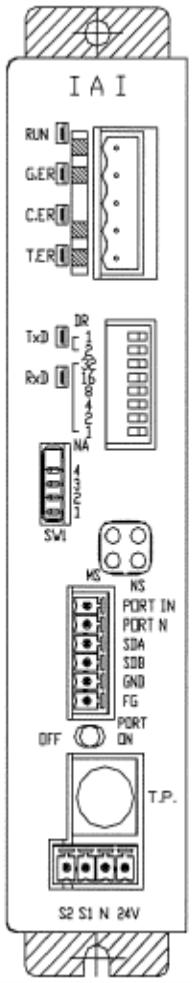
DeviceNet
Gateway Unit
RCM-GW-DV

Operation Manual, Second Edition



IAI America, Inc.

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1. Overview

1.1 DeviceNet Gateway Unit

The DeviceNet Gateway Unit (hereinafter referred to as “DeviceNet Gateway” or “Gateway Unit”) is used to connect a DeviceNet communication protocol network on which a host programmable controller (hereinafter “PLC”) operates, to a SIO communication sub-network (Modbus communication protocol) linking ROBO Cylinder controllers.

The physical standard to which the SIO communication network conforms is RS-485, and the slave addresses on this network are 1 through 16.

All data exchanged between the DeviceNet communication network and the Modbus SIO communication network are tentatively saved in the internal memory of the Gateway Unit, and then transferred cyclically. The PLC recognizes the Gateway Unit as a remote I/O device.
The Gateway Unit supports PCON-C/CG/SE, ACON-C/CG/SE, SCON-C and ERC2-NP/PN/SE controllers.

* “Gateway” is a term used in communication networks, referring to a device that converts data to/from different media and protocols to enable communication between networks.

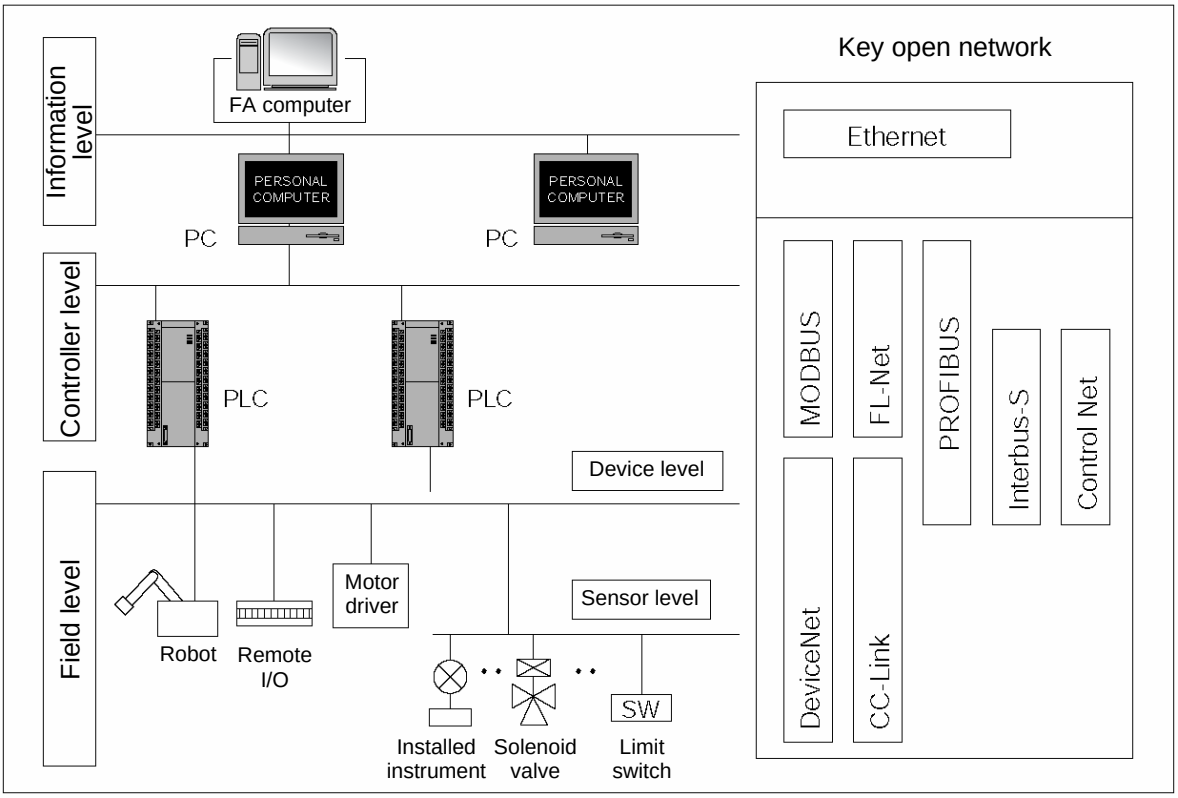
⚠ Caution

This manual only describes the controls feasible using the Gateway Unit. In the event of any conflict between this manual and the operation manual for the controller, the content of this manual will prevail. Refer to the operation manual for each controller for any function, parameter setting, alarm detail or any other information not described in this manual.

1.2 What Is DeviceNet?

(1) FA communication system

In FA communication, each communication specification varies depending on the communicating equipment, type of information, and purpose of communication, among others. In general, however, the FA communication system is divided into the information level, controller level and field level, as shown below.



(2) Information level

Also called “PLC upper network”, the main purpose of this network level is to transmit production information, etc., to information terminals. Ethernet is the most commonly used communication method for the information level.

(3) Controller level

Also called “Inter-PLC network”, this network level often handles real-time information of production lines.

(4) Field level

Also called “PLC lower network”, this network level is mainly used to save wirings for systems controlled by a single controller. In this sense, this network is regarded as a means for “wire-saving communication.” The field level is largely divided into the device level and the sensor level.

(5) DeviceNet

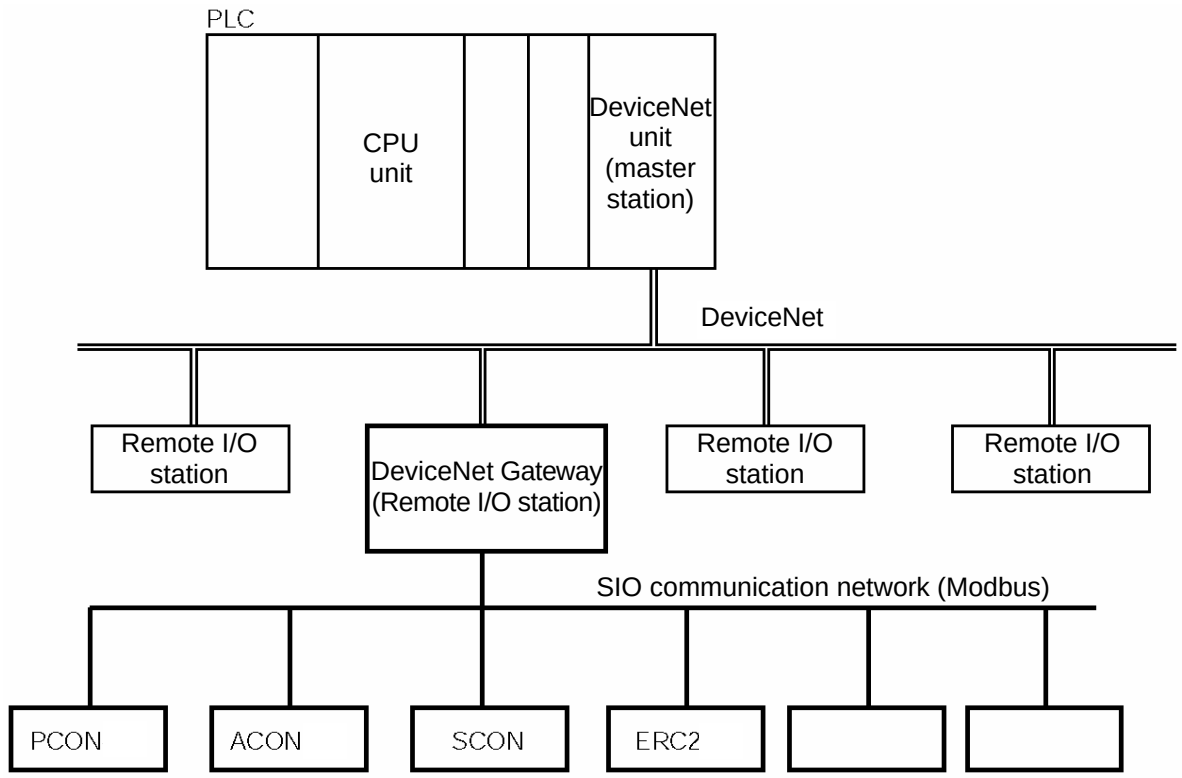
DeviceNet is a device-level open network used widely for FA and other applications. Since the communication specifications are open, DeviceNet-compliant devices made by different manufacturers can communicate with one another without dedicated programs.
Currently the DeviceNet standard is managed by a nonprofit organization called ODVA (Open DeviceNet Vendor Association, Inc.).
Key features of DeviceNet are listed below:

[1] A wire-saving communication network realizing complete multi-vendor connectivity
[2] The operating specifications are uniform around the world, which means that the same network configurations can be used overseas.
[3] Slave devices are treated as remote I/Os of the PLC in which the DeviceNet unit is installed. Accordingly, communication with slave devices does not require special programs.
[4] High line efficiency ensures high-speed responses.

* For details on DeviceNet, refer to the operation manuals for your master unit and PLC.
Along with this manual, also read the operation manual for each controller connected.
This DeviceNet Gateway cannot be used in any way not described as feasible in this manual.
To prevent malfunction, the customer is also advised not to use settings, wirings and other uses other than those described as feasible in this manual.

1.3 Application Example of Gateway Unit

The network illustrated below gives an application example of the Gateway Unit.



1.4 Features and Key Functions

1.4.1 Features

With the DeviceNet Gateway Unit, a desired operation mode can be selected from the position-number specification mode, direct numerical specification mode, and command specification mode.

(1) Position-number specification mode

In this mode, the actuator is operated by specifying position numbers. Up to 16 axes can be connected. The position data, speed, acceleration/deceleration, etc., must be entered beforehand in the position table.
Various status signals can be input/output and completed position numbers can be read. However, the current position cannot be monitored.

(2) Direct numerical specification mode

In this mode, the actuator is operated by directly specifying the position data, speed, acceleration/deceleration, positioning band, and current-limiting value for push-motion operation, in numerical values.
Various status signals can be input/output and current position data can be read.
There are five patterns in the direct numerical specification mode, each accommodating a different number of connected axes.

[1] Direct numerical specification mode, maximum 4 axes
[2] Direct numerical specification mode, maximum 6 axes
[3] Direct numerical specification mode, maximum 8 axes
[4] Direct numerical specification mode, maximum 10 axes
[5] Direct numerical specification mode, maximum 16 axes

(3) Command specification mode

In this mode, the actuator can be operated in two operation patterns: the “positioner operation” pattern in which the actuator is operated by specifying position numbers, and the “simple direct operation” pattern in which the actuator is operated by specifying the operation data directly in numerical values, while specifying all other items including the speed, acceleration/deceleration, positioning band, and current-limiting value for push-motion operation, using position numbers. A desired axis configuration can be designed using one or both of the two operation patterns. If the two operation patterns are combined, you must assign the axes sequentially from those conforming to the positioner operation pattern, followed by the axes conforming to the simple direct operation pattern.
The command specification mode is further classified into the Large mode (160 bytes of inputs and 160 bytes of outputs), Middle mode (128 bytes of inputs and 128 bytes of outputs), and Small mode (64 bytes of inputs and 64 bytes of outputs), according to the size of assigned areas. Up to 16 axes can be connected in this mode.

1.4.2 Key Functions

A comparison table of the key functions available in each mode of the Gateway Unit is given on the next page. When studying this table, also refer to the explanation of each operation mode provided in Chapter 6.

Key function		Position-number specification mode	Direct numerical specification mode					Command specification mode		
								Positioner operation		Simple direct operation
Operation by position data specification		x (Specified in the P table.)	○					○ (The P table is rewritten.)		○
Direct specification of speed and acceleration/deceleration		x (Specified in the P table.)	○					○ (The P table is rewritten.)		x (Specified in the P table.)
Direct specification of positioning band		x (Specified in the P table.)	○					○ (The P table is rewritten.)		x (Specified in the P table.)
Push-motion operation		○ (Specified in the P table.)	○					○ (Specified in the P table.)		○ (Specified in the P table.)
Operation by position number specification		○	x					○		x
Enabling position table		○	x					○		○
Maximum registrable positions		64	-					512		512
Completed position number read		○	x					○		x
Controller PIO pattern selection		x	x					○ *2		x
Zone (parameter)		○ (2 zones)	x					○ *3		x
Position zone (P table)		x	x					○ *4		x
Various status signal read		○	○					○		○
Speed change during movement		○	○					○		○
Operation at separate acceleration and deceleration		○	○					○		○ (Specified in the P table.)
Current position monitor *5		x	○					x		○
Commands	Command/response transmission	x	x					○		○
	P table data read/write	x	x					○		x
	Current position read *5	x	x					○		○
	Alarm code read	x	x					○		○
	Broadcast	x	x					○		x
Connectable axes		16	4	6	8	10	16	16		16
Maximum specifiable position data value		Set in the P table.	9999.99 mm					9999.99 mm		9999.99 mm
								Large mode	Middle mode	Small mode
Mode setting SW1		2	0	4	8	13	12	1	5	9
Gateway I/O bytes	Input	48	28	40	52	64	100	160	128	64
	Output	48	52	76	100	124	196	160	128	64

*1 P table = Position table
*2 PIO patterns of 0 to 5 can be selected.
*3 PIO patterns 1 to 3 are not available.
*4 PIO patterns 3 and 5 are not available.
*5 In current position monitor, the current position data can be read directly from the PLC because the data is assigned to Gateway output signals. In current position read, the current position is read indirectly using a read command sent from the PLC to the Gateway.

The table below lists the number of positions available for each controller in each PIO pattern, and the corresponding maximum number of positions that can be registered for the Gateway Unit. Take note that the number of positions may be limited in some cases.

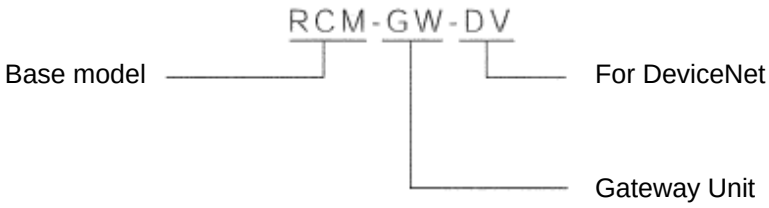
				PIO patterns (Parameter No. 25)						SE	
				0	1	2	3	4	5		
ERC2	Operation type			Standard	Electro-magnetic valve type	Zone signal type	Position zone type	-	-	Exclusive to SIO	
	Positioning points			8	3	16	16	-	-	64	
	Home return signal			○	x	x	x	-	-	○	Maximum Gateway positions
	Zone signal			○	x	○	x	-	-	○	
	P zone signal			x	x	x	○	-	-	○	
	Gateway controls	Position-number specification mode		8 *1	x	16 *1	16 *1	-	-	64	64
		Command specification	Positioner operation	*1 *3 8 (0)	x	*1 *3 16 (2)	*1 *3 16 (3)	-	-	*3 64 (0)	512
			Simple direct operation	-	x	-	-	-	-	-	512
PCON ACON SCON	Operation type			Position-ing mode	Teaching mode	256-point mode	512-point mode	Electro-magnetic valve mode 1	Electro-magnetic valve mode 2	Exclusive to SIO	
	Positioning points			64	64	256	512	7	3	64	
	Home return signal			○	○	○	○	○	x	○	Maximum Gateway positions
	Zone signal			○	x	x	x	○	○	○	
	P zone signal			○	○	○	x	○	○	○	
	Gateway controls	Position-number specification mode		64	64	256 ↓ 64 *2	512 ↓ 64 *2	7	x	64	64
		Command specification	Positioner operation	*3 64 (0)	*3 64 (1)	*3 256 (2)	*3 512 (3)	*3 7 (4)	x	*3 64 (0)	512
			Simple direct operation	-	-	-	-	-	x	-	512

*1 In an operation mode where position numbers are specified, the number of available positions is limited according to the PIO pattern selected (via parameter No. 25). (The Gateway can handle a greater number of positions.)

*2 Since the Gateway can handle 64 positions, the number of positions available for the controller is limited.

*3 With positioner operation axes under the command specification mode, align the setting of the controller's PIO pattern selection parameter with the I/O pattern set by Gateway control signals PPS0 to PPS2. The value that should be set by PPS0 to PPS2 is shown in parentheses after the number of positions.

1.5 Description of Model Name



2. Specifications and Name of Each Part

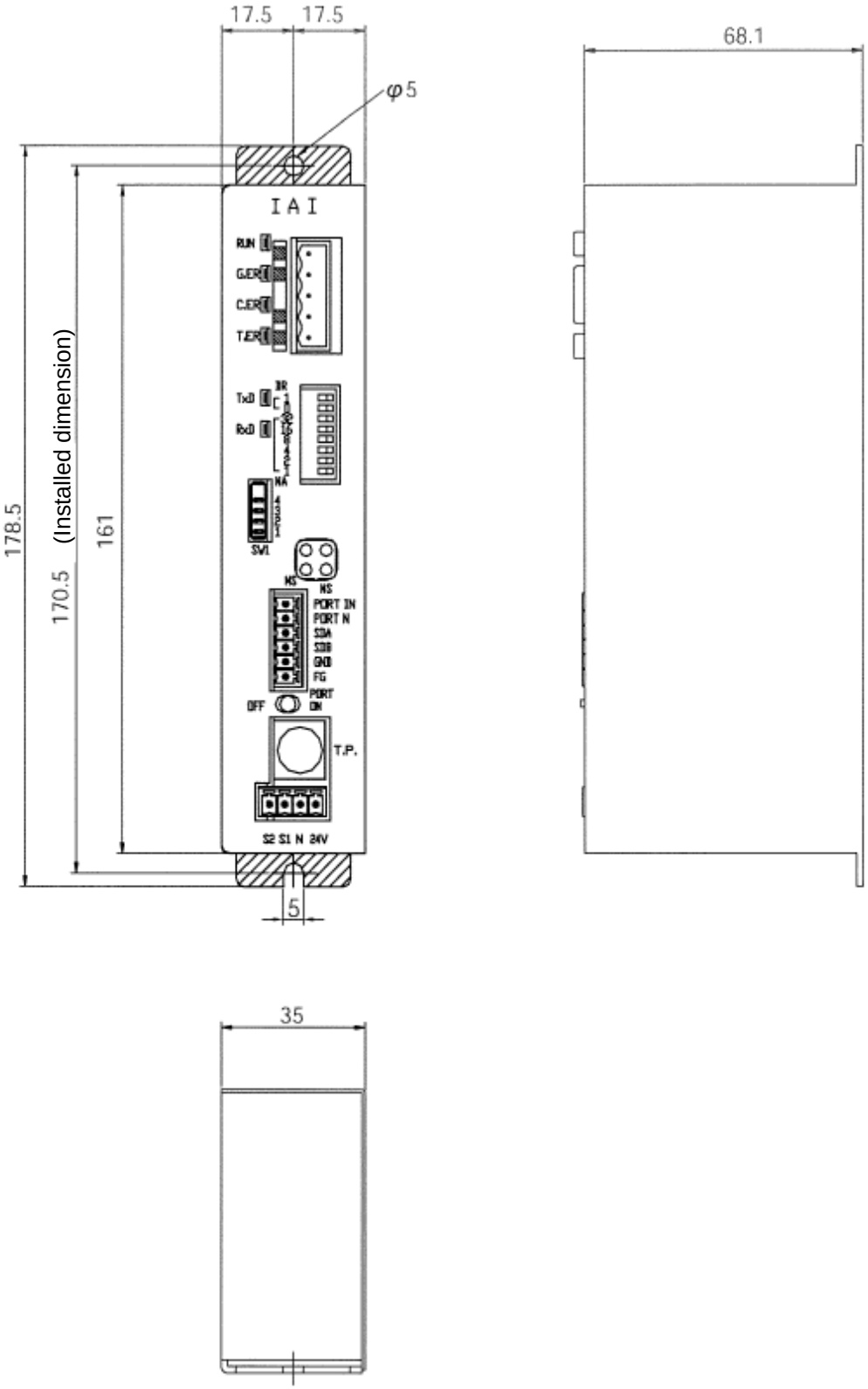
2.1 General Specifications

<table>
<tr><th colspan="2">Item</th><th colspan="4">Specification</th></tr>
<tr><td colspan="2">Power supply</td><td colspan="4">24 VDC ± 10%</td></tr>
<tr><td colspan="2">Current consumption</td><td colspan="4">300 mA max.</td></tr>
<tr><td rowspan="11">DeviceNet specifications</td><td rowspan="3">Communication standard</td><td colspan="4">A certified DeviceNet 2.0 interface module is used.</td></tr>
<tr><td colspan="4">Group 2 only server</td></tr>
<tr><td colspan="4">Insulated node of network powered operation type</td></tr>
<tr><td rowspan="3">Communication specification</td><td colspan="2" rowspan="3">Master-slave connection</td><td>Bit strobe</td></tr>
<tr><td>Polling</td></tr>
<tr><td>Cyclic</td></tr>
<tr><td>Baud rate</td><td colspan="4">500 k / 250 k / 125 kbps (Changed by DIP switches)</td></tr>
<tr><td rowspan="5">Communication cable length (*1)</td><td>Baud rate</td><td>Maximum network length</td><td>Maximum branch length</td><td>Total branch length</td></tr>
<tr><td>500 kbps</td><td>100 m</td><td rowspan="3">6 m</td><td>39 m</td></tr>
<tr><td>250 kbps</td><td>250 m</td><td>78 m</td></tr>
<tr><td>125 kbps</td><td>500 m</td><td>156 m</td></tr>
<tr><td colspan="4">Note) When a thick DeviceNet cable is used.</td></tr>
<tr><td>Occupied nodes</td><td colspan="4">1 node</td></tr>
<tr><td>Communication power supply</td><td colspan="4">Voltage: 24 VDC (supplied from DeviceNet)
Current consumption: 60 mA</td></tr>
<tr><td rowspan="9">SIO communication specifications</td><td>Transmission path configuration</td><td colspan="4">IAI's original multi-drop differential communication</td></tr>
<tr><td>Communication method</td><td colspan="4">Half-duplex</td></tr>
<tr><td>Synchronization method</td><td colspan="4">Asynchronous</td></tr>
<tr><td>Transmission path type</td><td colspan="4">EIA RS485, 2-wire type</td></tr>
<tr><td>Baud rate</td><td colspan="4">230.4 kbps</td></tr>
<tr><td>Error control method</td><td colspan="4">No parity bit, CRC (*2)</td></tr>
<tr><td>Communication cable length</td><td colspan="4">Total cable length: 100 m max.</td></tr>
<tr><td>Connected units</td><td colspan="4">16 axes max.</td></tr>
<tr><td>Communication cable</td><td colspan="4">Double shielded twisted-pair cable
(Recommended cable:
HK-SB/20276 X L, 2P X AWG22 by Taiyo Electric Wire & Cable)</td></tr>
<tr><td rowspan="6">Environment</td><td>Ambient operating temperature</td><td colspan="4">0 to 40° C</td></tr>
<tr><td>Ambient operating humidity</td><td colspan="4">85% RH or below (non-condensing)</td></tr>
<tr><td>Operating ambience</td><td colspan="4">Free from corrosive or flammable gases, oil mist or powder dust</td></tr>
<tr><td>Storage temperature</td><td colspan="4">-10 to 65° C</td></tr>
<tr><td>Storage humidity</td><td colspan="4">90% RH or below (non-condensing)</td></tr>
<tr><td>Vibration durability</td><td colspan="4">4.9 m/s^2 (0.5 G)</td></tr>
<tr><td colspan="2">Protection class</td><td colspan="4">IP20</td></tr>
<tr><td colspan="2">Weight</td><td colspan="4">480 g or below</td></tr>
</table>

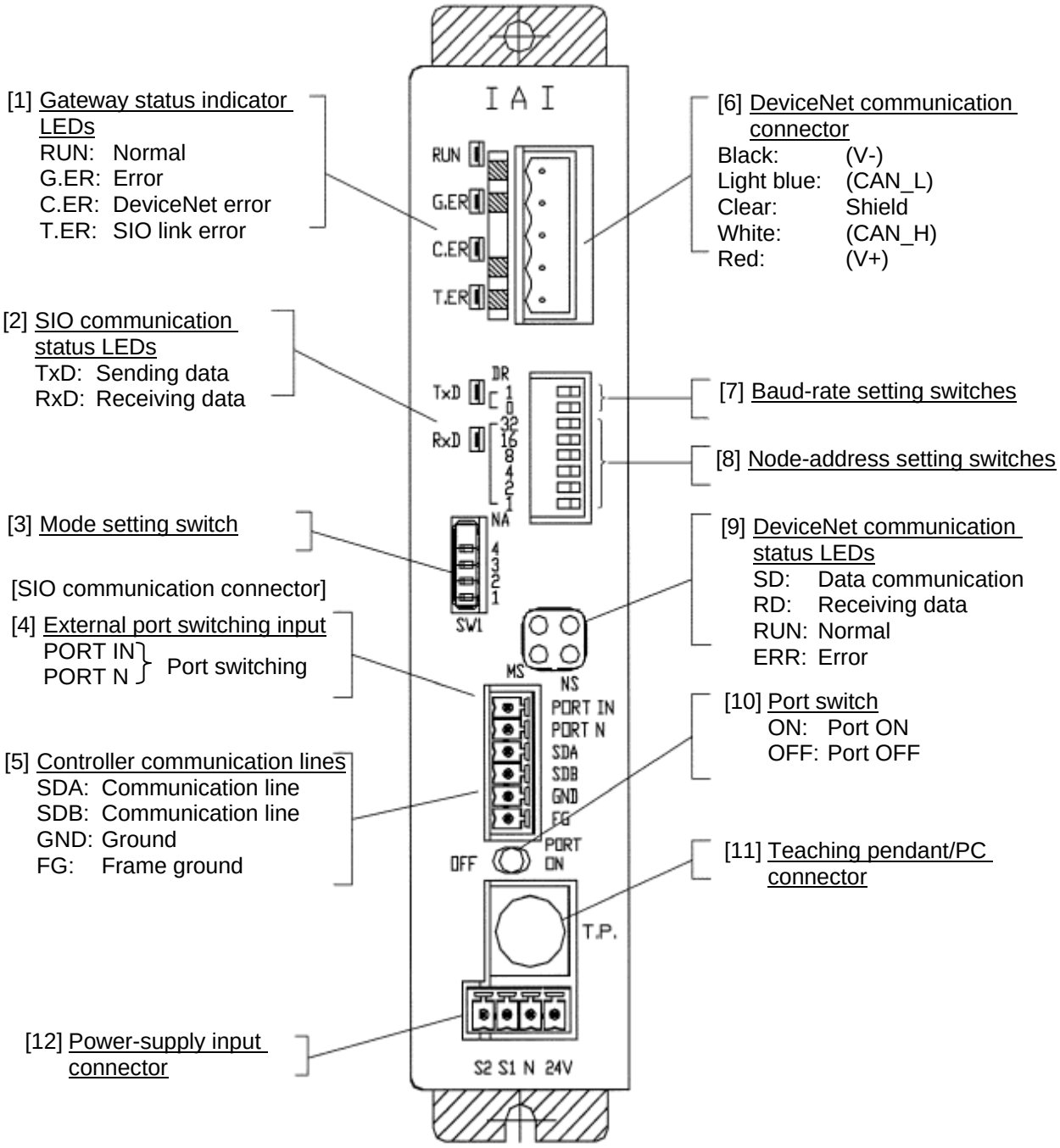
*1 Refer to the operation manuals for your master unit and PLC in the case of T-branch communication.

*2 CRC: Cyclic Redundancy Check
A data error detection method commonly used in synchronous transmission.

2.2 External Dimensions



2.3 Name and Function of Each Part



[1] Gateway status indicator LEDs

Indicated status		Description
RUN	Steady green	The Gateway CPU is operating.
	Unlit	CPU operation is stopped. If this LED does not come on after turning on the power, the Gateway is experiencing a CPU error.
G.ER	Steady red	The Gateway is experiencing a CPU error or major shutdown failure.
	Unlit	Normal state.
C.ER	Steady red	The DeviceNet module is experiencing an error or the Gateway CPU cannot recognize the DeviceNet connection. (Check the DeviceNet communication status per [9].) Even if this LED is lit, the teaching pendant or PC software can still be connected as long as the RUN LED is lit.
	Blinking red	While the port switch is ON, this LED blinks at 1-second intervals.
	Unlit	Normal state.
T.ER	Steady red	A communication error occurred between the DeviceNet Gateway and the ROBO Cylinder controller. (No response, overrun, framing error or CRC(*) error)
	Unlit	Normal state.

* CRC: Cyclic Redundancy Check
A data error detection method commonly used in synchronous transmission.

[2] SIO communication status LEDs

These LEDs are used to check the communication status between the DeviceNet Gateway and the ROBO Cylinder controller.
Each LED blinks when the host PLC is communicating with the ROBO Cylinder controller via the DeviceNet Gateway, or when the ROBO Cylinder controller is communicating with the teaching pendant or PC software connected via the DeviceNet Gateway.

Indicated status		Description
TxD	Blinking green	Sending data (DeviceNet Gateway → ROBO Cylinder controller)
	Unlit	Not sending data (DeviceNet Gateway → ROBO Cylinder controller)
RxD	Blinking green	Receiving data (ROBO Cylinder controller → DeviceNet gateway)
	Unlit	Not receiving data (ROBO Cylinder controller → DeviceNet gateway)

[3] Mode setting switch

This switch is used to set the operation mode of the DeviceNet Gateway.
Operate the switch after turning off the DeviceNet Gateway power.

○: ON X: OFF

No.	SW1					I/O bytes	
	4	3	2	1	Description	Output	Input
1	X	X	X	X	P. 4-5-1, maximum 4 axes	52	28
2	X	○	X	X	P. 4-5-1, maximum 6 axes	76	40
3	○	X	X	X	P. 4-5-1, maximum 8 axes	100	52
4	○	○	X	○	P. 4-5-1, maximum 10 axes	124	64
5	○	○	X	X	P. 4-5-1, maximum 16 axes	196	100
6	X	X	○	X	Position-number specification mode	48	48
7	X	X	X	○	Command specification mode, Large	160	160
8	X	○	X	○	Command specification mode, Middle	128	128
9	○	X	X	○	Command specification mode, Small	64	64

[4] External port switching input

The ON/OFF status of the teaching pendant/PC connector port can be switched using external signals (no-voltage contact type).
The connector port is enabled when the port switch [10] on the DeviceNet Gateway is OFF. When the input signal is ON, the port is also ON. (Refer to [10], “Port switch.”)

[5] Controller communication lines

This terminal is used to connect the communication lines to the SIO communication connector.
Refer to “I/O Signals of Gateway Unit” in Chapter 4.

[6] DeviceNet communication connector

This connector is used to connect the DeviceNet communication lines.
Refer to “I/O Signals of Gateway Unit” in Chapter 4.

[7] Baud-rate setting switches

Switches DR0 and DR1 are used to set a desired baud rate.

○: ON X: OFF

Baud rate	DR1	DR0
125 K	X	X
250 K	X	○
500 K	○	X

[8] Node-address setting switches

Switches NA1 to NA32 are used to set a desired node address.

○: ON X: OFF

Address	NA32	NA16	NA8	NA4	NA2	NA1
0	X	X	X	X	X	X
1	X	X	X	X	X	○
2	X	X	X	X	○	X
3	X	X	X	X	○	○
⋮	⋮	⋮	⋮	⋮	⋮	⋮
62	○	○	○	○	○	X
63	○	○	○	○	○	○

* Normally the node address of the master unit is set to 63.

[9] DeviceNet communication status LEDs

The two LEDs of MS and NS on the front face of the board indicate the node status and network status. (The remaining two LEDs are not used.)
These LEDs illuminate in one of two colors (red or green), and each LED indicates a different monitored status, as shown in the table below.

MS (Module Status) LED ..... This LED indicates the status of the node.
NS (Network Status) LED ..... This LED indicates the status of the network.

LED	Color	Indicated status	Description (meaning of indication)
MS	Green	Lit	The node is operating normally.
		Blink	The specified data size is exceeded.
	Red	Lit	A hardware error is present. The board must be replaced.
		Blink	A minor error, such as a DIP switch setting error or configuration error, is present. A normal condition can be restored by a reset operation, etc.
	-	Unlit	The power is not supplied.
NS	Green	Lit	Network connection has been established and communication is in progress without problem.
		Blink	The node is online, but network connection is not yet established. Communication is stopped. (The network is normal.)
	Red	Lit	A fatal error, such as duplicate node addresses or “bus off,” is present. Communication is disabled.
		Blink	A communication error is present. (A communication timeout occurred.)
	-	Unlit	• The node is offline. • The power is not supplied.

The node performs self-test when the power is input.
During the self-test, the monitor LEDs change their indications in the following sequence:

[1] The NS LED turns off.
[2] The MS LED illuminates in steady green (for approx. 0.25 second).
[3] The MS LED illuminates in steady red (for approx. 0.25 second).
[4] The MS LED illuminates in steady green.
[5] The NS LED illuminates in steady green (for approx. 0.25 second).
[6] The NS LED illuminates in steady red (for approx. 0.25 second).
[1] The NS LED turns off.

When the self-test is completed and communication starts successfully, both the MS and NS LEDs will change to steady green.

[10] Port switch

This switch is used to enable the teaching pendant/PC connector (TP) (PORT ON = Start communication).
Set this switch to the OFF position when connecting/removing the communication cable connector for teaching pendant or PC software. To use the teaching pendant or PC software, plug in the connector first, and then set the switch to the ON position.
(Also check the signal status of the port switching input [4].)
The maximum baud rate for communication between the teaching pendant or PC software and the DeviceNet Gateway is 115.2 kbps. The maximum baud rate for communication between the DeviceNet Gateway and the ROBO Cylinder controller is 230.4 kbps.

When the port is turned ON, DeviceNet communication error will not occur but data exchange via SIO communication will stop. Accordingly, output signals (data) from the PLC will not be output to the controller and the input signals (data) from the ROBO Cylinder controller will remain as the values that were effective immediately before the port was turned ON.
Since the DeviceNet Gateway outputs a port ON status signal (TPC) to the PLC, provide an interlock, etc., if necessary.
Refer to “I/O Signals of Gateway Unit” in Chapter 4 for the relationship with the emergency stop signal.

[11] Teaching pendant/PC connector

This connector is used to connect the communication cable connector for teaching pendant or PC software.

[12] Power-supply input

This connector is used to connect the power supply (24 VDC) of the DeviceNet Gateway. Refer to “I/O Signals of Gateway Unit” in Chapter 4.

3. Installation and Noise Elimination Measures

Exercise due caution regarding the installation environment.

3.1 Installation Environment.

a. The Gateway Unit is not dustproof or waterproof (oilproof). Accordingly, avoid using the Gateway Unit in a dusty place or place where the unit may come in contact with oil mist or splashed cutting fluid.
b. Prevent the Gateway Unit from receiving direct sunlight or irradiated heat from large heat sources such as heat treatment ovens.
c. Use the Gateway Unit in an environment of 0 to 40° C in ambient temperature and 85% or below in humidity (non-condensing) and free from corrosive or flammable gases.
d. Use the Gateway Unit in an environment where the unit will not receive external vibration or shock.
e. Prevent electrical noise from entering the Gateway Unit or its cables.

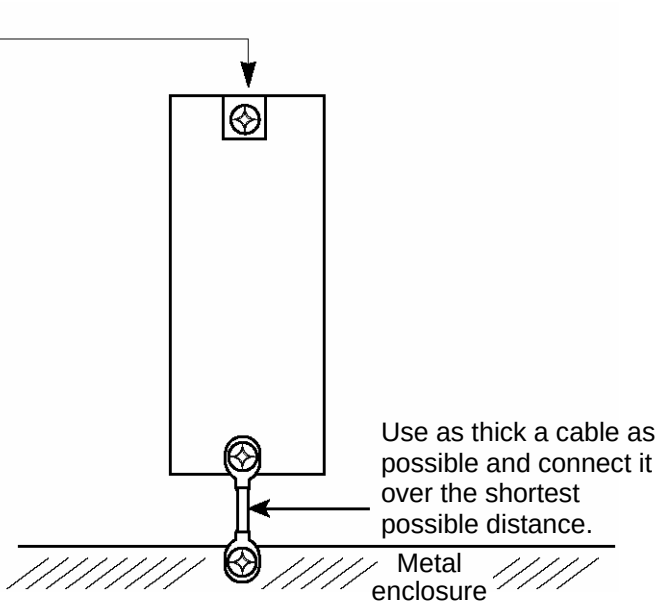
3.2 Supply Voltage

24 VDC ± 10% / Current consumption: 300 mA max.

3.3 Noise Elimination Measures and Grounding

a. Installing the Gateway Unit

Connect the Gateway Unit by directly securing it onto a metal enclosure using screws.



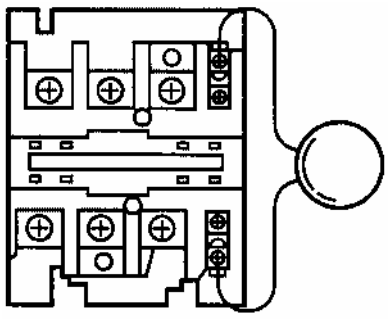
* Provide class D (3) grounding for the enclosure.

b. Notes on wiring method
Separate the communication lines of the Gateway Unit and Profibus module from lines carrying large current such as power circuits. (Do not bundle them together or place them in the same cable duct.)

c. Noise sources and elimination of noise
There are many noise sources, but the ones you should pay most attention to when building your system are solenoid valves, magnet switches and relays. Noise from these sources can be eliminated using the following measures.

[1] AC solenoid valves, magnet switches, relays

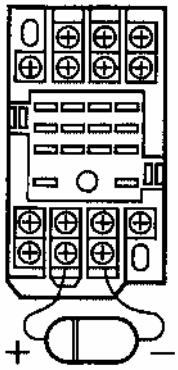
Measure --- Install a surge killer in parallel with the coil.



← Point
Install the surge killer in a location as close as possible to each coil.
If the surge killer is installed on a terminal block or away from the coil, its noise elimination effect will decrease.

[2] DC solenoid valves, magnet switches, relays

Measure --- Install a diode in parallel with the coil. Determine an appropriate diode capacity in accordance with the load capacity.

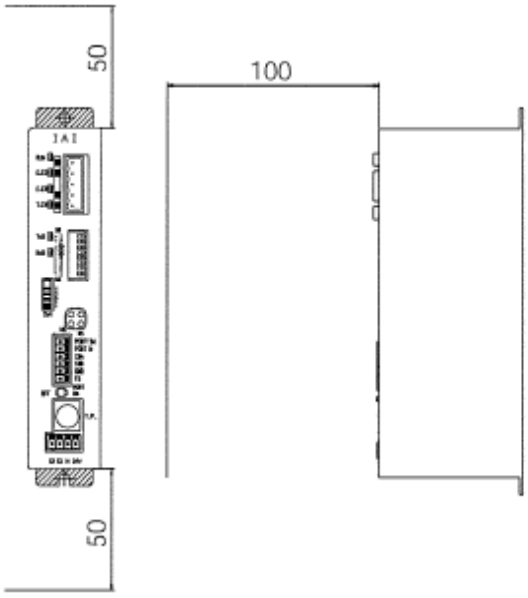


Anode Cathode

In a DC system, connecting the diode in reverse polarities may damage the diode, internal controller parts, and DC power supply. Exercise due caution.

3.4 Installation

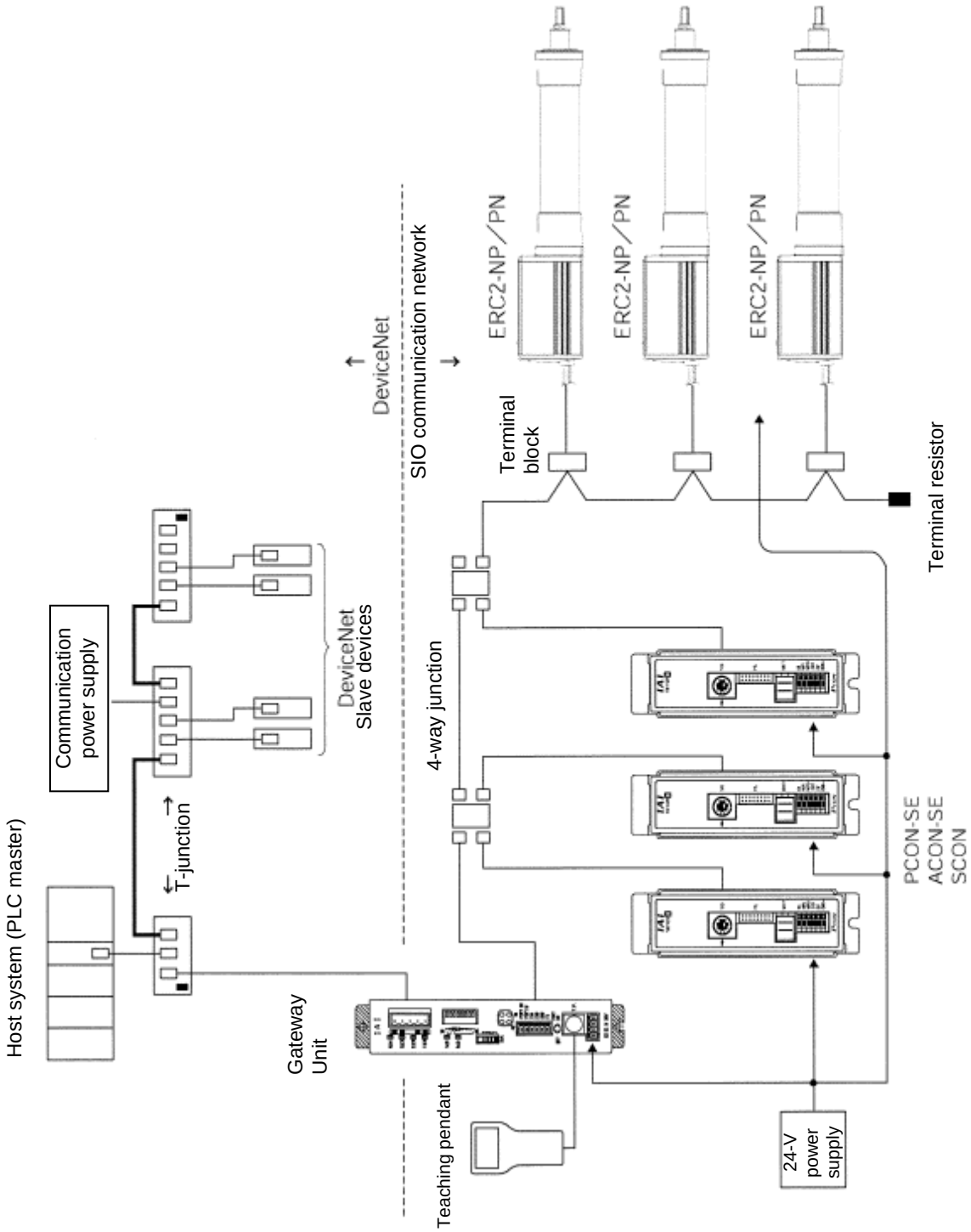
Examine appropriate settings for the control box size, installation position of the Gateway Unit and cooling method of the control box, so that the temperature around the Gateway Unit will remain at or below 40° C.
Install the Gateway Unit vertically on a wall, as shown below, and provide a minimum clearance of 50 mm above and below the unit, with a minimum clearance of 100 mm provided on all sides for wiring access.
If multiple Gateway Units are installed side by side, provide a sufficient space between the adjacent units so that any unit can be installed and removed easily.
If heat or noise is of concern, also provide appropriate measures.



4. Wiring

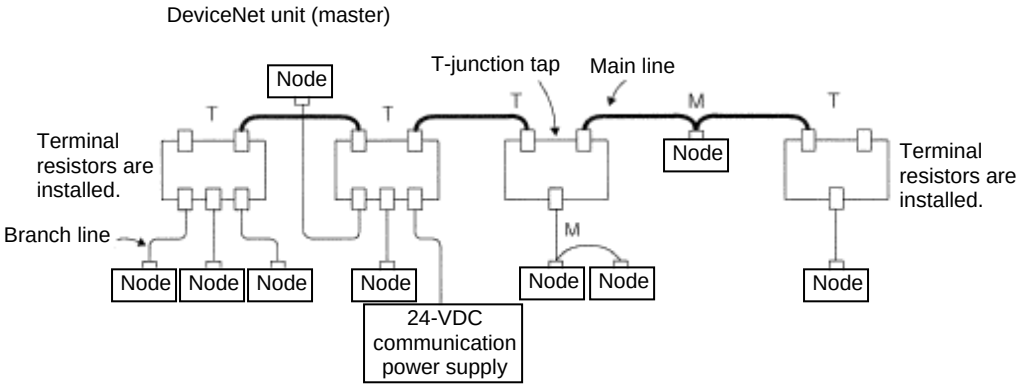
4.1 Overall Configuration

Shown below is an example of the DeviceNet system configuration using the Gateway Unit.

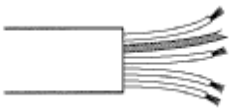


Reference: Overview of DeviceNet Network Configuration

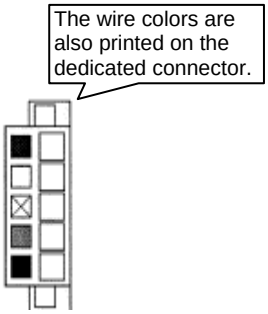
For details on DeviceNet, refer to the operation manual for the master (PLC). This section explains key points of network wiring.
Shown below is an example of the DeviceNet network.



(1) A device with an address connected to the network is called “node.” A node may be a master (DeviceNet unit in the figure above) that manages DeviceNet, or a slave that connects an external I/O. Masters and slaves can be arranged in any positions.
(2) A cable having a terminal resistor installed on both ends is called “main line” (thick line in the figure), while a cable branching from a main line is called “branch line” (thin line in the figure). Both cables use the dedicated five-lead DeviceNet cable. Either the thick cable or thin cable is used depending on the supplied current.
You can learn more about this dedicated cable on the ODVA website.
The dedicated cable is shown below.



Color	Signal type
Red	Power-supply cable + (V+)
White	Communication data high (CAN H)
-	Shield
Blue	Communication data low (CAN L)
Black	Power-supply cable - (V-)



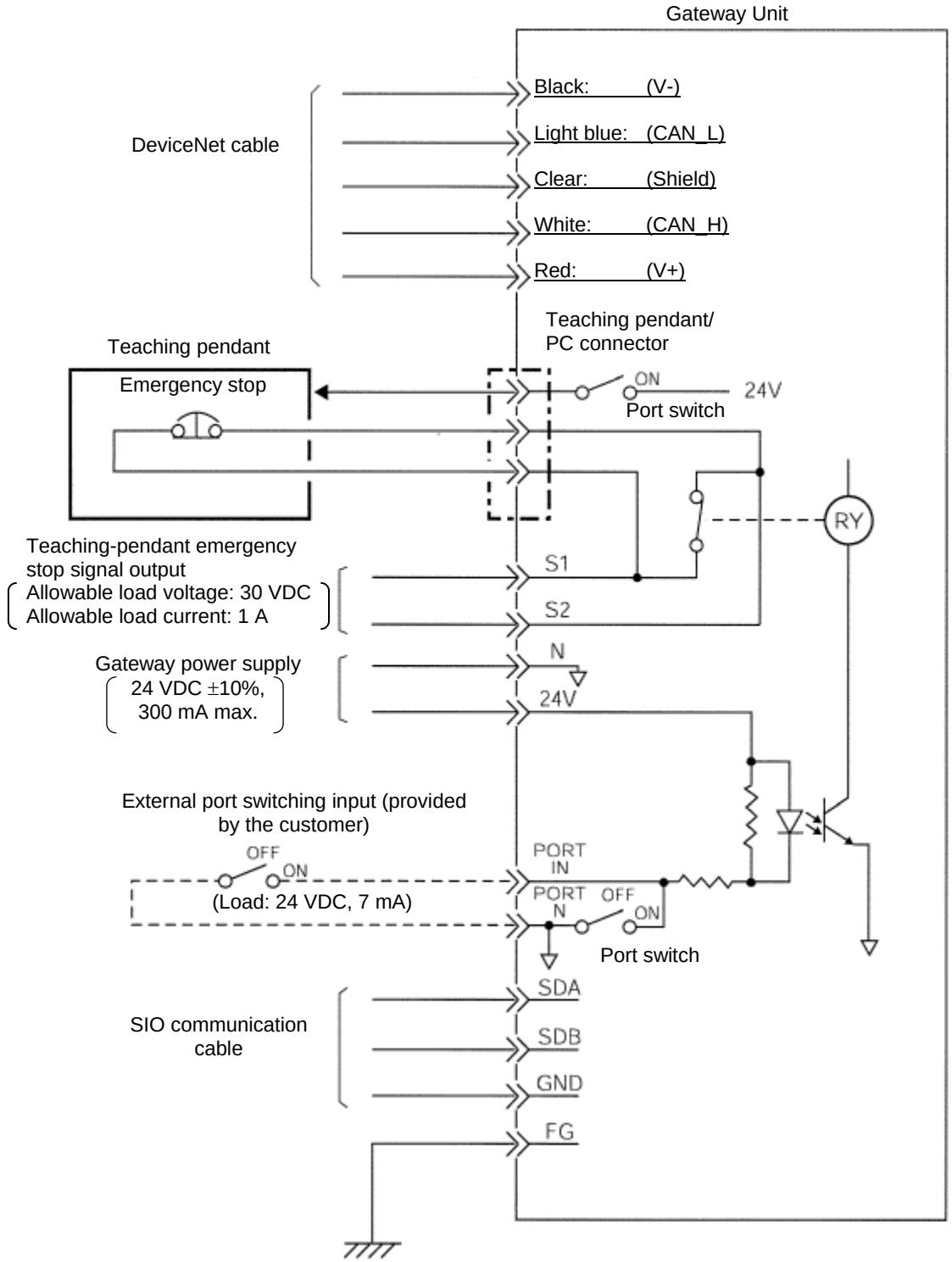
(3) Nodes can be connected in one of two ways. Both methods can be employed together in a single network.
[1] T-junction method --- A T-junction tap, etc., is used (indicated by “T” in the figure above).
[2] Multi-drop method --- A multi-drop connector is used to directly branch the cable at a node (indicated by “M” in the figure above).
(4) The communication power (24 VDC) must be supplied to each node via a five-lead cable.
(5) A terminal resistor must be installed on both ends of a main line.
(6) The baud rate is limited in accordance with the network lengths (total branch line length and maximum network length).

⚠ Caution

Align the ground potential level of the power supply of each controller connected to the Gateway Unit with the ground potential level of the power supply of the Gateway Unit.

4.2 I/O Signals of Gateway Unit

(1) Connection diagram

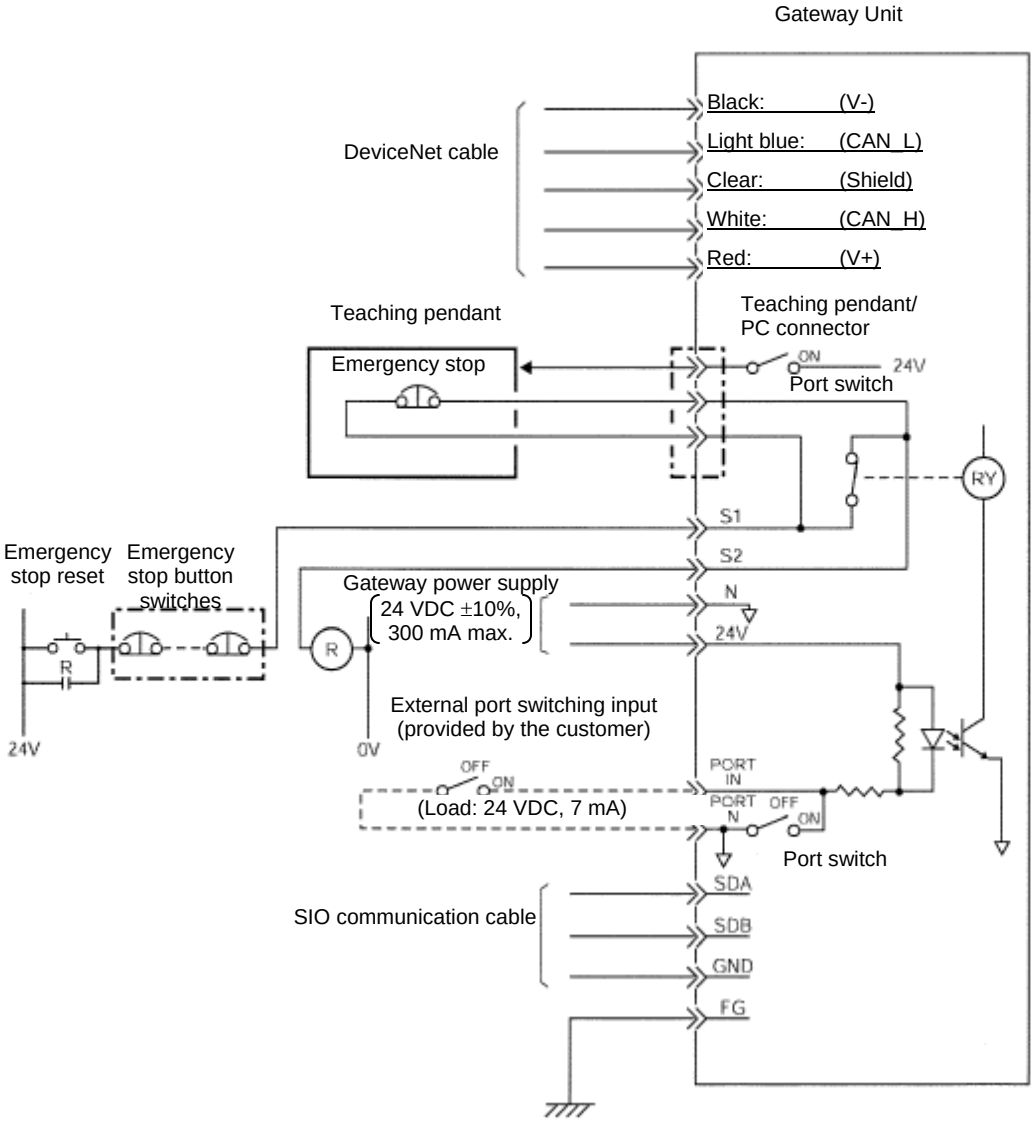


(2) Port control and emergency stop signal output

The teaching pendant/PC connector port can be operated by external signals, other than by ON/OFF switching of the port switch on the Gateway Unit.
While the port is ON, the Gateway Unit outputs contact signals of the emergency stop pushbutton switch on the teaching pendant. Therefore, you can design an emergency stop circuit or other protective circuit for the entire system by incorporating these signals.

External port switching input	Port switch	Teaching-pendant emergency stop signal output	Teaching pendant/PC connector port
OFF	OFF	Disabled (S1 and S2 shorted)	Disabled
ON	OFF	Enabled (S1, S2 = Teaching-pendant emergency stop contacts)	Enabled
OFF	ON		
ON	ON		

A reference example of the emergency stop circuit is shown below.



(3) I/O signal specifications and wires

	Symbol	Description	Specification	Connector and applicable wire	
Power-supply input connector	24 V	Positive side of the 24-VDC Gateway power supply	24 VDC ±10%	0.8 to 1.3 mm^2	The connection plug is a standard accessory. MC1.5/4-ST-3 • 5 (Phoenix Contact)
	N	Negative side of the 24-VDC Gateway power supply	Power consumption: 300 mA max.	AWG 18 to 16	
	S1	Teaching-pendant emergency stop signal output	Allowable load voltage: 30 VDC	0.08 to 1.5 mm^2	
	S2		Allowable load current: 1 A	AWG 28 to 16	
SIO communication connector	PORT IN	External port switching input	No-voltage (dry) contact input Load: 24 VDC, 7 mA	0.08 to 1.5 mm^2 AWG 28 to 16	The connection plug is a standard accessory. MC1.5/6-ST-3 • 81 (Phoenix Contact) The Gateway Unit has a built-in terminal resistor, so connect the terminal resistor at the end of the SIO communication line.
	PORT N				
	SDA	SIO communication line A	Align the potential level of the connected controller or ERC actuator with the potential level of the GND (ground).	Double shielded twisted-pair cable (AWG22) Recommended cable: HK-SB/20276 X L 2P X AWG22 by Taiyo Electric Wire & Cable	
	SDB	SIO communication line B			
	GND	Ground			
	FG	Frame ground	Internally connected to the frame.		
DeviceNet communication connector	Black: (V-)	Power supply -		Use the dedicated five-lead DeviceNet cable recommended by ODVA. To check the details, visit ODVA's website.	The connection plug is a standard accessory. In a DeviceNet network, a terminal resistor must be connected on both ends of a main line. Check the operation manual for the master (PLC).
	Light blue: (CAN_L)	Communication data low			
	Clear: (Shield)	Shield cable			
	White: (CAN_H)	Communication data high			
	Red: (V+)	Power supply +			

4.3 Design of SIO Communication Network (SIO Communication)

4.3.1 Wiring

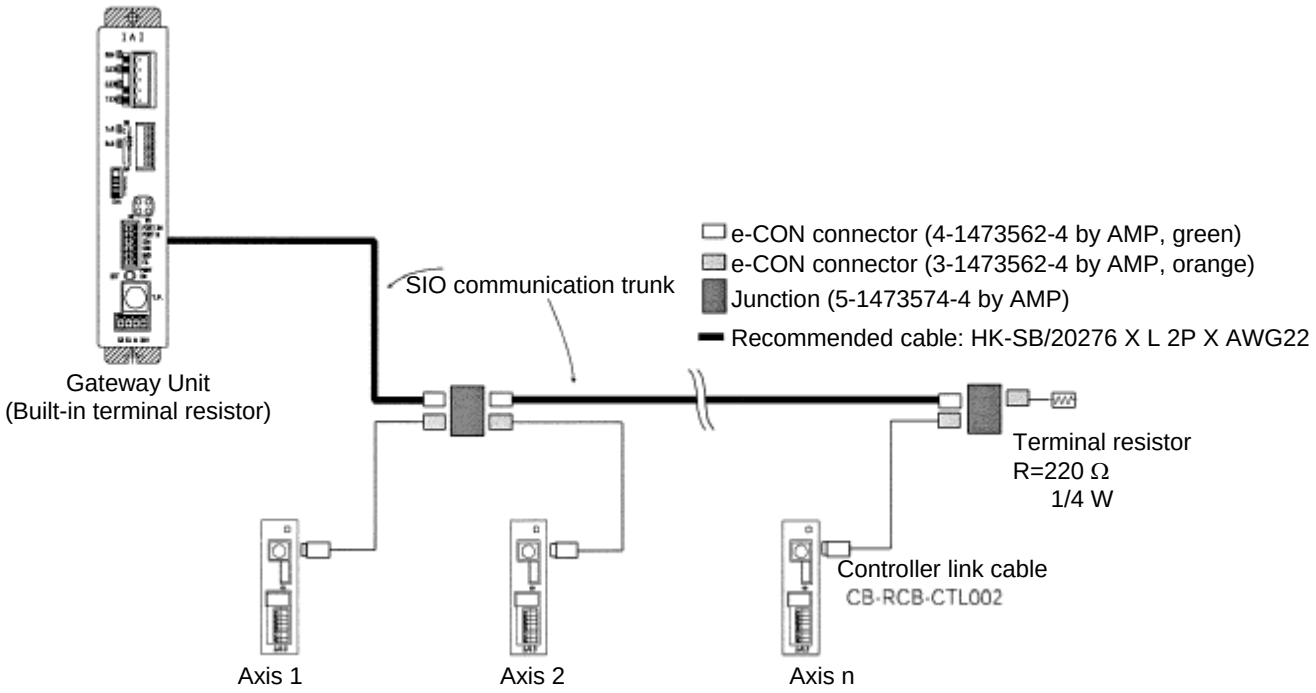
(1) Basics

Item	Description
Number of connected units	16 axes max. (The specific number varies depending on the operation mode. Refer to 1.4, “Features of Gateway Unit.”)
Communication cable length	Total cable length: 100 m max.
Communication cable	Double shielded twisted-pair cable (AWG22) Recommended cable: HK-SB/20276 X L 2P X AWG22 by Taiyo Electric Wire & Cable
Terminal resistor	220 Ω 1/4 W

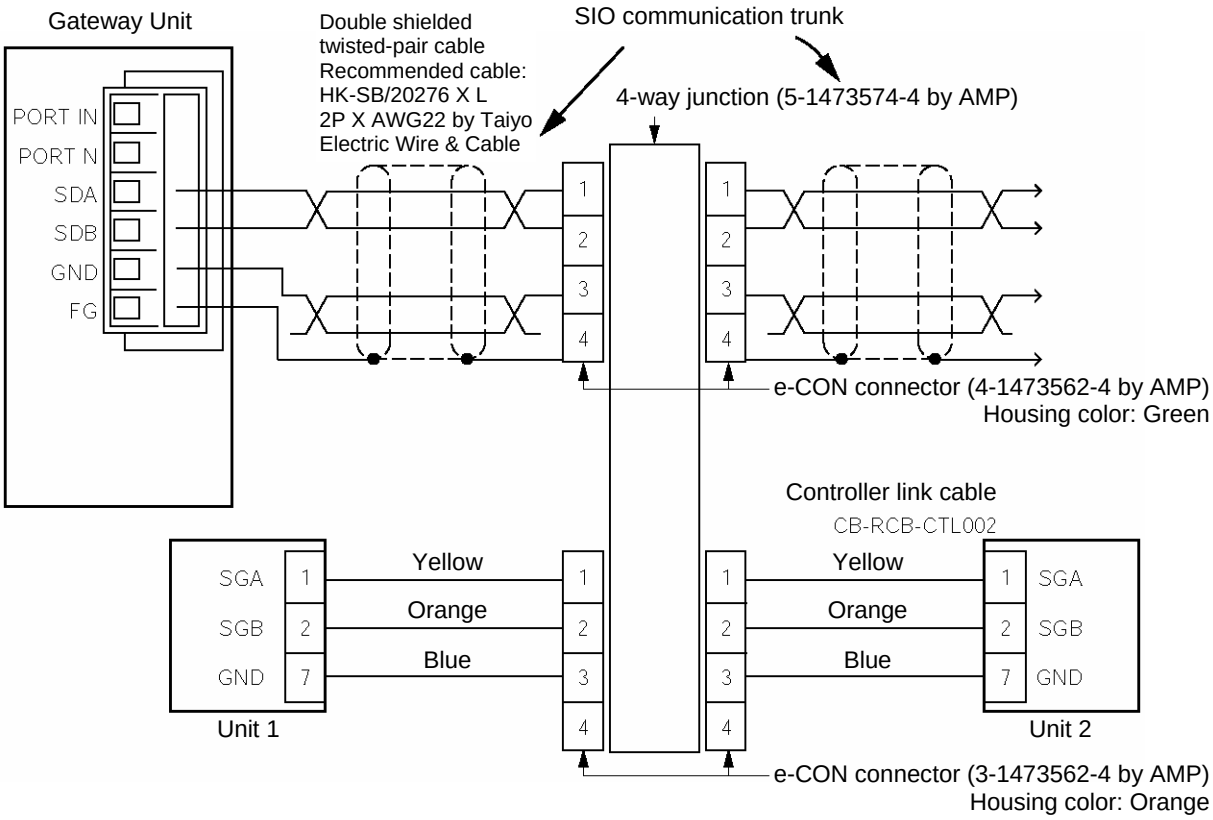
⚠ Caution

1. Connect the communication path to a bus and always connect a terminal resistor at the end. A terminal resistor is not needed on the Gateway Unit end, as the unit has a built-in terminal resistor.
2. The customer must provide the communication cable. If the recommended cable is not used, make sure the size of the cable to be used is AWG22.

(2) Linking PCON/ACON/SCON controllers via SIO communication

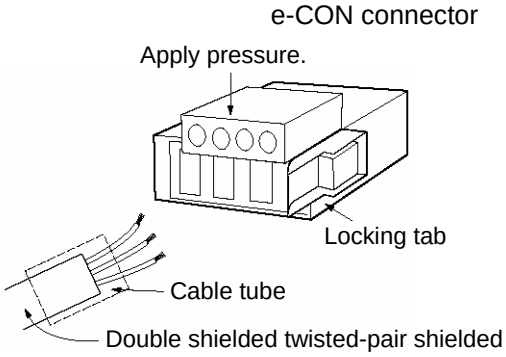


a. Detail connection diagram
Details of SIO link connection are illustrated below. Controller link cables are available as options, but the customer must provide the communication trunk.

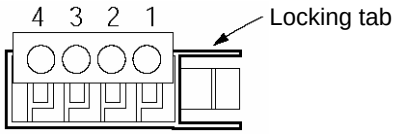


b. Producing a communication trunk

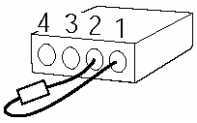
[1] Strip the sheath of a double shielded twisted-pair cable by approx. 15 to 20 mm.
[2] Place a cable protection tube over the cable.
[3] Insert three un-stripped core wires into the cable insertion holes in the connector.
[4] With the cable inserted in the press-fit cable housing, apply pressure from above to pressure-weld the core wires.
[5] Heat-treat the cable protection tube.



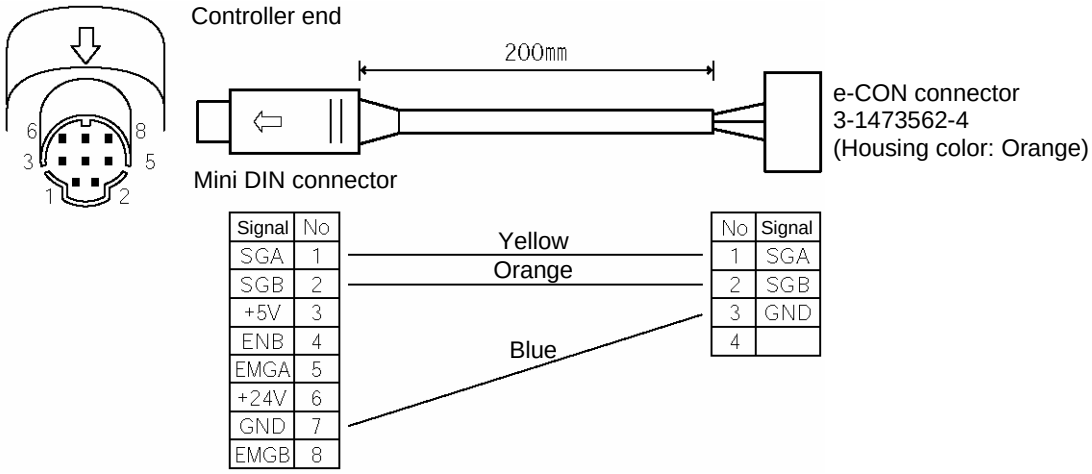
e-CON connector pin numbers



Always insert a terminal resistor (220 Ω, 1/4 W) at the end of the communication trunk (between pins 1 and 2 of the e-CON connector).



c. Controller link cable (CB-RCB-CTL002)
This cable is available as an option for each controller.



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

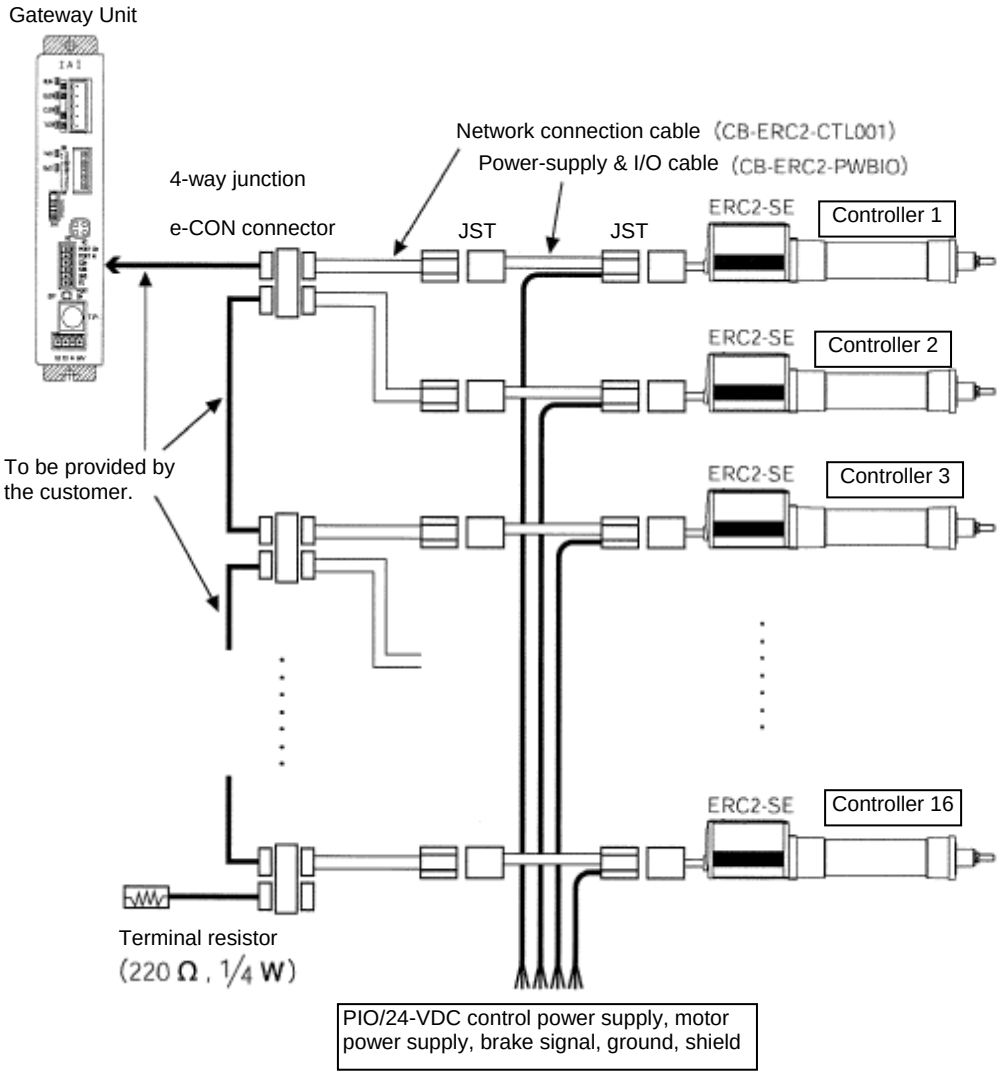
No	Signal
1	SGA
2	SGB
3	GND
4	

The following parts are supplied with the controller link cable.

[1] 4-way junction	Model: 5-1473574-4	by AMP	x 1 unit
[2] e-CON connector	4-1473562-4	by AMP	x 1 unit
	Outer diameter of applicable wire	1.35 to 1.6 mm	
[3] Terminal resistor	220 Ω 1/4 W	With e-CON connector	x 1 unit

(3) Linking ERC2-SE controllers via SIO communication

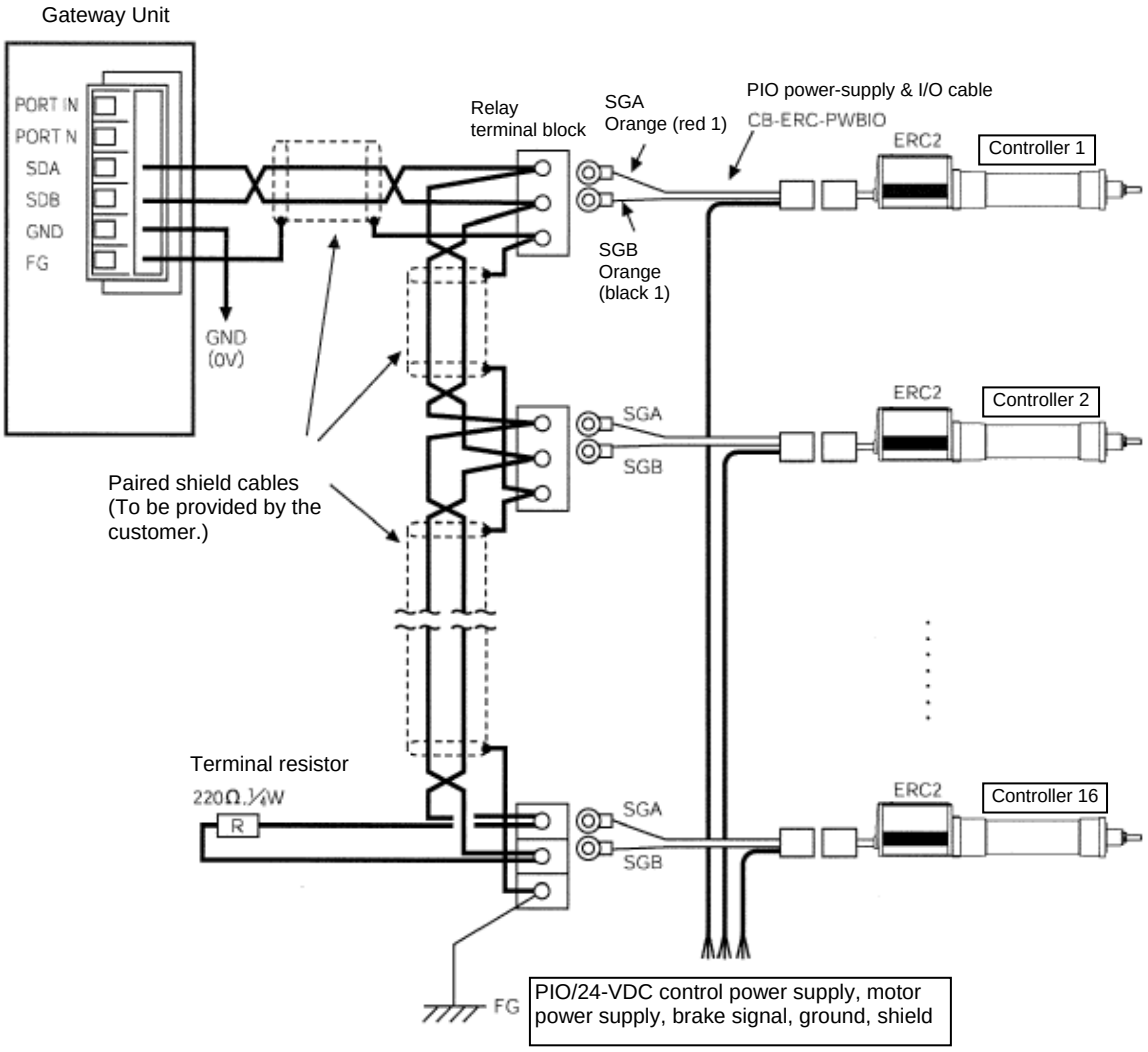
For details, refer to the operation manual for your ERC2-SE controller.
Use 4-way junctions to link the controllers as shown below.
The power-supply & I/O cable and network connection cable (including a 4-way junction or e-CON connectors) are standard accessories of each ERC2-SE controller.



(Note 1) If the total communication cable length is 10 m or longer and a communication error occurs because of difficulty establishing successful communication, connect a terminal resistor to the last axis.
(Note 2) If each actuator uses a separate power supply, use a same ground (0 V).
(Note 3) The power supply of the Gateway Unit and the control power supply of each ERC2 controller must share a common ground (0 V).
(Note 4) Connect the shield line to the FG terminal for each axis.
(Note 5) If the total link cable length exceeds 30 m, use a cable with a wire size of AWG22 or greater.

(4) Linking ERC2-NP/PN controllers via SIO communication

Use relay terminal blocks to link the controllers as shown below.



(Note 1)	If the total communication cable length is 10 m or longer and a communication error occurs because of difficulty establishing successful communication, connect a terminal resistor to the last axis.
(Note 2)	If each actuator uses a separate power supply, use a same ground (0 V).
(Note 3)	The power supply of the Gateway Unit and the control power supply of each ERC2 controller must share a common ground (0 V).
(Note 4)	Connect the shield line to the FG terminal for each axis.
(Note 5)	If the total link cable length exceeds 30 m, use a cable with a wire size of AWG22 or greater.

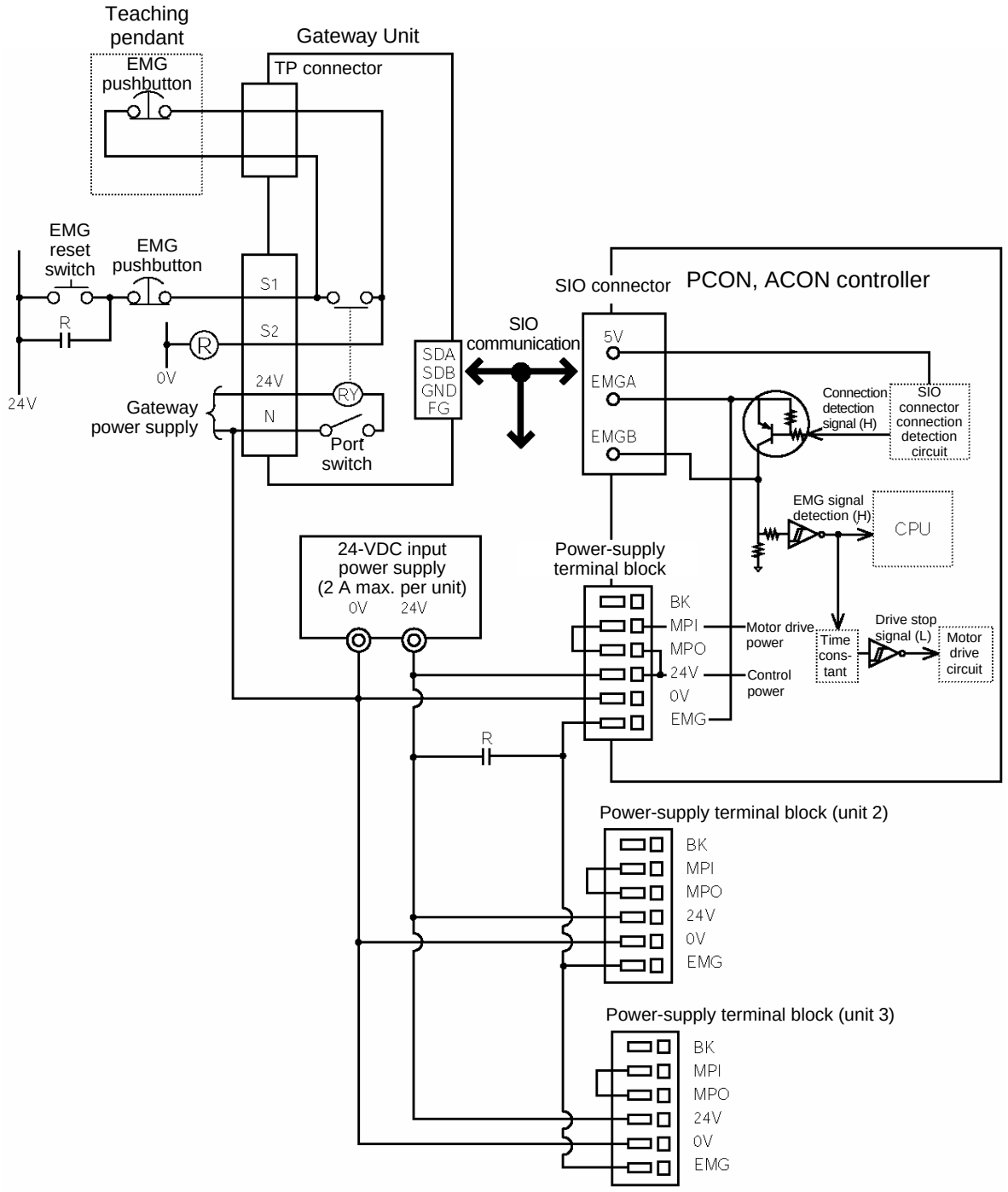
(5) Wiring the emergency stop (EMG) circuit

When designing an emergency stop circuit that incorporates the emergency stop switch on the teaching pendant connected to the Gateway Unit, emergency stop signals output from the “S1” and “S2” terminals of the Gateway Unit can be used.
This way, all connected ROBO Cylinder controllers can be stopped instantly in case of emergency by operating the emergency stop switch on the teaching pendant connected to the Gateway Unit.

⚠ Caution

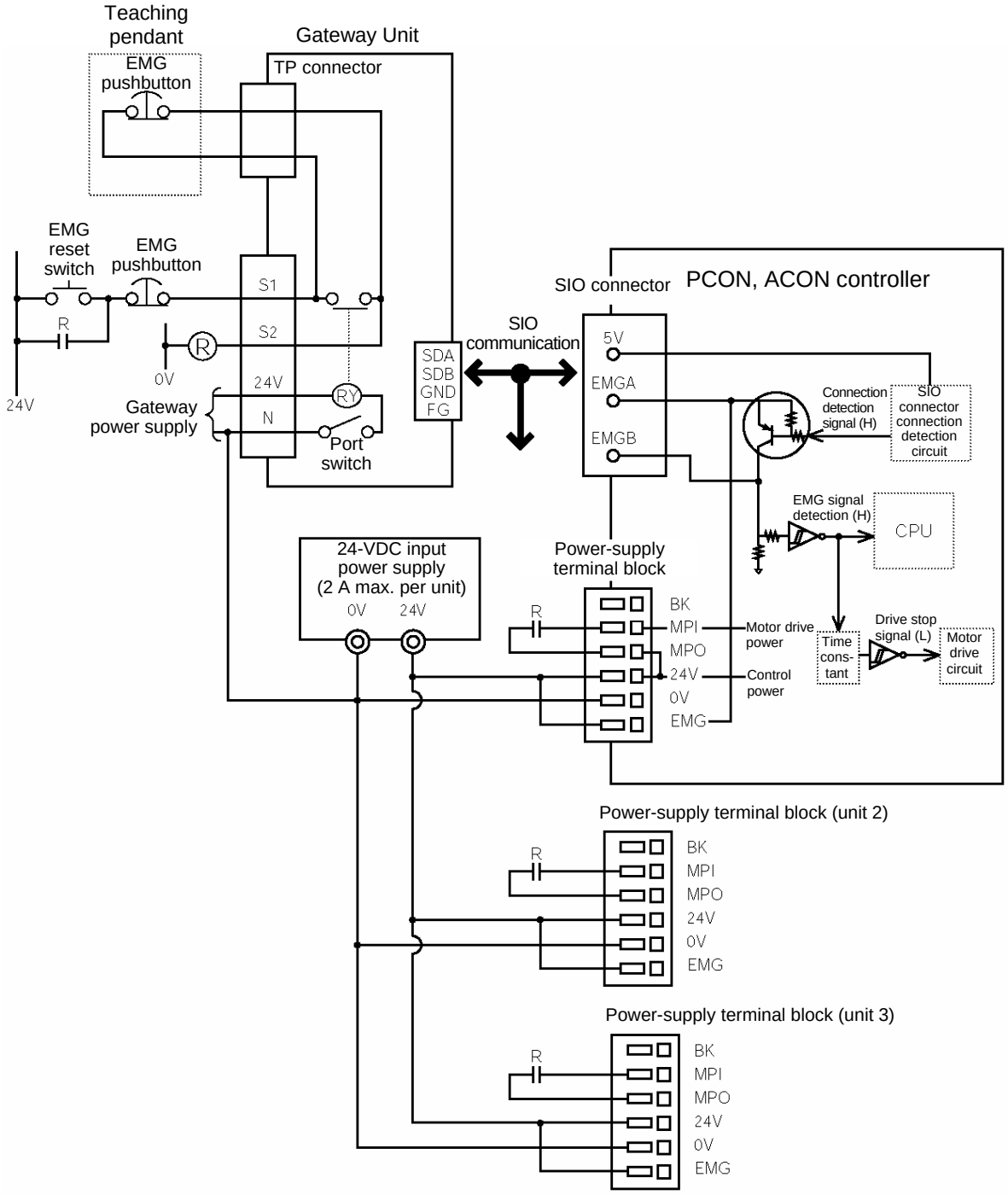
1. For details on the emergency stop processing implemented by ROBO Cylinder controllers, refer to the operation manual for your PCON, ACON, SCON or ERC2 controller.

[1] Example of cutting off drive signals



⚠ Caution: The input current that flows through EMG terminals is 5 mA. When connecting the contacts of EMG relay R to the EMG terminals of multiple controllers, check the current capacity of relay contacts.

[2] Example of cutting off motor drive power



4.3.2 Axis Number Setting

The following explanation applies to PCON, ACON, SCON and ERC2 controllers.

Set the axis number as a slave station number on the SIO communication network.
The axis number of axis 1 is “0,” while that of axis 16 is “F.” Set an appropriate axis number using a hexadecimal value between 0 and F.
Axis numbers can be set on the teaching pendant or in the PC software.

⊙ Operation in the PC software
[1] Open the main window → [2] Click **Settings (S)** → [3] Bring the cursor to **Controller Settings (C)** → [4] Click **Assign Axis Number (N)** → [5] Enter a number in the axis number table.

⊙ Operation on the teaching pendant RCM-T
[1] Open the User Adjustment window → [2] Bring the cursor to Assigned No. using the ▼ key → [3] Enter an axis number, and press Enter → [4] Enter “2” under Adjustment No., and press Enter.

⊙ Operation on the simple teaching pendant RCM-E
[1] Open the User Adjustment window → [2] Press Enter to open the Assigned No. window → [3] Enter an axis number, and press Enter → [4] Enter “2” under Adjustment No., and press Enter.

For details on each setting method, refer to the operation manual for your teaching pendant or PC software.

⚠ Caution

1. Each axis number must be unique.
2. Before setting an axis number for a given axis, disconnect the link cable of the applicable axis.
3. Connect a terminal resistor between SGA and SGB on the terminal module.

5. Overview of DeviceNet

All data exchanged between the master station and the controller are tentatively stored in the internal memory of the Gateway Unit, and then transmitted cyclically. Accordingly, the PLC program recognizes these data as remote DeviceNet I/Os.
Up to 16 ROBO Cylinder controllers can be connected to the Gateway Unit, with the connected controllers assigned an axis number of 0 to 15, respectively. The Gateway Unit simultaneously sends and receives data to/from the master station for all ROBO Cylinder controllers connected via SIO communication.

5.1 Address Assignment for the Master PLC (Omron CJ Series)

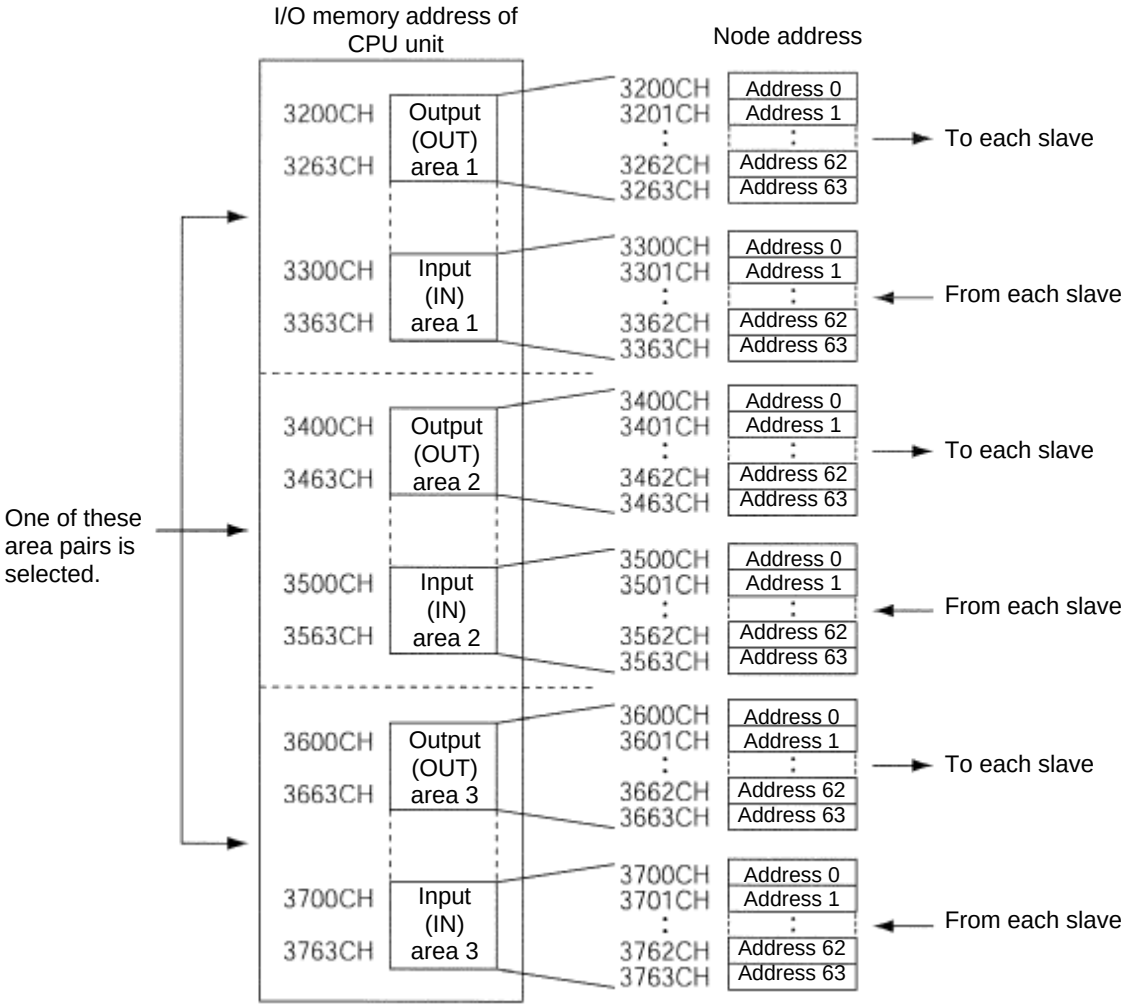
The DeviceNet unit (CPU unit) performs remote I/O communication with a slave, where data is exchanged automatically between the CPU unit and the slave without using programs in the PLC.
Each slave is assigned appropriate areas in the I/O memory of the CPU unit in which the master unit is installed. I/O memory areas can be assigned to slaves in one of three methods specified below:

[1] Fixed assignment
[2] Free assignment using a user setting table for free master area assignment (assignment DM)
[3] Free assignment using a configurator

The following pages provide an overview of method [1], as well as method [3] which is used more commonly.
For details, refer to the operation manual for your PLC.

(1) Fixed assignment

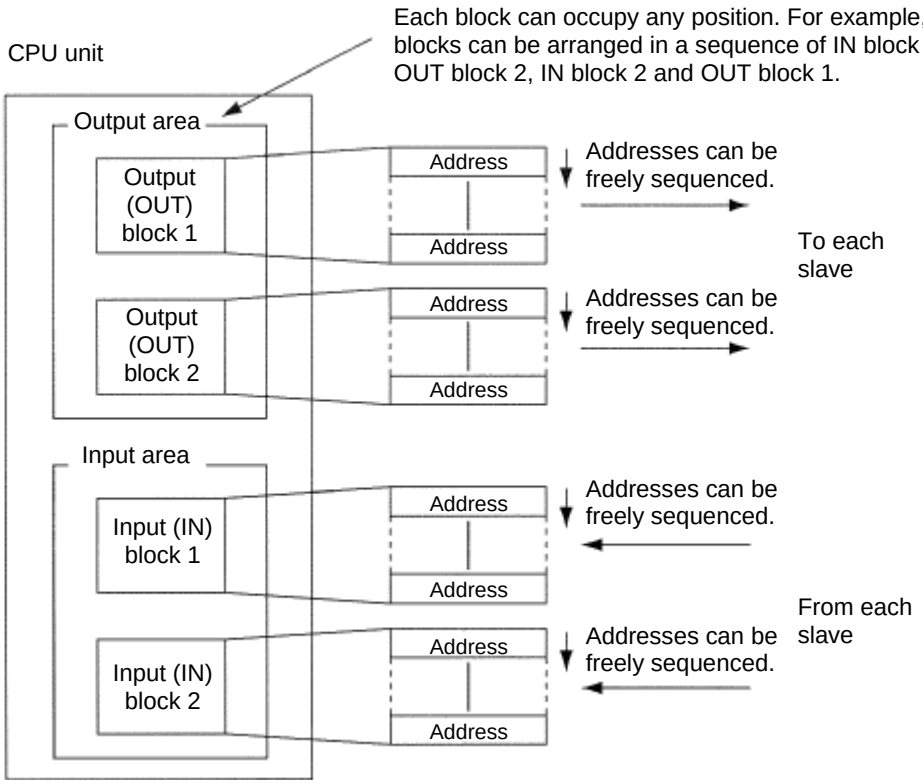
When a CJ-series master unit is used, one of three pairs of fixed assignment areas can be specified as assigned relay areas (using a specified soft switch).
In other words, three master units can be installed in a single PLC, with each master unit assigned different areas.



[1] When areas are selected for fixed assignment, I/O addresses in the applicable output and input areas will be assigned sequentially in the order of node addresses according to a fixed order.
[2] A slave having more than 16 I/O points occupies multiple channels.
[3] A slave having no more than 16 I/O points occupies the lower byte.
[4] The master unit will not occupy any channels even when the node address is set. (This applies to both fixed assignment and free assignment.)

(2) Free assignment using a configurator

By using a DeviceNet configurator, slaves can be assigned respectively to four blocks, including output area blocks 1 and 2 and input area blocks 1 and 2, in a desired node address order within each block. By using this free assignment function, up to 16 master units can be installed in a single PLC.



[1] One block has a maximum of 500 channels (i.e., there are 500 output channels x 2 and 500 input channels x 2). Each item can be assigned in desired areas within the applicable range specified below:

I/O relay:	0000~6143CH
Internal auxiliary relay:	W000~W511CH
Keep relay:	H000~H511CH
Data memory:	D00000~D32767
Expansion data memory:	E00000~E32767

[2] The blocks can be assigned in a desired order, and the assigned block areas and node addresses in each block can also be sequenced freely.

[3] A slave having more than 16 I/O points occupies multiple channels.

[4] A slave having no more than 16 I/O points occupies either the lower byte or upper byte.

* DeviceNet configurator

A software program for building, setting and managing DeviceNet networks using graphical screen interfaces. This software provides the following functions:

- Free assignment of remote I/O functions
- Setting of slave parameters
- Monitoring of master and slave communication statuses

6. Address Configuration of Gateway Unit

As explained in 1.4, “Features of Gateway Unit,” the connected controller(s) can be operated in three main modes.
The slave address configuration is different in each of these modes.

6.1 Position-number Specification Mode

In this mode, the actuator is operated by specifying position numbers in the position table. Up to 16 axes can be controlled. The position table must be set for each axis using the PC software or teaching pendant. Basically 64 positions from Nos. 0 to 63 can be specified. However, the number of available points may be limited depending on the PIO pattern selected for each axis (using the PIO pattern selection parameter). (Refer to the list in 1.4.2.)

The key control functions available in this mode are listed below.

Key function	○: Direct control Δ: Indirect control x: Disabled	Remarks
Home return operation	○	
Positioning operation	Δ	A number in the position table is specified.
Speed and acceleration/ deceleration setting	Δ	Set in the position table.
Pitch (incremental) feed	Δ	Set in the position table.
Push-motion operation	Δ	Set in the position table.
Speed change during movement	Δ	Two or more position numbers are combined. (Refer to the operation manual for your controller.)
Operation with acceleration and deceleration set differently	Δ	Set in the position table.
Pause	○	
Zone signal output	○	Each zone is set by parameters.
PIO pattern selection	X	(Note)

(Note) The number of positions may be limited depending on the PIO pattern selected (via parameter No. 25) for each connected controller. Specify position numbers in compliance with the position number limitation applicable to each controller. Normally, a maximum of 64 positions can be specified.

6.1.1 Overall Address Configuration

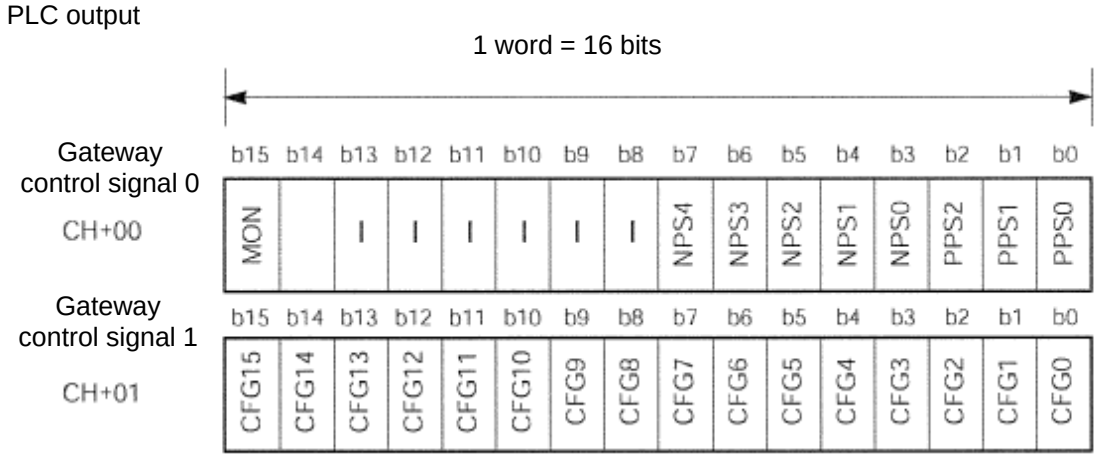
In the position-number specification mode, each Gateway control/status signal input or output consists of two words. With control signals for each axis, each PLC input or output area consists of one word, with the total address length fixed to 24 words each for inputs and outputs.
The values in parentheses indicate axis numbers.

Output from PLC ⇒ Gateway Unit ⇒ Input to each axis			Node address	Output from each axis ⇒ Gateway Unit ⇒ Input to PLC	
CH+	b15 Upper byte b8	b7 Lower byte b0		b15 Upper byte b8	b7 Lower byte b0
+00	Gateway control signal 0		00	Gateway status signal 0	
+01	Gateway control signal 1		01	Gateway status signal 1	
+02	Command position number (0)	Control signal (0)	02	Completed position number + zone signal (0)	Status signal (0)
+03	Command position number (1)	Control signal (1)	03	Completed position number + zone signal (1)	Status signal (1)
+04	Command position number (2)	Control signal (2)	04	Completed position number + zone signal (2)	Status signal (2)
+05	Command position number (3)	Control signal (3)	05	Completed position number + zone signal (3)	Status signal (3)
+06	Command position number (4)	Control signal (4)	06	Completed position number + zone signal (4)	Status signal (4)
+07	Command position number (5)	Control signal (5)	07	Completed position number + zone signal (5)	Status signal (5)
+08	Command position number (6)	Control signal (6)	08	Completed position number + zone signal (6)	Status signal (6)
+09	Command position number (7)	Control signal (7)	09	Completed position number + zone signal (7)	Status signal (7)
+10	Command position number (8)	Control signal (8)	10	Completed position number + zone signal (8)	Status signal (8)
+11	Command position number (9)	Control signal (9)	11	Completed position number + zone signal (9)	Status signal (9)
+12	Command position number (10)	Control signal (10)	12	Completed position number + zone signal (10)	Status signal (10)
+13	Command position number (11)	Control signal (11)	13	Completed position number + zone signal (11)	Status signal (11)
+14	Command position number (12)	Control signal (12)	14	Completed position number + zone signal (12)	Status signal (12)
+15	Command position number (13)	Control signal (13)	15	Completed position number + zone signal (13)	Status signal (13)
+16	Command position number (14)	Control signal (14)	16	Completed position number + zone signal (14)	Status signal (14)
+17	Command position number (15)	Control signal (15)	17	Completed position number + zone signal (15)	Status signal (15)
+18 +19 +20 +21 +22 +23	Cannot be used.		18 ~ 23	Cannot be used.	

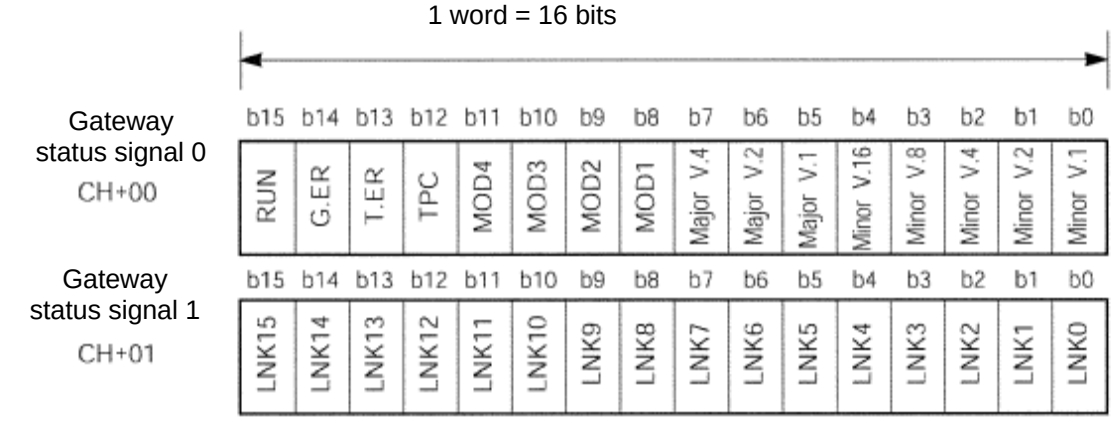
6.1.2 Gateway Control/Status Signals

As for the address configuration in each mode, the initial two channels provide signals used to control the Gateway Unit. Both input and output word registers consist of two words each.
It is recommended that data in these word registers be transferred to, and used in, bit registers.
Gateway control/status signals are used to control the ON/OFF status of SIO communication and monitor the SIO communication status and Gateway Unit status.
The configuration of Gateway control/status signals is the same among the three operation modes.

PLC output



PLC input



I/O Signal List

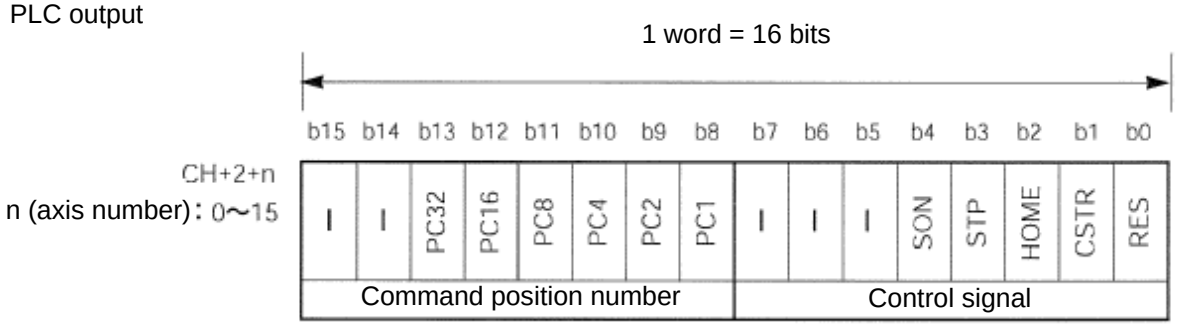
Signal type		Bit	Signal name	Description
PLC output	Control signal 0	15	MON	SIO link communication will start when this signal is turned ON, and stop when it is turned OFF. Do not turn the MON signal ON when CFG15 to 0 (linked axis connection) are all OFF. Also, do not turn all of CFG15 to 0 OFF when the MON signal is ON. If CFG15 to 0 are all turned OFF and the MON signal turned ON, the Gateway Unit will generate a SIO link error and the LED (T.ER) on the front face of the unit will illuminate.
		14-8	---	These bits cannot be used. Always set them to OFF (0).
		7	NPS4	These bits are used in the command specification mode. In any other mode, always set them to OFF (0). Set the number of axes (0 to 16) used via positioner operation, using a five-bit binary value.
		6	NPS3	
		5	NPS2	
		4	NPS1	
		3	NPS0	
		2	PPS2	These bits are used in the command specification mode. In any other mode, always set them to OFF (0). Set the I/O pattern (pattern 0 to 5) of each axis to be used via positioner operation, using a three-bit binary value.
		1	PPS1	
		0	PPS0	
	Control signal 1	15	CFG15	Link ON Axis No. 15 Specify the axis number corresponding to each axis to be linked. The axis will be connected when the signal is turned ON (1), and disconnected when it is turned OFF (0). ON/OFF switching is permitted even when the MON signal is ON. (Notes) ● Do not turn ON the axis number signal corresponding to any axis not physically connected. ● Do not turn ON any axis number signal other than the specifiable number selected by the mode setting switch. If either of the above conditions is breached, a SIO link error will occur.
		14	CFG14	14
		13	CFG13	13
		12	CFG12	12
		11	CFG11	11
		10	CFG10	10
		9	CFG9	9
		8	CFG8	8
		7	CFG7	7
		6	CFG6	6
		5	CFG5	5
		4	CFG4	4
		3	CFG3	3
		2	CFG2	2
		1	CFG1	1
		0	CFG0	0

Signal type		Bit	Signal name	Description	
PLC input	Control signal 0	15	RUN	Gateway Unit normal output	This signal remains ON while the Gateway Unit is operating normally. The signal is synchronized with the illumination of the LED (RUN) on the front face of the unit.
		14	G.ER	Gateway Unit error detection output	This signal turns ON when a major shutdown failure has been detected. The signal is synchronized with the illumination of the LED (G.ER) on the front face of the unit.
		13	T.ER	SIO communication error detection output	This signal turns ON when a SIO link communication error has been detected. The signal is synchronized with the illumination of the LED (T.ER) on the front face of the unit.
		12	TPC	Port switch ON output	The status of the port switch on the front face of the unit is output. This signal is ON while the port switch is ON.
		11	MOD4	Mode setting switch 4 output	The setting status of each pin of the mode setting switch is output. This bit will turn ON (change to 1) when the switch is turned ON.
		10	MOD3	Mode setting switch 3 output	
		9	MOD2	Mode setting switch 2 output	
		8	MOD1	Mode setting switch 1 output	
		7	Major V.4	The major version number is output as a three-bit binary value.	The Gateway version information is output. You may need to check this information in certain situations, such as when the Gateway encountered a problem. Provide the necessary wiring so that these signals can be read by the PLC. Example) If the version is 1.03, the major version number is “1” (data: 001), while the minor version number is “3” (data: 00011).
		6	Major V.2		
		5	Major V.1		
		4	Minor V.16	The major version number is output as a five-bit binary value.	
		3	Minor V.8		
		2	Minor V.4		
		1	Minor V.2		
		0	Minor V.1		
	Status signal 1	15	LNK15	Linked Axis No. 15	Link connection of an axis selected for link connection by any one of CFG15 to 0 will become enabled when the MON signal is turned ON. The signal corresponding to each axis whose link connection is enabled turns ON.
		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	

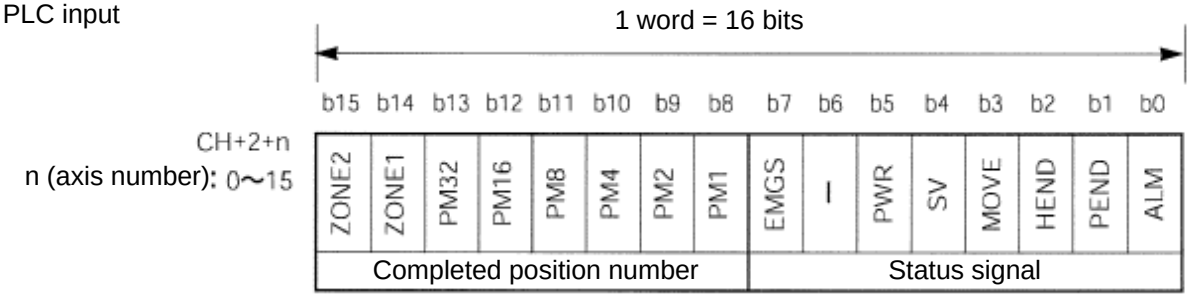
6.1.3 Assignment for Each Axis

With I/O signals for each axis, each PLC input or output area consists of one word (two bytes), respectively.
Control and status signals consist of ON (1)/OFF (0) signal bits.
Command position and completed position numbers are treated as one-byte (eight-bit) binary data.
Specify command position numbers within the position number range set for each controller axis.

PLC output



PLC input



I/O Signal Details

Signal type		Bit	Signal name	Description	Details
PLC output	Command position number	Six-bit data (b13-8)	-	Specify the command position number using a binary value. (Note 1)	5.3.2 (7)
	Control signal	b7	-	Cannot be used.	-
		b6	-	Cannot be used.	-
		b5	-	Cannot be used.	-
		b4	SON	Servo on command	5.3.2 (9)
		b3	STP	Pause command	5.3.2 (8)
		b2	HOME	Home return command	5.3.2 (10)
		b1	CSTR	Start command	5.3.2 (7)
		b0	RES	Reset command	5.3.2 (4)
PLC input	Zone signal output 2	b15	ZONE1 (Note 2)	The completed position number and zone signal status are output. Read the completed position number as a six-bit binary value.	5.3.2 (7) (11)
	Zone signal output 1	b14	ZONE1		
	Completed position number (alarm output)	Six-bit data (b13-8)	-		
	Status signal	b7	EMGS	Emergency stop	5.3.2 (2)
		b6	-	Cannot be used.	-
		b5	PWR	Controller ready	5.3.2 (1)
		b4	SV	Ready (servo is on)	5.3.2 (9)
		b3	MOVE	Moving	5.3.2 (7) (8)
		b2	HEND	Home return complete	5.3.2 (10)
		b1	PEND	Positioning complete	5.3.2 (7)
		b0	ALM	Alarm	5.3.2 (3)

(Note 1) The maximum number of positioning points is 16 under PIO control with ERC2-NP/PN controllers. When the Gateway Unit is connected, however, up to 64 points can be specified.
(Note 2) [ZONE 2] cannot be used with ERC2-NP/PN controllers.

6.2 Direct Numerical Specification Mode

In the direct numerical specification mode, the actuator is operated by specifying the position data, speed, acceleration/deceleration, positioning band (push band), and current-limiting value for push-motion operation, directly in numerical values.
There are five patterns, each accommodating a different number of connected axes. (The pattern is set using the mode setting switch SW1.)
The current position data can be read at any time.
There is no need to set the position table for each axis.

The key functions that can be controlled in this mode are summarized in the table below.

Key function	○: Direct control △: Indirect control X: Disabled	Remarks
Home return operation	○	
Positioning operation	○	
Speed/acceleration setting	○	
Pitch (incremental) feed	X	Pitch feed data cannot be processed directly. The host PLC must issue each command by adding/subtracting the pitch-feed distance data to/from the current position.
Push-motion operation	○	
Speed change during movement	○	Speed data is accepted at the start of positioning. To change the speed during movement, therefore, change the speed data during movement and then restart the positioning operation.
Operation with acceleration and deceleration set differently	○	Acceleration/deceleration data is accepted at the start of positioning. To specify a deceleration different from the acceleration, therefore, change the deceleration data during movement and then restart the positioning operation.
Pause	○	
Zone signal output	X	Monitor the current position using the PLC. (Note 1)
PIO pattern selection	X	(Note 2)

(Note 1) No strobe signal is provided for current position data. To check the current position from the PLC during movement, set zones and check if the data has remained inside a given zone for at least two scans.

(Note 2) Set the PIO pattern selection parameter (No. 25) of each connected controller to “0” (standard type). (PCON-C/CG, ACON-C/CG, SCON-C, ERC-2NP/PN)

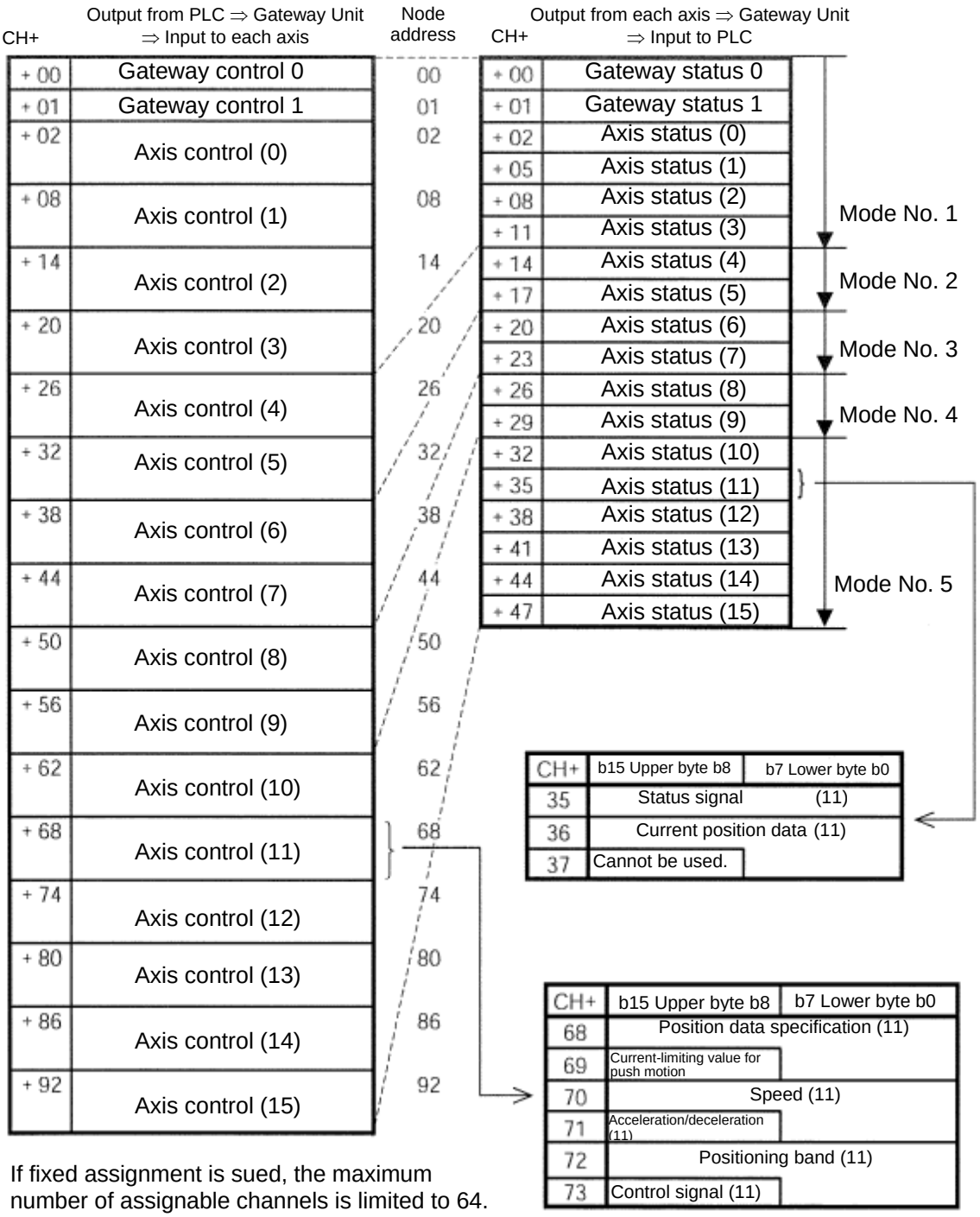
6.2.1 Overall address configuration

Each Gateway control/status signal input or output consists of two words. In the direct numerical specification mode, each axis control signal consists of the PLC output area (Gateway input area) containing six words and the PLC input area (Gateway output area) containing three words.
The number of controlled axes is set using the mode setting switch (SW1), and the data areas will vary depending on the settings of this switch.
The switch settings and corresponding data areas are shown in the table below.

No.	SW1					I/O bytes	
	4	3	2	1	Description	Output	Input
1	X	X	X	X	P. 4-5-1, maximum 4 axes	52	28
2	X	O	X	X	P. 4-5-1, maximum 6 axes	76	40
3	O	X	X	X	P. 4-5-1, maximum 8 axes	100	52
4	O	O	X	O	P. 4-5-1, maximum 10 axes	124	64
5	O	O	X	X	P. 4-5-1, maximum 16 axes	196	100

O: ON X: OFF

The overall address configuration is shown below.
"CH" indicates the head address of assigned areas in the DeviceNet master.
The values in parentheses indicate axis numbers.



* If fixed assignment is sued, the maximum number of assignable channels is limited to 64.

6.2.2 Gateway Control/Status Signals

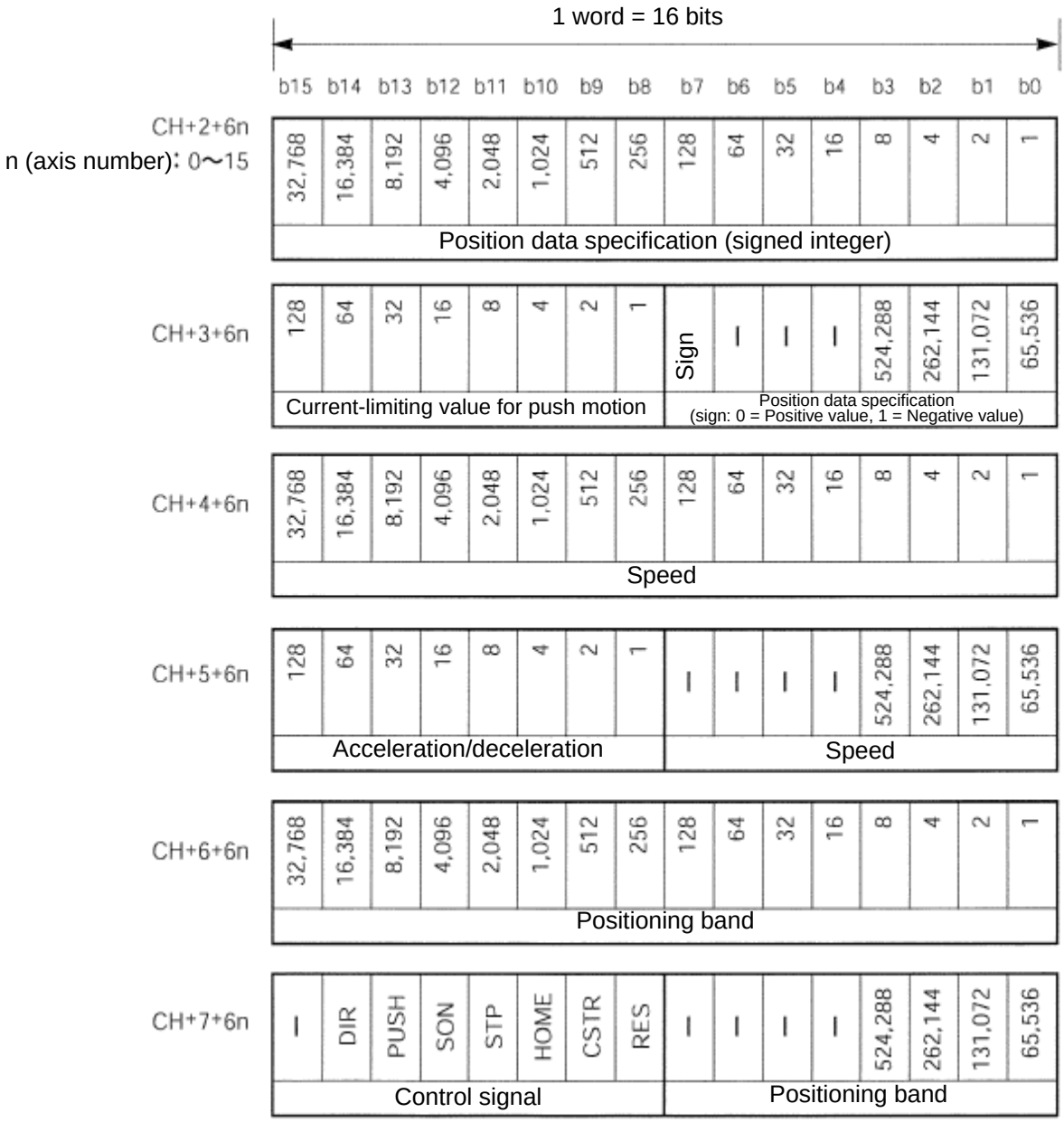
The same explanation in 6.1.2 applies here.

6.2.3 Assignment for each axis

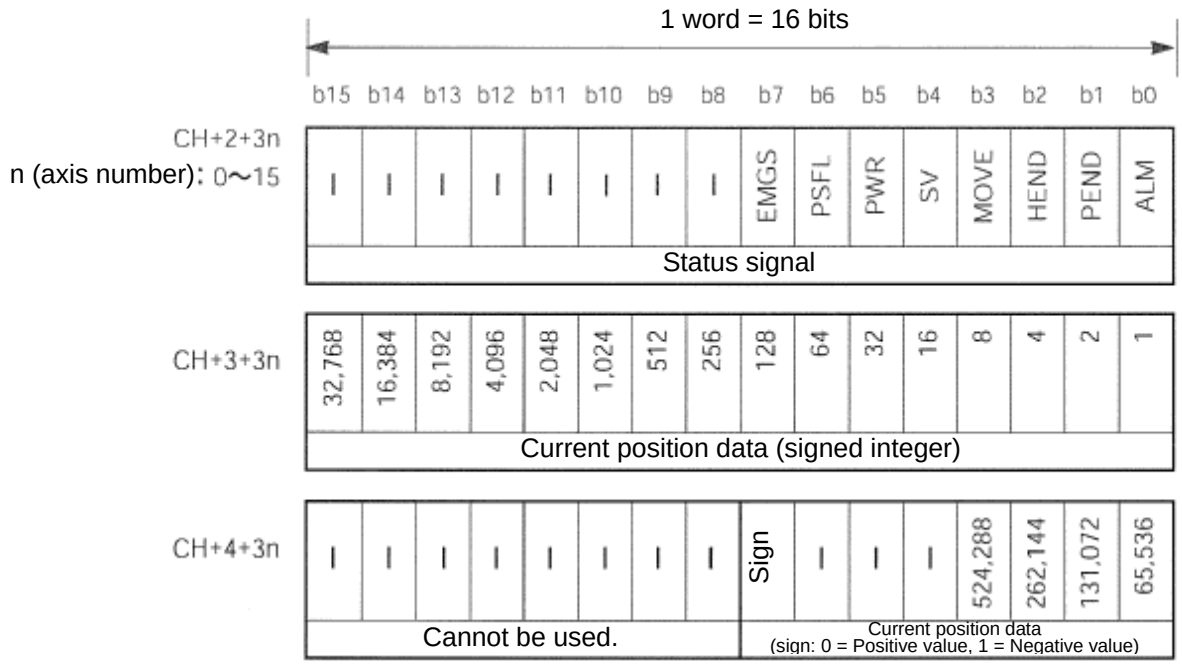
Control and status signals are set using ON (1)/OFF (0) signal bits, while current-limiting value for push-mode operation and acceleration/deceleration are set using one-byte (eight-bit) hexadecimal data. Speed, target position data, positioning band and current position data are one-and-a-half-word (24-bit) hexadecimal data.
It is recommended that control and status signals be transferred to, and used in, bit registers.
Set a desired current-limiting value for push motion, acceleration/deceleration or speed within the corresponding range specified for the applicable actuator, while target position data must be inside the soft stroke limits.

Units:	Current-limiting value = 1%, Acceleration/deceleration = 0.01 G, Speed = 1/100 mm/sec, Position data/positioning band = 1/100 mm

PLC output = Axis control signal



PLC input = Axis status signal



⚠ Caution

1. Signed 24-bit hexadecimal data output or input from/to the PLC is treated as a negative value when the most significant bit is “1.” Take note that all these data are treated as normal numerical data within the PLC.

I/O Signal Details

Signal type		Bit	Signal name	Description	Details
PLC output	Target position data	24-bit data	---	Set a signed 24-bit integer (unit: 0.01 mm) based on hexadecimal notation Example) To specify +25.4 mm, set “0009ECH” (“2540” in decimal notation). (Notes) ● The maximum settable value is +9999.99 mm = 999999 (decimal value) = 0F423FH (hexadecimal value). ● A negative value is indicated by a two’s complement. Accordingly, the most significant bit becomes “1.” ● Set position data within the soft stroke limits.	5.3.2 (5) (6)
	Current-limiting value for push motion	8-bit data	---	To set the push force, set the current-limiting value for push motion as a hexadecimal value (unit: %). The setting range is from “00H” to “FFH,” with FFH corresponding to 100%. Example) To specify 50%, set “7FH” (corresponding to the decimal value of 127 obtained by FFH (255) x 50%).	5.3.2 (6)
	Speed	24-bit data	---	Set a 24-bit integer (unit: 0.01 mm/sec) based on hexadecimal notation Example) To specify 200 mm/sec, set “004E20H” (“20000” in decimal notation). (Note) ● If speed is not set or the set speed is “0,” the actuator will remain stopped. No alarm will generate. If the set speed is changed to “0” during movement, the actuator will decelerate to a stop.	5.3.2 (5) (6)
	Acceleration/ deceleration	8-bit data	---	Set an eight-bit integer (unit: 0.01 G) based on hexadecimal notation. Example) To specify 0.2 G, set “14H” (“20” in decimal notation). The maximum value is “C8H” (“200” in decimal notation) corresponding to 2 G. (Note) ● Even if acceleration/deceleration is not set, the setting of parameter No. 9, “Default acceleration/deceleration” will not be applied.	5.3.2 (5) (6)

Signal type		Bit	Signal name	Description	Details
PLC output	Positioning band	24-bit data	---	Set a 24-bit integer (unit: 0.01 mm) based on hexadecimal notation Example) To specify +25.4 mm, set “0009ECH” (“2540” in decimal notation). (Notes) ● Set position data within the soft stroke limits. ● Specify the direction of push-motion operation using DIR. ● Even if positioning band is not set, the setting of parameter No. 10, “Default positioning band” will not be applied.	5.3.2 (6)
	Control signal	b15	---	Cannot be used.	---
		b14	DIR	Push direction specification (0 = Home return direction, 1 = Opposite to home return direction)	5.3.2 (6)
		b13	PUSH	Push-motion operation mode specification	5.3.2 (6)
		b12	SON	Servo on command	5.3.2 (9)
		b11	STP	Pause command	5.3.2 (8)
		b10	HOME	Home return command	5.3.2 (10)
		b9	CSTR	Start command	5.3.2 (7)
		b8	RES	Reset command	5.3.2 (4)
PLC input	Status signal	b15-8	---	Cannot be used.	---
		b7	EMGS	Emergency stop status	5.3.2 (2)
		b6	PSFL	Missed work	5.3.2 (6)
		b5	PWR	Controller ready	5.3.2 (1)
		b4	SV	Ready (servo is on)	5.3.2 (9)
		b3	MOVE	Moving	5.3.2 (5) (6) (8)
		b2	HEND	Home return complete	5.3.2 (10)
		b1	PEND	Positioning complete	5.3.2 (5) (6)
		b0	ALM	Alarm	5.3.2 (3)
	Current position data	24-bit data	---	The current position data is output as a signed 24-bit integer (unit: 0.01 mm) based on hexadecimal notation Example) To specify +25.4 mm, set “0009ECH” (“2540” in decimal notation). (Note) ● A negative value is indicated by a two’s complement. Accordingly, the most significant bit becomes “1.”	5.3.2 (5) (6)
	---	b15-8	---	Cannot be used.	---

6.3 Command Specification Mode

In this mode, two patterns can be combined, including the pattern in which the actuator is operated by specifying the target position data in numerical values and specifying all other positioning data using position numbers (simple direct operation), and the pattern in which the actuator is operated by specifying position numbers only (positioner operation).
You can also use request commands to read/write the position table, monitor the current value, and broadcast commands, among others.

Two operation patterns are available, including the “positioner operation” pattern in which the actuator is operated by specifying position numbers, and the “simple direct operation” pattern in which the actuator is operated by specifying the operation data directly in numerical values, while specifying all other items including the speed, acceleration/deceleration, positioning band, and current-limiting value for push-motion operation, using position numbers.
A desired axis configuration can be designed using one or both of the two operation patterns. If the two operation patterns are combined, you must assign the axes sequentially from those conforming to the positioner operation pattern, followed by the axes conforming to the simple direct operation pattern.
The command specification mode is further classified into the Large mode (160 bytes of inputs and 160 bytes of outputs), Middle mode (128 bytes of inputs and 128 bytes of outputs), and Small mode (64 bytes of inputs and 64 bytes of outputs), according to the size of assigned areas. Up to 16 axes can be connected in this mode.
You can also use request commands to read/write the position table (positioner operation only), read the current position, and broadcast commands (positioner operation only), among others.

⚠ Caution

The position table can be rewritten only via positioner operation. Take note that the position table cannot be rewritten more than 20,000 times or so.
If there are not enough positions to be registered, use the position table rewrite function to operate the actuator indirectly via numerical specification.

* With each function, the top row indicates positioner operation, while the bottom row indicates simple direct operation.

Key function	○: Direct control Δ: Indirect control X: Disabled	Remarks
Home return operation	○	
	○	
Positioning operation	Δ	Positioning operation is performed by specifying an applicable number in the position table. (Note 1)
	○ Δ	Set all positioning data other than position data in the position table, and specify the position data and position table number at the same time.
Speed/acceleration setting	Δ	Set in the position table. (Note 1)
	Δ	Set in the position table.
Pitch (incremental) feed	Δ	Set in the position table. (Note 1)
	X	Pitch feed data cannot be processed directly. The host PLC must issue each command by adding/subtracting the pitch-feed distance data to/from the current position.
Push-motion operation	Δ	Set in the position table. (Note 1)
	Δ	Set in the position table.
Speed change during movement	Δ	Speed change is implemented by combining two or more position numbers. (Refer to the operation manual for your controller.)
	Δ	
Operation with acceleration and deceleration set differently	Δ	Set in the position table. (Note 1)
	Δ	Set in the position table.
Pause	○	
	○	
Zone signal output	○	The zone signal output is set in the position table or via a parameter. (Note 2)
	X	The current position data is constantly output from the Gateway, so use the PLC to monitor the current position data. (Note 3)
PIO pattern selection	○	(Note 4)
	X	(Note 5)

(Note 1) The position table data can be written (rewritten) from the PLC using a request command (position table data write). To use this function, the necessary data must be written to the position data beforehand.

(Note 2) The current position data can be read using a request command, but this data is not output constantly.

(Note 3) No strobe signal is provided for the current position data. To check the current position from the PLC during movement, set zones and check if the data has remained inside a given zone for at least two scans.

(Note 4) This parameter is not available with PCON-SE, ACON-SE and ERC2-SE controllers.

(Note 5) Set the PIO pattern selection parameter (No. 25) of each connected controller to “0” (standard type).

6.3.1 Overall address configuration

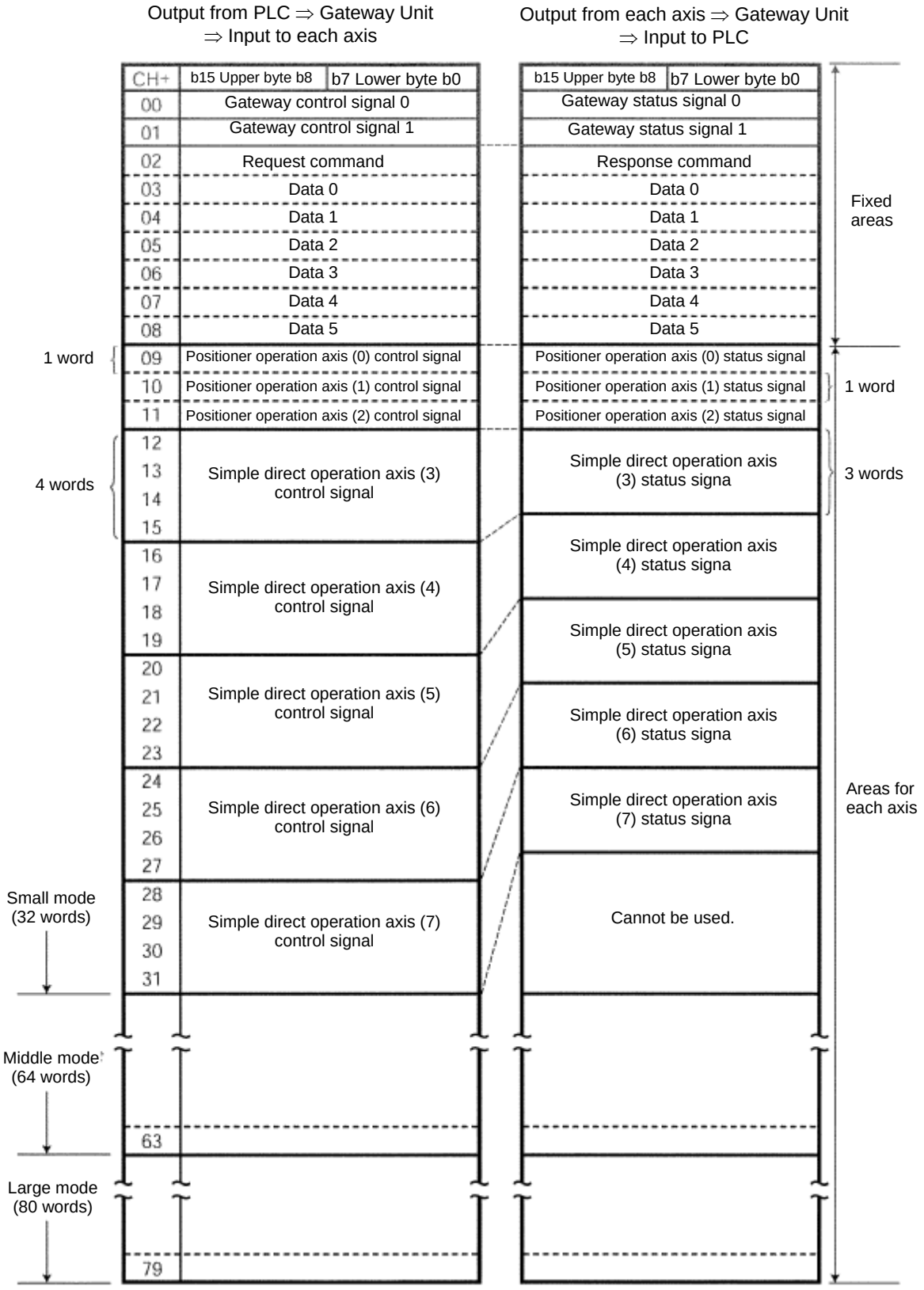
Each Gateway control signal input or output consists of two words. Only in this mode, PPS0 to PPS2 and NPS0 to NPS4 of control word 0 are used to set the pattern and number of position-number specification axes. This is followed by the command I/O areas each consisting of seven words, and the Gateway control signal and command I/O areas each consisting of nine words. These areas are fixed.
Although the control areas for each axis are assigned immediately after the fixed areas, positioner operation axes should always be assigned first, followed by simple direct operation axes.
When assigning areas for each axis, make sure no empty bytes remain in between assigned bytes.
The total I/O area size of the Gateway varies according to how the mode setting switch SW1 is set, as shown in the table below.

Mode number	SW1				-	Total I/O areas	Fixed areas	Control areas for each axis
	4	3	2	1				
7	X	X	X	○	Large mode	160 bytes = 80 words each	9 words each	71 words each
8	X	○	X	○	Middle mode	128 bytes = 64 words each		55 words each
9	○	X	X	○	Small mode	64 bytes = 32 words each		23 words each

Up to 16 axes can be assigned, including positioner operation axes and simple direct operation axes, within the areas specified in the table above.
With positioner operation axes, each axis control signal consists of one word for both input and output. With simple direct operation axes, three PLC input signal words and four PLC output signal words are available.
The following page provides an example, where three positioner operation axes and five simple direct operation axes are assigned in the Small mode.

6.3.2 Gateway Control/Status Signals

The same explanation in 6.1.2 applies here.



* The values in the “CH+” column indicate relative channel numbers counted from the first Gateway channel.
* The values in parentheses indicate axis numbers on the SIO communication network.

6.3.3 Assignment for each axis

The I/O signals are associated with different area sizes and contents between positioner operation axes and simple direct operation axes.

(1) Control/status signals of a positioner operation axis

Each axis is assigned one word of PLC output (control signal) and one word of PLC input (status signal), as shown below. One of six patterns is used according to the PIO pattern set by the Gateway control signal PPS.

1 word = 16 bits

PLC output

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Pattern 0 (standard mode) PPS=000	SON	RES	CSTR	STP	HOME	—	BKRL	—	—	—	PC32	PC16	PC8	PC4	PC2	PC1
	Control signal								Command position number							
Pattern 1 (teaching mode) PPS=001	SON	RES	CSTR/PWRT	STP	HOME	—	JOG−	JOG+	JISL	MOD	PC32	PC16	PC8	PC4	PC2	PC1
	Control signal								Command position number							
Pattern 2 (256-point positioning mode) PPS=010	SON	RES	CSTR	STP	HOME	—	BKRL	—	PC128	PC64	PC32	PC16	PC8	PC4	PC2	PC1
	Control signal								Command position number							
Pattern 3 (512-point positioning mode) PPS=011	SON	RES	CSTR	STP	HOME	—	BKRL	PC256	PC128	PC64	PC32	PC16	PC8	PC4	PC2	PC1
	Control signal								Command position number							
Pattern 4 (electromagnetic valve mode 1) PPS=100	SON	RES	—	STP	HOME	—	BKRL	—	—	ST6	ST5	ST4	ST3	ST2	ST1	ST0
	Control signal								Start position							
Pattern 5 (*) PPS=101	—	—	PC32	PC16	PC8	PC4	PC2	PC1	—	—	—	SON	STP	HOME	CSTR	RES
	Command position number								Control signal							

(*) The assignments are the same as those in the “position-number specification mode” of the Gateway Unit.

PLC input																		
	Pattern 0	BALM	ALM	EMGS	SV	PEND	HEND	RMDS	PZONE	ZONE1	MOVE	PM32	PM16	PM8	PM4	PM2	PM1
		Status signal										Completed position number					
	Pattern 1	BALM	ALM	EMGS	SV	PEND/WEND	HEND	RMDS	PZONE	MODS	MOVE	PM32	PM16	PM8	PM4	PM2	PM1
		Status signal										Completed position number					
	Pattern 2	BALM	ALM	EMGS	SV	PEND	HEND	RMDS	PZONE	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1
		Status signal								Completed position number							
	Pattern 3	BALM	ALM	EMGS	SV	PEND	HEND	RMDS	PM256	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1
		Status signal								Completed position number							
	Pattern 4	BALM	ALM	EMGS	SV	PEND	HEND	RMDS	PZONE	ZONE1	PE6	PE5	PE4	PE3	PE2	PE1	PE0
		Status signal								Completed position number							
	Pattern 5 (*) PPS=101	ZONE2	ZONE1	PM32	PM16	PM8	PM4	PM2	PM1	EMGS	—	PWR	SV	MOVE	HEND	PEND	ALM
		Completed position number								Status signal							

(*) The assignments are the same as those in the “position-number specification mode” of the Gateway Unit.

I/O Signal Details

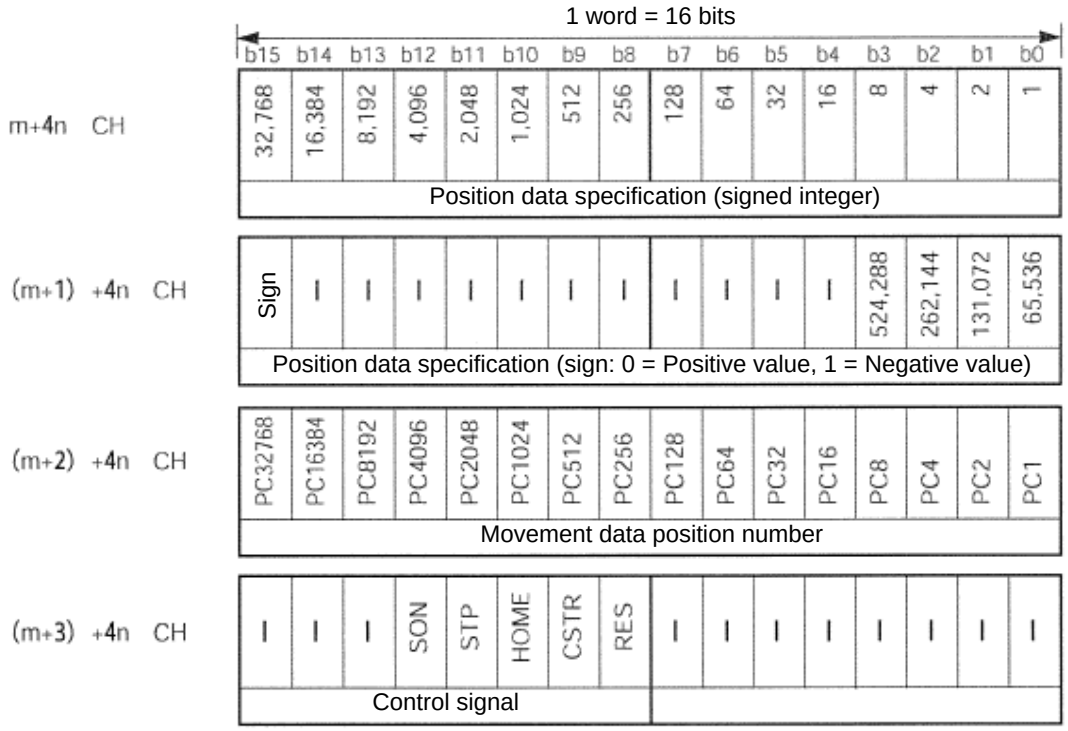
Signal type		Bit	Signal name	Pattern No.	Description	Details
PLC output	Control signal	b15 (b4)	SON	0 to 5	Servo on command	
		b14 (b0)	RES	0 to 5	Reset command	
		b13 (b1)	CSTR	0, 2, 3, 5	Start command	
			PWRT	1	Position data load command TEAC	
		b12 (b3)	STP	0 to 5	Pause command	
		b11 (b2)	HOME	0 to 5	Home return command	
		b9	BKRL	0, 2 to 4	Forced brake release	
		b9	JOG-	1	Jog- command	
		b8	JOG+	1	Jog+ command	
		b7	JISL	1	Jog/inching switching	
		b6	MOD	1	Teaching mode command	
	Command position number	b8-b0 (b13-b8)	PC***	0 to 3, 5	Specify the command position number using a binary value.	
		b6-b0	ST0-ST6	4	Specify the start position using a bit pattern.	
PLC input	Status signal	b15	BALM	0 to 4	Battery voltage low alarm	
		b14 (b0)	ALM	0 to 5	Alarm	
		b13 (b7)	EMGS	0 to 5	Emergency stop	
		b12 (b4)	SV	0 to 5	Ready (servo is on)	
		b11 (b1)	PEND	0, 2 to 5	Positioning complete	
		b11	WEND	1	Position data load command status TEAC	
		b10 (b2)	HEND	0 to 5	Home return complete	
		b9	RMDS	0 to 4	Operation mode status	
		b8	PZONE	0 to 2, 4	Position zone output monitor	
		b7 (b14)	ZONE1	0, 4, 5	Zone output monitor 1	
		(b15)	ZONE2	5	Zone output monitor 2	
		b7	MODS	1	Teaching mode status	
		b6	MOVE	0, 1	Moving	
	Completed position number	b8 to b0 (b13-b8)	PM***	0 to 3, 5	The completed position number is read as a binary value.	
		b6 to b0	PE0 to PE6	4	The completed position is read as a bit pattern.	

* The values in parentheses shown in the “Bit” column apply to pattern No. 5.

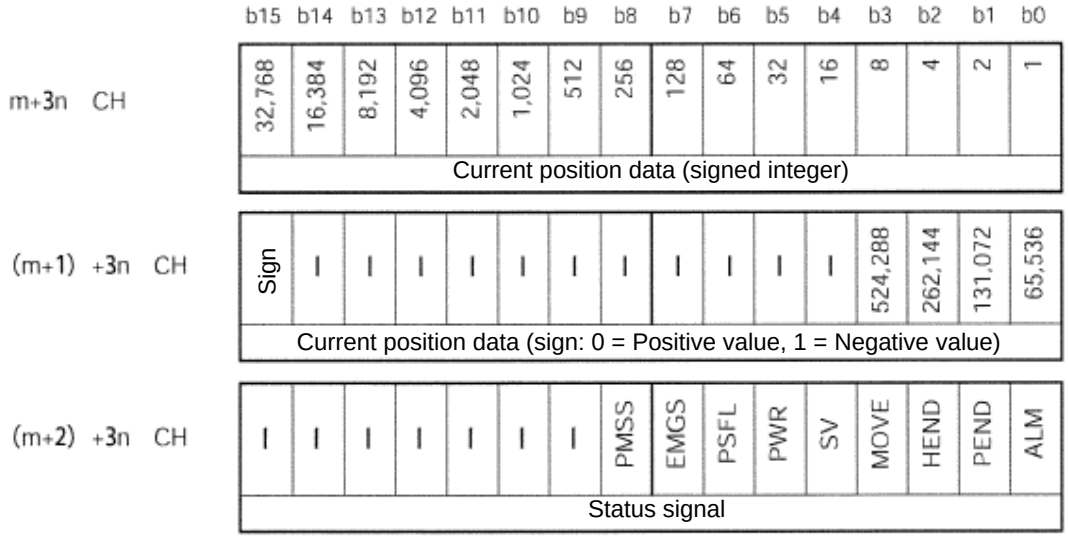
(2) Control/status signals of a simple direct operation axis

Each axis is assigned four words of PLC outputs (control signals) and three words of PLC inputs (status signals), as shown below. The target position data and current position data are indicated by signed 32-bit hexadecimal integers that are multiples of 0.01 mm.

PLC output = Control signal



PLC input = Status signal



* m indicates the head address assigned to a simple direct operation axis. (m = 12 in the example shown on the “Overall address configuration” page.)

* n indicates a sequential number, such as 0, 1, 2, …, assigned only to a simple direct operation axis, counted from the first simple direct operation axis. (n = 0 to 4 in the example shown on the “Overall address configuration” page.)

I/O Signal Details

Signal type		Bit	Signal name	Description	Details
PLC output	Target position data	32-bit data	---	Set a signed 32-bit integer (unit: 0.01 mm) based on hexadecimal notation Example) To specify +25.4 mm, set “Hex0009EC” (“2540” in decimal notation). ● The maximum settable value is +9999.99 mm = 999999 (decimal value) = 0F423FH (hexadecimal value). ● A negative value is indicated by a two’s complement. Accordingly, the most significant bit becomes “1.”	
	Movement data position number	16-bit data	---	When setting movement data other than position data in the position table, specify the applicable position number using a hexadecimal value.	
	Control signal	b15-b13	---	Cannot be used.	
		b12	SON	Servo on command	
		b11	STP	Pause command	
		b10	HOME	Home return command	
		b9	CSTR	Start command	
		b8	RES	Reset command	
		b7-b0	---	Cannot be used.	
PLC input	Current position data	32-bit data	---	The current position data is output as a signed 32-bit integer (unit: 0.01 mm) based on hexadecimal notation. The same example and note for position data specification also apply here.	
	Status signal	b15-b9	---	Cannot be used.	
		b8	PMSS	PIO/Modbus switching status 0: PIO, 1: Modbus A PIO/Modbus switching command is used to switch between the two modes.	
		b7	EMGS	Emergency stop status	
		b6	PSEL	Missed work	
		b5	PWR	Controller ready	
		b4	SV	Ready (servo is on)	
		b3	MOVE	Moving	
		b2	HEND	Home return complete	
		b1	PEND	Positioning complete	
		b0	ALM	Alarm	

6.3.4 Command Areas

Command areas are available in the command specification mode, and the various commands explained below can be used to read/write the position table, among others.

(1) Address configuration

The request command area and response command area consist of seven words each (CH+2 to CH+8).

※1 CH+	Output from PLC ⇒ Gateway Unit ⇒ Input to each axis		Output from each axis ⇒ Gateway Unit ⇒ Input to PLC	
	b15 Upper byte b8	b7 Lower byte b0	b15 Upper byte b8	b7 Lower byte b0
2	Request command		Response command	
3	Data 0		Data 0	
4	Data 1		Data 1 *3 (error code)	
5	Data 2		Data 2	
6	Data 3		Data 3	
7	Data 4 (RSV) *2		Data 4 (RSV) *2	
8	Data 5 (RSV) *2		Data 5 (RSV) *2	

*1) The values in the “CH+” column indicate relative channel numbers counted from the first Gateway channel.
*2) Data 4 (RSV) and data 5 (RSV) are not currently used.
*3) If a command error occurs, the most significant bit (b15) of the response command will turn ON and a corresponding error code will be set in response data 1.

(2) Command list

The available commands and corresponding command codes are listed below.

Function category	Code	Description	Positioner operation axis	Simple direct operation axis
Handshake	0000H	Clear a request command	○	○
Position table data write	1000H	Write a target position	○	X
	1001H	Write a positioning band		
	1002H	Write a speed		
	1003H	Write an individual zone boundary +		
	1004H	Write an individual zone boundary –		
	1005H	Write an acceleration		
	1006H	Write a deceleration		
	1007H	Write a current-limiting value for push-motion operation		
	1008H	Write a load current threshold		
	1009H	Write a push-motion operation setting		
Position table data read	1040H	Read a target position	○	X
	1041H	Read a positioning band		
	1042H	Read a speed		
	1043H	Read an individual zone boundary +		
	1044H	Read an individual zone boundary –		
	1045H	Read an acceleration		
	1046H	Read a deceleration		
	1047H	Read a current-limiting value for push-motion operation		
	1048H	Read a load current threshold		
	1049H	Read a push-motion operation setting		
Position table data write (ROM)	0DA0H	Write a POS write coil	○	X
	02E0H	Read a POS write completion coil		
Present alarm code read	0342H	Read a present alarm code	○	○
Current value monitor	0440H	Monitor the current position of a specified axis	○	○
Group-specified broadcast	0D03H	Synchronously move multiple axes to the position corresponding to the same POS number	○	X
PIO/Modbus control switching	0DA1H	Switch between PIO and Modbus modes.	X	○

○: Available, X: Not available

(3) Each command and data format

[1] “Position table data write” command

Command name	CH+	PLC output (request)	PLC input (response)
Write a target position	+2	1000H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Position data *1	
	5		
	6	Axis number 0 to FH *2	
	7	(RSV)	
	8	(RSV)	
Write a positioning band	+2	1001H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Positioning band data *3	
	5		
	6	Axis number 0 to FH *2	
	7	(RSV)	
	8	(RSV)	
Write a speed	+2	1002H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Speed data *3	
	5		
	6	Axis number 0 to FH *2	
	7	(RSV)	
	8	(RSV)	
Write an individual zone boundary +	+2	1003H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Position data *1	
	5		
	6	Axis number 0 to FH *2	
	7	(RSV)	
	8	(RSV)	
Write an individual zone boundary –	+2	1004H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Position data *1	
	5		
	6	Axis number 0 to FH *2	
	7	(RSV)	
	8	(RSV)	
Write an acceleration	+2	1005H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Acceleration data *4	
	5		
	6	Axis number 0 to FH *2	
	7	(RSV)	
	8	(RSV)	

Command name	CH+	PLC output (request)	PLC input (response)
Write a deceleration	+2	1006H	Same as the requested value, if the command was successful.
	3	Position number	
	4	Deceleration data *4	
	5	0	
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Write a current-limiting value for push-motion operation *5	+2	1007H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0000 ~ 00FFH (00FH: Maximum current)	
	5		
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Write a load current threshold	+2	1008H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0000 ~ 00FFH (00FH: Maximum current)	
	5	0	
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Write a push-motion operation setting	+2	1009H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0: Normal operation 1: Push-motion operation (home return direction) *6 3: Push-motion operation (opposite to home return direction)	
	5	0	
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	

*1) Signed 32-bit integer data
*2) Axis numbers 0 to 15 correspond to data 00 to 0FH, respectively.
*3) 32-bit integer data
*4) Eight-bit integer data
*5) This command will not become effective unless push-motion operation is set for the position data effective before the write operation.
*6) The positioning band is indicated with a negative sign when the data is viewed in the PC software, etc.

[2] "Position table data read" command

Command name	CH+	PLC output (request)	PLC input (response)
Read a target position	+2	1040H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	Target position data *2
	5	0	
	6	Axis number 0 to FH *1	Same as the requested value, if the command was successful.
	7	(RSV)	
	8	(RSV)	
Read a positioning band	+2	1041H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	Positioning band data *3
	5	0	
	6	Axis number 0 to FH	Same as the requested value, if the command was successful.
	7	(RSV)	
	8	(RSV)	
Read a speed	+2	1042H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	Speed data *3
	5	0	
	6	Axis number 0 to FH	Same as the requested value, if the command was successful.
	7	(RSV)	
	8	(RSV)	
Read an individual zone boundary +	+2	1043H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	Individual zone boundary + data *2
	5	0	
	6	Axis number 0 to FH	Same as the requested value, if the command was successful.
	7	(RSV)	
	8	(RSV)	
Read an individual zone boundary –	+2	1044H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	Individual zone boundary – data *2
	5	0	
	6	Axis number 0 to FH	Same as the requested value, if the command was successful.
	7	(RSV)	
	8	(RSV)	
Read an acceleration	+2	1045H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	Acceleration data *4
	5	0	Same as the requested value, if the command was successful.
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	

Command name	CH+	PLC output (request)	PLC input (response)
Read a deceleration	+2	1046H	Same as the requested value, if the command was successful.
	3	Deceleration read POS number	
	4	0	Deceleration data *4
	5	0	Same as the requested value, if the command was successful.
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Read a current-limiting value for push-motion operation	+2	1047H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	0000 ~ 00FFH (00FH: Maximum current)
	5	0	Same as the requested value, if the command was successful.
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Read a load current threshold	+2	1048H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	0000 ~ 00FFH (00FH: Maximum current)
	5	0	Same as the requested value, if the command was successful.
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Read a push-motion operation setting	+2	1049H	Same as the requested value, if the command was successful.
	3	Position number	
	4	0	0: Normal operation 1: Push-motion operation (home return direction) 3: Push-motion operation (opposite to home return direction)
	5	0	Same as the requested value, if the command was successful.
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	

*1) Axis numbers 0 to 15 correspond to data 00 to 0FH, respectively.
*2) Signed 32-bit integer data
*3) 32-bit integer data
*4) Eight-bit integer data

[3] "Position table data write (ROM)" command

Command name	CH+	PLC output (request)	PLC input (response)
Position table data write (ROM) coil write	+2	0DA0H	Same as the requested value, if the command was successful.
	3	0	
	4	0	
	5	0	
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	
Position table data write (ROM) completion coil write	+2	02E0H	Same as the requested value, if the command was successful.
	3	0	
	4	0	00FFH = Data is being written to ROM 0000H = Data has been written to ROM
	5	0	
	6	Axis number 0 to FH	Same as the requested value, if the command was successful.
	7	(RSV)	
	8	(RSV)	

[4] "Present alarm code read" command

Command name	CH+	PLC output (request)	PLC input (response)
Read a present alarm code	+2	0342H	Same as the requested value, if the command was successful.
	3	0	
	4	0	Alarm code
	5	0	Same as the requested value, if the command was successful.
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	

[5] “Current value monitor” command

Command name	CH+	PLC output (request)	PLC input (response)
Current specified-axis position monitor	+2	0440H	Same as the requested value, if the command was successful.
	3	0	
	4	0	Current position of a specified axis (signed 32-bit integer)
	5	0	
	6	Axis number 0 to FH	
	7	(RSV)	
	8	(RSV)	

[6] "Group-specified broadcast" command

The axes specified by a group number are started simultaneously toward the position specified by a POS number.
This command causes the Gateway to communicate with each ROBO Cylinder controller in the broadcast mode, and accordingly the ROBO Cylinder controller does not return any response.
The response result indicated by a PLC input only means that the command has been sent successfully to the ROBO Cylinder controller; it does not indicate the status of the ROBO Cylinder controller. Check the status of each ROBO Cylinder controller using the status signal for the applicable axis.

CH+	PLC output (request)	PLC input (response)
+2	0D03H	Same as the requested value, if the command was successful.
3	Target POS number *1	
4	Group ID number *2	
5	0	
6	0	
7	(RSV)	
8	(RSV)	

*1) The values that can be specified vary depending on the type and settings of each ROBO Cylinder controller.
*2) If this number is "0," all linked axes will move regardless of the group specification. Set the group number using the applicable system parameter in the PC software.
*3) If a movement command is issued using a control word for a given axis while the axes are still moving as a result of this command, the movement by this command will be cancelled and the latest movement command will be executed. Take note, therefore, that each axis has two interfaces for movement command. Always use one interface at a time.
*4) Take note that even when the link is cancelled by turning OFF the applicable CFG bit of the gateway control signal, the controller will always receive and execute this command once a link is established.

[7] "PIO/Modbus switching" command

CH+	PLC output (request)	PLC input (response)
+2	0DA1H	Same as the requested value, if the command was successful.
3	0	
4	Coil ON/OFF 00FFH = ON: Modbus (Disable PIO commands) 0000H = OFF: PIO (Enable PIO commands) *2	
5	0	
6	Axis number 0 to FH	
7	0	
8	0	

*1) The PIO/Modbus switching status is reflected in the status signal PMSS. This command cannot be set for position-number specification axes (an invalid request error (0103H) will generate).
*2) Even if the coil is turned OFF (PIO commands are enabled), it is still possible to change the position data for a given axis via Modbus communication from the PLC (the link must be maintained).
*3) The controller receives and executes movement commands received via Modbus communication, even in the PIO control mode.

(4) Error response

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

Code	Description
0101H	Invalid axis number *1
0102H	Invalid position number *1
0103H	Invalid request command *1
0201H	Communication failure
0202H	Command not executable by the controller

*1) If an error is found as a result of checking the data received from the PLC, the Gateway Unit will set an error code in the response data without sending the command to the controller.
*2) If link is not yet established at all, nothing will be shown in the response command.

7. Communication Signal Details

7.1 Overview of Communication Signal Timings

When a given control signal is turned ON to operate the ROBO Cylinder controller using the sequence program in the PLC, the maximum response time before a response (status) signal will be received is expressed 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

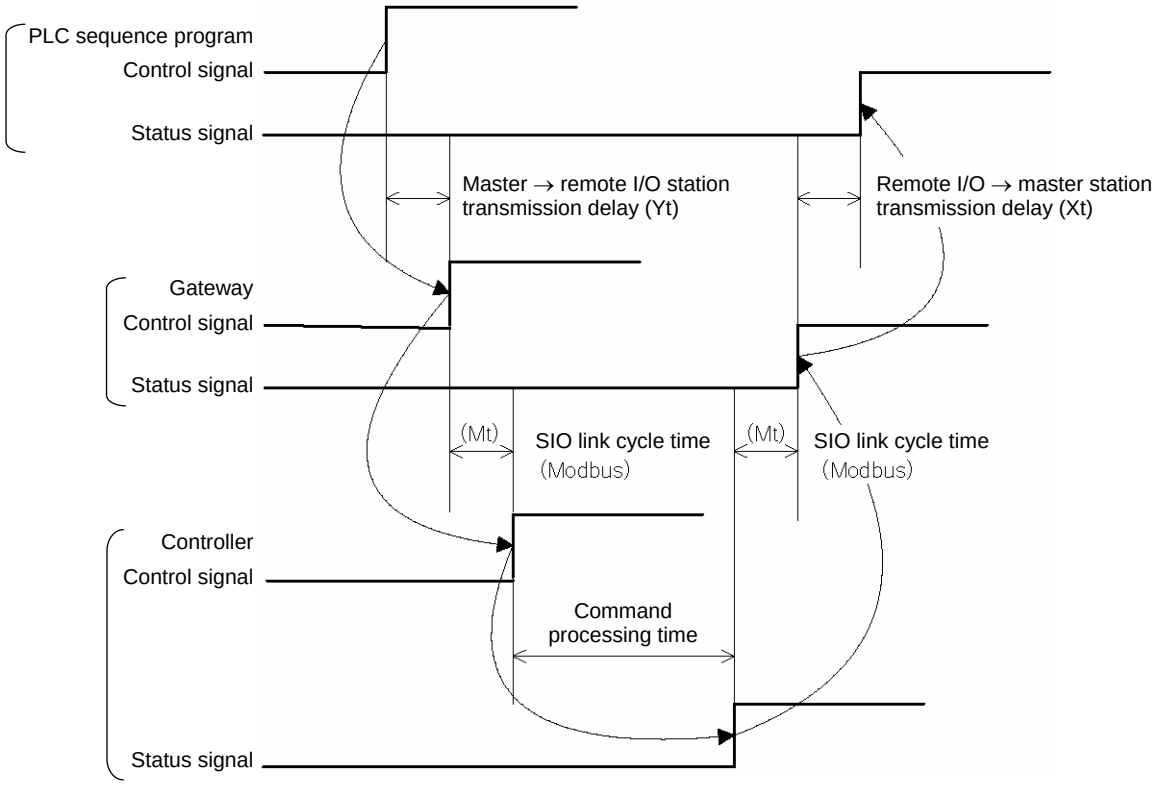
n: Number of controlled axes

Yt: Master → remote I/O station transmission delay

Xt: Remote I/O → master station transmission delay

} DeviceNet transmission delay

For the master → remote I/O station transmission delay (Yt) and remote I/O → master station transmission delay (Xt), refer to the operation manuals for your DeviceNet master unit and PLC.



(Note) If a communication error occurs due to a problem along the transmission path, etc., a communication retry or retries (up to three times) may occur, in which case the SIO link cycle time (Mt) will be extended.

7.2 Communication Signals and Operation Timings

(1) Controller ready (PWR)

This signal turns ON when the controller has become ready following the power on.

- Function

  This signal turns ON once the controller has been successfully initialized and become ready following the power on, regardless of whether or not an alarm is present or the servo is on or off. Even if an alarm is present, PWR is always ON as long as the controller is ready.
  PWR is synchronized with the status indicator LED (green) on the front face of the controller.

(2) Emergency stop (EMGS)

This signal turns ON when the controller has actuated an emergency stop.

- Function

  This signal turns ON when the controller has actuated an emergency stop due to occurrence of a controller alarm or triggering of the emergency stop circuit (refer to 4.3.1), or the motor drive power has been cut off. EMGS will turn OFF once the emergency stop is cancelled.

(3) Alarm (ALM)

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

- Function

  This signal turns ON when the controller has detected an error and its protective circuit (function) has actuated.
  It can be turned OFF by turning the reset (RES) signal ON after removing the cause of the alarm (excluding cold-start level alarms).
  When an alarm is detected, the ALM LED (red) on the front face of the alarm will illuminate. This LED remains unlit while the controller is normal.
  With ERC2-NP/PN/SE controllers, the LED at the top of the motor unit will illuminate in red. The LED will return to green once the servo is turned on.

(4) Reset (RES)

This signal has two functions. It can be used to reset controller alarms or cancel the remaining travel distance while the actuator is paused.

- Function

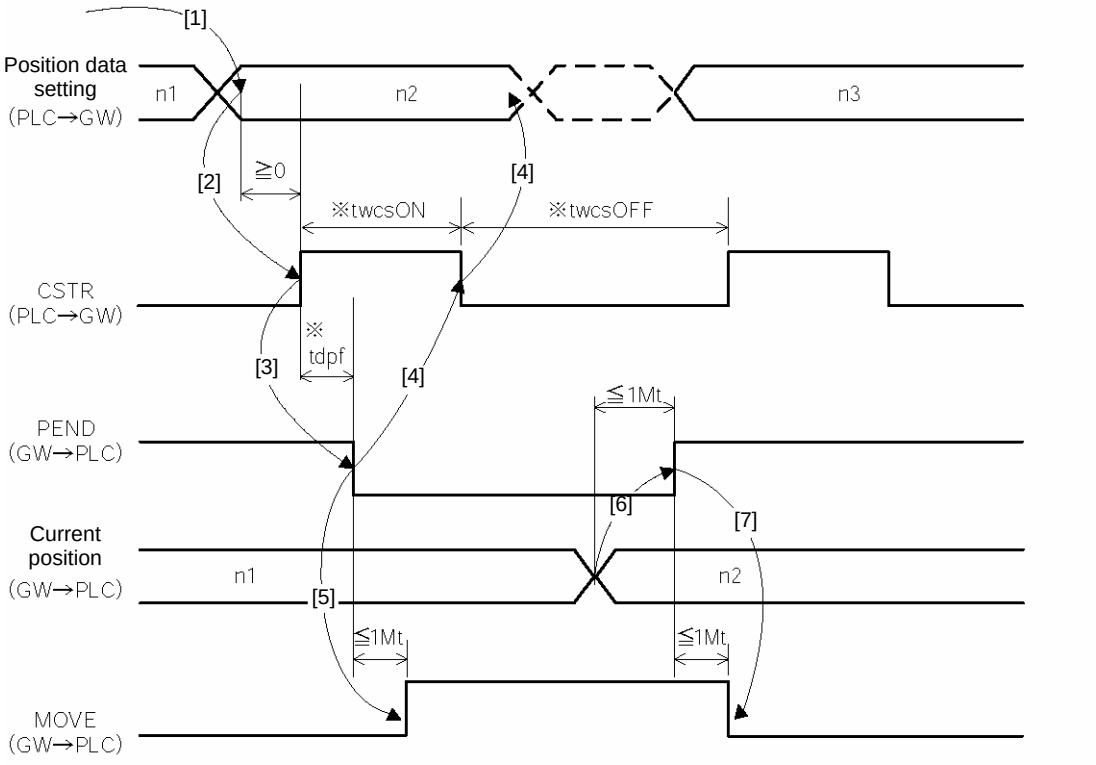
  [1] If an alarm is present, the alarm signal can be reset by turning this signal ON after removing the cause of the alarm (excluding cold-start level alarms).
  [2] Turning this signal ON while the actuator is paused will cancel the remaining travel distance.

(5) Normal positioning operation in the direct numerical specification mode (Position data, current position data, CSTR, PEND, MOVE, acceleration/deceleration data, speed data)

A function is provided to operate the ROBO Cylinder by writing the target position data, acceleration/deceleration data and speed data to the link registers in the PLC, without using the position table in the controller.

a. Basic positioning operation

[1] Set the target position data in the position data specification area.
[2] Turn CSTR (start) ON the moment [1] occurs or briefly thereafter (≥ 0).
In a normal condition, turn CSTR ON while PEND (positioning complete) is ON or MOVE (moving signal) is OFF.
The target position data is sent to the controller at the ON edge of CSTR (leading edge of the signal).
[3] PEND turns OFF tdpf after CSTR has turned ON.
[4] Cause CSTR to turn OFF upon turning OFF of PEND or turning ON of MOVE (moving).
Do not change the target position data unless CSTR turns OFF.
[5] MOVE turns ON the moment PEND turns OFF or within 1 Mt thereafter.
[6] The current position data is constantly updated. PEND turns ON the moment the current position is updated or within 1 Mt thereafter, as long as the remaining travel distance is within the range of controller parameter No. 10, “Default positioning band” and CSTR is OFF.
To monitor the stopped position data after completion of positioning, therefore, wait for an appropriate time (time needed for the actuator to complete the remaining travel distance) after PEND has turned ON.
Also note that even when the actuator is stopped, the current position data may still change slightly due to vibration, etc., Consider this change when handling position data.
[7] MOVE turns OFF the moment PEND turns ON or within 1 Mt thereafter.
[8] The target position data can be changed during movement.
To change the target position data during movement, change the target position data, wait for a while (longer than the PLC scan time), and then turn CSTR ON.
In this case, keep CSTR ON for tdpf or longer. Also provide a minimum interval of 1 Mt after CSTR turns OFF until it turns ON again.



※Yt+2Mt+Xt≦tdpf≦Yt+2Mt+Xt+7 (msec)
twcsON ≧1Mt
twcsOFF ≧1Mt

b. Acceleration/deceleration and speed data specification

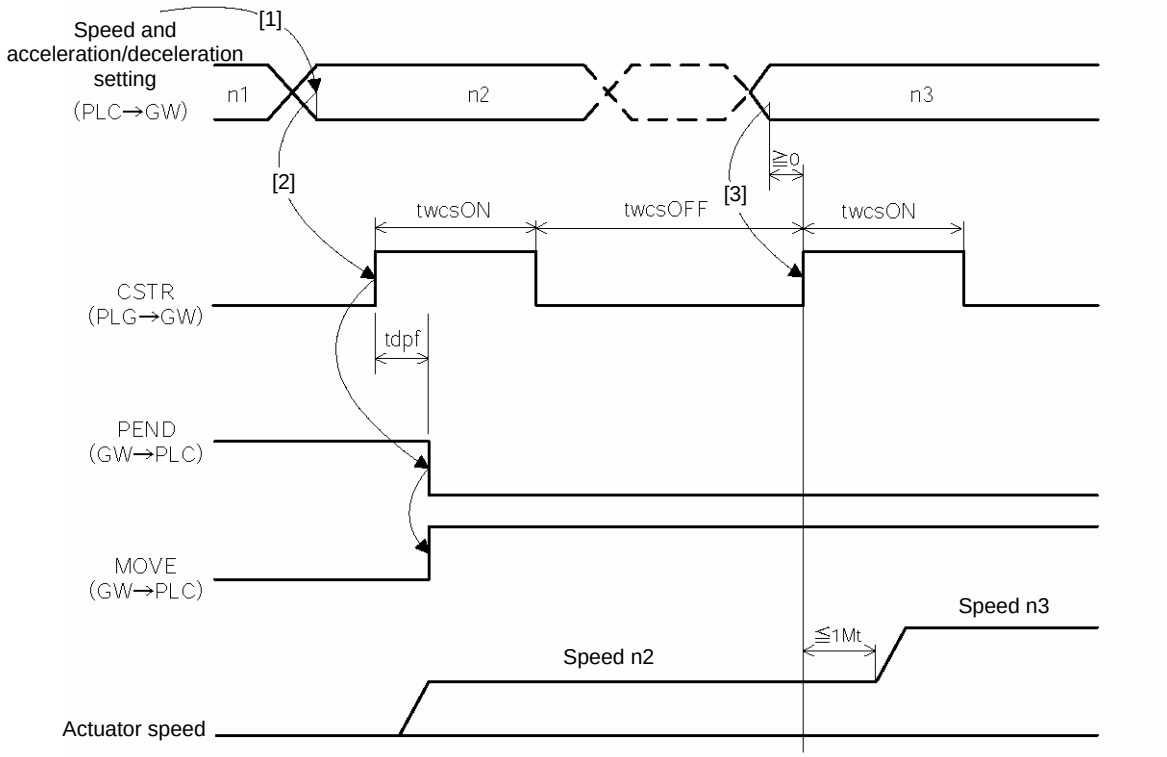
[1] Set the acceleration/deceleration and speed data in the respective specification areas simultaneously as or before setting the target position data in a.
If acceleration/deceleration is not set, the setting of parameter No. 9, “Default acceleration/deceleration” will be applied. If speed is not set or the set speed is “0,” the actuator will remain stopped. No alarm will generate.

[2] The acceleration/deceleration and speed data is sent to the controller together with the target position data at the ON edge of CSTR (start) (leading edge of the signal).

[3] The acceleration/deceleration or speed data can be changed during movement.
To change the acceleration/deceleration or speed data during movement, change the acceleration/deceleration or speed data, and then turn CSTR ON.
In this case, keep CSTR ON for tdpf or longer. Also provide a minimum interval of 1 Mt after CSTR turns OFF until it turns ON again.
If the set speed is changed to “0” during movement, the actuator will decelerate to a stop. No alarm will generate.

⚠ Caution

1. Target position data must be set even if you only want to change the acceleration/deceleration or speed data during movement.
2. Acceleration/deceleration or speed data must be set even if you only want to change the target position during movement.



twcsON≧1Mt
twcsOFF≧1Mt

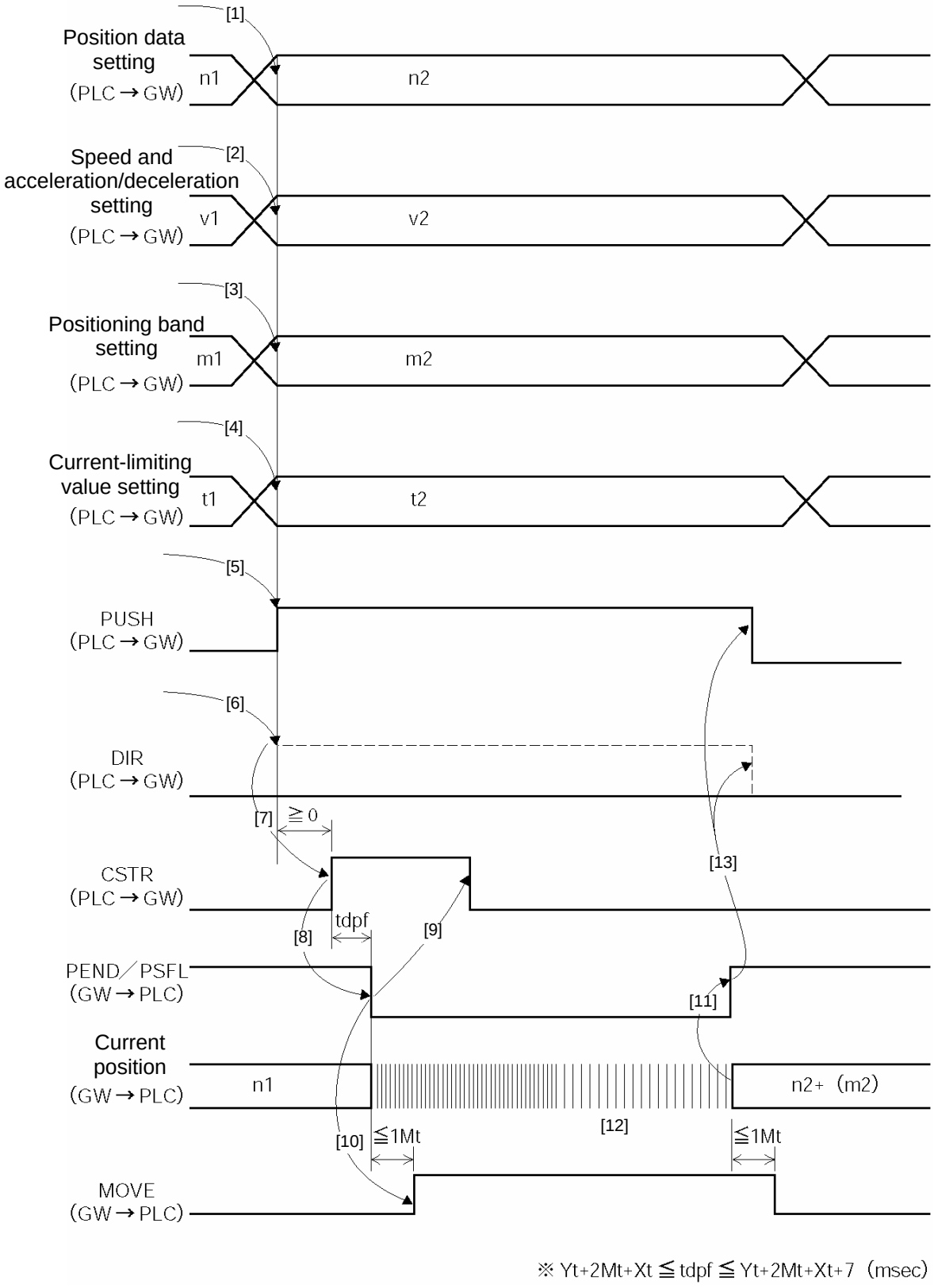
(6) Push-motion operation in the direct numerical specification mode
(Position data, acceleration/deceleration data, speed data, current-limiting value, positioning band, current position data, DIR, PUSH, CSTR, PEND, MOVE)

A function is provided to operate the actuator in the push-motion operation mode by writing the position data, acceleration/deceleration data, speed data, current-limiting value and positioning band directly to the link registers in the PLC, without using the position table in the controller.

[1] Set the push-motion start position data in the position data specification area.
[2] Set the speed at which to travel to the push-motion start position in the speed specification area, and set the corresponding acceleration/deceleration in the acceleration/deceleration area. Even if acceleration/deceleration is not set, the setting of parameter No. 9, "Default acceleration/deceleration" will not be applied.
[3] Set the push-motion travel distance (maximum push distance) in the positioning band specification area. (*)
[4] the current-limiting value for setting push force in the current-limiting value area.
[5] Turn the PUSH (push-motion operation mode specification) signal ON.
[6] Select the push direction using the DIR (push direction specification) signal.
If the DIR signal is ON, push-motion operation will be performed in the direction opposite to the home return operation. If the DIR signal is OFF, push-motion operation will be performed in the home return direction.
[7] Turn CSTR (start) ON simultaneously or briefly thereafter (≥ 0).
Turn CSTR ON while PEND (positioning complete) is ON or MOVE (moving signal) is OFF.
The data set in [1] through [4] is sent to the controller at the ON edge of CSTR (leading edge of the signal).
[8] PEND turns OFF tdpf after CSTR has turned ON.
[9] Cause CSTR to turn OFF upon turning OFF of PEND or turning ON of MOVE (moving).
[10] MOVE turns ON the moment PEND turns OFF or within 1 Mt thereafter
[11] PEND turns ON if CSTR is OFF and the motor current has reached the current-limiting value set in [4] as a result of push-motion operation (push-motion operation has completed).
If the positioning band set in [3] has been reached but the motor current has not yet reached the current-limiting value set in [4], the PSFL (missed work) signal turns ON.
In this case, PEND does not turn ON (the actuator has missed the work).
[12] The current position data is constantly updated.
[13] PUSH and DIR turn OFF upon turning ON of PEND or PSFL.

⊙ Normal positioning in the push-motion operation enable mode
During normal positioning in the push-motion operation enable mode, the signal in [5] remains OFF while the actuator operates. The setting in [4] is not required, either. PEND turns ON if CSTR is OFF when the remaining travel distance has entered the positioning band specification data set in [3]. All other steps are the same as those in 5.3.2 (5), "Positioning operation in the numerical specification mode."

* Even if positioning band is not set, the setting of parameter No. 10, "Default positioning band" will not be applied.



※ Yt+2Mt+Xt ≦ tdpf ≦ Yt+2Mt+Xt+7 （msec）

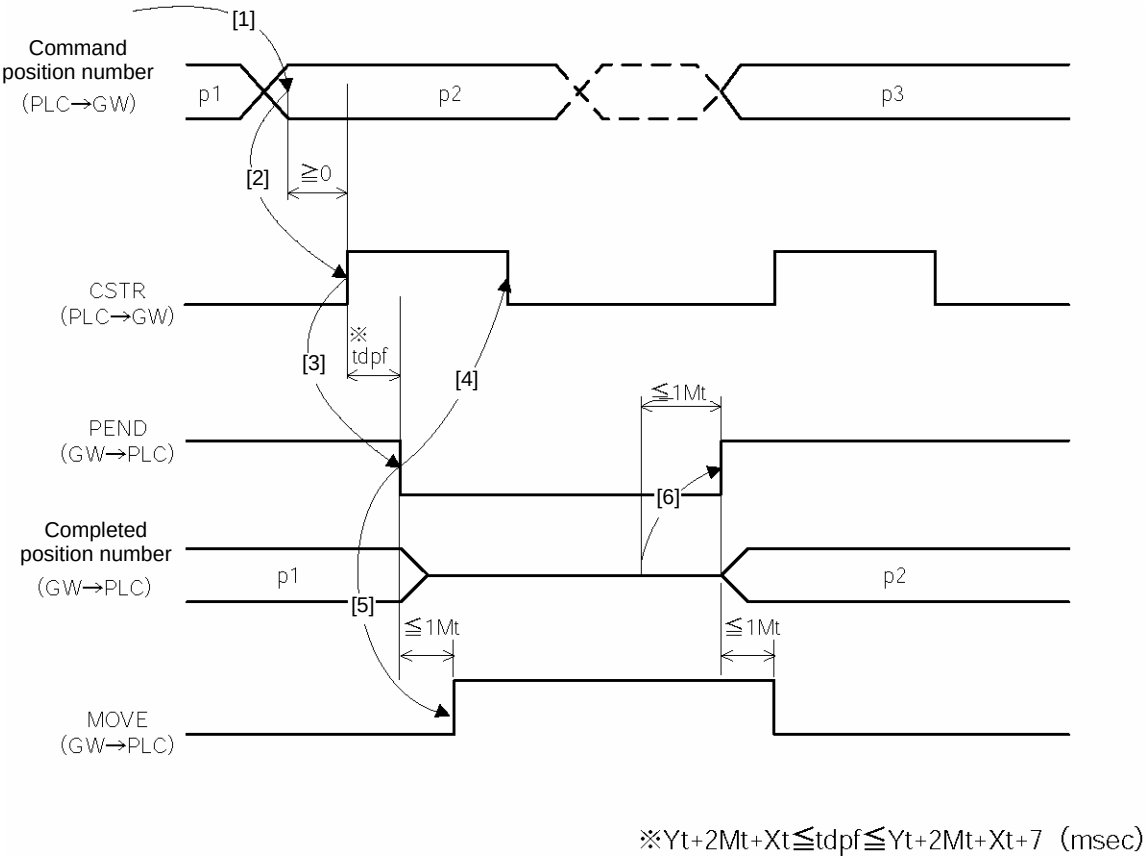
(7) Operation in the position-number specification mode
(Command position number, completed position number, CSTR, PEND, MOVE)

■ Function

The actuator is operated by specifying position data, speed, acceleration/deceleration and other data in the controller's position table beforehand, and specifying a desired position number using the link register in the PLC.

The push-motion operation, speed change operation during movement, and pitch feed by relative coordinate specification, are the same as the corresponding operations in the PIO mode (using the I/O cable). Refer to the sections in the operation manual where these operations in the PIO mode are explained.

[1] Set the position number in the command position number area.
[2] Turn CSTR (start) ON simultaneously on briefly thereafter (≥ 0).
[3] PEND (positioning complete) turns OFF tdpf after CSTR has turned ON.
[4] Cause CSTR to turn OFF upon turning OFF of PEND or turning ON of MOVE (moving).
[5] MOVE turns ON the moment PEND turns OFF or within 1 Mt thereafter
[6] The completed position number and PEND are output if CSTR is OFF when the remaining travel distance has entered the range set in controller parameter No. 10, "Default positioning band."
To read the completed position number after completion of positioning, therefore, wait for an appropriate time (time needed for the actuator to complete the remaining travel distance) after PEND has turned ON.



※Yt+2Mt+Xt≦tdpf≦Yt+2Mt+Xt+7 (msec)

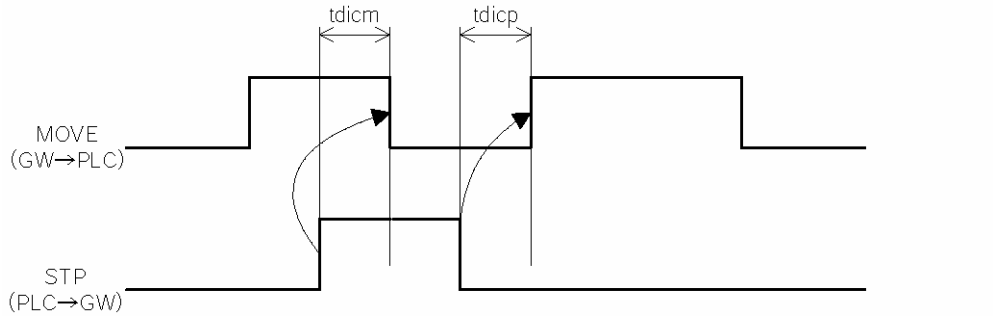
(8) Pause (STP, MOVE)

This function is used to pause the axis while moving.

■ Function

The STP (pause) signal can be used to stop and restart axis movement. The axis stops moving while the STP signal is ON.

The relationship of the STP signal and MOVE (moving) signal is shown below.



tdicm ≤ Acceleration/deceleration

tdicp ≤ Yt + 2Mt + Xt + 6 (msec)

(9) Servo on (SON), ready (SV)

The SON (servo on) signal is used to set the motor ready.

When the servo is turned on, the SV LED (green) on the front face of the controller will illuminate.

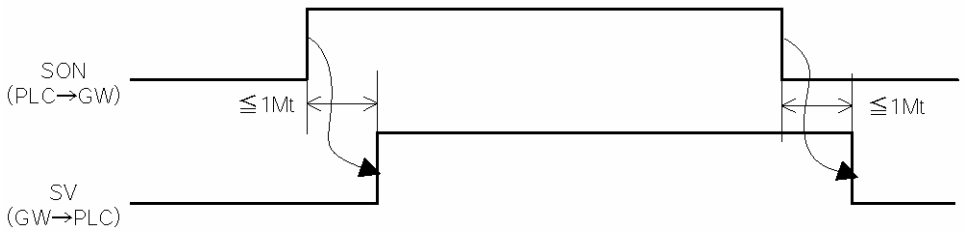
With ERC2-NP/PN/SE controllers, the LED at the top of the motor unit will illuminate.

■ Function

The controller servo can be turned on/off using the SON (servo on) signal.

The controller servo remains on and the actuator can be operated while the SON signal is ON.

The relationship of the SON signal and SV signal is shown below.



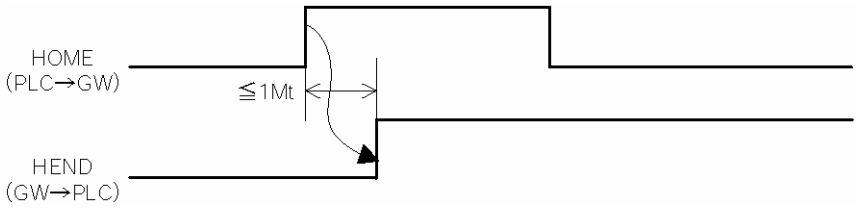
(10) Home return (HOME, HEND)

a. Standard specification (incremental)

Home return is performed at the ON edge of the HOME (home return) signal (leading edge of the signal).

When the home return has completed, the HEND (home return complete) signal turns ON.

Turn the HOME signal OFF when the HEND signal has turned ON. Even after home return has been completed once, another home return can be performed using the HOME signal.



⚠ Caution

1. If, in the position-number specification mode a positioning command to a given position is issued without performing any home return following the power on, the actuator will perform home return and then perform the positioning operation. Thereafter, home return will not be performed prior to each positioning operation.
2. If the aforementioned operation is performed in a mode other than the position-number specification mode, error code 83, "Alarm home ABS (absolute position movement command before completion of home return)" will generate.

b. Absolute specification (optional)

With the absolute controller, perform an absolute reset using the teaching pendant or PC software only once after the controller has been started for the first time. Once an absolute reset is done, you need not perform home return every time the power is turned on.

This section explains how to use the home return signal to perform an absolute reset.

(Refer to the operation manual for the controller for details on the absolute reset. The ERC2 does not support the following procedure.)

[1] When the controller power is turned on, the ALM LED (red) on the controller should illuminate. The alarm (ALM) signal is ON, and the alarm code (PM8 to PM1) signals output "1101."

[2] If the slider or rod is positioned near the home-side mechanical end or home, move it by hand to the opposite direction until the slider/rod is sufficiently away from the mechanical end or home. If the actuator is equipped with a brake, release the brake using the brake release switch on the controller. After the slider/rod has been moved, actuate the brake again.

[3] Turn the reset (RES) signal ON (≥ Mt).

[4] Reset the controller's emergency stop or turn on the motor drive power. The ALM LED (red) on the controller should illuminate.

[5] Turn the servo on (SON) signal ON. The RUN LED (green) on the controller will illuminate with the servo turned on.
The positioning completed (PEND) signal and servo on (SV) signal will be output.

[6] Home return is performed at the ON edge of the home return (HOME) signal (leading edge of the signal). When the home return has completed, the home return complete (HEND) signal turns ON and the absolute coordinates are established where the home is defined as the position at which the home return has completed.
Turn the home return (HOME) signal OFF when the home return complete (HEND) signal has turned ON. Even after home return has been completed once, another home return can be performed using the home return (HOME) signal.

(11) Zone (ZONE1, ZONE2)

In the position-number specification mode, two zone signals can be output inside arbitrary zones set by parameters.
The ZONE1 (zone 1) signal turns ON inside the zone set by parameter No. 1 (Zone boundary 1+) and No. 2 (Zone boundary 1-).
The ZONE2 (zone 2) signal turns ON inside the zone set by parameter No. 23 (Zone boundary 2+) and No. 24 (Zone boundary 2-).

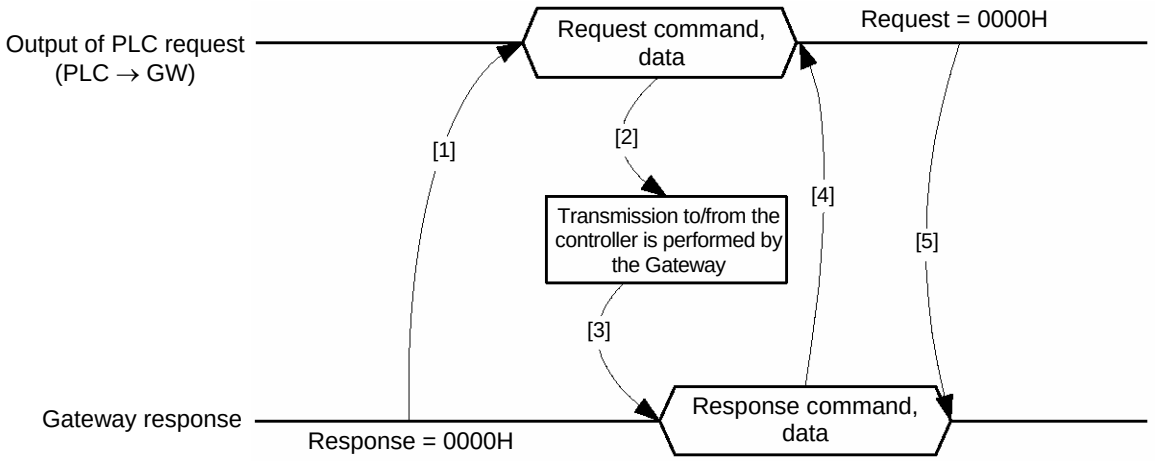
⚠ Caution

1. Zone signals are not supported in any other mode but the position-number specification mode.
2. Use zone signals after home return has completed (while the HEND signal is ON). As long as the HEND (home return complete) signal is ON, zone signals are effective even when the servo is or an emergency stop is being actuated.

7.3 Command Transmission

Commands can be used in the command specification mode.
A timing chart of command transmission is given below.
Every time control/status data is exchanged for any of the connected axes in normal operations, the Gateway Unit analyzes each request command and responds to the command.
The PLC and Gateway perform the following steps:

[1] After confirming zeros in a response command, the PLC application sets the next request command and data required.
[2] After detecting non-zero data in the request command, the Gateway Unit sends the request data to the applicable axis.
[3] After receiving a response from the applicable axis, the Gateway outputs a response result.
[4] After checking the response result, the PLC application clears the request command.
[5] After detecting that the request command has been cleared, the Gateway clears the response command and waits for the next command.
Steps [1] through [5] are repeated in continuous command transmissions.



8. System Design

The following settings are required for the DeviceNet master (PLC) to communicate with the controller via the Gateway.

[1] Controller settings for enabling SIO (Modbus) communication between the Gateway Unit and the controller

[2] PLC and Gateway Unit settings for enabling DeviceNet communication between the PLC and the Gateway Unit

8.1 Settings for Controller Communication

For the controller to be able to communicate with the Gateway, the settings specified below must be performed.

(1) Setting the axis number

Set a unique axis number in a range of 0 to 15.

Take note that the range of settable axis numbers varies depending on the operation mode of the Gateway Unit.

The steps to set an axis number using the PC (software) are explained below. For details, refer to the operation manual for your PC (software) or teaching pendant.

[1] Connect the PC (software) or teaching pendant to the Gateway Unit, and turn the port switch ON.

(Note) Link only the target axis via SIO. Specifically, connect only the target axis to the 4-way junction. When setting an axis number for the next axis, swap the connectors for the current and next axes.

[2] Start the PC software.

[3] Click **Settings (S)**, and then select **Controller Settings**.

[4] Click **Assign Axis Number (N)**.

[5] When the axis number assignment table appears, set a desired number.

[6] Click **OK**, and then press the Esc button.

[7] Swap the SIO link cables to set an axis number for the next axis.

[8] When all axis numbers have been set, connect all axes to the SIO link.

(Note) You can also disconnect only the target axis from the SIO link and connect it to the PC or teaching pendant via one-on-one connection. (Steps [2] to [6] above are the same.)

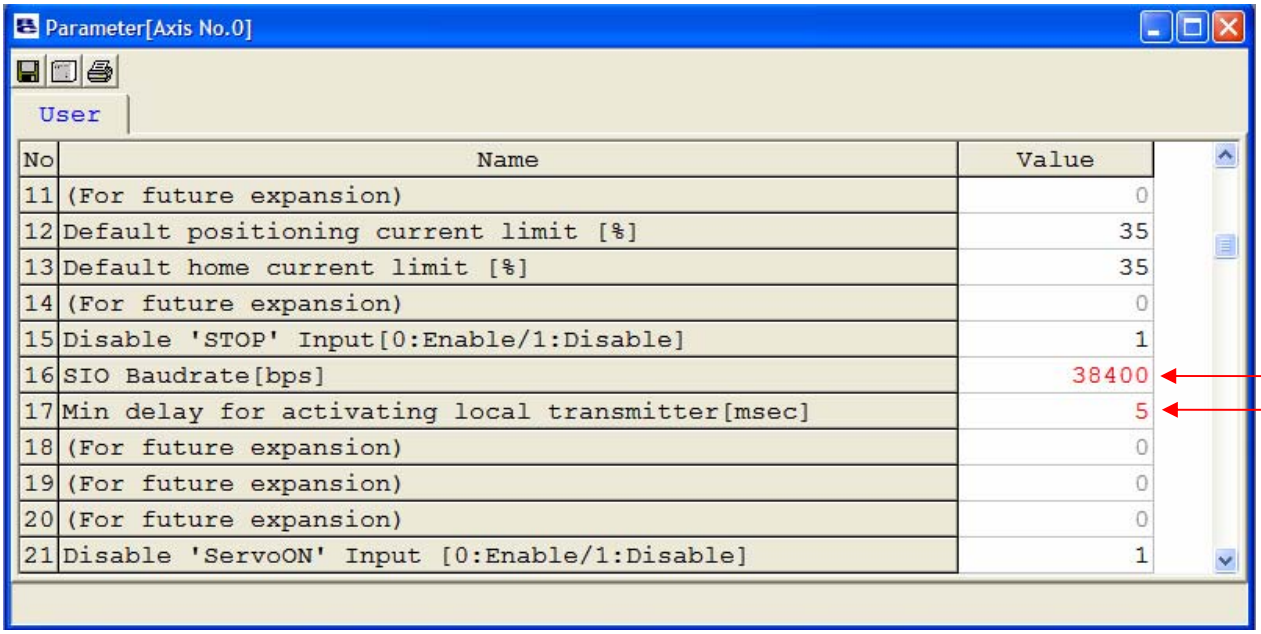
(2) Setting the baud rate for SIO communication

Set the applicable parameter using the PC software or teaching pendant in the same manner as in (1).

[1] Set parameter No. 16, “SIO baud rate” to “230400” (230.4 kbps).
SIO communication cannot be performed at any other baud rate but 230.4 kbps.

[2] Set parameter No. 17, “Slave transmitter activation minimum delay” to “5” or less.
To turn the communication cycle at the maximum speed, set “0.”

The figure below shows the user parameter setting screen of the PC software.



8.2 DeviceNet Settings

For the Gateway Unit to be able to communicate with the master station, the settings specified below must be performed.

○: ON X: OFF

Item	Gateway Unit setting						PLC master setting
Baud rate	Baud-rate setting switches						Baud-rate setting switches
Node address	Address setting switch						Gateway node addresses
Assignments	No.	Mode setting switch SW1				Occupied area settings		
		4	3	2	1	Output (bytes)	Input (bytes)	
	1	x	x	x	x	52	28	Direct numerical specification mode, 4 axes
	2	x	○	x	x	76	40	Direct numerical specification mode, 6 axes
	3	○	x	x	x	100	52	Direct numerical specification mode, 8 axes
	4	○	○	x	○	124	64	Direct numerical specification mode, 10 axes
	5	○	○	x	x	196	100	Direct numerical specification mode, 16 axes
	6	x	x	○	x	48	48	Position-number specification mode, 16 axes
	7	x	x	x	○	160	160	Command specification mode, Large
	8	x	○	x	○	128	128	Command specification mode, Middle
	9	○	x	x	○	64	64	Command specification mode, Small

(1) Setting the baud rate for DeviceNet communication

The baud rate must be the same between the Gateway Unit and the PLC master.

[1] Gateway Unit
Baud-rate setting switches (DR0, DR1) (Refer to 2.3.)

[2] PLC master
Baud-rate setting switches of the master unit (Refer to the operation manual for the PLC.)

(2) Node address

[1] Gateway Unit
Node-address setting switches (NA1 to NA32) (Refer to 2.3.)

[2] PLC master
Node-address setting switches (Refer to the operation manual for the PLC.)

* Normally the node address of the PLC master is set to 63.

(3) Setting the Gateway Unit mode

Set the operation mode of the Gateway Unit using the mode setting switch SW1 (refer to 2.3). The settings of this switch determine the I/O size of the Gateway Unit. Accordingly, register this information in the master as a slave-station I/O assignment setting. (Refer to 8.3.3.)

8.3 Building a Network via Free Assignment

Slave address assignment can be performed automatically using a DeviceNet configurator.
Omron's configurator comes preinstalled with an EDS file for Omron DeviceNet products. However, this file must be installed separately in the Gateway Unit to support IAI slave devices. Download the EDS file from IAI's website.

Website: http://www.iai-robot.co.jp File name: rcm-gw-dr.eds

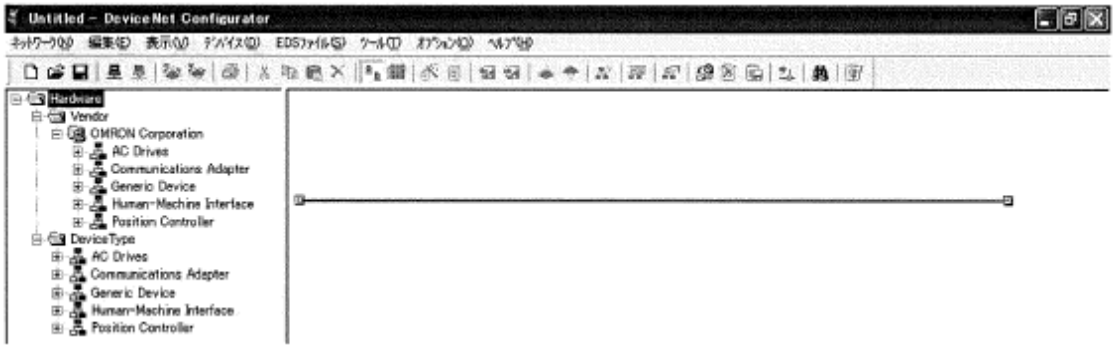
This section explains the network configuration procedure based on free assignment. For details, refer to the operation manual for your PLC. The example given below assumes use of DeviceNet Configurator Ver. 2.10.

* A DeviceNet configurator is a software program for building, setting and managing DeviceNet networks using graphical screen interfaces.

8.3.1 Starting the Configurator

Before commencing the procedure, connect the PLC and PC using a dedicated RS232C cable.

- From the **Start** menu, point to **Programs (P)**, point to **DeviceNet Tools**, and then select **DeviceNet Configurator** to start the configurator.
- The initial configurator window opens as follows.



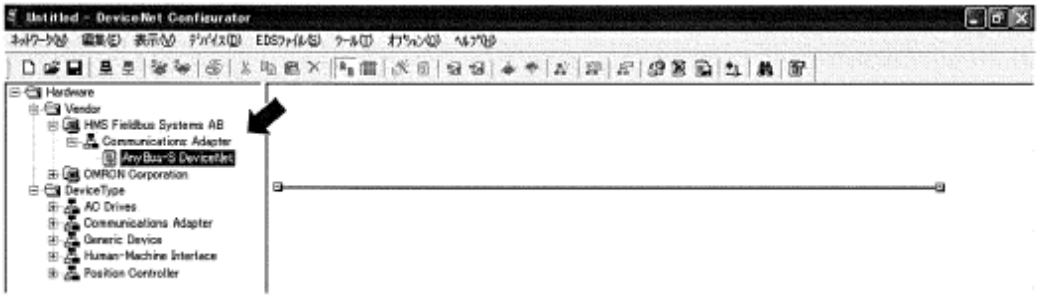
8.3.2 Creation of Network Configuration

(1) Installing a EDS file

[1] In the hardware list shown on the left side of the initial window, select “Communications Adapter” under “Device Type.”

[2] Click **EDS File (S)**, and then select **Install (I)**. Specify the location where the EDS file is stored, and install the file.

[3] When the registration is complete, a new level for HMS Fieldbus System AB is created below Vendor.

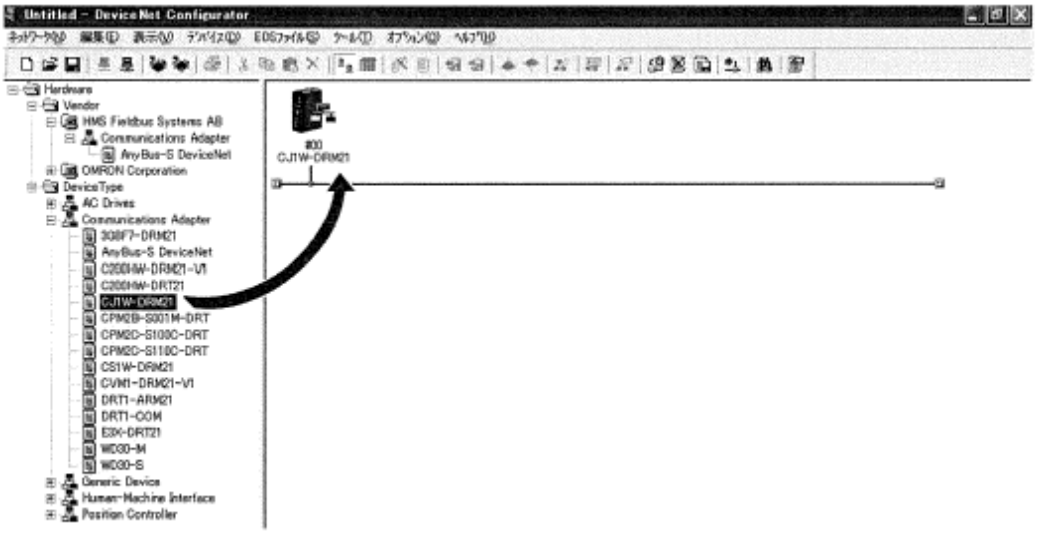


(2) Registering the master station

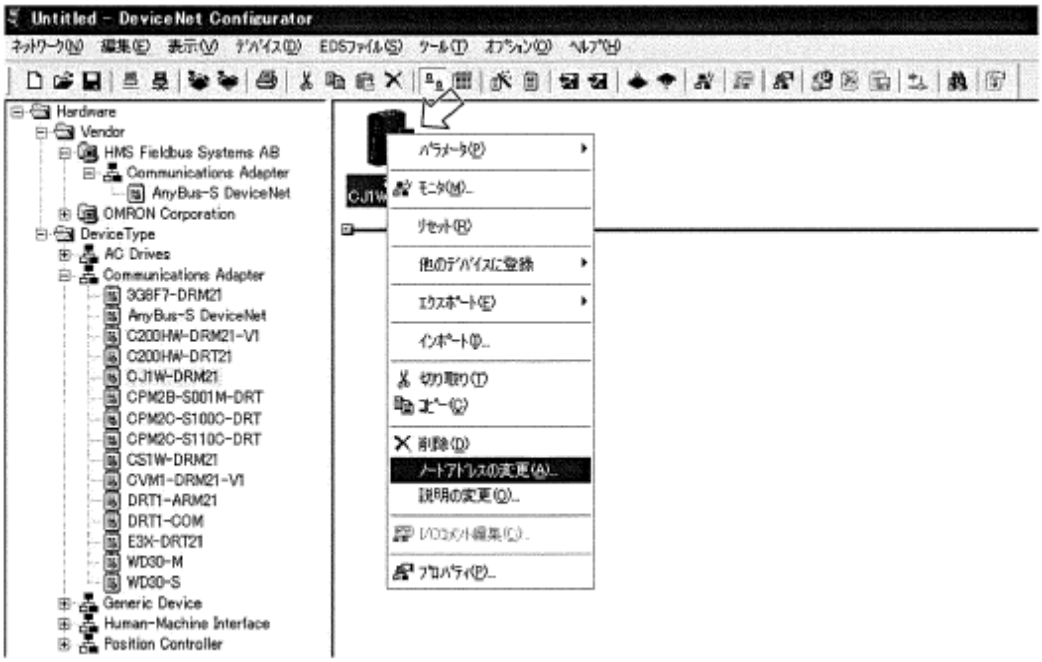
Register the master station (CJ1W-DRM21) to the network.

[1] Manual operation

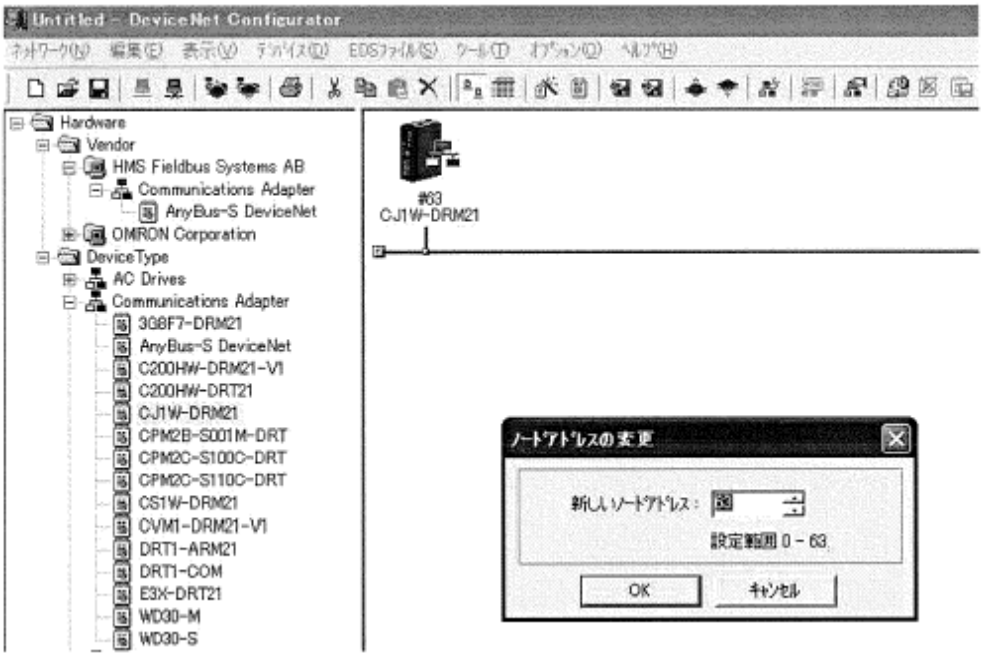
- Drag the master unit from the hardware list and drop it onto the network configuration pane.



- In the above window, bring the arrow over the master (to select the node), and then click the right mouse button. Next, double-click **Change Node Address (A)**.

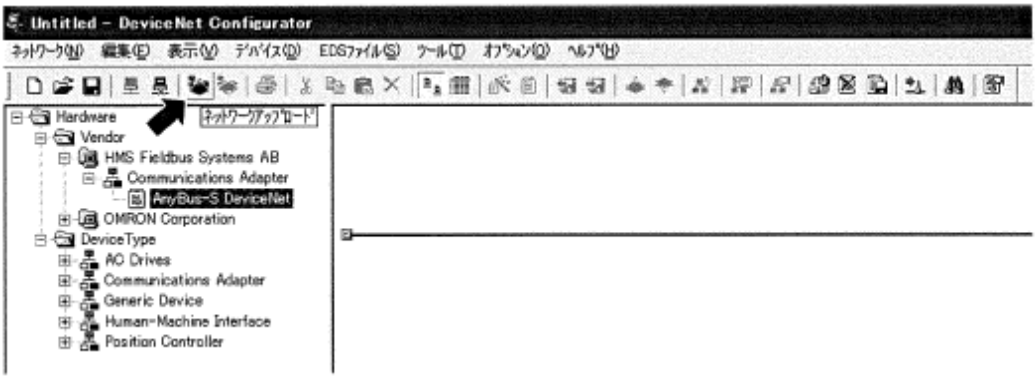


- Next, set the node address to 63 (a desired value between 0 and 63 can be selected).

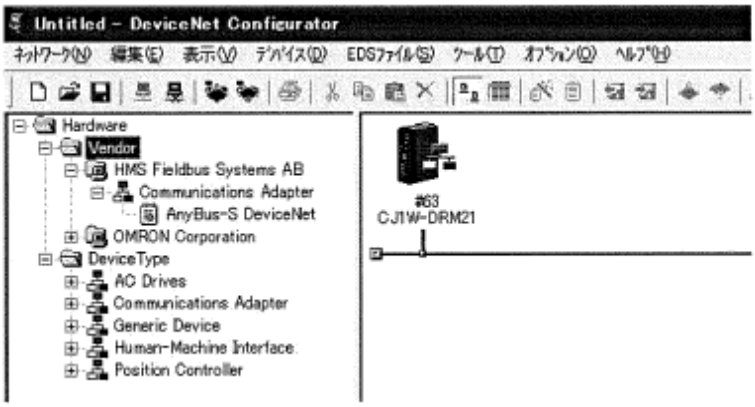


[2] Automatic recognition

- Click **Network Upload**.

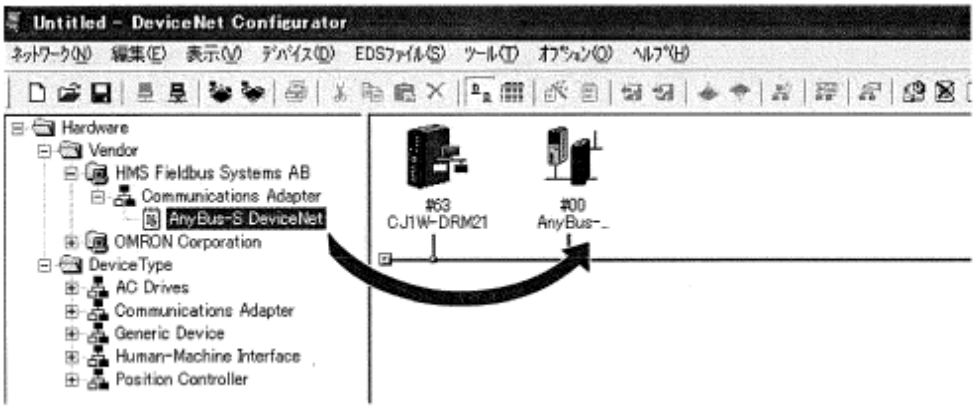


- The master station (CJ1W-DRM21) is automatically recognized and registered in the network configuration pane on the right side of the window.



(3) Registering the slave

In the hardware list, select the EDS file list you have registered in (1), and then drag and drop the file to add it the network configuration pane.
The slave is automatically assigned a node address in the order in which it is registered in the network configuration pane.

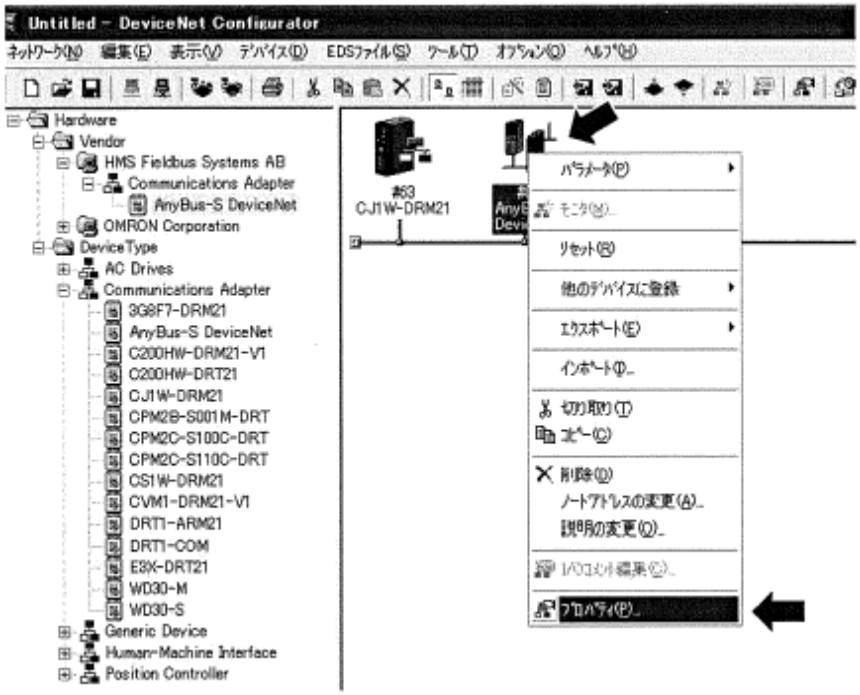


8.3.3 Creating a Scan List

A scan list is where the slaves that communicate with the master via remote I/O communication over the DeviceNet network are registered. Use the configurator to assign I/Os for the slave station and register the assignments to the master.

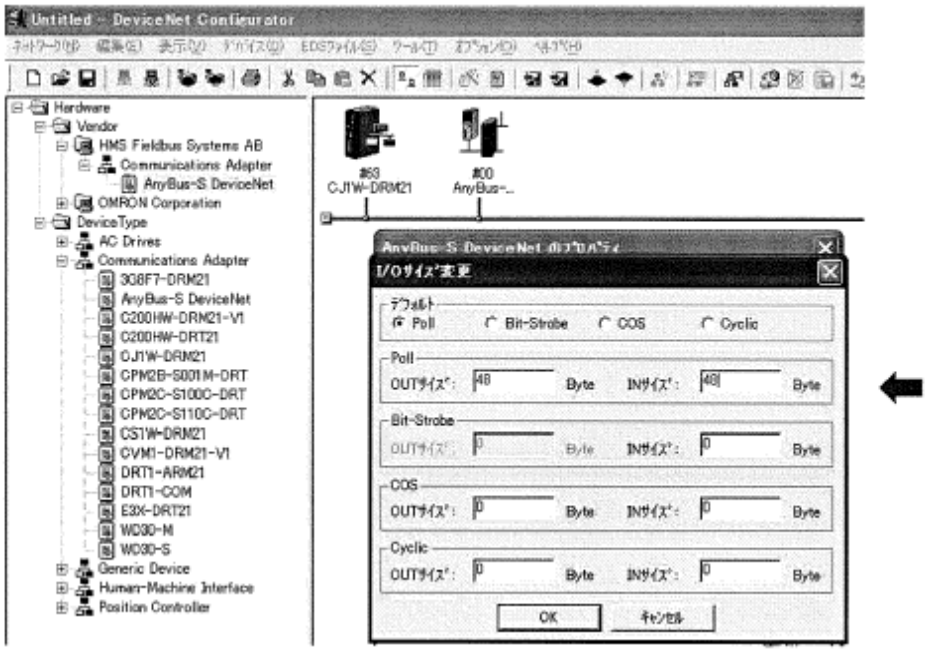
(1) Setting the I/O size for the slave station (Assigning I/Os for the Gateway Unit)

[1] Select and right-click the slave station (node) added in step (3) of 8.3.2, and then left-click **Properties (P)**.



[2] When the AnyBus-S DeviceNet Properties window appears, click the “I/O Information” tab, and then click **Edit**.

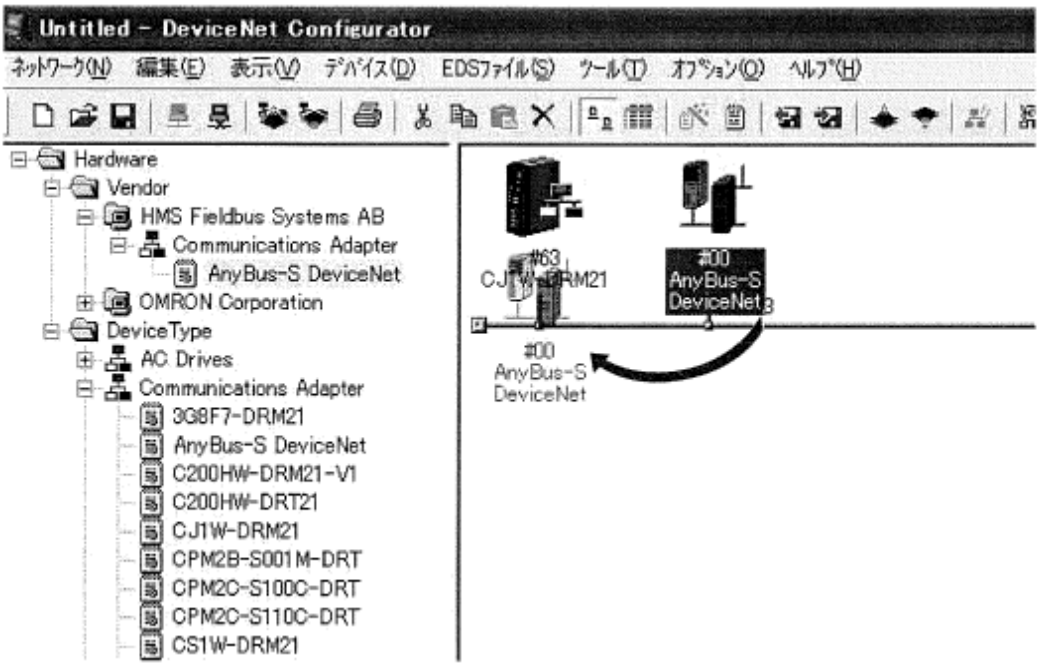
[3] When the I/O size change window appears, go to the Poll area and set IN/OUT sizes in the respective fields.
In the screen shown below, the Gateway Unit is used in the position-number specification mode. (OUT = 48 bytes, IN = 48 bytes)



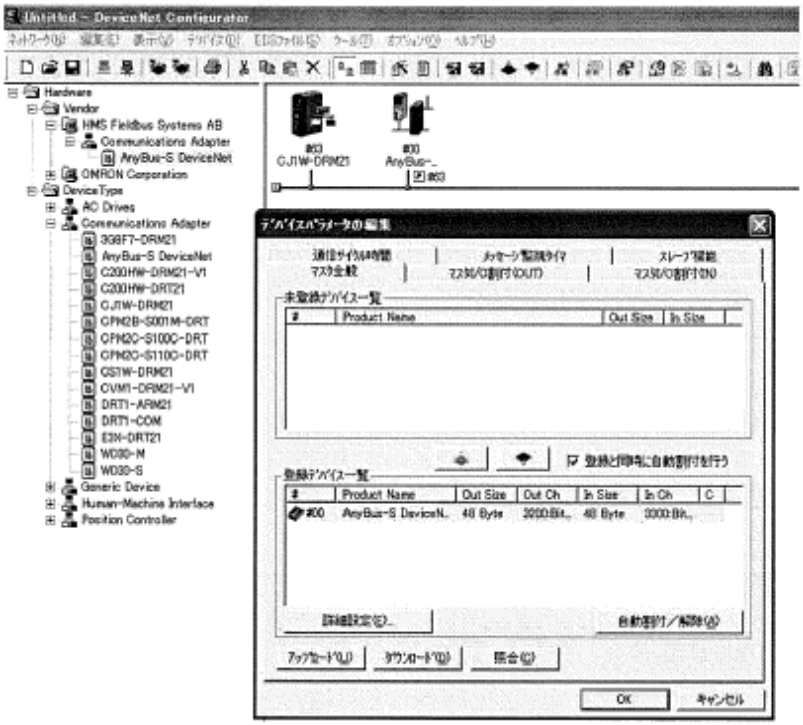
[4] After both sizes have been set, click **OK** to display the AnyBus-S Properties window. Confirm that the values you have just set are shown, and then click **Close**.

(2) Registering the slave station (Gateway Unit) to the master

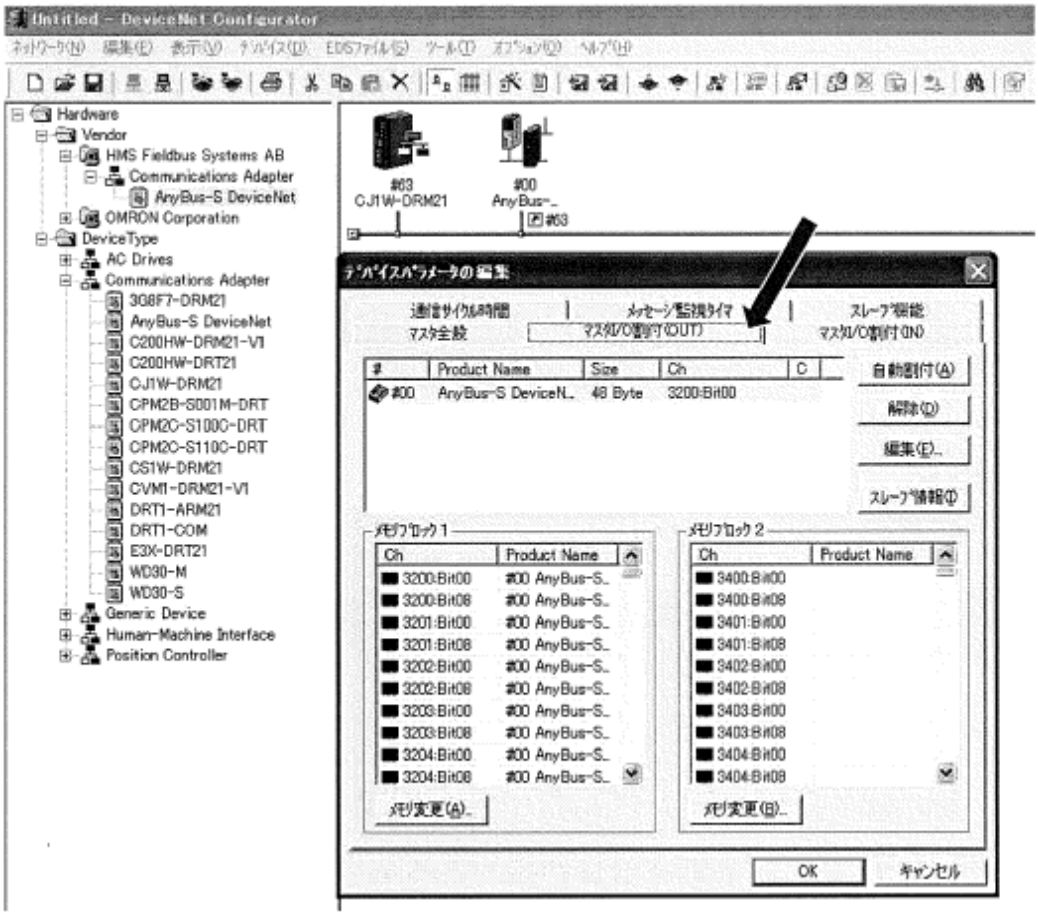
[1] In the network configuration pane, drag the slave station and drop it over the master to register the slave to the master.



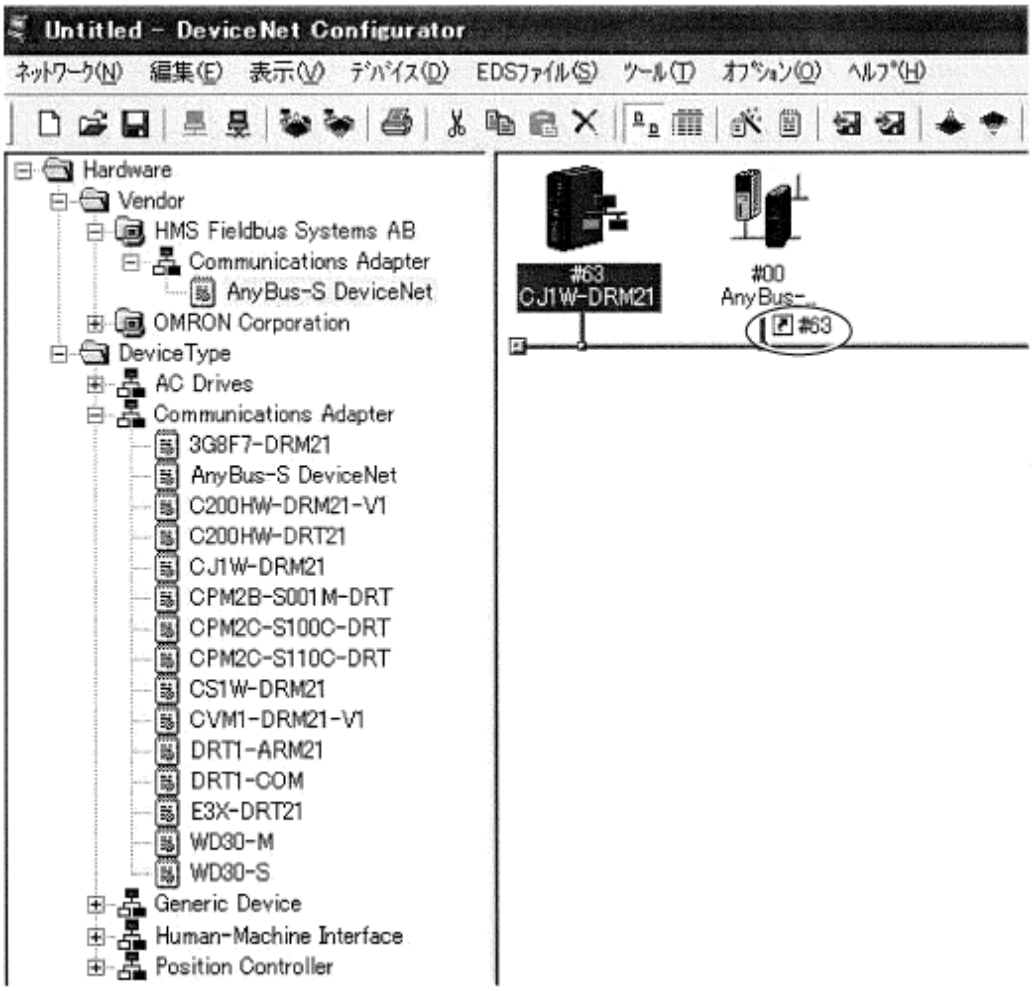
[2] In the network configuration pane, double-click the master station to open the device parameters edit window and confirm that the items shown in the list of registered devices correspond to the settings you have entered in step (1) of 8.3.3.



[3] Still in the device parameters edit window, go to the “Master I/O Assignment (OUT)” tab and “Master I/O Assignment (IN)” tab to check the results of automatic assignment.

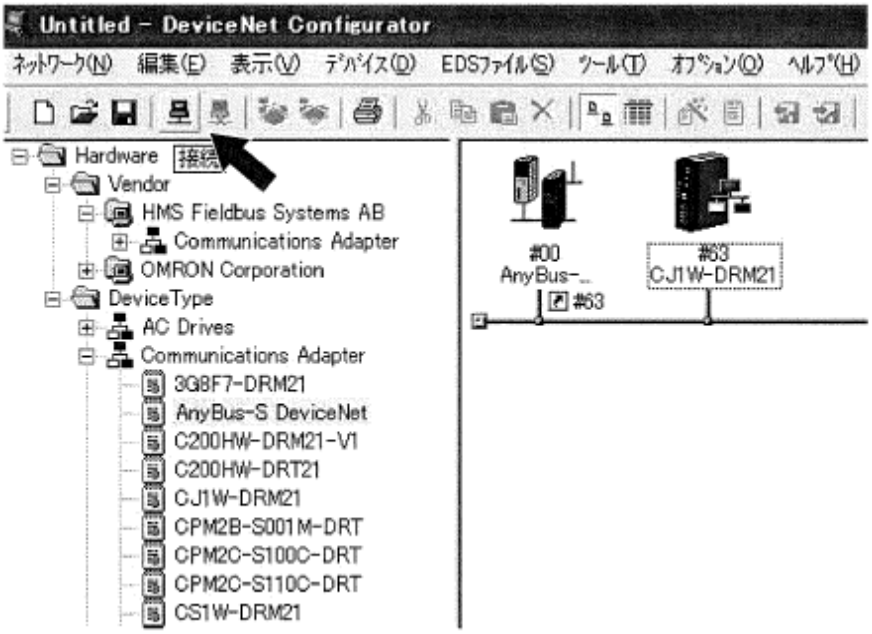


[4] Once the slave station has been registered in the master station, a return-arrow icon and a master node address preceded by # are displayed at the bottom right of the slave station icon.



8.3.4 Online Connection

(1) Click **Network (N)** and then select **Connect** to bring the system online.
(You can also click the Connect icon in the toolbar.)



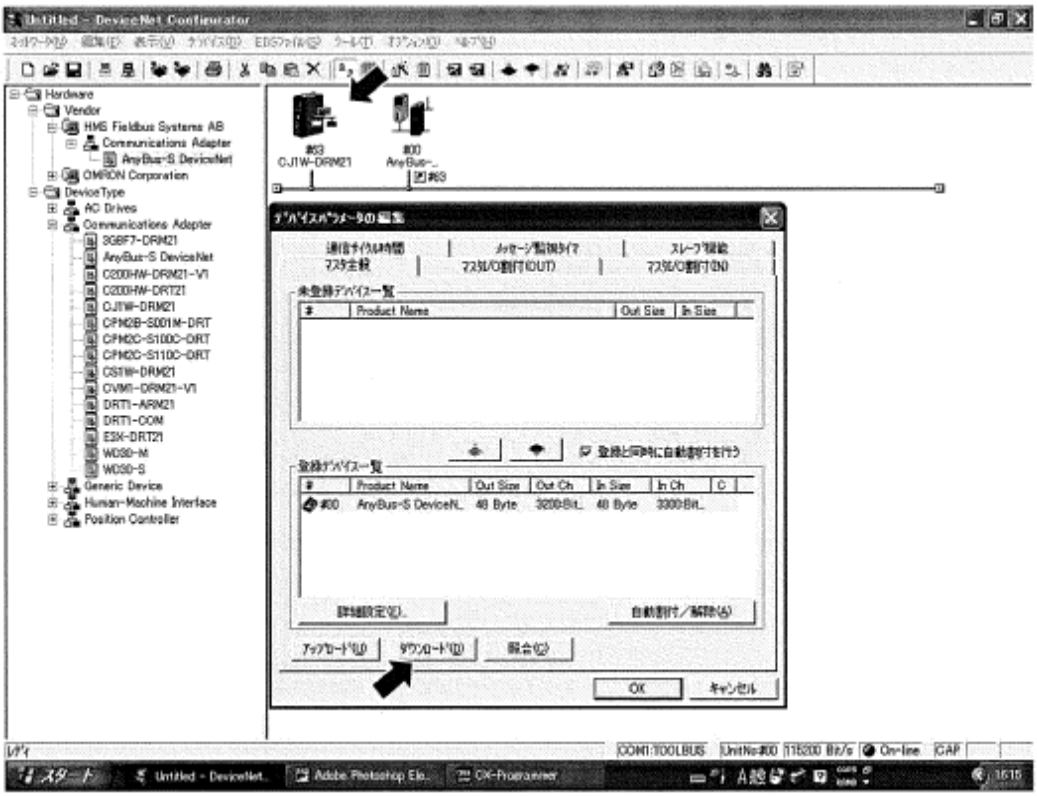
(2) When the interface settings window appears, set each item as shown in the sample screen below, and then click **OK**.

(3) When the system has been successfully brought online, the indicator in the status bar found in the bottom right-hand corner of the screen changes to blue and the text changes from “Off-line” to “On-line.”

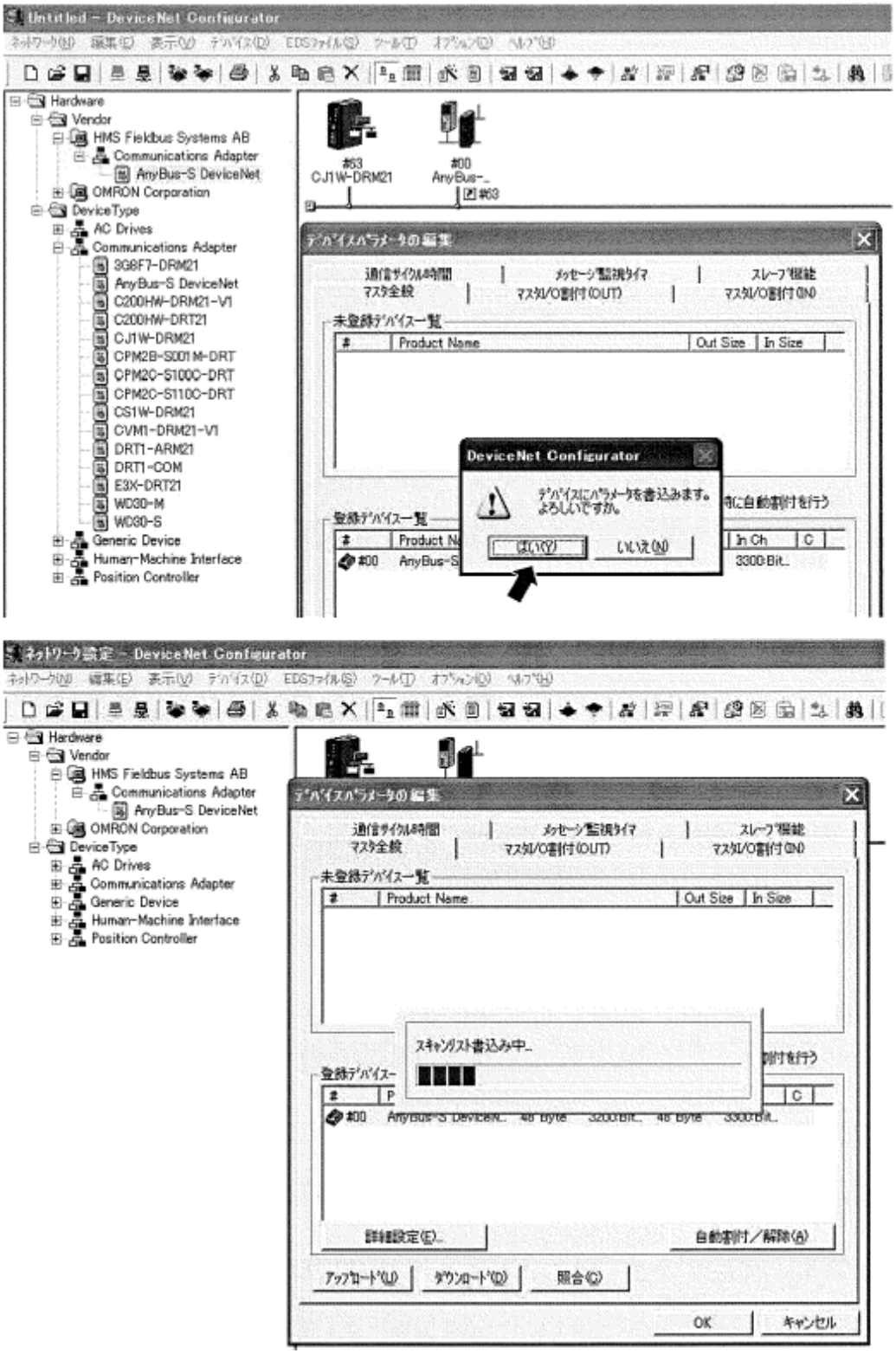
8.3.5 Downloading the Master Scan List

Download to the network master the scan list, settings and other information that have been creased and updated to this point. Take note that the PLC must be in the “program mode” to be able to download the scan list.

(1) Double-click the master icon, confirm the device parameters again, and then click **Download**.



(2) When the following message dialog box appears asking whether you really want to write the device parameters, click **Yes**.



(3) When all device parameters have been written, click **Yes**.

9. Troubleshooting

9.1 Actions to Be Taken upon Problems

If you encountered a problem, follow the steps below to take appropriate actions in order to restore the system quickly and prevent the same problem from occurring again:

a. Check the statuses of various LED indicators on the Gateway Unit.
   [1] Gateway Unit status indicator LEDs (RUN, G.ER, C.ER, T.ER)
   [2] SIO communication status LEDs (TxD, RxD)
   [3] DeviceNet communication status LEDs (MS, NS)
b. Check the host controller (PLC, master station) for abnormality.
c. Check the controller for abnormality.
d. Check the power-supply voltage of the Gateway Unit.
e. Check the cables for contact problem, disconnection and pinching.
   To check continuity, turn off the power and disconnect the wiring.
f. Check the noise elimination measures (connection of ground lines, installation of surge killers, connection of terminal resistors on communication lines, etc.).
g. Check operations using the teaching pendant or PC software.
   Connect the teaching pendant or PC software to the Gateway Unit and operate each axis to check the operations and also see if any alarm generates.
h. Check the I/O signals transmitted between the PLC and the controller.
   [1] Check the I/O signals of the PLC using the monitor function of the PC software CX-Programmer (Omron product), etc.
   [2] Check the I/O signals of the controller using the status monitor function of the PC software or teaching pendant.
   [3] Confirm that the signals checked in [1] and [2] above are consistent.
i. Check the events leading up to the problem, as well as the operating condition when the problem occurred.
j. Analyze the cause.
k. Implement countermeasures.

Before contacting IAI, check the items specified in a through i and inform us of the results.

9.2 Failure Diagnosis

Failure conditions are classified into the following three types:

a. Gateway Unit error
b. SIO communication error
c. DeviceNet communication error

9.2.1 Gateway Unit Error

If the Gateway status indicator LED RUN (green) turns off G.ER (red) turns on while the specified power is supplied, the Gateway Unit is experiencing a control error.

★ Check the power-supply voltage of the Gateway Unit. If the specified power is supplied, turn off the power, and then turn it back on. If the RUN (green) LED still remains unlit or G.ER (red) LED turns on again, contact IAI.

9.2.2 SIO Communication Error

If a SIO communication occurs, the Gateway status indicator LED T.ER (red) will turn on. The communication status can also be checked using the TxD (green) and RxD (green) LEDs.
For details, refer to [2], “SIO communication status LEDs” in 1.2, “Name and Function of Each Part.”

★ Check the following items:
[1] Check if the communication lines are wired correctly.
[2] Check if CFG15 to 0 (linked axis selection) are set correctly. For details, refer to the I/O signal list in 5.1.3, “Gateway Control Signals.”
[3] Check if the ground potential level (0 V) of the controller is the same as the ground potential level of the Gateway Unit. Especially when multiple controllers are linked, check if the grounds of all controllers share the same line.
[4] Check if the terminal resistors are connected correctly and if their resistances are appropriate.
[5] Check for presence of any power line or other noise source near the wiring paths of SIO communication lines.

9.2.3 DeviceNet Communication Error

If you encountered a problem with DeviceNet, check the operating condition and remove the cause by referring to the table below. The monitor LEDs illuminate in two different colors (red/green). The statues of these indicators can be used to check the DeviceNet status.

If an error occurs, the MS or NS LED will illuminate or blink in red. If you find a blinking or steady red LED, check the connections of power-supply and communication cables and also check (reset) the baud-rate and node-address setting switches once again, and then reconnect the power.

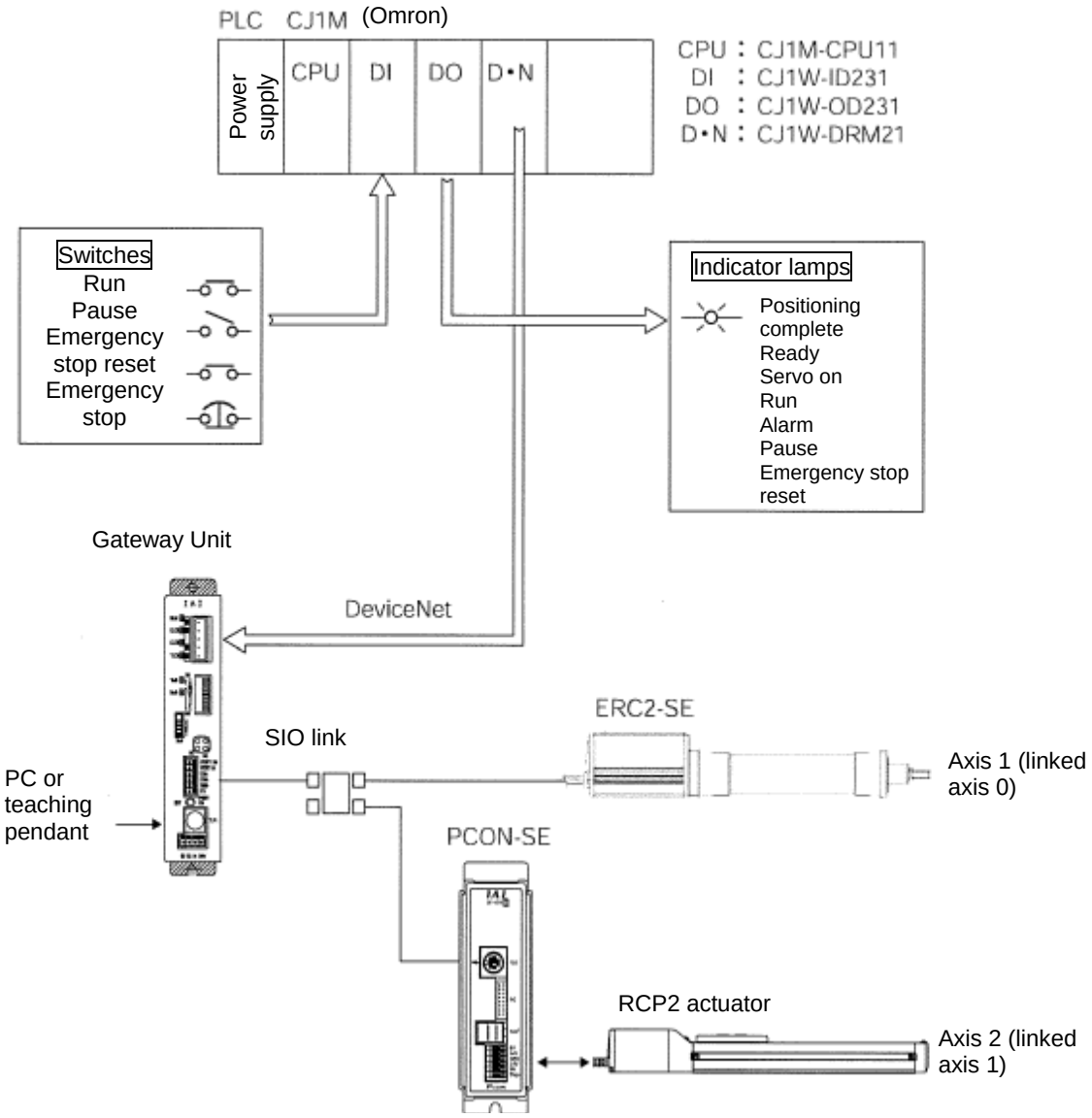
○: Steady light, ●: Unlit, X: Blinking

Monitor LEDs				Status	Countermeasure
MS		NS			
Green	Red	Green	Red		
○	-	○	-	Normal	
○	-	●	●	Waiting for the node address duplication check to be completed by the master	● Check if the baud rate of the master matches the baud rates of all slaves. If any inappropriate setting is found, make the necessary correction and then restart the system. ● Check if the connectors are properly engaged. ● Check if the communication power (24 VDC) is supplied. ● Check if the master is operating correctly. ● Check the communication cables for disconnection.
○	-	⊙	-	Waiting for connection to be established with the master	● Check if the master is operating correctly. ● Check if the slave is registered in the scan list of the master.
-	○	●	●	Hardware error	● Contact IAI. (The DeviceNet board may have to be replaced.)
-	⊙	●	●	DIP switch setting error	● Check if the baud rate of the slave matches the baud rate of the master. ● Check if all items are configured correctly. ● If any inappropriate setting is found, make the necessary correction and then restart the system.
○	-	-	○	Detection of duplicate node addresses or “bus off” (halting of communication due to frequent data errors)	● Correct the node address(es) and then restart the system. ● Check if the baud rate of the slave matches the baud rate of the master. ● Check if the communication cable length is appropriate. ● Check the communication cables for disconnection or loose or disconnected connector. ● Check if the terminal resistors are installed correctly. ● Check for possible effect of noise, such as presence of noise sources nearby or power lines running in parallel with the communication cables. ● If any inappropriate setting is found, make the necessary correction and then restart the system.
○	-	-	⊙	Communication time out	● Check if the baud rate of the slave matches the baud rate of the master. ● Check if the communication cable length is appropriate. ● Check the communication cables for disconnection or loose or disconnected connector. ● Check if the terminal resistors are installed correctly. ● Check for possible effect of noise, such as presence of noise sources nearby or power lines running in parallel with the communication cables. ● If any inappropriate setting is found, make the necessary correction and then restart the system.
The NS LED alternates between steady green and blinking green, or the NS LED alternates between blinking red and blinking green.				Communication error	● Check if the slave is registered in the scan list of the master. ● Check the I/O areas for duplicate assignment to other slave. ● Check the I/O areas for overflow beyond the areas permitted by the master unit (in the case of fixed assignment).

10. Example of DeviceNet Operation

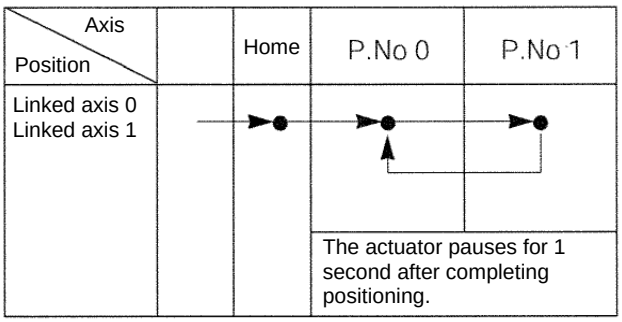
This chapter provides an example of operating ERC2-SE and PCON-SE controllers via DeviceNet using an Omron PLC (from specifying various settings to conducting checks per a ladder sequence flowchart).

10.1 Configuration Overview



10.2 Actuator Operation Pattern

Both linked axes 0 and 1 are operated in the position-number specification mode.
The operation pattern is specified below. Specifically, position No. 0 is specified to cause the actuator to move to position No. 0 after completion of home return. The actuator pauses for 1 second in this position, after which position No. 1 is specified to cause the actuator to move to position No. 1. The actuator pauses for 1 second in this position, after which position No. 0 is specified. These steps are repeated to make the actuator move back and forth between position Nos. 0 and 1.



10.3 Various Controller Settings

(1) Setting the axis number
Refer to 8.1.

(2) Setting the baud rate for SIO communication
Refer to 8.1.

(3) Creating a position table

After (2), perform the following steps in the initial window of the PC software:

[1] Click **Position (T)**, and then select **Edit/Teach (E)**.
[2] Select axis 0, click **>**, and then click **OK**.
[3] When the position data edit window for axis 0 appears, enter the applicable data.
[4] Transfer the data to the controller, and then click **X** to close the edit window.
[5] Repeat steps [1] to [4] by selecting axis 1.
[6] Shut down the PC software.
[7] Remove the PC cable from the Gateway unit, and turn the port switch OFF.

⚠ Caution

After specifying any of the various settings pertaining to each SIO-linked axis or creating a position table by connecting the PC (software) or teaching pendant to the Gateway Unit, always change the MANU operation mode to <Monitor Mode 2> before shutting down the PC software or teaching pendant.
Otherwise, the controller cannot be started from the PLC next time.
For details, refer to the operation manual for your PC software or teaching pendant.

10.4 Setting Up the Gateway Unit

(1) Setting the Gateway Unit mode

Since the actuators are operated in the position-number specification mode, set each position of the mode setting switch (SW1) as follows:
1: OFF 2: ON 3: OFF 4: OFF

(2) Setting the node address and baud rate for the Gateway Unit

Node address = 0
Baud rate = 500 kbps
To effect the above settings, set the DIP switches as follows:
DR1: ON DR2: OFF
NA1, 2, 4, 8, 16, 32: All OFF

10.5 Setting Up the DeviceNet Master Unit (CJ1W-DRM21)

(1) Setting the unit number

On the PLC, set “0” indicating a CPU high-function unit.

(2) Setting the node address

Set the master unit’s node address on the network to “63” to prevent duplication with other slaves within the range of 0 to 63.

(3) Setting the baud rate, etc.

The baud rate is set to 500 kbps. Accordingly, set the DIP switches as follows:
1: OFF 2: ON 3: OFF 4: OFF
* For details, refer to the operation manual for your PLC.

10.6 Configuring the Network

Each slave (Gateway Unit) must be assigned appropriate areas in the I/O memory of the CPU unit in which the master unit is installed.
I/O areas can be assigned automatically based on free assignment using a DeviceNet configurator or according to a fixed order using CX-Programmer.

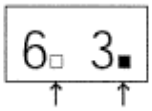
10.6.1 Free Assignment

Refer to 8.3.

10.6.2 Fixed Assignment

Area 1 (3200CH to 3263CH/3300CH to 3363CH) is assigned.
The procedure to assign this area using CX-Programmer (version 6.0 or later) is explained below.
Take note that an I/O table for the PLC system is assumed to have been created in advance. For details, refer to the operation manual for your PLC.

(1) Bring CX-Programmer online, and then change the mode to “Program.”
(2) Double-click **I/O Table/Unit Settings** to open the I/O table.
(3) Click **Options (O)** and then select **Transfer [PLC → PC]**.
(4) Select the **I/O table and high-function unit setting data** check box, and then click **Transfer**.
(5) When the transfer result is displayed, check the result and then click **OK**.
(6) When the I/O table appears, right-click “CJ1W-DRM21” in the CPU rack, and then click **Edit High-function Unit Settings**. The parameter edit window appears.
(7) Click the **Clear Scan List** switch and set “Clear Scan List.”
(8) Click **Transfer [PC → Unit] (T)**.
When the transfer is completed, the scan list is cleared and the seven-segment LEDs of the master unit (CJ1W-DRM21) show the following display:



(9) In the parameter edit window, reset the **Clear Scan List** switch to “Off.”
(10) Set the **Master Fixed Assignment Area Setting 1** switch to “Enable,” and then click **Transfer [PC → Unit (T)]**.
(11) When the transfer is completed, reset the setting in (10) to “Off.”
(12) Set the **Enable Scan List** switch to “Enable,” and then click **Transfer [PC → Unit (T)]**.
(13) When the transfer is completed, the scan list becomes effective and the left dot that was blinking in (8) turns off. Fixed assignment is now completed.

10.6.3 Address Assignment for the Gateway Unit

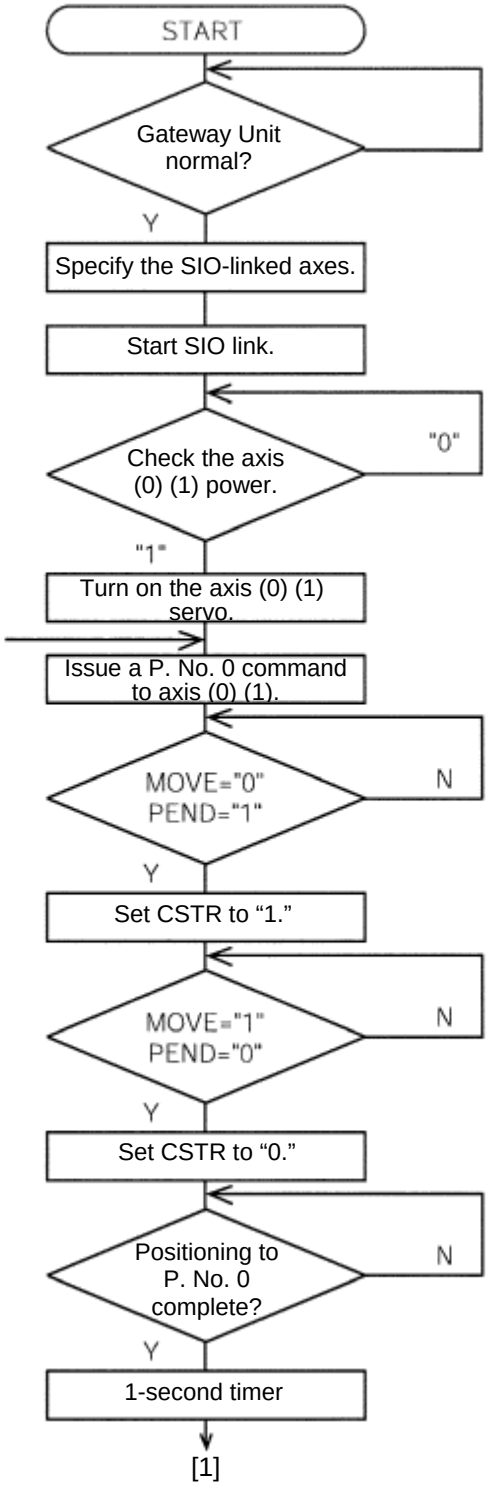
Regardless of whether free assignment or fixed assignment is used, Gateway Unit addresses will be assigned as follows. Inputs and outputs will each occupy 24 channels. (Axes 0 and 1 are physically used.)

(Position-number specification mode)

CH	PLC output		Note address	CH	PLC input	
3200	Gateway control signal 0		00	3300	Gateway status signal 0	
1	Gateway control signal 1		01	1	Gateway status signal 1	
3202	Position number axis (0)	Control signal (0)	02	3302	Completed position number (0)	Status signal (0)
3	Position number axis (1)	Control signal (1)	03	3	Completed position number (1)	Status signal (1)
4	Position number axis (2)	Control signal (2)	04	4	Completed position number (2)	Status signal (2)
5	Position number axis (3)	Control signal (3)	05	5	Completed position number (3)	Status signal (3)
6	Position number axis (4)	Control signal (4)	06	6	Completed position number (4)	Status signal (4)
7	Position number axis (5)	Control signal (5)	07	7	Completed position number (5)	Status signal (5)
8	Position number axis (6)	Control signal (6)	08	8	Completed position number (6)	Status signal (6)
9	Position number axis (7)	Control signal (7)	09	9	Completed position number (7)	Status signal (7)
3210	Position number axis (8)	Control signal (8)	10	3310	Completed position number (8)	Status signal (8)
1	Position number axis (9)	Control signal (9)	11	1	Completed position number (9)	Status signal (9)
2	Position number axis (10)	Control signal (10)	12	2	Completed position number (10)	Status signal (10)
3	Position number axis (11)	Control signal (11)	13	3	Completed position number (11)	Status signal (11)
4	Position number axis (12)	Control signal (12)	14	4	Completed position number (12)	Status signal (12)
5	Position number axis (13)	Control signal (13)	15	5	Completed position number (13)	Status signal (13)
6	Position number axis (14)	Control signal (14)	16	6	Completed position number (14)	Status signal (14)
3217	Position number axis (15)	Control signal (15)	17	3317	Completed position number (15)	Status signal (15)
3223	Cannot be used.		23	3323	Cannot be used.	
3263			63	3363		

10.7 Ladder Sequence Flowchart

The operation flowchart of axis 1 (axis 0) and axis 2 (axis 1), which are DeviceNet slave axes, is shown below. The values in parentheses indicate SIO-linked axis numbers.



b15 = 1 and b14 = b13 = 0, for 3300CH

Set b0 and b1 of 3201CH to “1.”

Set b15 of 3200CH to “1.”

b5 of 3302CH and b5 of 3303CH are “1.”

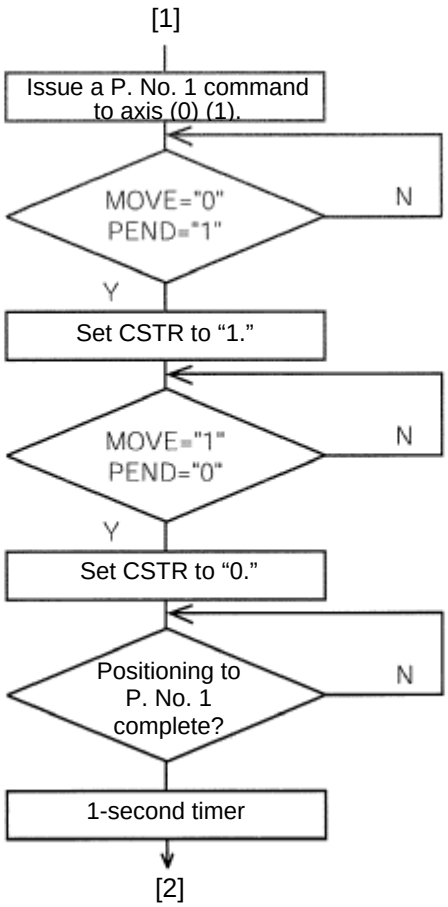
Set b4 of 3202CH and b4 of 3203CH to “1.”

Set b13 to b8 of 3202CH and 3203 CH to “0.”

MOVE: b3 of 3302CH/3303CH
PEND: b1 of 3302CH/3303CH

3202CHb1
3203CHb1

PM1: b8 of 3302CH/3303CH
PM2: b9 of 3302CH/3303CH
PM4: b10 of 3302CH/3303CH
PM8: b11 of 3302CH/3303CH
PM16: b12 of 3302CH/3303CH
PM32: b13 of 3302CH/3303CH


[1]
Issue a P. No. 1 command to axis (0) (1).
MOVE="0"
PEND="1"
N
Y
Set CSTR to “1.”
MOVE="1"
PEND="0"
N
Y
Set CSTR to “0.”
Positioning to P. No. 1 complete?
N
1-second timer
[2]

Catalog No.: MJ0168-2A

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