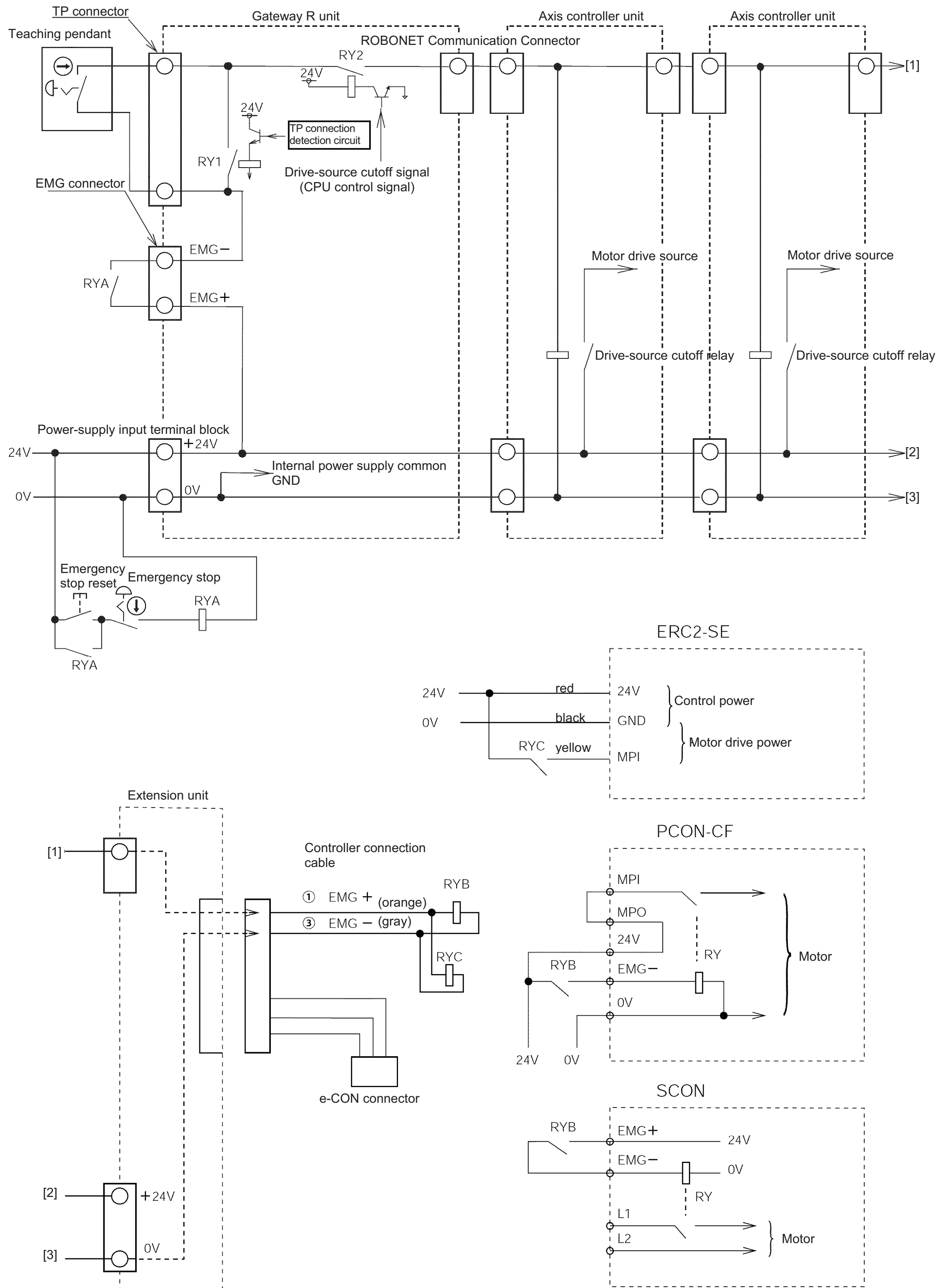
2.2.7 Emergency Stop Circuit

(1) An emergency stop circuit for normal layout and multi-stage layout is shown below.





(2) An emergency stop circuit for normal layout when external SIO link is used is shown below.



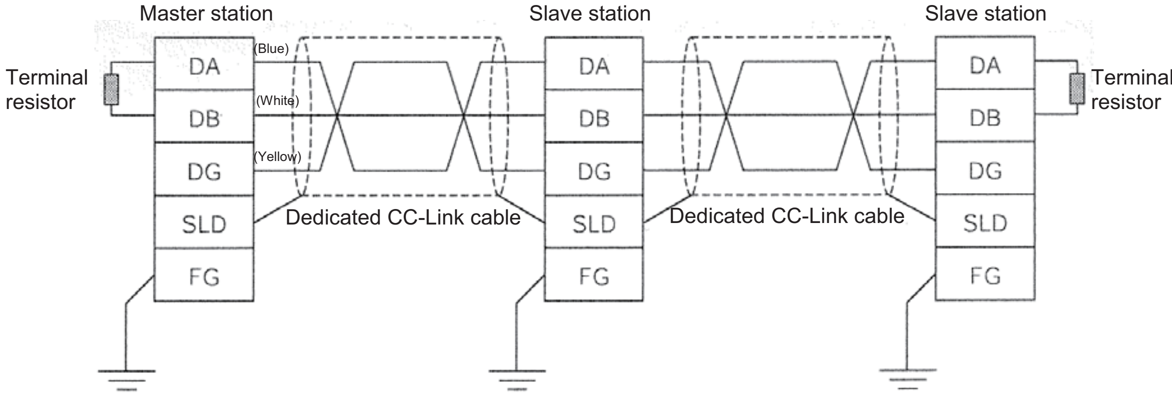
Caution

1. For the relay RYA, use a relay with a rated contact capacity of 160 mA or more.
2. Relays that can be connected between the EMG+ and EMG- terminals of the extension unit are subject to limitations in that the total sum of “10 mA x number of controllers connected to the extension unit” and “coil current of the relay connected between the EMG+ and EMG- terminals” must not exceed 160 mA.
3. For the drive power source of each connected controller, refer to the first step guide or operation manual of the controller.
4. Do not short the EMG+ (orange) and EMG- (gray) wires of the controller connection cable.

2.2.8 Network Wiring

(1) CC-Link

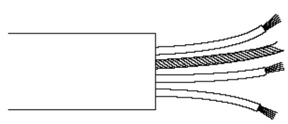
Check the operation manual for the master (PLC) for details on CC-Link. The following explains the points to note regarding network wiring.
An example of network connection is shown below.



[1] An equipment connected via CC-Link is called a "station," and 1 to 64 can be set as slave station numbers. Both master and slave stations can be set in any positions.

[2] Each station is connected based on direct line branching at the station. T-branches using commercial terminal blocks, etc., are also supported.

[3] Use a dedicated 3-core shielded twisted pair cable for CC-Link.
The details of the dedicated cable are as follows.



Color	Signal type
Blue	Communication line A (DA)
White	Communication line B (DB)
Yellow	Communication ground line (DG)
---	Shield (SLD)

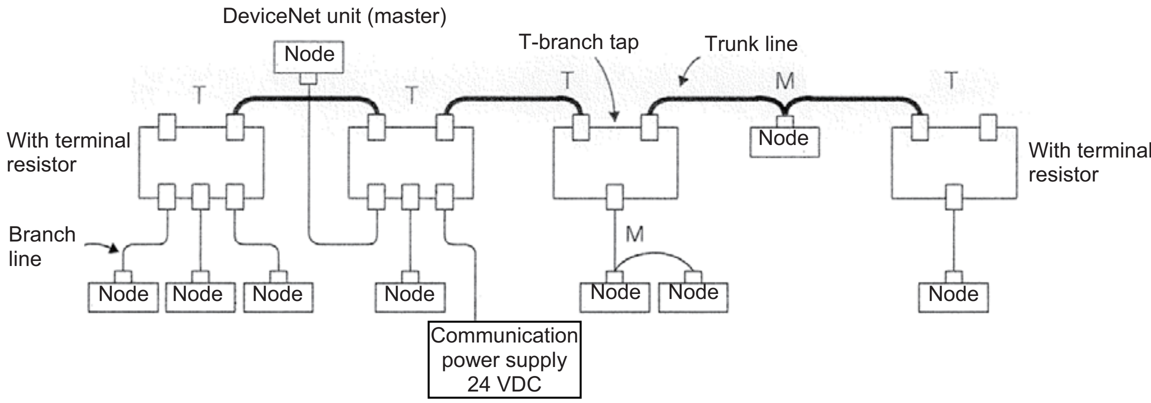
[4] A terminal resistor must be installed on both ends of the CC-Link system. Each terminal resistor is connected between "DA" and "DB." Take note that the required terminal resistor varies depending on the applicable cable, as shown below.

Cable name	Terminal resistor
Dedicated CC-Link cable (ver. 1.00, ver. 1.10)	110 Ω, 1/2 W
Dedicated high-performance CC-Link cable (ver. 1.00)	130 Ω, 1/2 W

[5] The baud rate is limited by the length of the network (total branch line length, maximum network length).

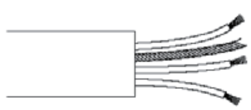
(2) DeviceNet

Check the operation manual for the master (PLC) for details on DeviceNet. The following explains the points to note regarding network wiring.
An example of network connection is shown below.

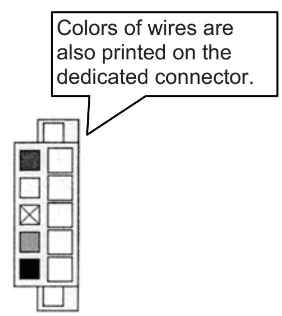


(1) An equipment connected to a network and having an assigned address is called a “node.” A node may be the master (DeviceNet unit in the above figure) that manages the DeviceNet network, or a slave that connects external I/Os to the network. Both master and slave nodes can be set in any positions.

(2) A terminal resistor is required on both ends of a trunk line (bold line in the figure). A cable branching from a trunk line (normal line in the figure) is called a “branch line.”
Use a dedicated 5-wire cable for DeviceNet. Select a thick cable or thin cable according to the supplied current.
The dedicated cable is explained on the ODVA website.
The details of the dedicated cable are as follows.



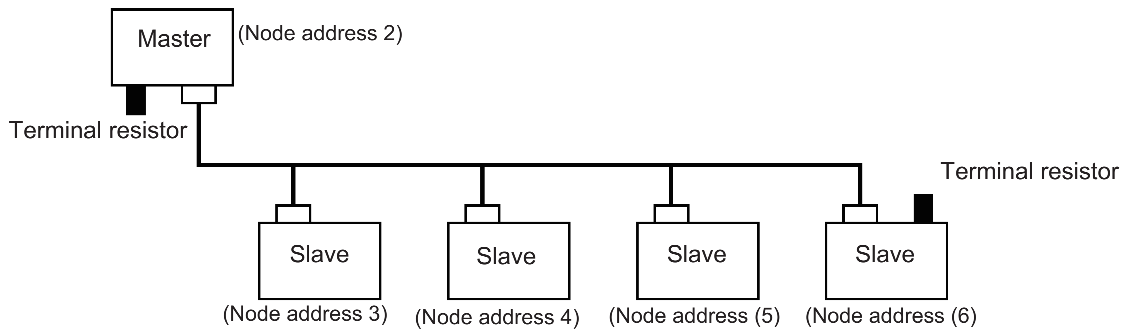
Color	Signal type
Red	Power cable + (V+)
White	Communication data high (CAN H)
---	Shield
Blue	Communication data low (CAN L)
Black	Power cable - (V-)



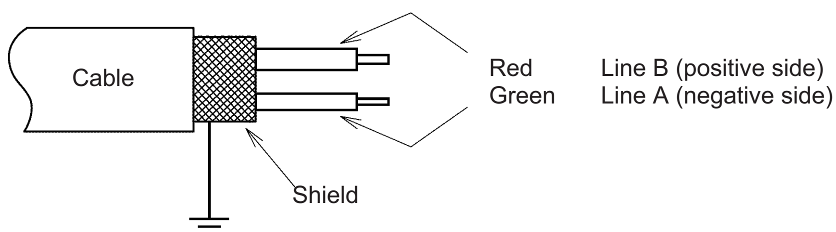
(3) Nodes can be connected in one of the following two ways. Both methods can be used together in a single network.
  [1] T-branch method Use a T-branch tap, etc.
  [2] Multi-drop method Use a multi-drop connector to branch the line directly at the node.
(4) Communication power (24 VDC) must be supplied to each node via a 5-wire cable.
(5) A terminal resistor must be installed on both ends of a trunk line.
The Gateway R unit (RGW-DV) does not come with a terminal resistor.
Connect Omron's terminal-block terminal resistor (121 Ω ± 1 %, 1/4 W) or T-branch tap with terminal resistor (121 Ω ± 1%, 1/4 W), or other resistor of the same specification, directly between the white and blue wires at the communication connector.
(6) The baud rate is limited by the length of the network (total branch line length, maximum network length).

(3) Profibus-DP

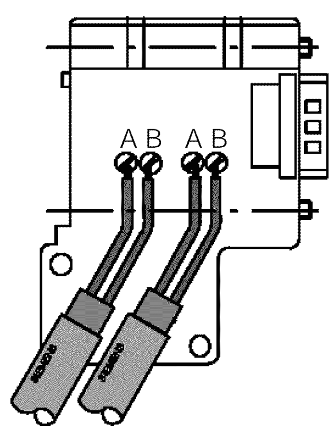
For details on Profibus-DP, refer to the operation manual of the master (PLC) and also visit the website of the Japanese Profibus Organization. The following explains the points to note regarding network wiring. A network connection example is shown below



[1] A device connected to a network and to which an address is assigned is called a "Node." A node may be the master or a slave. Up to 32 nodes can be connected in one segment.
[2] It is recommended that the master be connected to one end of the network. Normally the node address of the master is 2 and each slave has a node address of 3 to 32.
Node address 0 is reserved for a monitoring or diagnostic device, while node address 1 is reserved for a monitoring device.
[3] A terminal resistor must be installed at both ends of each segment of the network.
[4] For the Profibus cable, use a Profibus-DP cable of type A conforming to the EN 50170 standard. This cable is a shielded 2-core twisted pair cable.



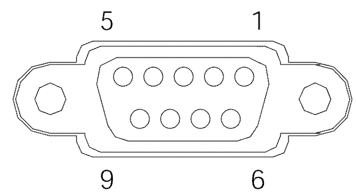
[5] The network connectors are D-sub, 9-pin connectors conforming to the EN 50170 standard.
As for network bus connectors, screw-type connectors like the one shown below and quick connectors where the cables are inserted into provided holes are available.



When a connector with terminal resistor is used, turn on the terminal resistor switch only for the terminal slave and turn off the switches for all other slaves.

[6] The RGW-PR connector is a D-Sub, 9-pin Profibus-DP connector (female) recommended in the EN 50170 standard. Network connectors are not provided.

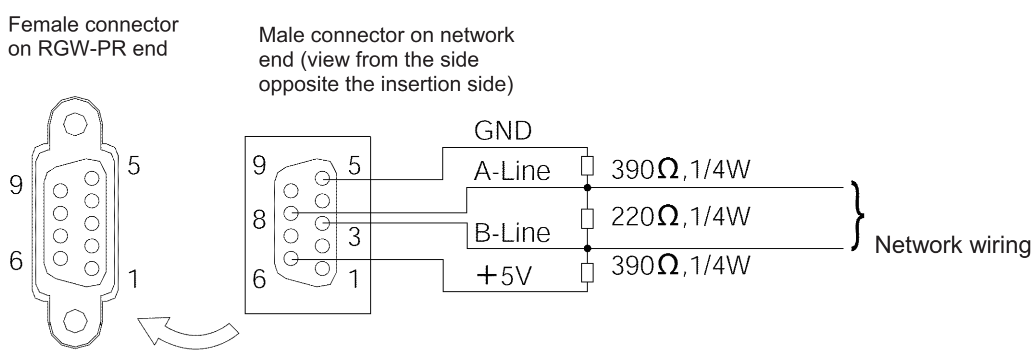
Pin number	Signal name	Explanation
1	NC	Not connected
2	NC	Not connected
3	B-Line	Communication line B (positive side)
4	NC	Not connected
5	GND	Signal ground
6	+5 V	+5-V output
7	NC	Not connected
8	A-Line	Communication line A (negative side)
9	NC	Not connected
Housing	Shield	Cable shield



⚠ Caution

The RGW-PR does not have terminal resistor setting switches. If the RGW-PR is connected at the end of a network, connect a terminal resistor to the network connector or use a connector with terminal resistor, as specified below.

- Connecting a terminal resistor

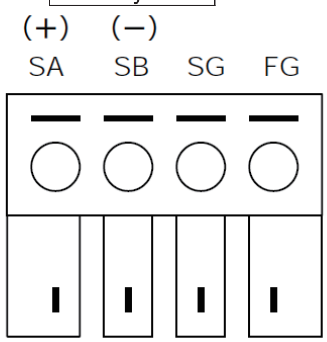


- Profibus connector (with terminal resistor)
  (Example) SUBCON-PLUS-PROFIB/AX/SC (Phoenix Contact)

(3) RS485SIO

Using the 2-wire method, connect the Gateway R unit (RGW-SIO) to the RS-422A/485 port on the serial communication unit (SCU) of the PLC, as shown below.

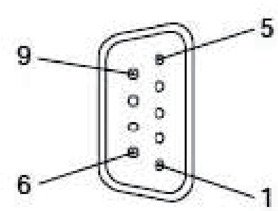
Gateway R unit



Cable connector (supplied)
MC1.5/4-ST-3.5 (manufactured by Phoenix Contact)

PLC-SCU

RS-422A/485 connector



(D-sub 9-pin male connector as viewed from the soldered side)

Signal name	Explanation
SA	Communication line A (+)
SB	Communication line B (-)
SG	Signal ground
FG	Frame ground

Connector pin arrangements

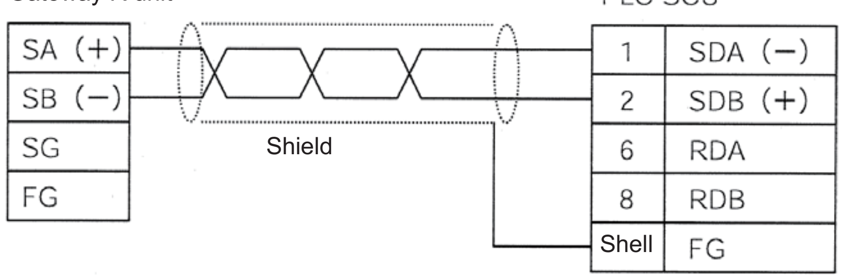
Pin No.	Abbreviation	Signal name	Input/output
1 *1	SDA	Send data -	Output
2 *1	SDB	Send data +	Output
3	NC	Not used	-
4	NC	Not used	-
5	NC	Not used	-
6 *1	RDA	Receive data -	Input
7	NC	Not used	-
8 *1	RDB	Receive data +	Input
9	NC	Not used	-
Shell *2	FG	Shield	-

*1 For 2-wire connection, use pins 1 and 2, or pins 6 and 8.
*2 The shell is connected to the ground terminal (GR) of the power-supply unit through the SCU. Accordingly, the shield will be grounded when the GR of the power-supply unit is connected to ground.

Use a shielded twisted pair cable (AWG28-16) for the communication cable.

Gateway R unit

PLC-SCU

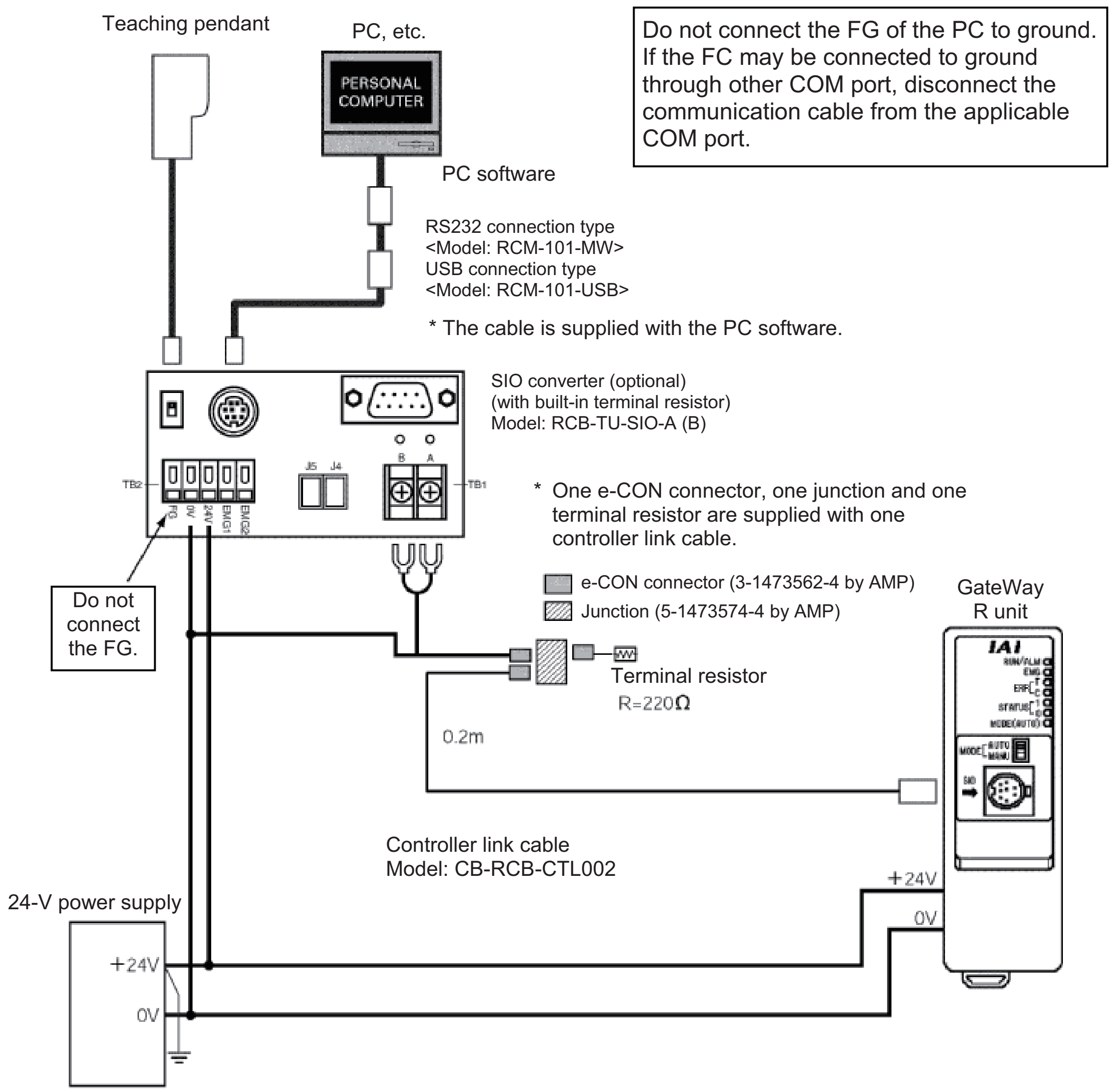


⚠ Caution

1. The polarities of corresponding pins are reversed on the ROBONET end and PLC end of the communication line. When connecting the ROBONET and PLC, connect the pins of the same polarities.
   SA (+) on Gateway R ⇔ SDB (+) on SCU, SB (-) on Gateway R ⇔ SDA (-) on SCU,
2. Connect the shield to ground only on the PLC-SCU end.

2.2.9 How to Connect Teaching Tool When Grounding Positive Terminal of 24-V Power Supply

If the positive terminal of the 24-V power supply is grounded (= the +24-V side is grounded), use a SIO converter as shown below to connect a teaching pendant or PC to the Gateway R unit. At this time, do not connect the FG of the SIO converter.



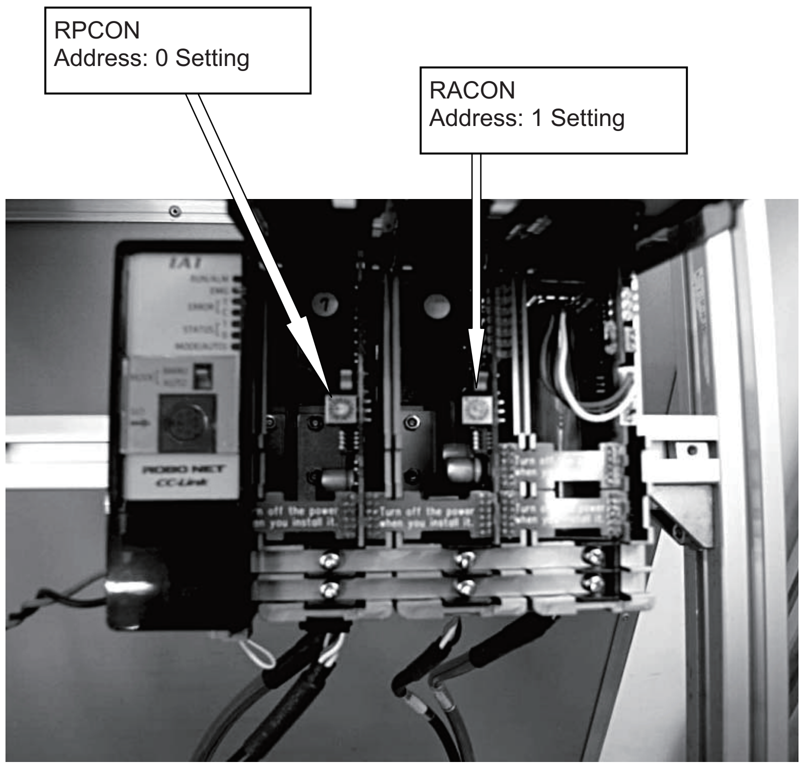
With the ROBONET, basically the negative terminal of the 24-V power supply is grounded (= the 0-V side is grounded). Since most teaching pendants and PCs have their communication ground line and FG (frame ground) shorted internally, grounding the 24-V power supply at the positive terminal (= grounding the +24-V side) will cause the 24-V power supply to short when a teaching pendant or PC is connected to the Gateway R unit, resulting in damage to the teaching pendant or PC.

⚠ Caution

Do not connect the FG of the SIO converter.

Chapter 3 Controller Address Setting

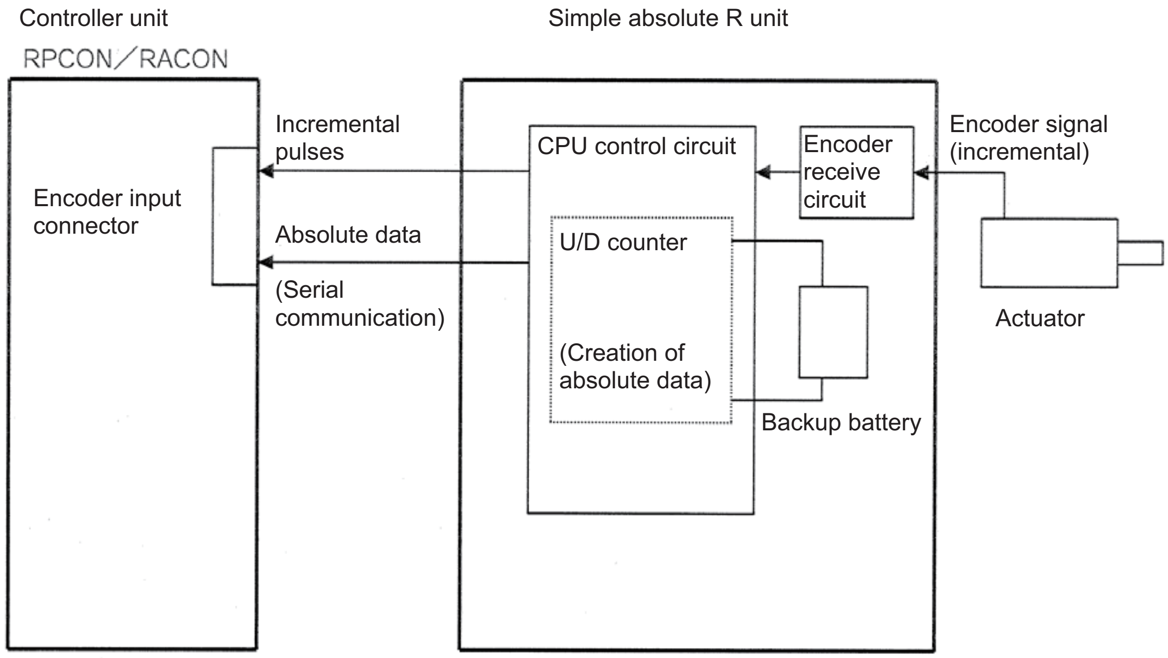
The address of each controller unit is set using the address setting switch (hexadecimal rotary switch) provided on the front face of the unit. The range of settable addresses is 0 to F. After setting the operation mode of each axis using the gateway parameter setting tool (refer to 5.1), set an applicable address using the checkboxes by making sure no address duplication occurs.
An example of setting is shown below.
So that you can remember the addresses easily, you may want to assign 0 to F to the respective units sequentially, starting from the unit on the immediate right of the Gateway R unit.
The addresses of SCON, PCON-CF and ERC2 for external SIO link are set in the same manner.



Chapter 4 Absolute Reset

4.1 Overview of Simple Absolute System

To combine the RPCON or RACON controller unit with the simple absolute R unit for use as an absolute axis, an absolute reset must be performed. Once an absolute reset is performed, home return will no longer be required every time the power to the controller unit is turned off.
An internal block diagram of the simple absolute R unit is shown below.

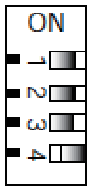


The startup procedure is as follows:

[1] Set the configuration switches (piano switches)
[2] Connect the backup battery
[3] Perform an absolute reset

4.2 Setting the Configuration Switches

The configuration switches are used to change the level of retention function with respect to absolute data.
<u>Disconnect the backup battery before setting the configuration switches (piano switches).</u>
<u>Connect the backup battery after the switch settings have been changed.</u>
(For the location of the switches, refer to 5.4.1, “Nomenclature” in “ROBONET Operation Manual – Specification.”)



Configuration switches (Slide each switch to the left to turn it “ON.”)

These switches are used to set the maximum motor speed at which absolute data can be stored, or change the mode. (The switches are arranged in the order of 1, 2, 3 and 4, from the top.)

Switch	Function
1	Speed setting switch 1
2	Speed setting switch 2
3	Update-mode selector switch (Keep this switch in the “OFF” position.)
4	Model selector switch (Keep this switch in the “ON” position.)

[Speed setting switches]
If the motor speed reaches or exceeds the specified level while the controller power is off, the absolute data will be lost and an absolute encoder error will generate. A desired motor speed can be set from among the four levels. The lower the motor speed, the longer the backup battery will last.

Setting Switch		Encoder Max. Rotation Speed [rpm]		Battery Retention Time (reference)
1	2	When the connected actuator is a model other than RCA2-***N;	When the connected actuator is RCA2-***N;	
OFF	OFF	100	75	20 days
ON	OFF	200	150	15 days
OFF	ON	400	300	10 days (Default setting)
ON	ON	800	600	5 days

*1 The retention times of the backup battery are reference values in a condition where the original battery is used at normal temperature with the motor operated intermittently for short periods at speeds within the specified range, or with the motor not operated at all.
Even though the motor remains within the specified speed range, the retention time will become shorter if the motor is operated continuously.

*2 The default settings are “OFF” for switch 1 and “400 rpm” for switch 2 (ON).

[Update-mode selector switch]

Switch 3	Function
ON	Update mode
OFF	Normal mode

This switch need not be used in a normal condition of use, and should therefore remain in the "OFF" position. (Do not set the switch to the "ON" position.)
In the update mode, the RDY/ALM LED blinks in green and red alternately.

[Model selector switch]

Switch 4	Function
ON	Keep this switch in the "ON" position (default setting).
OFF	---

4.3 Connecting the Backup Battery

After the configuration switches have been set, connect the backup battery to the backup battery connector.

4.4 Setting the Parameters

If the simple absolute R unit is installed later, the setting of a user parameter in the controller unit must be changed.
(If you have purchased your controller unit and simple absolute R unit together, this parameter has already been set at the factory.)

User parameters are set using the PC software or teaching pendant.

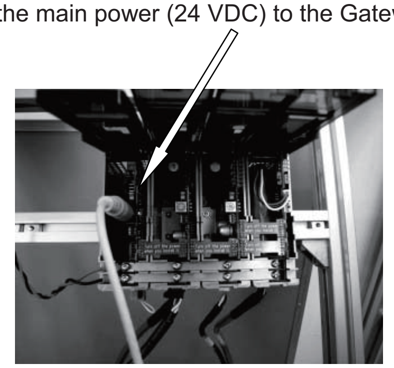
Parameter to be changed: User parameter No. 83, “Absolute unit” [0: Do not use / 1: Use]

If the absolute unit is to be used, set this parameter to [1: Use].

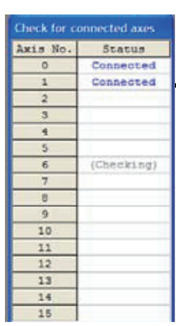
4.5 Performing an Absolute Reset

4.5.1 Performing an Absolute Reset in the PC Software

(1) Connect the PC and Gateway R unit using a dedicated communication cable.
(2) Set the MODE switch on the Gateway R unit to the “MANU” (top) side.
(3) Supply the main power (24 VDC) to the Gateway R unit, controller unit and simple absolute R unit.

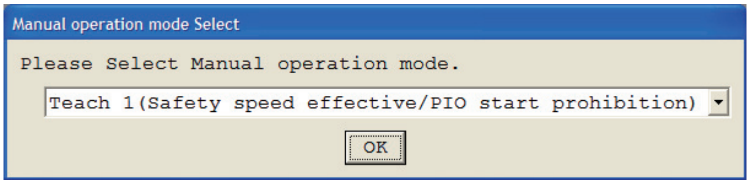


(4) Start the RC PC software.

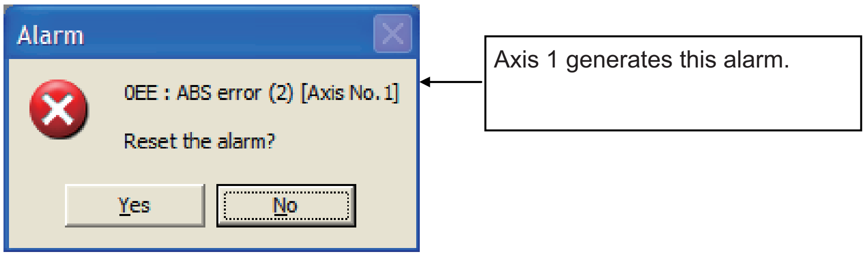


An example where axis No. 1 is a simple absolute axis is explained.

(5) Select a desired manual operation mode.
Select teaching mode 1 or teaching mode 2.

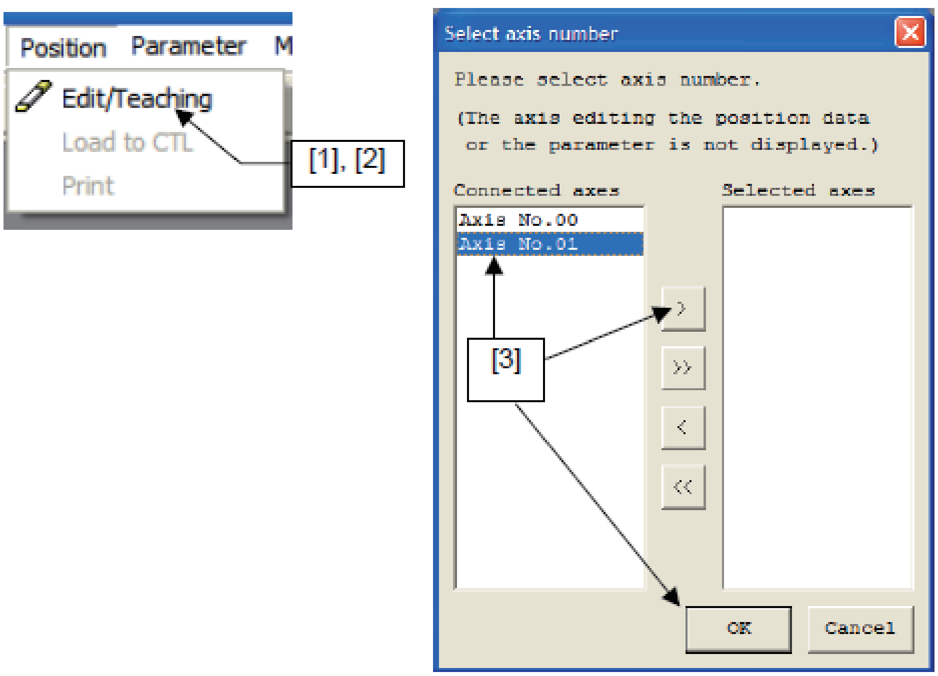


(6) “0EE: Absolute encoder error (2)” generates.

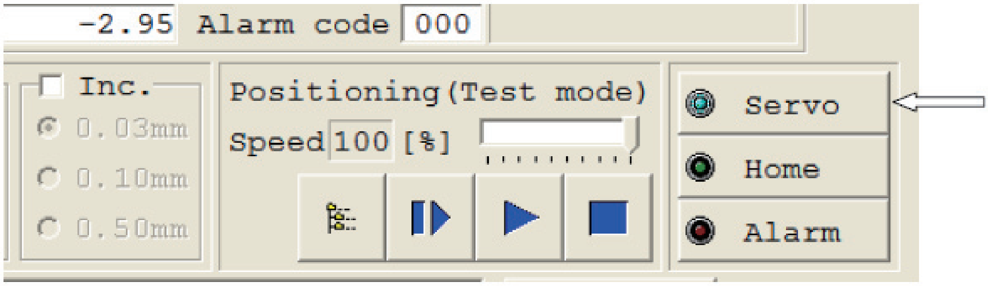


(7) Select **Yes (Y)**.

(8) From **Position (T)** [1], select **Edit/Teach (E)** [2], select the applicable address [3], and then select **OK**.

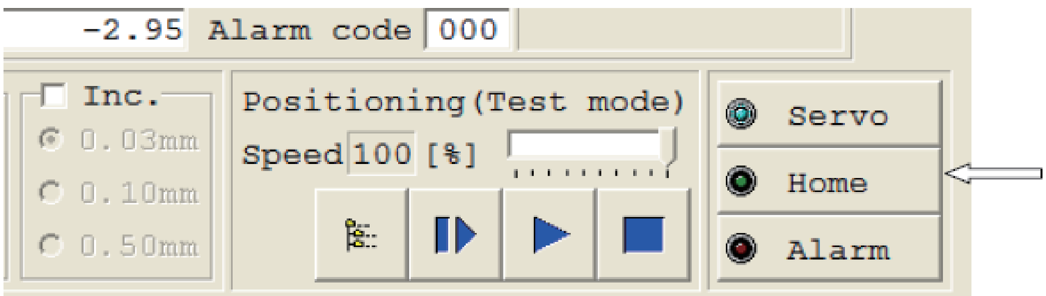


(9) When the position data dialog box appears, click the servo ON button.



After the servo has turned on properly, the servo lamp illuminates in blue.

(10) Click the home return button.



After the home return is successfully completed, the home lamp illuminates in blue.

This completes the absolute reset.

4.5.2 Performing an Absolute Reset from the Host

An absolute reset is performed by inputting the home return signal from the host PLC through the Gateway R unit, followed by home return operation.

(1) Supply the main power (24 VDC) to the Gateway R unit, controller unit and simple absolute R unit.
(2) An absolute encoder error (2) alarm is output.
(3) Input the RES signal to reset the alarm.
(4) Cancel the STP signal (pause).
(5) Input the SON signal (servo ON).
If the signal command has been successful, the SV lamp on the controller unit illuminates in green.
(6) Input the HOME signal (home return) to perform home return operation.
If the signal command has been successful, the SV lamp on the controller unit illuminates in green upon completion of home return.
(7) The absolute reset is deemed complete when the home return is completed (HEND signal turns ON).

⚠ Caution

The network must be already set up before an absolute reset can be performed from the host PLC.

Chapter 5 Network Setup

5.1 How to Use the ROBONET Gateway Parameter Setting Tool

This section explains the parameter setting tool of Version 1.0.4.0 or later. To set up the network, use this tool to set the following items on the ROBONET side:
[1] Station number
[2] Baud rate over the field network
[3] Operation mode of each axis

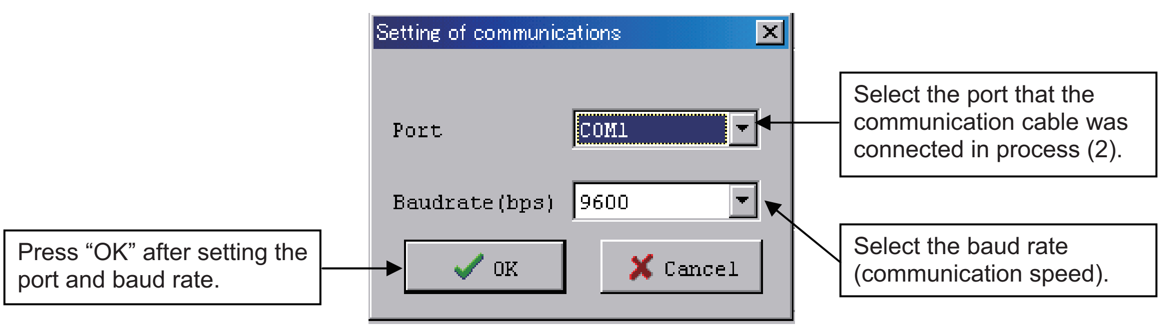
Before setting the above items, install the "gateway parameter setting tool" software in the PC.
The tool software is provided in the CD-ROM containing PC software. It can also be downloaded from IAI's website.

5.1.1 Operating Environment

(1) This tool can be used on a PC running any of the following operating systems:
(Set the display resolution to 800 x 600 (SVGA) or higher.)
• Windows98SE • WindowsMe • Windows2000 • WindowsXP
(2) Serial port
RS-232C serial port or USB port
(3) Connection cable
Communication cable for RC PC software

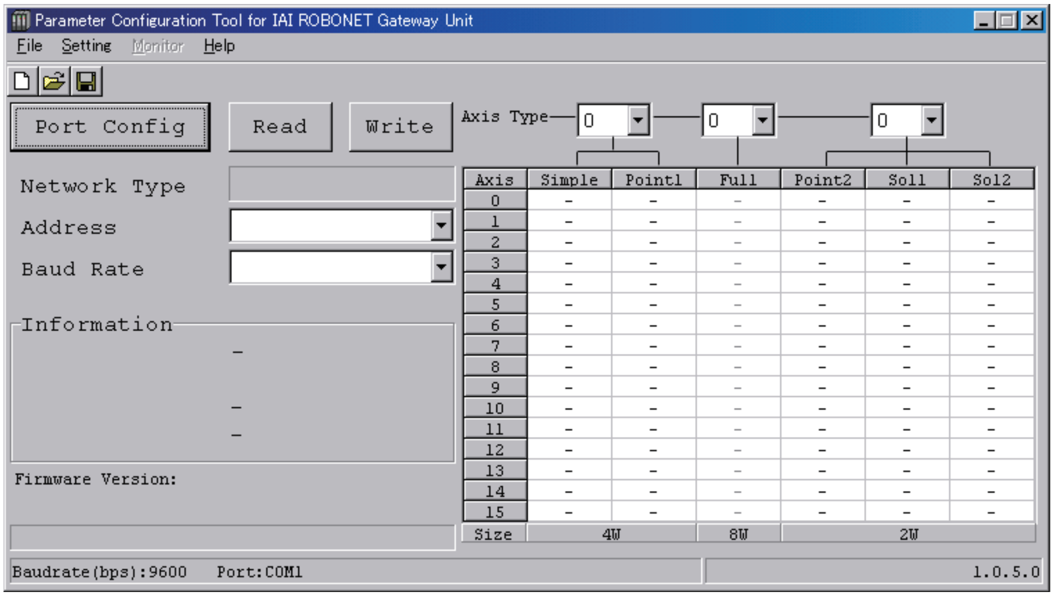
5.1.2 Launching the Setting Tool

(1) Set the display resolution of the PC to 800 x 600 (SVGA) or higher. If the tool is started when the display resolution is set to a lower option, a warning message will appear.
(2) Connect the Gateway R unit with the PC using the communication cable that came with the PC software, and set the operation mode of the Gateway R unit to "MANU."
(3) From the **Start** menu, click **Programs (P)**, click **IAI**, click **ROBONET**, and select **ROBONET Gateway Parameter Setting Tool** to launch the setting tool.
(4) Communication setup (when the tool is launched for the first time)
If the tool was launched for the first time, the communication setup dialog box is displayed before the main screen.
In this dialog box, select the COM port connecting the Gateway R unit and PC, as well as the applicable baud rate.
Select the COM port and baud rate of the PC to which the communication cable was connected in (2).
The tool will communicate with the Gateway R unit according to the "COM port" and "baud rate" set in this dialog box.
[Note] You can also change the settings made here, in the main screen.



Communication Setting Screen

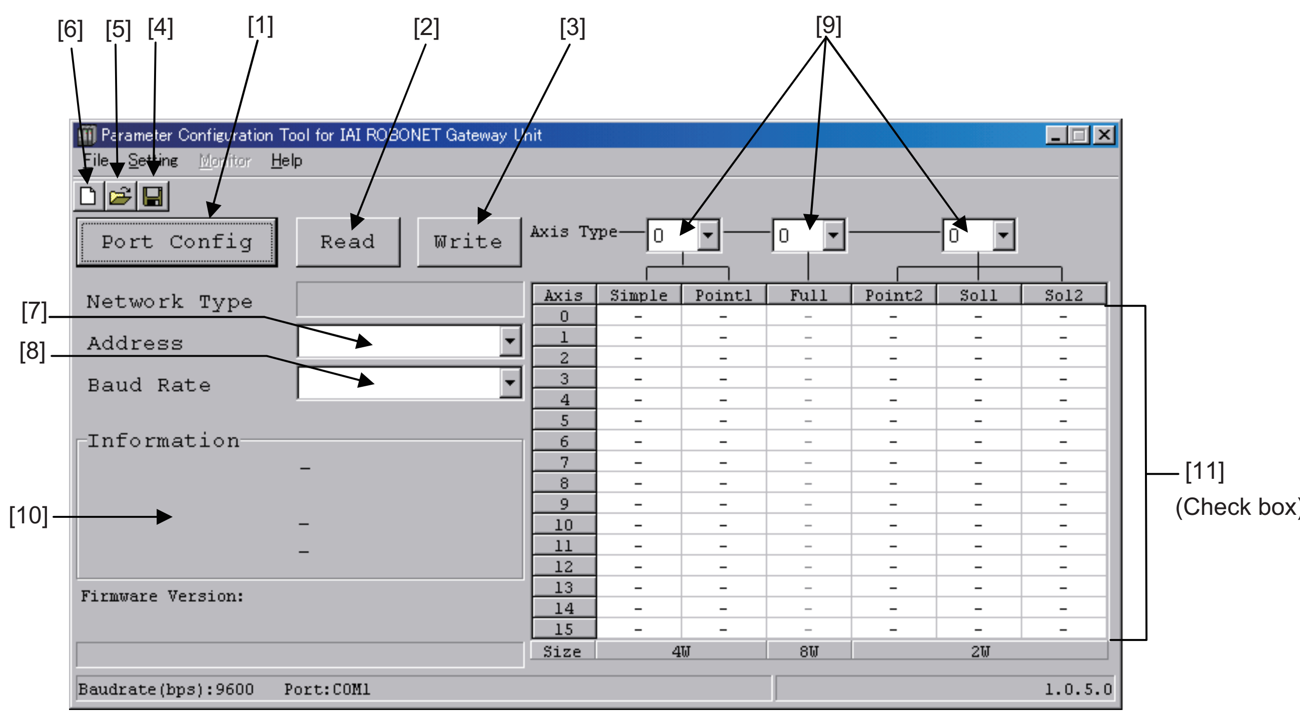
(5) The following main screen is displayed.



In the main screen, set the station number (address), baud rate, and operation mode of each axis.

5.1.3 Explanation of the Main Screen

The screen in the setting example is explained by assuming a CC-Link system.
The same screen is used with a DeviceNet, Profibus or RS485SIO system.



- Button operations
  - [1] Tool Communication Setup
    Clicking this button opens the communication setup dialog box.
  - [2] Load
    Clicking this button loads the parameters from the Gateway R unit.
  - [3] Transfer
    Transfer to the Gateway R unit the parameters that have been set.
  - [4] Save
    Save the currently set parameters to a file.
  - [5] Open
    Open the saved parameters.
  - [6] New
    Create new parameters.

- Combo box operations
  - [7] Address
    Select and set the address (station number) of the Gateway R unit to be used by the host.
  - [8] Baud Rate
    Select/set an appropriate baud rate when the network type is CC-Link or RS485.
    The baud rate is set automatically for all other network types. (The tool shows “Auto.”)
  - [9] Setting of number of axis
    This setting determines the number of occupied stations (CC-Link) or I/O size (DeviceNet, Profibus, RS485).

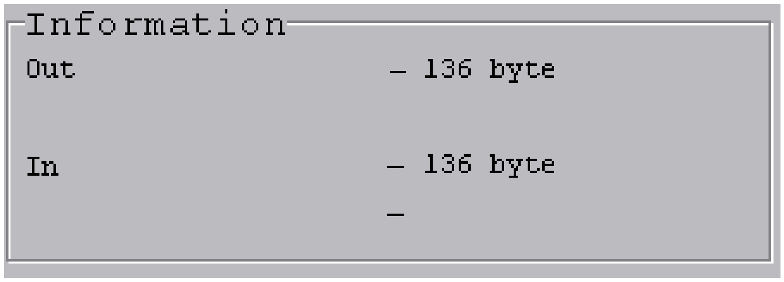
[10] Occupancy Information

The items shown in this area are used to check the current settings. The displayed items vary depending on the network type, as shown below.

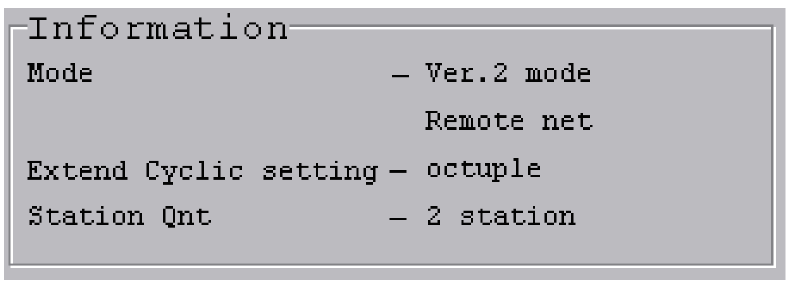
- Display of occupied port information when the network type is Profibus, DeviceNet or RS485

  Out --- Output data size (bytes)

  In --- Input data size (bytes)



- Display of occupied station information when the network type is CC-Link



[11] Editing the operation mode of each axis (checkboxes)

One of four operation modes can be set. Select a desired operation mode for each address using the corresponding checkbox.
Left-click the applicable cell to place an asterisk (*) in the cell.
The occupied I/O size per axis in each mode is as follows:

(1) Positioner 1 mode --- 4 words each for input and output
(2) Simple direct mode --- 4 words each for input and output
(3) Direct numerical specification (positioning) mode --- 8 words each for input and output
(4) Positioner 2 mode --- 2 words each for input and output
(5) Solenoid valve mode 1 --- 2 words each for input and output
(6) Solenoid valve mode 2 2 words each for input and output

Caution

1. If the positioner 1 mode, simple direct mode and direct numerical specification (positioning) mode are combined, set positioner 1 mode and simple direct mode axes sequentially starting from the youngest axis number, and then specify direct numerical specification (positioning) mode axes.
   Setting cannot be made in the reverse order.
2. Modes in the group that contains the positioner 1 mode, simple direct mode and direct numerical specification (positioning) mode cannot be combined with modes in the group that contains the positioner 2 mode, solenoid valve mode 1 and solenoid valve mode 2.
   (Example) The positioner 1 mode and solenoid valve mode 1 cannot be combined.

Number of connectable axes

- Number of axes in positioner 1 mode or simple direct mode = X
  Number of axes in direct numerical specification (positioning) mode = Y

  Under the above conditions, the numbers of connectable axes X and Y should satisfy the following formula:
  $X + 2Y \leq 16$ (axes)

  The number of I/O words is calculated by the formula below:
  $4 (X + 2Y) + 8$ (words)

- If the number of axes in the positioner 2 mode, solenoid valve mode 1 or solenoid valve mode 2 is 7:
  $Z \leq 16$ (axes)

  The number of I/O words is calculated by the formula below:
  $2Z + 8$ (words)

Setting Ranges

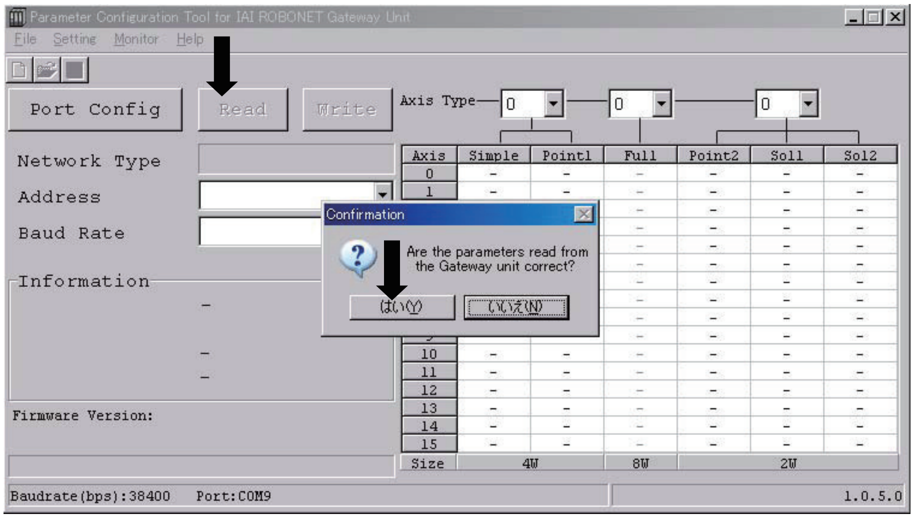
Network type	CC-Link	DeviceNet	Profibus	RS485SIO	
				Modbus gateway mode	SIO through mode
[7] Address	Desired value from 1 to 64 (Normally the master unit has address 0.)	Desired value from 0 to 63 (Normally the master unit has address 63.)	Desired value from 1 to 125	63 (fixed)	-
[8] Baud rate	156 Kbps 635 Kbps 2.5 Mbps 5 Mbps 10 Mbps	Auto	Auto	9.6 Kbps 19.2 Kbps 38.4 Kbps 57.6 Kbps 115.2 Kbps 230.4 Kbps	38.4 Kbps 57.6 Kbps 115.2 Kbps 230.4 Kbps
[10] Displayed occupancy information I/O size (bytes)	-	Number of (positioner 1/simple direct mode) axes x 8 + Number of direct numerical specification (positioning) mode axes x 16 + 16 Or, Number of positioner 2 mode axes x 4.			-

5.1.4 Operating Procedures

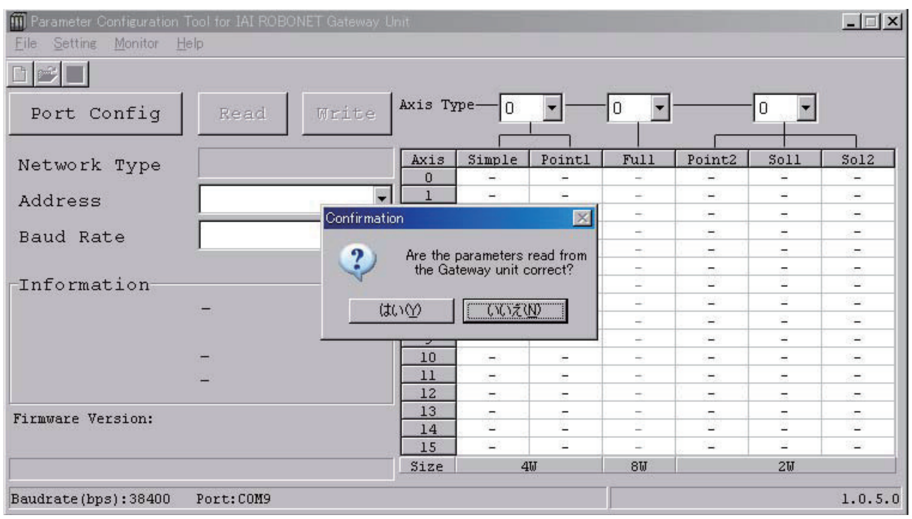
(1) Loading the parameters

This tool establishes communication with the Gateway R unit when the parameters are loaded. Accordingly, always load the parameters if the tool or Gateway R unit has been restarted.

[1] Click the **Load** button. When a message box appears, asking if you want to permit a parameter load, select **Yes** to load the parameters.



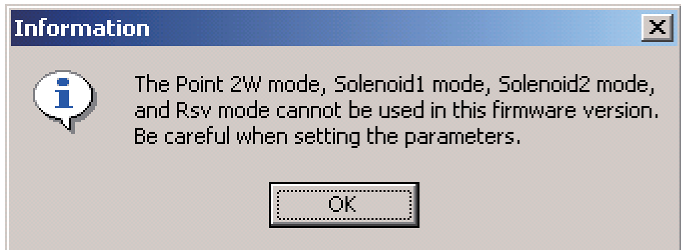
[2] When all parameters have been loaded, a message box appears to inform you of the completion of load. Click **OK**.



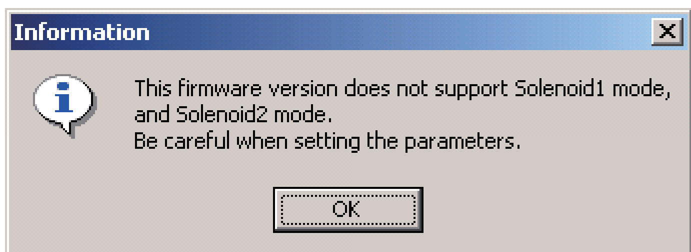
[3] If the tool has failed to load the parameters, the following message appears.

Caution

If the firmware of the Gateway R unit does not support the positioner 2 mode, solenoid valve mode 1 or solenoid valve mode 2, the following message will appear:



When the firmware version is 000A or older



When the firmware version is 000B

(2) Editing (setting) the parameters

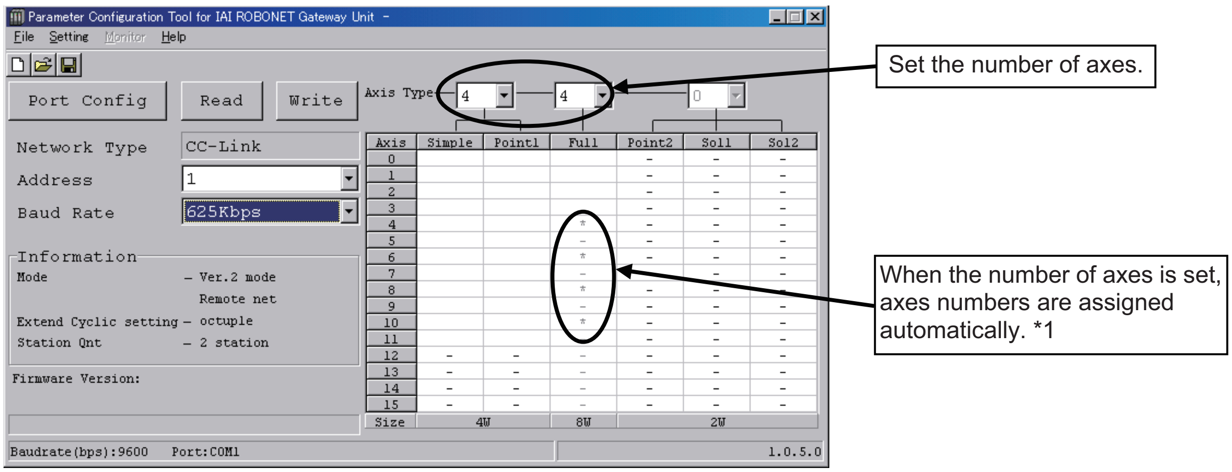
Edit the address, baud rate and enable operation according to the explanations given in 5.1.3.

(3) Editing (setting) the operation mode of each axis

Set the operation mode of each axis using the checkboxes shown on the right side of the screen.

- Example of using four axes operating in the simple direct mode/positioner 1 mode and four axes operating in the direct numerical specification mode (positioning mode)

[1] Setting of number of axis
Set the number of axes in each mode above the check boxes.

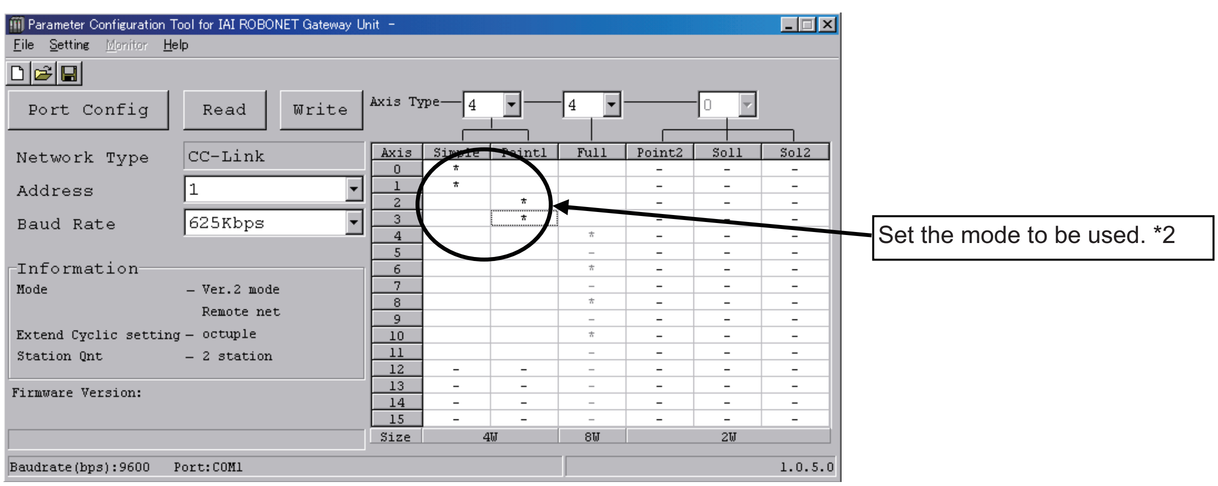


*1 Axes in the direct numerical specification mode (positioning mode) are assigned automatically after the axes in the simple direct/positioner 1 modes. Axes in the direct numerical specification mode (positioning mode) cannot be assigned before or between axes in the simple direct/positioner 1 modes.

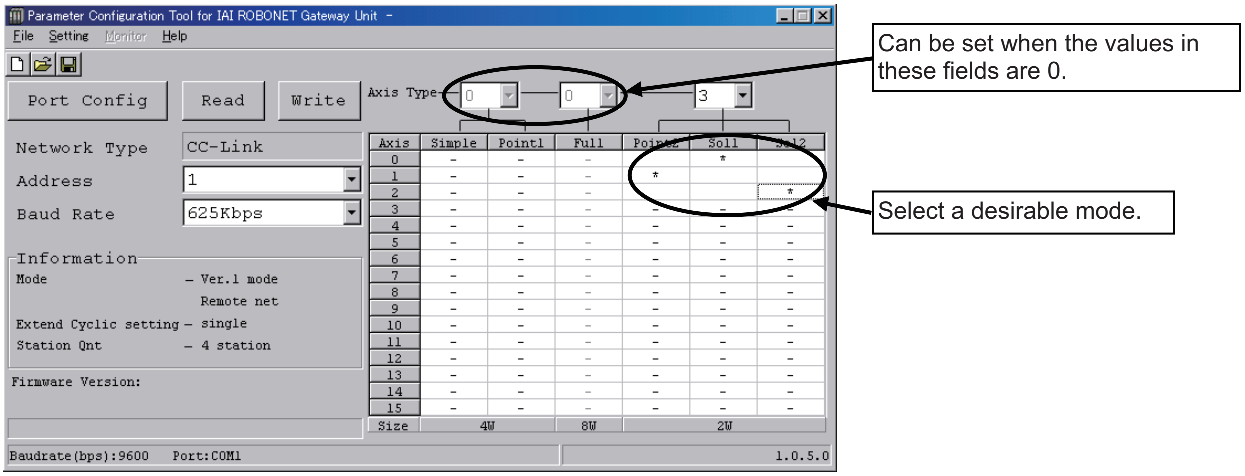
[2] For axes used in the simple direct/positioner 1 modes, click an applicable cell to the right of each applicable axis number to specify which mode will be used.

*2 Each time a cell is clicked, the display will cycle as follows: blank (not selected) → * (selected) → (*) (reserved axis) → blank.

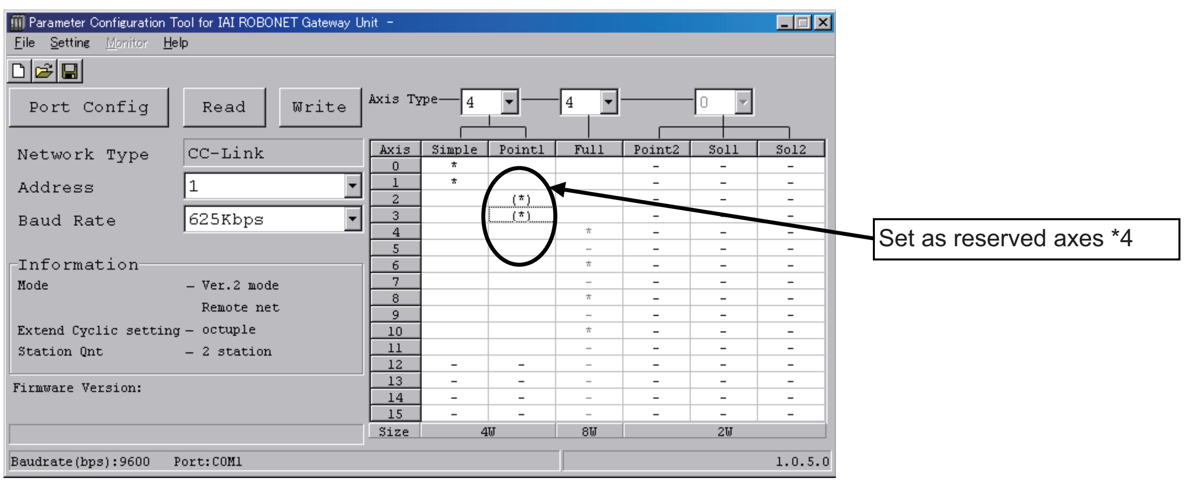
If the simple direct mode is set for axes 0 and 1 and the positioner 1 mode for axes 2 and 3, the screen will look like the one shown below.



■ Example of Using in Positioner 2 Mode, Solenoid Valve Mode 1 or Solenoid Valve Mode 2
If a 0 number of axis is set in the simple direct/positioner 1 mode or direct numerical specification mode (positioning mode), the positioner 2 mode, solenoid valve mode 1 or solenoid valve mode 2 can be set.
*3 Every time a cell is clicked, its status cycles in the sequence of blank (not selected) → * (selected) → (*) (reserved axis) → blank.



■ Setting of reserved axes
You can set reserved axes in consideration of future expansion of axis configuration.
Click the cell of each applicable axis to display the (*) mark.
An example of setting axes 2 to 3 as reserved axes in the positioner 1 mode is shown below.

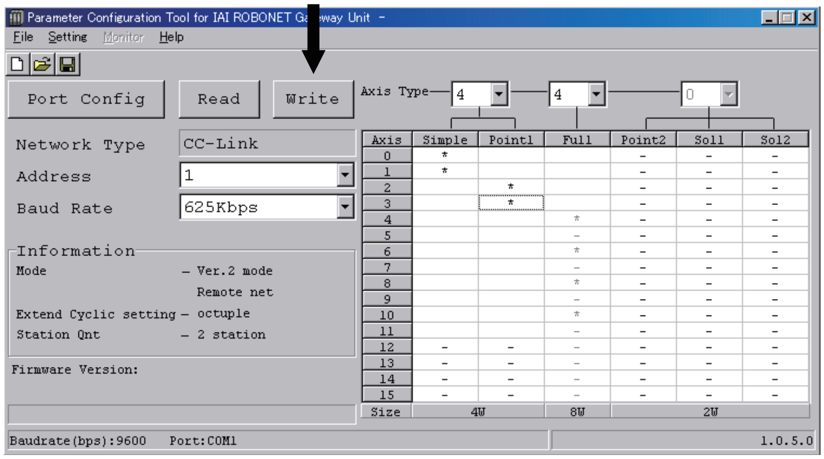


*4 Any axis of axis No. 0 to 15 can be set as a reserved axis.
The data areas of reserved axes are also treated as occupied.

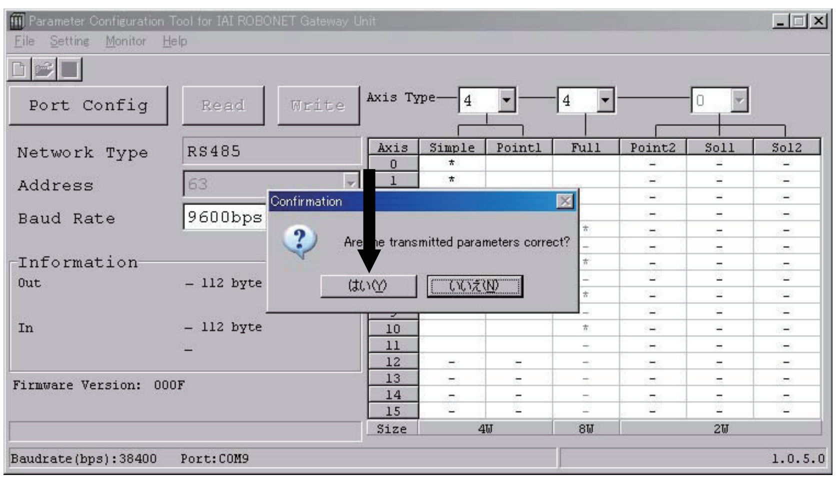
(4) Transferring the parameters

When all necessary items have been edited (set), transfer the parameters to the Gateway R unit.
When transferring the parameters, set the operation mode of the Gateway R unit to "MANU."

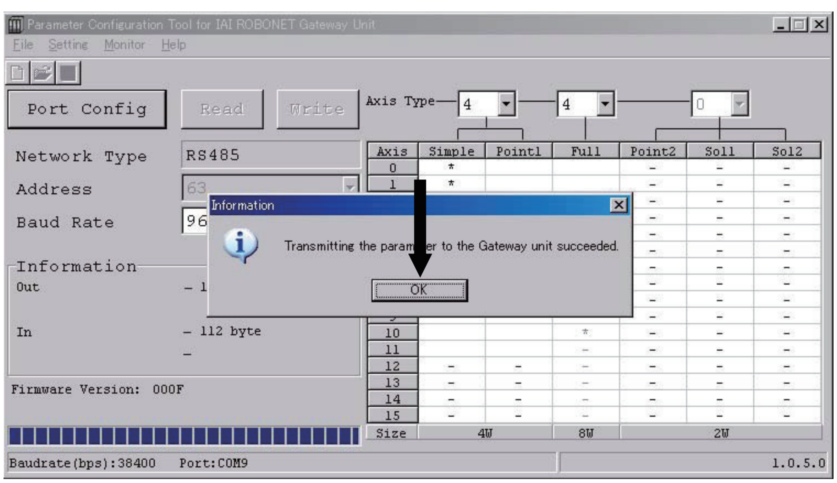
[1] Click the **Transfer** button.



[2] When a message box appears to confirm writing of parameters, click **Yes (Y)**.



[3] When all parameters have been written, click the **OK** button.

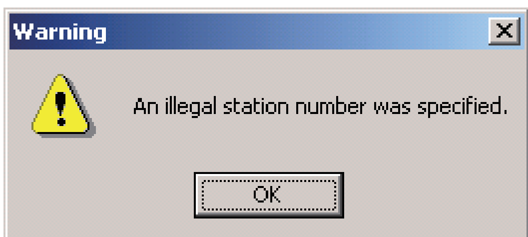


Caution

If one of the following warning messages appears, the parameters contain one or more invalid settings. Correct the applicable setting or settings, and then transfer the parameters again.

- If not all items have been selected in the editing of operation mode for each axis, the following warning message will appear and the transfer will stop.

- In a CC-Link system, a warning message will appear if the following condition is not satisfied and the transfer will stop.
  Selected station number + Number of occupied stations determined by the final number of selected axes – 1 (station number of the selected station) $\leq$ 64



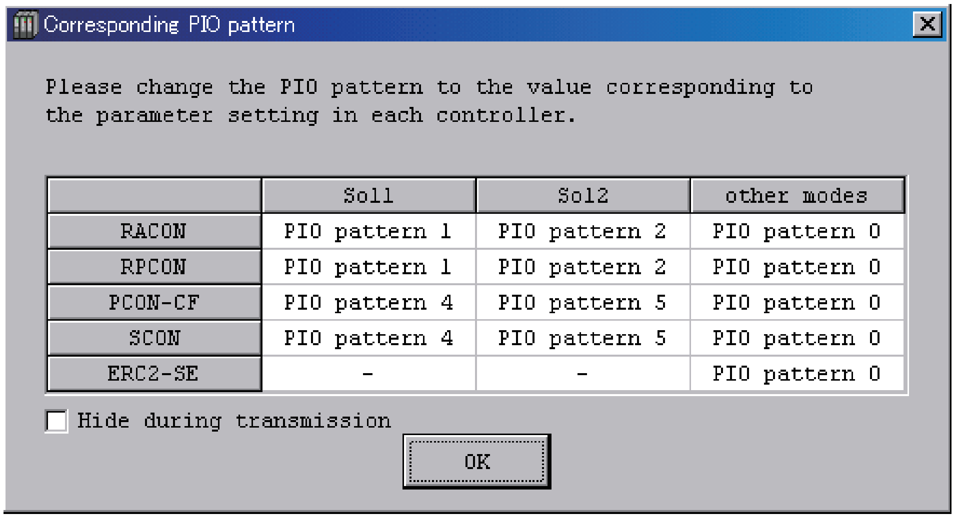
Caution

If parameters are transferred while the Gateway R unit is operating in the AUTO mode, the following warning message will appear. Change the operation mode to MANU and then transfer the parameters again.

If **OK** is clicked four times or more in the AUTO mode despite the warning, transfer will be forcibly terminated.

● Reference

Once the data has been transferred, the following screen opens.
You can check on this screen the PIO pattern number of the applicable controller you should set for the specified mode.
If the "Do not show this screen after the transfer" check box is selected in the bottom left-hand corner of the screen, this screen will no longer appear from the next transfer.



Corresponding PIO pattern

Please change the PIO pattern to the value corresponding to the parameter setting in each controller.

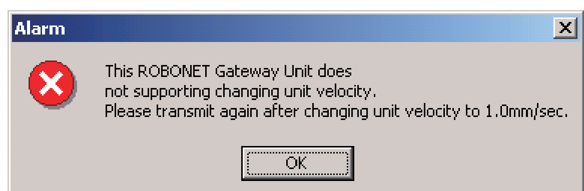
	Sol1	Sol2	other modes
RACON	PIO pattern 1	PIO pattern 2	PIO pattern 0
RPCON	PIO pattern 1	PIO pattern 2	PIO pattern 0
PCON-CF	PIO pattern 4	PIO pattern 5	PIO pattern 0
SCON	PIO pattern 4	PIO pattern 5	PIO pattern 0
ERC2-SE	-	-	PIO pattern 0

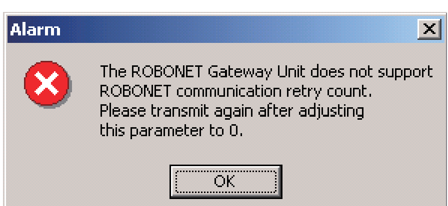
Hide during transmission

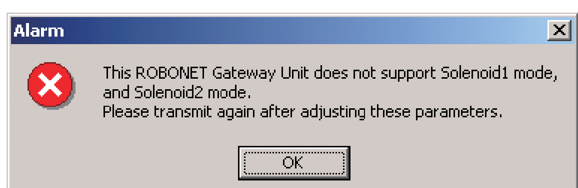
OK

Caution

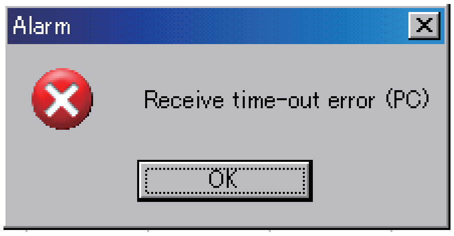
If the firmware version of the Gateway R unit does not support any new function you have set by a corresponding parameter, an attempt to transfer the parameters will cause one of the following messages to appear and the transfer will be cancelled. In this case, correct the setting of the applicable parameter by referring to (5), "Other settings" on the following page and transfer the parameters again.
The "2W modes" include the positioner 2 mode, solenoid valve mode 1 and solenoid valve mode 2.







If the parameter transfer has failed, the following warning messages will appear.



(5) Other settings (Special parameters)

Perform the settings explained in this section if the following functions are used.

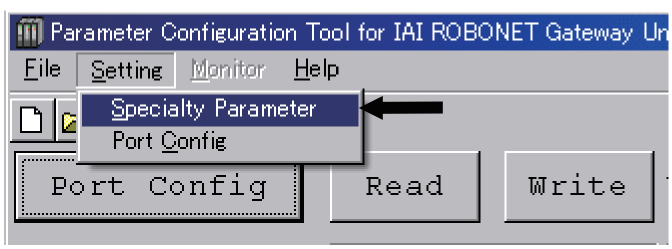
(i) Enable operation: Specify the control method of the controller to be applied when an enable operation is performed.

(ii) Status latch after servo OFF upon occurrence of ERR_T:
Select whether or not to turn OFF the servo of each controller and disable commands for all axes upon occurrence of ERR-T.

(iii) Servo OFF upon occurrence of ERR_C:
Select whether or not to turn OFF the servo of each controller upon occurrence of ERR-C.

(iv) Limit of speed (Limited to the direct numerical specification (positioning) mode):
Set either 1.0 mm/sec or 0.1 mm/sec as the unit of speed for axes for which the direct numerical specification (positioning) mode is set.

[1] Open the special parameter setting screen.
Click [Settings] from the menu bar on the main screen of the ROBONET gateway parameter setting tool and select [Special Parameters].

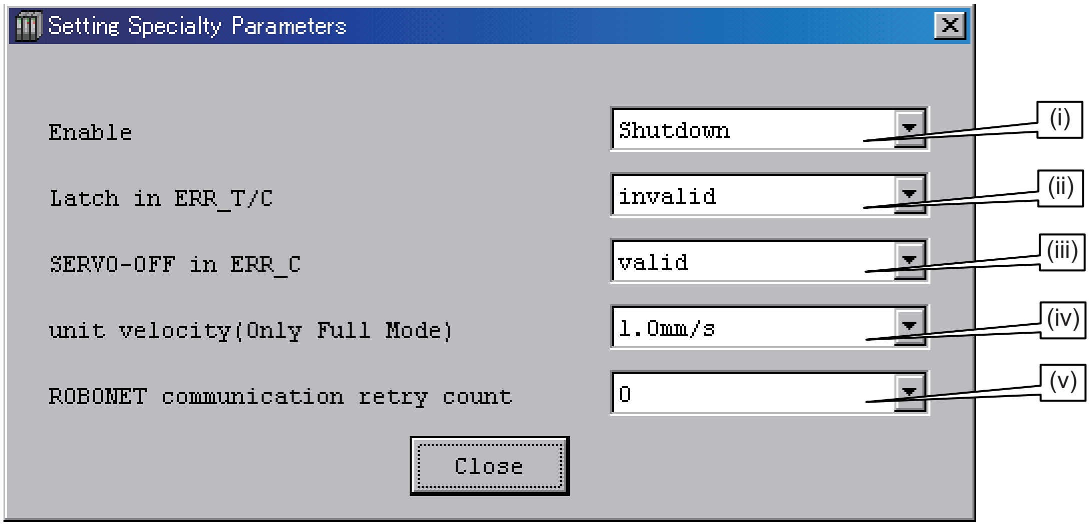


Caution

[Special Parameters] remains grayed out until [Load], [Open] or [New] is selected.

[2] Set the necessary items.

* Fewer setting items may be available depending on the versions of the ROBONET gateway parameter setting tool and firmware.



(i) Enable operation --- If the enable function is enabled, you can select the control method of the controller to be applied when an enable operation is performed.

(Enable function is enabled = User setting switch (SW1) on the Gateway R unit is ON)

Selected item	Operation
Shutdown control (factory setting)	Decelerate the actuator to a stop, and then turn OFF the servo and shut down the drive source.
Servo control	Decelerate the actuator to a stop, and then turn OFF the servo.

(iii) Status latch after servo OFF upon occurrence of ERR_T ---
You can select whether to turn OFF the servo of each controller and disable control commands upon occurrence of ERR-T. The factory setting is to disable this function. (Firmware version 000F or later)

Caution : When starting the system

[While starting, the system is unstable and the likelihood of ERR-T occurring is high. Accordingly, start the system by setting the control signal bit “RTE” to 1. (Refer to 3.7.2.)
Be sure to reset the “RTE” bit to 0 after confirming that the status signal bit “RUN” has switched to 1.

(iii) Servo OFF upon occurrence of ERR_C ---
You can select whether to turn OFF the servo of each controller upon occurrence of ERR_C. The factory setting is to enable this function. (Firmware version 000C or later)

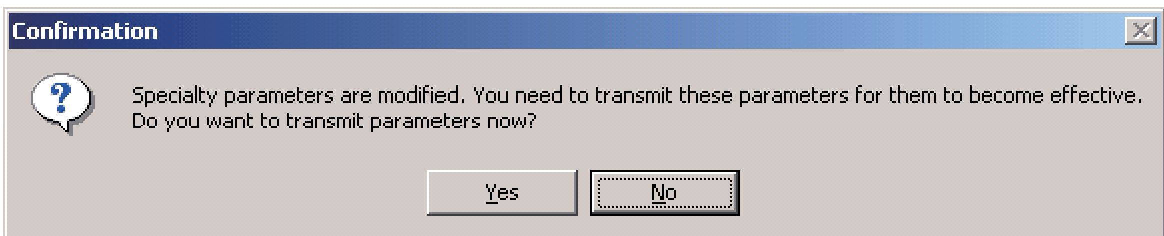
(iv) Unit of speed (Limited to the direct numerical specification (positioning) mode) ---
You can set either 1.0 mm/sec or 0.1 mm/sec as the unit of speed for axes for which the direct numerical specification (positioning) mode is set. The factory setting is 1.0 mm/sec. (Firmware version 000C or later)

(v) ROBONET communication retry count --- You can set a desired number from 0 to 6 to specify how many times ROBONET communication (communication between the ROBONET gateway and RACON or other unit) will be retried if unsuccessful. The factory setting is 2. (Firmware version 000F or later)

⚠ Caution

[The unit of speed (limited to the direct numerical specification (positioning) mode) cannot be changed unless the direct numerical specification (positioning) mode is set for at least one axis.

[3] When all special parameters have been set, click [Close] to close the screen. The following message appears.

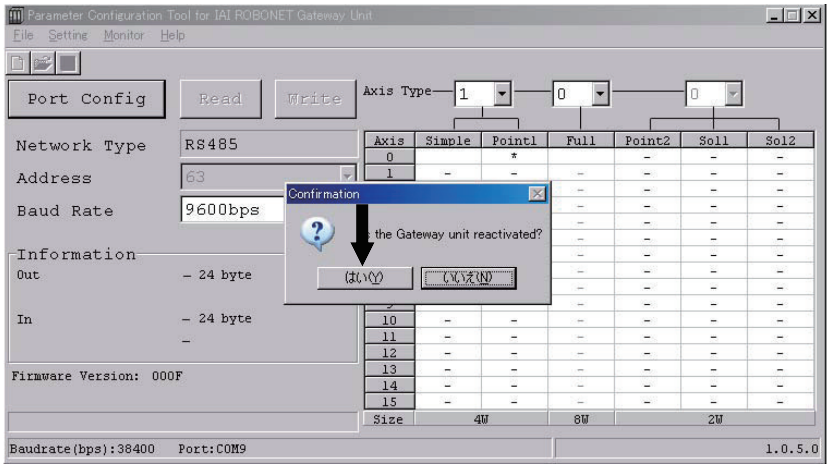


Click [Yes] to transfer the parameters. If [No] is selected, the parameters will not be transferred and any changes you have made to the parameters will not become effective.

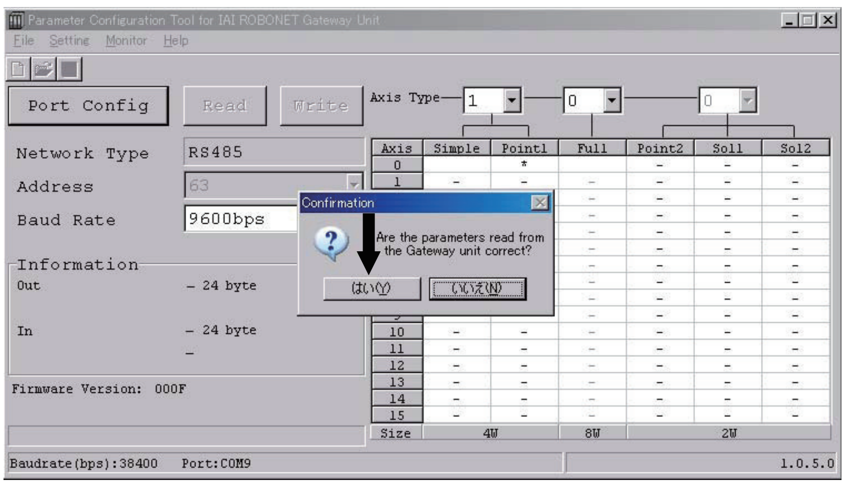
(6) Restarting the Gateway R unit

The Gateway R unit must be restarted to make the transferred parameters effective.

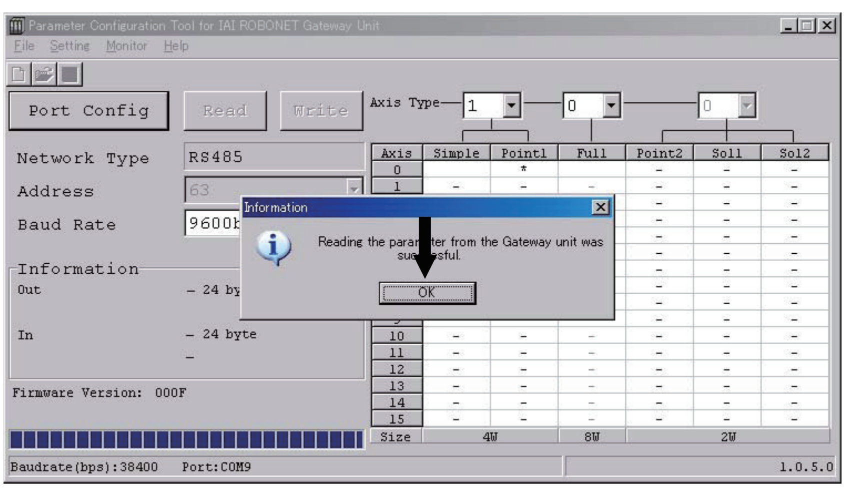
[1] When the parameter transfer is completed, a message box appears and prompts you to restart the unit, as shown below. Click **Yes (Y)**.



[2] After the unit has been restarted, a message box appears again, prompting you to load the parameters. Click **Yes (Y)**.

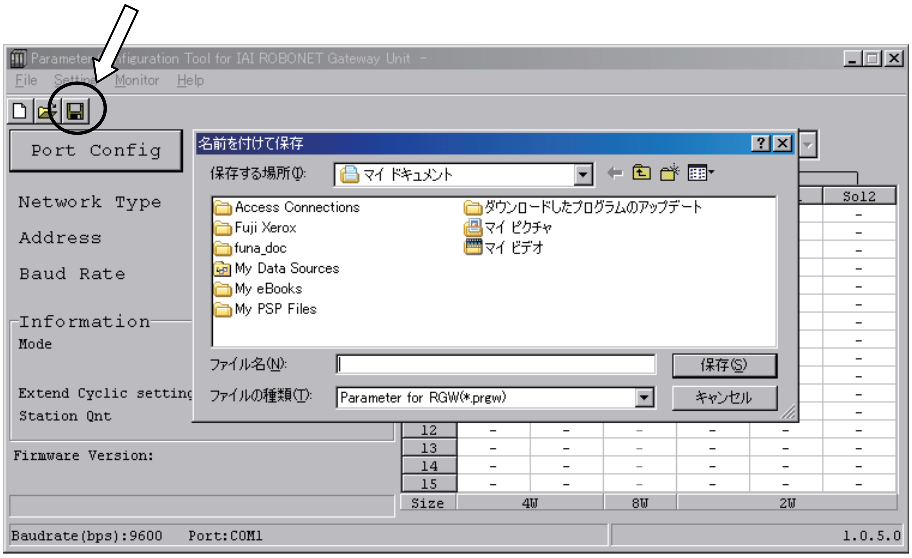


[3] When the parameter load is completed, click the **OK** button. Confirm that the displayed parameters are correct.



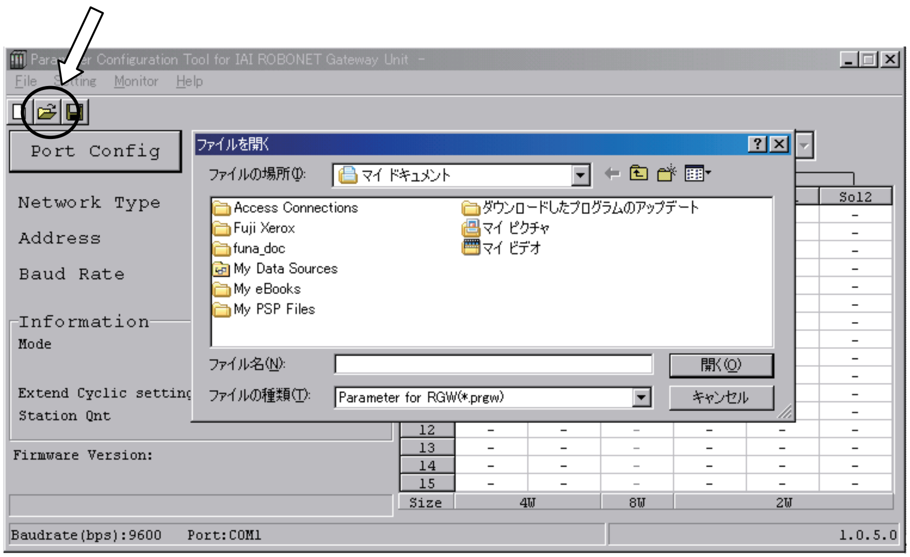
(7) Saving parameters

Save the gateway parameters you have set. Click the **Save to File** button in the top left-hand corner of the window, specify the destination and file name, and then click the **Save (S)** button.



(8) Opening saved parameters

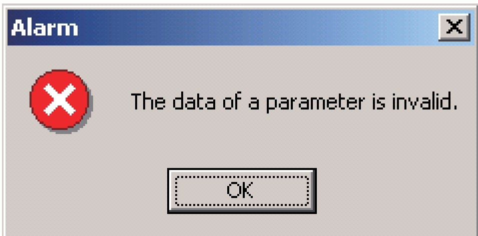
Click the **Open File** button in the top left-hand corner of the window, specify the file in which parameters are saved, and then click the **Open (O)** button.



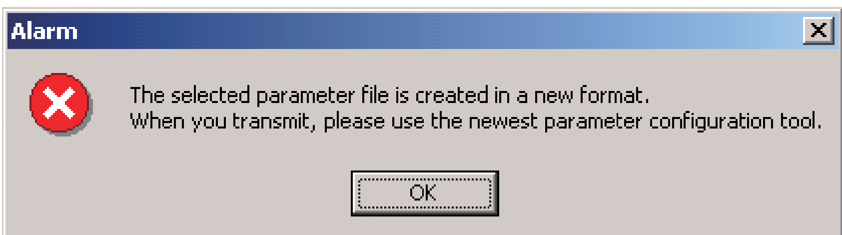
Caution

The following message may appear occasionally, although it should not be displayed in normal conditions of use.

1. The following error message will appear when a file is opened, if the parameter file contains undefined data or missing data.

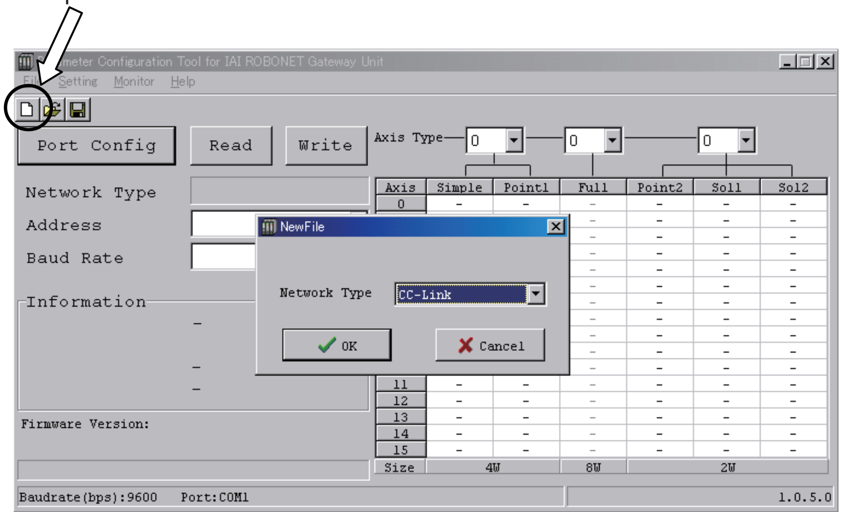


2. The following error message will appear if an attempt is made to open a parameter file created or saved with the setting tool of a newer version than the tool currently used. In this case, update the setting tool to the latest version.

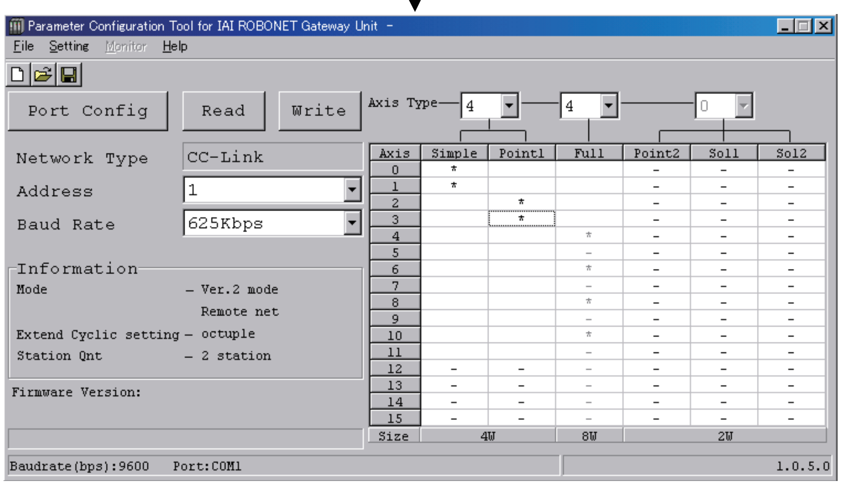


(9) Creating new parameters

Click the **Open File** button in the top left-hand corner of the window to open the following screen.
Select the network type and click the **OK** button. When the main screen for the selected network type appears, set each parameter.

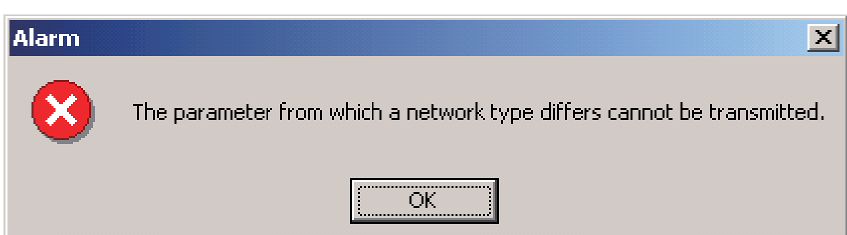


When CC-Link is selected as the network type



⚠ Caution

The parameters created here can be transferred. If the network type of the Gateway R unit to transfer the parameters to is different from the network type of the parameters, the following alarm message will appear at the time of transfer



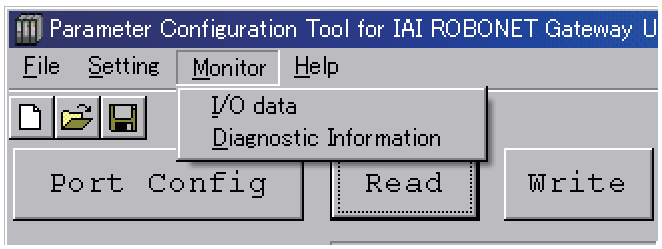
(10) Monitor Function

- You can monitor data received from the master and data sent to the master.
- You can also check how many communication errors (ERR-T, ERR-C) have occurred.

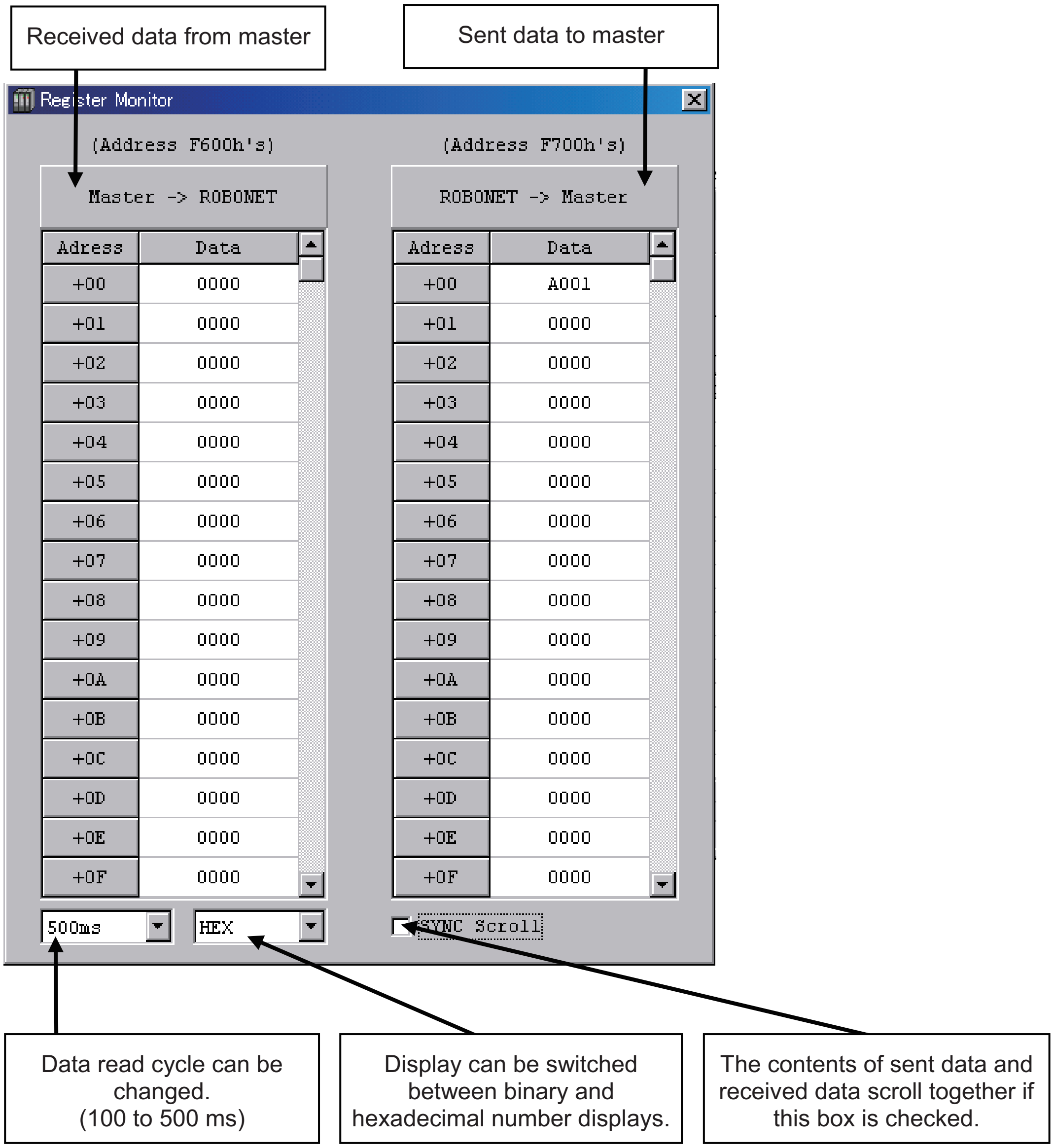
Caution

To use the monitor function, be sure to set the MODE switch on the Gateway R unit to the AUTO position. If this switch is in the MANU position, invalid data is displayed.

[1] Clicking [Monitor] from the menu bar on the main screen of the ROBONET gateway parameter setting tool opens the drop-down menu where you can select [I/O Data] or [Diagnostic Information] as shown below.



[2]-1 Select [I/O Data], and the register monitor screen will appear. (The default display mode is hexadecimal. The sample screen shown below is in the binary display mode.)

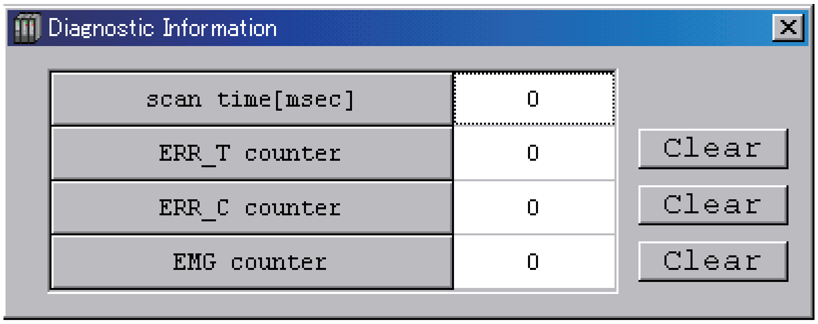


The farthest left digit of data represents the F bit (bit 15), while the farthest right digit represents bit 0.

Address	Data															
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
+00	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1
+01																

•
•

[2]-2 Select [Diagnostic Information], and the screen showing the number of occurrences of ERR-T/C will appear.
* Some items may not be displayed depending on the version of the ROBONET gateway parameter setting tool.



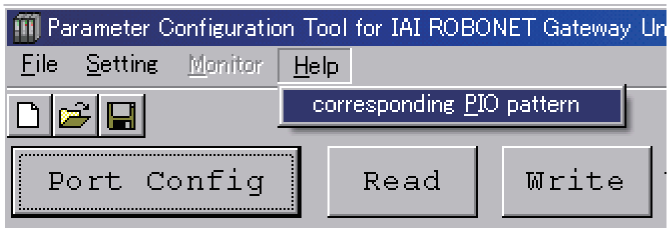
Caution

ERR-T and ERR-C may occur immediately after the power is turned on, but these errors will not affect operations.

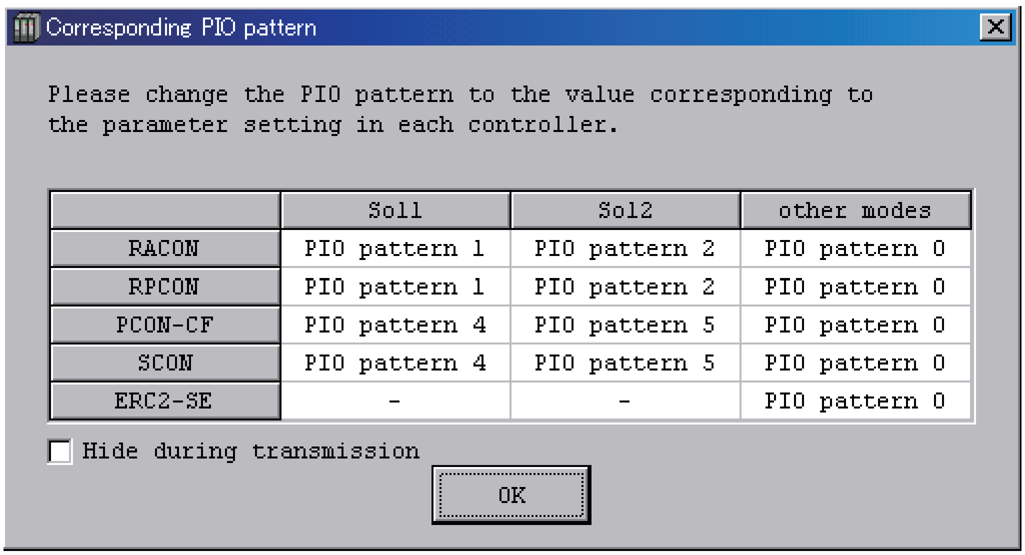
(11) Auxiliary Setting Function

You can check the PIO pattern number of the applicable controller you should set for the mode set with the gateway parameter setting tool.

[1] Click [Help] from the menu bar on the main screen of the ROBONET gateway parameter setting tool, and then select [PIO Pattern for Each Mode].



[2] Adjust the PIO pattern of the applicable controller (set by a parameter) to the mode you have just set.



This screen also appears after transferring the parameters.
If the “Do not show this screen after the transfer” check box is selected in the bottom left-hand corner of the screen, this screen will no longer appear after the transfer.

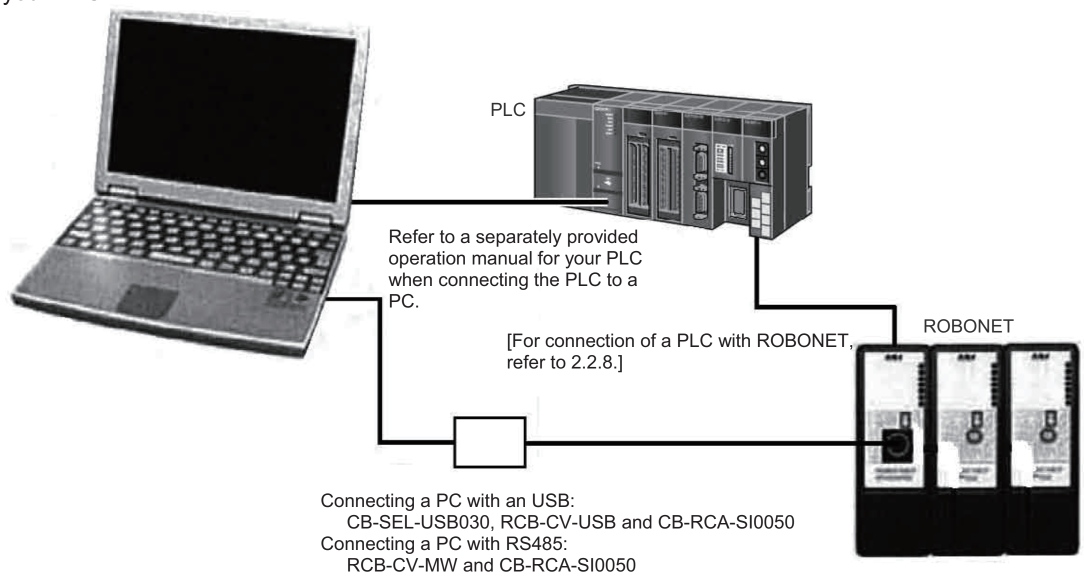
5.2 Setting Up the Master

5.2.1 CC-Link

To operate a CC-Link system, the network parameters of the PLC must be set. These parameters are set using Mitsubishi Electric’s sequencer programming software GX-Developer.

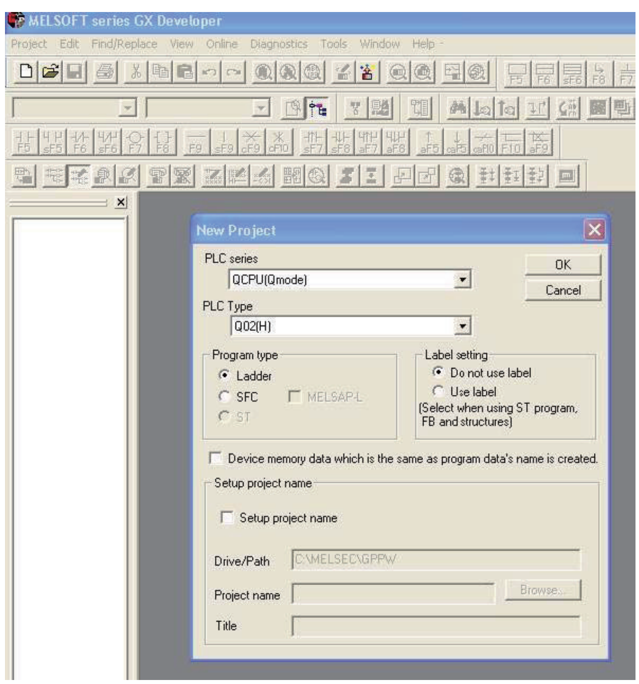
- Network parameters
  These parameters are set in the master station and include the number of CC-Link units connected, buffer memory of the master station (RX, RY, etc.), address of the CPU device to be refreshed automatically, number of retries after failed communication, and station information.

How each parameter is set is explained below, along with a setting example. For details, refer to the CC-Link operation manual for your PLC.



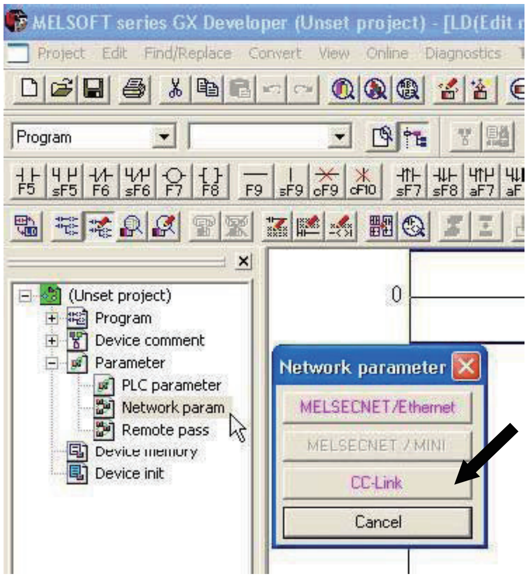
(1) Launching GX-Developer

Launch GX-Developer and click **New Project** from the **Project** menu. The screen below opens.
Set the series and type of the applicable PC. In this example, “QCPU (Q mode)” and “Q00” are set under “PC Series” and “ PC Type,” respectively. Click the **OK** button.

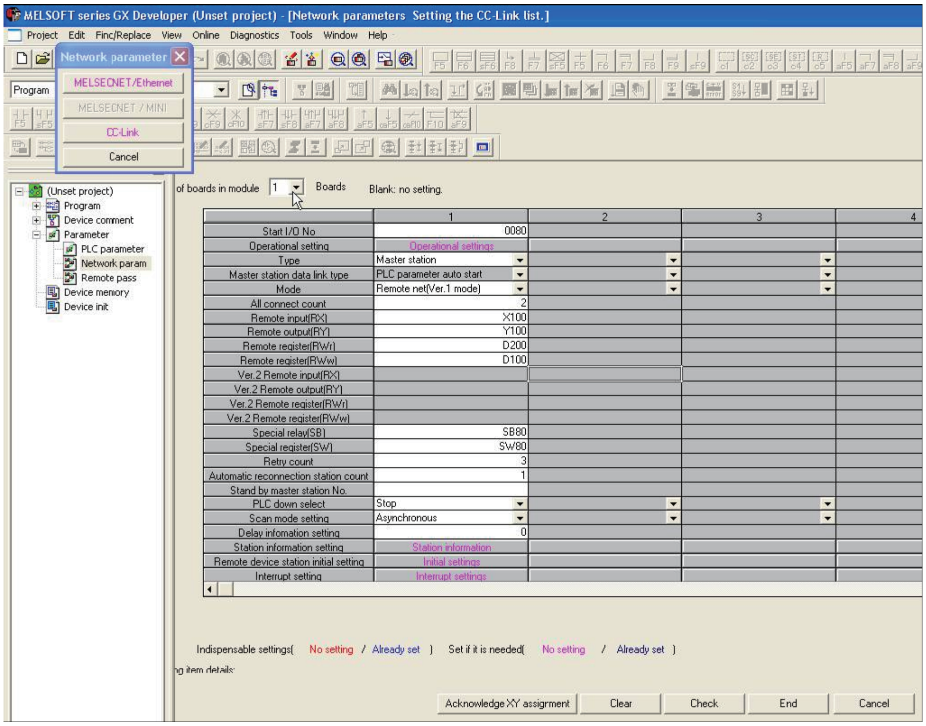


(2) Setting the parameters

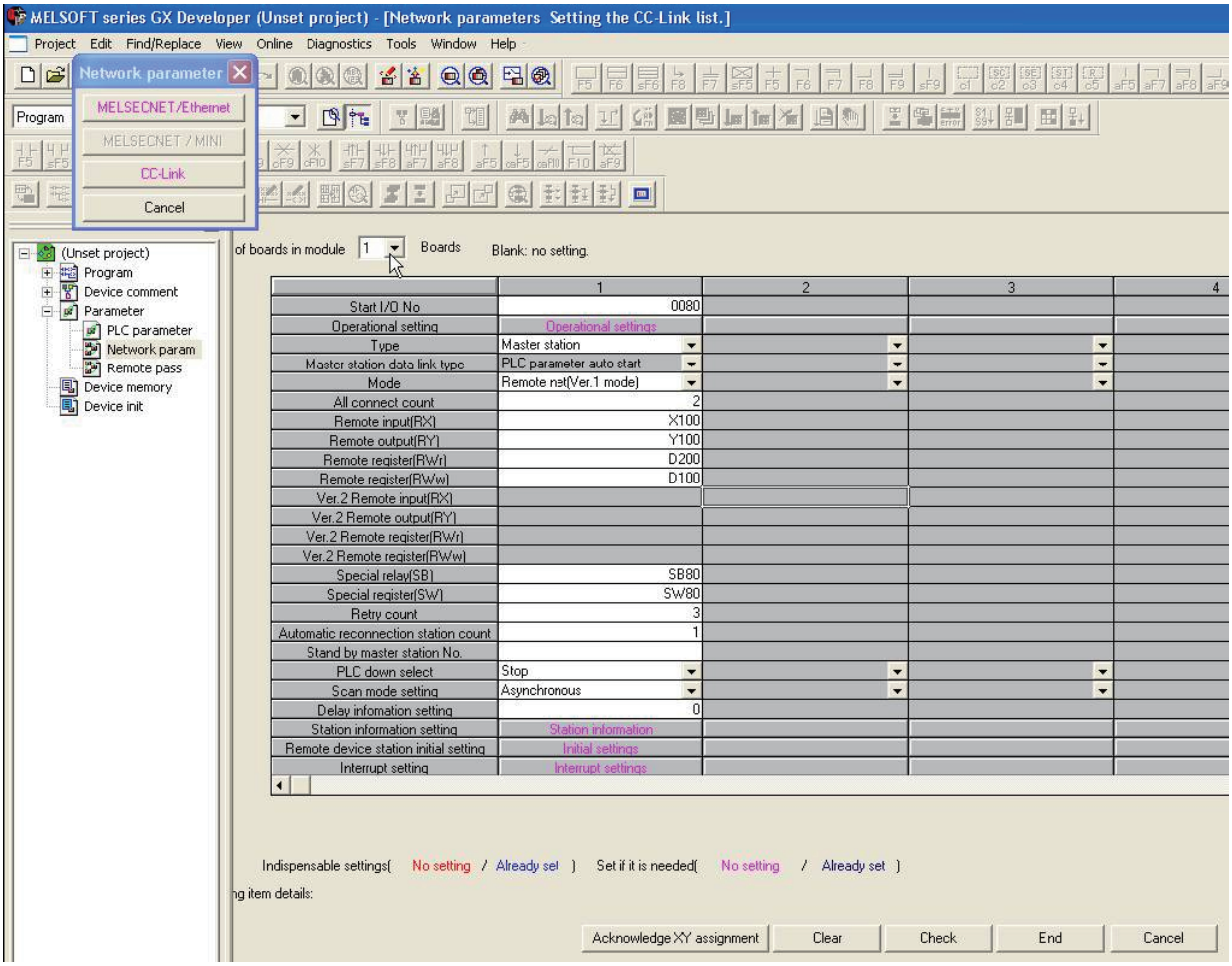
[1] In the project data list, double-click "Network Parameters." When the network parameter selection dialog box appears, click the **CC-Link** button.



[2] When the CC-Link network parameter setting screen appears, set "1" under "Number of Units."
(Master station is set for 1 in this operation.)



[3] Set other parameters as shown below. “Mode Setting” should be set to “Remote Network Version 1 Mode,” because the master is set as a version 1 remote device station according to the occupancy information reflecting the settings of ROBONET gateway parameters (refer to 5.2.2 (3), “Setting the operation mode of each axis”).

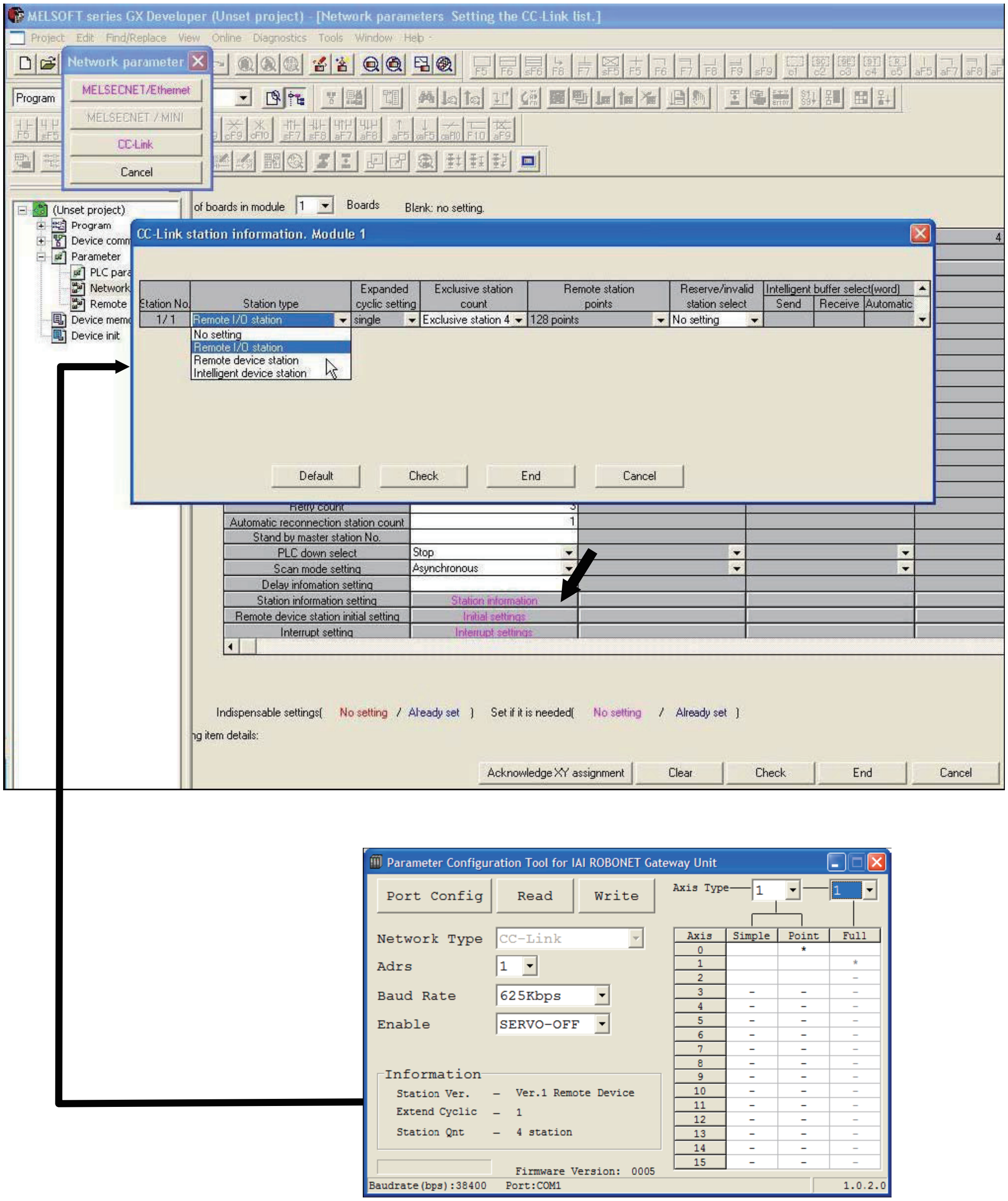


The system configuration parameters described in 5.2 are set as follows:

- “First I/O No.” --- I/O address of the master unit. Set to “0080.”
- “Total Number of Connected Units” --- Number of remote stations. Set to “1.”
- “Remote Input (RX) Refresh Device” --- X100
- “Remote Output (RY) Refresh Device” --- Y100
- “Remote Register (RWr) Refresh Device” --- D200
- “Remote Register (RWw) Refresh Device” --- D100
- Special Relay (SB) Refresh Device --- SB80
- Special Relay (SW) Refresh Device --- SW80

Assign the buffer memory of the master station to the internal devices of the PLC-CPU. (Desired assignments can be specified.)

[4] Click the **Station Information** button to open the edit screen for station information unit 1, set the remote station as shown below, and then click the **Apply** button at the bottom of the screen.
The settings should conform to the occupancy information reflecting the settings of ROBONET gateway parameter.
The ROBONET gateway parameter setting screen below applies to the example of system configuration used in 5.2.

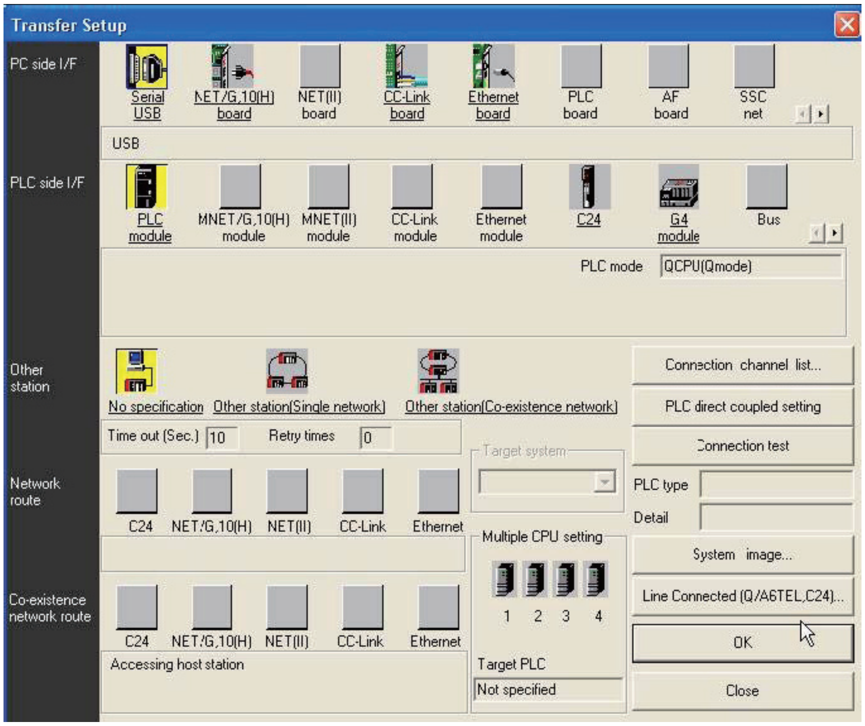


[5] Save the project.

(3) Writing the parameters

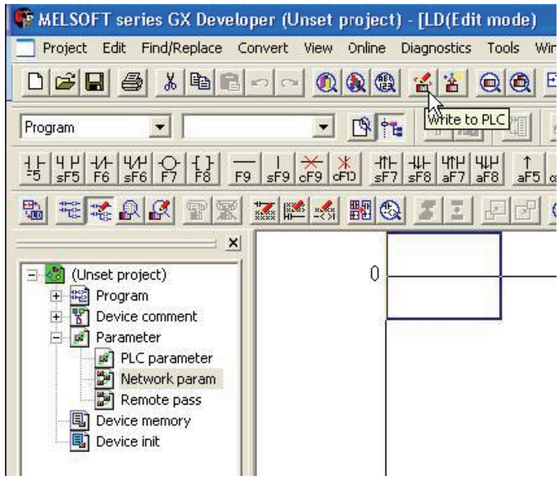
Write to the PLC the parameters you have set in (2).

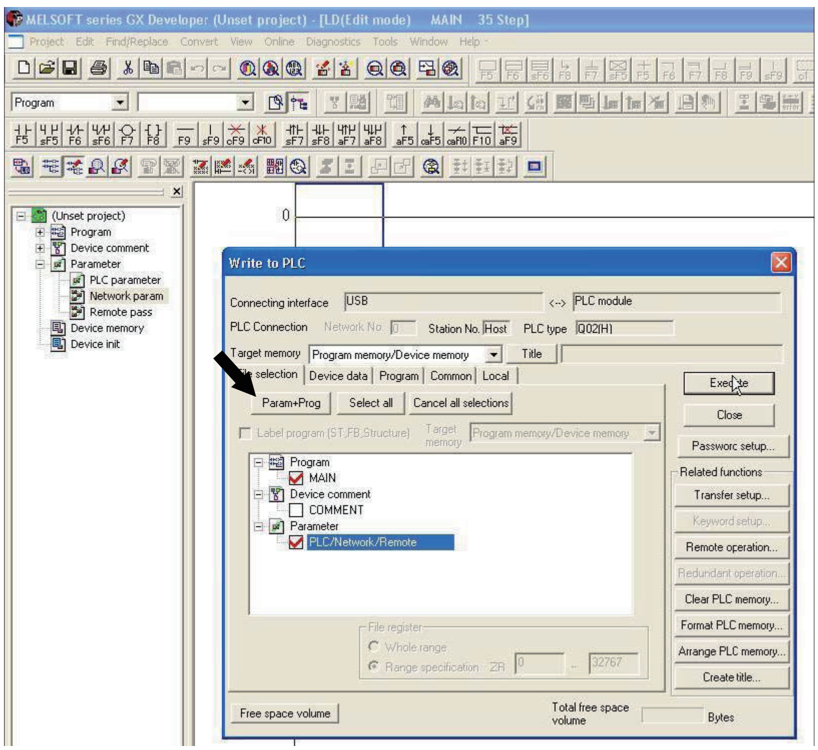
[1] Specifying the connection destination
Click **Specify Connection Destination (C)** from the **Online (O)** menu. The following connection destination specification screen appears.



Confirm that the respective items are set as follows:
PC I/F: Serial USB
PLC I/F: CPU unit
Other Station: Other station not specified
If the settings are correct, click the **OK** button.

[2] Writing
Click the PC write tool button to display the PC write dialog box.





In the PC write dialog box, click the **Parameters + Programs** button and then select “MAIN” and “PC/Network” under “Programs” and “Parameters,” respectively.
Clicking the **Write** button starts the writing of parameters. When all parameters have been written, a confirmation message box appears. Click **OK** and then **Close** to complete the parameter write.

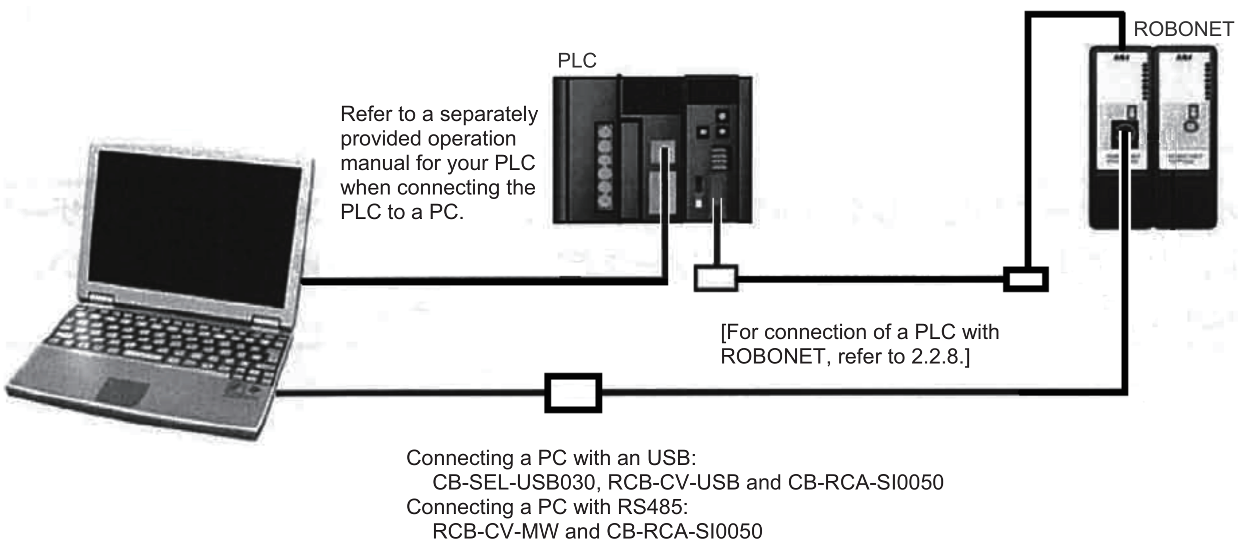
[3] Resetting the PLC-CPU
The parameters will become effective when the CPU of the PLC is reset.

5.2.2 DeviceNet

Slave addresses are assigned using DeviceNet Configurator (addresses can be assigned freely).
This configurator by Omron comes preinstalled with the EDS files for Omron's DeviceNet products. However, the EDS file for ROBONET is not preinstalled and must be installed separately. Download the EDS file for ROBONET (robonet_2_1.eds) from our website at the following address:

Website: http://www.intelligentactuator.com

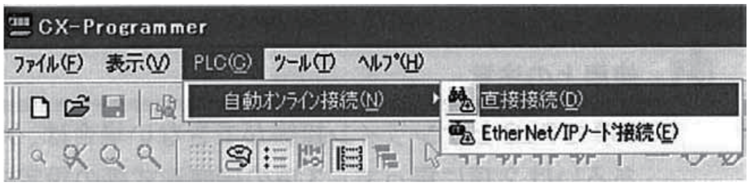
In this section, the network configuration procedure using CX-Integrator based on free assignment is explained (using the following system configuration as an example).



(1) PLC online connection

[1] Launching CX-Programmer

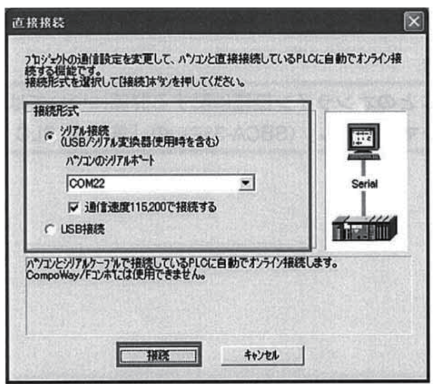
- Connect the PLC and PC using a dedicated RS232C cable, and turn the PLC power on.
- Launch CX-Programmer.
- Select [PLC] from the menu bar, select [Automatic Online Connection], and then select [Direct Connection].



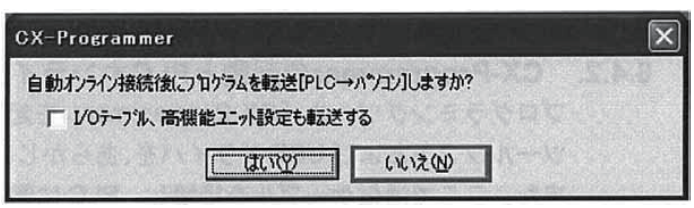
[2] Connecting with the PLC

- Select “Serial connection” in the [Direct Connection] screen.
- Select the COM port number to which the PLC is connected in the “PC serial port” field.
- Select the checkbox for “Connect at the communication speed of 115,200.”
- Click [Connect].

* If multiple “PC serial ports” exist, open Window’s Device Manager, and select the same port as the “COM port number” described under “Ports (COM & LPT).”



- When the following dialog box appears, click [No].



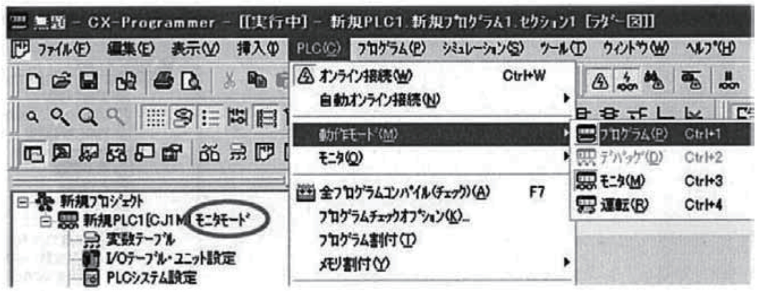
- When automatic connection is established, confirm that the connection is now online.

* The connection is online if the “  icon” is selected (depressed).

(2) Creating an I/O table

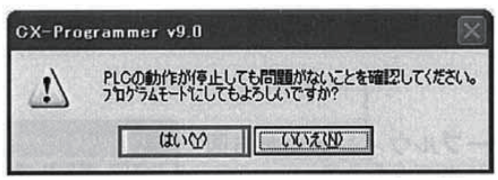
[1] Change the PLC operation mode to the “program mode.”

- Select [PLC] from the CX-Programmer menu bar, select [Operation Modes], and then select [Program].

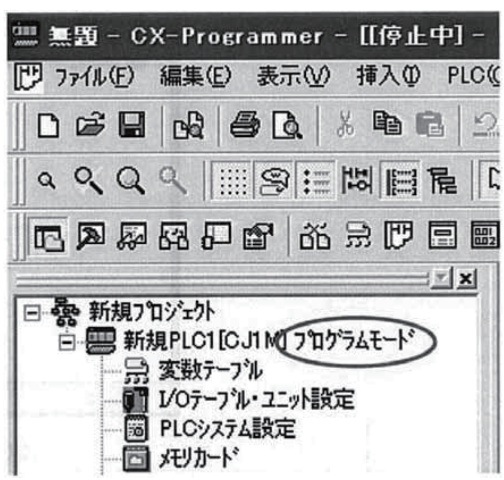


- When the dialog box appears, click [Yes].

* Dialog boxes may not appear depending on the CX-Programmer environment settings. The following explanation is based on the assumption that the checkbox for “Check all operations that affect the PLC” is selected.

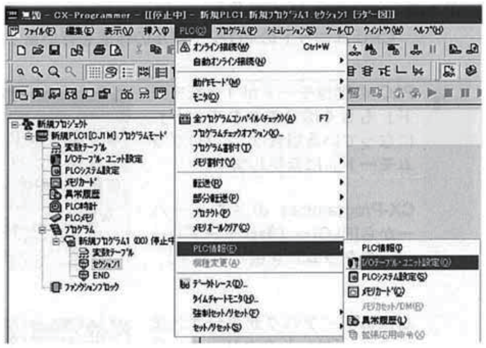


- Confirm that “Program Mode” is displayed to the right of the PLC model on the CX-Programmer project tree.



[2] Creating an I/O table

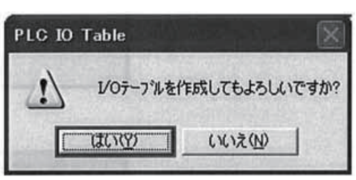
- Select [PLC] from the CX-Programmer menu bar, select [PLC Information], and then select [I/O Table/Unit Settings].



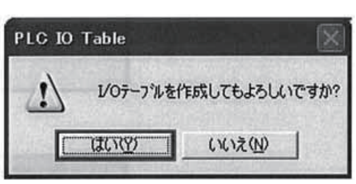
- The I/O table window appears.

- Select [Options] from the menu bar in the I/O table window, and then select [Create I/O Table].

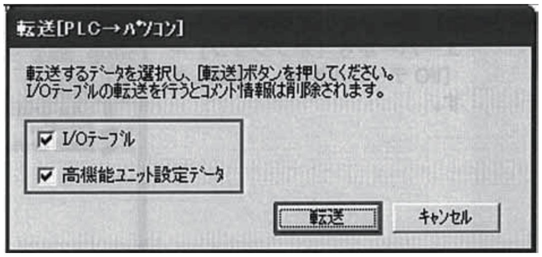
- When the following dialog box appears, click [Yes].



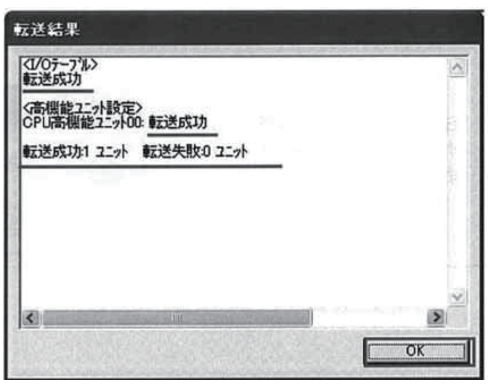
- When the following dialog box appears, click [Yes].



[3] Transferring an I/O table
- When the [Transfer [PLC → PC]] dialog box appears, select the checkboxes for [I/O Table] and [High-Function CPU Unit Settings Data], and click [Transfer].

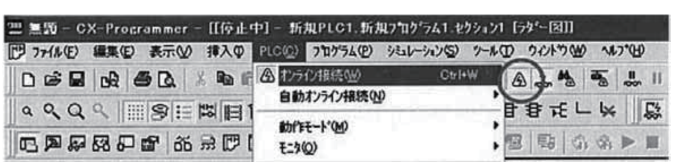


- When the transfer has been successful, the [Transfer Result] dialog box will appear.
- If the result shows “Transfer successful: 1 unit” and “Transfer failed: 0 unit,” the I/O table has been successfully created.
- Click [OK] after confirming that the transfer has been successful.



- Bring CX-Programmer offline. Select [PLC] from the menu bar and then select [Online Connection].

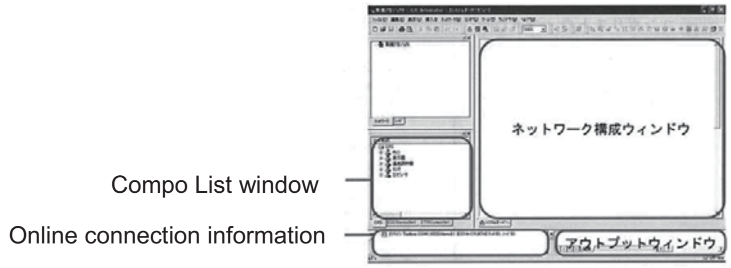
* The connection is offline if the “  icon” is not selected (not depressed).



(3) Installing the EDS file

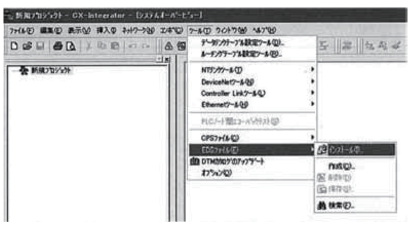
[1] Launching CX-Integrator

- Launch CX-Integrator.
- If the “Compo List window” is not displayed, select [Display] from the menu bar, select [Window] and then select [Compo List].



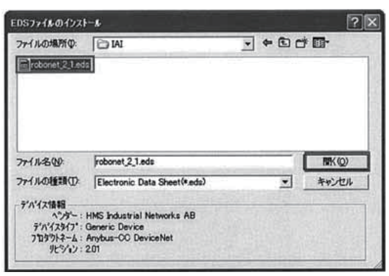
[2] Installing the EDS file

- [Tools] from the menu bar, select [EDS File] and then select [Install].



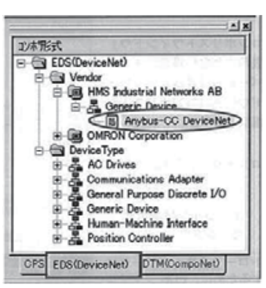
- Select the EDS file to be installed, “robonet_2_1.eds,” and click [Open].

* For the method of obtaining the EDS file, refer to the “Beginning of this section (5.2.2).”



- When the following dialog box appears, click [No].

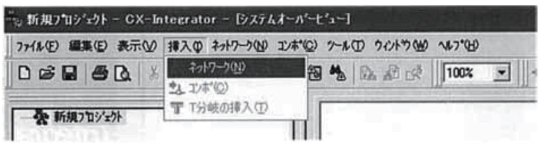
- Select the [EDS (DeviceNet)] tab in the Compo List window, and confirm that the compo device that was installed has been added.



(4) Creating a network configuration

[1] Registering the master unit online

- Select [Insert] from the CX-Integrator menu bar, and select [Network].

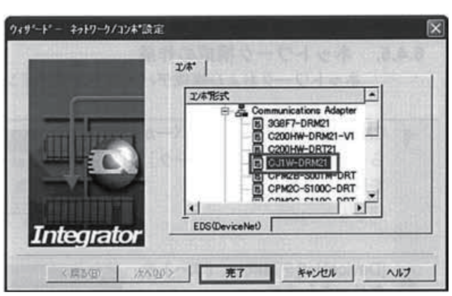


- When the “Wizard – Network/Compo Setup” dialog box appears, select [DeviceNet] and click [Next].

- Select the checkbox for [Not used] for Network address, and click [Finish].

- Select [Insert] from the menu bar, and then select [Compo].

- Select the master unit from the Compo list, and click [Finish].

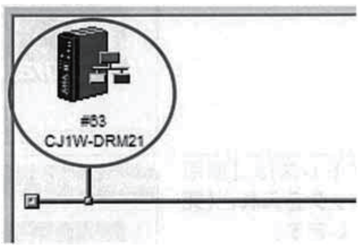


The master unit location will be as follows.

EDS
└ Vender
　└OMRON Corporation
　　└Communications Adaptor
　　　└ Model of the master unit to be used

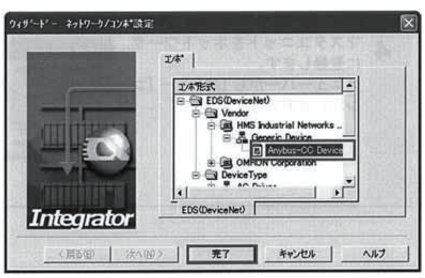
- When the “Node address setup” dialog box appears, enter the node address and click [OK].

- Confirm that the master unit has been registered to the Network configuration window.



[2] Registering a controller
- Select [Insert] from the menu bar, and select [Compo].

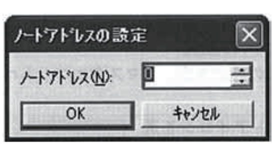
- Select the slave unit to be connected from the Compo list, and click [Finish].



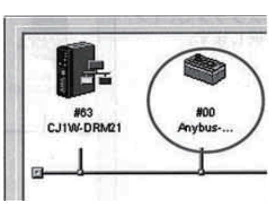
The slave unit location will be as follows.

EDS
└ Vender
└HMS Industrial Networks
└Generic Device
└Anybus-CC DeviceNet

- When the “Node address setup” dialog box appears, enter the node address and click [OK].



- Confirm that the slave unit has been registered to the Network configuration window.

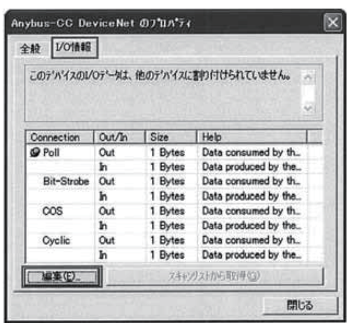


(5) Setting the configuration device

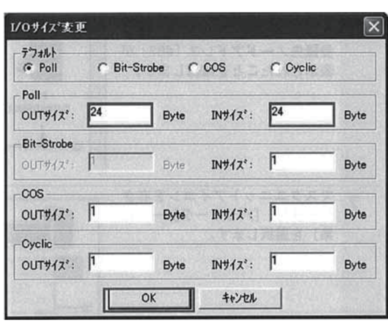
[1] Registering the node address of the registration destination

- With the slave unit icon selected, right-click and select [Properties].

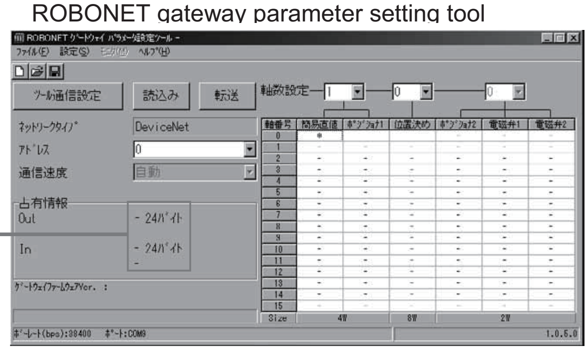
- When the dialog box for the connected slave unit appears, select the [I/O Information] tab and click [Edit].



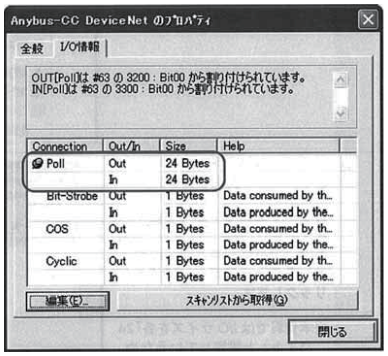
- When the [Change I/O Size] dialog box appears, select [Poll] for [Default], and enter the [Occupancy Information] values specified in "ROBONET gateway parameter setting tool" in the [Out size] and [In size] fields under the [Poll] section.
  * The [Occupancy Information] can be checked on the main screen of the "ROBONET gateway parameter setting tool."



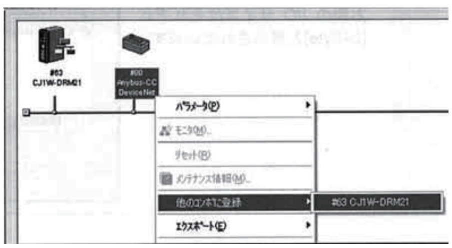
ROBONET gateway parameter setting tool



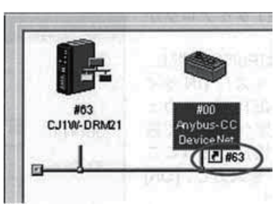
- When the dialog box for the connected slave unit appears, confirm that the [Sizes] of the [Out/In] fields are set to the values entered, and click [Close].



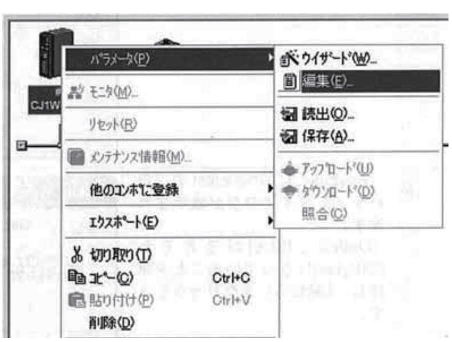
- With the slave unit selected in the Network configuration window, right-click and select [Register to Another Compo], and then select [Master Unit].



- Confirm that the node address of the registration destination is displayed with the slave unit icon in the Network configuration window.



- Right-click the master unit icon, and select [Parameters] and then select [Edit].



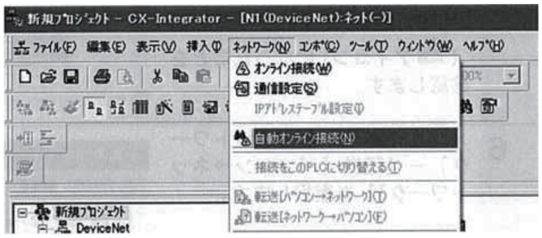
- When the [Edit Device Parameters] dialog box appears, confirm that the slave unit has been registered to the [List of Registered Devices], and the [Out Size] and the [In Size] fields show the values that were entered, and click [OK].
  * The sizes are set to [24 bytes] in the figure below as the I/O sizes are set to “24 bytes.”

(5) Transferring the Settings

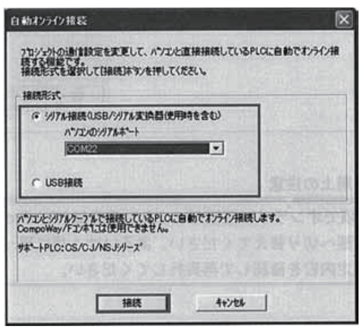
Bring the PLC connection online and transfer the settings.
If the CX-Programmer and other connections are online, bring them offline or terminate the connections.
When the settings have been successfully transferred, a remote I/O communication will start automatically.

[1] Transferring the settings to the PLC

- Select [Network] from the menu bar, and then select [Automatic Online Connection].

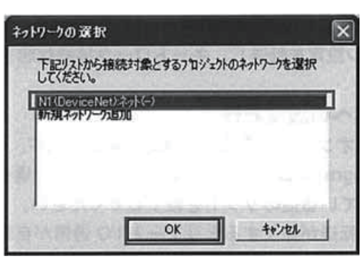


- Select “Serial Connection” in the [Direct Connection] screen.
- Select the COM port number to which the PLC is connected in the “PC serial port” field.
- Click [Connect].
  * If multiple “PC serial ports” exist, open Window’s Device Manager, and select the same port as the “COM port number” described under “Ports (COM & LPT).”

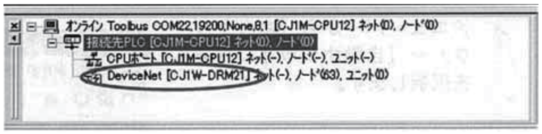


- Right-click [DeviceNet] in the “Online Connection Information window” and select [Connect].

- Select [DeviceNet] in the [Network Selection] dialog box, and click [OK].

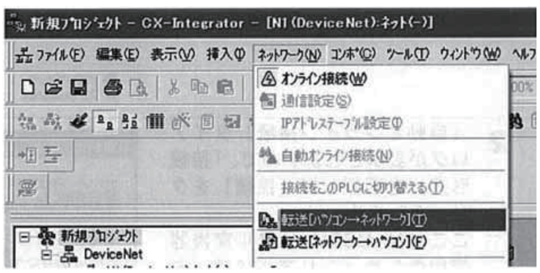


- Confirm that [DeviceNet] in the “Online Connection Information window” has been brought to online (set to the  icon).

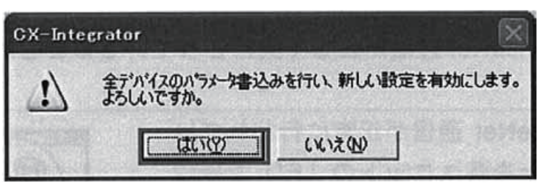


⚠ Caution:	If online connection cannot be established, check the connection status of CX-Programmer and bring it offline, and perform this procedure again from the beginning after checking the cable connection and connection configuration settings.

- Select [Network] from the menu bar, and then select [Transfer [PC → Network]].



- When the dialog box is displayed, click [Yes].
  The transfer will start.

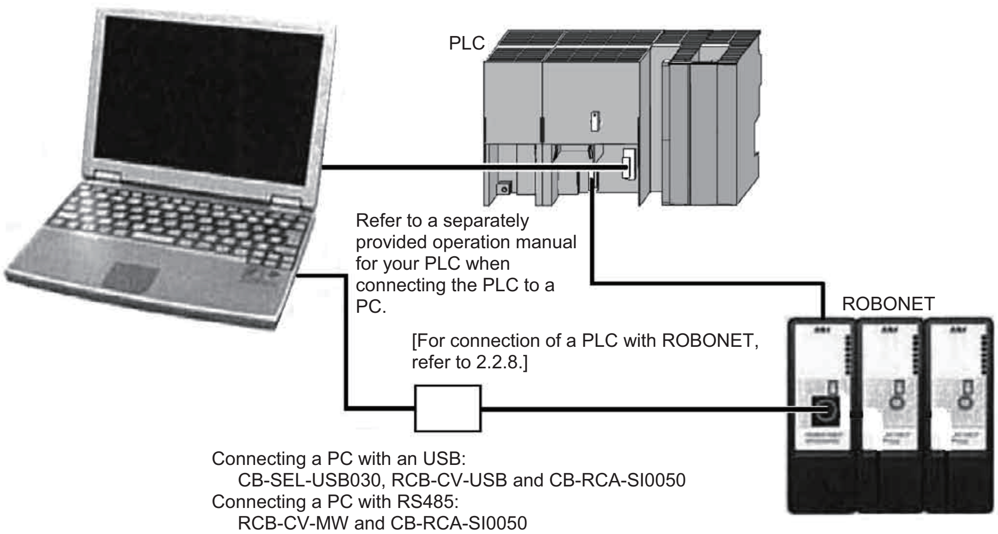


- When the transfer is completed, the result will appear in the “Output window.”
  The settings have been transferred successfully if the window displays “Error 0, Caution 0.”

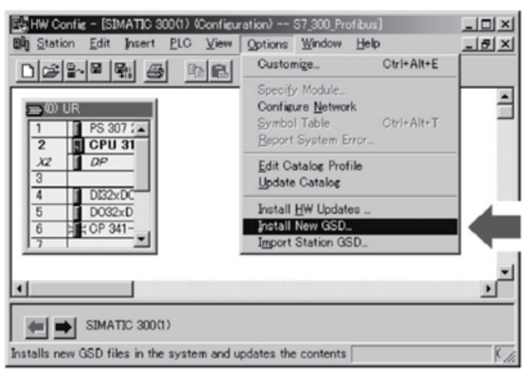
5.2.3 Profibus

(1) Installing the GSD file

An example of installation using Siemens's STEP7 HardWare Configuration (hereinafter referred to as "HW Config") is explained. To define a gateway, a GSD file for the gateway must be downloaded in advance. The GSD file you need is "IAIOB2F.gsd," which can be downloaded from our website.
In this section, the procedure is explained using the following system configuration as an example.

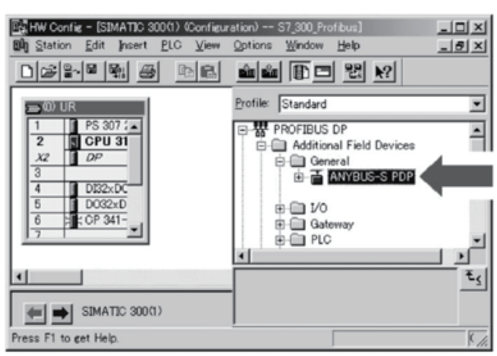


Launch the HW Config software and install the downloaded GSD file. Select **Options** from the menu bar and left-click **Install New GSD** in the pull-down menu.



<Importing the GSD file>

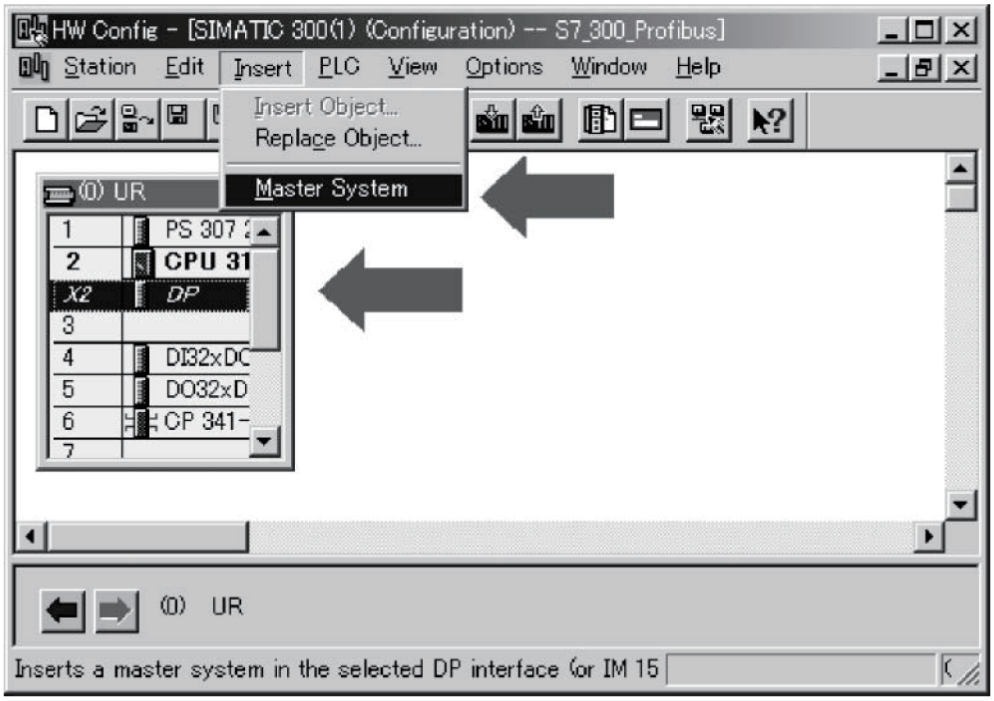
When the GSD file has been successfully imported, a new "ANYBUS-PDP" level is created in the catalog window of HW Config, as shown below.



<Catalog window after importing the GSD file>

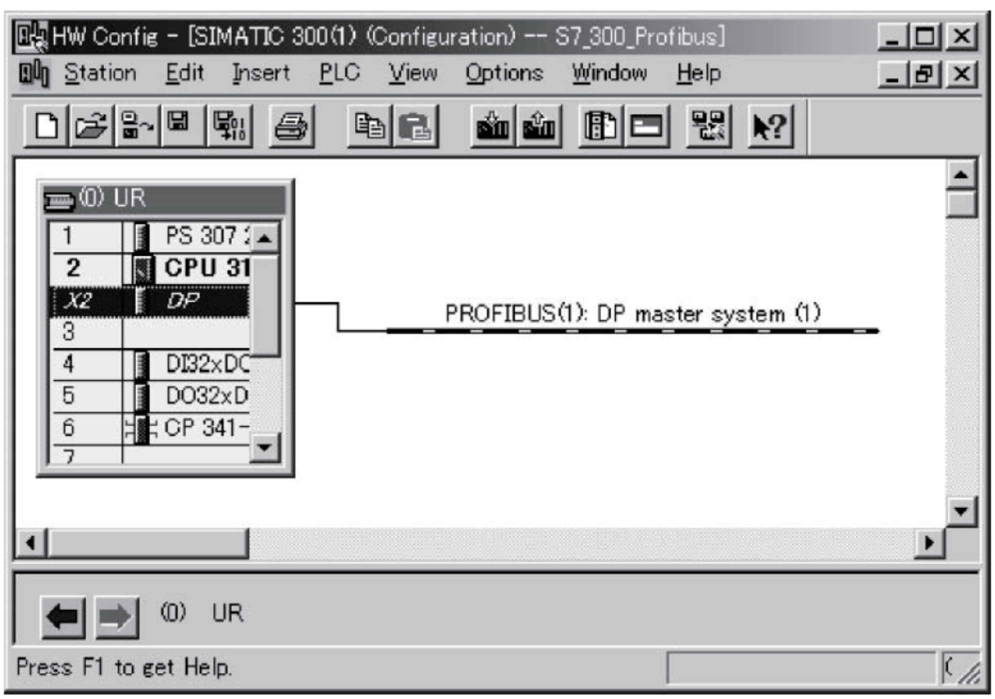
(2) Inserting the Profibus-DP master system

Select **Insert** from the menu bar, select **Master System** in the pull-down menu, and left-click **DP**.
The Profibus-DP master system is inserted.



<Inserting the master system>

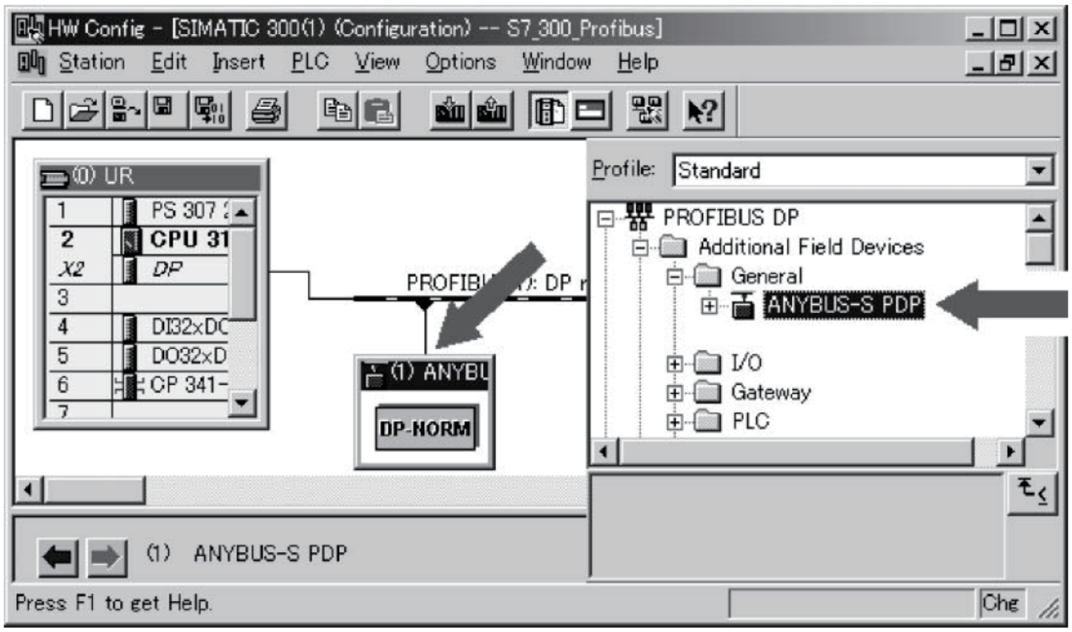
When the insertion has been successful, the master system is displayed as shown below.



<Inserted Profibus-DP master system>

(3) Inserting the gateway rack into the network

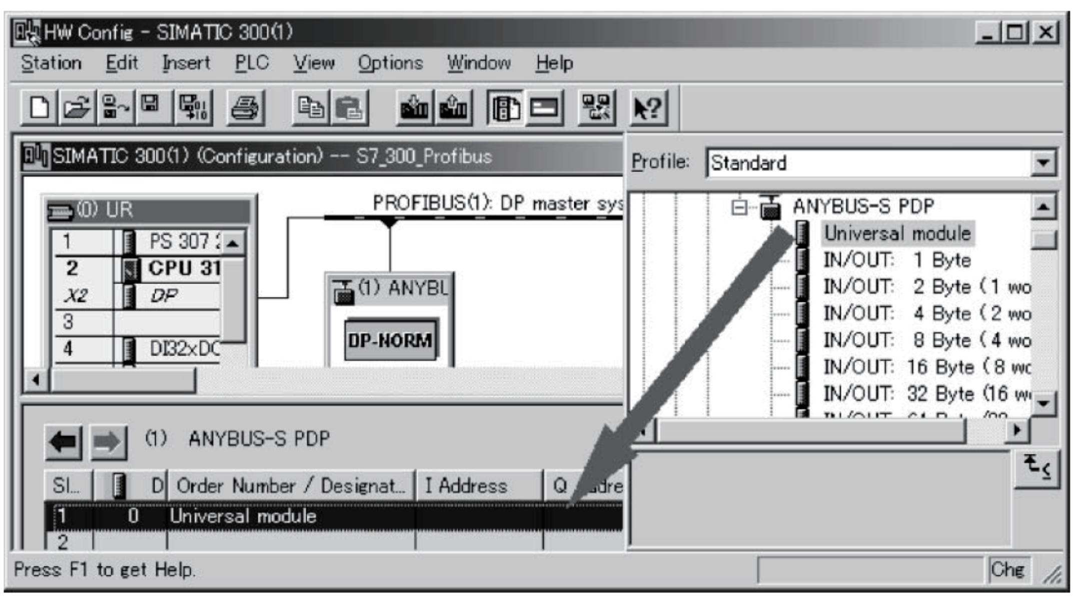
Insert the rack module by dragging “ANYBUS-S PDP” in the catalog window and dropping it over the master system, as shown below.
The address is set automatically. To change the address, do so in the Properties dialog box. The address of the gateway rack must correspond to the address switch setting of the gateway.



<Inserting the rack into the network>

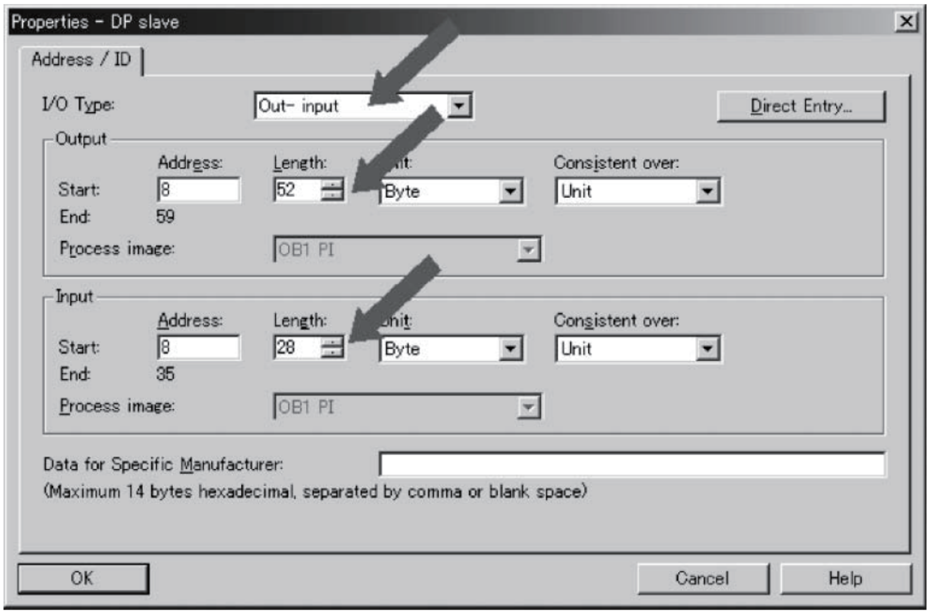
(4) Setting I/O assignments – Inserting the universal module

Insert the universal module into the rack described in the preceding step, as shown below. Since the universal module provides only up to 64 input bytes and 64 output bytes, another universal module must be inserted if 10 or more axes are used.



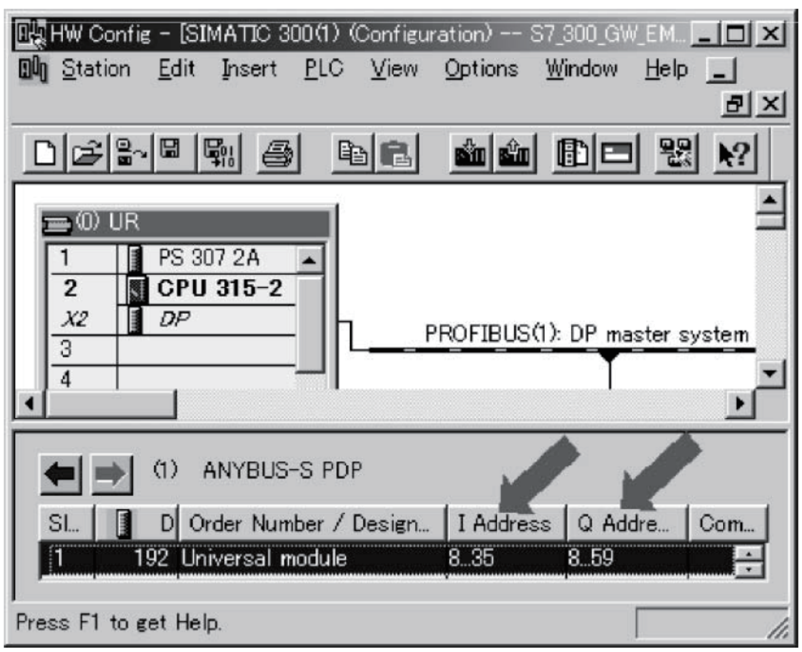
<Inserting the universal module into the rack>

Double-clicking the inserted universal module opens the Properties dialog box shown below.
Set “Out-input” under “I/O Type,” and set the output length and input length according to the occupancy information set by the ROBONET gateway parameter setting tool. In the example below, four numerical axes are connected. Since the addresses are set automatically, change them if necessary.



<Setting the I/O lengths of the universal module>

When the **OK** button is left-clicked, the settings are reflected in the universal module, as shown below.

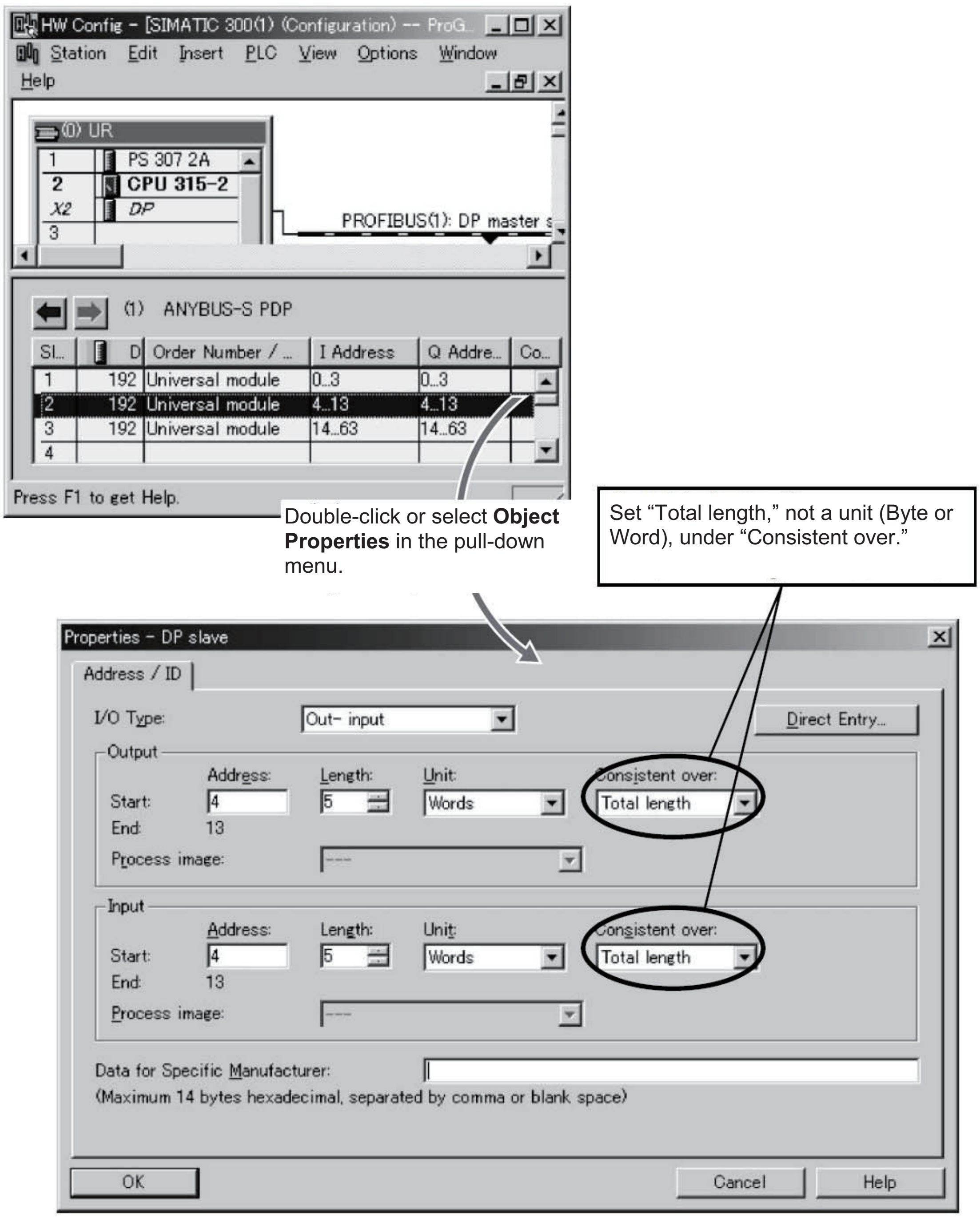


<Universal module after the I/O lengths have been set>

All settings are now completed. Download the settings to the PLC.

(5) Setting the I/O data consistency

Under the normal settings, consistency of I/O data is assured in units of words or bytes for in the case of a Profibus system. It is important that the command area be read and written in a manner maintaining consistency between the command codes and parameters.
To access data consistently, consistency parameters must be set in HW Config and SFC14 or SFC15 must be used to access data.
With command-related FBs, SFC14 or 15 is used to access the first five words in the command area.
Accordingly, consistency parameters must be set for the I/O area data corresponding to these five words, as explained in the example below.



5.2.4 RS485SIO

1. Modbus gageway mode

The procedures for setting and starting the master are explained below. If function blocks are to be used, download the following file in advance from our website.
Dedicated ROBONET function block file: RBNET_RW
Website: http://www.iai-robot.co.jp

1. Set up the PLC (1) Set the switches on the serial communication unit (SCU) (2) Create an I/O table (3) Set up the PLC system (4) Set up the serial communication unit (SCU) software

↓

2. Import the function block definitions Download the dedicated ROBONET function block file (RBNET_RW) from the website to the PC.

↓

3. Assign the function block definitions (Generate an instance) * Insert a function block in the ladder section window.

↓

4. Set parameters for the function block * Set parameters for the function block instance and assign I/Os for communication with external devices.

↓

5. Create a ladder sequence

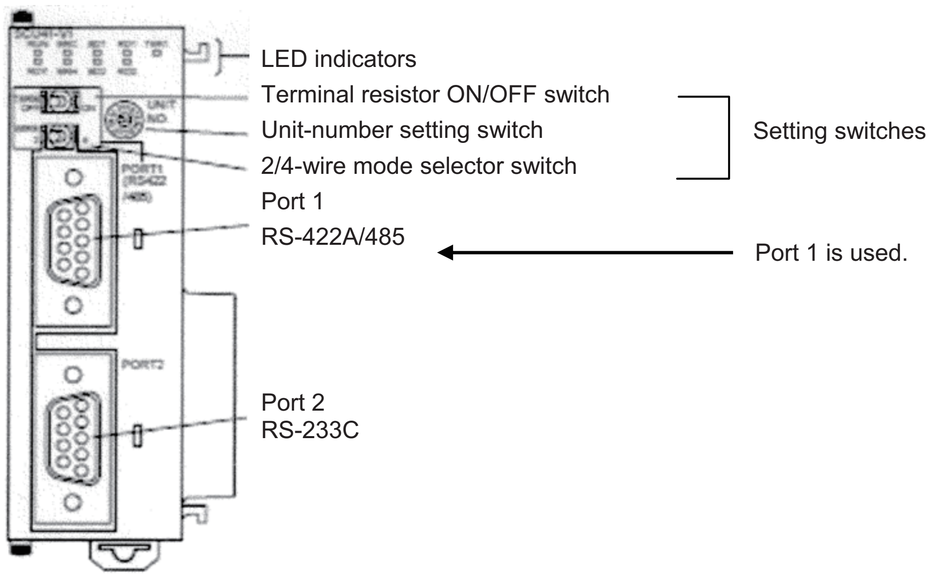
The above procedure applies to the Modbus gateway mode. Accordingly, set DIP switch 2 on the RS485SIO gateway unit to the “OFF” (left) position. Function blocks can be used in the Modbus gateway mode.

* Steps 3 to 5 in the above flow are required when function blocks are used. If function blocks are not used, these steps can be omitted.

(1) Setting up the PLC

[1] Setting the switches on the serial communication unit (SCU)
For details, refer to the operation manual for your PLC.
The following explains an example with the serial communication unit CJ1W-SCU41-V1.

Model number: CJ1W-SCU41-V1



- Setting the unit number
  Set a desired unit number between 0 and F to assign I/Os for communication with high-function CPU units.
  High-function CPU units are units that mainly provide communication functions and include serial communication units, DeviceNet master units and controller link units. If two or more of these units are used, set a unique number for each unit.
  According to the unit number settings, 25 channels of internal assignment area are allocated for each unit.

- Turning the terminal resistor on/off
  The terminal resistor should be turned on. Accordingly, set this switch to the right position (TERM/ON).

- 2/4-wire mode selection
  The 2-wire mode is used. Accordingly, set this switch to the left position (WIRE/2).

[2] Creating an I/O table

[a] Launch CX-Programmer (Version 7.0).

[b] Connect CX-Programmer to the PLC.
You can connect CX-Programmer to the PLC by setting the network type, baud rate and other necessary items in an offline state, or by selecting a connection port to automatically bring the connection online.

[c] Set the PLC operation mode to “Program.”

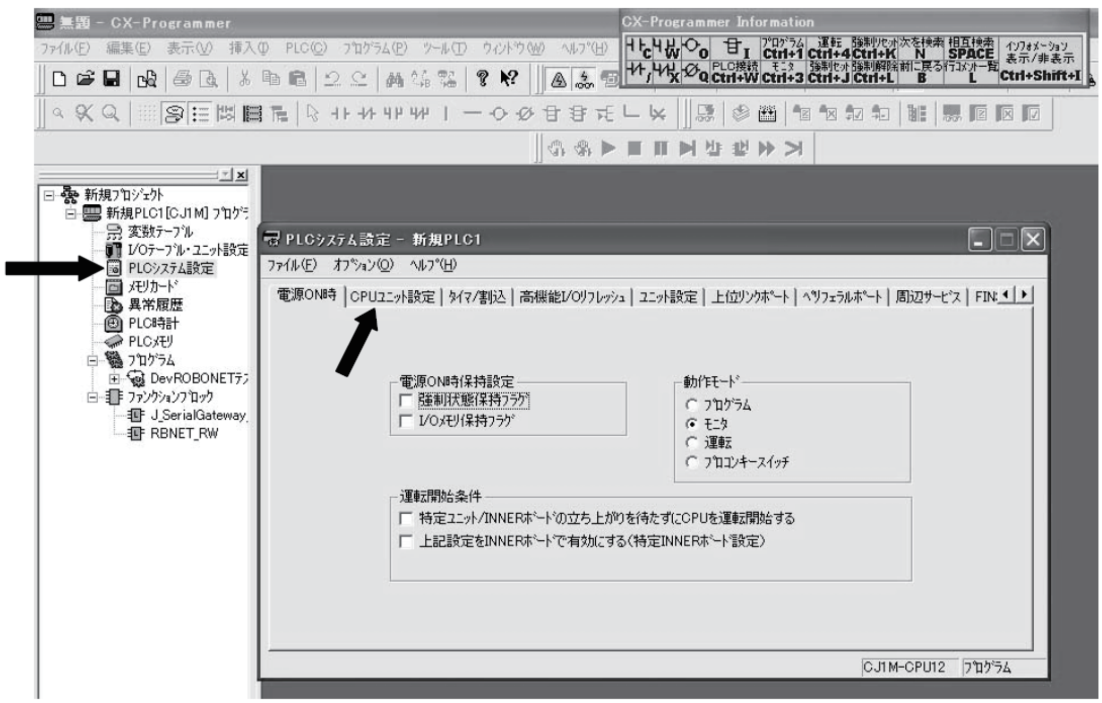
[d] Double-clicking “I/O Table/Unit Settings” in the workspace window opens the I/O table dialog box. From the **Options (O)** menu, select **Create I/O Table (R)** and manually create an I/O table.

- The CJ series PLC has been shipped with the “Automatic generation upon power ON” setting enabled. Accordingly, channel numbers (I/Os) are assigned automatically to the basic I/O units that are mounted when the power is turned on, even when an I/O table is not yet registered. Take note that unit numbers must be set in advance for high-function CPU units and high-function units such as serial communication units.

[3] Setting up the PLC system
Set the CPU operation.

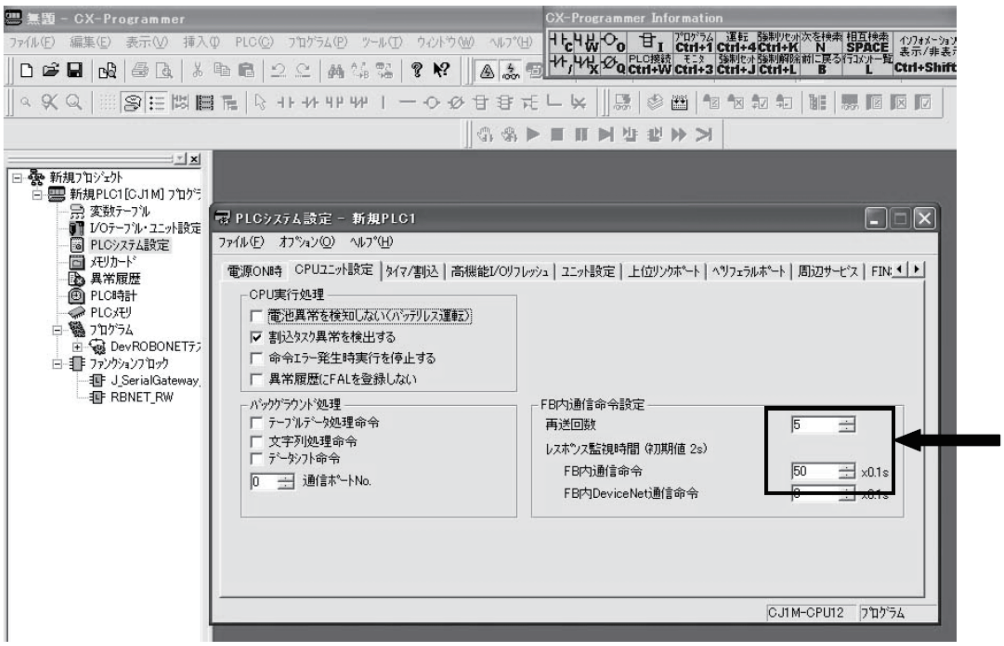
[a] Bring the CX-Programmer and PLC connection online and set the PLC operation mode to “Program.”

[b] Double-click “PLC System Settings” in the workspace window to open the PLC System Settings dialog box.

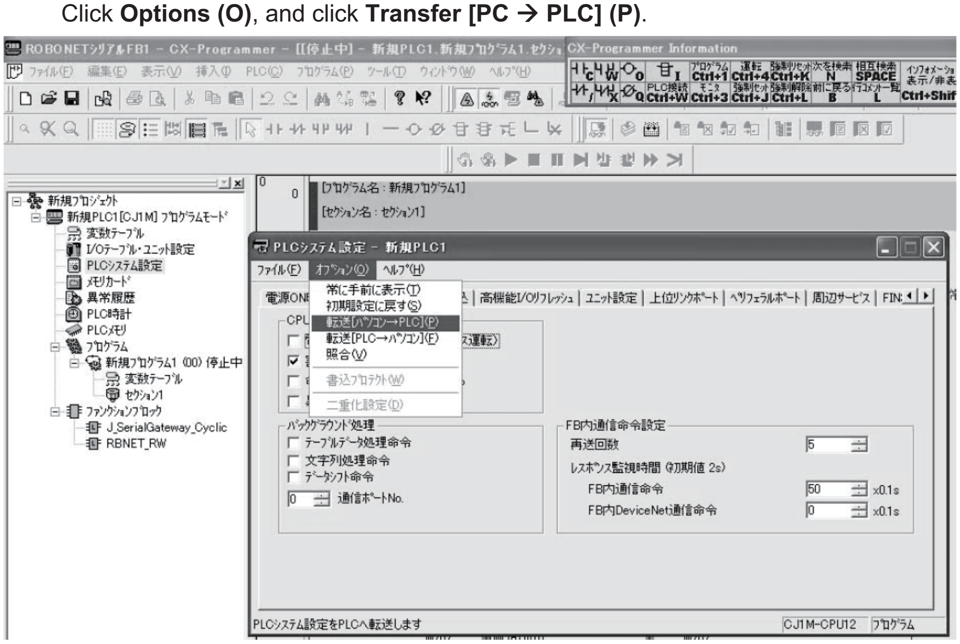


[c] Double-click the **CPU Unit Settings** tab in the PLC System Settings dialog box, and set the necessary items in the "Communication Command Settings in FB" area as follows:

- Number of Resends: Set the number of times the data will be resent if the PLC has experienced a communication error while communicating with the gateway unit.
  (Example) 5
- Response Monitoring Time/Communication Commands in FB:
  Response monitoring time per communication cycle.
  Set this monitoring time to 5 seconds or longer.



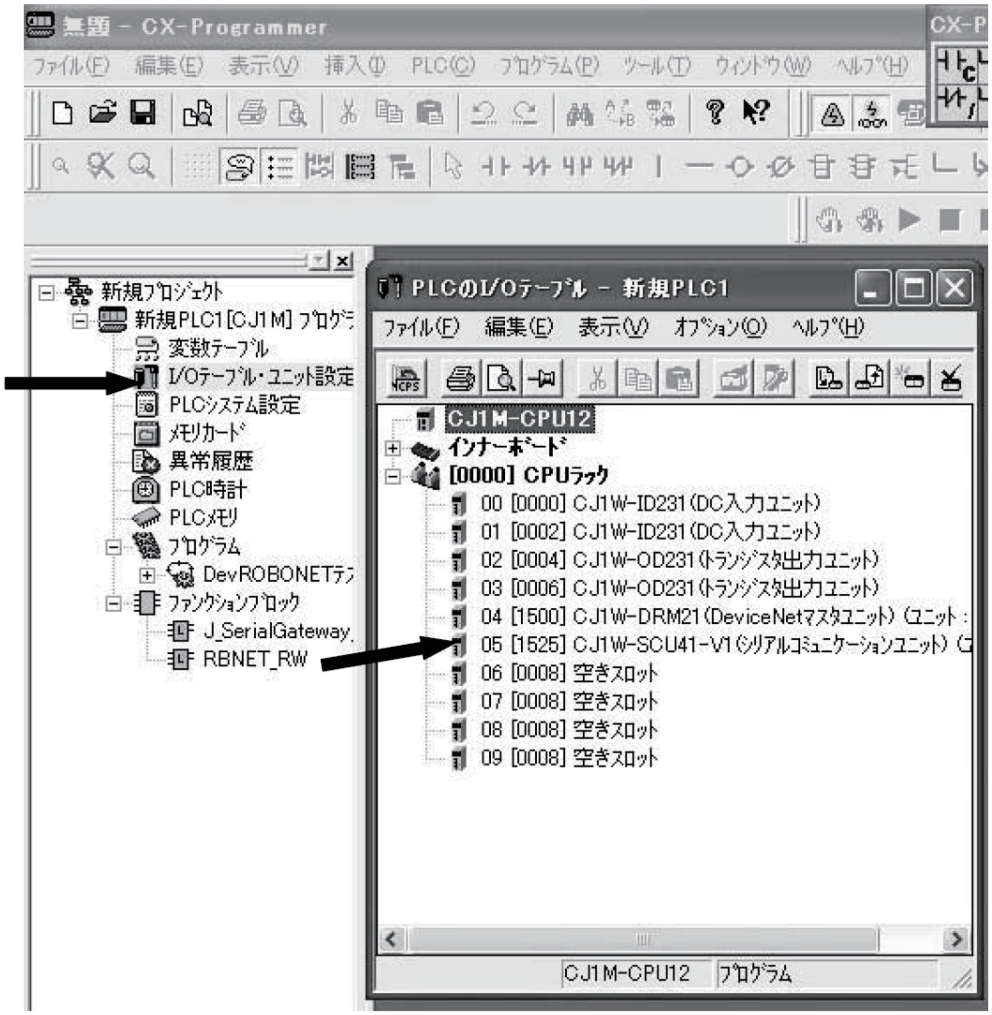
[d] When the above items have been set, transfer the settings to the PLC.
Click **Options (O)**, and click **Transfer [PC → PLC] (P)**.



When a dialog box appears and asks if you want to transfer the settings to the PLC, click **Yes**.

[4] Setting up the serial communication unit (SCU) software
In the same condition as in the previous step (online, program mode), set the operation of the serial communication unit.

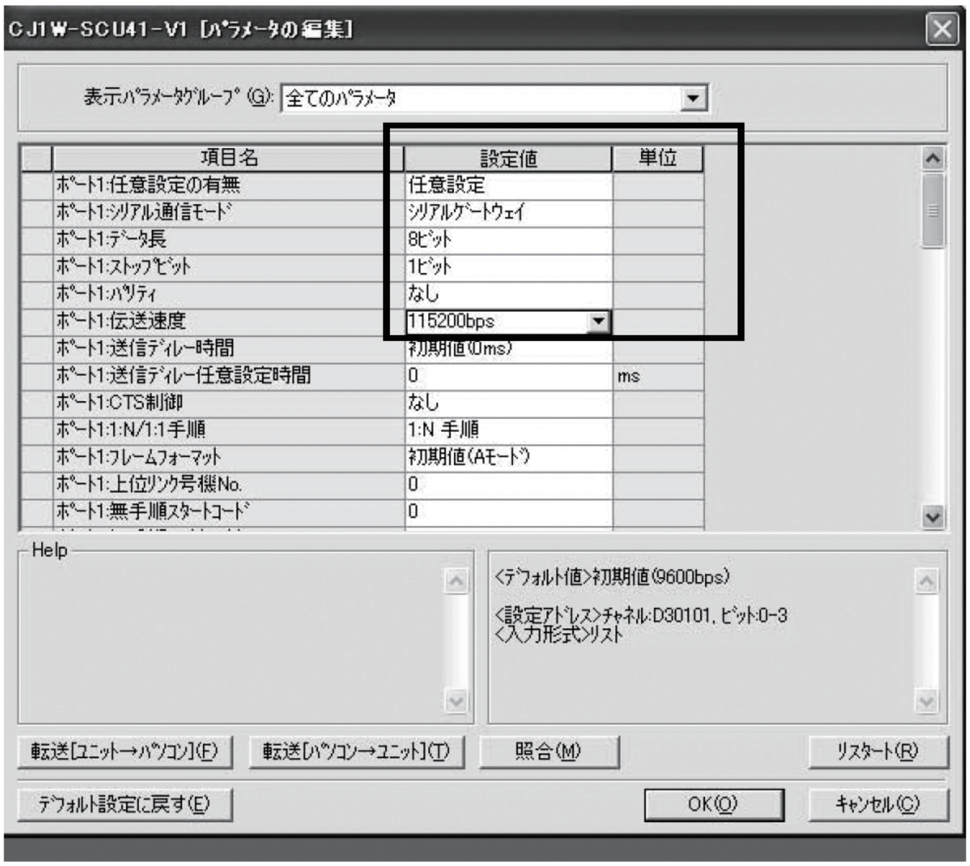
[a] Double-click “I/O Table/Unit Settings” in the workspace window to open the I/O table. Double-click the serial communication unit.

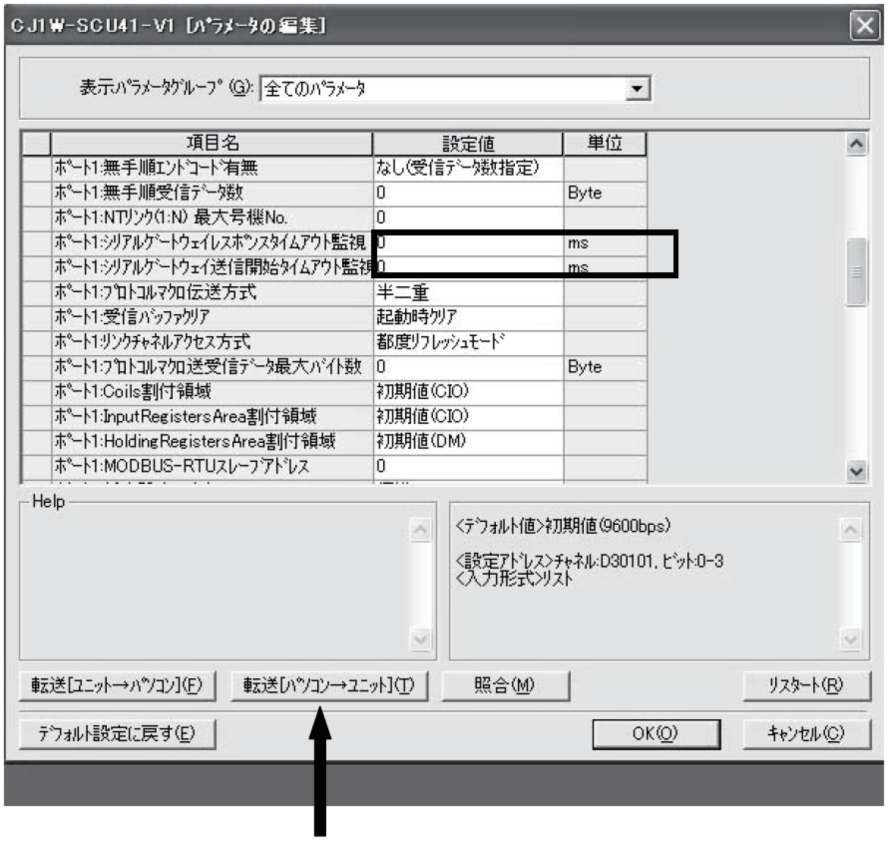


[b] When the parameter edit dialog box for the serial communication unit appears, set the communication parameters separately for the applicable port.

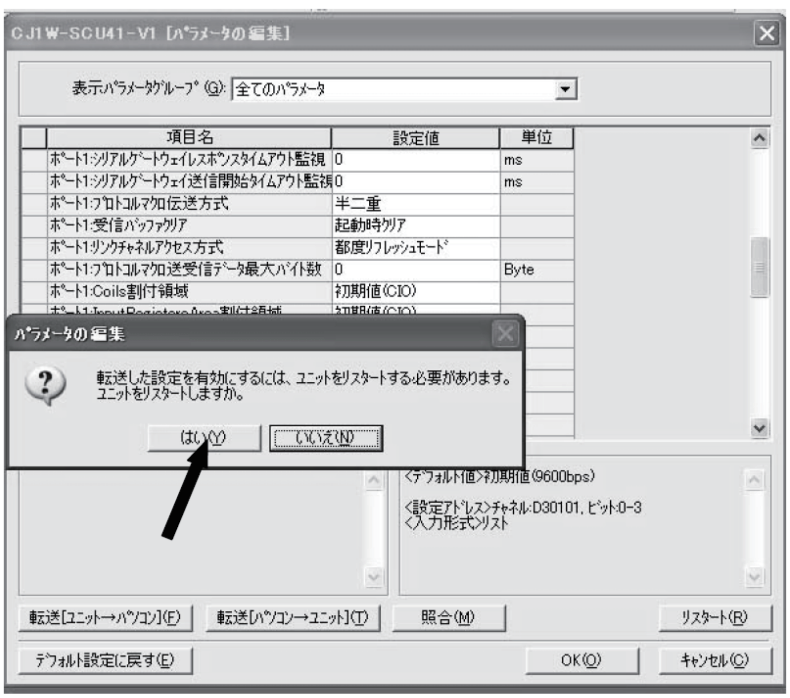
The gateway unit and serial communication unit (CJ1W-SCU41-V1) are connected via the RS485 protocol. Accordingly, the port to be used is “1” and each item is set as follows:

- Port 1 optional setting: Optional setting
- Port 1 serial communication mode: Serial gateway
- Port 1 data length: 8 bits
- Port 1 stop bit: 1 bit
- Port 1 parity: None
- Port 1 baud rate: Set the same baud rate specified for the gateway unit.
  (Example) 115200bps
- Monitoring time for serial gateway response timeout: 0 (default value)
- Monitoring time for serial gateway send start timeout: 0 (default value)





[c] Once all necessary items have been set, click the **Transfer [PC → Unit] (T)** tab. When the transfer is completed, the program prompts you to restart the unit. Click **Yes**.

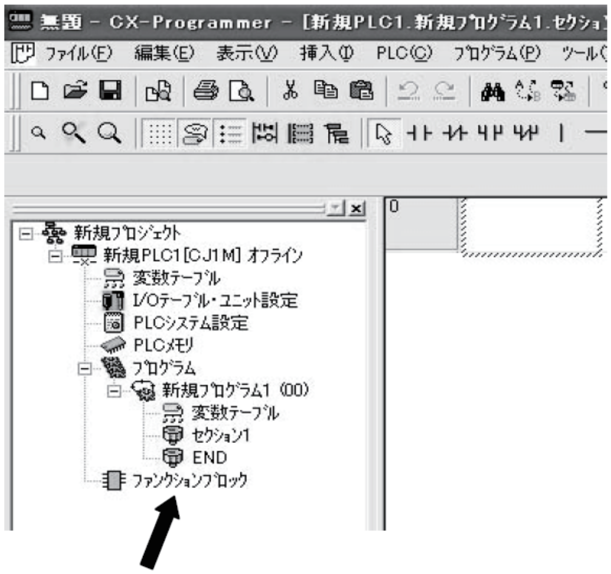


(2) Importing the function block definitions

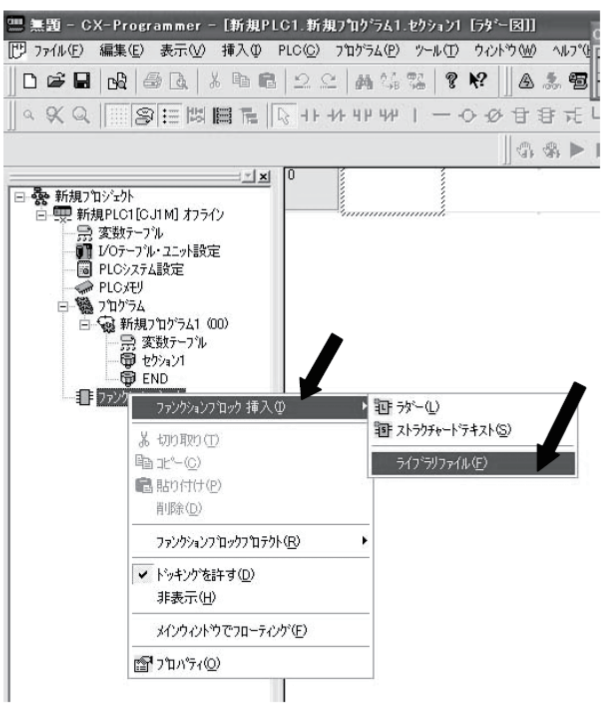
[1] Before importing the definitions, download from our website the CXF file for dedicated ROBONET function block (file name: RBNET_RW).

[2] Launch CX-Programmer and keep it offline.

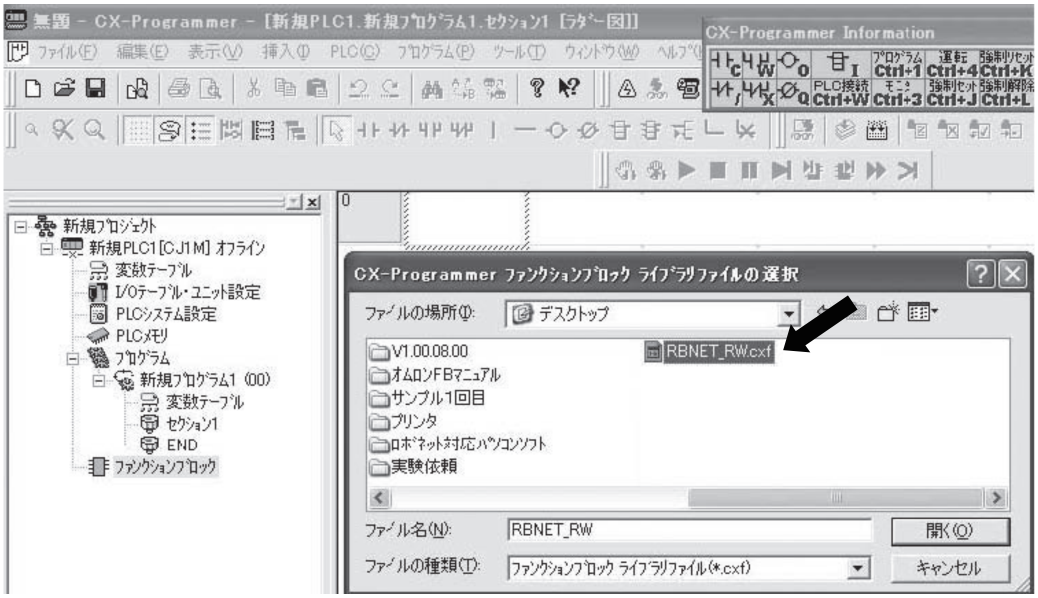
[3] Select **File (F)** from the menu bar and click **New (N)**. The following screen appears.



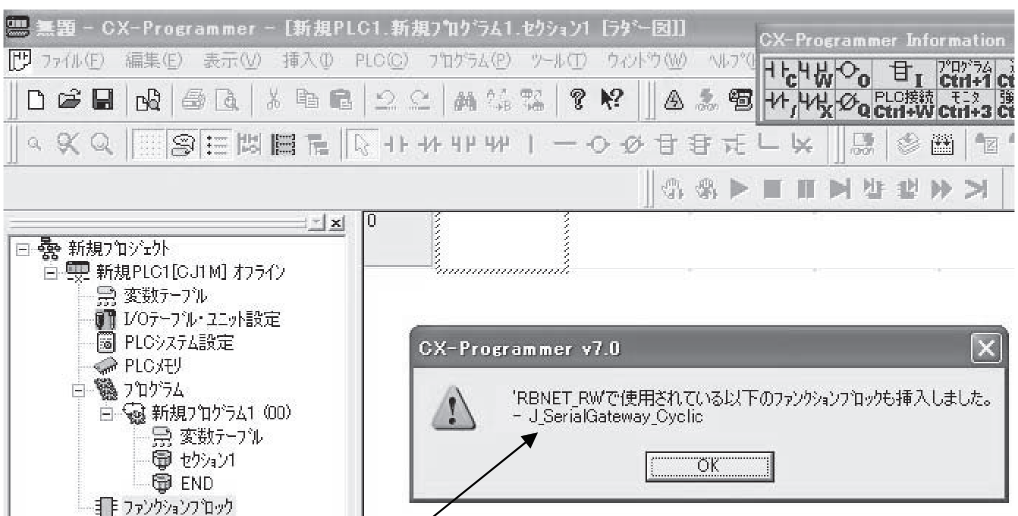
[4] In the above screen, right-click the “Function Blocks” icon, click **Insert Function Block (I)**, and click **Library File (F)**.



[5] When the function block library selection dialog box appears, specify the CXF function block file (RBNET_RW) and opens the file from the location where it is saved.

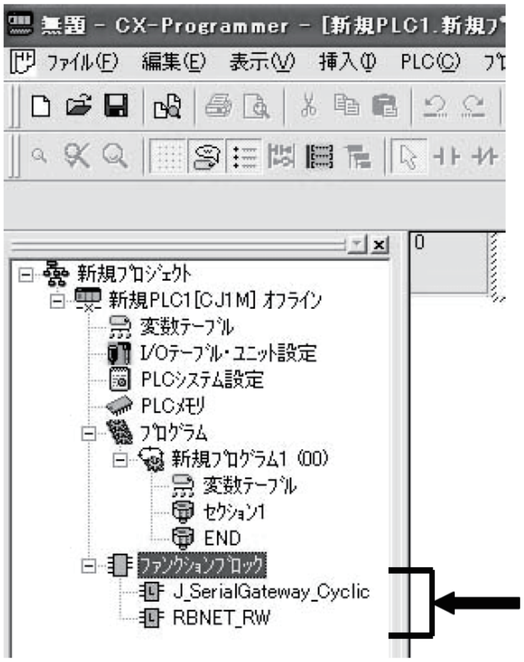


[6] When the import of function block definitions is completed, click **OK**.



One more function block (J_SerialGateway_Cyclic) is imported. Be careful not to delete this function block.

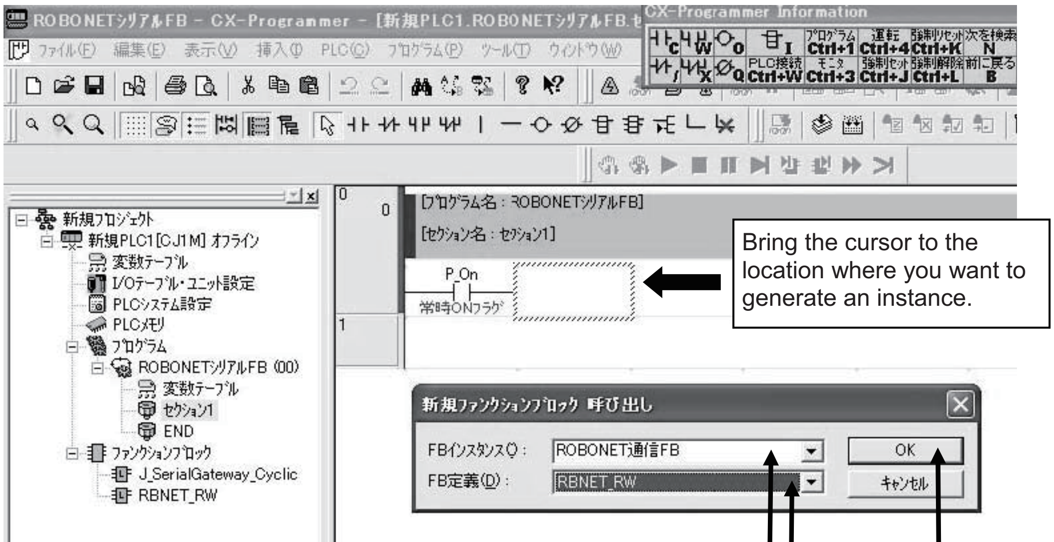
[7] If the import of function block definitions has been successful, the RBNET_RW.cxf file is now added to the function block tree. (J_SerialGateway_Cyclic is also added simultaneously.)



(3) Generating an instance

Generate an instance of function block definitions in the ladder section window.

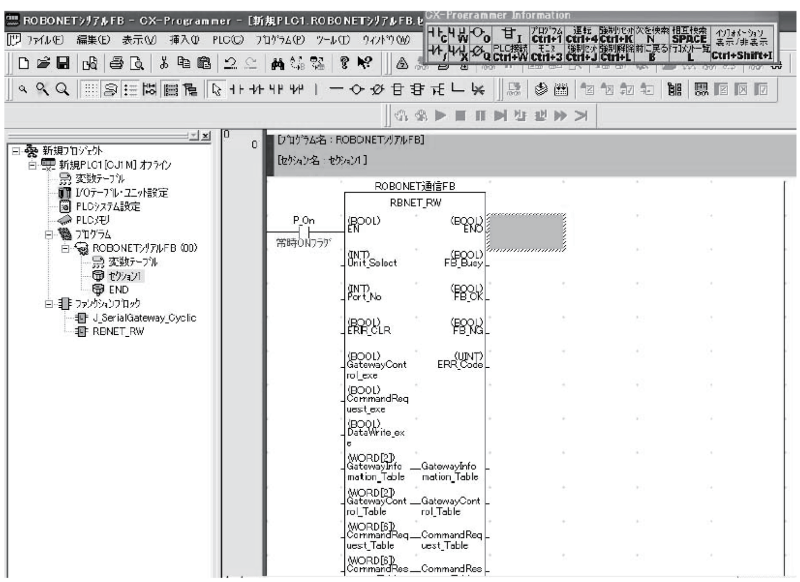
[1] In the same condition as in (2) (PLC is offline), move the cursor to the location in the ladder section window where you want to generate an instance, and press the “F” key. The window to call a new function block opens.



[2] Perform the following operations in the function block call window:

- In “FB Instance (I),” enter the name you want to assign to the FB (any name).
- In “FB Definitions (D),” select the function block definitions (RBNET_RW) that have been imported.
- Click **OK**.

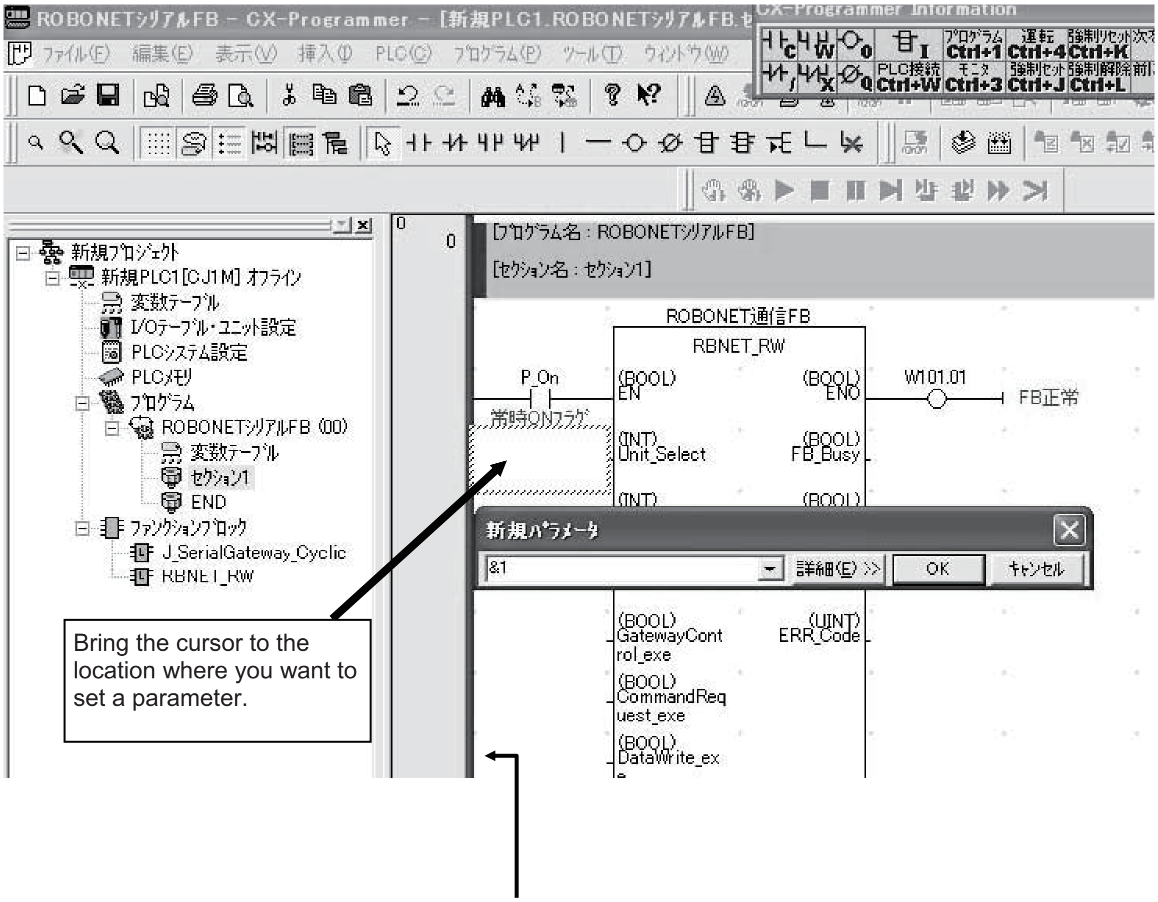
[3] An instance is created as follows.



(4) Setting function block parameters

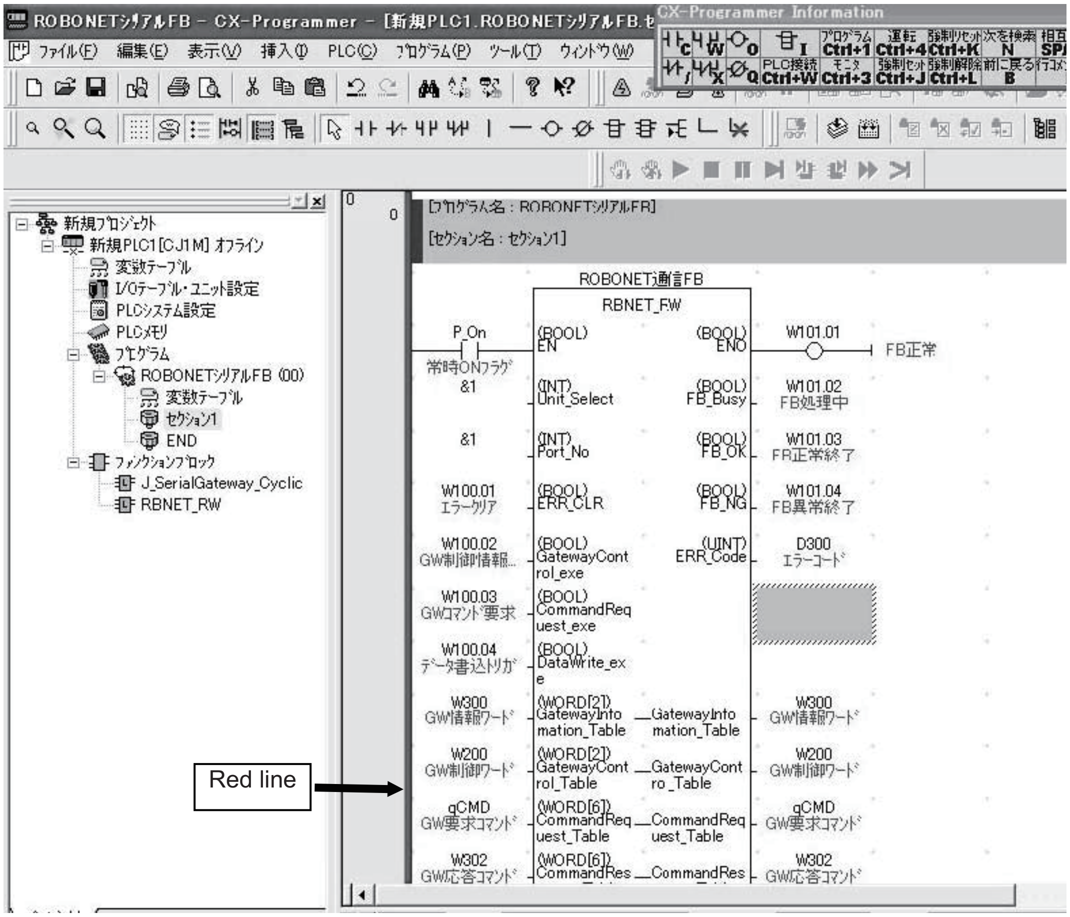
Set parameters for the function block instance generated in (3) to assign I/Os for communication with external devices.

[1] Bring the cursor to the location where you want to set a parameter, and press the “P” key. When the parameter edit window opens, set a value or address appropriate for the data type.



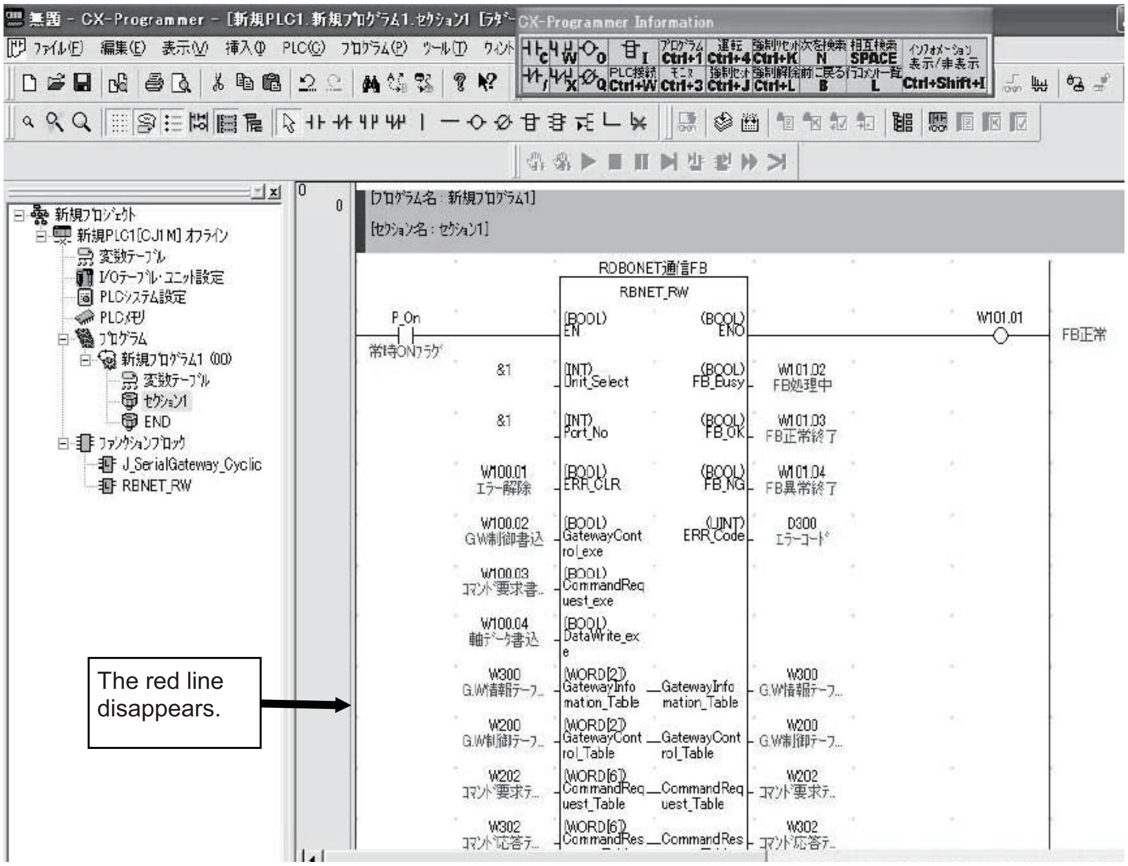
A red line is displayed along the left edge of the window until all parameters are set.

[2] When all parameters have been set, the window should look like the one shown below.



- EN (the FB operates when this parameter is "ON") and ENO (this parameter turns "ON" while the FB is operating) at the top of the FB are connected using contact points and lines just like you do in a normal ladder sequence.
- Each pair of variables shown on the right and left and connected by a horizontal line in the lower section of the instance are I/O variables that can be directly read and written in the FB. Accordingly, these variables are used for both input and output. With these I/O variables, setting a parameter for the left variable (input) automatically sets the same address for the right variable (output).

[3] When the cursor is moved to the next line in the function block, the red line in (2) disappears and the window looks like the one shown below.



2. SIO Through Mode

If the SIO through mode is to be used, refer to the operation manual on serial communication (Modbus version).
In this mode, the Gateway R unit exchanges data with the host master in units of bytes (at the specified baud rate). It also exchanges data with the controller unit at the baud rage of 230.4 kbps. In other words, communication data is passed to the host and subordinate devices through the Gateway R unit at different baud rates (according to the settings). The communication mode of the host (Modbus/RTU or ASCII) is automatically detected by the controller unit.

Caution

1. The baud rates of 9600 bps and 19200 bps cannot be set in this mode.
2. If this mode is to be used, set the user setting switch SW2 on the Gateway R unit to the ON (right) position.

5.3 Creating a Controller Position Table

If the ROBONET system is to be used in the positioner mode or simple direct mode, a position table must be registered in the controller beforehand. The items that must be set are summarized in the table below.

	Positioner mode	Simple direct mode
Position	○	X *
Speed	○	○
Acceleration	○	○
Deceleration	○	○
Positioning band	○	○

* In the simple direct mode, position data commands are specified directly by the PLC as numerical values.

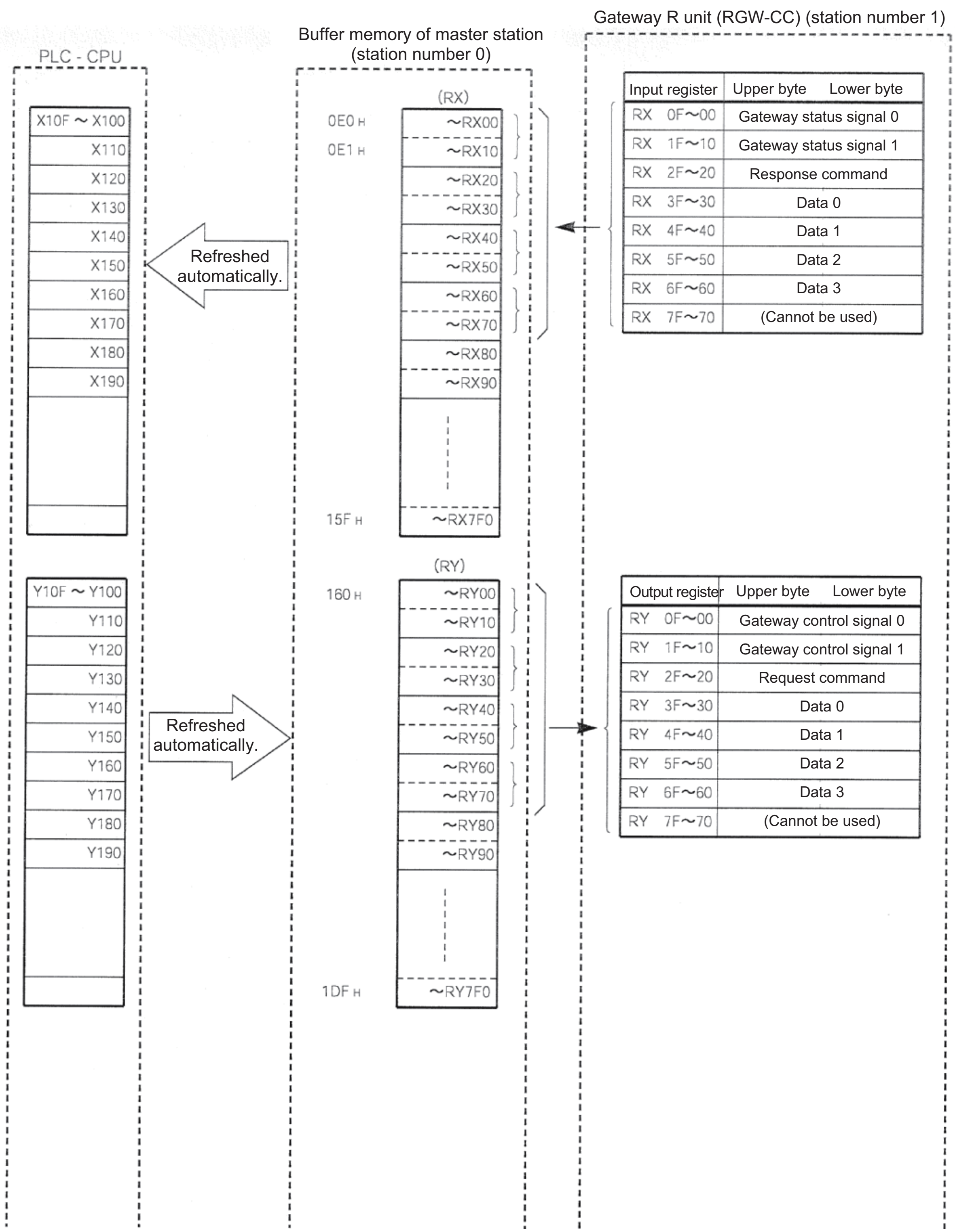
For details, refer to Chapter 4, “Controller Unit” in “ROBONET Operation Manual – Specification” and the operation manual for your PC software or teaching pendant.

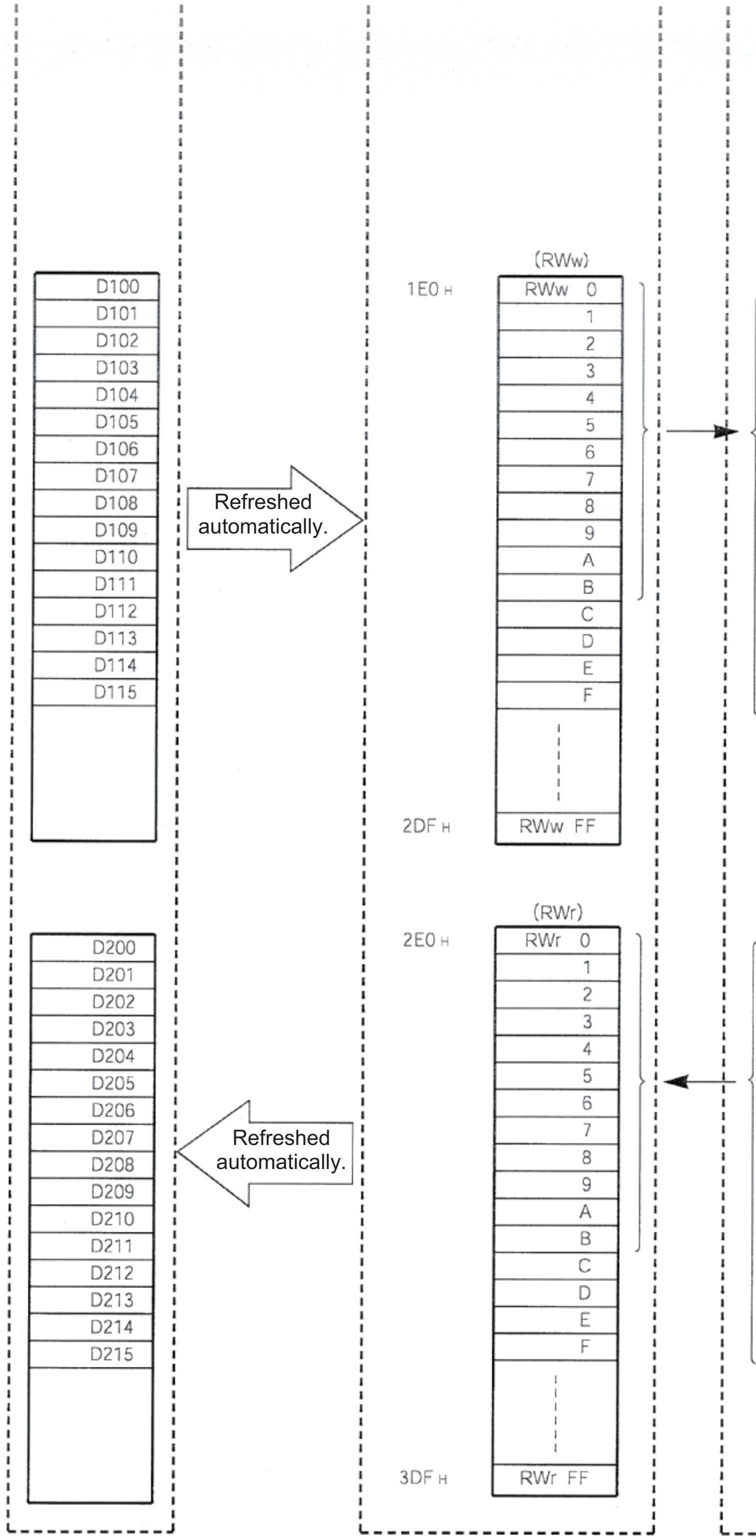
MEMO

5.4 Address Correlation Diagram

The correlation between the PLC's I/O addresses (internal addresses) and the ROBONET addresses (gateway addresses) over the network that has been set up is explained for CC-Link, DeviceNet and RS485SIO systems.
5.2 and 5.3 explained an example of network configuration and the configuration procedure. The descriptions in this section assume the settings used in this example.
A PLC sequence for ROBONET operation can be created based on the applicable settings.

5.4.1 Address Correlation Diagram for CC-Link System (Example)





Output register	Upper byte Lower byte
RWw 00	(Axis 0) Position data specification (L)
RWw 01	(Axis 0) Position data specification (H)
RWw 02	(Axis 0) Position number
RWw 03	(Axis 0) Control signal
RWw 04	(Axis 1) Position data specification (L)
RWw 05	(Axis 1) Position data specification (H)
RWw 06	(Axis 1) Positioning band specification (L)
RWw 07	(Axis 1) Positioning band specification (L)
RWw 08	(Axis 1) Speed specification
RWw 09	(Axis 1) Acceleration/deceleration spec.
RWw 0A	(Axis 1) Push current limiting value
RWw 0B	(Axis 1) Control signal

Input register	Upper byte Lower byte
RWr 00	(Axis 0) Current position data (L)
RWr 01	(Axis 0) Current position data (H)
RWr 02	(Axis 0) Position number
RWr 03	(Axis 0) Status signal
RWr 04	(Axis 1) Current position data (L)
RWr 05	(Axis 1) rrent position data (H)
RWr 06	(Axis 1) Current ampere value (L)
RWr 07	(Axis 1) Current ampere value (H)
RWr 08	(Axis 1) Current speed
RWr 09	(Axis 1) (Cannot be used)
RWr 0A	(Axis 1) Alarm
RWr 0B	(Axis 1) Status signal

5.4.2 Address Correlation Diagram for DeviceNet System (Example)

Master station (station number 63)

PLC address (channel number)
3200
3201
3202
3203
3204
3205
3206
3207
3208
3209
3210
3211
3212
3213
3214
3215
3216
3217
3218
3219
3220
3221
•
•
•

Refreshed automatically.

Gateway R unit (RGW-DV) (station number 0)

Gateway register (PLC output) Upper byte Lower byte	Corresponding channel (node address)
Gateway control signal 0	0
Gateway control signal 1	1
Request command	2
Data 0	3
Data 1	4
Data 2	5
Data 3	6
(Cannot be used)	7
(Axis 0) Position data specification (L)	8
(Axis 0) Position data specification (H)	9
(Axis 0) Position number	10
(Axis 0) Control signal	11
(Axis 1) Position data specification (L)	12
(Axis 1) Position data specification (H)	13
(Axis 1) Positioning band specification (L)	14
(Axis 1) Positioning band specification (H)	15
(Axis 1) Speed specification	16
(Axis 1) Acceleration/deceleration spec.	17
(Axis 1) Push current limiting value	18
(Axis 1) Control signal	19
•	20
•	21
•	•
•	•
•	•

PLC address (channel number)
3300
3301
3302
3303
3304
3305
3306
3307
3308
3309
3310
3311
3312
3313
3314
3315
3316
3317
3318
3319
3320
3321
•
•
•

Refreshed automatically.

Gateway register (PLC input) Upper byte Lower byte	Corresponding channel (node address)
Gateway status signal 0	0
Gateway status signal 1	1
Response command	2
Data 0	3
Data 1	4
Data 2	5
Data 3	6
(Cannot be used)	7
(Axis 0) Current position data (L)	8
(Axis 0) Current position data (H)	9
(Axis 0) Completed position number	10
(Axis 0) Status signal	11
(Axis 1) Current position data (L)	12
(Axis 1) Current position data (H)	13
(Axis 1) Current ampere value (L)	14
(Axis 1) Current ampere value (H)	15
(Axis 1) Current speed data	16
(Cannot be used)	17
(Axis 1) Alarm	18
(Axis 1) Status signal	19
•	20
•	21
•	•
•	•
•	•

5.4.3 Address Correlation Diagram for RS485SIO System (Example)

The following diagram assumes the Modbus gateway mode and use of a function block.

PLC

Address assignments

Function block	
Variable name	Set address
GateWay Contorol Table	W200
	W201
Command Request Table	W202
	W203
	W204
	W205
	W206
	W207
Date Write Table	W208
	W209
	W210
	W211
	W212
	W213
	W214
	W215
	W216
	W217
	W218
	W219

Gateway R unit (RGW-SIO)

Gateway register (PLC output) Upper byte / Lower byte	Address
Gateway control signal 0	F600
Gateway control signal 1	F601
Request command	F602
Data 0	F603
Data 1	F604
Data 2	F605
Data 3	F606
(Cannot be used)	F607
(Axis 0) Position data specification (L)	F608
(Axis 0) Position data specification (H)	F609
(Axis 0) Position number	F60A
(Axis 0) Control signal	F60B
(Axis 1) Position data specification (L)	F60C
(Axis 1) Position data specification (H)	F60D
(Axis 1) Positioning band specification (L)	F60E
(Axis 1) Positioning band specification (H)	F60F
(Axis 1) Speed specification	F610
(Axis 1) Acceleration/deceleration spec.	F611
(Axis 1) Push current limiting value	F612
(Axis 1) Control signal	F613

Address assignments

Function block	
Variable name	Set address
GateWay Infomation Table	W300
	W301
Command Response Table	W302
	W303
	W304
	W305
	W306
	W307
Date Read Table	W308
	W309
	W310
	W311
	W312
	W313
	W314
	W315
	W316
	W317
	W318
	W319

Gateway register (PLC input) Upper byte / Lower byte	Address
Gateway status signal 0	F700
Gateway status signal 1	F701
Response command	F702
Data 0	F703
Data 1	F704
Data 2	F705
Data 3	F706
(Cannot be used)	F707
(Axis 0) Current position data (L)	F708
(Axis 0) Current position data (H)	F709
(Axis 0) Completed position number	F70A
(Axis 0) Status signal	F70B
(Axis 1) Position data specification (L)	F70C
(Axis 1) Position data specification (H)	F70D
(Axis 1) Current ampere value (L)	F70E
(Axis 1) Current ampere value (H)	F70F
(Axis 1) Current speed data	F710
(Cannot be used)	F711
(Axis 1) Alarm	F712
(Axis 1) Status signal	F713

Chapter 6 Setting for External SIO Link and Other

6.1 SCON/PCON-CF Settings and Signal Assignments

SCON controllers can be operated only in the positioner mode. They cannot be operated in the pulse-train input mode. For SCON controllers, set the parameters as follows.

(1) User parameters

○: Applicable X: Not applicable

No.	Name	Description of setting (change)	SCON	PCON-CF
16	SIO baud rate	38400 bps (Default) → Change to 230400 bps.	○	○
17	Minimum delay for slave transmitter activation	5 msec (Default) → Change to 2 msec.	○	○
18	PIO pattern selection	Default: 0 (Standard type) → Set a value between 0 and 3. *	○	○
19	PIO power monitoring	Default: 0 (Enable) → Change to 1 (Disable).	○	X

* The solenoid valve mode cannot be set under 4 and 5. Also, the maximum positions that can be registered varies depending on the mode.

(2) Piano switches (Limited to SCON controllers)
Set piano switch 1 on the front panel of the SCON to the OFF position to change to the positioner mode.

(3) Mode selector switch
Set the mode selector switch on the front panel of the SCON/PCON-CF to MANU.

(4) Signal assignment
The assignment of each signal for the SCON/PCON-CF is the same as with the RPCON/RACON. Refer to “ROBONET Specification.”

(5) Set the axis number using the rotary switches.

6.2 Other

Items to note regarding the condition of user setting switch SW1 on the Gateway R unit are given below.

(1) When SW1 = OFF (TP enable switch signal disabled)
The TP enable switch signal of each connected RPCON, RACON, PCON-CF or SCON controller becomes ineffective regardless of the enable operation parameter set by the gateway parameter tool.

(2) When SW1 = ON (TP enable switch signal enabled)
[1] When the enable operation parameter is set to “Shutdown control”
When the TP enable switch is disabled, each connected RPCON, RACON, PCON-CF or SCON controller stops (the axis decelerates to a stop → the servo turns off → the drive source is cut off).
[2] When the enable operation parameter is set to “Servo control”
When the TP enable switch is disabled, each connected RPCON or RACON controller stops (the axis decelerates to a stop → the servo turns off), but each PCON-CF or SCON controller corresponding to an external link axis does not stop and continues to operate.

The table below summarizes the above information.
Operations when the TP enable switch is enabled

		Enable operation set by the parameter setting tool	
		Shutdown (default)	Servo control
Axis operation when the TP enable switch is disabled	RACON or RPCON	The axis decelerates to a stop → the servo turns off → the drive source is cut off (Same as when an emergency stop is actuated.)	The axis decelerates to a stop → the servo turns off
	External link axis	The axis decelerates to a stop → the servo turns off → the drive source is cut off (Same as when an emergency stop is actuated.)	The axis does not stop (operation continues). *
Processing by the Gateway R unit when the TP enable switch is disabled		• Drive-source cutoff signal ON → RY2 contacts “Open” • Enable signal (disabled state) passed to the RACON or RPCON controller → (The controller causes the actuator to decelerate to a stop and then the servo turns off). The enable signal is not output to external link axes.	• Drive-source cutoff signal OFF → RY2 contacts “Closed” • Enable signal (disabled state) passed to the RACON or RPCON controller → (The controller causes the actuator to decelerate to a stop and then the servo turns off). The enable signal is not output to external link axes.

* The drive-source cutoff signal of the Gateway R unit remains OFF and the TP enable signal is not output to external link axes. Accordingly, the operation does not stop even when the TP enable switch is disabled.

⚠ Caution

To enable the TP enable operation when external SIO link axes are used, set the enable operation to “Shutdown (default).” The emergency stop line signal (EMG+, EMG-) is output to external SIO link axes, but the TP enable signal is not output to these axes.

Part 3 Maintenance

Chapter 1 Troubleshooting

1.1 Actions to Be Taken upon Problems

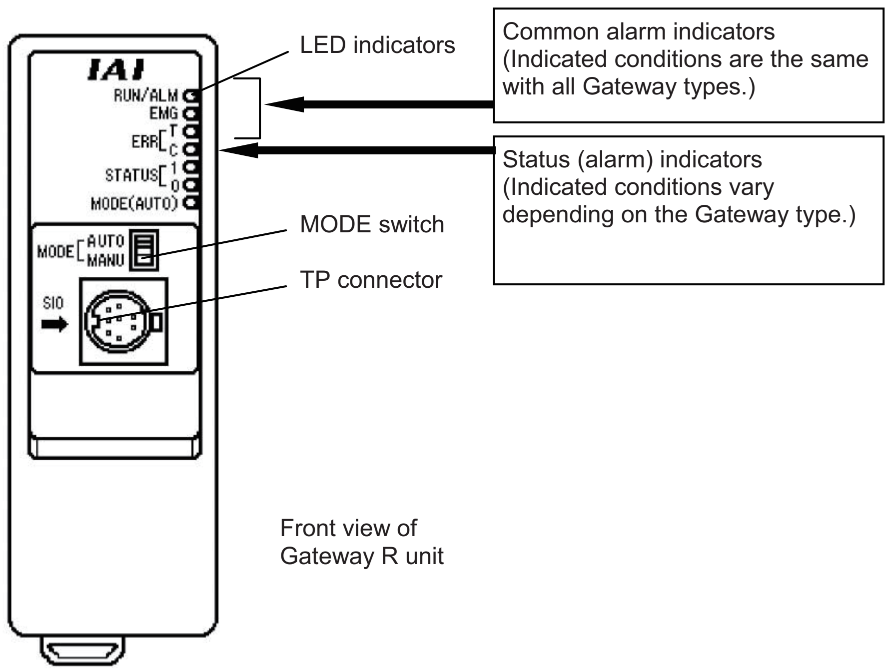
If you encountered a problem, follow the procedure below for speedy recovery and to prevent the same problem from occurring again:

a. Check the LED indicators on the Gateway R unit
   RUN/ALM, ERROR-T, ERROR-C, STATUS-0, STATUS-1, EMG
b. Check the host controller (PLC master station) for abnormality
c. Check the LED indicators on the controller unit
   SV/ALM, TX/RX, STATUS0 to STATUS3
   (If the ALM LED is illuminating in red, the STATUS0 to STATUS3 LEDs indicate an applicable simple alarm code.)
d. Check the LED indicators on the simple absolute R unit
   RDY/ALM, STATUS0 to STATUS1
e. Check if the power-supply voltage is within a range of 24 V ± 10%
   With a DeviceNet system, check the communication power supply (24 V).
f. Check the wiring of the ROBONET communication connection board, simple absolute connection board, motor cable and encoder cable
g. Check the network cable connection
   (In particular, pay attention to the connection points on the terminal block and connector.)
h. Check the installation condition of network terminal resistor and their resistance values
i. Conduct operation check using the teaching pendant or PC software
   Connect the teaching pendant or PC software to the Gateway R unit and set the MODE switch to “MANU.” In this condition, operate each axis and check if an alarm generates.
j. Check the I/O signals transmitted between the PLC and controller unit
   [1] On the PLC side, check the I/O signals using the monitor function of a dedicated tool (Mitsubishi GX Developer, Omron CX Programmer, etc.)
   [2] On the control unit side, check the I/O signals using the status monitor function of the teaching pendant or PC software.
   [3] Confirm that the I/O signals checked in steps [1] and [2] above are consistent.
k. Identify the background leading to the problem as well as the operating condition when the problem occurred
l. Analyze the cause of problem
m. Take appropriate actions

If the problem cannot be resolved, contact IAI after conducting the checks in a to k.

1.2 Alarms of the Gateway R unit

The Gateway R unit indicates various alarms using the LED indicators provided on the front face of the unit.
The four LEDs of RUN/ALM, EMG, ERR-T and ERR-C indicate the same conditions regardless of the gateway type (common alarm indicators).
The STATUS0 and STATUS1 LEDs are status (alarm) indicators and what they indicate varies depending on the gateway type.
Two or more common alarm indicators and status indicators are actuated for each alarm depending on the nature of the alarm.



Front view of Gateway R unit

1.2.1 Common Alarms

The table below lists the alarms and their descriptions.

LED name	Displayed color	Condition	Action
RUN/ALM	Green	Normal	-
	Orange	An alarm is present (applicable to all alarms).	Check the ERROR-T/C and STATUS-0/1 LEDs.
EMG	Red	An emergency stop is actuated.	Check the emergency-stop pushbutton and emergency-stop circuit.
	Unlit	An emergency stop is not actuated.	-
ERROR-T	Unlit	Normal	-
	Orange	ROBONET communication error [1] The axis configuration parameters do not match the actual axis configuration (address). [2] Internal bus communication with the controller experienced an error. [3] Not all controllers are ready.	[1] Review the parameter settings and address setting. [2] Check the status of the SV/ALM and TX/RX LEDs on the controller unit to identify the axis that generated the error. Turn off the power and then turn it back on. Check the ROBONET communication connection board for proper insertion. [3] The ROBONET link is operating normally, but the CRDY signal of a specific axis is turned OFF. Monitor each axis to identify and replace the problem axis.
ERROR-C	Unlit	Normal	-
	Orange	Fieldbus communication error	Check the details using the STATUS0 and 1 LEDs.

1.2.2 Alarms by Field Network Type

The alarms indicated by the STATUS0 and STATUS1 LEDs vary depending on the field network type, as shown below.

(1) CC-Link

LED name	Displayed color	Condition	Action
STATUS-1	Unlit	[1] Normal [2] Reset process is in progress.	- -
	Orange	[1] CRC error (*1) [2] A station number setting error occurred after a reset. (*2) [3] A baud rate setting error occurred after a reset. (*3)	[1] Noise in the communication line or disconnected communication cable is suspected, among others. Check the applicable items and take an appropriate action. [2] Review the station number setting. [3] Set the MODE switch on the master side to 4 or smaller.
	Blinking orange (0.4 sec)	The station number or baud rate changed from the specified value after a reset.	-
STATUS-0	Green	[1] Refresh or polling data was received successfully after joining the network. [2] Refresh data was received successfully.	-
	Unlit	[1] The unit is yet to join the network. [2] Channel carrier waves were detected. [3] A timeout occurred. [4] Reset process is in progress.	This condition indicates that the unit is offline, meaning that it is not linked to the host master. Check the power supplies of the master and gateway unit, communication cable, station number and baud rate settings of the gateway unit, and network parameter settings of the master.

(*1) CRC: Cyclic Redundancy Check
A data error detection method widely used in synchronous transmission.

(*2) Since the station number of the master is normally set to 0, the setting range is 1 to 64. The number of stations, including occupied stations, must not exceed 64.

(*3) The Gateway R unit and master communicate with each other when the master is in the online mode. In the online mode, the MODE switch on the master is set to any one of 0 to 4 (when QJ61BT11N is used).

(2) DeviceNet

LED name	Displayed color	Condition	Action
STATUS-1	Unlit	Offline/no power	Communication with the master is not yet established. Check the DeviceNet communication power supply (+24 V), power supply of the gateway unit, communication cable, etc.
	Green	The unit is online and connection has been established (normal).	-
	Blinking green (1 Hz)	The unit is online but connection has not been established yet.	The occupancy information or station number of the master is inconsistent with the corresponding information of the gateway unit. Review these settings.
	Orange	Fatal error	Replace the gateway unit.
	Blinking orange (1 Hz)	Connection timeout	The master cannot be recognized. Check the condition of the master and communication cable.
	Alternating red/green	Self-diagnosis is being performed.	-
STATUS-0	Unlit	No power	Check the power supply of the gateway unit.
	Green	Normal operation (normal)	-
	Blinking green (1 Hz)	Configuration information is not available or incomplete.	Check the configuration settings again.
	Orange	Irrecoverable failure	Replace the gateway unit.
	Blinking orange (1 Hz)	Recoverable failure	Reconnect the power.
	Alternating orange/green	Self-diagnosis is being performed.	-

(3) Profibus

LED name	Displayed color	Condition	Action
STATUS-1	Unlit	Offline/no power	Communication with the master is not yet established. Check the station number setting, power supply, communication cable, etc.
	Green	Online (data exchanged) (normal)	-
	Blinking green	Online (data cleared)	A clear command is being received from the master following a network error. Reset the master.
	Orange	Parameter error	Check the network parameters again.
	Blinking orange	Configuration error	The occupancy information of the master is different from that of the gateway unit. The coverage of the gateway unit may be smaller. Check the settings again.
STATUS-0	Unlit	No power, or initialization not yet performed	Check the power supply.
	Green	Initialization has completed (normal).	-
	Blinking green	Initialization has completed (diagnosis event triggered).	Reconnect the power.
	Orange	Exceptional error	Replace the gateway unit.

(4) RS485SIO

LED name	Displayed color	Condition	Action
STATUS-1	Unlit	Data send stopped	-
	Green	Sending data	-
STATUS-0	Unlit	Data receive stopped	-
	Green	Receiving data	-

* These are not alarm signals.

1.2.3 Examples of Indicator Statuses Corresponding to Representative Alarms

Examples of indicator statuses corresponding to representative alarms are shown for CC-Link and DeviceNet systems.

(1) CC-Link

●: Lit ○: Unlit ⊙: Blinking

Gateway unit				Master	Operation/condition
ERROR-T (Orange)	ERROR-C (Orange)	STATUS-1 (Orange)	STATUS-0 (Orange)	ERR (Red)	
○	○	○	●	○	Normal
○	○	○	○	●	The 24-V power supply of the gateway unit is turned off.
○	●	○	○	○	The power supply of the master is turned off.
○	●	○	○		The network cable is disconnected.
●	○	○	●	○	The ROBONET communication connection board is detached.
○	●	○	○	●	The station number setting of the gateway unit is different from the station number registered to the master.
○	●	○	○	●	The baud speed setting of the master is different from the corresponding setting of the gateway unit.
●	●	○	●	○	The axis configuration (occupancy information) of the gateway unit is different from the actual configuration.
○	○	○	●	⊙	The master network parameter for number of connected units is different from the actual number of units.
○	●	○	○	●	The master network parameter for station type is wrong.
○	●	○	○	●	The master network parameter for number of occupied station is wrong.

(2) DeviceNet

●: Lit ○: Unlit ⊙: Blinking

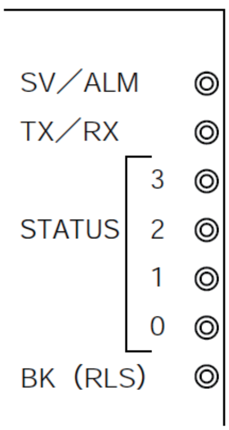
Gateway unit				Master	Operation/condition
ERROR-T (Orange)	ERROR-C (Orange)	STATUS-1	STATUS-0	NS	
○	○	● Green	● Green	● Green	Normal
○	●	● Green	● Green	⊙ Red	The 24-V power supply of the gateway unit is turned off.
○	●	⊙ Orange	● Green	○	The power supply of the master is turned off.
○	●	○	● Green	⊙ Red	The network cable is disconnected.
●	○	● Green	● Green	● Green	The ROBONET communication connection board is detached.
○	⊙	⊙ Green	● Green	⊙ Red	The station number setting of the gateway unit is different from the station number registered to the master.
○	⊙	⊙ Green	● Green	⊙ Red	The axis configuration (occupancy information) of the gateway unit is different from the actual configuration.
○	⊙	⊙ Green	● Green	⊙ Red	The I/O size setting in the master scan list is wrong.
○	●	⊙ Orange	● Green	⊙ Red	The station number setting (switch) of the master unit has been changed after the network was set up.

1.3 Alarms of the Controller Unit and Simple Absolute R Unit

1.3.1 Overview of Alarms

(1) The status monitor LEDs shown below are provided on the front face of the RACON and RPCON units. When an alarm generates, the nature of the alarm can be checked using these LEDs.

Front face of unit



Symbol	Explanation
SV/ALM	This LED illuminates in red when an alarm is present or emergency stop is actuated (if an emergency stop is actuated, STATUS0 to 3 remain unlit). The LED illuminates in green when the servo is ON, and remains unlit when the servo is OFF.
TX/RX	Communication line status (This LED illuminates in green when data is being sent, and in yellow when data is being received.)
STATUS3 STATUS2 STATUS1 STATUS0	When an alarm occurs, these LEDs indicate the applicable simple alarm code. (When the servo is ON, these LEDs are used to monitor current.)
BK (RLS)	This LED illuminates in yellow while the brake is released, and remains unlit while the brake is actuated.

When an alarm occurs, the applicable simple alarm code is indicated as a binary code by the STATUS0 to STATUS3 LEDs. To be able to check the nature of alarms in more details, connect the PC software or teaching pendant to the Gateway R unit, select the target axis, and monitor alarms.
When the gateway unit is operating in the positioner mode or simple direct mode, a simple alarm code is output, only if an alarm has occurred, in the completed position number area (PM1 to PM512) of the gateway unit. Accordingly, alarms can be monitored by the host PLC through monitoring of this area. The host PLC can also read alarm codes (not simple alarm codes) using commands.
If the gateway unit is operating in the direct numerical specification mode, alarm codes (not simple alarm codes) are output in the alarm code area of the gateway unit. Accordingly, alarms can be monitored by the host PLC through monitoring of this area.

(2) Three status monitor LEDs are provided on the front face of the simple absolute R unit. When an alarm has generated or other problem has occurred, check the status of these LEDs.
The details are described in 5.4.2 of "ROBONET Operation Manual – Specification." The tables below provide an overview.

RDY/ALM		Operation
Steady green	Steady red	
○	-	System normal
-	○	System abnormal

RDY/ALM		Operation
Blinking green	Blinking red	
○	○	Update mode *

STATUS1		Operation
Steady green	Steady red	
○	-	Absolute reset completed (RDY illuminating in green)
-	○	Absolute reset not yet completed (RDY illuminating in green)
-	○	FPGA notification error (RDY illuminating in red)

STATUS0			Operation
Steady green	Steady orange	Steady red	
○	-	-	Battery fully charged
-	○	-	Battery charging
-	-	○	Battery not connected

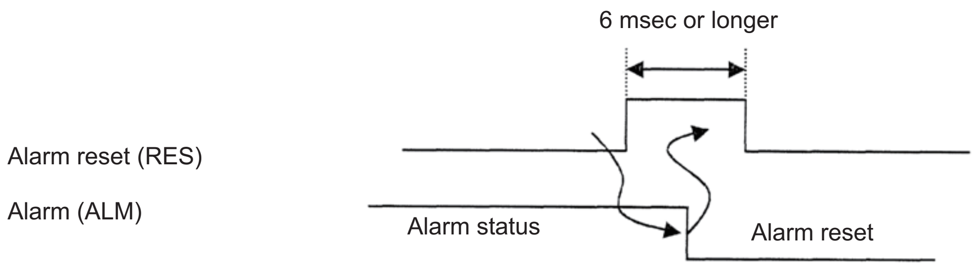
* The unit is in the update mode. Disconnect the battery and set piano switch 3 to the "OFF" position. For information on how to set the piano switches, refer to 4.2, "Setting the Configuration Switches."

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

Alarm level	ALM lamp	ALM signal logic	Condition of generation	Reset method
Operation cancellation	Lit	“1”	After deceleration stop Servo OFF	Input the alarm reset signal (RES) from the PLC. Perform a reset action from the PC/teaching pendant.
Cold start	Lit	“1”	After deceleration stop Servo OFF	Reconnect the power.

* The ALM signal uses the positive logic.
After the power is turned on, this signal remains “0” while the system is normal, and turns “1” if an alarm has occurred.
(Since the signal becomes “0” when the power is cut off, it cannot be used as an interlock signal.)

■ How to reset operation-cancellation alarms
Input the alarm reset (RES) signal for 6 msec or longer.
The ALM signal will return to “0” after the above period. Confirm the “0” status and then set the RES signal to “0” (OFF).



⚠ Caution

Reset each alarm after identifying and removing its cause.
If the cause of the alarm cannot be removed, or the alarm cannot be reset even after its cause has been removed, contact IAI.
If the same alarm generates again after a reset, the cause of the alarm has not been removed. In this case, repeating the reset action may result in a burned motor or other undesired condition. Be sure to identify the cause and remove it before resetting the alarm.

An alarm list for RACON and RPCON is provided on the next page.

Alarm List

STATUS 3	STATUS 2	STATUS 1	STATUS 0	Simple code	Alarm code	Alarm name	Reset method *	RPCON	RACON
○	○	●	○	2	90	Software reset command with servo ON		○	○
					91	Position number error during teaching		○	○
					92	PWRT signal detection during movement		○	○
					93	PWRT signal detection before home return		○	○
○	○	●	●	3	80	Movement command with servo OFF		○	○
					83	Absolute position movement command before home return		○	○
					84	Movement command during home return		○	○
					85	Position number error during movement		○	○
					A7	Command deceleration error		○	○
○	●	○	○	4	F4	Unmatched PCB error	●	○	○
○	●	●	○	6	A1	Parameter data error		○	○
					A2	Position data error		○	○
					A3	Position-command information data error		○	○
○	●	●	●	7	B6	Phase-Z detection timeout		x	○
					B7	Indeterminable magnetic pole	●	x	○
					B8	Excitation detection error	●	○	x
					BA	Home sensor not detected		○	○
					BE	Home return timeout		○	○
●	○	○	○	8	C0	Excessive actual speed		○	○
●	○	○	●	9	C8	Overcurrent	●	x	○
					C9	Overvoltage		○	○
					CA	Overheat		○	○
					CB	Current-sensor offset adjustment error	●	x	○
					CC	Control power-supply voltage error		○	○
					CE	Control power-supply voltage low		○	○
●	○	●	●	B	D8	Deviation overflow		○	○
					D9	Software stroke limit over error		○	○
					DC	Push & hold operation out-of-range error		○	○
●	●	○	○	C	C1	Servo error		○	○
					D2	Excessive motor power-supply voltage		○	x
					E0	Overload	●	x	○
					F0	Driver logic error	●	x	○
●	●	○	●	D	E5	Encoder receive error	●	x	○
					E8	Phase A/B open	●	○	○
					E9	Phase A open	●	○	○
					EA	Phase B open	●	○	x
					ED	Absolute encoder error (1)	●	○	x
					EE	Absolute encoder error (2)		○	○
					EF	Absolute encoder error (3)		○	○
●	●	●	○	E	FA	CPU error	●	○	○
●	●	●	●	F	F5	Nonvolatile memory write verification error		○	○
					F6	Nonvolatile memory write timeout		○	○
					F8	Damaged nonvolatile memory data	●	○	○

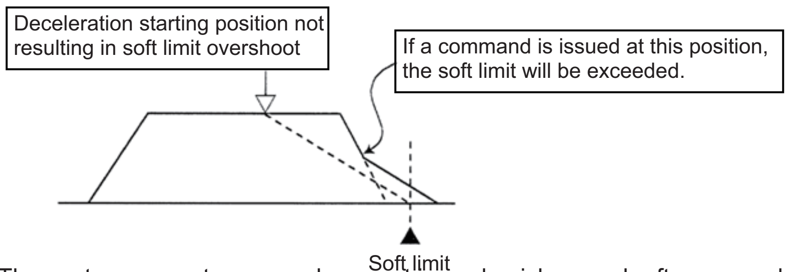
○: Unlit ●: Lit ○: Available X: Not available

* Alarms denoted by ● in the "Reset method" field are cold-start alarms. These alarms cannot be reset unless the power is turned off once. Other alarms can be reset by inputting the reset signal.

1.3.2 Alarms, Causes and Actions

(1) Operation-cancellation alarms (These alarms can be reset with the reset signal.)

Code	Alarm name	Cause/action
080	Movement command with servo OFF	Cause: A movement command was issued as a numerical command when the servo was OFF. Action: Confirm that the servo is ON (SV or PEND is “1”) before issuing a movement command.
083	Numerical command before home return	Cause: A numerical command involving an absolute position was issued before home return was completed. (Simple direct or direct numerical command mode) Action: Perform home return and confirm a completion signal (HEND) before issuing a movement command.
084	Movement command during home return	Cause: A movement command was issued as a numerical command while home return was in progress. Action: Perform home return and confirm a completion signal (HEND) before issuing a movement command.
085	Position number error during movement	Cause: A position number not yet registered in the position table was specified in the positioner mode. Action: Check the position table again.
090	Software reset with servo ON	Cause: A software reset command was received when the servo was ON. Action: Send a software reset command to the controller after confirming that the servo is OFF (SV is “0”).
091	Position number error during teaching	Cause: An invalid position number was specified when writing the current position via teaching operation. Action: 768 position numbers from 0 to 767 can be used with the RACON and RPCON. Use position numbers within this range.
092	PWRT signal detection during movement	Cause: The current position write signal (PWRT) was input during jogging when teaching operation was performed in the positioner mode. Action: Input the PWRT signal after confirming that no jog button is pressed and that the axis is stopped (MOVE signal is “0”).
093	PWRT signal detection before home return	Cause: The current position write signal (PWRT) was input before home return was completed when teaching operation was performed in the positioner mode. Action: Input the HOME signal first to perform home return and confirm the completion of home return (HEND signal is “1”) before inputting the PWRT signal.

Code	Alarm name	Cause/action
0A2	Position data error	Cause: [1] A movement command was input when a target position was not set in the "Position" field. [2] The target position in the "Position" field exceeds the specified soft limits. Action: [1] Set a target position first. [2] Change the target position to a value within the specified soft limits.
0A3	Position command data error	Cause: The speed or acceleration/deceleration in the numerical command exceeds the maximum setting. Action: Change the speed or acceleration/deceleration to an appropriate value.
0A7	Command deceleration error	When the target position is near a soft limit and the deceleration is set low, issuing a command with the applicable position number while the actuator is moving may cause the actuator to exceed the soft limit.  Cause: The next movement command was not issued quick enough after a speed change implemented while the actuator was moving. Action: Change the speed quickly so that the actuator will not overshoot by exceeding the soft limit.
0B5	Phase Z position error	The position at which phase Z was detected during the home return was outside the specified range, or phase Z was not detected. Cause : Defective encoder Action : Contact IAI.
0B6	Phase-Z detection timeout (RACON only)	This controller performs magnetic-pole phase detection (pole sensing) when the servo is turned on for the first time after the power ON. This alarm indicates that the encoder phase-Z signal could not be recognized within the specified time. • When the detail code is H'0001: Pole sensing operation + Magnetic pole check • When the detail code is H'0002: Operation after reversing upon push & hold action following a home return Cause: [1] Loose or disconnected encoder-relay or motor-extension cable connector [2] Brake cannot be released on an actuator equipped with brake. [3] Large motor load due to application of external force [4] Large slide resistance of the actuator itself Action: [1] Check the wiring condition of the extension cables. [2] Check the wiring condition of the brake cable. Also, turn on/off the brake release switch and check if the brake makes "click" sounds. [3] Check for abnormality in the assembly condition of mechanical parts. [4] If the payload is normal, cut off the power and move the actuator by hand to check the slide resistance. If the actuator itself is suspected, such as when a faulty encoder is a likely cause, please contact IAI.

Code	Alarm name	Cause/action
0BA	Home sensor not detected	This alarm indicates that the actuator equipped with the home check sensor has not yet successfully completed the home return operation. Cause: [1] The work part contacted a surrounding equipment or structure during home return. [2] The slide resistance of the actuator is high in some location. [3] The home check sensor is not properly installed, faulty or open. Action: If the work part is not contacting any surrounding equipment or structure, [2] or [3] is suspected. Please contact IAI.
0BE	Home return timeout	Cause: Home return does not complete after elapse of the time set by the applicable manufacturer's parameter following the start of home return operation. (This alarm does not generate in normal operations.) Action: The controller and actuator combination may be wrong, among others. Please contact IAI.
0C0	Excessive actual speed	Cause: The motor speed exceeded the maximum speed set by the applicable manufacturer's parameter. Although this alarm does not generate in normal operations, it may occur if the load decreased before a servo error was detected and the actuator moved quickly as a result, which can be caused by various reasons including the following: [1] The slide resistance of the actuator is high in some location. [2] The load increased due to momentary application of external force. Action: Check the assembly condition of mechanical parts for any abnormality. If the actuator itself is suspected as the cause, please contact IAI.
0C1	Servo error (RPCON only)	This alarm indicates that the motor could not be operated for 2 seconds or more after the movement command was accepted and before the target position was reached. Cause: [1] The motor-extension cable connector is loose or open. [2] If the actuator is equipped with a brake, the brake cannot be released. [3] The load increased due to application of external force. [4] The slide resistance of the actuator itself is high. Action: [1] Check the wiring condition of the motor-extension cable. [2] Check the wiring condition of the brake cable. Also, turn on/off the brake release switch and check if the brake makes "click" sounds. [3] Check the assembly condition of mechanical parts for any abnormality. [4] If the payload is normal, turn off the power and move the actuator by hand to check the slide resistance. If the actuator itself is suspected as the cause, please contact IAI.
0C9	Motor power-supply overvoltage	This alarm indicates that the motor power-supply voltage is excessively high (24 V + 20%: 28.8 V or above). Cause: [1] The 24-V input power-supply voltage is high. [2] A faulty part inside the controller Action: Check the input power-supply voltage. If the voltage is normal, please contact IAI.

Code	Alarm name	Cause/action
0CC	Control power-supply overvoltage	This alarm indicates that the 24-V input power-supply voltage is excessively high (24 V + 20%: 28.8 V or above). Cause: [1] The 24-V input power-supply voltage is high. [2] A faulty part inside the controller Action: Check the input power-supply voltage. If the voltage is normal, please contact IAI.
0CE	Control power-supply voltage low	This alarm indicates that the 24-V input power-supply voltage is low (24 V - 20%: 19.2 V or below). Cause: [1] The 24-V input power-supply voltage is low. [2] A faulty part inside the controller Action: Check the input power-supply voltage. If the voltage is normal, please contact IAI.
0D2	Motor power-supply overvoltage (RACON only)	Cause: [1] The input power-supply voltage of the motor is high. [2] A faulty part inside the controller Action: Check the input power-supply voltage of the motor. If the voltage is normal, please contact IAI.
0D8	Deviation overflow	The position deviation counter has overflowed. Cause: [1] The speed dropped during movement due to the effect of an external force, etc. [2] The acceleration is set too high for the loading mass. Action: [1] Check the load conditions—such as whether the work part is contacting a surrounding object or the brake is released—and then correct the abnormality, if any. [2] An overload condition is suspected, so review the payload.
0D9	Soft limit over error	Cause: The current position of the actuator is outside the software stroke limits following the completion of home return. Action: Move the actuator to a position within the software stroke limits.
0DC	Push & hold operation out-of-range error	This alarm generates when the actuator was pushed back to the target position due to an excessive push force after completion of push & hold operation. Review the entire system.
0ED	Absolute encoder error (1)	Cause: [1] When the power was reconnected following the completion of an absolute reset, the current position changed due to an external factor or other cause occurring while the controller was communicating with the absolute unit. [2] When an absolute reset was performed, the current position changed due to an external factor or other cause occurring while the controller was communicating with the absolute unit. Action: [1] When the detail code is H'0001: Turn off the power and make sure the actuator is not receiving vibration, etc., and then turn the power back on. [2] When the detail code is H'0002: Perform the home return operation after making sure the actuator is not receiving vibration, etc.

Code	Alarm name	Cause/action
0EE	Absolute encoder error (2)	Cause: [1] The power was turned on for the first time after the battery connection. [2] When the detail code is H'0001: The battery voltage dropped to a level where the encoder counter in the absolute unit could no longer be retained. [3] When the detail code is H'0002: The encoder connector was unplugged during a power outage, or the encoder cable was disconnected. [4] When the detail code is H'0003: A relevant parameter was changed. [5] When the detail code is H'0004: The battery voltage dropped to 3.1 V. [6] When the detail code is H'0005: No battery is connected. Action: If [1], [2] or [4] is suspected, perform an absolute reset by following the specified procedure. (Refer to the absolute reset method in 4.5.) [3] or [5]: Supply power for at least 48 hours to fully charge the battery, and then perform an absolute reset. * It takes 72 hours to fully charge the discharged battery. [6] Check the battery connection.
0EF	Absolute encoder error (3)	Cause: The current value changed at a speed equal to or greater than the specified speed due to an external factor or other cause occurring when the power was cut off. Action: Change the applicable settings in the simple absolute unit and take other measures to prevent the actuator from moving at or above the specified speed while the power is cut off. If the battery retention time has an ample allowance, increase the specified motor speed. (Refer to 4.2 in "Startup") If this error has occurred, perform an absolute reset according to the specified procedure.

(2) Cold start level

<table>
<tr><th>Code</th><th>Alarm name</th><th>Cause/action</th></tr>
<tr><td>0A1</td><td>Parameter error</td><td>Cause: The input range of data in the parameter area is not appropriate.
(Example) This alarm generates when the magnitude relationship of a pair of input values is clearly inappropriate, such as when the values of soft limit + and soft limit – were input wrongly as 200.3 mm and 300 mm, respectively.
Action: Change the input data to appropriate values.</td></tr>
<tr><td>0A8</td><td>Unsupported motor/encoder type</td><td>Cause: The motor type or encoder type set by a parameter is not supported.
Action: If the alarm generates again after reconnecting the power, contact IAI.</td></tr>
<tr><td>0B4</td><td>Inconsistent electrical angle</td><td>Cause: The position deviation counter has overflowed.
Action: Check the load conditions such as whether the work part is contacting any nearby object and whether the brake is released.
If this alarm generated before confirmation of electrical angles (while phase Z was not yet detected), a deviation overflow may be a possibility. If this is the case, the motor wire may be broken or output from the encoder wire may be abnormal. Check the cable connections.</td></tr>
<tr><td>0B7</td><td>Indeterminable magnetic pole (RACON only)</td><td rowspan="2">This controller performs magnetic-pole phase detection (pole sensing) when the servo is turned on for the first time after the power ON. This alarm indicates that the magnetic-pole phase could not be recognized within the specified time.
Cause: [1] Loose or disconnected motor-extension cable connector
[2] Brake cannot be released on an actuator equipped with brake.
[3] Large motor load due to application of external force
[4] Large slide resistance of the actuator itself
Action: [1] Check the wiring condition of the motor-extension cable.
[2] Check the wiring condition of the brake cable. Also, turn on/off the brake release switch and check if the brake makes “click” sounds.
[3] Check for abnormality in the assembly condition of mechanical parts.
[4] If the payload is normal, cut off the power and move the actuator by hand to check the slide resistance.
If the actuator itself is suspected as the cause, please contact IAI.</td></tr>
<tr><td>0B8</td><td>Excitation detection error (RPCON only)</td></tr>
<tr><td>0C8</td><td>Overcurrent (RACON only)</td><td>Cause: The output current from the power-supply circuit became abnormally high.
This alarm should not generate in normal conditions of use. If it does, deterioration of motor coil isolation is suspected.
Action: Measure the line resistances between motor connection wires U, V and W, and the isolation resistance with respect to the ground, to check for deterioration of isolation.
If you require the above measurements, please contact IAI.</td></tr>
<tr><td>0CA</td><td>Overheat</td><td>This alarm indicates that the temperature around the power transistor or regenerative resistor in the controller is excessively high (95°C or above).
Cause: [1] The ambient temperature is high.
[2] The regenerative energy is excessive. (In the case of an actuator installed vertically, the deceleration setting for downward movement is too high.)
[3] A faulty part inside the controller
Action: [1] Lower the ambient temperature of the controller.
[2] Review the settings and decrease the deceleration.
If [1] and [2] do not apply, please contact IAI.</td></tr>
</table>

Code	Alarm name	Cause/action
0CB	Current-sensor offset adjustment error (RACON only)	When the controller is started, the condition of the current detection sensor in the controller is checked as part of the initialization process. This alarm indicates that an error was found in this sensor during the check. Cause: [1] Faulty current detection sensor or surrounding part [2] Inappropriate offset adjustment. Action: The board must be replaced or the offset must be adjusted. Please contact IAI.
0E0	Overload (RACON only)	Cause: [1] The load increased due to application of external force. [2] If the actuator is equipped with a brake, the brake cannot be released. [3] The slide resistance of the actuator is high in some location. Action: [1] Review the condition around the work part. If the work part is receiving any abnormally high external force, make the necessary corrections. [2] Turn on the brake release switch to see if the brake is released. If the brake is not released, a faulty brake, cable disconnection or defective brake-circuit component in the controller is suspected, among others. [3] If the work part can be moved by hand, do so to check for locations where the slide resistance increases. If [2] or [3] is the case, please contact IAI. Note: Be sure to remove the cause of the alarm before resuming the operation. If the power was cut off, wait for at least 30 minutes before turning on the power again to prevent the motor coil from burning.
0E5	Encoder receive error	Cause: [1] The controller power was turned on before the simple absolute unit when the 24-V power was input. [2] When the detail code is H'0001: The controller is unable to communicate with the absolute unit properly due to noise, etc. [3] When the detail code is H'0002: The controller is unable to communicate with the absolute unit properly due to a disconnected communication wire in the encoder cable, etc. Action: [1] Turn on the power to the simple absolute unit before (or simultaneously with) the controller power. [2] Change the installation location of the controller. Implement noise elimination measures such as providing a FG, noise filter, clamp filter, etc. [3] Check the encoder-extension cable between the controller and simple absolute unit for looseness. If necessary, replace the cable.

Code	Alarm name	Cause/action
0E8	Phase-A/B open detection	Encoder signals cannot be detected correctly. Cause: [1] Loose or disconnected encoder-extension cable connector [2] Piano switch 4 of the simple absolute R unit is set incorrectly. [3] If a RA10C actuator is combined with other actuator, the combination of encoder cables is wrong. Action: [1] Check the connector for looseness or disconnection. [2] Check the piano switch setting by referring to 4.2. [3] Check the model number of the encoder cable (cable between the simple absolute unit and actuator). Note) The following model numbers apply only to the RCP2 series: Cable model number for RA10C actuator: CB-RFA-* For other actuator: CB-RCP2-*
0E9	Phase-A open detection (RPCON only)	
0EA	Phase-B open detection (RPCON only)	
0F0	Driver logic error (RACON only)	Cause: An excessive load, unmatched parameter (motor type), noise and faulty controller are suspected, among others. Action: Please contact IAI.
0F4	Unmatched PCB	This controller uses a different motor drive circuit depending on the motor capacity, and thus adopts a different printed circuit board (PCB) appropriate for each motor capacity. For this reason, whether the motor type set by the applicable manufacturer's parameter matches the circuit board is checked in the initialization process after startup. This alarm indicates that the two do not match. Cause: The parameter was not input correctly or the correct circuit board was not assembled. Action: Should this error occur, please contact IAI.
0F5	Nonvolatile memory write verification error	When data has been written to the nonvolatile memory, the written data is read again to check (verify) if it matches the original data. This alarm indicates that the two data do not match. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (As a guide, the nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm generates again after reconnecting the power, please contact IAI.
0F6	Nonvolatile memory write timeout	This error indicates that response was not received within the specified time after data was written to the nonvolatile memory. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (As a guide, the nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm generates again after reconnecting the power, please contact IAI.
0F8	Damaged nonvolatile memory	Abnormal data was detected during the nonvolatile memory check after startup. Cause: [1] Faulty nonvolatile memory [2] The memory has been rewritten more than 100,000 times. (As a guide, the nominal rewrite limit of the nonvolatile memory is around 100,000 times.) Action: If the alarm generates again after reconnecting the power, please contact IAI.
0FA	CPU error	The CPU is not operating properly. Cause: [1] Faulty CPU [2] Malfunction due to noise Action: If the alarm generates again after reconnecting the power, please contact IAI.

1.3.3 Messages Displayed during Operation Using the Teaching Pendant or PC Software

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

Code	Message	Description
112	Invalid data	An invalid value was input in a parameter. (Example) 9601 was input as the serial communication speed by mistake. Input an appropriate value again.
113	Value too small	The input value is smaller than the setting range.
114	Value too large	The input value is larger than the setting range. Refer to the actuator specifications or parameter table and input an appropriate value again.
115	Home return not completed	The current position was written when home return was not yet completed. Execute home return again.
117	No movement data	Target position is not set under the selected position number. Input the target position first.
11E	Unmatched paired data	The values indicating the magnitude relationship of a pair of data are inappropriate. (Example) The same value was input in both the parameters for soft limits + and –. Input appropriate values again.
11F	Absolute position too small	The minimum movement toward the target position is determined by the lead length of the drive system and resolution of the encoder. This message indicates that the input target value is smaller than the minimum movement. (Example) If the lead length is 20 mm, the encoder's resolution is 800 pulses and accordingly the minimum movement becomes 20 ÷ 800 = 0.025 mm/pulse. In this case, this message will be displayed if 0.02 mm is input as the target position.
121	Push & hold search end over	The final position in push & hold operation exceeds the soft limit. This has no negative effect if the actuator contacts the work part. If the actuator misses the work part, however, the soft limit will be reached and thus this message is displayed. Change either the target position or positioning band.
122	Multiple axes connected at assignment	An address was assigned when multiple axes were connected. Assign each address only when one axis is connected.
180 181 182 183	Address change OK Controller initialization OK Home change all clear I/O function changed	These messages are displayed to confirm operation. (They do not indicate an operation error or other abnormality.)
202	Emergency stop	This message indicates that an emergency stop has been actuated. (It does not indicate an error.)
20A	Servo off during operation	This message indicates that the servo ON signal (SON) was turned OFF by the PLC while the actuator was moving, and that the servo turned off and the movement was disabled as a result.

Code	Message	Description
20C	CSTR-ON during operation	This message indicates that a start command signal (CSTR) was changed to "1" by the PLC while the actuator was moving, and that duplicate movement commands occurred as a result.
20E	Soft limit over	This message indicates that a soft limit was reached.
210	HOME-ON during operation	This message indicates that the home return signal (HOME) was changed to "1" by the PLC while the actuator was moving, and that duplicate movement commands occurred as a result.
221	Write prohibited in monitor mode	This message indicates that an attempt was made to write position table data or parameter in the monitor mode.
223	Operation prohibited n monitor mode	This message indicates that an attempt was made to move the actuator in the monitor mode.
301 302 304 305 306 308 30A 30B	Overrun error (M) Framing error (M) SCIR-QUE OV (M) SCIS-QUE OV (M) R-BF OV Response timeout (M) Packet R-QUE OV Packet S-QUE OV	These messages indicate that an error occurred during serial communication with the controller. Cause: [1] Garbage data due to the effect of noise [2] Duplicate slave station numbers when multiple controllers are controlled by serial communication Action: [1] Adjust the wiring in a manner eliminating the effect of noise and review the installation of equipment, etc. [2] Change the slave station numbers to avoid duplication. If the message is still displayed after taking the above actions, please contact IAI.
307	Memory command denied	This message indicates that a command was denied during serial communication with the controller.
309	Write address error	This message indicates that an indeterminate WRITE address error occurred during serial communication with the controller.
		These conditions do not occur in normal operations. Should they occur, record the entire error list before cutting off the power for use in the cause investigation. Also contact IAI.
30C	No connected axis	This message indicates that no controller address is recognized. Cause: [1] The controller is not operating properly. (power supply error, failure, etc.) [2] Only the supplied communication cable (SGA/SGB) is disconnected. [3] If a SIO converter is used, 24V is supplied to the converter but the link cable is not connected. [4] The ADRS switch settings are duplicated by mistake when multiple controllers are linked. Action: [1] Check if the RDY lamp on the controller is lit. If the lamp is not lit, the controller is faulty. [2] If a spare teaching pendant is available, replace the current pendant with the spare unit, or with a PC, and see if the message disappears. [3] Supply the power after connecting the link cable between the converter and controller. [4] Make sure the ADRS switch settings are not duplicated. If the message is still displayed after taking the above actions, please contact IAI.

Chapter2 Maintenance/Inspection

Carry out daily or periodic inspection to make sure your ROBONET continues to demonstrate its functions fully.

⚠ Danger

- Do not touch the terminals while the power is supplied. Doing so may result in electric shock.
- Connect the backup battery correctly. Do not charge, disassemble, heat, throw into fire, short-circuit or solder the backup battery.
  Incorrect handling of the backup battery may cause heat generation, explosion or ignition, resulting in injury or fire.
- Always turn off the ROBONET power before cleaning the parts or tightening the terminal screws and unit lock screws (screws on the end plates).
  If the power remains supplied, electric shock may result.
  Loose terminal screws can cause malfunction.
  On the other hand, excessive tightening may damage the screws or units, causing parts or units to detach, short-circuit or malfunction.

⚠ Caution

- Do not disassemble or modify each unit.
  Doing so may result in failure, malfunction, injury or fire.
- Always turn off the ROBONET power before connecting/disconnecting the units and motor/encoder cables. Failure to do so may cause unit failure or malfunction.
- Do not drop the backup battery or otherwise apply impact on it.
  The impact of drop, etc., may damage the backup battery and cause battery fluid to leak inside the battery.
  If the backup battery was dropped or otherwise received impact, do not use the battery but dispose of it properly.
- Before touching any unit, always touch a grounded metal, etc., to discharge the electrostatic charges in your body.
  Failure to do so may cause unit failure or malfunction.
- Use cellular phones, PHSs and other wireless devices as far away as possible from the ROBONET.
  Using wireless devices nearby may cause the ROBONET to malfunction.

2.1 Periodic Inspection Items

The ROBONET may suffer deterioration of electronic parts or exhibit other undesirable conditions depending on the environment. To prevent these problems, periodic inspection is necessary.
The standard inspection interval is six months to one year. Shorten the interval depending on the surrounding environment.

No.	Inspection item	Description	Judgment criterion	Action
1	Supply voltage	Measure the voltage at the power-supply terminal block to check if the voltage fluctuation meets the judgment criterion.	Voltage fluctuation is within the specified range of 24 V ± 10%.	Change the settings so that the supply voltage meets the judgment criterion.
2	Surrounding environment	Ambient temperature (If a panel is used, the temperature inside the panel represents the ambient temperature.)	0 to 40°C	Measure the ambient temperature using a temperature gauge and adjust the surrounding environment so that the measured value falls within the ambient operating temperature range.
		Ambient humidity (If a panel is used, the humidity inside the panel represents the surrounding humidity.)	95% RH or below, non-condensing.	Measure the ambient humidity using a hygrometer and adjust the surrounding environment so that the measured value falls within the ambient operating humidity range.
		Ambience	Free from corrosive or flammable gases.	Check by smell or using a gas sensor, etc.
			Not exposed to splashes or mist of water, oil and chemicals.	Remove, and shield the ROBONET from, sources of splashes/mist
			Free from deposits of dust particles, salt, iron powder or other powder dust.	Remove, and shield the ROBONET from, sources of powder dust.
		Direct exposure to sunlight	Not exposed to direct sunlight.	Shield the ROBONET from direct sunlight.
		Direct transmission of vibration or impact to the body	Meeting the vibration resistance and impact resistance specifications.	Install cushions or other means for withstanding vibration and impact.
		Nearby noise sources	Absence of noise sources nearby.	Move noise sources away from the ROBONET or shield the ROBONET from noise sources.
3	Installation condition	Installation condition of each unit on the DIN rail	No loosening of unit mounting parts.	Install the unit again and lock it firmly.
4	Connection condition	Firm connection of each power-supply connection plate between units	Connection plate screws are tightened firmly.	Retighten the screws to eliminate any looseness.
		Firm insertion of each communication connection board between units	Inserted completely.	Insert the board again.
		Firm insertion of the connection board between the simple absolute R unit and controller unit	Inserted completely.	Insert the board again.

No.	Inspection item	Description	Judgment criterion	Action
4	Connection condition	Loose wiring connectors (motor cable, encoder cable, field network cable, emergency-stop circuit)	Not loose.	Insert the connector again until it is locked. Note) The encoder cable connector is not locked, so insert the cable again all the way until it stops.
		Broken wiring cables	No exterior abnormality.	Visually check each cable and replace it if necessary.
5	Air-cooling fan	Operation of the internal air-cooling fan in the upper section of the controller unit (visual check)	Operating.	Replace the controller unit.
6	Backup battery	Expiration or consumption of the backup battery (AB-7) for simple absolute R unit	The battery lasts for three years. The expiration date specified on the expiration date label attached on the battery has not passed.	Replace the backup battery if the expiration date has passed, even when the battery is not faulty.

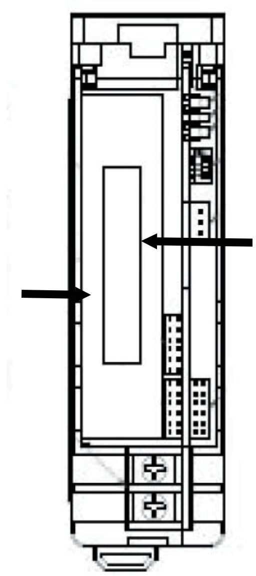
2.2 Important Information on Unit Replacement

If any of the units comprising the ROBONET system exhibits abnormality and the unit must be replaced, take heed of the following points:

- Replace the unit with the power turned off.
- After the replacement, check the new unit for abnormality.
- When sending the defective unit to IAI for repair, attach a piece of paper to the unit describing the abnormal condition as specifically as possible.
- Back up the position data, parameters, PLC data and other necessary data in case the data is lost.

2.3 Replacing the Backup Battery

The backup battery for simple absolute R unit lasts for three years. The expiration date label is attached on the front face of the battery, as shown below. Replace the backup battery if the expiration date has passed, even when the battery is not faulty.



Backup battery

Expiration date label

AB-7

To be replaced by: February 2010

(Example of description)

Front view of simple absolute R unit
(cover open)

<Replacement procedure for backup battery>

(1) To ensure safety, stop all axis operations and turn off the power.
(2) Unplug the backup battery connector and pull out the battery from the unit.
(3) Set a new battery in the unit and plug in the battery connector.
(4) Turn on the power.
(5) Perform an absolute reset of each applicable axis.
The absolute reset procedure is the same as the method used at startup. Refer to 4.5 Startup in Part 2.

* Appendix

List of Specifications of Connectable Actuators

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

Caution

- The push force is based on the rated push speed (factory setting) indicated in the list, and provides only a guideline.
- Make sure the actual push force is equal to or greater than the minimum push force. If not, the push force will not stabilize.
- Do not change the setting of push speed (parameter No. 7). If you must change the push speed, consult IAI.
- If, among the operating conditions, the positioning speed is set to a value equal to or smaller than the push speed, the push speed will become the set speed and the specified push force will not generate.

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (rod type)	RA2C	Ball screw	800	1	Horizontal/ vertical	25	0.05	50	100	3
	RA3C	Ball screw	800	5	Horizontal/ vertical	187	0.2	21	73.5	20
				2.5	Horizontal/ vertical	114		50	156.8	
	RGD3C	Ball screw	800	5	Horizontal/ vertical	187	0.2	21	73.5	20
				2.5	Horizontal	114		50	156.8	
					Vertical	93				
	RA4C	Ball screw	800	10	Horizontal/ vertical	458 (at ~250 st) 350 (at 300 st)	0.2	30	150	20
				5	Horizontal/ vertical	250 (at 50 ~200 st) 237 (at 250 st) 175 (at 300 st)		75	284	
				2.5	Horizontal	125 (at 50 ~200 st) 118 (at 250 st) 87 (at 300 st)		150	358	
					Vertical	114				
	RGS4C	Ball screw	800	10	Horizontal/ vertical	458 (at ~250 st) 350 (at 300 st)	0.2	30	150	20
				5	Horizontal/ vertical	250 (at 50 ~200 st) 237 (at 250 st) 175 (at 300 st)		75	284	
				2.5	Horizontal	125 (at 50 ~200 st) 118 (at 250 st) 87 (at 300 st)		150	358	
					Vertical	114				

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (rod type)	RGD4C	Ball screw	800	10	Horizontal/ vertical	458 (at ~250 st) 350 (at 300 st)	0.2	30	150	20
				5	Horizontal/ vertical	250 (at 50 ~200 st) 237 (at 250 st) 175 (at 300 st)		75	284	
				2.5	Horizontal	125 (at 50 ~200 st) 118 (at 250 st) 87 (at 300 st)		150	258	
					Vertical	114				
	RA6C	Ball screw	800	16	Horizontal	450	0.2	75	240	20
					vertical	400				
				8	Horizontal/ vertical	210		130	470	
				4	Horizontal/ vertical	130		300	800	
	RGS6C	Ball screw	800	16	Horizontal	450	0.2	75	240	20
					Vertical	400				
				8	Horizontal/ vertical	210		130	470	
				4	Horizontal/ vertical	130		300	800	
	RGD6C	Ball screw	800	16	Horizontal	450	0.2	75	240	20
					Vertical	400				
				8	Horizontal/ vertical	210		130	470	
				4	Horizontal/ vertical	130		300	800	
	SRA4R	Ball screw	800	5	Horizontal/ vertical	250	0.3	26	90	20
				2.5	Horizontal	124	0.2	50	170	
					Vertical	125				
	SRGS4R	Ball screw	800	5	Horizontal/ vertical	250	0.3	26	90	20
				2.5	Horizontal	124	0.2	50	170	
					Vertical	125				
	SRGD4R	Ball screw	800	5	Horizontal/ vertical	250	0.3	26	90	20
				2.5	Horizontal	124	0.2	50	170	
					Vertical	125				
RCP2 (slider type)	SA5C	Ball screw	800	12	Horizontal	600	0.7	40	120	20
					Vertical		0.3			
				6	Horizontal	300	0.7	75	220	
					Vertical		0.3			
				3	Horizontal	150	0.7	140	350	
					Vertical		0.3			

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (slider type)	SA5R	Ball screw	800	12	Horizontal	600	0.3	-	-	-
					Vertical		0.2			
				6	Horizontal	300	0.3	-	-	-
					Vertical		0.2			
				3	Horizontal	150	0.2	-	-	-
					Vertical		0.2			
	SA6C	Ball screw	800	12	Horizontal	600 (at 50 ~550 st) 540 (at 600 st)	0.7	40	120	20
					Vertical		0.3			
				6	Horizontal	300 (at 50 ~550 st) 270 (at 600 st)	0.7	75	220	
					Vertical		0.3			
				3	Horizontal	150 (at 50 ~550 st) 135 (at 600 st)	0.7	140	350	
					Vertical		0.3			
	SA6R	Ball screw	800	12	Horizontal	600 (at 50 ~550 st) 540 (at 600 st)	0.3	-	-	-
					Vertical		0.2			
				6	Horizontal	300 (at 50 ~550 st) 270 (at 600 st)	0.3	-	-	-
					Vertical		0.2			
				3	Horizontal	150 (at 50 ~550 st) 135 (at 600 st)	0.2	-	-	-
					Vertical		0.2			
	SA7C	Ball screw	800	16	Horizontal	533 (at 50 ~700 st) 480 (at 800 st)	0.3	90	250	20
					Vertical	400 (at 50 ~ 700 st) 400 (at 800 st)	0.2			
				8	Horizontal	266 (at 50 ~ 700 st) 240 (at 800 st)	0.3	150	500	
					Vertical		0.2			
				4	Horizontal	133 (at 50 ~ 700 st) 120 (at 800 st)	0.2	280	800	
					Vertical		0.2			
	SA7R	Ball screw	800	16	Horizontal	533 (at 50 ~ 700 st) 480 (at 800 st) 400 (at 50 ~ 700 st) 400 (at 800 st)	0.3	-	-	-
					Vertical		0.2			
				8	Horizontal	266 (at 50 ~ 700 st) 240 (at 800 st)	0.3	-	-	-
					Vertical		0.2			
				4	Horizontal	133 (at 50 ~ 700 st) 120 (at 800 st)	0.2	-	-	-
					Vertical		0.2			
	SS7C	Ball screw	800	12	Horizontal	600 (at 50 ~ 500 st) 470 (at 600 st)	0.3	40	120	20
					Vertical	400 (at 50 ~ 700 st) 400 (at 800 st)	0.2			
				6	Horizontal	300 (at 50 ~ 500 st) 230 (at 600 st)	0.3	75	220	
					Vertical		0.2			
				3	Horizontal	150 (at 50 ~ 500 st) 115 (at 600 st)	0.2	140	350	
					Vertical		0.2			
	SS7R	Ball screw	800	12	Horizontal	600 (at 50 ~ 500 st) 470 (at 600 st)	0.3	-	-	-
					Vertical	440 (at 50 ~ 700 st) 440 (at 800 st)	0.2			
				6	Horizontal	250 (at 50 ~ 500 st) 230 (at 600 st)	0.3	-	-	
					Vertical		0.2			
				3	Horizontal	105 (at 50 ~ 500 st) 105 (at 600 st)	0.2	-	-	
					Vertical		0.2			

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (slider type)	SS8C	Ball screw	800	20	Horizontal	666 (at 50 ~800 st) 625 (at ~ 900 st) 515 (at ~ 1000 st)	0.3	50	180	20
					Vertical	600 (at 50 ~800 st) 600 (at ~ 900 st) 515 (at ~ 1000 st)	0.2			
				10	Horizontal	333 (at 50 ~800 st) 310 (at ~ 900 st) 255 (at ~ 1000 st)	0.3	95	320	
					Vertical	300 (at 50 ~800 st) 300 (at ~ 900 st) 255 (at ~ 1000 st)	0.2			
				5	Horizontal	165 (at 50 ~800 st) 155 (at ~ 900 st) 125 (at ~ 1000 st)	0.2	180	630	
					Vertical	150 (at 50 ~800 st) 150 (at ~ 900 st) 125 (at ~ 1000 st)	0.2			
	SS8R	Ball screw	800	20	Horizontal	600 (at 50 ~800 st) 600(at ~ 900 st) 515 (at ~ 1000 st)	0.3	-	-	-
					Vertical	333 (at 50 ~800 st) 333 (at ~ 900 st) 333 (at ~ 1000 st)	0.2			
				10	Horizontal	300 (at 50 ~800 st) 300 (at ~ 900 st) 255 (at ~ 1000 st)	0.3	-	-	-
					Vertical	250 (at 50 ~800 st) 250 (at ~ 900 st) 250 (at ~ 1000 st)	0.2			
				5	Horizontal	160 (at 50 ~800 st) 155 (at ~ 900 st) 125 (at ~ 1000 st)	0.2	-	-	-
					Vertical	140 (at 50 ~800 st) 140 (at ~ 900 st) 140 (at ~ 1000 st)	0.2			
	HS8C	Ball screw	800	30	Horizontal	1200 (at 50 ~800 st) 1000(at ~ 900 st) 800 (at ~ 1000 st)	0.3	-	-	-
					Vertical	750 (at 50 ~800 st) 750 (at ~ 900 st) 750 (at ~ 1000 st)	0.2			
	HS8R	Ball screw	800	30	Horizontal	1200 (at 50 ~ 800 st) 1000(at ~ 900 st) 800 (at ~ 1000 st)	0.3	-	-	-
					Vertical	750 (at 50 ~ 800 st) 750 (at ~ 900 st) 750 (at ~ 1000 st)	0.2			
RCP2 (belt type	BA6/ BA6U	Belt	800	Equivalent to 54	Horizontal	1000	0.5	-	-	-
	BA7/ BA7U	Belt	800	Equivalent to 54	Horizontal	1500	0.5	-	-	-

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (gripper type)	GRSS	-	800	Gear ratio: 1/30	-	78	-	4	14	20
	GRLS	-	800	Gear ratio: 1/30	-	600°/s	-	1.8	6.4	5°/s
	GRS	-	800	Gear ratio: 1	-	33.3	-	9	21	5
	GRM	-	800	Gear ratio: 1	-	36.7	-	23	80	5
	GRST	-	800	1.05 (standard)	-	34	-	15	40	5
		-	800	2.27 (high speed)	-	75	-	7.5	20	5
	GR3LS	-	800	Gear ratio: 1/30	-	200	-	5	18	5°/s
	GR3LM	-	800	Gear ratio: 1/30	-	200	-	15	51	5°/s
	GR3SS	-	800	Gear ratio: 1/30	-	40	-	7	22	5
	GR3SM	-	800	Gear ratio: 1/30	-	50	-	30	102	5
RCP2 (rotary type)	RTBS	-	800	Gear ratio: 1/30	-	400°/s	-	-	-	-
				Gear ratio: 1/45	-	266°/s	-	-	-	-
	RTBSL	-	800	Gear ratio: 1/30	-	400°/s	-	-	-	-
				Gear ratio: 1/45	-	266°/s	-	-	-	-
	RTCS	-	800	Gear ratio: 1/30	-	400°/s	-	-	-	-
				Gear ratio: 1/45	-	266°/s	-	-	-	-
	RTCSL	-	800	Gear ratio: 1/30	-	400°/s	-	-	-	-
				Gear ratio: 1/45	-	266°/s	-	-	-	-
	RTB	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
	RTBL	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
	RTC	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP2 (rotary type)	RTCL	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
	RTBB	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
	RTBBL	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
	RTCB	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
	RTCBL	-	800	Gear ratio: 1/20	-	600°/s	-	-	-	-
				Gear ratio: 1/30	-	400°/s	-	-	-	-
RCP3 (rod type)	RA2AC	Lead screw	800	4	Horizontal/ vertical	180 (at 25 st) 200 (at 50 ~ 100 st)	0.2	0.9	16.1	5
				2		100		1.9	28.3	
				1		50		3.8	39.5	
	RA2BC	Lead screw	800	6	Horizontal/ vertical	180 (at 25 st) 280 (at 50 st) 300 (at 75 ~ 150 st)	0.2	0.6	11.9	5
				4		180 (at 25 st) 200 (at 50 ~ 100 st)		0.9	16.1	
				2		100		1.9	28.3	
	RA2AR	Lead screw	800	4	Horizontal/ vertical	180 (at 25 st) 200 (at 50 ~ 100 st)	0.2	0.9	16.1	5
				2		100		1.9	28.3	
				1		50		3.8	39.5	
	RA2BR	Lead screw	800	6	Horizontal/ vertical	180 (at 25 st) 280 (at 50 st) 300 (at 75 ~ 150 st)	0.2	0.6	11.9	5
				4		180 (at 25 st) 200 (at 50 ~ 100 st)		0.9	16.1	
				2		100		1.9	28.3	
RCP3 (slider type)	SA2AC	Lead screw	800	4	Horizontal	180 (at 25 st) 200 (at 50 ~ 100 st)	0.2	-	-	-
				2		100				
				1		50				
	SA2BC	Lead screw	800	6	Horizontal	180 (at 25 st) 280 (at 50 st) 300 (at 75 ~ 150 st)	0.2	-	-	-
				4		180 (at 25 st) 200 (at 50 ~ 100 st)				
				2		100				

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (slider type)	SA2AR	Lead screw	800	4	Horizontal	180 (at 25 st) 200 (at 50 ~ 100 st)	0.2	-	-	-
				2		100				
				1		50				
	SA2BR	Lead screw	800	6	Horizontal	180 (at 25 st) 280 (at 50 st) 300 (at 75 ~ 150 st)	0.2	-	-	-
				4		180 (at 25 st) 200 (at 50 ~ 100 st)				
				2		100				
	SA3C	Ball screw	800	6	Horizontal	300	0.3	9	15	20
					Vertical		0.2			
				4	Horizontal	200	0.3	14	22	
					Vertical		0.2			
				2	Horizontal	100	0.2	27	44	
					Vertical		0.2			
	SA3R	Ball screw	800	6	Horizontal	300	0.3	9	15	-
					Vertical		0.2			
				4	Horizontal	200	0.3	14	22	
					Vertical		0.2			
				2	Horizontal	100	0.2	27	44	
					Vertical		0.2			
	SA4C	Ball screw	800	10	Horizontal	500	0.7	20	34	20
					Vertical		0.3			
				5	Horizontal	250	0.7	40	68	
					Vertical		0.3			
				2.5	Horizontal	125	0.7	82	136	
					Vertical		0.3			
	SA4R	Ball screw	800	10	Horizontal	500	0.3	20	34	-
					Vertical		0.2			
				5	Horizontal	250	0.3	40	68	
					Vertical		0.2			
				2.5	Horizontal	125	0.2	82	136	
					Vertical		0.2			
	SA5C	Ball screw	800	12	Horizontal	600	0.7	30	47	20
					Vertical		0.3			
				6	Horizontal	300	0.7	58	95	
					Vertical		0.3			
				3	Horizontal	150	0.7	112	189	
					Vertical		0.3			
	SA5R	Ball screw	800	12	Horizontal	600	0.3	30	47	20
					Vertical		0.2			
				6	Horizontal	300	0.3	58	95	
					Vertical		0.2			
				3	Horizontal	150	0.2	112	189	
					Vertical		0.2			

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (slider type)	SA6C	Ball screw	800	12	Horizontal	600 (at 50 ~ 550 st) 540 (at ~ 600 st)	0.7	30	47	20
					Vertical		0.3			
				6	Horizontal	300 (at 50 ~ 550 st) 270 (at ~ 600 st)	0.7	58	95	
					Vertical		0.3			
				3	Horizontal	150 (at 50 ~ 550 st) 135 (at ~ 600 st)	0.7	112	189	
					Vertical		0.3			
	SA6R	Ball screw	800	12	Horizontal	600 (at 50 ~ 550 st) 540 (at ~ 600 st)	0.3	30	47	20
					Vertical		0.2			
				6	Horizontal	300 (at 50 ~ 550 st) 270 (at ~ 600 st)	0.3	58	95	
					Vertical		0.2			
				3	Horizontal	150 (at 50 ~ 550 st) 135 (at ~ 600 st)	0.2	112	189	
					Vertical		0.2			
RCP3 (table type)	TA3C	Ball screw	800	6	Horizontal	300	0.3	5.4	9	20
					Vertical	200	0.2			
				4	Horizontal	200	0.3	8.4	14	
					Vertical	133	0.2			
				2	Horizontal	100	0.2	16.8	28	
					Vertical	67	0.2			
	TA3R	Ball screw	800	6	Horizontal	300	0.3	5.4	9	20
					Vertical	200	0.2			
				4	Horizontal	200	0.3	8.4	14	
					Vertical	133	0.2			
				2	Horizontal	100	0.2	16.8	28	
					Vertical	67	0.2			
	TA4C	Ball screw	800	6	Horizontal	300	0.3	9	15	20
					Vertical		0.2			
				4	Horizontal	200	0.3	13.2	22	
					Vertical		0.2			
				2	Horizontal	100	0.2	26.4	44	
					Vertical		0.2			
	TA4R	Ball screw	800	6	Horizontal	300	0.3	9	15	20
					Vertical		0.2			
				4	Horizontal	200	0.3	13.2	22	
					Vertical		0.2			
				2	Horizontal	100	0.2	26.4	44	
					Vertical		0.2			
	TA5C	Ball screw	800	10	Horizontal	465	0.3	20	34	20
					Vertical	400	0.2			
				5	Horizontal	250	0.3	40	68	
					Vertical		0.2			
				2.5	Horizontal	125	0.2	82	136	
					Vertical		0.2			
	TA5R	Ball screw	800	10	Horizontal	465	0.3	20	34	20
					Vertical	400	0.2			
				5	Horizontal	250	0.3	40	68	
					Vertical		0.2			
				2.5	Horizontal	125	0.2	82	136	
					Vertical		0.2			

Actuator series	Type	Feed screw	Encoder resolution	Lead [mm]	Mounting direction	Maximum speed [mm/s]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCP3 (table type)	TA6C	Ball screw	800	12	Horizontal	560	0.3	30	47	20
					Vertical	500	0.2			
				6	Horizontal	300	0.3	58	95	
					Vertical		0.2			
				3	Horizontal	150	0.2	112	189	
					Vertical		0.2			
	TA6R	Ball screw	800	12	Horizontal	560	0.3	30	47	20
					Vertical	500	0.2			
				6	Horizontal	300	0.3	58	95	
					Vertical		0.2			
				3	Horizontal	150	0.2	112	189	
					Vertical		0.2			
	TA7C	Ball screw	800	12	Horizontal	600	0.3	30	47	20
					Vertical	580	0.2			
				6	Horizontal	300	0.3	58	95	
					Vertical		0.2			
				3	Horizontal	150	0.2	112	189	
					Vertical		0.2			
	TA7R	Ball screw	800	12	Horizontal	600	0.3	30	47	20
					Vertical	580	0.2			
				6	Horizontal	300	0.3	58	95	
					Vertical		0.2			
				3	Horizontal	150	0.2	112	189	
					Vertical		0.2			

[RACON]

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA (rod type)	RA3C	Ball screw	20	800	10	Horizontal/vertical	500	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					5	Horizontal/vertical	250	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					2.5	Horizontal/vertical	125	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
	RGS3C	Ball screw	20	800	10	Horizontal/vertical	500	Energy-saving mode: 0.3	-	-	-
								High-acceleration/deceleration mode: 1.0	-	-	-
					5	Horizontal/vertical	250	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					2.5	Horizontal/vertical	125	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
	RGD3C	Ball screw	20	800	10	Horizontal/vertical	500	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					5	Horizontal/vertical	250	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					2.5	Horizontal/vertical	125	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
	RA3D	Ball screw	20	800	10	Horizontal/vertical	500	0.3	-	-	-
									-	-	-
					5	Horizontal/vertical	250	0.3	-	-	-
									-	-	-
					2.5	Horizontal/vertical	125	0.2	-	-	-
									-	-	-
	RGS3D	Ball screw	20	800	10	Horizontal/vertical	500	0.3	-	-	-
									-	-	-
					5	Horizontal/vertical	250	0.3	-	-	-
									-	-	-
					2.5	Horizontal/vertical	125	0.2	-	-	-
									-	-	-
	RGD3D	Ball screw	20	800	10	Horizontal/vertical	500	0.3	-	-	-
									-	-	-
					5	Horizontal/vertical	250	0.3	-	-	-
									-	-	-
					2.5	Horizontal/vertical	125	0.2	-	-	-
									-	-	-
	RA3R	Ball screw	20	800	10	Horizontal/vertical	500	0.3	-	-	-
									-	-	-
					5	Horizontal/vertical	250	0.3	-	-	-
									-	-	-
					2.5	Horizontal/vertical	125	0.2	-	-	-
									-	-	-
	RGD3R	Ball screw	20	800	10	Horizontal/vertical	500	0.3	-	-	-
									-	-	-
					5	Horizontal/vertical	250	0.3	-	-	-
									-	-	-
					2.5	Horizontal/vertical	125	0.2	-	-	-
									-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA (rod type)	RA4C	Ball screw	20	800	12	Horizontal/ vertical	600	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	300	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	150	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
			30	800	12	Horizontal/ vertical	600	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	300	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	150	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
	RGS4C	Ball screw	20	800	12	Horizontal/ vertical	600	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	300	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	150	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
			30	800	12	Horizontal/ vertical	600	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	300	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	150	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
	RGD4C	Ball screw	20	800	12	Horizontal/ vertical	600	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	300	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	150	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
			30	800	12	Horizontal/ vertical	600	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	300	Energy-saving mode: 0.3	-	-	-
								High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	150	Energy-saving mode: 0.2	-	-	-
								High-acceleration/ deceleration mode: 0.2	-	-	-
	RA4D	Ball screw	20	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
			30	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA (rod type)	RGS4D	Ball screw	20	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
			30	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
	RGD4D	Ball screw	20	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
			30	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
	RA4R	Ball screw	20	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
			30	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
	RGD4R	Ball screw	20	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-
			30	800	12	Horizontal/ vertical	600	0.3	-	-	-
									-	-	-
					6	Horizontal/ vertical	300	0.3	-	-	-
									-	-	-
					3	Horizontal/ vertical	150	0.2	-	-	-
									-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA (rod type)	SRA4R	Ball screw	20	800	5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
	SRGS4R	Ball screw	20	800	5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
	SRGD4R	Ball screw	20	800	5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
RCA (slider type)	SA4C	Ball screw	20	800	10	Horizontal/ vertical	665	Energy-saving mode: 0.3 High-acceleration/ deceleration mode: 1.0	-	-	-
					5	Horizontal/ vertical	330	Energy-saving mode: 0.3 High-acceleration/ deceleration mode: 1.0	-	-	-
					2.5	Horizontal/ vertical	165	Energy-saving mode: 0.2 High-acceleration/ deceleration mode: 0.2	-	-	-
	SA4D	Ball screw	20	800	10	Horizontal/ vertical	665	0.3	-	-	-
					5	Horizontal/ vertical	330	0.3	-	-	-
					2.5	Horizontal/ vertical	165	0.2	-	-	-
	SA4R	Ball screw	20	800	10	Horizontal/ vertical	665	0.3	-	-	-
					5	Horizontal/ vertical	330	0.3	-	-	-
					2.5	Horizontal/ vertical	165	0.2	-	-	-
	SA5C	Ball screw	20	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st)	Energy-saving mode: 0.3 High-acceleration/ deceleration mode: 0.8	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st)	Energy-saving mode: 0.3 High-acceleration/ deceleration mode: 0.8	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st)	Energy-saving mode: 0.2 High-acceleration/ deceleration mode: 0.2	-	-	-
	SA5D	Ball screw	20	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st)	0.3	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st)	0.3	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st)	0.2	-	-	-
	SA5R	Ball screw	20	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st)	0.3	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st)	0.3	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st)	0.2	-	-	-
	SA6C	Ball screw	30	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st) 640 (at 550 st) 540 (at 600 st)	Energy-saving mode: 0.3 High-acceleration/ deceleration mode: 1.0	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st) 320 (at 550 st) 270 (at 600 st)	Energy-saving mode: 0.3 High-acceleration/ deceleration mode: 1.0	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st) 160 (at 550 st) 135 (at 600 st)	Energy-saving mode: 0.2 High-acceleration/ deceleration mode: 0.2	-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA2 (slider type)	SA6D	Ball screw	30	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st) 640 (at 550 st) 540 (at 600 st)	0.3	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st) 320 (at 550 st) 270 (at 600 st)	0.3	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st) 160 (at 550 st) 135 (at 600 st)	0.2	-	-	-
	SA6R	Ball screw	30	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st) 640 (at 550 st) 540 (at 600 st)	0.3	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st) 320 (at 550 st) 270 (at 600 st)	0.3	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st) 160 (at 550 st) 135 (at 600 st)	0.2	-	-	-
	SS4D	Ball screw	20	800	10	Horizontal/ vertical	665	0.3	-	-	-
					5	Horizontal/ vertical	330	0.3	-	-	-
					2.5	Horizontal/ vertical	165	0.2	-	-	-
	SS5D	Ball screw	20	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st)	0.3	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st)	0.3	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st)	0.2	-	-	-
	SS6D	Ball screw	30	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st) 640 (at 550 st) 540 (at 600 st)	0.3	-	-	-
					6	Horizontal/ vertical	400 (at 50~450 st) 380 (at 500 st) 320 (at 550 st) 270 (at 600 st)	0.3	-	-	-
					3	Horizontal/ vertical	200 (at 50~450 st) 190 (at 500 st) 160 (at 550 st) 135 (at 600 st)	0.2	-	-	-
RCA (arm type)	SA4R	Ball screw	20	800	10	Horizontal/ vertical	665	0.3	-	-	-
					5		330	0.3	-	-	-
					2.5		165	0.2	-	-	-
	SA5R	Ball screw	20	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st)	0.3	-	-	-
					6		400 (at 50~450 st) 380 (at 500 st)	0.3	-	-	-
					3		200 (at 50~450 st) 190 (at 500 st)	0.2	-	-	-
	SA6R	Ball screw	30	800	12	Horizontal/ vertical	800 (at 50~450 st) 760 (at 500 st) 640 (at 550 st) 540 (at 600 st)	0.3	-	-	-
					6		400 (at 50~450 st) 380 (at 500 st) 320 (at 550 st) 270 (at 600 st)	0.3	-	-	-
					3		200 (at 50~450 st) 190 (at 500 st) 160 (at 550 st) 135 (at 600 st)	0.2	-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA2 (rod type)	RN3N	Lead screw	10	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	RP3N	Lead screw	10	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	GS3N	Lead screw	10	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	GD3N	Lead screw	10	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	SD3N	Lead screw	10	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	RN4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	RP4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA2 (rod type)	GS4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	GD4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	SD4N	Ball screw	20	1048	6	Horizontal	240 (at 25 st) 300 (at 50~75 st)	0.3	-	-	-
						Vertical	200 (at 25 st) 300 (at 50~75 st)	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	200 (at 25 st) 300 (at 50~75 st)	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
RCA2 (slider type)	SA3C	Ball screw	10	800	6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	SA3R	Ball screw	10	800	6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-

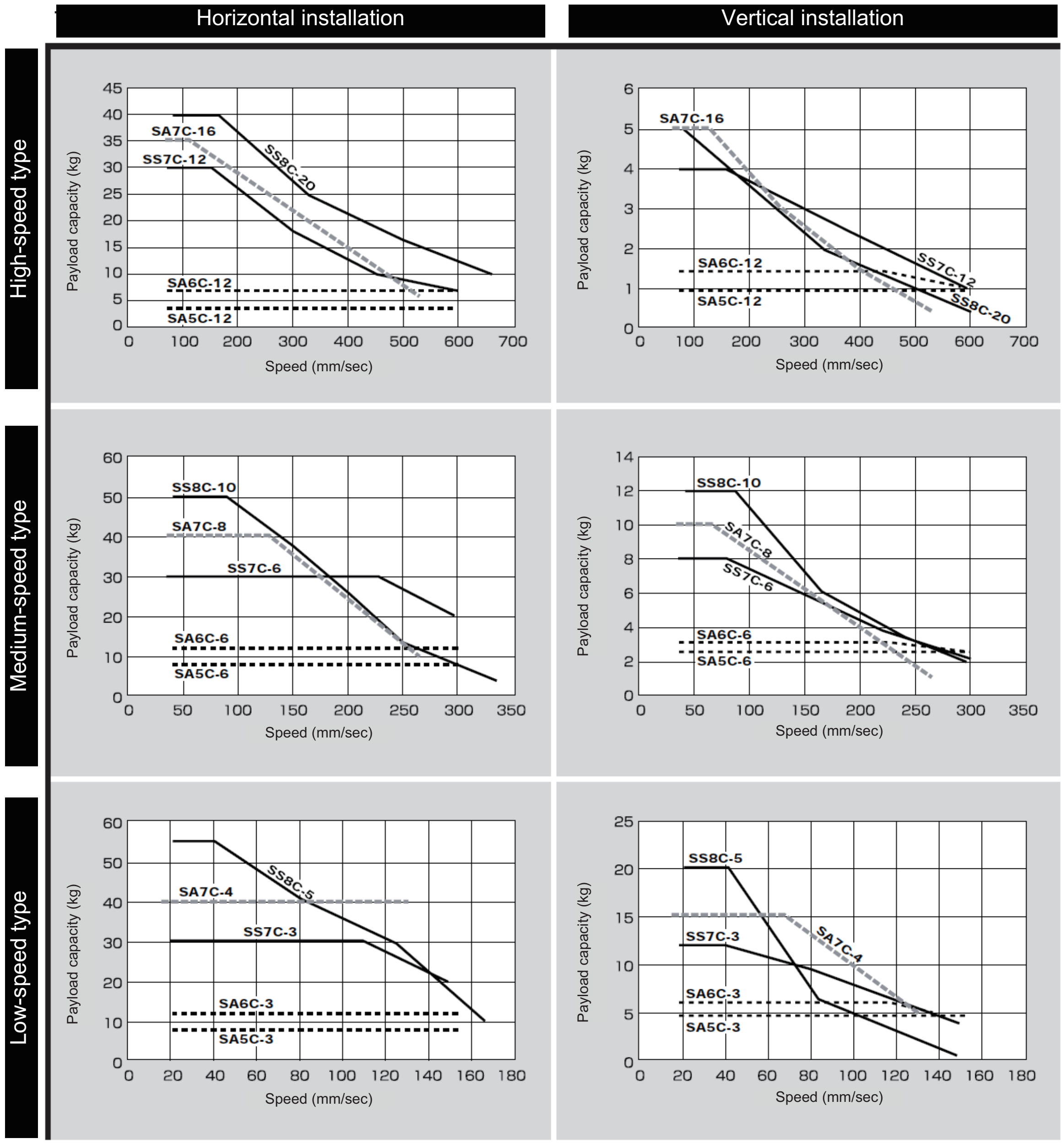
Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA2 (slider type)	SA4C	Ball screw	20	800	10	Horizontal	500	0.3	-	-	-
						Vertical		0.2	-	-	-
					5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
	SA4R	Ball screw	20	800	10	Horizontal	500	0.3	-	-	-
						Vertical		0.2	-	-	-
					5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
	SA5C	Ball screw	20	800	12	Horizontal	600	0.3	-	-	-
						Vertical		0.2	-	-	-
					6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150	0.2	-	-	-
						Vertical		0.2	-	-	-
	SA5R	Ball screw	20	800	12	Horizontal	600	0.3	-	-	-
						Vertical		0.2	-	-	-
					6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150	0.2	-	-	-
						Vertical		0.2	-	-	-
	SA6C	Ball screw	30	800	12	Horizontal	600 (at 50~550 st) 540 (at 600 st)	0.3	-	-	-
						Vertical		0.2	-	-	-
					6	Horizontal	300 (at 50~550 st) 270 (at 600 st)	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150 (at 50~550 st) 135 (at 600 st)	0.2	-	-	-
						Vertical		0.2	-	-	-
	SA6R	Ball screw	30	800	12	Horizontal	600 (at 50~550 st) 540 (at 600 st)	0.3	-	-	-
						Vertical		0.2	-	-	-
					6	Horizontal	300 (at 50~550 st) 270 (at 600 st)	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150 (at 50~550 st) 135 (at 600 st)	0.2	-	-	-
						Vertical		0.2	-	-	-
RCA2 (table type)	TC3N	Lead screw	20	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	TW3N	Lead screw	20	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				
	TF3N	Lead screw	20	1048	4	Horizontal/ vertical	200	0.2	-	-	-
					2		100				
					1		50				

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA2 (table type)	TC4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	TW4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	TF4N	Ball screw	20	1048	6	Horizontal	270	0.3	-	-	-
						Vertical	220	0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
		Lead screw			6	Horizontal	220	0.2	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.2	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA4C	Ball screw	10	800	6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA4R	Ball screw	10	800	6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					4	Horizontal	200	0.3	-	-	-
						Vertical		0.2	-	-	-
					2	Horizontal	100	0.2	-	-	-
						Vertical		0.2	-	-	-

Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCA2 (table type)	TA5C	Ball screw	20	800	10	Horizontal	465	0.3	-	-	-
						Vertical	400	0.2	-	-	-
					5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA5R	Ball screw	20	800	10	Horizontal	465	0.3	-	-	-
						Vertical	400	0.2	-	-	-
					5	Horizontal	250	0.3	-	-	-
						Vertical		0.2	-	-	-
					2.5	Horizontal	125	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA6C	Ball screw	20	800	12	Horizontal	560	0.3	-	-	-
						Vertical	500	0.2	-	-	-
					6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA6R	Ball screw	20	800	12	Horizontal	560	0.3	-	-	-
						Vertical	500	0.2	-	-	-
					6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA7C	Ball screw	30	800	12	Horizontal	600	0.3	-	-	-
						Vertical	580	0.2	-	-	-
					6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150	0.2	-	-	-
						Vertical		0.2	-	-	-
	TA7R	Ball screw	30	800	12	Horizontal	600	0.3	-	-	-
						Vertical	580	0.2	-	-	-
					6	Horizontal	300	0.3	-	-	-
						Vertical		0.2	-	-	-
					3	Horizontal	150	0.2	-	-	-
						Vertical		0.2	-	-	-

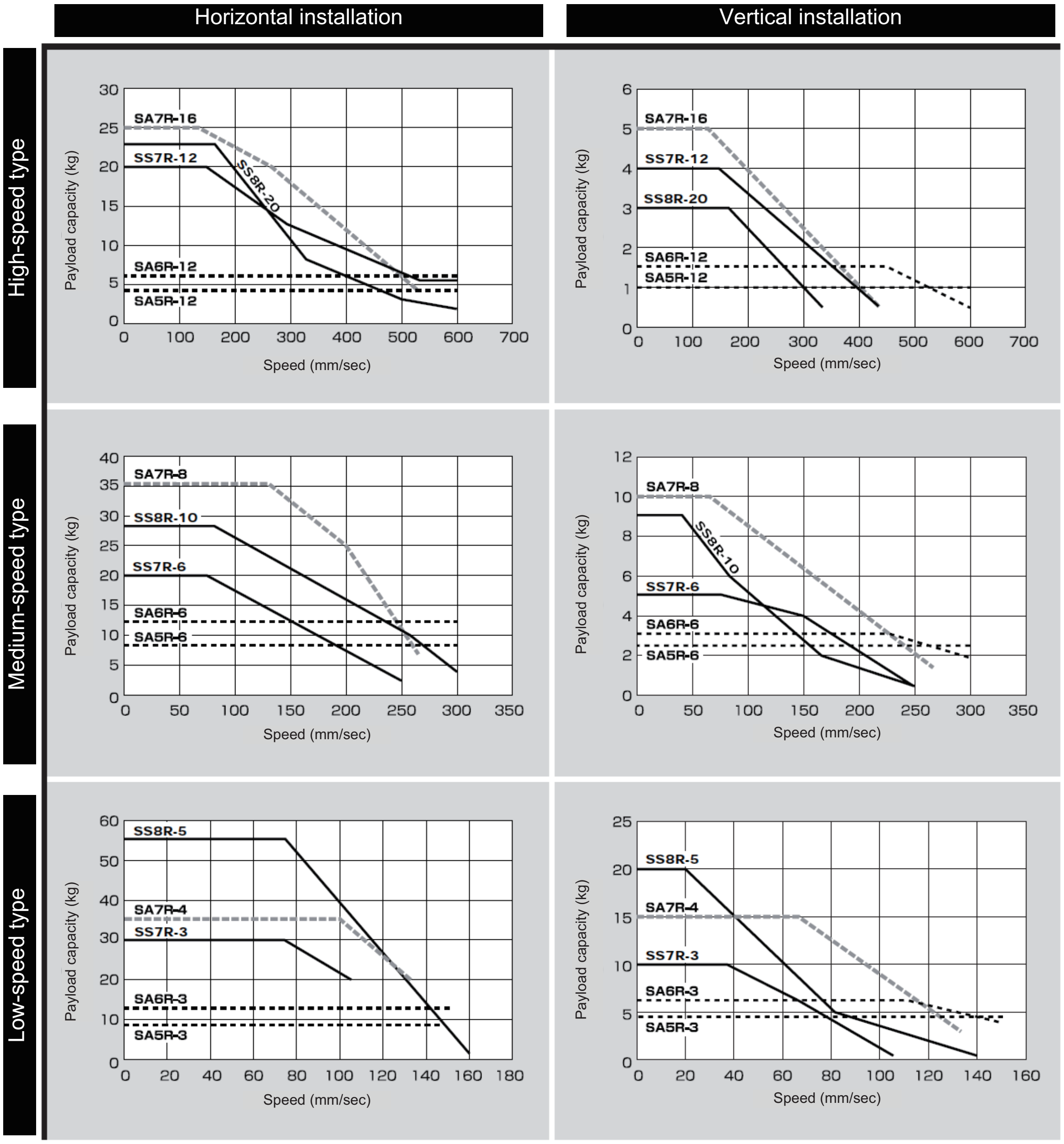
Actuator series	Type	Feed screw	Motor output [W]	Encoder resolution	Lead [mm]	Mounting direction	Maximum stroke [mm]	Maximum acceleration/ deceleration [G]	Minimum push force [N]	Maximum push force [N]	Rated push speed [mm/s]
RCL	RA1L	Linear	-	715	-	Horizontal/ vertical	300	2	0.75	2	2
	RA2L			855		Horizontal/ vertical	340	2	1.5	4	4
	RA3L			1145		Horizontal/ vertical	450	2	3	8	8
	SA1L			715		Horizontal	420	2	-	-	-
	SA2L			855		Horizontal	460	2	-	-	-
	SA3L			1145		Horizontal	600	2	-	-	-
	SA4L			715		Horizontal	1200	2	-	-	-
	SM4L			715		Horizontal	1200	2	-	-	-
	SA5L			855		Horizontal	1400	2	-	-	-
	SM5L			855		Horizontal	1400	2	-	-	-
	SA6L			1145		Horizontal	1600	2	-	-	-
	SM6L			1145		Horizontal	1600	2	-	-	-

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



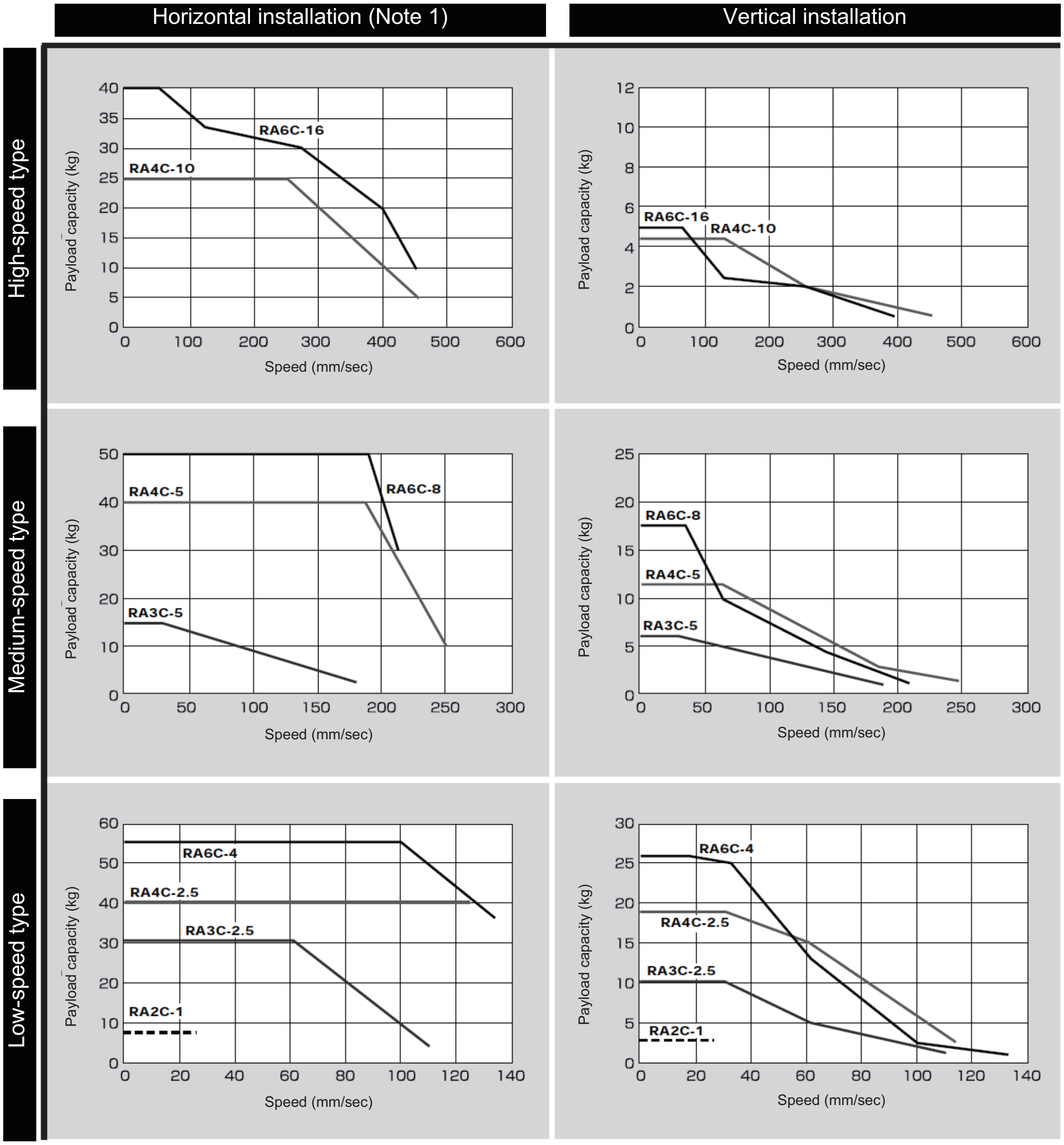
(Note) In the above graphs, the number after the type code indicates the lead.

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



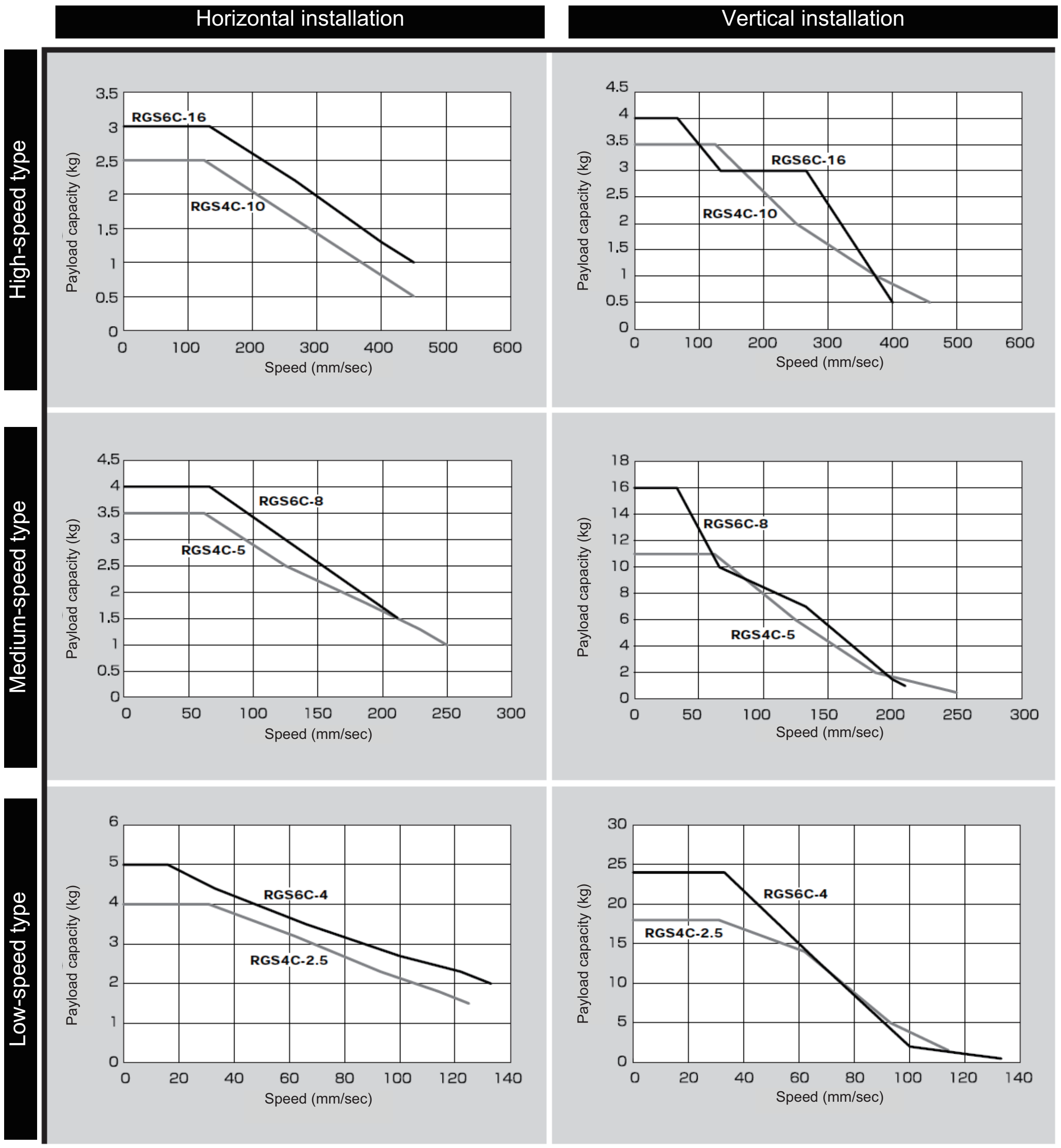
(Note) In the above graphs, the number after the type code indicates the lead.

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



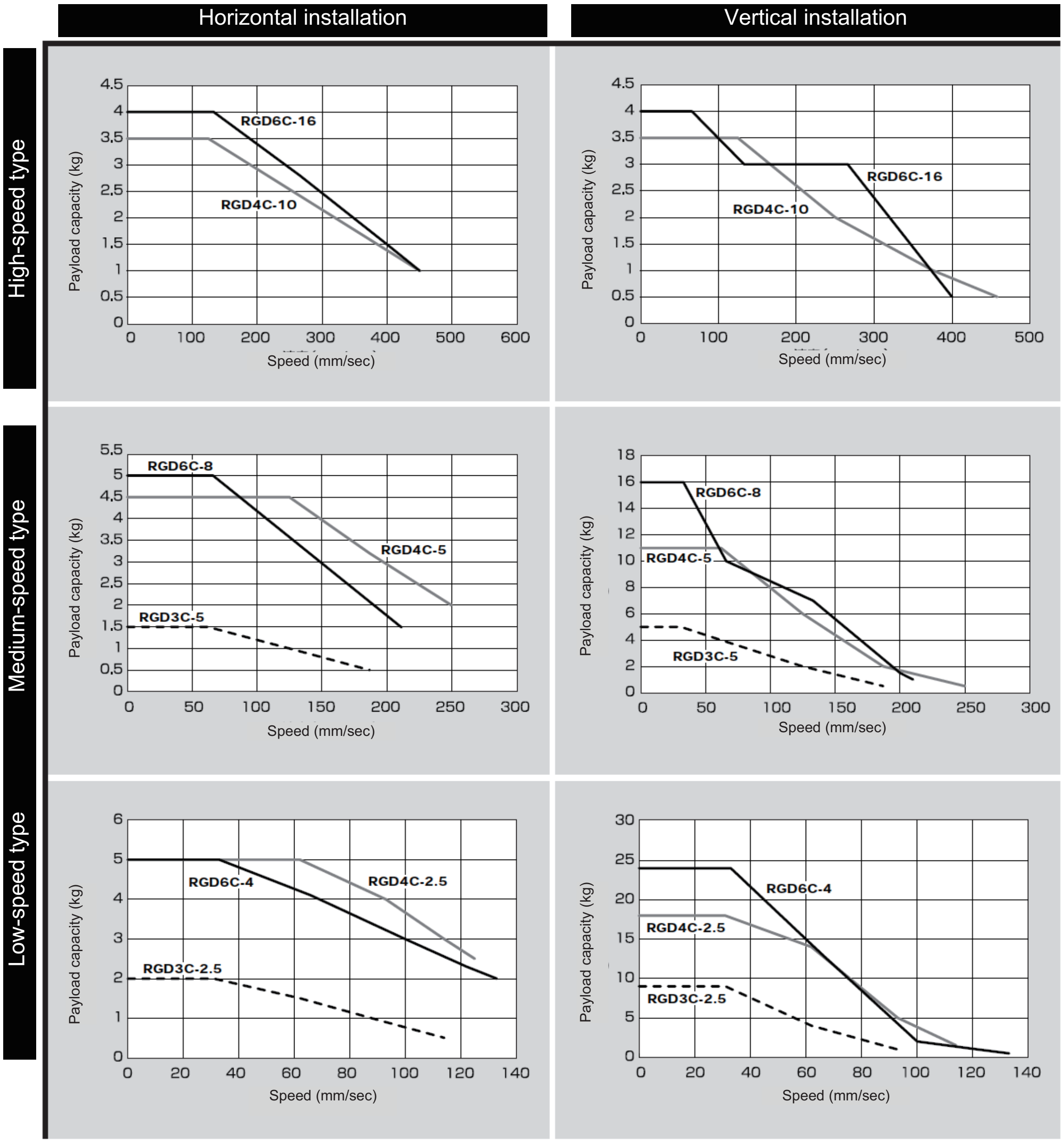
(Note) In the above graphs, the number after the type code indicates the lead.
(Note 1) The figures for horizontal installation assume use of an external guide.

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



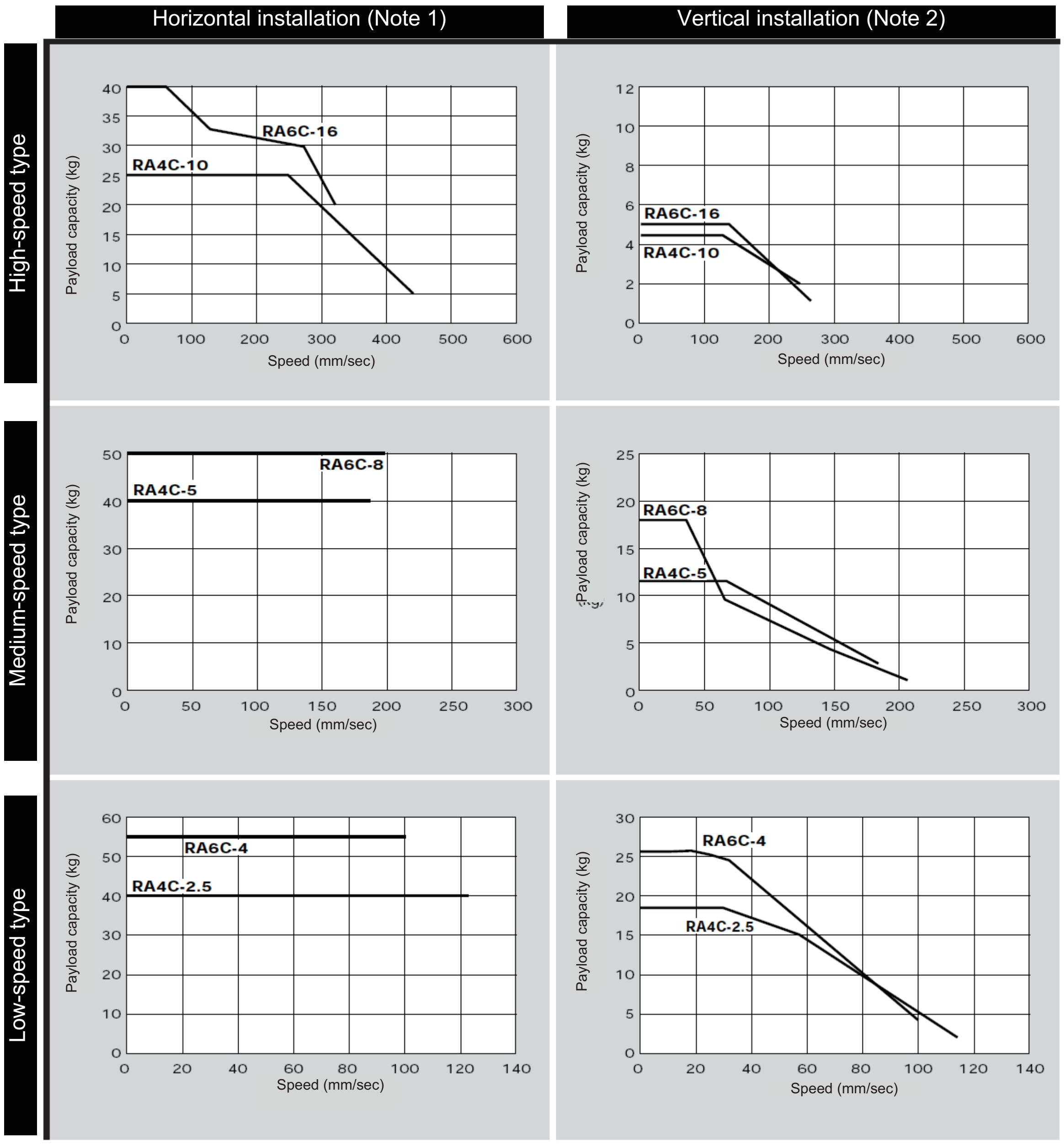
(Note) In the above graphs, the number after the type code indicates the lead.

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



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

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



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

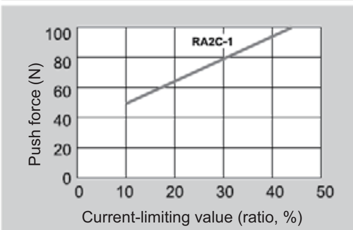
Push Force and Current-limiting Value

Caution

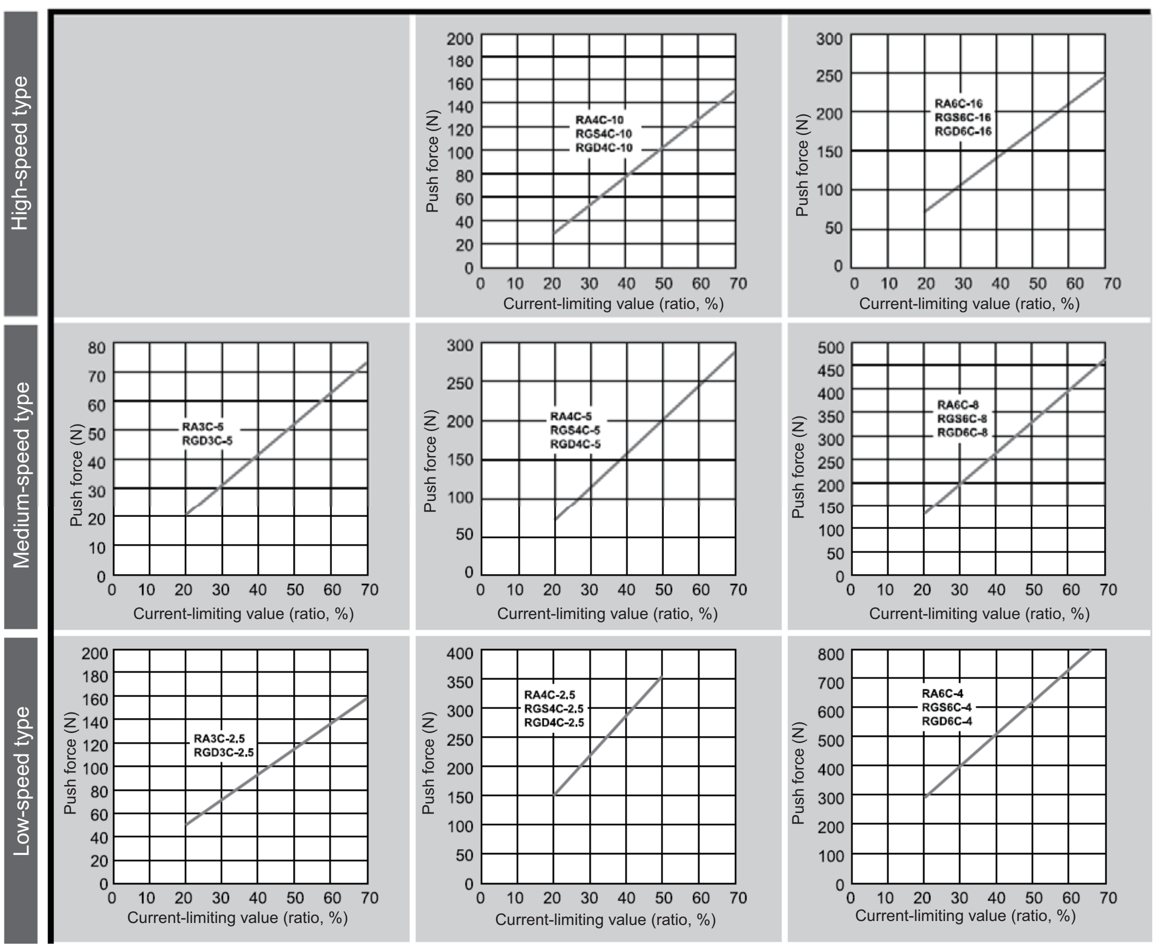
- The relationship of push force and current-limiting value is based on the rated push speed (factory setting) and provides only a guideline.
- Make sure the actual push force is equal to or greater than the minimum push force. If not, the push force will not stabilize.
- Do not change the setting of push speed (parameter No. 7). If you must change the push speed, consult IAI.
- If, among the operating conditions, the positioning speed is set to a value equal to or smaller than the push speed, the push speed will become the set speed and the specified push force will not generate.

RCP2 Series | Rod Type

RA2C Type

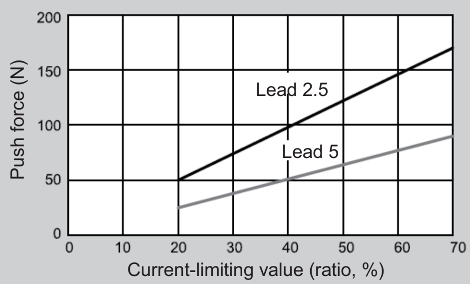


RA3C/RGD3C | RA4C/RGS4C/RGD4C | RA6C/RGS6C/RGD6C



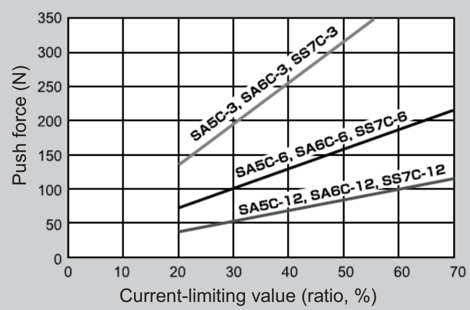
RCP2 Series **Short Type**

SRA4R/SRGS4R/SRGD4R

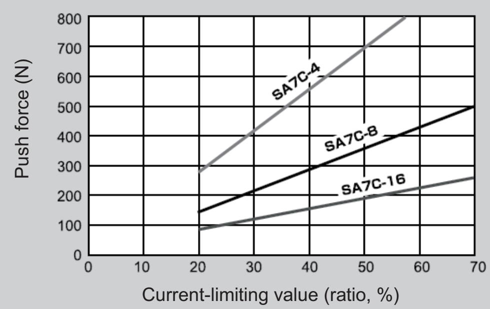


RCP2 Series **Slider Type**

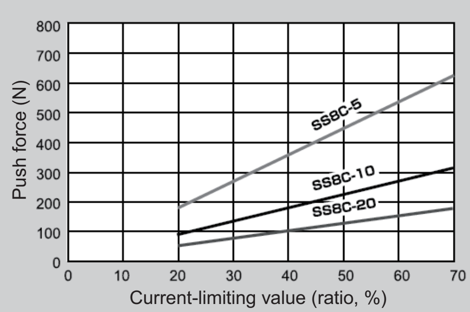
SA5C/SA6C/SS7C Type



SA7C Type

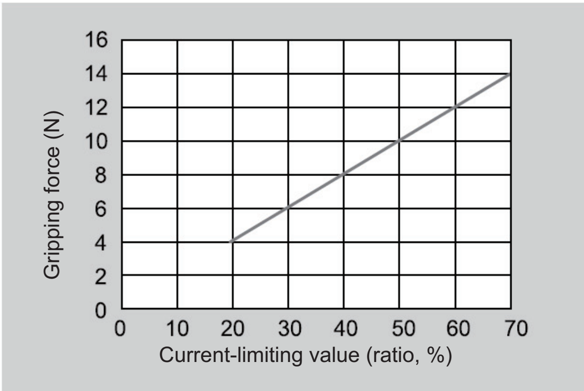


SS8C Type

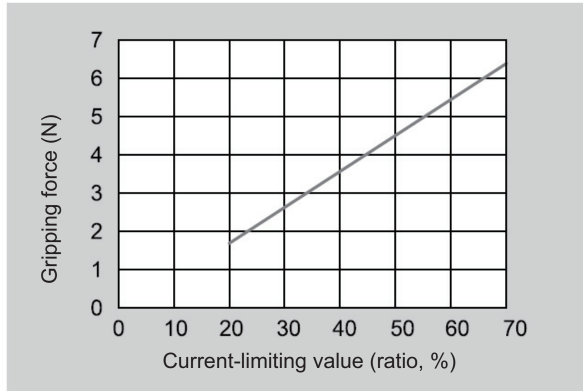


RCP2 Series | **Gripper**

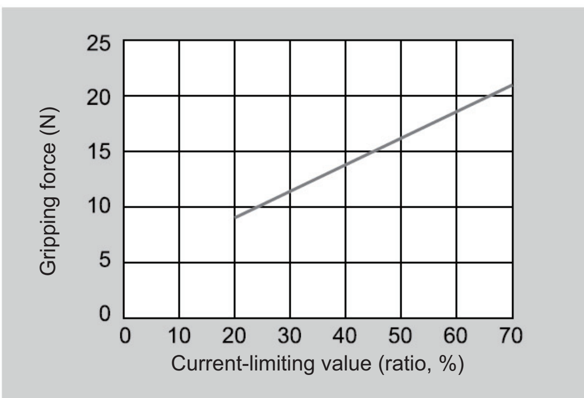
GRSS



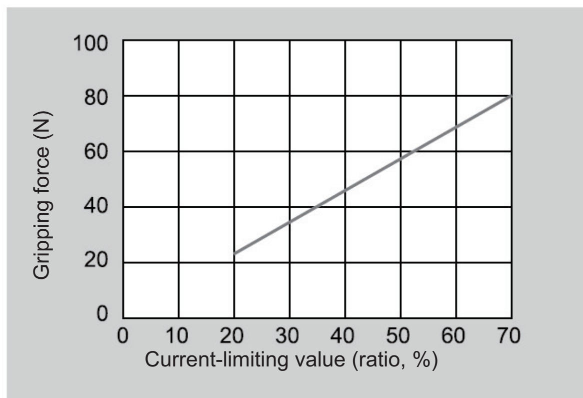
GRLS



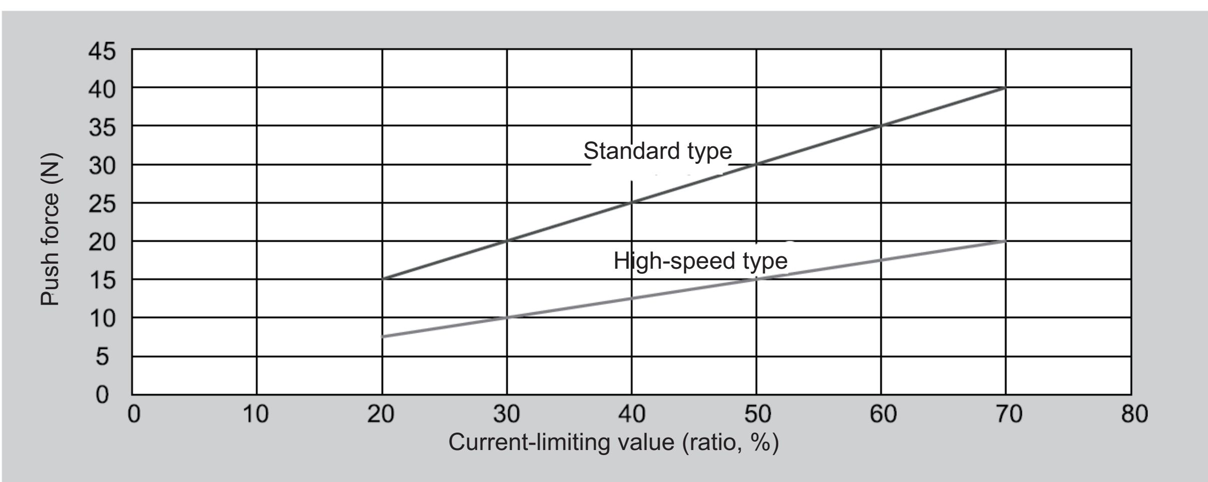
GRS



GRM

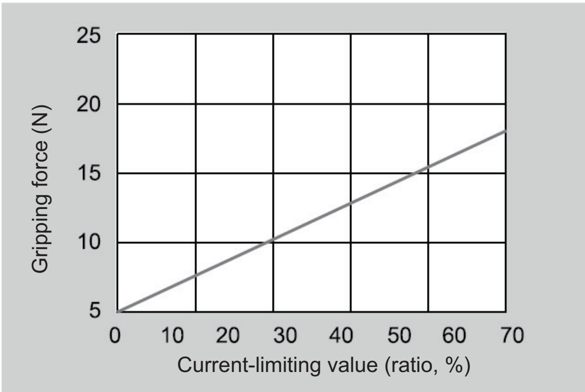


GRST

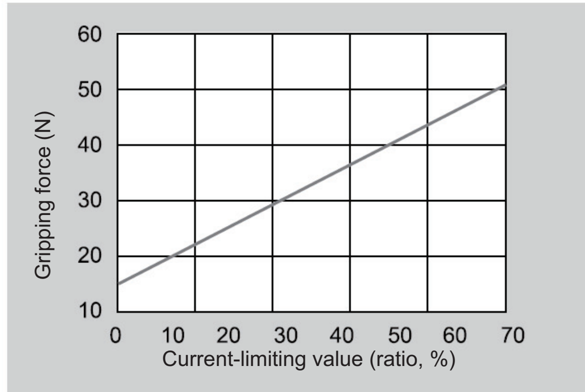


RCP2 Series | **3-finger Gripper**

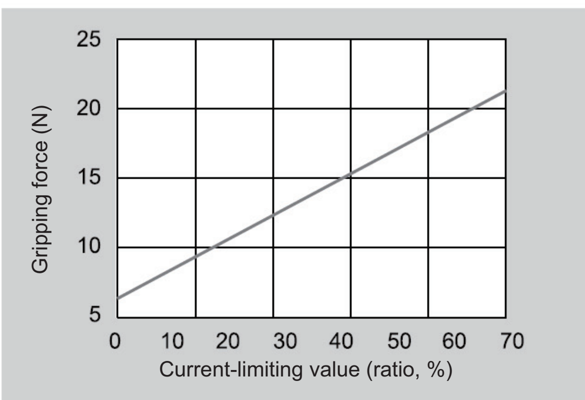
GR3LS



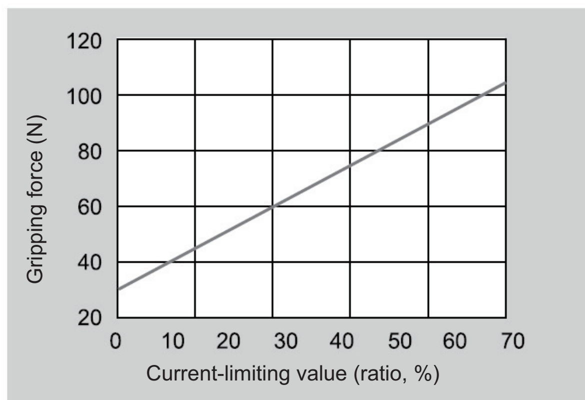
GR3LM



GR3SS

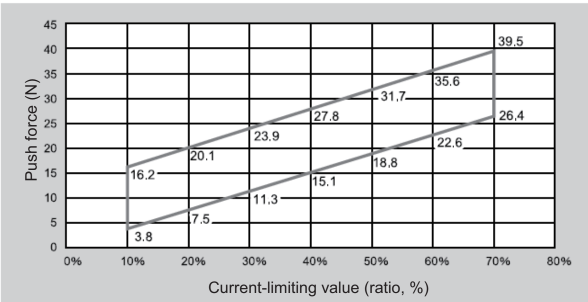


GR3SM

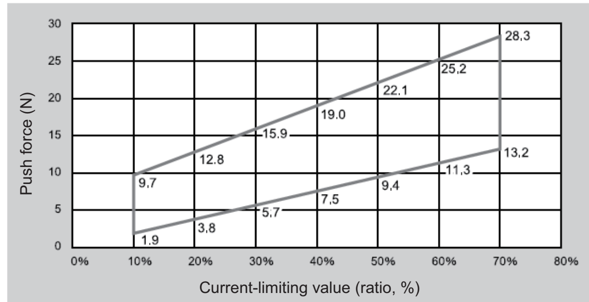


RCP3 Series | Slim, Compact Rod Type

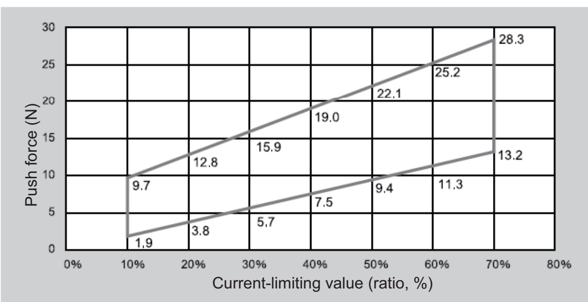
RA2AC/RA2AR Lead 1



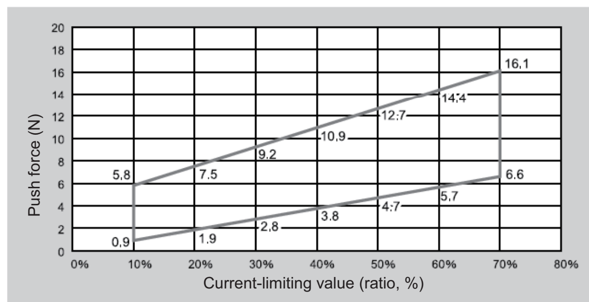
RA2BC/RA2BR Lead 2



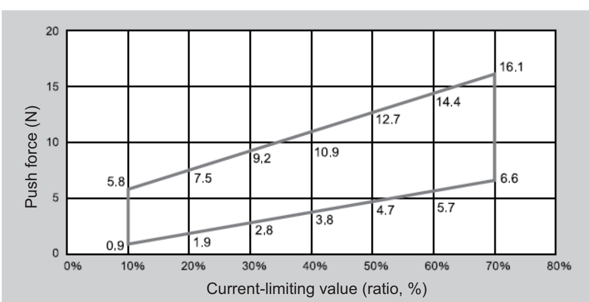
RA2AC/RA2AR Lead 2



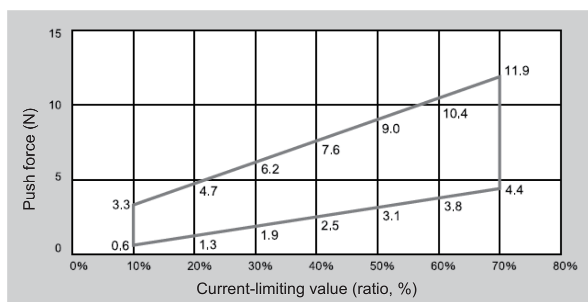
RA2BC/RA2BR Lead 4



RA2AC/RA2AR Lead 4

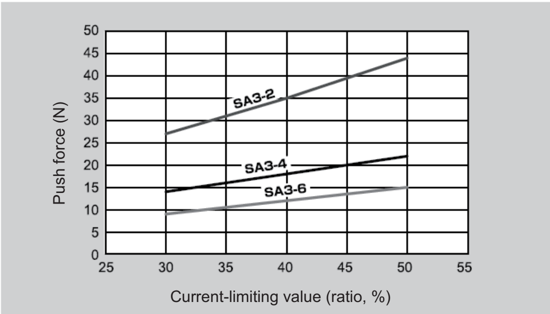


RA2BC/RA2BR Lead 6

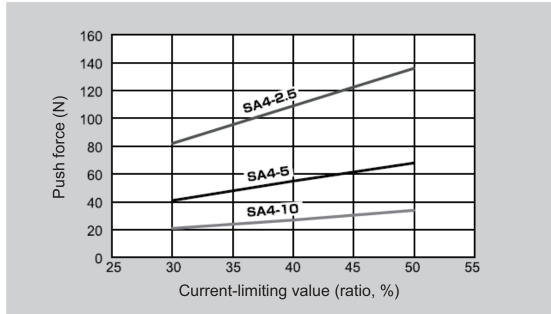


RCP3 Series Slider Type

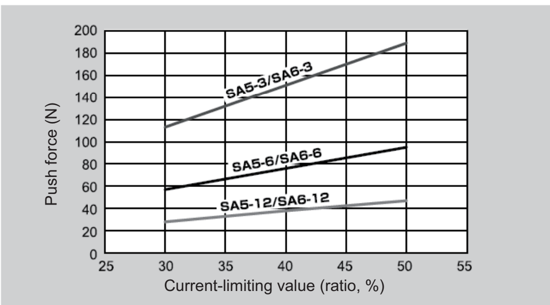
SA3C Type



SA4C Type

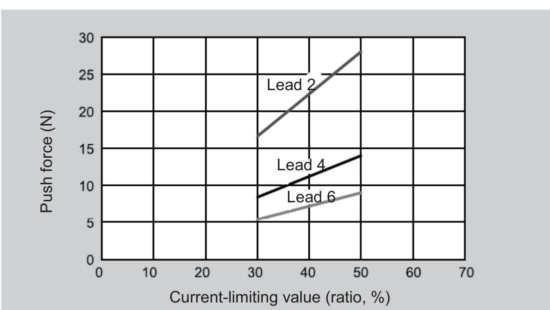


SA5C/SA6C Type

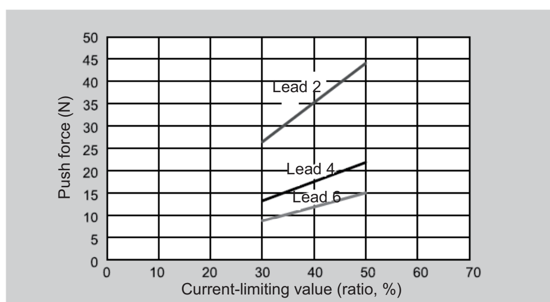


RCP3 Series Slim, Compact Table Type

TA3C/TA3R Type

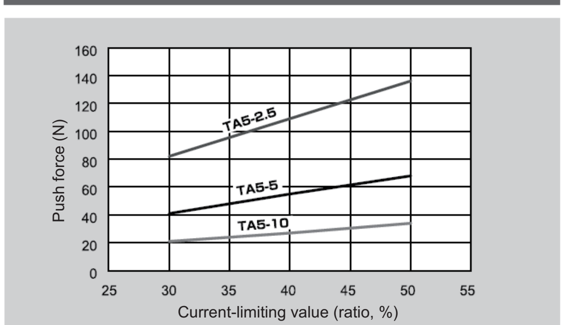


TA4C/TA4R Type

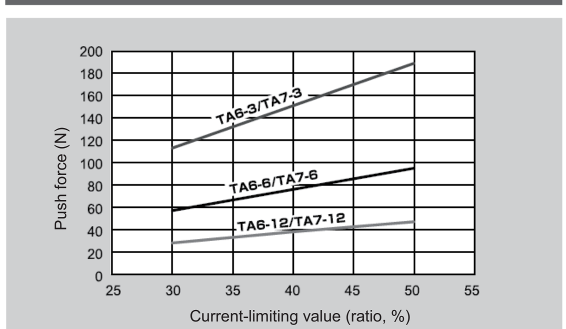


RCP3 Series Table Type

TA5C Type

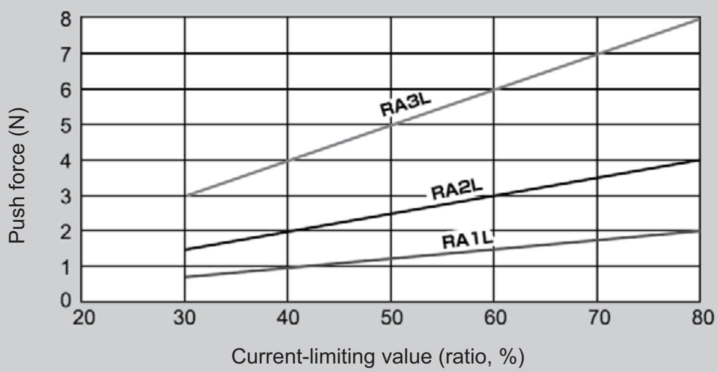


TA6C/TA7C Type



RCL Series | Micro-cylinder

RA1L/RA2L/RA3L



Change History

Revision Date	Description of Revision
August 2008	First edition • Maintenance at Startup Section and Specifications Section integrated
January 2009	Second edition • Addition of UL standards application page
June 2009	Third edition • Electromagnetic valve mode 1 and 2 added, velocity unit switchover function added, corresponded to parameter create tool version update
October 2009	Fourth edition • Transportation notes in Caution for Safety changed, RTE Signal table revised, Error Codes 0B5, 0A8 and 0B4 added, Error Code 0A1 moved to cold start
February 2010	Fifth edition • Descriptions corresponding to Pollution Degree 2 added in Environment for Use
March 2010	Sixth edition • High-Acceleration Transportation Type added to applicable actuators
May 2010	Seventh edition • Caution for Safety swapped with Safety Guide, applicable actuator specifications and the values for pressing force and current control added
December 2010	Eighth edition • System diagrams added to CC-LINK (Pg. 302) and PROFIBUS (Pg. 321), made OMRON tool instruction correspond to integrator
February 2011	Ninth edition • Statement in PROFIBUS specifications changed, RMOD and ECE signals added to Gateway control signals, LOAD and TRQS signals added (Pg. 69 and 92), correction made to explanation regarding response (Pg. 138)
April 2011	Tenth edition • Explanation for CE Marking moved to Overseas Specifications Manual
November 2011	Eleventh edition • MEND signal added to Direct Indication Mode, encoder rotation setting of absolute unit set for each actuator

MEMO

MEMO

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